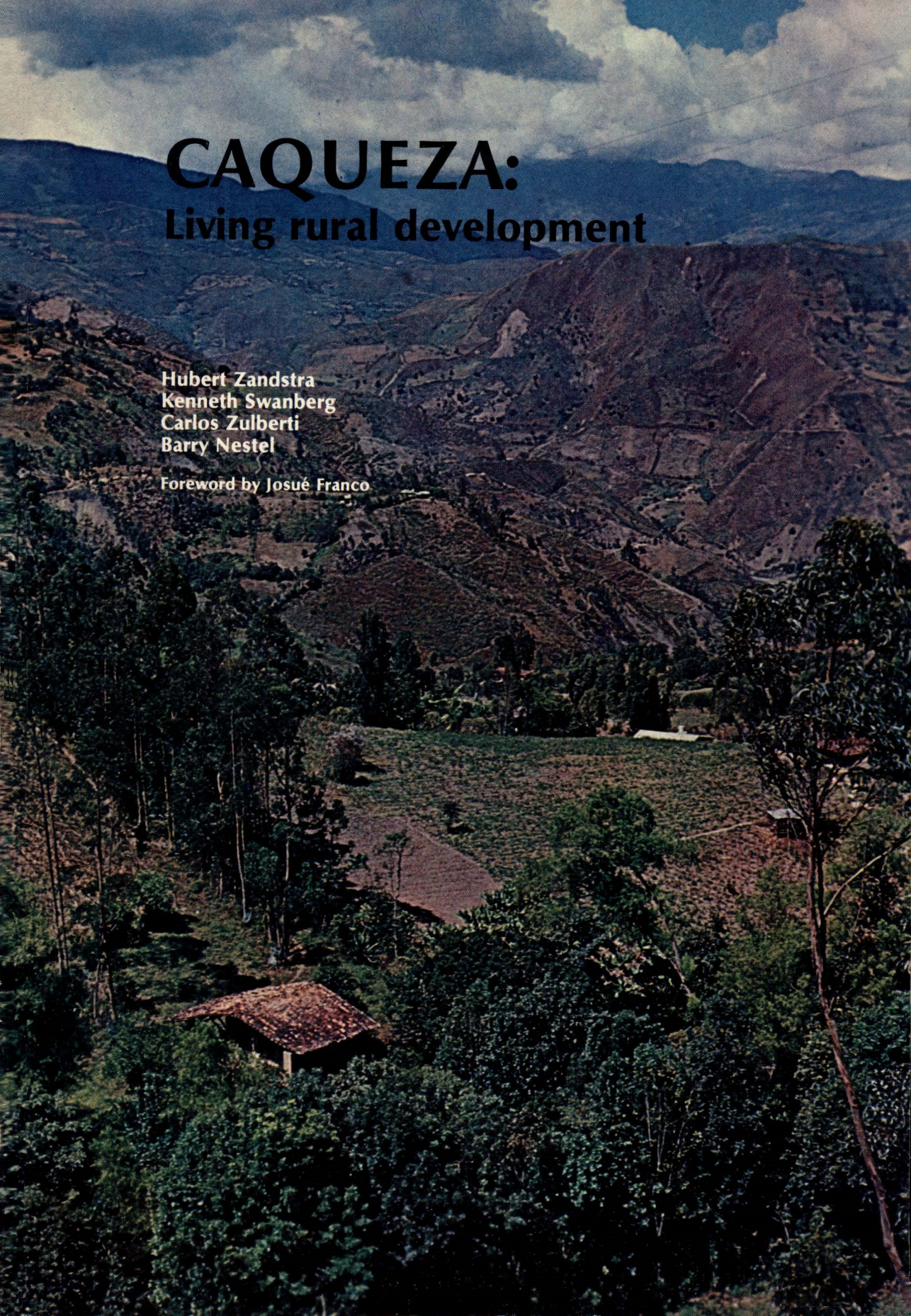

CAQUEZA:
Living rural development

Hubert Zandstra
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Barry Nestel

Foreword by Josué Franco

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Hubert Zandstra is a Canadian soil scientist who was IDRC's field team coordinator and agronomist in the Caqueza Project from 1971 to 1975. He is currently leader of the multiple cropping program at the International Rice Research Institute in the Philippines.

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Barry Nestel is British and was an associate director of IDRC's Agriculture, Food and Nutrition Sciences Division from 1970 to 1976. During this time he negotiated and managed IDRC's involvement in Caqueza. He currently works out of England as an independent consultant.

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Hubert Zandstra, Kenneth Swanberg, Carlos Zulberti, and Barry Nestel

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Publisher's Note

We are grateful to Dr Josué Franco for writing the Foreword to this book. Dr Franco is the Colombian who has been most closely associated with this project. Originally trained as a veterinarian, he was the Colombian Agricultural Institute's (ICA) Director for the region that included Caqueza when the project was initiated in early 1971. He later became Deputy Director of ICA responsible for all rural development activities and since mid-1976 has been Director-General of ICA.

One of the authors, Dr Barry Nestel, acted as editor of the entire text and volunteered many weeks of his time to put the material into publishable form. His mammoth editorial contribution is gratefully acknowledged.

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Foreword

When the Caqueza Project was initiated and the first agreements of cooperation were signed with the International Development Research Centre, it was difficult to visualize the scope of the project about to take place in that area. As the project progressed, it became evident that the cooperation of institutions and officials from different parts of the world represented a step forward in the complex problem of rural development, understood as the improvement of the living standards of the small farmer.

For Colombia, the Caqueza Project was of crucial importance, particularly in the methodological aspects of rural development. Most likely, the people involved in the project would think now that at the beginning there was not too clear a definition of goals to be achieved. However, although still far from a final solution, we have to admit that several concepts have been clarified and several situations have been modified, all of them of utmost importance in the efforts to improve the welfare of the rural populations.

For ICA, the Colombian Agricultural Institute, various internal changes related directly or indirectly to the Caqueza Project. In the field of research, new methodologies and strategies have come from it, especially in relation to multiple cropping systems. In the transfer of technology, the successes and failures of the Caqueza Project were incorporated into the experience of ICA, complementing the knowledge of the professional staff devoted to this task. In the social aspects, even though there was no accumulation of experience about the methodology to be pursued, at least its traditional contents were questioned as well as the sort of training personnel working in those areas should receive.

To a large extent, the concept of the Integrated Rural Development Program was based on the experiences of Caqueza and other similar projects handled by ICA in different parts of Colombia. Institutional efforts to improve the knowledge on the small farmer and of his complex social-economic world were inspired by the research carried out by the Caqueza Project.

Emphasis should be placed as well on an important impact aspect of this project: the linkage of the project to the university and vice versa, resulting in excellent information for the project and a better training for the student, and showing that the extrapolation of this experience will reduce research costs and give real meaning to the technical capacity of the university.

Whoever visits Caqueza today possibly will not find a radical change in the living standards of its people. But, whoever analyzes the processes of rural development in Colombia will find a direct or indirect reference to the methodology developed there.

To the above considerations we should add that the flexibility and understanding on the part of IDRC in handling the agreement permitted the success obtained. The fact of having learnt to live with the constraints of a developing country, without interfering in its decision-making processes, deserves mention as a prime example of true coordination between institutions. ICA on its part, was always willing to listen to any suggestions IDRC had and to implement them in its activities. Colombia and ICA are most grateful and indebted to IDRC.

Josué Franco

Director-General, ICA

Acknowledgments

The Caqueza Project owes its philosophy and development to a large team of people. It would never have been initiated without the courage and imagination of Jorge Ortiz Mendez and the support of W. David Hopper (Director-General of ICA and President of IDRC respectively in 1970). Having been initiated, its successful implementation resulted from the contributions of many people.

In its early days the project cut across traditional hierarchical lines within ICA and only the determination of the late Miguel Hernandez and the late Canuto Cardona enabled it to survive considerable internal opposition. In the project team itself, a group of dynamic men and women, including Ciro Villamizar, Roberto Gonzalez, German Escobar, Luis Alfonso Chudt, Lelia Cruz, and Agustin Cobos, have been responsible for carrying out and/or supervising much of the work described in this book. In the mid-1970s, the training activities of William Amezquita and Ester Zulberti did much to ensure that Caqueza did not remain an isolated pilot project but had a training influence at the national level.

The project's strongest supporter within ICA has always been Josué Franco who in 1970 was ICA's Director for Region No. 1, which included Caqueza. Later he became Deputy Director-General of ICA in charge of Development and, in 1976, Director-General of the organization. Dr Franco's constant support and encouragement, more than anything else, served to weld the local and foreign staff of the Caqueza Project into an effective development team.

There were many other people who also made significant inputs to the story told in this book. The list below records the names and positions within ICA and associated organizations of those to whom the authors are particularly indebted.

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Secretary (IDRC/ICA): Nhora Moreno

Introduction

This is a book about *people*: three groups of people. The largest group consists of Colombian small farmers with limited capital resources and educational backgrounds, trying to make a dignified living out of 2–4 hectares of parceled hillside land. The smallest group, which remains largely in the background of this story, is made up of politicians and planners formulating a national agricultural development policy whose objective is to improve the lot of these small farmers. Between these two groups of people are the agricultural technicians who are attempting to bridge the gap between farmers and planners by developing production strategies that the farmers are able and willing to use and that will enable the planner's goals of higher production and incomes from the small farm sector to be met.

This book tells the story of the relationships between these groups of people in Colombia throughout a 5-year period during which the National Government gave considerable priority to the small farm sector. It is *not* a text book on rural development but rather a case history describing the successes and failures associated with the process of establishing a flexible methodology for the development of a fairly typical Andean agricultural area, specifically the region in the East of Cundinamarca known as Caqueza.

The story began in 1970 when a team from the Colombian Agricultural Institute (ICA), the research and extension arm of the Ministry of Agriculture of Colombia, took a look at rural development projects in other parts of the world and decided that a modified form of the Mexican "Puebla" approach appeared to be the most appropriate model for a new approach to rural development in Colombia. This conclusion was accepted by the Colombian Government, and, as a consequence, early in 1971, ICA established four "experimental" projects based on the Puebla model. This model involved a substantial on-farm research component and ICA invited several overseas agencies to join it in partnership in developing the necessary adaptive research. In this way, the newly formed International Development Research Centre (IDRC) in Canada became involved in the Caqueza Project with the specific objectives of helping ICA to:

(1) develop and prove a strategy for the transference of technical, economic, and social knowledge to small farmers that would promote their active participation in matters such as the use of credit and purchased inputs, the sale of their products, and the betterment of their social conditions;
(2) use this strategy to bring about higher crop and animal yields, improved economic returns, and better family living in the project area;
(3) establish a system whereby the farmers of the project area assumed increasing responsibility for the execution and expansion of this strategy using their own initiative; and
(4) measure the changes in the community and in its incomes that resulted from the project.

IDRC's support was initially requested for a 2-year period and was specifically destined for assistance to prepare updated basic data, test new technology in the project area, train staff, and establish a basis for evaluating progress. After the project had been operational for a year, additional IDRC support was provided, largely to finance undergraduate and graduate students to do field work for their theses in the project area and to enable them to participate in project activities as part of their training.

During the first 2 years of the project a number of unforeseen problems became apparent. Paramount amongst these was the fact that most professional agriculturalists working in Colombia had a training that was heavily biased toward large farm and plantation agriculture. Research was heavily oriented in this direction and was carried out almost entirely on large farms or on experimental stations that simulated large farm conditions. This situation was exacerbated by the fact that most postgraduate training took place in the United States and involved studying the problems of a modern, high-input agriculture. As a result of this, knowledge of the local, complex, multiple-cropping, risk-aversion system practiced by the small farmer was extremely limited.

A basic tenet of the new rural development projects (RDPs) was their on-farm research activities, which served both to provide information and to convince farmers of the advantages of changes in technology. At the start of the RDPs in Colombia, these activities received only sporadic support from the highly trained agriculturalists at the research centres, and most of the on-farm research had to be carried out by young agronomists with very little research experience. In addition, the activities in rural development for which these agronomists were responsible were administratively located in the *development* rather than the *research* department of ICA. This created understandable difficulties in recognizing the on-farm experiments as being research.

Another problem encountered related to understanding and defining how rural development activities were to be evaluated. The traditional approach to evaluation in Colombia had been to measure the number of farmers involved in a program, the land area covered, or the amount of credit disbursed, and to totally disregard any evaluation of the impact of the program in terms of farmer incomes or well-being. A closer look at the well-being function, however, indicated that farmers often had a different sense of values than planners and technicians. Thus, in many cases, early efforts at evaluation in Caqueza turned out to be frustrating and unrewarding, except in terms of serving as a learning process.

A third difficulty that arose early in the project's existence was the question of institutional relations. Although the project was entitled "A Rural Development Project," it was placed in the hands of ICA, the agency responsible for research, extension, and postgraduate education in the agricultural field. The results obtained by the project made it very apparent that progress in agricultural development depended on factors over which ICA had only limited control, such as credit and marketing. The need for strong interagency links was recognized at the field level early on in the work, but continuous problems of interagency jealousies at all levels hindered any one agency from being able to take the lead in integrated rural development activities. Considerable strides were made in overcoming this problem but there still remained the difficulty of forging close links with agencies both within the agricultural sector and outside of it, working in health, education, and social welfare. Without such intra- and intersectorial links, true "rural development" appeared difficult to achieve. However, in the 5th year of the project the National Planning Office recognized

this issue and started to take steps to coordinate development implementation as well as development planning.

The lessons learned during the first 2 years' activities were drawn on in mid-1973 to structure a further 3 years of IDRC support for the Caqueza Project. This involved much closer links between research, training, and development. The specific objectives of this second phase of the project were:

(1) to create an integrated rural development/research/training system oriented to the needs of small farmers and based on a partnership that would involve both Colombian professionals and small farmers in active roles;

(2) to prepare Colombian technical personnel at various levels for working in a rural development system by:
   (i) involving graduate students in the ICA–National University Graduate Program in aspects of rural development through undertaking agronomic, economic, and socioeconomic thesis research at the regional and project level;
   (ii) utilizing current project findings and experience as source material for a national training program using short in-service courses to orient new and existing professional and middle level technical staff to evolve technical, extension, and communication ideas;
   (iii) involving university professors and their students in rural development problems and processes by their active participation in project activities to influence a better adjustment of curricula to the real necessities of the country; and

(3) to strengthen research activities applicable to areas of subsistence agriculture, test new agricultural techniques and crop varieties, and evaluate the results of changes brought about on individual farms and in the community as a whole.

The formulation of these broader-based objectives was only possible because during the first 2 years of the project there had been a considerable change in the outlook toward rural development within Colombia, and specifically within ICA itself. The traditional approach of ICA was primarily agronomically oriented even though its organizational structure embraced disciplines in the social sciences. Most of the ICA senior staff held Ph.D.s in crop science, and this discipline, especially plant breeding, had traditionally dominated the outlook of the organization. During the early 1970s, ICA's heavy involvement in rural development resulted in some reorientation of its philosophy and led to a recognition that, although the organization possessed adequate resources to undertake research on agronomic problems, it lacked much of the know-how and expertise to deliver these research findings to the small farmer. To overcome this problem, the central research program, traditionally geared to large farmers, initiated a much stronger small-farm orientation and a much greater socioeconomic input, strengthening considerably the divisions of sociology, economics, and evaluation.

These changes represented an original effort toward developing an indigenous approach to rural development, rather than an attempt to transfer the foreign technology in which most of the senior staff of ICA were trained. Associated with this indigenous approach was a substantial measure of reorganization within ICA that linked research and rural development activities more closely and involved the development of new training methods for field staff.

The early experiences in the experimental RDPs, particularly Caqueza, generated a great deal of new information on farmer behaviour and risk aversion, and a better understanding was gained of the links between technical and socio-economic problems associated with rural change. Easily accessible from Bogota, the Caqueza Project received many visitors and the approach, enthusiasm, and motivation of its staff convinced many national policymakers that the project was starting to develop a viable strategy for rural development. Indeed, a resultant problem has been that, from time to time, Colombian planners and politicians have wanted to multiply this type of project at a rate that has caused concern to the ICA directive staff from the standpoint of the availability of adequate technology and human resources.

After 5 years of activity the project continues its learning process. Some of its earlier experiences have, however, been translated into field programs. The most important lesson learned from the project is that there is often a considerable difference between what the farmer really wants and what the politician and planner feel that he needs. The early emphasis on developing and transferring a new high-production technology has been replaced in the research program by an effort that seeks to make improved technology available to the farmer. The farmers have constantly stressed that what they require are packages of technology that they can afford to utilize, given the price and credit framework available to them, that are associated with a marketing system that is sufficiently responsive to demand changes so as to encourage them to use new technology to achieve higher production. They have rejected, and will probably continue to reject, technology offered them in isolation of credit and marketing links.

During the 3rd and 4th years of the project a great deal of information was gained from research conducted by the project staff and by undergraduate and postgraduate students from a number of local universities. The additional information gathered in this way also made it possible to initiate a series of in-service training courses based on case studies. This helped to orientate field staff in other RDPs. During the 3rd and 4th years of the program the expatriate staff of IDRC moved first to the ICA Regional Office, which embraces one-ninth of the country, an area with four Caqueza-like projects, and later to the ICA Central Planning Office, which covers the whole of Colombia. In the 5th year a substantial part of their time was spent working with the agricultural staff of the National Planning Agency. In this way, although Caqueza was used throughout the 5 years as a research laboratory, considerable effort was made in the later years to spread both the research and its findings to other RDPs. Thus an effort was made to avoid either the impression or the reality that Caqueza was a high-input nonrepeatable "model" project.

The story told in this book is an incomplete one. It reveals promising achievements in terms of reorienting research methodology, dissemination, and training techniques, but it only represents the first phase of a dynamic approach to rural development. Considerable progress has been made by ICA in the process of institutional restructuring to respond to rural development needs; however, certain weaknesses still exist. For example, during the first 5 years of the project's existence, in every key post associated with rural development there was a turnover of two to six personnel. Indeed, in the 20 or so key posts associated with rural development at the national level, there was only one person still present in late 1975 who was an incumbent of any of these posts in mid-1971.

The low level of salaries paid to the agricultural staff in the public sector is an important, although not the sole, cause of this turnover in personnel. The institutional instability that it causes constitutes a major constraint to a forceful rural development program or indeed to any kind of program. This is particularly relevant in terms of interinstitutional relationships because in so many instances these are built up by personal contacts, and the constant shuffling of personnel, rather than the lack of competence, goodwill, or motivation, is undoubtedly a key constraint to a truly integrated approach to rural development.

Notwithstanding this, ICA's Caqueza Project has contributed significantly to rural development methodologies relevant to other locations. For this reason there appears to be considerable merit in recording the chronological development of activities and policies in the project and in trying to analyze the lessons learned to date. As will be seen from the bibliography, most of the research in the project has been carried out by Colombians and not by expatriate advisors. A number of the people most closely associated with this research have spent periods away from the project on training courses and others have been transferred and promoted to other projects as part of the national effort to increase this type of activity. This book is, therefore, written by those who have been fortuitous enough to observe the rural development scene at Caqueza over 5 years. It has been written in consultation with the large number of Colombian field staff who have been primarily responsible for the work described.

The first part of the book briefly describes the evolution of thinking regarding rural development philosophy in Colombia in recent years and outlines the model that ICA adopted for a new approach to rural development in the 1970s. The third chapter provides specific information on the Caqueza Project and relates this to the national rural development framework.

The second part of the book describes chronologically the activities and lessons of each of the 5 years studied. Although each year is designated sequentially in the text as one of "observation," "learning," "change," "synthesis," and "impact," the development process was dynamic with considerable spillover from year to year. Although in the 5th year the lessons of experience were synthesized into action programs, there continued to be an observation and learning of newer concepts and ideas whose synthesis remained for the future.

Part three deals in some depth with the analysis and interpretation of the results of the first 5 years. It examines the research methodology that was tested and the extent to which the new production technology was adopted by farmers.

Part four examines some of the nontechnological factors influencing adoption rates. It focuses specifically on risk, credit, marketing, training, and, in general, on buffer institutions.

The final part of the book describes the measurement of achievements in terms of (*a*) periodic efforts to evaluate activities and (*b*) as an overview of the project as a whole. The policy implications of the project at both the national and the international level are also discussed in the final chapter.

At the end of their 5-year involvement, the IDRC team felt that they had largely fulfilled their catalytic role in helping to generate a new and indigenous approach to rural development strategy amongst the field technicians of ICA. There is little doubt that given the immense personnel resources of this institution (over 200 agricultural scientists with M.Sc.s and about 50 Ph.D.s), limited

outside assistance should be required from the technical standpoint. The problems to be faced in the future lie largely in the institutional field. They embrace not only the stabilization of personnel within ICA, the strengthening of its linkages with other institutions both in the agricultural and in other sectors, but also the creation of effective institutional mechanisms that will enable the findings of in situ rural development research in fields such as credit and marketing to be used to generate and implement national policies that will be effective mechanisms for serving the small farmer.

Institutional changes of the nature called for above involve delicate political decisions that have to be made by nationals of the country. The findings of the research in Caqueza have already reached the stage when the information on which to base such decisions is starting to become available. Nevertheless, the story told in this book raises at least as many questions as it answers but it makes it very clear that if small farmers are to be able to realize the benefits of new agricultural production technology, this technology must be based on an understanding of their real needs and constraints and not on what outsiders consider these needs to be.

Acronyms and Abbreviations

ALADER	*Asociación Latinoamericana de Desarrollo Rural* (Latin American Association for Rural Development)
CAJA AGRARIA	*Caja de Crédito Agrario, Industrial y Minero* (Agricultural Credit Bank)
CAMINOS VECINALES	The Rural Road Program of the Ministry of Works
CARE	*Cooperativa Americana de Remesas al Exterior* (A U.S.-sponsored food-aid program)
CECORA	*Central de Cooperativas de la Reforma Agraria* (The Central Cooperative of the Land Reform Institute)
CIAT	*Centro Internacional de Agricultura Tropical* (International Centre for Tropical Agriculture)
CIDA	Canadian International Development Agency
CIMDER	*Centro de Investigaciones Multidisciplinarias en Desarrollo Rural* (Centre for Multidisciplinary Research in Rural Development)
CIMMYT	*Centro Internacional el Mejoramiento del Maíz y el Trigo* (International Maize and Wheat Improvement Center)
COFIAGRO	*Corporación Financiera de Fomento Agropecuario y de Exportaciones* (Agricultural Finance Corporation)
CUSO	Canadian University Service Overseas
DANE	*Departamento Administrativo Nacional de Estadística* (National Department of Statistics)
FAO	Food and Agriculture Organization of the United Nations
IBRD	International Bank for Reconstruction and Development (World Bank)
ICA	*Instituto Colombiano Agropecuario* (Colombian Agricultural Institute)
ICBF	*Instituto Colombiano de Bienestar Familiar* (Colombian Institute for Family Welfare)
ICEL	*Instituto Colombiano de Electrificación* (Colombian Institute for Electrification)
IDB	Inter-American Development Bank
IDEMA	*Instituto de Mercadeo Agropecuario* (Agricultural Marketing Institute)

IDRC	International Development Research Centre
INCORA	*Instituto Nacional de Colonisación y Reforma Agraria* (Colombian Institute of Land Reform)
INDERENA	*Instituto Nacional de los Recursos Renovables y del Ambiente* (National Institute for Natural Resources)
INPES	*Instituto Nacional de Programas Especiales de Salud* (National Institute for Special Health Programs)
INSFOPAL	*Instituto Nacional de Fomento Municipal* (Institute of Water Supplies and Sewages for Small Cities)
PINA	*Programa Integrado de Nutrición y Alimentación* (National Food and Nutrition Program)
RDPs	Rural Development Projects
SENA	*Servicio Nacional de Aprendizaje* (National Apprenticeship Service)
TSG	Technical Support Group
TTD	Technology Transfer Districts
US-AID	United States Agency for International Development

Exchange Rates

The following average exchange rates have been used in the text;

Year	*Colombian Pesos per U.S. $*
1971	20.0
1972	22.0
1973	23.7
1974	26.1
1975	31.0

Part I

The Evolution of the Caqueza Project Design

THE EVOLUTION OF THE CAQUEZA PROJECT DESIGN

The publicity attached to the "green revolution" has brought about a recent shift in development strategy in many Third World countries, which are now giving a renewed emphasis to agriculture. Past efforts at agricultural development have often met with limited success, especially on small farms, which form the largest number of farm enterprises in developing countries. However, it is recognized that these farmers and their families produce an important part of the national food supply and are the main potential consumers of food production increases. They also are a vital component of the human resources of the Third World and represent an enormous potential for national development.

In the following chapter a brief overview is given of some of the more recent approaches that have been used to increase agricultural production and to improve the living conditions of small farmers. From these approaches and with the knowledge of its own experiences, the Colombian Government attempted to develop a strategy that was specifically designed for its own rural sector. The formulation of this strategy is described in Chapter 2, prior to presenting in Chapter 3 a detailed description of the area, people, and infrastructure of the specific project located in the Caqueza area.

These three chapters, therefore, provide the background information as to why, how, and what the Colombian concept of a rural development project was.

Within the framework of the strategy described, the rest of this book goes on to discuss and evaluate the successes and failures experienced during the first 5 years of operation of the project in Caqueza.

Chapter 1

Historical Perspectives of Rural Development Strategy

About half of Colombia's population is rural and, in common with many developing countries, there is a problematical small farm sector. Of the approximately 1.5 million farm families, over half farm less than 5 ha of land, which, with the exception of certain labour-intensive crops, provide them with limited incomes. The owners or tenants of these small farms usually have difficulty in obtaining additional land; possess limited information on the use of new technology; encounter problems in obtaining access to credit and modern inputs; and are confronted with markets that are poorly organized and often offer unattractive prices. As a result of this situation the yields of most crops have stagnated at a low level in spite of various efforts to change this situation.

Throughout the past 25 years Colombia has explored various approaches to economic and agricultural development. In the 1950s and early 1960s Colombian planning emphasized industrialization on the premise that the industrial sector was the one with the highest marginal productivity for invested capital and therefore the one in which investment would lead to the greatest acceleration of national growth, which, in turn, would lead to a general rise in incomes. It was assumed that industrialization, through its generation of capital and employment, would automatically stimulate agricultural growth.

By the mid-1960s it was apparent that this approach was not having a significant impact on the agricultural sector, and in 1968 there was a major policy change that gave the Ministry of Agriculture, through a series of semiautonomous agencies, full responsibility for agricultural and livestock planning and for drawing up and implementing a comprehensive agricultural development policy as well as for controlling, regulating, and coordinating the programs of the different organizations functioning within the agricultural and livestock sectors. At this time particular attention was given to the need to introduce new agricultural technology onto both small and large farms.

The earliest efforts to disseminate new agricultural technology were based on *community development* and *agricultural extension* programs. It was thought that rural communities were inefficient in their use of existing resources and that although better technology was available it was not being used. Communication and education programs were promoted to stimulate rural people to improve their factor productivities, and the philosophy of the era was to "help the people to help themselves" or "show the backward peasant how to use modern inputs."

The assumption that low productivity was caused by inefficient resource use was largely derived from experiences in the developed world. However, at

about this time the studies of economists such as Hopper (50), Yotopoulos (129), and Chennareddy (11) contradicted this conclusion, giving support to Schultz (100) and his theory of the *efficient but poor* small farmer, who used his very limited resources in a highly efficient manner. Given this situation, it was not surprising that community development schemes and efforts to create institutions that adopted a North American type of system for agricultural extension were failing to generate any significant increase in per capita incomes on small farms in the Third World.

During the 1960s certain approaches that were neither extension nor community development, in the generally recognized interpretation of these terms, were also widely used in Colombia. One of the earliest of these was the *Empresas Comunitarias Campesinas*, an organizational format also tried out with variations in Chile, Venezuela, and Peru. In essence, this involved the creation of peasant community enterprises or production cooperatives that were based on consolidated or associative land ownership. Colombia is said to have formed over 500 of these enterprises associated with its land reform program. They represented a form of land tenure that lay between private and state ownership. However, although this program was, and still is, widespread in Colombia, the institutional support structure to ensure its success does not yet appear to be strongly developed.

A somewhat related program that was heavily promoted from 1966 to 1970 was the *Asociación de Usuarios Campesinos*, which was an effort to group peasants so that they were better able to use the services that the State provided for agricultural development. However, many of these groups evolved into political lobbies and hence, it has become difficult to clearly identify their impact on either rural productivity or incomes.

Perhaps a more successful approach has been the farm radio program, which has been under way in Colombia now for about 25 years. This consists of combining radio programs specifically addressed to rural communities, with group meetings presided over by a trained local leader. The format is supplemented by written and visual materials and supported by field instructors who train community development leaders. This program has grown from a humble beginning into a vast and powerful network sustained by a central organization that has excellent radio and printing facilities. Although this program has undoubtedly had an important educational impact, it is clear that it can only work with existing information and is not able to have a major impact on some of the institutional constraints that are major hindrances to small farm development.

During the late 1950s and early 1960s, U.S.-type agricultural extension activities were given a great deal of attention in both Colombia and other Latin American countries. A recent evaluation of this program by US-AID (117) has suggested that it had a rather limited impact. This appears to be attributable to the fact that much of the technology being promoted was not suitable for local conditions and additionally, much of the required support structure, which would have enabled the small farmer to adopt the new technology, was not forthcoming.

In the early 1960s the "green revolution," arising from adoption of the research efforts on plant breeding at the International Centre for the Improvement of Maize and Wheat (CIMMYT) and the International Rice Research Institute (IRRI), started to make its impact in certain countries. New hybrid seeds were developed that increased the yields of wheat by as much as fivefold and produced similar but smaller yield increases in rice. It was postulated that because

of these yield increases, the money, time, and talent invested in the new international centres was likely to yield a greater benefit than had arisen from previous investments in community development and agricultural extension programs.

Nevertheless, full-scale adoption of the new hybrid seeds by small farmers did not occur. It became apparent that the generation of new technology alone did not provide a complete solution for either helping the rural poor to achieve a significantly higher level of living or for bringing about a major impact on national economic growth. The constraints on adaptation and the intricacies of adoption appeared to be much more complex than was originally hypothesized.

One of the major problems was that the new technologies usually required a much higher level of purchased inputs, and low-income farmers often needed to go heavily in debt to acquire such inputs. As a result they hesitated to adopt them; indeed, a number of studies have shown that the green revolution technology has been more readily adopted by large farmers than by small ones (46). Futhermore, the generation of this new technology has been shown to be heavily reliant on institutional changes in areas such as credit and marketing. Without such changes the primary beneficiaries of technological change appear to be those who already have superior endowments of land and social status and, indeed, in some areas the green revolution appears to have exacerbated existing social imbalances and economic disparities (46).

This situation now appears to be well recognized by some of the strongest advocates of using technological change as a tool for rural development. In a recent sector policy paper, the World Bank, who have planned a quinquennial allocation of $3.5 billion for integrated rural development, stated: "*rural areas have labour, land, and at least some capital which, if mobilized, could reduce poverty and improve the quality of life. This implies fuller development of existing resources, ... the introduction of new production technology, and the creation of new types of institutions and organization*" (128).

Nevertheless, the question of how to transform existing institutions so as to enable society to capture the economic gains implicit in new technological alternatives remains largely unanswered. However, some significant progress has been made in this direction by a series of so-called RDPs.

The first of these to gain worldwide recognition was probably the project at Borgo a Mozzano in Italy. Subsequent important projects of a similar nature, which will be referred to here, are Comilla in Pakistan, the Intensive Agricultural District Program in India, and the Puebla Project in Mexico. Each program has incorporated various aspects of extension and community development strategies, but each has gone much further in attempting to show how the process of growth and change must be initiated. Each one has, in its own way, also confronted the task identified earlier of having to incorporate institutional change as an endogenous activity if the "society" is to capture the economic gains implicit in the technical alternatives.

Borgo a Mozzano

The project at Borgo a Mozzano in rural Italy, initiated by the Shell Foundation in 1954, was the earliest of this group of integrated rural development projects. Its main features, which have served as guidelines for most of the succeeding projects, were:

(1) choosing a representative community;
(2) engaging extension workers (in agriculture and home economics) to live and work in the community for several years;

(3) surveying the socioeconomic and technical conditions of the rural community at the start of the project in cooperation with a local university research institution;
(4) preparing and implementing an extension program with the principal aim of improving *net income* from farming;
(5) initiating the program by introducing simple changes that could produce financial returns quickly, and gradually expanding into more complex and long-term changes as the knowledge, confidence, and means of the farmers increased;
(6) providing no special financial or material aid to the farmers to implement the program; and
(7) evaluating, as far as possible in economic terms, the increase in net income obtained by the farmers following the advice given to them (126).

Three features of this project are of particular interest: the link to a research institute and the intimacy the field workers developed with the project region (through field trials) ensured that maximum local benefits could be obtained from the new technology; the fact that supply and marketing institutions evolved simultaneously (as Italy progressed in general) obviated the need for project action in those fields; and the field staff worked at creating innovativeness (recombining existing resources among the people).

The project has demonstrated the success of its original design by attaining substantial production and income increases for the community. By comparing 1954 production and income averages with 1964 data, net income increased 154%, agricultural production went up 173%, and net productivity per working unit employed expanded by 249%.

During the same period, yields rose 97% in wheat, 172% in corn, 271% in potatoes, and 144% in olive oil production; all of these increases were significantly greater than the national average. The Shell Company went on to establish similar projects in Portugal, Nigeria, Trinidad, Thailand, and Venezuela. In addition, a training centre for agronomists and rural development workers from all over the world was set up at Borgo a Mozzano. It appears that the key to success of Borgo a Mozzano was the strategy of first obtaining intimate knowledge of the local people and their problems, and then seeking local solutions (126). This led to inducing the people of the project area to mobilize to improve their own welfare.

The Comilla Project

This project, which began in the early 1960s, had various objectives. The project area of Comilla was designated by the Pakistan Government as "a rural development laboratory" and attempts were made to generate the following techniques:

(1) the development of agricultural research "attuned to the expressed and apparent needs of rural people";
(2) the creation of cooperative activities "devised to increase the intensity and productivity of agriculture, with machinery and other innovations, through the cooperative enterprise system";
(3) the implementation of rural works programs, utilizing the dry-season labour surplus to provide isolated areas with roads, drainage and irrigation canals, bridges, and culverts;

(4) the establishment of rural education for functional literacy and for rural youth programs; and
(5) the introduction of a women's program to stimulate women into taking a more active role in generating family welfare (74).

Probably the most important feature of this program was not the introduction of new technology, but the emphasis, through the promotion of cooperative activity, of self-generation of investment capital by means of forced savings and the reinvestment of new capital generated through productivity gains. That the project, after 15 years, has not transformed the area into an "island of developed society" should not be attributed to faulty design, but perhaps to the problems of political instability, population growth, and adverse climatic conditions experienced in recent years.

Nevertheless, the Comilla Project has developed a number of outstanding operating principles for preparing a fragmented, resource-poor agriculture for the development process. By self-generation of capital through forced communal savings, cash for the purchased inputs required by the new technologies became available, and the inherent risks that accompanied cash outlays were somewhat shared within the cooperative structure. As has been pointed out (69), the objective of the cooperative movement and the Comilla Producer's Union was to generate countervailing power in the form of savings that would serve the farmers as working capital. The project stressed the theme "you are being crushed by the power of capital. The same power will redeem you if you learn to possess and control it." The basic principles of capitalization were considered as the means of freeing peasant farmers from the low-productivity trap associated with their poor resource base.

Intensive Agricultural District Program (IADP)

This program grew out of the Government of India's concern for stagnating food production in the late 1950s and its desire to launch a new strategy for agricultural development. The IADP planned to concentrate on rapid increases in agricultural production in certain pilot areas while serving as a pace-setting path-finding experimental program initiating new ideas in agricultural development. The program's objectives were:

(1) to demonstrate, in pilot districts, the most effective ways of expanding food production by cooperative efforts between the centre, the state, the district, the block, the village, and the individual cultivators;
(2) to increase the income of the cultivator and his family;
(3) to increase the economic resources and the potential of the villages;
(4) to provide an adequate agricultural base for more rapid economic development and social progress (75).

Seven districts were selected for this program in the early 1960s and by 1967–68 the number of districts had grown to 16 in a program that cost about U.S. $100 million in its first decade (77).

The program recognized the need for: (1) enough trained agricultural and cooperative workers for an intensive effort; (2) technical inputs and production credit in response to farmers' needs so that they could apply modern methods to increase yields; (3) effective local institutions to provide production credit and supplies; (4) remunerative prices to provide economic incentives to farmers; and (5) an effective program of information assistance and support in each district. The program assumed that the underlying infrastructure in India was reasonably

adequate, that sufficient production credit and technical inputs would be available in the pilot districts, and that the technical means of increasing yields were known. Two package concepts were introduced, one of education and supporting services and the other of improved production practices and methods (75).

Early evaluations of the IADP suggested that it had had limited success. A Government of India report suggested that the reason for this was "*the archaic administrative system that exists in the country. This system, based essentially on checks and balances evolved in a different time and for a different purpose, has proven woefully inadequate for any operation, the aim of which is not to maintain the "status quo" but to change it...*" (51).

A more recent evaluation claims that the IADP programs have had a large and significant effect on food grain yield performance and have induced the adoption of significant increases in modern inputs, especially fertilizer. However, the program has not brought about greater total factor productivity, which suggests that implicit or explicit subsidies for inputs such as fertilizers and tractors are not the way to purchase real economic growth from the social standpoint. Indeed the program's contribution to real economic growth appears to have been very modest and it has been compared unfavourably with the impact of Indian agricultural research, which is claimed to be the major determinant of the productivity change in Indian agriculture in recent years (77).

The IADP program appears to have had a payoff of approximately the same order of magnitude as other development efforts, with the exception of investment in research, and to have yielded social returns of approximately the same order of magnitude as have been realized in more conventional extension programs. Nevertheless, the success of the IADP in inducing technological change, independent of the socioeconomic implications of this, does appear to have provided a stimulus for the formation of similar regional development projects elsewhere in the world, perhaps most significantly at Puebla in Mexico.

The Puebla Project

Certain aspects of the Indian experience were capitalized on in the conceptualization of the Puebla Project in Mexico. This project was designed to develop a technique that would allow the traditional agricultural sector to contribute to an overall increase in world food production as well as to improve living conditions among the rural poor. The overall objectives were to develop a strategy for increasing yields of basic food crops in areas where small subsistence holdings predominate, and where production risk stems from the vagaries of natural rainfall. A heavy weighting for project success was given to the condition that "a general political environment favorable to increased production" could be developed, and the change agents would be skillful and highly dedicated (79).

Although some recent evaluations of the Puebla Project suggest that the choice of technique in concentrating the research efforts on only one crop (corn) was only a stepping stone to integrated rural development, it is unlikely that this was fully recognized at the time of the project's conception (15). The general idea of the project was to create an environment in which poor farmers would adopt new technology in basic crop production, the specific goal of doubling corn yields in 5 years being selected as the prime target of the program. Nevertheless, the plan, as it was formally presented, called for simultaneous action on several activities. These included:

(1) introducing and field testing the adaptability of high-yielding corn varieties to local conditions;
(2) generating information on optimal corn production practices, and communicating this information effectively to farmers and agricultural leaders;
(3) assuring the timely and local supply of farm inputs;
(4) making available crop insurance programs;
(5) providing adequate production credit at reasonable rates of interest; and
(6) establishing accessible markets with stable prices for any surplus corn produced.

Although the program has had its shortcomings, a key concept emerging from it has been imitated in a number of other projects, namely that the first "essential activity" for introducing new technology is to "field test" it to assure its adaptability and to define the optimal economic level of input use. The other activities listed above, though also "essential" in nature, are not specifically innovative and have been used in the projects already referred to.

Perhaps the strongest criticism of the Puebla Project is that income increases were expected from higher corn yields in an area where income derived from corn production was only a small proportion of the total income. The second generation of Puebla Project staff have recognized this and have redirected their package recommendation to include new technology for intercropped corn, crops other than corn, and for animal production.

The specific goal of doubling corn production was not achieved, probably because the use of modern technology for corn production in the area was not sufficiently profitable to cover the higher risks that its production entailed. Although crop insurance, credit, and marketing were included in the program, the degree of bureaucracy inherent in these institutions, and the lack of economic "countervailing power" on behalf of the small farmer limited the extent to which he could benefit from these services. Nevertheless, the project is devoting considerable efforts to overcoming these institutional constraints, and significant further progress is now being made.

The experience of the programs discussed above has been widely drawn on in a large number of countries during the past 5 years. Recent studies have reviewed the progress made in 17 African RDPs (70) and 36 such projects in Africa and Latin America (24). These two detailed reviews have generally highlighted the limited effectiveness of most of the programs discussed. They have both suggested mechanisms whereby these programs might be made more effective in the future. The latter study has highlighted Caqueza as being one of the more innovative and promising of 36 projects studied.

In this book, as in the case of publications from Borgo a Mozzano, Comilla, and Puebla, Caqueza is described by some of those who actually "lived" the project for several years of its existence. Although this opens the door to a considerable amount of subjective bias, it also makes it possible to discuss, in some detail, the personal and human issues that appear to have been very closely associated with some of the successes and failures of this and other RDPs.

Chapter 2

The Formulation of Integrated Rural Development Activities in Colombia

The lessons learned from agricultural and rural development efforts elsewhere in the world, briefly touched on in Chapter 1, were not lost on Colombian agricultural planners, who in the late 1960s tried to come closer to grips with the problems of low production and low incomes on the many small farms that characterize much of Colombian agriculture. This chapter describes how both local and foreign experience were utilized to develop a new strategy for rural development in Colombia. To understand this strategy it is necessary to examine first the performance of early Colombian efforts in the field of agricultural extension, as this was the main contact between policy and farmers in the 1950s and 1960s.

Agricultural Extension in Colombia

There are a number of agricultural extension services in Colombia operated by commodity organizations of which that of the coffee growers' association is probably the best known and the most successful. There is also a government service associated with the agrarian reform agency (INCORA). The Agrarian Bank (CAJA AGRARIA) also provides some technical assistance to its borrowers. However, the largest extension effort relates to the Extension Division of the Ministry of Agriculture, now absorbed into the Rural Development Department of the Colombian Agricultural Institute (*Instituto Colombiano Agropecuario* (ICA)).

The history of official extension starts in 1953 when, with United States assistance, the *Servicio Técnico Agricola Colombiano-Americano (STACA)* was created. In 1954, the activities of this organization led to the establishment of three extension agencies in the Department of Boyaca. From 1954, the activities of STACA expanded gradually to include 10 extension agencies in Boyaca and a cooperative extension project with the Department of Valle del Cauca.

In 1958 the Colombian government decided to extend STACA to cover the whole country, and for this reason all of its personnel were incorporated into the Ministry of Agriculture in a new Division of Extension Services. This Division consisted of three sections: (1) Agricultural and Animal Production; (2) Home Economics; and (3) 4-H Clubs. During the period 1958–67 the Extension Division made use of information generated on research stations and disseminated

this in printed form to extension agents and by in-service training courses to extension agency staff.

The number of extension agencies throughout the country eventually grew to 46. Each agency consisted of a small office, usually placed in the market town of an agricultural region. It was manned by an agronomist, a veterinarian, sometimes a home economist, and generally some agricultural technicians. One task of an extension agency was to give technical assistance to farmers who owned less than 10 ha of land. The technical assistance was mostly associated with the planning of credit and the organization of field days, meetings, and training courses for farmers and their wives. A second task of the extension agency was the execution of regional demonstration trials. These trials were formulated by the research staff of the national commodity and soil fertility programs. Each agency was responsible for the planting, maintenance, harvesting, and recording of data on a number of such trials.

For each trial, seed, fertilizer, and insecticides were supplied in preweighed packages together with the experimental design and a diagram of the plot sequence in each replicate. The regional trials were employed as a central focus for field days in which the recommendations published by the national research programs were discussed, often by personnel from these programs specifically invited to the field days. In addition to regional trials, extension agency personnel often emphasized commercial demonstrations in which recommended varieties and cultural practices were applied to demonstration plots on private farms.

Over the years, extension agency personnel began to express dissatisfaction with the way their task was structured, feeling that they were often flooded with demands for regional trials, had few possibilities to initiate their own activities and were too heavily centrally directed. The frustration of extension agency personnel was also related to their position in the national structure of the Ministry of Agriculture. Although they carried prime responsibility for the execution of the agricultural extension program and constituted the part of the Ministry that was visible to farmers and leaders in rural areas, they were not accorded very much freedom of action, authority to decide on programs, or operating budgets to execute them. This often led to a considerable lack of adjustment of the agencies' activities in terms of the needs of the area in which they operated.

Professionally, extension agency personnel were also handicapped. They lacked representation as they were physically and organizationally removed from the decision-making centres of the Ministry. This meant limited possibilities for promotion, study leave, and other career opportunities. These conditions resulted in a large staff turnover and many vacant posts in the extension agencies. This, in turn, limited the efficiency of the extension services.

In retrospect, it appears that during the 1960s the Extension Division worked in isolation from other government and private entities. The Division suffered from lack of trained personnel and from administrative limits imposed by the Ministry. In addition, continuous changes in leadership and policy interfered with its programs and, in particular, contributed to the lack of coordination between the extension services and agricultural research programs, which, at that time, were directed by a separate organization responsible for agricultural research, the *Departamento de Investigaciones Agropecuarias* (DIA).

Because of heavy criticism of the lack of impact of the Extension Division, it was decided in 1968 to pool the agricultural research and the extension services into the new Colombian Agricultural Institute (*Instituto Colombiano Agropecuario* (ICA)). This was to be staffed and directed by personnel from DIA, which, contrary to the Extension Division, had established a good reputation based on well-trained staff and more efficient work methods. The problems of the extension service were now placed in the hands of ICA, which was largely managed by personnel with an agricultural research background. ICA recognized the existence of both commercial and subsistence sectors in Colombian agriculture. In a document formulating agriculture extension policy, they noted that the commercial sector required agricultural production technology but did not necessarily need training in the efficient use and economical application of this technology. In contrast to this, the subsistence sector needed not only to obtain the technology but also to learn the elemental basics of agronomy, animal production, and veterinary medicine to enable them to effectively apply the technology. Without such assistance the small-farm sector would continue to be unproductive and unprofitable and the owners would not share in any benefits of economic growth. Nevertheless, it was recognized that the extension methods employed at that time were inadequate to bring about a change in these small agricultural enterprises and that priority needed to be placed on overcoming this problem (53).

The initial result of this analysis was the recognition of the need for programing initiated at the farm level (*Programación de base*). This implied that extension agencies would become the executors of a policy in which extension activities were defined according to the needs expressed by farmers and farmers' groups in the region. These areas of requested action would be used as the building blocks for a regional, and later a national, policy. The implementation of this policy — in contrast to previous extension efforts in which the central planners decreed the extension agency activities — led to a steady stream of information coming in from the field. This, in turn, led to a strong realization at both regional and national levels of (*a*) the lack of coordination within ICA between its research and its extension activities and (*b*) the paucity of dialogue between ICA, as the agency responsible for technical assistance, and other rural agencies responsible for such activities as credit, marketing, and family welfare. This feedback from the field to the regional and national planners and administrators became stronger over the years and eventually led to a reorientation of both ICA's research focus and its organizational structure.

A second result of analyzing the extension program was a decision to modify the basic philosophy and structure of this program. Initially this modification stressed commodity production goals for certain food crops, such as corn and wheat, and for beef and milk production. Still later, it became policy to focus activities in economically depressed rural regions to accelerate the development of these regions (7, 76).

These new policy developments, in terms of programing at the farm level, stressing commodity goals, and focusing on depressed areas, all emerged in 1969 and 1970 after the merger of the research and extension services. In 1970 the senior managers of ICA, through a tour of rural development activities in other parts of the world, attempted to incorporate the lessons of experience from Colombia and those of the RDPs that they had seen elsewhere in the world to develop a new rural development strategy particularly suited to Colombian conditions.

ICA's Conceptualization of Rural Development

From their visits to RDPs elsewhere in the world, the ICA policymakers concluded that the Puebla Project came closest to serving as a model for Colombia. However, the Puebla Project confined its early activities to corn (for which purposes it had ready access to the expertise of CIMMYT), whereas ICA wished to take account of the fact that in Colombia small farmers use intercropping very extensively and they are dependent on a wide range of crops. Furthermore, ICA wished to give emphasis in the Colombian program to social welfare as well as to production. They conceived rural development as involving not just greater agricultural productivity, but also higher incomes, better income distribution, and improved living conditions. Although this involved many nonagricultural factors (and this involvement would later be seen to result in a number of difficulties), it was postulated that the necessary income and motivation to bring about overall change in the rural areas could only be generated by manipulating the production relationships that arise from a use of the combination of land, labour, capital, and technology.

Because land availability was usually limited in the highly populated small farm areas of Colombia and labour supply was thought to be usually in excess for the existing production relationships, income growth in such circumstances appeared possible only by the injection of new capital or of new technology. Given this situation, ICA felt justified in taking the lead in a broad integrated approach to rural development, notwithstanding the fact that it possessed a limited understanding of the social and economic consequences of technological change in different social, economic, and political climates and the ways in which this can be managed. Such knowledge is difficult to encounter anywhere in the world, and, as we shall see, one of ICA's primary goals was to acquire such information from its new development strategy.

Given this background, ICA defined the goals of its rural development program as being to:

> *"... generate and develop strategies to attack the restraints to social and economical development in specific geographic areas, characterized by the presence of subsistence farmers, through the incorporation of technologies which will rapidly increase the production of basic and traditional commodities in order to improve nutritional and income levels."*

The objectives for individual RDPs were formulated as follows: (1) to improve the standard of living, through improved community organization, housing, health, and education; (2) to increase the productivity of basic crops and animals; (3) to obtain efficient use of credit and marketing facilities; and (4) to encourage and obtain the integration of subsistence farmers' populations into associations and groups (53).

From these general objectives the following specific objectives were derived: (1) to increase employment opportunities in the rural areas; (2) to increase family incomes; (3) to improve the nutritional status of the rural population; (4) to respond to the demand for food products and raw materials for industry; (5) to identify methods for institutional coordination that will lead toward clear programing, avoiding duplication, and to the better availability of massive and integrated services of the State in rural areas; and (6) to use the projects as a training laboratory for farmers and their children and for professionals in agricultural, animal production, social, and economic sciences.

To establish research to achieve these objectives, a series of areas suitable for experimental RDPs were identified in 1970. These areas met the criteria previously expressed of being predominately small-farm, low-income zones, many of which were located in the Andean region where much cultivation takes place on steep hillsides. They were areas where ICA felt that it would be possible to meet the program's goals, through the implementation of suitable action strategies supported by multidisciplinary ICA teams working in conjunction with other agencies.

The RDP program was not officially inaugurated until 8 November 1971, but in practice it started operations in four experimental areas almost a year earlier. The number of projects was later increased to 6, 14, and then 22 and at one time 100 projects were planned. However, by the end of 1975, there were 20 projects operating effectively. The four earliest, to which we shall refer from time to time, are known as (common names in parentheses): *Provincia del Oriente de Cundinamarca* (Caqueza), *Comarca del Oriente Antioqueño* (Rionegro), *Norte del Cauca* (Norte del Cauca), and *Provincia de García Rovira* (Garcia Rovira).

The initial criteria for defining project areas were that they should operate in well-defined regions with approximately 10 000–15 000 small farmers' families. Project staff within the region were to comprise a maximum of six professionals: a project director (generally an agronomist), two professionals specializing in agricultural and animal production, a disseminator, a home economist, and a project programmer/evaluator. This group of professionals, supported by a larger number of technical and home assistants, would work as an interdisciplinary team, in this way allowing the project to adjust to specific demands at different times of the year.

The RDPs were to initiate research on existing farmers' production methods aimed toward the testing of available improved agricultural technology in the region. From the information obtained, production recommendations were to be formulated; these would be promoted through farmers' meetings, field days, and leaflets (7).

Farmers' participation was to be an essential component of the RDPs. This was primarily reflected in on-farm research to adapt production technology and in the project's activities related to farmers' organizations. The RDPs also had the responsibility of coordinating the activities of other institutions to avoid duplication of programs and to improve the channels of communication between the region's population and these institutions.

The project's target population included all "small farmers," which for Andean agricultural regions meant any farmer with a holding of less than 10 ha. Another definition sometimes used was to include any farmer with equity below U.S. $15 000. This definition was derived from the criteria of credit-worthiness of the CAJA AGRARIA.

The first RDPs established in Colombia were seen by ICA as experimental projects from which experience was to be gathered. These projects also served a role in training personnel for future RDPs as the program expanded. Because of the experimental nature of the early projects, and the lack of knowledge of appropriate methodologies ICA invited CIMMYT, the Ford Foundation, and the International Development Research Centre (IDRC) to cooperate in the first projects. This cooperation took various forms. CIMMYT trained personnel at Puebla for a number of projects and provided technical advice over a 2-year period to the Rionegro Project. The Ford Foundation supported a large baseline

survey at Garcia Rovira and trained to the Ph.D. level a Colombian who was to play a key role in the national program in 1975. IDRC provided two and later three full-time advisors plus training and equipment for the Caqueza Project over a 5-year period.

Throughout the whole time, a close dialogue was maintained between ICA, CIMMYT, Ford, and IDRC in terms of individual agency involvements. Administratively, the projects' situation was that they were responsible directly to the Regional Director of one of the nine regional offices of ICA (76). This meant that although the RDPs had obtained increased authority in administrative and financial matters, as compared with the previous extension agencies, most personnel and financial decisions continued to be made at the regional level.

Technically at the national level, the RDPs were initially part of the Division of Special Projects in the Development Department of ICA. In 1973, the Special Projects and Extension Divisions were merged into a Rural Development Division.

Project Organization

Coordination

Each project was originally staffed to contain an interdisciplinary team organized into six units, each of which concentrated on a specific component of the project's activities. The project director was in charge of institutional coordination, which sought to channel the programs of the different organizations operating in the project area toward common goals. This aspect of the project's work was designed to ensure that programs executed by other institutions would not operate in isolation according to the specific policy of these institutions (as normally occurred), but would be oriented toward mutually agreed goals. This work involved coordination of programs with entities responsible for agricultural credit, marketing, rural infrastructure (roads, water, electricity), family welfare, and adult education (76). These institutions, as well as the municipal councils, local banks, agricultural colleges, and farmers' organizations, were considered to be the *support structure* of the project with which the institutional coordinator was to work.

Agricultural and Animal Production

The agricultural production unit was concerned with testing traditional production methods and examining their possible modification through the introduction of new technologies (76). Its goal was to ensure that these technological changes were adapted to the region and that they would provide substantial improvements in yield per unit of area and of capital invested. Specifically, its activity was seen as the planning and execution of experimental trials on farmer's fields to identify modifications that were economically justified and could be readily adopted by farmers. This research was generally expected to focus on the performance of varieties and the identification of fertilizer levels and cultural practices, such as plant populations and plant protection. It was recognized by RDP planners that animal production research, although poorly defined in its methodology, would be of an operational nature, testing out the practical and economic feasibility of improved animal production methods in the region.

The agricultural production unit was expected to be staffed by a soil fertility or crop production specialist and the animal production unit by an animal scientist or veterinarian.

Dissemination[1]

The dissemination unit was responsible for all promotional and dissemination aspects of the project. This included the explanation of the project to farmers and local civic and religious leaders and the communication of changes in agricultural production methods recommended by the project. The unit was expected to be an agent of social change and not to consider the introduction of improved agricultural practices as its sole function (7). It also planned to concentrate on community organization, generally through group formation or strengthening of existing groups, which would provide the basis for cooperative or communal activities, such as production cooperatives. A strengthened community organization would also serve as a vehicle for activities developed by institutional coordination, such as public work projects and public health campaigns.

The dissemination unit was to be staffed by one professional who would receive support from staff of all other units and from technical assistants who were expected to dedicate from 30 to 50% of their time to dissemination activities. The disseminator would be responsible for programing the dissemination activities of all personnel in a coordinated program. In this way the project planned to ensure that its research findings were rapidly transmitted to the farmer.

Home Economics

The home economics unit was designed to involve rural women in the development activities. This unit would focus on nutrition, improved housing and sanitation, health, education, and recreation. The approach to be used was predominantly one of training and education of farm family groups, particularly, but not exclusively, directed toward the woman's needs. Although most programs would, therefore, be of a dissemination nature, the unit was also programed to be involved in the organization and support of community programs in the areas mentioned above. The unit was staffed with a home economist with one or two nongraduate home assistants.

Programing/Evaluation

This unit was included in the project to be able to quantify changes obtained in the project region with respect to agricultural production, farmers' income, adoption of improved production methods, and to evaluate the impact of the project's programs and those of cooperating institutions. The unit was responsible for the incorporation of the results of its work into the project design and methodology. It was also in charge of determining the situation in the project area at the start of the project by conducting a baseline "diagnostic" study to measure physical, demographic, educational, institutional, and agricultural

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[1]The term "dissemination" is the closest the authors were able to get to *divulgación*, the Spanish term ICA started to use as a replacement for "extension," a word that was purposely avoided to break the link with hitherto unsuccessful efforts to transfer technology to small farmers.

production data. The unit was staffed by one professional, generally an economist, sociologist, or, occasionally, an agronomist with economics training.

Discussion

There are obvious similarities between the Colombian RDPs and the Comilla and Puebla projects. In terms of objectives, the Colombian projects appear more similar to the Comilla Project than to Puebla. However, because of language affinities, the training of Colombian personnel at Puebla, and a greater similarity of institutional structures at the operational level, the Colombian projects closely resembled the Puebla model in many respects.

However, while Puebla focused on a single dominant crop (corn) (9), the Colombian RDPs were designed to be responsive to the production characteristics of the areas in which they operated. This involved taking into account wide variations in ecology and production practices as well as in ethnic and settlement patterns.

In addition, the Colombian program was not limited to agricultural production but also took into account family welfare-oriented programs in the areas of sanitation, food preparation, nutrition, and child care. Although a welfare objective was also present in the design of the Comilla Project, the reason for its inclusion in the RDPs in Colombia was, in fact, the result of earlier decisions by ICA about the necessity for rural dissemination activities to be more strongly family-oriented.

The Colombian RDPs also formalized the requirement for interinstitution coordination, by defining the responsibility of the project leader as an institutional coordinator. One of his functions was to seek the involvement of institutions with responsibilities in the areas of infrastructure, credit, education, and health, so that these were built into the project's program. For this coordinating activity, the project director was given no specific authority over the staff of these other institutions in the region, so that coordination had to be based entirely on mutual collaboration and as a response to the project's ability to mobilize small farmers toward participating in certain programs.

The Colombian RDPs were built up on the existing institutional structure in a project area. They did not involve the creation of institutions, but set out to induce institutional change in response to farmers' needs. This aspect of the RDPs is important in understanding the institutional environment in which they operated and some of the constraints with which they were faced.

Within most project areas public institutions existed with responsibilities for farm credit (CAJA AGRARIA[2] as well as Commercial Banks), marketing (IDEMA[3] and CECORA[4]), cooperative activities (CECORA, COFIAGRO[5]),

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[2]CAJA AGRARIA (*Caja de Crédito Agrario, Industrial y Minero*) is the official Government Bank responsible for credit for agricultural inputs.

[3]IDEMA (the *Instituto de Mercadeo Agropecuario*) is the government organization responsible for agricultural marketing of inputs and produce.

[4]CECORA (the *Central de Cooperativas de la Reforma Agraria*) is a second-degree cooperative established to service cooperatives established by the Colombian Institute of Land Reform (INCORA).

[5]COFIAGRO (the *Corporación Financiera de Fomento Agropecuario y de Exportaciones*) is a semiautonomous government organization responsible for the financing of agricultural enterprises, particularly in the area of marketing and processing.

adult education (SENA[6]), family welfare (PINA[7]), and infrastructural development (CAMINOS VECINALES,[8] ICEL,[9] INSFOPAL[10]). Some of these institutions already had active programs operating in the regions in which the new ICA RDPs were being established.

It was hoped, however, that the RDPs would establish leadership in the project region through the development of interinstitutional programs and contacts and because of their close identification with farmers and their problems. The projects were expected to identify the priority needs of the farmers in the region, the organization of these farmers into participating groups, and the promotion of programs with the most appropriate executing agency to meet the felt needs.

At the regional and national level, it was planned that ICA would utilize existing interinstitutional committees, or establish these where necessary, to encourage coordination of programs with other institutions and to provide support for cooperative programs identified by the RDPs. Although this approach seemed logical, its weaknesses lay in the fact that ICA had no mandate to organize or coordinate other institutions at either the project, the regional, or the national levels. Coordination essentially had to depend on the willingness of individuals to work together — a subject to which we shall return in describing the experiences of the project.

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[6]SENA (the *Servicio Nacional de Aprendizaje*) is the government institute responsible for adult education in urban and rural areas.

[7]PINA (the *Programa Integrado de Nutrición y Alimentación*) is a nutritional support program under the auspices of the Colombian Institute for Family Welfare (ICBF).

[8]CAMINOS VECINALES is a program of the Ministry of Public Works to expand the rural road network.

[9]ICEL (the *Instituto Colombiano de Electrificación*) is a government institute responsible for rural and urban electrification.

[10]INSFOPAL (the *Instituto Nacional de Fomento Municipal*) is a government institute supporting the establishment of municipal services, such as water and sewage services.

Chapter 3

Characteristics of the Caqueza Project Area

Much of the experience obtained in the Caqueza Project has been based on interpreting the project region in terms of its physical, demographic, agricultural, infrastructural, and institutional characteristics. Early on in the project the staff carried out a baseline study involving over 620 farm families (37). This study, plus various secondary surveys, have been used to provide the information for this chapter, which provides an overview of the project area. Later (in Chapter 9) we shall return to examine farming practices in the Caqueza region in considerably more detail.

The Project Area

Nearly an hour from Bogota (Fig. 1) by paved road leading to the town of Villavicencio, the visitor to the Caqueza Project travels through the pass of Green Cross, at an altitude of approximately 3300 m. Here, on a clear day, there is an impressive view of part of the region in which the project operates. The town of Une lies to the right, Chipaque is located ahead, and Caqueza in the far distance. Continuing downhill to Chipaque and Caqueza, it is possible to observe a gradual change in the vegetation, agricultural production patterns, population density, and, most noticeably of all, temperature. Because of large differences in temperature and ecology, three dominant zones of agricultural production are close together. The highest zone, above 2300 m, is predominantly a pasture and potato-growing region, although farmers grow small amounts of corn for home consumption. The vegetation in this region is primarily Kikuyu grass (*Pennisetum clandestinum*) for pasture, with roadside trees of various species of eucalyptus.

Below the small town of Chipaque, the winding road to Caqueza enters the second agricultural production zone. In this region potato production diminishes and corn production increases. There is also a scattering of horticultural crops. Kikuyu grass still dominates as a pasture species but in addition to eucalyptus, roadside trees include large numbers of attractive weeping willows. This zone lies between 1800 and 2300 m above sea level and has a much higher population density than the first region. The average daily temperature lies between 13 and 16 °C.

From Chipaque the road continues its descent and half way to Caqueza the third production zone begins. Agricultural activity in this region is dominated by corn production, generally in association with beans. Farms are smaller and

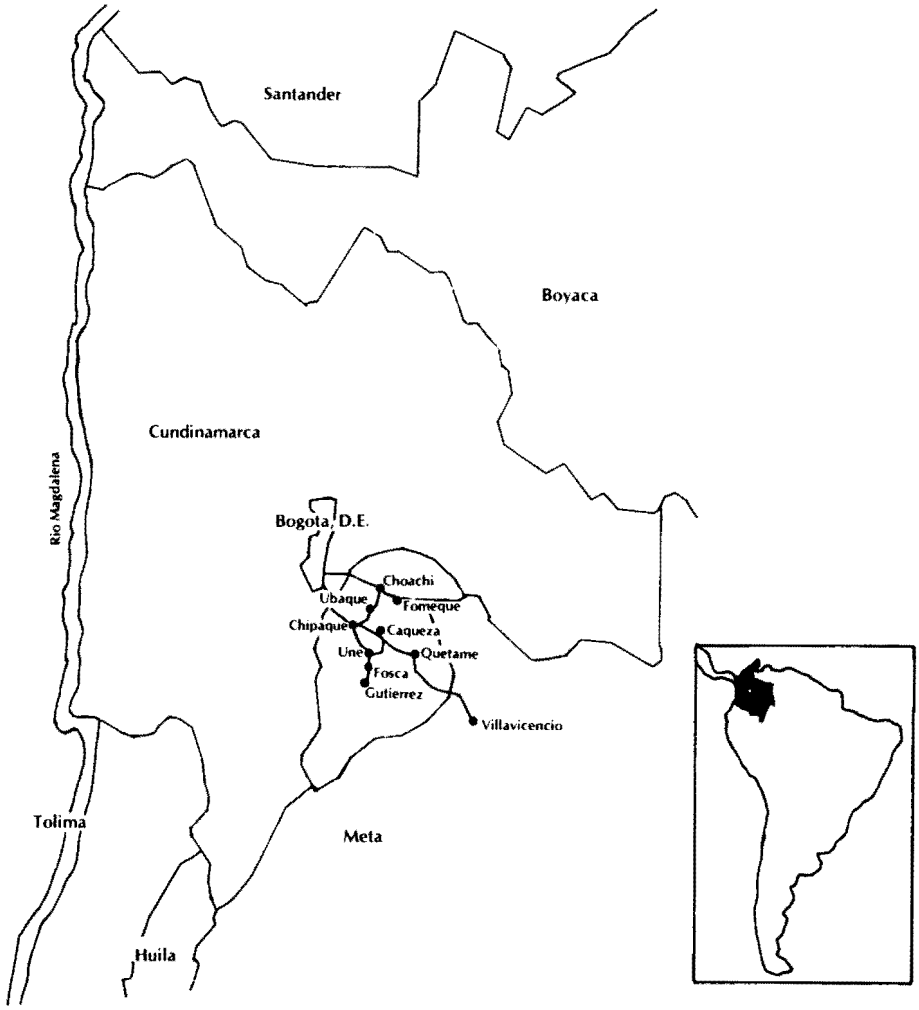


Fig. 1. *Location of the Caqueza Project area.*

generally less attractive than those in the higher regions and there are fewer pastures and milk cattle. The dominant grass species is molasses grass (*Melinis minutiflora*) and fence rows of Guatemala grass (*Tripsacum laxum*) catch the eye. The region is drier than the higher parts of the project, both because of lower precipitation and because of higher evapotranspiration, as the average daily temperature is 19 °C.

The centrally located municipality of the nine municipalities in the project area is Caqueza whose market town of 3700 people lies 45 km or 1½ hours from Bogota. Caqueza has the smallest area of any municipality in the region, but the highest population density. The other municipalities of Chipaque, Choachi, Fomeque, Fosca, Gutierrez, Quetame, Ubaque, and Une all lie from 30 to 120 minutes by road from Caqueza, mainly along unpaved roads. They are all areas with Chibcha Indian names that predate the Spanish Conquest and where peasant farmers have tilled the hillside soils for centuries.

The Land

Eastern Cundinamarca is composed of nine municipalities covering an area of 227200 hectares. Three of them, Caqueza (10700 ha), Chipaque (12400 ha), and Ubaque (11600 ha), were the original foci of the rural development effort, although six other municipalities were included in the operational area of the project. Of the total area in the region, 40% is not suitable for agriculture due to limitations of topography. Slopes range from 10 to 50% across the area and altitude above sea level ranges from 1000 to 4000 m. Forty-two percent of the area is above 2800 m, 25% between 2800 and 2300 m, and 33% between 1000 and 2300 m (Table 1).

The region is crossed by a sparse network of roads, most of which are concentrated in the better agricultural areas. In total, there are 377 km of road of various types. The principal road crossing the region leads from Bogota to Villavicencio, a city of over 50000 people on the edge of the eastern lowland plains or *llanos*. This road is paved and carries almost all the traffic and merchandise passing between the two areas. It passes through both the towns of Caqueza and Chipaque, which are 45 km and 28 km respectively from Bogota. All nine municipal centres are connected by road and additional neighbourhood roads are being constructed and maintained to improve farmer access to local market towns.

A number of rivers rise in the mountains of the area near the divide and flow eastwards down toward the llanos. Due to uneven rainfall, the regime of these rivers varies considerably according to the season. Rainfall records are available for seven of the municipalities for a period of 20 years, during which time the yearly average rainfall has been between 970 mm in the driest municipio (Chipaque) and 2500 mm in the wettest one (Quetame). Monthly rainfall averages, depending on municipality, range from 10 to 30 mm in January up to from 120 to 360 mm in July.

Table 1. General characteristics of the project area (37, 52).

Municipality	Area *(ha)*	Altitude *(m)*	Mean temperature (°C)	Urban population	Rural population	People per km²
Caqueza	10700	1876	19	3735	10545	133
Chipaque	12400	2400	16	2028	6114	65
Choachi	21500	1927	18	2635	8164	50
Fomeque	48100	1825	18	2842	8072	22
Fosca	12300	2113	17	1008	5985	56
Gutierrez	52200	2350	16	993	3650	8
Quetame	41600	1496	20	1059	7892	22
Ubaque	11600	1867	18	778	7277	69
Une	16800	2376	16	2165	4511	40
Total	227200	-	-	17243	62210	35

Soils in the area fall into classes III, IV, V, and VII in the usual land use capability classification, all having one or more of the following limitations: erosion, poor internal or external drainage, or both, rocks, and claypan. Rainfall and minimum temperatures are also limitations for crops in some areas. Textures vary from very fine sandy loam to heavy clay; soil organic matter from 3 to 30%; pH from 4.5 to 8.0; exchangeable aluminium from 0 to 4 meq/100 g; available phosphorus from 1 to 200 ppm and exchangeable potassium from 0.2 to 1.2 meq/100 g.

Population

The population of the project area declined at a rate of 0.9% per annum between 1964 and 1973 due to migration (118). At the time of the national census at the end of 1973 it was 79 500. Twenty-one percent of this population lived in the nine municipal towns and the residual 79% was scattered in small villages and on individual farms. Because of migration the population structure was highly skewed.

In 1970, 30% of the population was under 10 years old and 58% under 20 years old. The respective figures for 1954 were 31 and 52% and for 1964, 28 and 48%. Over 80% of the population were born in the municipality in which they currently live.

Average family size was 7.5 persons. Bearing in mind the age structure of the population, this suggests the existence of a heavy migration (probably to Bogota). There also appears to be some migration to the larger towns in the project area, probably from the remoter areas where population has increased very little in the last 20 years.

The economically active population is defined as persons between 12 and 65 years of age who are gainfully employed or who work on family farms or business for at least one-third of the year. Using this definition the percentage of persons economically active declined from 54% in 1938 to 27% in 1964. A contributing factor to this decline appears to be the mechanization of agriculture in the neighbouring llanos that used to provide a great deal of seasonal work for people from the project area (and probably explains why the wives tend to be such capable farm managers). In 1972, 22% of household heads migrated temporarily at some time during the year, 46% of these to the llanos, and 40% to Bogota. Most of such migration was for 6 months or more.

Institutions and Services

The area is served by a number of institutions whose role is related to providing services necessary for social welfare, such as health, credit, education, public utilities, roads, etc.

In 1970, 20 986 persons or 23.6% of the total population in the area were of school age. Of these, 15 095 or 72% were actually attending schools. There are 224 official primary schools in the area and 3 private ones; 36 of these are in towns and 191 in rural areas. Secondary schools are found only in the towns, and

of the 18 existing, 6 are government schools and 12 are private. There is a teacher training school in Caqueza and an agricultural technical school in Fomeque. In 1971, the ratio of students to teachers was 30:1.

The latest survey on school levels reached was carried out in 1964. The situation has changed somewhat since then, and some sample surveys of present conditions have been made by the project staff. Approximately 62% of the total population have only attended primary school, 27% have no schooling, 8% have attended secondary school, and 3% have attended university or some other type of higher training. It has been estimated that about 80% of the population over 7 years is literate; however, many of these cannot be considered functionally literate.

Health services in the region are found principally in hospitals in the municipal centres of Caqueza and Fomeque, plus four health centres, and five health posts. The hospitals have a doctor as director and three assistant paramedicals; the health centres have a doctor 3 days a week plus paramedical assistants; and health posts are manned by public health nurses. Medical attention is not within reach of all inhabitants in the region since for each health service unit there are 8160 people to be served and these units are not evenly distributed. Medical attention in 1971 at the centres included 18321 consultancies involving 11434 patients. Prenatal care accounted for 3054 consultancies involving 1189 patients. Despite the fact that health service facilities are limited, the utilization of hospital bed-days was only just over 60%.

A nutrition and hygiene study was carried out in 366 homes. It was found that corn and potatoes are the principal components of the local diet and, along with milk, vegetables, and various types of beans, form 74% of regular diets. Little meat and few eggs are eaten. Flush toilets were found in 8% of the houses, 12.5% had latrines, and the remaining 79.5% had no sanitary facilities.

Forty-eight percent of the population live in houses with less than two persons per room, 34% with two to less than three persons per room, and 18% with three or more per room. Forty percent of the population live in houses of only two rooms and 47% of the houses have earthen floors. In 70% of the houses, pigs and chickens run loose around the house and kitchen, creating further health hazards.

Public utilities are poor in most of the region. Electricity is sporadic but all municipal centres are connected to the power network and plans are under way to improve the service. All municipal centres have water delivered either by open canal or pipe from rivers and streams up to 6 miles away. All are gravity systems and no water treatment is provided. In the whole area, 82% of the population is not reached by such water systems and must carry their water from local streams.

All municipal centres have post offices, long distance telephone, telegraph, and radio reception. Three have local telephone systems, one a local radio station, and four receive television broadcasts. Only three have market buildings; the rest hold their markets in the open central square of the town. All but two have a municipal slaughterhouse where, for a small fee, farmers can bring their animals to be slaughtered.

The Farming Economy

Farm sizes in the region vary although most of them are very small. Sixty-five percent of the farms covering 28.5% of the land are in units of less than 5 ha;

The road from Bogota to Caqueza winds its way up and then down through the Eastern Cordillera. At the higher altitude the land is mainly in pasture with some potatoes and a little corn. (Photo: Jaime Rojas)

22% are between 5 and 10 ha and cover 11% of the land area. Only 4% of the farms are over 30 ha in size but these units account for 42% of the land; however, much of this is upland and mountain grazing and some forest land, which is unsuitable for cultivation.

Seventy percent of the farmers own their own land, 18% are renters, and 12% both own and rent land. Land use in the area is oriented strongly to corn and potatoes, which are grown on about 87% of the cultivated land under annual crops. The corn and potatoes are grown in association with a variety of crops especially beans, kidney beans, and peas. Approximately 40% (93600 ha) of the total land area is farmed; of this, 51% is in pasture, 31% in fallow, and 18% in annual or permanent crops. About three-quarters of the farms contained livestock: the average cattle herd was five head and poultry flock 22 birds. The 6000 farms with swine averaged two pigs each.

To obtain more specific information on cropping practices, yields, costs, and returns, a study was undertaken of 400 holdings belonging to 334 farmers in five municipalites. The results, discussed in more detail in Chapter 9, indicate that there are five principal crop associations in the area and that some usually yield better than others. Red bean/corn associations produce higher incomes than do associations involving these two crops plus other kinds of beans. The usual practice is to grow the red bean/corn association without fertilizer. Beans grown with potatoes yield three times as well as those grown with corn since fertilizer is always used with potatoes. In comparing the yields obtained by traditional methods in the zone with those developed by agricultural experimentation in the same zone, large differences were noted, indicating that there was a good potential for increasing yields of both crops and livestock.

Using data from a study conducted in seven municipalities in 1972, net annual returns per hectare for different enterprises varied from U.S. $45 for corn/legume associations, to $200 for potatoes and beans, on up to $800 for tomatoes. Returns on permanent crops ranged from $79 per ha for fruits up to $141 per ha for coffee. Cattle gave an annual return of $19 per head. These "average" figures do, of course, vary somewhat according to municipality and farmer involved.

Average 1972 farm family income in this survey was U.S. $638. As family size averaged 7.5 persons, the average income per capita was $85; of this, $68 was derived from agriculture. Of the total family income, about 80% was used for food so that disposable family income was in the range of $100-150 per annum.

The average per capita income was only a third of the national figure for Colombia ($250), although the family income figure was more than half the national figure ($1250). This low rural income/large family size picture was not atypical of the situation seen in other rural development project areas in Colombia and in Mexico.

Credit is available to small farmers and renters in the area through the CAJA AGRARIA commercial banks and private sources. In 1971, 60% of the farm families in the project area were covered by the zone of influence of the six local agencies of the CAJA and 67% of the farmers in the project area used credit from the CAJA and other sources. Of this credit, 84% was for crops (37%) and livestock (47%), the rest being given for housing (15%) and small industry (1%).

The average amount per loan was about U.S. $200. Two-thirds of the agricultural loans were for potatoes, vegetables, and tomatoes, as corn and beans traditionally have little cash investment, only labour.

Interviews with 42 trucker-wholesalers in the region showed that there is very little specialization in marketing crops. The truckers buy produce in municipal markets where about 90% of the region's agricultural production is sold. The number of truckers at any market varies from 20 to 100, depending on the day, season, and size of market. Buying appears to be very competitive as trucks are not always filled and earnings are not high. There was no evidence of collusion between truckers to keep prices low. Almost no storage of produce is undertaken as facilities are lacking and no organized or controlled grading or pricing system exists. Although truckers may have preferred places to sell their acquired goods, no firm sales contracts or production contracts are entered into with the exception of milk and eggs. The produce is sold in Bogota and Villavicencio.

Part II

Five Years of Experience in Caqueza

FIVE YEARS OF EXPERIENCE IN CAQUEZA

The following chapters describe the history of the Caqueza Project from its beginnings in 1971. As the project is an ongoing one, these chapters in no sense represent a final report on the project but are a collection of the experiences gathered during 5 years of operation. The chapters describe the activities during this period and record the work that has been done and the lessons learned during this time. To do this effectively, both successes and failures are included. They also attempt to describe how the concept of rural development, as understood by the team working in Caqueza, has changed through time and how new ideas have been generated on the basis of the experiences obtained during 5 years of working with the small farmers of the region. A description is also given of the administrative and institutional changes that were associated with the lessons of experience during these formative years.

This historical perspective is presented to provide a better understanding of the various factors that accelerated or retarded the action programs of the project, to explain the sequence of changes in orientation, and to understand the reasons for achievements and mistakes. The presentation has been carried out chronologically to provide the reader with an idea of the sequence of events and thought that each success or failure generated. No apology is made for the fact that the project has followed a trial and error approach. Such a course of action was inevitable, bearing in mind the diffuseness of the original objectives of the project and the initial lack of real understanding as to what integrated rural development was all about. Some problems have been solved, others have not, and the project was, and still is, exploring better ways of achieving its objectives.

The authors hope that this chronologically descriptive approach will be useful to those people or institutions who are or will be interested in or closely related to rural development. This description of the experiences gained in Caqueza may also help others to avoid repeating the same mistakes.

Each chapter of Part II consists of an introduction followed by a description of the activities carried out in programing, research, communications, and evaluation. The chapters continue with the presentation of the action plans carried out by the project in collaboration with other ICA programs and with other institutions. They describe the relations of the project with the local community. The chapters also refer to some of the activities the project had to carry out that were not directly related to its specific functions as a promotor of rural development, but were part of ICA's overall responsibilities in the fields of plant protection and animal health. They go on to discuss project management aspects relating to the staff, their work conditions, and the budget used to carry out the programs and the training received by the project staff. Each chapter concludes with a presentation of

the conceptual changes arising from the year's activities and the lessons learned.

Although this approach provides a very comprehensive description of technical and institutional factors and community relations, there is also a need to take into account the human factor as expressed by the interrelations between the different individuals in the project and others who had influence on or contributed to it. Many of these interactions had significant effects on the project. A great deal of authority was delegated to the project staff and this naturally led to a wide range of different points of view about existing problems and possible solutions. Such a situation was probably inevitable given the fact that the project was based in a small town in which there were very few young professionals other than those in the project team. They were, therefore, thrown into very close proximity not only during working hours, but during evenings and weekends as well.

The whole issue of personal contact is one whose importance is easily underestimated in this type of activity. The presence of a team of between 10 and 20 professionals and technical assistants trying to achieve the same objectives through complementary actions requires an infinite number of personal contacts not only within the team but also with other professionals working in other programs within the same institutions and with professionals from related institutions. In addition, the field team in an RDP has close contact with the small farmers themselves, their wives, the rural youth, and the rural community leaders.

Many of these relationships can be far removed from the technical aspects of the projects and can become very personal. This has both advantages and disadvantages. In many cases, the authors have not been aware of these contacts and of their influence; in others it has been possible to specifically relate these contacts to project results and, from time to time, reference to this will be made in the text. The impression has been gained that the significance of these personal interactions as a factor influencing the success or failure of RDPs is considerable and that this does represent a subject that is frequently ignored and that probably warrants a great deal of further study.

Chapter 4

1971: The First Year — A Year of Observation

The Caqueza Project initiated activities as an RDP in March 1971. The project took over the same office and part of the staff of the existing extension agency that had been working there since August 1970 and had responsibility for the same area. Hence, it was not a completely fresh start, and as a consequence it was necessary to continue with some activities that were already under way under the auspices of the extension agency. Three examples of this continuation of activities are:

(1) In October of 1970, two professionals from a fertilizer project conducted in conjunction with the Food and Agriculture Organization of the United Nations (FAO) visited the area and selected sites for joint ICA/FAO fertilizer trials. In January 1971 soil samples were taken from these sites and the ICA extension agency was asked to perform planting experiments on them.

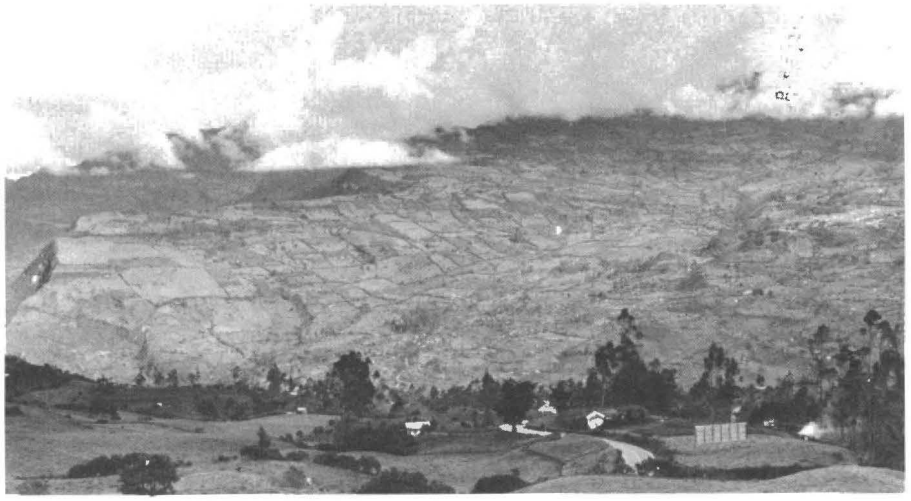
(2) The extension agency had been supervising regional trials to test the adaptability of new improved corn varieties and hybrids and potato varieties, all of which had been developed by ICA's Research Department. These trials were now incorporated into project activities.

(3) Early in 1971 the extension agency provided the Municipal Farmers Association with five defibrinator machines to mechanize fiber production from fique or giant cabuya (*Furcraea gigantea*), a traditional crop of the area. The new RDP took over the responsibility for such activities as helping to organize the use of these machines, to find spare parts when they needed repairing, and to assist in marketing the gunny sacks that were the end product of the fique crop.

Although the total project area included nine municipalities covering 227 000 ha, given the limited staff available and the lack of vehicles, it was decided to concentrate initial efforts in only three of them: Caqueza, Chipaque, and Ubaque (a total of 34 700 ha). These were the most densely populated municipalities in the area and were those to which access was easiest.

Organization and Programing

The project was planned to have about double the staff (14) of an extension agency as it was envisaged that it would embrace a much wider range of activities. Theoretically there was a coordinator (director) and professionals in charge of each of its five technical units (crop production; animal production; programing and evaluation; dissemination; and home economics). In addition, six field



Below an atlitude of about 8000 feet (about 2500 metres) above sea level, virtually all the land is cultivated in many small farms. (Photo: Jaime Rojas)

officers (designated locally as "technical assistants") and two home assistants, at the diploma level, were assigned to assist the professionals. The planned organization chart, which was not actually realized during the year, is shown in Fig. 2.

In spite of ICA laying down general and specific objectives (see Chapter 2), there were only very general work guidelines and no specific programs defined for the staff. To assist in specifying more precise guidelines, to identify project activities, and to technically and administratively support the project, a Regional Advisory Committee was created in April 1971. The permanent members of this committee were ICA's Regional Director, the Director of the Research Department of ICA, the National Coordinator of Rural Development Projects,[11] and the project director. This committee originally planned to have monthly meetings but this occurred only at the very beginning of the project and the frequency of these meetings soon decreased.

The project began its formal activities immediately prior to the planting season in April 1971. The initial efforts were devoted to organizing and planting the agronomic research trials previously managed by the extension agency. In addition, a number of trials were planned and carried out to meet the specific goals of the project. The fact that 54 experiments were programed meant that the crop production unit was heavily involved for the whole year. The large number of visits required at planting, weeding, and harvest time, other control visits, plus the organization of field days occupied the staff of that particular unit to the extent that the animal production and home economics units had to help them out. As a result of this, activities in these latter two units were severely curtailed during the year. A further reason for this was that both these units and the programing/evaluation one lacked a clear focus and the staff found it easier to collaborate with the crop production unit than to define the roles of their own units.

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[11]This position was created by resolution dated 13 August 1971. Its function was to coordinate the efforts of the six RDPs operating at that time.

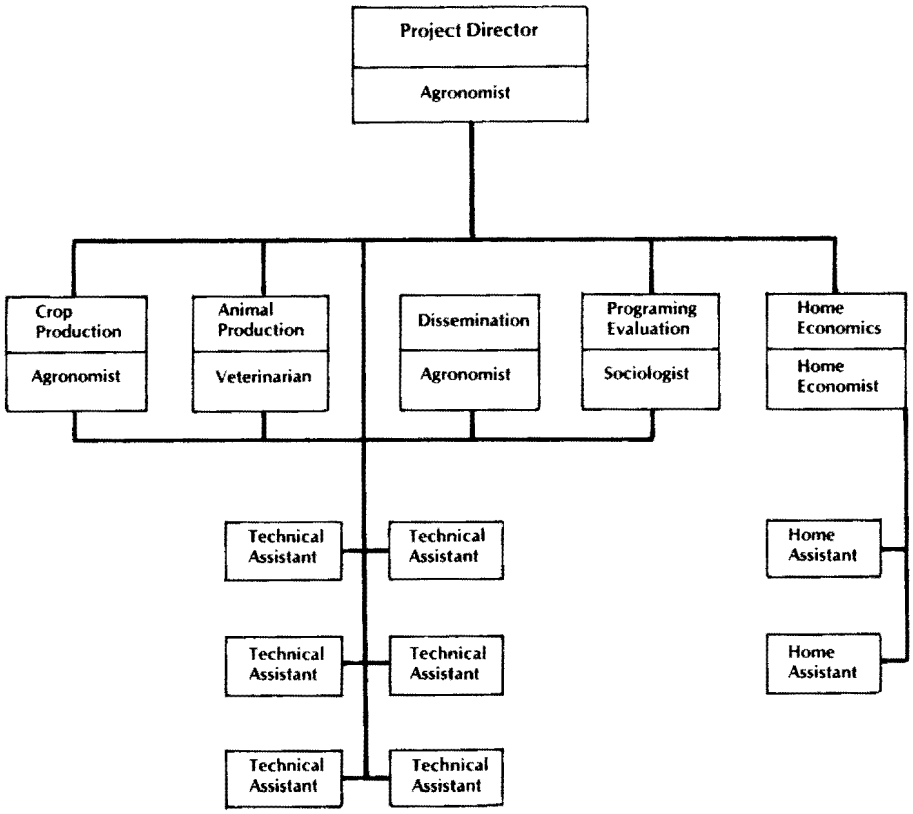


Fig. 2. *Organization of the Caqueza Project, 1971.*

Several attempts were made to define a comprehensive animal production program. Some of these were too ambitious and extensive to be practical; others were too general. A major problem was that animal production was of secondary interest to the farmers. They used animals for draught power and to consume crop residues. Occasionally, in the case of poultry, some small, business-oriented production units existed. The main lines of action in animal production that emerged during the year were:

(1) conducting short courses and publishing leaflets on animal production in general, commonly found diseases and their treatment, vaccination requirements and procedures, and improved feeding techniques;
(2) providing technical assistance for the prophylaxis, diagnosis, and control of animal diseases; in special cases therapeutic and surgical treatments were administered;
(3) analyzing the current state of animal production in the area; and
(4) demonstrating improved animal production methods on small farms.

After considerable discussion, the home economics unit decided to concentrate its activities in the following spheres: (1) nutrition and food preparation; (2) personnel health and hygiene; (3) first aid; (4) dressmaking; (5) home improvement; (6) vegetable gardens. The program was carried out through personal visits and group meetings with farmers' wives and young people. It was designed to be complementary to the other programs and to be a way of involving the whole family in development activities.

The programing/evaluation unit did not start operating until a sociologist was recruited in August 1971. His initial activities were to help the home economics unit develop its program. After that his main task involved organizing, programing, and conducting the socioeconomic diagnostic study, which the project team considered to be an early priority for the overall program.

The dissemination unit was not staffed until December 1971. For this reason, the dissemination effort was run by the project director and operated with the help of all personnel. Dissemination activities were flexible, depending on the time of year, special visitors, and new contacts with farmers. These activities were organized at the weekly staff meetings where the program for the next 7 days was formulated. These staff meetings were also used to interchange information and experiences and to record the most important activities carried out during the preceding week. After July, this system was institutionalized by the director who asked for monthly reports of activities from all project personnel.

Research

The research program was originally oriented toward crop production, mainly in the two crops identified as the most widely produced in the area, namely corn and potatoes. Four types of experiments involving 54 separate farmers were planned for these two crops. These trials are briefly reviewed below.

(a) Eight demonstrations of corn fertilization under the ICA-FAO agreement — These trials were designed with the advice of the ICA-FAO project coordinator and the director of the national corn program. Their objective was to obtain information on the responses to fertilization of traditional as well as improved varieties and hybrids of corn. They also served to illustrate to farmers the techniques and advantages of using soil tests as a basis for determining individual fertilizer recommendations. The trials compared nonfertilized plots with plots receiving a fertilizer treatment that was based on soil tests. These trials were not very popular with the project staff who felt that randomized soil testing did not provide an operationally feasible method for making recommendations in the project area because of the parcelled nature of the farms and the very wide range of soil types encountered. Nevetheless, this was an on-going research program that they were instructed to continue.

(b) Fifteen regional trials using corn hybrids and varieties developed by ICA — These trials were part of a national program designed to evaluate the geographical areas of adaptation of improved germ plasm produced and distributed by ICA's Research Department. They were essentially demonstration and evaluation trials whose location was decided on jointly by the Research Department and ICA's regional offices.

(c) Fifteen regional trials of potato varieties — These trials had the same characteristics as the corn trials. Five new potato varieties were compared with the most popular local varieties.

(d) Sixteen experimental trials on corn and potato production — The design of these experiments was made with the advice of: (1) the professional in charge of production from the Rionegro Project, who was trained at Puebla; (2) a specialist from the Soils Program of ICA; and (3) an IDRC advisor. Their objective was to develop and demonstrate a technological package along the lines of the Puebla Project approach. However, they differed from the Mexican approach in that rather than being carried out in monoculture, they were incorporated into the intercropping systems most widely used in the area.

Within this group of trials three were designed to measure the effect of different levels of fertilization with nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) on traditional varieties of intercropped corn and beans. Four experiments were designed to observe the responses of corn to fertilization with N, P_2O_5, and K_2O treatments using two levels of plant density and different varieties of corn (which was always intercropped with beans). Four simpler experiments, again using corn grown with beans, were designed to measure fertilizer and plant density effects. Three experiments were established to measure the response to fertilizer of potatoes grown in association with corn and beans, and two experiments were designed to measure fertilizer responses of corn and broad beans when these crops were grown in conjunction with potatoes. All 54 trials were designed for farmers' fields.

The main differences between the RDP approach and the former extension approach was that the 16 experiments, for whose design, execution, and analysis the project was responsible, were specifically established to generate technological packages based on information obtained by local experiments instead of following the previous custom of using a general recommendation suggested by ICA's experimental stations. All of these experiments followed the same techniques of soil preparation, planting, harvesting, and the interplanting of "associated" crops that the farmers of the region traditionally used. In this way, it was thought, it would be possible to generate technological packages that would be accepted by the small farmers of the region.

This program was very ambitious, particularly considering the lack of research experience of the staff and the scarcity of available transportation. By planting time it was apparent that it would have to be curtailed in size and it was decided to reduce the number of trials by cancelling the three potato fertilization trials and the four trials studying fertilizer and planting density effects on corn. However, the number of corn/bean fertilizer trials with traditional varieties was increased from three to five. In addition, only 10 rather than 15 of the corn variety trials were seeded; two were lost due to poor germination and three never got started. Thus, the final number of experiments was 44. Even with this reduced number the project personnel were overextended and were not able to visit the trials as often as they wished.

One of the main problems encountered in the first year's research in corn production was the poor emergence of improved corn varieties, especially the hybrids. Initially, the project staff thought this was a result of poor seed quality. ICA specialists who made field observations at the time, however, reported that only one hybrid showed poor germination. In the other cases, poor soil preparation and lack of moisture were the most important reasons for the low emergence rate. This was one of the first important lessons learned in the project. Improved corn varieties and hybrids required a better seed bed and higher soil moisture than did the local varieties.

The first year of agronomic research resulted in the first tentative recommendations for fertilizing corn-bean associations. It also led to the selection, from the 10 corn hybrids and varieties tested, of three that outperformed the traditional varieties in identifiable parts of the project area. The research on potato varieties showed three out of five tested as being clearly superior to the traditional seed. In organoleptic tests on field days, however, farmers rejected one of these three improved varieties. These results are discussed in more detail in Chapter 10.

No research as such was carried out in animal production or in home economics during the first year. By the end of the year, 16 purebred sows (Duroc

Jersey) had been sold at subsidized prices to farmers in the area and a demonstration program of feeding with concentrates was initiated. A few questionnaires were filled out by farmers who had semicommercial poultry production units, but these questionnaires were never really utilized.

The "baseline" study that was intended to provide the basic information required for future impact evaluation was not initiated until late in 1971. Two main reasons explain this delay. First, the people in the area were reluctant to give information about the size of their land holding, actual production levels, and family income to complete strangers who represented the national government. They feared that this information would be used for tax increases or for land reform purposes. The second reason for the delay was that no personnel with survey experience were available to carry out this kind of research during the first part of the year. Nevertheless, between the arrival of the evaluator in August and the end of the year, the development of questionnaires was completed and the collection of secondary and field data was initiated.

Dissemination

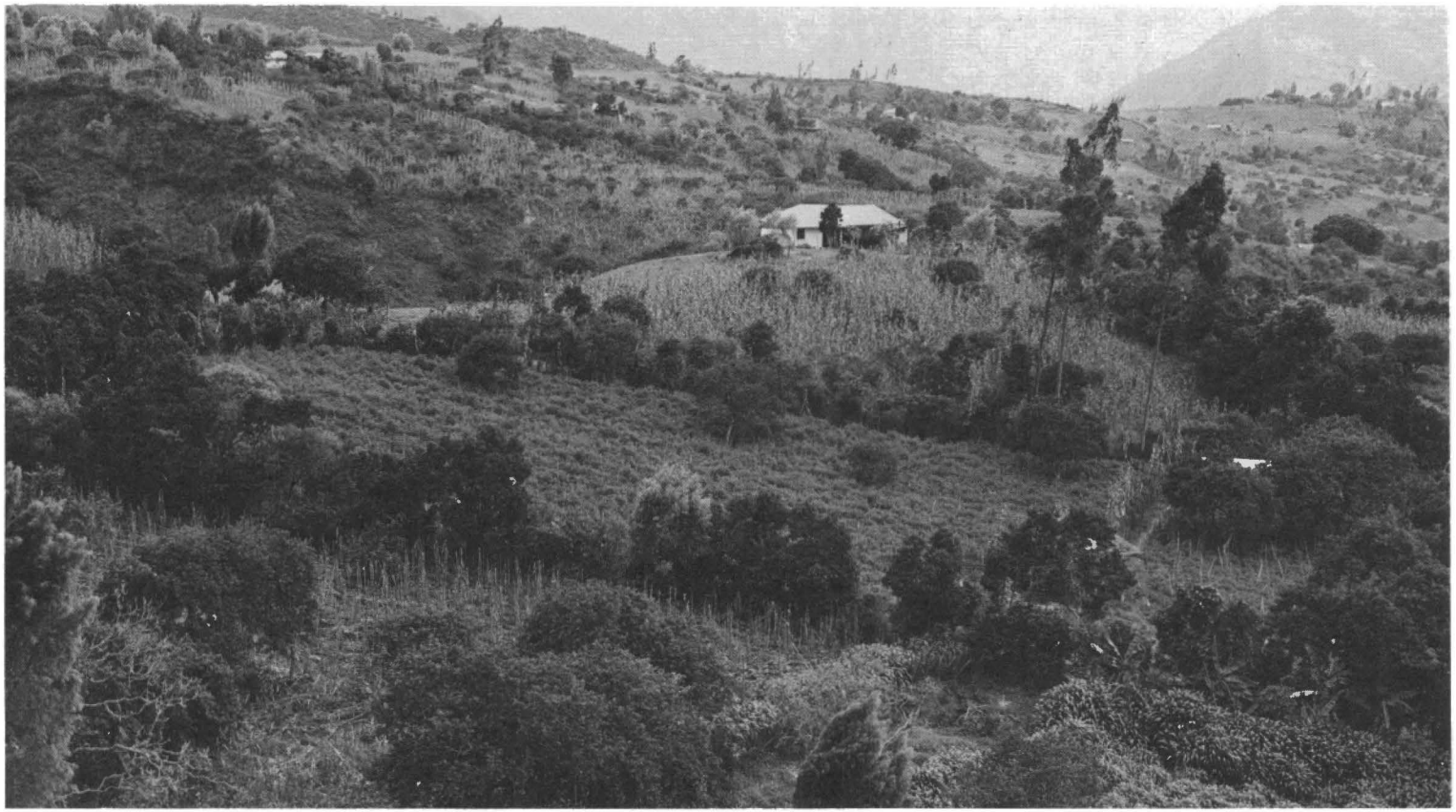
A major effort was made during the first year to familiarize the people in the area with the project personnel and objectives. Personal visits to farmers' homes and meetings with small groups of farmers, wives, and young people were frequent. In addition, the attention-getting technique of showing films (mainly about other RDPs like Puebla and Borgo a Mozzano) was used to establish further contacts. To increase impact and attendance, these films generally had to be shown after working hours, but this did not seem to deter the highly motivated project staff. During meetings and after film shows they explained the functions of ICA and encouraged each *vereda* (the smallest geographical community unit, encompassing between 50 and 150 families) to elect representatives to the existing farmers' organizations in the region.

Field days were also organized on the sites of the experiments and demonstration plots, and the publication of a newsletter was started. Advice was given to farmers both on field visits and when they visited the project office, and short courses were given on various topics. The main objective was to get to know the people in the area and their farming practices and, at the same time, to let them know what the project was all about.

According to project records, 198 meetings were held with 3623 men, 1837 women, and 1715 children participating. Twenty short courses in animal production were given, and with the help of additional home economics staff from the regional office, 14 courses were taught on nutrition and food preparation, health care, clothing, home improvement, and family organization.

Evaluation

As already mentioned, the project unit responsible for evaluation had a late start and spent a great deal of time trying to organize the data collection for the baseline study. Contacts were made with several institutions that had some experience in this kind of research. One of them, the CAJA AGRARIA, decided to jointly sponsor the baseline study and at the same time to provide the evaluator with reliable data on agricultural credit in the area. Secondary information was also obtained from local authorities and the national census bureau. By the end of the year the questionnaires were ready to be used in the field. Because the



The farms lie close together; their average size is about 2 hectares and this land is often divided into a number of distinct parcels. (Photo: Luis Gabriel Bohorquez)

sample size was to be about 700 it was decided to recruit part-time interviewers to accelerate the collection of data.

Publications

In May 1971, the project started publishing a biweekly newsletter called *Oriente en Marcha* ("The Marching East"; the formal name for the Caqueza Project is "East of Cundinamarca"). This short mimeographed publication had two objectives: one was to serve as a means of communication between the project and the rural families as well as among the farmers themselves, and the other was to publicize the project to other ICA programs, to other institutions related to the agricultural sector, to the government, and to people in national and international institutions interested in rural development. The mailing list had more than 200 names.

Opinions about this publication were requested from those who had received it. The responses were generally favourable regarding the vocabulary being used (which was adapted for the rural families' reading and comprehension levels) and the form of presentation. Unfortunately criticism from within ICA seriously affected the publication. The degree of autonomy given to RDPs was resented by some of the centrally located personnel and the project was accused of trying to be an "independent republic," working alone, without consulting all the expertise possessed by ICA. As a result, regional control was imposed, and the text of each edition had to be approved by the Regional Director. This inevitably led to delays, which, coupled with the frequent lack of paper, delayed subsequent productions. Nonetheless, 10 issues were published during the first year.

As this was the first year of project work, no other publications were produced during the year. The project's first annual report and research findings were not published until 1972.

Relations with Other ICA Programs

Early on in the project's life its staff realized that they could not work alone and would need technical support from other ICA divisions. For this reason many senior staff of the Research Department were invited to visit the project and make recommendations about possible research or action programs.

For obvious reasons, the research programs most involved in this liaison were those with corn and potatoes. Nevertheless, several other programs expressed interest in the project's activities. For example, ICA's Infrastructure Division designed and constructed a footbridge to cross one of the rivers of the area and helped in the implementation of a home economics project that promoted rural latrines, by helping to get a bulk discount from the manufacturer who supplied the toilets. In addition, a Regional Task Force of three home economists spent 3 months in the project area strengthening the activities of the home economist by teaching several courses, visiting a substantial number of families, and helping in the formation of women's groups.

Four ICA central laboratories provided specialized services to the project. These were: (1) the soil analysis laboratory, which analyzed all soil samples from the experimental trials; (2) the entomology laboratory, which identified insects from farmers' crops that could not be identified by project personnel; (3) the phytopathology laboratory, which identified plant diseases found in the project

area; and (4) the veterinary laboratory, which assisted in diagnosing animal diseases.

The veterinary laboratory was instrumental in confirming an outbreak of foot-and-mouth disease in two different townships, and twice identified outbreaks of Newcastle disease in poultry. With the assistance of the Animal Health Division of ICA, intensive vaccination programs were initiated. These led to the effective control of all four outbreaks.

By the middle of the year it became evident to the project staff that they lacked adequate analytical knowledge and capacity in economics. For this reason, support from ICA's Agricultural Economics Division was sought. After a visit by three professionals from this Division it was decided to conduct some in-service courses in production economics for the project staff.

Relations with Other Institutions

One of the specific functions of the project was to coordinate its actions with other institutions active in the area in order to promote improved "living standards" through integrated action programs. A number of contacts with other institutions were established and some coordinated action programs were started. A list of the institutions involved and the programs developed follows.

(1) INDERENA — This is the National Institute for Natural Resources, which had a tree nursery in the area. In conjunction with the INDERENA staff of this nursery, a demonstration afforestation program was developed for execution in 1972.

(2) CAMINOS VECINALES — This "pick and shovel" rural road program of the Agriculture Ministry planned four roads in the area with the dual aim of both improving access to distant farms and of providing income to unemployed labour in the area, especially during those periods of the year when farm labour requirements were low. The project collaborated with this program by forming farmers' groups interested in working on the roads, and linking them with CAMINOS VECINALES.

(3) CAJA AGRARIA — At the national level, a program for supervised credit under a general ICA-CAJA AGRARIA agreement, partially funded by US-AID, was developed during late 1971 for disbursement in 1972. The CAJA AGRARIA also provided personnel support, data, and funds for the jointly sponsored diagnostic study of the project area. This included a contract with students from the University of Los Andes to carry out an ecological study.

(4) SENA — This institute, responsible for the training of apprentices, arranged funding for scholarships to train 10 farmers' sons from the project area in one of their training centres.

(5) Private Enterprise — A meeting was held with a number of producers of veterinary supplies to inform them about the projects' activities in order to ensure an adequate supply of veterinary products in the project area.

Relations with the Community

One of the first steps taken by project staff was to establish contact and to become acquainted with the political, military, and religious authorities in the

area. They also participated in meetings of the municipal associations of farmers, many of which took place in the project's office. They also taught agricultural production courses in the two secondary schools of Caqueza. In collaboration with the Caqueza hospital they organized a vaccination course. Field days were organized, and the project veterinarian judged the stock at local livestock shows.

It was emphasized that the project would work with all people without racial, religious, or political distinction. For this reason it was decided that the project staff would not attend meetings where people were elected, in order to avoid any appearance of partiality. The staff went so far as to ensure an even representation among the political affiliations of farmers with whom they established demonstration trials or on whose farms they organized meetings. Because of the project's intensive participation in community life, the staff were accepted as a part of the community, with all the advantages and disadvantages that accompanied this identification.

Other Activities

In addition to the activities already described, the project staff had to carry out certain other duties in their capacity as ICA staff.

As a part of the National Veterinary Public Health Program, ICA was required to prepare bills of health for all animals and animal by-products transported through the region. Since Caqueza is situated half-way between the national capital and Villavicencio (the departmental capital of a region that raises a substantial amount of the country's beef), the veterinarian of the project had to sign a bill of health for each truck transporting cattle through Caqueza. Monthly résumés with the number of each bill issued, the number of animals included, etc., had to be sent to the office of Animal Health Services in Bogota.

Another official duty was related to municipal animal shows. Before each show could be organized, a clean bill of health for the area had to be provided by a district veterinarian. In the nine municipalities covered by the project, this was the task of the project veterinarian. This required the organization of district vaccination campaigns before each show. A report on each campaign had then to be submitted to ICA's Animal Health Division before the show could be officially authorized.

The general manager of ICA signed an agreement with the head of DANE (the National Department of Statistics) by which all RDP and extension agency personnel had to collaborate in the collecting of data for the national agrarian census that took place in 1971. As a consequence of this, project staff had to dedicate a considerable amount of time helping census agents carry out their duties.

Toward the end of 1971 the director of ICA's Extension Division asked the project to collaborate in collecting farmers' responses for two studies being done by that division. Farmers' meetings had to be held to evaluate the farmers' comprehension of some 30 leaflets published by ICA.

The director of the Post-Graduate Training Program at ICA's Central Tibaitata experiment station decided that graduate students had to spend their summers gaining field experience in extension agencies or RDPs. Two students were assigned to the Caqueza Project and each spent an average of 45 days in the project area. A class of home economics students and their professors from the University of Caldas also visited the project to explore the possibility of students spending time in the project to acquire field experience.

Receiving visitors consumed a lot of staff time. Visitors included staff from other RDPs, extension agencies, other programs within ICA, students from several universities, government officials (including the Minister of Agriculture), representatives from international institutions such as CUSO, CIAT, US-AID, CIMMYT, IDRC (see Acronyms and Abbreviations list), and journalists from the national press. Attention to visitors was considered very important by the project staff, but the visitors did not always provide advance notice. On other occasions groups planned visits and cancelled without informing the project. For these reasons, the project director asked ICA's Regional Director and the National RDP Coordinator to give consideration to trying to coordinate visits to minimize the loss of project staff time.

The sum effect of all these activities was to place a very heavy work load and responsibility on the young and inexperienced project staff. The situation was not eased by their difficulty in obtaining reasonable accommodation in Caqueza — a small town with very limited facilities.

Personnel, Vehicles, and Budget

The extension agency, which opened in Caqueza in August 1970 and predated the RDP, was directed by an agronomist with a veterinarian as his assistant. The agency also had a home economist, four technical assistants, a peace corps volunteer, a secretary, and a labourer.

The creation of the RDP in March 1971 absorbed the extension agency, and its head was replaced by another agronomist who had been trained for 5 months in the Puebla Project, and who had then been working in the Rionegro Project, which was established a few months before Caqueza. At the time of this change, a field assistant resigned and was immediately replaced. The project, therefore, started with 10 staff members, of whom the agronomist (who was called both the "coordinator" and the "director") and the veterinarian had vehicles and three of the technical assistants had small motorcycles.

In April, an agronomist without a vehicle joined the project, in charge of the crop production unit. The home economist resigned and was replaced by a home assistant. In May the veterinarian resigned, but was soon replaced by another veterinarian; however, the latter had no vehicle.

In July, the Peace Corps volunteer left and a sociologist was named in charge of the evaluation unit. He also lacked transport. At the end of this month, two additional motorcycles were assigned to the project.

In September, the director presented his resignation, which was accepted at the end of November. He was immediately replaced by another agronomist. Also, in November, a second home assistant and the first IDRC advisor (a soil scientist) joined the project staff. All these people, with the exception of the agronomist in charge of the project, came without vehicles.

The personnel and vehicle situations at the end of the year were as follows: an agronomist with transport as director and coordinator of the project; one agronomist in charge of the crop production unit without a vehicle; one veterinarian in charge of animal production and a sociologist in charge of the programing evaluation unit, both without vehicles. No professional was in charge of the home economics unit but two home assistants were on staff and one of them had a small motorcycle. In addition to the professionals, there were five technical assistants, all with motorcycles (Fig. 3).

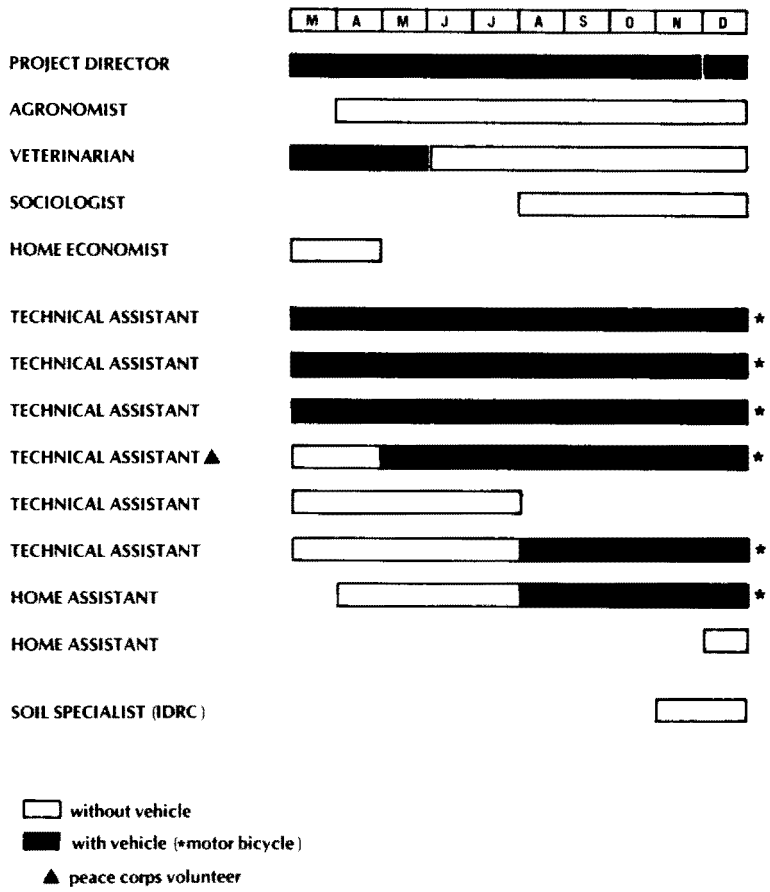


Fig. 3. Caqueza Project staff, 1971.

In spite of several memoranda, letters, and personal visits to regional and national offices, the transport situation was not resolved before the end of the year, and eventually became one of the reasons for the resignation of the first project director. The basic cause of the transport problem was that ICA only supplied very senior officials with vehicles. Field staff purchase their vehicles from ICA under a special credit program and they receive a mileage allowance for their use. A combination of the large staff expansion for rural development and a shortage of funds in this credit program plus the fact that young graduates were sometimes reluctant to take on the financial burdens of a vehicle purchase immediately they secured a job, resulted in a severe shortage of transport for field projects. This situation is not a new one in Colombia: it is often alleviated in foreign-supported projects (such as Caqueza) through the provision of vehicles by donors.

It has not been possible to determine the ICA operational budget for the first year of operation, although it appears to have been of the order of U.S. $30 000, used mainly for salaries.

In June 1971, an ICA request of Can. $150 000 for financial support to the Caqueza Project was approved by the IDRC Board of Governors and in August

IDRC and ICA signed a 2-year agreement. The IDRC funds were designated for the salaries of two advisors to the project (one soil specialist and one agricultural economist), the training of project personnel, office construction and supplies, five pickup trucks, communication equipment, and staff travel to other RDPs outside Colombia.

During 1971, a relatively small amount of money from the ICA–IDRC agreement was spent. The funds paid for a 5-week training course in Chapingo (Mexico) for the agronomist in charge of the crop production unit to learn crop research techniques. He also visited the Puebla Project and other Mexican RDPs. In September, two field assistants also spent 4 weeks in Puebla learning the dissemination techniques being used there. The trucks were ordered in September but did not arrive until February 1972. By the end of the year, one of the foreign advisors had started working and the other was in the process of being recruited.

Project Management

The first project director, because of his experience in the Puebla Project and his charismatic and dynamic personality, very quickly established a tremendous *esprit de corps* in the project. Project personnel felt they had been given the opportunity to prove to ICA administrators that young professionals, given the responsibility, could provide the long sought-for answer to the problems of small farmers in agricultural-oriented or rural development programs. To a great extent, because of the Puebla experience, project personnel felt that the initiation of ICA's RDPs would represent a considerable downward transfer of responsibility and decision-making authority from the National and Regional offices to the project level. The project staff hoped to be allowed a similar scope in decision-making to that enjoyed by the Puebla Project staff, ignoring the fact that the Puebla Project was not part of an established national institutional network and that it derived considerable autonomy of action from its strong link to CIMMYT.

The fact that this was not to come about caused friction between the project and the existing administrative structure. In particular, those ICA administrators not familiar with the goals of the projects, or those in some way threatened by the highly motivated "get the job done" attitude of the RDP staff, accused the project of steamrolling over established rules and practices in ICA. The project was considered to be demanding; it often asked awkward questions when it felt justified; and it jumped responsibility channels to get its way. These *enfants terribles* of Caqueza requested adjustments in administrative procedures and in staff management methods that had been the jealously guarded prerogatives of the National and Regional offices. The project also had the uncanny habit of operating in the gray areas of ICA's regulations and on the margins (or just outside) of ICA's accepted areas of activity.

On the other hand, project staff felt that they were not allowed or unable to do the job they were recruited to do. There were either no funds, no transportation, no personnel, or no paper, or when there were funds the project could not spend these on highly necessary items without prior processing and approval from the Regional Office. The project staff felt that whatever directions came from Bogota were urban-centred, showed no understanding of rural development, and certainly had no idea about small farmer-related subjects. The first project director was not able to tolerate the discrepancy between what he felt he

was asked to do and the resources available to him. From August until November, he submitted his resignation at least four times in an "all or nothing" bargaining process. In November his resignation was finally accepted as it had become clear that no compromise could be arrived at.

The new project director, although considerably less aggressive, continued to find himself in the position of having to request adjustments in existing administrative procedures to allow the project staff at least some freedom of action. Gradually both groups, the project on one hand and the Regional Office on the other, developed sufficient understanding, and, with that, enough tolerance for each other's viewpoint, that a productive working relationship was established. To a great extent, due to the sympathetic cooperation of the ICA Regional Director, the Director of the Rural Development Department, and the National RDP Coordinator, requests from the project were not offhandedly rejected as being impossible demands, and serious efforts toward accommodation were made. This process of mutual adjustment was to continue throughout the project's existence, but ICA's flexibility and willingness to make adjustments would, in the following 5 years, turn out to be most impressive. Nonetheless, it is productive to examine to what extent the decision-making responsibility was allowed to shift to the project level.

In Caqueza, the project team initially functioned as a unit, polarized by its strong leader and a very able and strong-minded crop production agronomist.

Fifty-eight percent of the population of the project area are under 20 years of age. The area contains 245 schools but many of the 227 of these that are primary schools are only able to offer 3 years of schooling. (Photo: Neill McKee)

The very strong direction of the project, however, placed undue stress on the professionals who had to contend with the more nebulous areas of project activity. Puebla training provided knowledge in crop production research and dissemination methodologies. No such action patterns were available to the veterinarian, who was continously asked to come up with a definite and feasible research and action program in animal production (a discipline for which he was only marginally prepared). This led to the transfer of one veterinarian and the near transfer of his replacement. The programmer/evaluator was expected to define, in a very short time, the task of the evaluator in an RDP and to do the same for the home economics unit. Both evaluation and home economics programs were so complex that they were to become the major topics of discussion for several national and international meetings on rural development. The inability of the evaluator to give a precise definition to these programs and his tendency to approach problems analytically, attempting to use all the available data, led to understandable differences of opinion between him and the action-oriented project director. It did, however, allow the project to become more questioning in its approach to the ill-defined task it had been given, and created greater awareness of its task as an ICA experimental project, not only with respect to action programs, but also in its role of analyzing development policy so that the Caqueza results could help formulate a clearer definition of the operational aspects of rural development at the national level.

Conceptual Development

In spite of what was said in the resolution creating the RDPs, namely that "ICA had the technology available to improve the well-being of the small farmer's family," the project started with a different approach. Agronomic research was carried out to test the "goodness of fit" of experimental station recommendations by incorporating them into the common practices of the farmers of the region. By the end of the year some important lessons had been learned. Under the prevailing conditions of the area, the traditional corn varieties outperformed the improved varieties. The hybrids responded better to higher levels of fertilization (particularly nitrogen) than did the traditional varieties. However, they required better soil preparation and were more affected than were local varieties by low soil moisture levels and certain diseases. To obtain the high yield potential of the hybrids, farmers had to use fertilizers, improve their soil preparation, and wait for moisture accumulation in the soil. Initial analyses of research results also indicated that the number of plants per hectare could be increased when additional fertilizer was applied. New problems of postharvest storage occurred because the hybrid grain was more susceptible to certain insects. With potatoes, the use of improved varieties, and to a minor extent proper seed selection, increased production substantially, but the major problem related to increasing farm income from potato production was the large month-to-month fluctuation in potato prices.

Although the project goals included an understanding of the entire production system of the small farmer, the initial work emphasized the strictly agronomic aspects of production. The staff soon became aware, however, that the resolution of agronomic programs was only a part of their task. Economic as well as social problems arose that led them to ask for more research in those areas and for more specialized assistance in analyzing different factors affecting the complete well-being of the rural family. They realized that their approach to

dissemination was inadequate. A whole new set of ideas was emerging, but by the end of 1971 these ideas were still very imprecise.

Résumé of the Year

The first year of operation was essentially a year of establishing the project. In spite of the delay in filling some of the staff positions and the lack of transportation for the professionals, the amount of work done was impressive. The highly motivated project personnel carried out their activities even during weekends and after working hours. They established a good relationship with the local community and contacted thousands of farmers, housewives, and young people. They also coordinated activities with other institutions and by the end of the year the possibility of working closely with the CAJA AGRARIA in credit supervision had become a reality.

The field work and the increased contact with farmers allowed the project staff to identify several unforeseen areas of activity that, if neglected, appeared likely to substantially limit the project's progress. Given these circumstances, they requested a substantial increase in staff for 1972. The old extension approach that considered the communication of the new technology to farmers as the only activity required was being forgotten and replaced by the idea that more had to be known about the farmers' present production system before anything could be done about changing it. But agronomic knowledge alone was not enough; socioeconomic knowledge was required as well. This was a year of observing the requirements for rural development to occur. The project staff began to comprehend that no surefire methodology existed, and that a long process of trial and error lay ahead of them. In spite of the administrative, personnel, and budgetary problems that were encountered, staff morale was high at the end of the year and 1972 was entered with enthusiasm.

Chapter 5

1972: The Second Year — A Year of Learning

The experience gained in 1971 from Caqueza and the other five Colombian RDPs convinced ICA's management of the need to increase the staff of each project. With the staffing level of 1971 it was difficult to increase the area of influence of the project beyond that of the old extension agencies, particularly since the RDPs were expected to carry out applied research and to supervise credit. For this reason ICA decided to increase the number of professionals and technical assistants in each project.

The increase proved to be timely since, although the main emphasis of the project was still placed on increasing incomes through higher agricultural production, the staff were becoming increasingly concerned about the socioeconomic implications of their work. In Caqueza, advantage was taken of the increase in staff to change the organizational structure of the project and to prepare a detailed plan of activities for the whole year.

At the same time the RDP program as a whole received with mixed blessings a Government policy directive that called upon ICA to increase the total number of RDPs in the country from six to 20. Although this was a compliment to the activities of the first year of the Rural Development Program, it placed a considerable strain on ICA's management in terms of organizing and staffing new projects and it also caused concern in that many ICA personnel, at all levels, felt that the RDP strategy was far from proven and was not yet ready for expansion. However, the Government was committed to developing the rural areas and its land reform program was under constant criticism so that an expanded RDP program was clearly an option that warranted exploration.

Organization and Programing

A detailed and ambitious program for the year was prepared by the coordinator at the beginning of 1972 (82). The responsibilities and functions of every project member were described with a corresponding schedule of his activities. This program included activities for the new personnel authorized at the end of 1971.

The experience gained in 1971 led the National Coordinator to change the organizational structure of all RDPs by creating a new unit (soil and fertilizer) so that each project now had six working units apart from central coordination (Fig. 4). The new unit was charged with overall responsibility for fertilizer experiments, which were the most demanding aspect of the field work in 1971, and

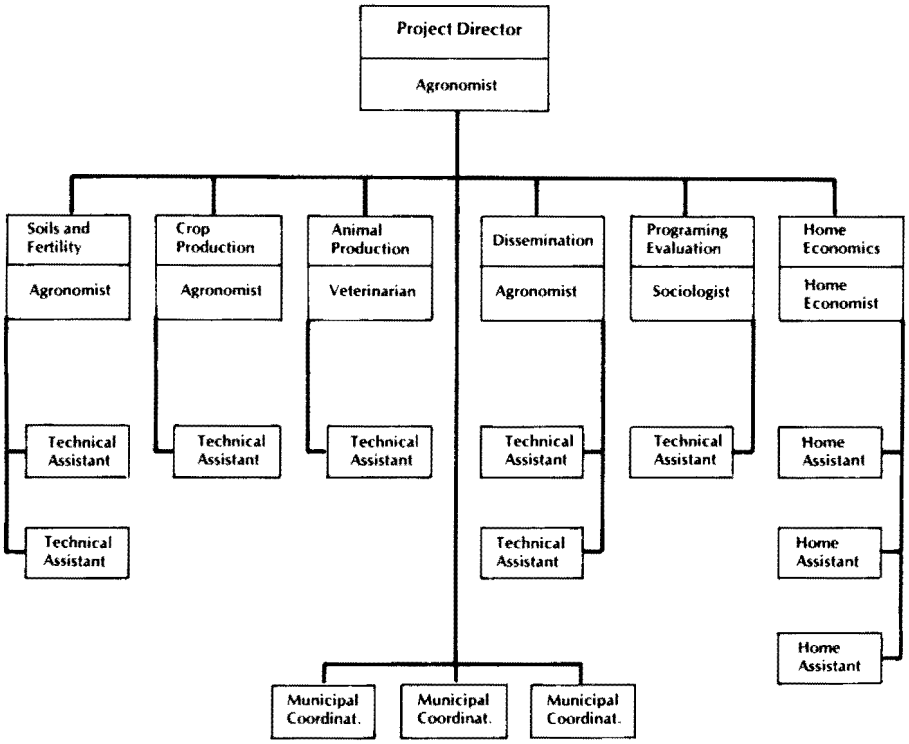


Fig. 4. *Organization of the Caqueza Project, early 1972.*

which were considered to be the adaptive research most likely to generate new recommendations to the farmers.

New positions of *municipal coordinators* were created. Three technical assistants were located in the field, one in each municipality where the project was working. Their main task was to supervise experiments, to coordinate action programs, and to serve as district officers working with all of the project staff who had activities in their particular municipality. In June, a further reorganization took place. The programing and evaluation unit worked directly under the director but the soils and fertilizer, crop production, animal production, and extension units were placed under one agronomist designated as an agricultural production coordinator.

A third change that took place was that, to provide clearer lines of authority and to avoid overlapping responsibilities, each professional had at least one technical assistant specifically allocated to assist him on a full-time basis.

Each unit was programed with the help of an advisory committee formed by project staff, specialists in the pertinent area from ICA's National and Regional offices, and the expatriate advisors from IDRC. These committees could be called upon by the unit in case of need. They were not designed to have regular meetings and were, therefore, little more than an identified source of information and advice.

Although not all of the results of the previous year's agronomic research had been statistically analyzed at the start of 1972, some general conclusions pertinent to agricultural production could be identified. These formed the basis

for the design of the project's research proposals and the technical assistance provided to farmers.

The general conclusions drawn from the 1971 work were:

(1) The most common associations in the region were corn-bean, corn-broad bean and potatoes-peas;
(2) Farmers did not fertilize corn associations, nor did they control pests;
(3) Farmers fertilized potato fields in which they controlled fungal and insect pests;
(4) The potatoes-corn-bean association (common in other areas in Colombia) was not widely found in this area. Where it occurred, it presented problems at harvest time because the potatoes were harvested first. In this process, bean and corn plants were damaged. Additionally, heavy rains at bean planting time substantially reduced bean stands;
(5) In general, land was poorly prepared, especially in the lower altitude corn-growing area where soils were low in organic matter content. In heavy textured soils this led to poor emergence of corn hybrids, which usually had small seed;
(6) Farmers used low plant populations. Production could often be increased merely by increasing plant population;
(7) The use of improved varieties of potatoes substantially increased production but marketing problems (low prices, difficulties in selling) were commonly encountered when the region had a good potato crop;
(8) Weeds were a big problem in corn associations;
(9) Postharvest losses due to pests caused considerable damage to the corn crop;
(10) Yield responses to nitrogenous fertilizer were both large and widespread in corn. Improved corn varieties did not outproduce the traditional ones unless they were heavily fertilized with nitrogen;
(11) Some soils were poor in phosphorus. Isolated plant zinc and magnesium deficiencies were also identified on the basis of leaf symptoms and subsequent leaf analyses.

On the basis of these findings, the following programs were structured for 1972:

Soils and Fertilizer Unit — Thirty experiments were programed for the corn-bean, the corn-broad bean, and the potato-bean associations. These experiments were designed to provide information about the optimum combinations of nitrogenous and phosphatic fertilizers, and to study the interaction between fertilizer, weed control, variety, seeding density, and seeding time.

Crop Production Unit — Approximately 13% of the cultivated land was used to produce horticultural crops. The crop production unit sought assistance from the Horticultural Division of ICA to find out which vegetable varieties were best suited to the region and what were the most appropriate fertilizer levels for onions, lettuce, beets, and tomatoes. After receiving this information, variety trials were seeded in farmers' fields.

This unit also collected material affected by pests and diseases in order to have these identified and to develop phytosanitary recommendations for their control.

Animal Production Unit — As in the previous year, this unit was not really programed to do research as such. It focused on traditional communication

campaigns and demonstration activities, such as: supervising credit for dairy, swine, and egg production; providing preventive health care (vaccination, use of antiparasitic drugs, etc.); introducing improved breeds; and conducting short courses on hygiene, nutrition, etc. The only research planned was some cost analysis studies designed to improve the planning of livestock credit.

Home Economics Unit — The large number of visits made to farmers' homes during 1971 had provided the staff of this unit with sufficient experience to enable them to identify the following problems relating to their field of interest: family relationships; lack of home management capacity; poor hygiene due to animals and people living in the same quarters; widespread consumption of food with low nutritive value; lack of latrines or other sanitary facilities; poor housing, education, and recreational facilities due to low income levels; and lack of skill in dressmaking.

Meetings organized to discuss family relationships and lack of home management capacity were poorly attended and not well received but there was a considerable demand for dressmaking courses. It was decided to promote these to generate goodwill and to use them as a tool to focus discussion on family issues in order to understand them better.

The home economists, therefore, conducted courses in dressmaking, handicrafts, health and sanitation (personal cleanliness, house cleanliness,

Much of the basic information about the area was collected from a series of surveys that brought the project staff into close contact with the farmers and their families. (Photo: Ron Poling)

latrine upkeep, first aid, etc.), and nutrition (food preparation with milk, legumes, and fruits, and vegetable garden programs to promote home consumption of vegetables).

In addition, a simplified brick-making machine was demonstrated. Its use by farmers enabled them to increase the number of rooms in their houses and to increase the window area of their living quarters.

Evaluation Unit — The main task of this unit was the continuation and publication of the baseline study started the previous year. Additionally an evaluation study of the activities carried out during the first year was planned as well as a cost-benefit analysis of the project.

Dissemination Unit — This unit did not have a professional in charge when the year's activities were being planned and for this reason only general guidelines were set up. The unit was to have responsibility for: supervising credit; coordinating the dissemination activities of other units; forming different committees or working groups; preparing dissemination material that would notify farmers about what the project was doing and the results obtained; coordinating activities with other institutions represented in the region.

A substantial amount of time and effort was spent developing this program. However, as the year went by a number of activities had to be modified due to changes in approach as a result of experiences gained, delays in staff recruitment, lack of transportation, misjudging the time needed for working on publications and administrative matters, and better understanding the work involved in the supervision of credit programs.

To help overcome these problems the project director held biweekly meetings that allowed each unit to discuss its work load, ask for support from other units, and arrange for transport sharing. These meetings also served as an important forum for new ideas, and provided opportunities to make changes in the program. In June, it was decided to hold such meetings every week.

The National Advisory Committee for the project had planned to hold monthly meetings, but the national expansion in RDPs made this difficult and the committee met only three times during the year. In one of these meetings it was decided to include the municipality of Fosca within the project's area of concentration since Fosca's municipal leaders had formally requested this of ICA. The inclusion of Fosca raised the number of municipalities in which the project was concentrating to four out of the nine in the whole project area.

Research

As mentioned earlier, much of the work done by the project was called research when in reality it was demonstration. The only three units that conducted true research during 1972 were the soils and fertilizer, crop production, and evaluation units.

The soils and fertilizer unit planted 30 trials of the corn–bean, corn–broad bean, and potato–bean associations following the first year's approach of conducting research on the most commonly found crops in the area. The variables studied were responses to nitrogen and phosphorus fertilization, planting density, effect of weed control, and choice of variety. Planting time was also considered to be an important variable, but could not be examined as farmers refused to change their traditional planting dates. To a lesser extent this also occurred with other variables such as plant population, weed control, and thinning. However, there were never difficulties with fertilizer trials particularly as the project

supplied the fertilizer for these. Since all experiments were conducted on farmers' land, differences of opinion did arise from time to time and the project staff learned to accept this as one of the realities of doing on-farm research.

One obvious miscalculation of the project's capacities was its plan to make a soils map of the area in order to define its fertilizer recommendations. This was soon recognized as beyond the project's capabilities and support of the National Geographical Institute was enlisted for this task.

Corn and potatoes are the two staple crops in the project area. Corn is a subsistence, low input, low income crop, and potatoes are subjected to substantial problems of price fluctuation and marketing. In an effort to examine the possibilities of diversification, the crop production unit planted: (*a*) two demonstration fields with plots of cabbage, beets, lettuce, carrots, and onions; (*b*) 10 variety trials with peas, tomatoes, cabbage, and onions; and (*c*) three fertilizer trials with peas and cabbages. The results of these trials were collected, analyzed, and incorporated into the project recommendations, but they were never published. This was not an uncommon situation as more immediate duties rarely allowed the staff the time to properly record their experiences. For example, the agronomist in charge of these trials was put in charge of dissemination in the middle of the year. As a result of this and the constant movement of staff from the project, a lot of useful information was lost.

Much of the project area lies more than 2900 m above sea level and has a vegetative cover well suited for keeping sheep. At one time there was a large sheep population but as a consequence of inbreeding and disease problems, few sheep remain. The animal production unit established three demonstration units with sheep and one with swine. The latter was designed to observe the adaptation of purebred animals and the possibility of crossbreeding these with poor quality local sows. No useful information was recorded from these pig and sheep demonstrations, again largely because the veterinarian was still responsible for mass or regulatory work that had priority.

The animal production unit also established six trials studying the response of pasture to four levels of nitrogen. Three trials were with Kikuyu grass (*Pennisetum clandestinum*) and three with imperial grass (*Axonopus scoparius*). The unit also installed 11 pit silos for corn stalks. These had a total capacity of 26 tonnes (t).These silos were an effort to improve the quality of the diet of dairy cattle, which are fed on dry corn stalks for several months of the year. As with the other animal work these trials were little more than demonstrations although they provided some rough guideline information for project staff. Neither they nor the studies on the costs of animal production referred to earlier were ever analyzed or written up.

The programing and evaluation unit completed its diagnostic study, analyzed the data, and wrote up over half of the report. The unit also collected and analyzed data on the adoption rates of corn and potato recommendations, and the corn data were later published (31). The planned cost-benefit analysis of the project appeared beyond the capacity of the available human resources and was abandoned.

During the year, it became evident that a substantial amount of applied research was needed in the project. At the same time it was recognized that there was insufficient project staff to conduct this research, especially in animal production. Graduate and postgraduate students from various local universities were, therefore, encouraged to do their dissertation research in Caqueza working on problems identified by the project staff. The idea behind this was twofold:

(1) to increase the amount of applied research done in Caqueza; and (2) to familiarize students and their advisors with rural development problems.

This research was funded by a supplementary grant of Can. $53000 from IDRC, most of which was used to cover students' expenses. In 1972, four students started their dissertation research in this program. The first study to be completed focused on the improvement of land preparation implements for hillside farms (49). Two studies dealt with the effects of fertilization and plant densities on yields of the potatoes–bean association and the other analyzed the costs and return to production factors in corn.

In collaboration with ICA's Division of Agricultural Engineering, a study was carried out dealing with corn storage facilities. The results have been widely used in Caqueza and other areas in order to improve on-farm storage techniques.

Dissemination

Three project units were heavily involved in dissemination activities: the dissemination unit itself, the home economics unit, and the animal production unit. During 1972, a number of meetings were held with farmers to discuss with them both the project and the new credit program. A total of 1900 farmers participated in these meetings. In addition, 660 farmers participated in field days that were the project's initial effort both to work with groups and to let farmers take the leadership in group meetings.

Sixteen hundred farm advisory visits were made and courses were conducted in cooperatives, corn and potato production, and soil fertility. These courses were designed to facilitate an understanding of the results of the project's field trials and to encourage adoption of the project's recommendations, and were well attended and appeared to be popular.

The home economics unit organized a house improvement program through which seven houses were rebuilt and three new ones constructed. Fifty families participated in a course that taught how to make furniture and furnishings. Courses were also given in nutrition and 16 vegetable gardens were established in school gardens and on farms. The health and hygiene course was taken by 277 wives, and 50 new latrines were installed. Courses were also given in sewing, weaving, and handicrafts with an attendance of 160 women.

In November 1972, under the supervision of the project evaluator, four home economics students carried out an analysis of the activities of the home economics unit. It was found that relatively few people knew about the program, possibly because the activities concentrated on a few families. It also became clear that the action programs had relatively little relation to the felt needs of the people. The results of the study (41) suggested that there was a need to advertise the home economics program more strongly; to visit more rural families to get acquainted with their problems; and to concentrate on activities that would have a broad impact.

The animal production unit, continuing with its preventive health orientation, vaccinated 1300 animals against foot and mouth disease, 14500 poultry against Newcastle disease, and administered 600 doses of other vaccines. Advice was provided to 1200 farmers at the project office, and 148 clinical visits were made.

In June the project office was moved from an unimportant side street to a building that faced the main square. This placed the office in the centre of

Caqueza and substantially increased the number of farmers and their wives who visited the office.

The project also became involved in credit supervision during the year as a result of a US $1 million loan from US-AID to ICA, who matched this sum with the equivalent in pesos of U.S. $2 million. These funds were specifically designated for providing supervised credit to small farmers with the CAJA AGRARIA handling the financial aspects of the loans and ICA providing technical supervision. The loans were to be channeled through RDPs and certain extension agencies, and the staff of the projects and agencies were to advise farmers how to obtain and utilize the credit.

As a result of this, project staff made several visits to each loan applicant to assist him in preparing a detailed investment plan. They also prepared a regional loan target for the CAJA AGRARIA in advance of the preparation of individual farm plans. After credit applications had been approved, project staff provided technical assistance to the recipients. This involved giving advice on the correct use of inputs and supervising the whole production process.

The staff initially planned for a loan of U.S. $47 000 for the project area. Of this sum, U.S. $17 000 was to be used for inputs for 91 farmers planting a total of 150 ha of corn and 30 ha of potatoes and U.S. $30 000 was for livestock credits for 35 dairy cattle, 15 swine, and 3 poultry units. Ninety-five percent of these loans were actually disbursed.

The preparaton and supervision of this credit program, to which the staff were instructed to give priority, ate heavily into other activities and necessitated an input from all project staff. This had obvious implications for other programs and curtailed both the research and the writing up of results.

Evaluation

As noted earlier, the main task of the programing and evaluation unit involved collecting and analyzing data for the diagnostic study, the report of which was more than half completed by the end of the year. The unit also started to evaluate project activities. Its first study was to find out how many farmers in the project area knew about the project and in what way the people's knowledge of the project was affected by the number of meetings held.

It was found that after more than a year of activities, 70% of the farmers in areas where there had been dissemination activities did not know what the project was trying to do and 80% of the farmers who had had experimental trials on their farms in 1971 did not understand the results of those trials. It was also found that the number of meetings held in a district did not relate to the state of local knowledge of the project, as these meetings tended to draw the same audience much of the time.

Some doubts were expressed about the validity of these results in terms of the accuracy of the sampling techniques. Nevertheless they did lead to a reorientation of project activities from fewer meetings to more personal farm visits and to a greater emphasis being placed on letting farmers know the results of experiments on their lands.

A second evaluation study measured 1972 adoption rates for corn recommendations. These recommendations had six components: seeds, fertilizers, plant spacing, seeds per hill, thinning, and pest control. A résumé of the results is presented in Table 2.

Table 2. 1972 Adoption rates of corn recommendations (31).

	Used recommended rates (%)	Did not use recommended rates (%)	Used less than recommended rates (%)	Used more than recommended rates (%)
Variety or hybrid	83	17		
10-30-10 fertilization	9		65	26
First urea fertilization		83	4	13
Second urea fertilization		52	43	5
Seeding distance between furrows	86		9	5
Seeding distance between plants	82			18
Seeds per hill	4		96	
Thinning	61	39		
Cutworm[a] control	87	13		
Armyworm[b] control	78	22		
Cob worm[c] control	0	100		

[a] *Agrotis spp., Spodoptera frugiperda, Prodenia ornitogalli.*
[b] *Spodoptera frugiperda.*
[c] *Heleothis* spp.

None of the farmers followed all the recommendations made by the project. They tended to adopt the cheap and uncomplicated recommendations and reject the expensive and complicated ones (fertilizers). In a subsequent survey it was estimated that only 55% of the 10-30-10 fertilizer recommended and only 20% of the total urea recommended were actually used. These results suggested that there was a need to simplify the corn recommendations, particularly in their fertilizer components. The possibility of introducing the recommendations step by step instead of providing one complex package was also considered.

A similar study of adoption rates was made in potatoes. The results showed a much higher rate of adoption of the recommendations including those for fertilizer. This was attributed to the fact that potatoes were already heavily fertilized by most farmers, and in many cases the recommendation implied a reduction, rather than an increase, in fertilizer use.

Publications

The project continued to publish its newsletter "The Marching East." However, the frequency of publication decreased because of lack of funds, and only nine numbers were published during the year.

Twenty mimeographed publications were prepared during 1972, covering a wide range of subjects. This was a reflection of the increased importance the project staff assigned to the writing up of their experiences. Some documents were conceptual in nature and resulted from the project staff's need for a clearer

In discussing motivation and goals with farmers and their wives, the education of children was frequently cited as a primary goal. However, many of the rural children did not settle down easily at school and a preprimary school program was established to try to improve their comprehension. (Photo: Jack Redden)

definition of what rural development really meant and from the encouragement that the project director gave to the staff in terms of writing down their ideas and viewpoints. A good example of this is the publication dealing with the justification of the strategy and the model for rural development (60). In a similar vein, papers were written on the methodology for carrying out "level of living" research as a component of development strategies (33) and for defining the type of evaluation to be used for dissemination programs (32).

Four publications presented the results of completed work: one analyzed the results of the potato production research carried out during 1971 (42); another discussed the adoption of new technology in corn (31); the third evaluated the activities of the home economics unit (41); and the fourth described the construction of a foot bridge by ICA's Infrastructure Division (54). A proposal to organize visits for the interchange of experiences between farmers (6) as well as a project to establish school restaurants in combination with PINA (30) were also published.

A number of reports resulted from requests by ICA's management for programing and budgeting purposes. All in all, 11 documents with an average length of 30 pages reported on activities of 1971 and on programs, budget, and projected activities for 1972, providing detailed job descriptions for project staff and of plans for credit and technical assistance (8, 20, 34, 59, 82, 83, 84, 86, 87, 88,

89). One additional document is of special interest: it describes the project area, organization, and activities and was prepared for the First International Seminar for Regional Rural Development Projects held in Bogota in September 1972 (85).

Relations with Other ICA Programs

The interaction of the project with other ICA programs was considerable during the first year. During the second year this cooperation increased still further. Nonetheless, problems continued and even increased because of the continuing lack of definition of tasks and responsibilities.

Some ICA central research staff felt that project staff should fulfill the role of data collectors and that the researchers should then analyze the information collected and publish recommendations with little field staff participation or recognition. This was not accepted by the project staff who felt that the separation of tasks between research and dissemination was counterproductive. They felt that in any on-farm research carried out in RDPs the research specialists should contribute their experimental design and subject matter knowledge and the project staff their field experience. Both groups should actively participate in the implementation and supervision of the experiments and in the analysis and final determination of the recommendations. The field staff resented being always regarded as junior partners, and this resulted in a number of clashes that led to several unfinished projects.

Notwithstanding this, good working relations were maintained with the potato and corn programs; the soil analysis, entomology, phytopathology, and veterinary laboratories; the regional home economics unit; the Infrastructure (another bridge was constructed) and Economics divisions. In addition, new activities were initiated with other ICA programs, such as:

(1) simplified corn storage facilities were constructed by the Agricultural Engineering Division, who also conducted a study on surface water utilization on the project area;
(2) 10 horticultural demonstration trials were planted based on technical advice from ICA's Horticultural Division;
(3) 30 sheep were sold to producers in the Chipaque area by ICA's San Jorge sheep farm;
(4) 22 purebred pigs bred at ICA's Central Research Station at Tibaitata were sold at subsidized prices to farmers of the region in order to start a breeding and demonstration program;
(5) short courses in communications and agricultural economics, and training in corn, potato, and bean production (with special emphasis on pests and disease control) were given by Tibaitata station staff to project personnel;
(6) in coordination with the joint graduate studies program of ICA and the National University, the project staff commenced supervision of four graduate students preparing their M.Sc. dissertation research in the project area.

Relations with Other Institutions

The number of contacts with other institutions, especially with the CAJA AGRARIA, also increased during 1972. To implement the supervised credit program, the project staff needed to determine the cost of production of the

most important crops and animal production activities and to understand the economic implications of adopting their recommendations. This was a very useful learning experience for the project staff who were now confronted with facing the economic realities of their recommendations instead of only considering their technical implications. Besides this, they soon discovered the administrative problems associated with credit programs and the difficulties that small farmers had in obtaining the required amount of credit on time. The project staff were also confronted with the problem of ensuring the supply of inputs specified in the loan programs. All too often these inputs were unavailable or did not arrive on time. For example, in the potato credit program the recommended varieties were not available in Caqueza and the project staff had to obtain seed from an ICA research station and carry this in their own vehicles to get it to the farmers in time for planting. They also had to change their recommendations because the types of fertilizer and insecticide that they recommended were not available in the area.

The credit program did not originate from within the project, indeed it imposed an additional load on the staff. Nevertheless, because of the close contact of the project personnel with the farmers, they received the brunt of any criticism associated with the credit and supply problems. This brought home to them very forcibly the need for close interinstitutional collaboration.

Amongst the projects' interinstitutional activities during the year were the following:

(1) INDERENA: A reafforestation program was initiated by planting three demonstration plots on farmers' land.

(2) CAMINOS VECINALES: The four "pick and shovel" rural roads planned during 1971 were constructed in 1972. More than 1000 farmers and landless labourers of the region participated in the construction of 16 km of new roads. Most of this work was done during the months in which crop labour requirements were low.

(3) SENA: The fellowships given by the Minister of Agriculture in 1971 were used in 1972 by youngsters from the project region who studied in SENA training centres.

(4) PINA: Plans were developed with this Nutrition Institute to create seven school restaurants and four snack bars. The first restaurant was inaugurated in November 1972.

(5) CECORA: Coordination with this cooperative institution ensured the supply of the concentrated feed for the purebred pigs that had been bought by the project.

(6) NATIONAL SUPERINTENDENCY OF COOPERATIVES: Instructors were sent by this institution to give two courses on cooperatives to farmers and project staff.

(7) MINISTRY OF EDUCATION: A literacy program was organized with the participation of final year students from the two high schools in the area.

(8) MINISTRY OF HEALTH: A health campaign was organized in one of the "veredas" of the project. Sixty-five medical consultations and 50 dental consultations took place and 150 doses of vaccine were administered by local hospital personnel.

(9) PEDERNAL CORONA: This private toilet-making company cooperated in the installation of 50 latrines in the project region by giving a short course to the project staff on the method of installation and by providing the latrines at discount prices.

Relations with the Community

To obtain greater community participation and to improve the coordination of programs in various institutions, the project proposed the idea of having a municipal committee decide on action priorities for the region. As a consequence of this the Caqueza Pro-Development Committee was created in June 1972. This committee had five subcommittees: credit; housing; infrastructure; health and education; and agriculture. The committee was formed from local representatives of institutions such as PINA, CAJA AGRARIA, CAMINOS VECINALES, INDERENA, Santiago Gutierrez High School, Maria Auxiliadora High School, the Caqueza hospital, as well as the mayor, the priest, the education inspector, and eight farmers. Project staff were also invited to participate in committee meetings.

The formation of this committee was a delicate activity with considerable political overtones. It was felt that the mayor should not preside over the committee and several unsuccessful attempts were made to convince a farmer member to accept this task. Eventually the task was taken on by the project director.

The main achievement of this committee was the organization of a consumer cooperative. The project realized the difficulties involved in the establishment of a cooperative, but the strong enthusiasm of the farmers on the committee made the idea worth pursuing. Project staff spent time promoting the cooperative on field days, during home visits, and at special meetings. They also helped during a fund-raising campaign whose main activity was the raffle of a cow. Although the cooperative did not start functioning until 1973, the basic ground work was done, and almost everything was ready for its opening by the end of 1972.

Apart from this activity the committee coordinated a school restaurant and snack bar program promoted by PINA and CARE. It also functioned quite effectively as a social action pressure group. It sent various delegations and many telegrams to Bogota to obtain a nutritionist for the area and to speed up the establishment of electrical services in Caqueza.

Other Activities

As in 1971, the project staff had to undertake activities not directly related to rural development. However, the ICA/FAO and the Regional variety trial programs were discontinued. Nevertheless, the veterinarian had to continue preparing bills of animal health (260 during 1972), supervising animal shows, and collecting information for outsiders. The situation with respect to this last point became so demanding and unmanageable that the general manager of ICA ultimately decided that no information could be requested from the project without the express permission of his office. This decision came as a consequence of requests such as one for 10 samples of room dust taken in five different municipalities to be sent for a national plan of mite recognition, with only 2 weeks notice!

The First International Seminar of Regional Rural Development Projects was planned during the first half of the year. The seminar took place in Bogota in September 1972 with the participation of field staff from projects in Mexico, Peru, Honduras, El Salvador, Paraguay, Ecuador, and Colombia. Representatives of national and international organizations also participated as observers.

The meetings were held in Bogota and participants visited the Caqueza, Norte de Cauca, and Rionegro projects. This was a useful seminar for the project's professional staff, their IDRC advisors, and ICA policymakers. There was an opportunity to interchange experiences with people from other countries and from projects with several years of experience in the field. The presentations, as well as the discussions, were considered important learning experiences. As a result of this meeting the Latin American Association for Rural Development (ALADER) was created.

Professionals, students, and journalists visited the project during the year. Many of these were from Colombian institutions, but a considerable number of persons from other countries and international institutions visited the project. The project records indicate a total of 598 visitors during 1972.

The land for the construction of a training centre was bought in June and during August and September the plans for construction were finally approved.

Personnel, Vehicles, and Budget

With the authorization of ICA to increase the staff of its RDPs, one home economist, two agronomists, four technical assistants, three drivers, and one secretary were added to the staff of the Caqueza Project during the first 4 months of the year (see Fig. 5). The first agronomist recruited was in charge of the dissemination unit but he left to continue studies in Chapingo (Mexico) in June and was not replaced. The other agronomist was in charge of the Crop Production unit until September, at which time he was provisionally moved to the dissemination unit. Because of this he had to largely abandon his work on horticultural crops.

Two technical assistants left the project in March but they were soon replaced. Later in the year, a home assistant and a technical assistant left without being replaced. In January 1972, the second IDRC advisor to the project, an agricultural economist, became part of the team.

As planned in the ICA–IDRC agreement, various members of the project left for short training periods. The sociologist in charge of the evaluation unit spent nearly 2 months visiting the Plan Puebla and the DAGEM project in Mexico. During the last week of his stay he was joined by the director of the Caqueza Project and the IDRC agricultural economics advisor. The latter two, after visiting Puebla and DAGEM, proceeded to visit RDPs in El Salvador and Honduras. In August, one of the technical assistants went to Panama for a 4-month course in cooperatives.

The vehicle situation improved substantially at the beginning of the year with the arrival of five pickup trucks bought by IDRC as part of the ICA–IDRC agreement. Three of those vehicles were directly assigned to the project and three drivers were recruited. The other two vehicles were assigned to the advisors. Later in the year the advisors handed one of their trucks to the project and shared the remaining one.

The vehicle bonanza did not last very long; by the middle of the year two trucks were in need of repairs and the others needed new tires. At times, parts for the trucks as well as for the technical assitants' motorcycles were difficult to find and, aggravated by money shortages, it sometimes took 2 or 3 months to have a vehicle repaired. The trucks were more expensive to purchase than the jeeps normally bought by ICA staff with an ICA loan, so their use presented a

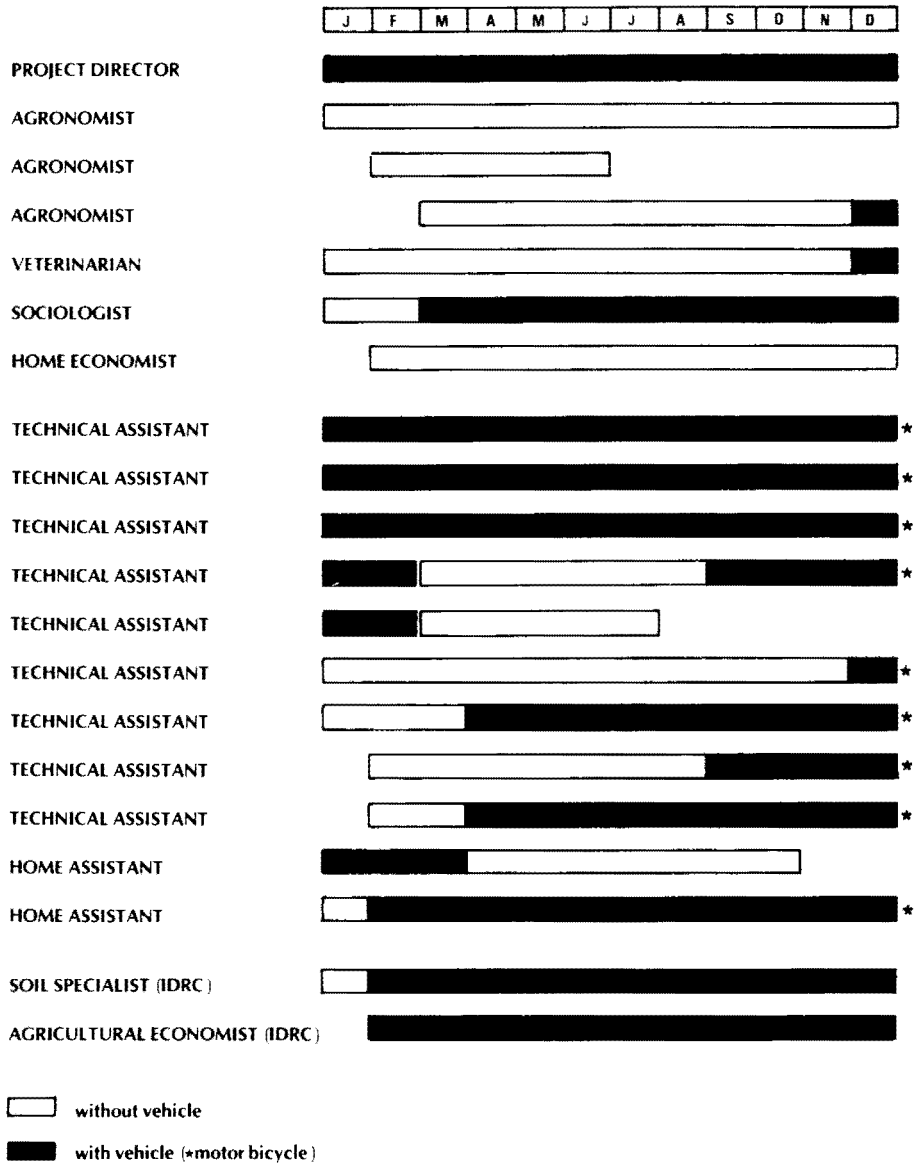


Fig. 5. Caqueza Project staff, 1972.

problem within the ICA transport policy regulations. To overcome this situation ICA switched three of the new trucks for new jeeps in its central transport pool and sold the latter to project staff late in the year.

The project budget approved for the year was U.S. $88600, of which $62400 was for personnel expenses and the rest for general operating expenses. In June, the general expenses budget was increased by U.S. $50000 to cover the costs of buying a plot of land for the training building and for audiovisual equipment. Unfortunately, by 13 September, the economic situation of ICA had deteriorated and all expenditures with the exception of salaries, office rent, and

utilities were prohibited. This meant that from September on money was unavailable for gasoline, travel, field days, or other project costs. In addition, all positions were frozen and nobody could be hired. This situation lasted until the end of the year and considerably limited the project's ability to complete the activities it had planned for the year. Of the U.S. $64 400 budgeted for personnel, only $45 700 (71%) was utilized, although 98% of the general purposes expenses of $24 200 were used.

Project Management

During the second year of the project, conflicts between the project staff and the regional and national ICA administrative authorities diminished. This was due to several factors: the project director was less aggressive; ICA's structure had changed to better cope with the demands of its RDPs (by the end of 1972 the Special Projects and Extension divisions were merged); and the project staff realized that they had to work within the existing institutional framework. Internal differences within the project also diminished as a consequence of a decreased emphasis on agronomic research and a better definition of the animal production and home economics program. The evaluator produced some interesting results that helped to justify the role of a sociologist in the project. Differences of opinion continued to occur, but the weekly staff meetings provided a useful forum where every member of the project could have his say. The discussions were not always constructive but, in general, helped to develop a common understanding of the problems being tackled. The staff decided to keep records of each meeting and this further contributed to this common understanding.

Conceptual Developments

The weekly discussions resulted in important conceptual developments. The first year's motto "Transform the small, traditional farmer into a commercial farmer; from peasant to businessman" was considered to be incomplete, as it looked at only one of the components of the welfare situation. The staff now accepted that the project needed to set its sights more clearly on bringing about the improved well-being of the rural family and not only on increasing farm income. They recognized that, given the mandate of ICA, this would entail much more coordinated activity with other institutions and it was not a task for ICA alone. The sociologist (evaluator of the project) and the agricultural economics advisor played an important role in shifting the focus of the project from being strictly production oriented toward a more socioeconomical point of view. As a result of this, there was an acceptance of the value of economic and social research within the project — a situation that did not exist during the first year that the evaluator was with the project.

The problems associated with increased potato production (low prices, no buyers) led the project staff and the National Coordinator for Rural Development Projects to recognize that marketing was one of the important problems in the project. This conclusion was strongly supported by discussions with farmers who considered that marketing problems were one of the limitations to shifting production patterns from low (corn) to high (horticulture) income crops in the Caqueza region.

The need to shift the veterinarian's clinical approach to a more production-oriented one was agreed upon and supported by the veterinarian himself. The project staff also recognized that the intermediate goal of increasing production of corn and potatoes per unit area was not a final goal. The final goal was to maintain the existing level of production and reduce the area needed for staple crops. This would free land for high income crops, such as vegetables, with which the project had begun to experiment on a small scale.

Finally, the need for a theoretical model of rural development was strongly emphasized in order to have a frame of reference for the action programs that the project wished to generate. This model was written up in collaboration with all the professional staff to the project (60). It helped them to better understand rural development and which action program could be generated to achieve the desired objectives. At the same time the staff achieved a better understanding of their own roles. This was important as it was realized that the project, in its experimental role, was being followed very closely by national as well as international institutions.

Résumé of the Year

The second year of project activities was a year of learning. The conceptual understanding of rural development increased substantially. While no definitive answers were found, the project staff had a clearer understanding of their task. As a consequence they developed more precise action programs. Too many action programs were started, however, without considering the time required to implement and operate them and because of this, as well as budgetary and staffing problems, many programs were never completed.

The project did not suffer too badly from changes in personnel although these did curtail the research output. The project staff were learning to work together as a team and to have open and constructive discussions. The first evaluation results helped to rearrange priorities and showed that the adoption of technology did not only depend on the transmission of the message to the farmers. It became more and more apparent that many farmers knew the message but were not always able or willing to apply it.

The supervised credit program proved to be a useful learning experience even though it was very time consuming. It showed that credit was essential for the adoption of new technology. However, the low adoption rates for certain practices presented the project with a new range of problems.

The year ended with ICA, and consequently the project, having serious economic problems. However, project morale was good because the efforts put into the creation of the cooperative were finally bringing results and the likelihood of its inauguration within a short time was high.

Chapter 6

1973: The Third Year — A Year of Change

The 1972 decision to open 14 new RDPs meant that nearly 300 professionals and technical assistants had to be recruited or reassigned within ICA to staff the new projects. Most of these people lacked training or previous experience in RDPs. As a consequence the staff of the six original RDPs were called upon to prepare short training courses for the newly recruited staff. To further augment the training of professionals the joint postgraduate training program of ICA and the National University created a new interdisciplinary program for its M.Sc. degree in which students could major in rural development.

In spite of the growing recognition given by the Government to the importance of the RDPs and the additional support at Caqueza provided by the IDRC funding, the project suffered serious budgetary problems throughout the year. In July, the President of the country instructed all semiautonomous official institutes, such as ICA, to substantially reduce their expenditures and to give priority only to urgent matters. Later in the year, in September, a mandatory 10% reduction was made in ICA's budget. Furthermore, because of a general budgetary crisis, the flow of funds from the Treasury to ICA was often delayed. In the Caqueza Project very little ICA money was available for travel allowances, field days, gasoline, and experiments (fertilizer and seeds).

The project also suffered from staff changes during the year. Of the six professionals who had been working at the beginning of the year, four were replaced, including the director of the project. Thirteen assistants were recruited, eight of them replacing people who resigned, thus increasing the total support staff from nine to 14.

This combination of economic problems and staff changes affected project activities, especially field work by the project staff, which continued at a lower rate than planned. However, this was largely compensated for by the growth of student research activities.

Organization and Programing

The increase in the number of support staff was used to extend the area of direct project action. The municipality of Une was selected to join the other four that were already receiving direct attention.

The staff changes during the year made it difficult to systematize an organization chart because, at certain periods of the year, the project staff had to be organized according to the people available. By the end of the year the situation had stabilized and the organizational pattern was similar to that illustrated in Fig. 6.

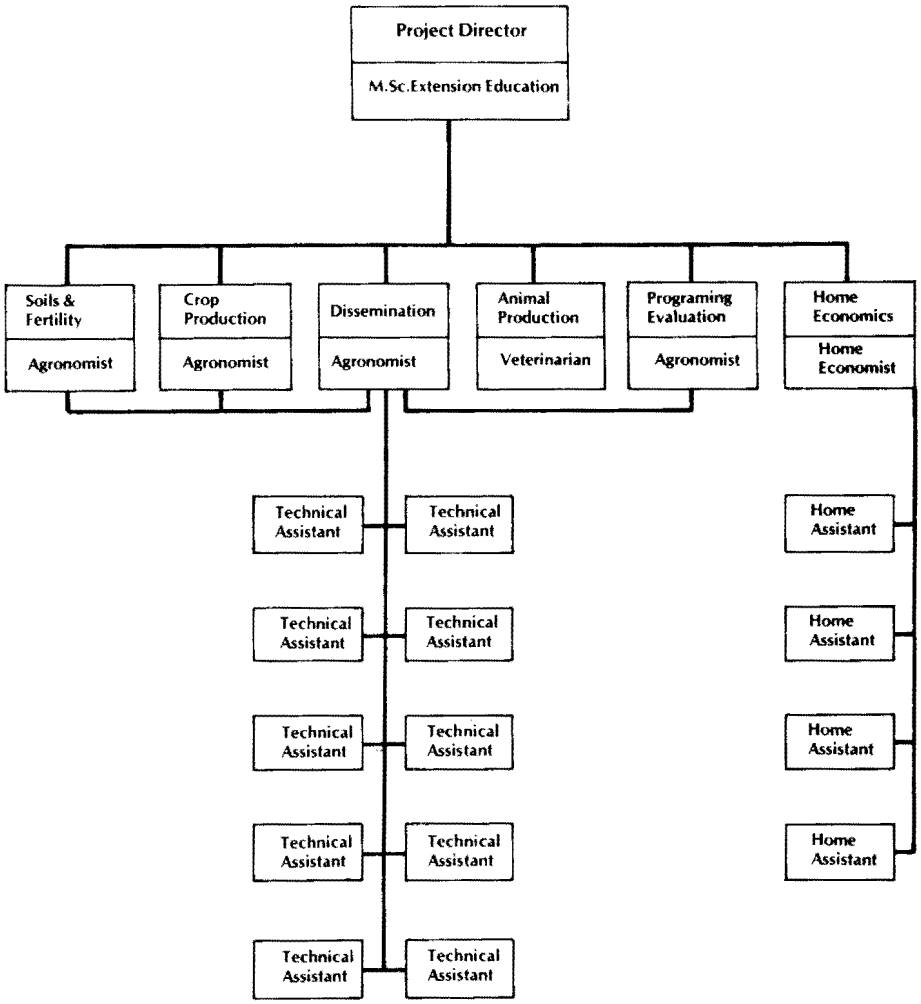


Fig. 6. *Organization of the Caqueza Project, 1973.*

An important organizational change took place that gave the agronomist in charge of the dissemination unit the responsibility for internal project coordination. All technical assistants were placed under his authority and the professional staff had to obtain his approval before assigning any work to them. This change was successful in that it allowed the project director to devote much more of his time to interinstitutional coordination and to administrative matters. A second successful structural change made during the year was that every assistant (other than those in home economics) was allocated to a restricted geographical area in which he coordinated all project activities. This system helped to reduce travel time and costs. It also provided a workable means of team action, which resulted in a better integration of project activities.

Activities programed for 1973 had been prepared at the end of 1972. The initial program proved much too ambitious, in view of the economic and personnel constraints, and had to be severely curtailed. The project staff still lacked a realistic concept of how much work they might successfully achieve, bearing in

mind all the activities of the project. Overprograming was a common experience in all Colombian RDPs and was not helped by the tendency, sometimes politically unavoidable, of the central staff of ICA to commit RDP staff to additional and unforeseen tasks when an annual program was already under way.

Research

Two significant changes took place in the research program during the year. Firstly, while agronomic experiments (potato associations, corn associations, and horticultural crops) were continued, a number of economic, nutritional, and communication studies were started. Second, a large part of the research was carried out by graduate and undergraduate students.

The student-research system worked as follows:

(a) a list of Caqueza Project research needs was prepared with a short description of the work entailed;

(b) the list was discussed with ICA's Research Department personnel in order to involve them in rural development problems, to use their specialized expertise to set research priorities, and to identify possible thesis advisors to guide the students on experimental design, etc.;

(c) the list was made available to students of the ICA-National University graduate program and to students of other universities;

(d) if a student selected any project from the list or he proposed a study considered important for the Caqueza Project, he received financial support from the IDRC grant to the project. This support was used for data collection, travel costs, final typing, etc. (no living allowances were paid);

(e) the student was guided by a thesis committee, which, in almost all cases, included either the project director or one of the project's IDRC advisors.

In practice, this turned out to be an effective program because the students had to prepare a thesis in order to graduate. The cost per student was U.S. $500–1500 exclusive of computer facilities. The latter were provided by the local IDRC office, which had a Hewlett-Packard model 9830 and a programmer. This computer was a considerable incentive to the students who were given ready access to it, whereas they normally had to wait a long time for access to the Central Government Computer at DANE. Furthermore, all data recorded from the project were stored in a tape data bank to which ICA staff had access. This data bank helped avoid duplication of work and data could be retrieved for cross-checking and sensitivity analysis. By early 1976 nearly 100 magnetic tapes were in this bank.

This system provided the Caqueza Project with a unique research capacity that enabled in-depth studies of the area to be carried out and provided students and researchers, accustomed to working only on experimental stations, with an opportunity to conduct research under field conditions.

The process of involving ICA's Research Department in this student program was not an easy, quick, and smooth one. It implied that the field staff were, to some extent, through their farmer contacts, deciding what research was required. Furthermore, they were supporting this research with funds not available to the Research Department. Fortunately, a growing number of younger research staff responded positively to this approach and recognized that they could work with it in a collaborative program.

One of the underlying reasons why researchers originally opposed research in the RDPs was that promotion in the Research Department is partially based on publication credits and therefore the researchers wished to control all research activities in their field. However, the student program offered a compromise in the possibility of coauthoring work with students being supervised, and gradually an increasing number of research staff came to recognize this.

As in previous years, the project staff planted corn–bean, potatoes–peas, horticultural, and pasture experiments. They also conducted a nutritional survey and started to record farm accounts. The farm account records were thought to be a potentially valuable source of year-round information about the farmers' economy. Initially, the technical assistants were in charge of helping selected farmers keep these records using notebooks. This approach, however, failed because nobody exercised adequate control or supervision and consequently, the notebooks were not kept up regularly. A second approach was then tried. Farm account books designed by the ICA Economics Division were printed and distributed to about 200 farmers. One technical assistant was put in charge of giving advice to the farmers on how to use these books. He was also responsible for the whole continuous data collection process. Unfortunately he resigned after 6 months, and it was then discovered that not a single account book had been kept up to date. A third attempt to get this system going was tried by involving all the technical assitants; once again it failed, the technical assistants claiming that they were too busy with other activities.

Research completed by students during the year included studies on: (*a*) an improved, ox-driven plow; (*b*) productivity analysis of horticultural crops; (*c*) variety and plant population trials for the potatoes–bean association; (*d*) plant population, nitrogen, and phosphorus fertilization levels for the same association.

Studies were started on the real cost of credit; labour utilization and availability; the economic feasibility of milk production; returns to egg production; marginal factor productivities for the most important crops; the rate of adoption of technology; decision-making; the establishment of a standard-of-living index; nitrogen application methods; least-cost linear programing for human diets; potato technology recommendations; and the relationship of field history to soil phosphorus levels.

Dissemination

The 1972 evaluation of the dissemination program indicated that it was achieving very limited success. As a consequence of this, some of the IDRC funding was used to contract a Ph.D. in anthropology who, under the auspices of the Canadian University Services Overseas (CUSO) program, started working with the project in February 1973 in an attempt to achieve better communication with the farmers.

His main tasks were:

(1) to evaluate the existing communication processes in the region and their potential use by the project;
(2) to organize the loan, maintenance, and use of audiovisual equipment available to the project;
(3) to establish audiovisual material and communication campaigns using the methods based on the peoples' attitudes and values as determined by his research;

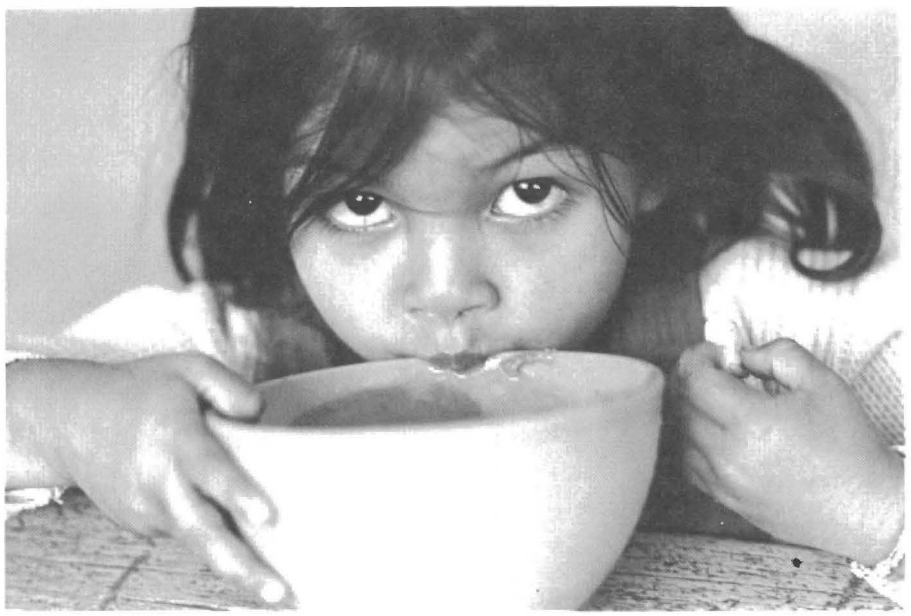
(4) to develop audiovisual material for future use in the training of professionals for other RDPs.

It was found that the weekly municipal markets played a key role in the existing communication system. At these markets, the farmers as well as their wives contacted other farmers, storekeepers, marketing intermediaries, travelers, and, in some cases, the mayor or other political functionaries. These meetings with different people provided the farmers with a substantial amount of social, as well as technical, information.

Another important source of information was the radio. The possibility of setting up a small transmitter in the project area was looked into but found to be impractical.

A system for using the project's audiovisual equipment at the *vereda* level was implemented, as well as a scheme to obtain films from embassies, private institutions, etc., on loan. Both systems worked well initially, but broke down when there was a massive change in project personnel.

Very little new audiovisual material was created, partially because ICA insisted that the IDRC funds for this task had to be controlled by ICA's Communication Division whose relations with the anthropologist were strained. This was one of the only two occasions during the 5 years when there were significant problems between the expatriate advisors and ICA staff. In spite of this problem (which was later resolved), the anthropologist started to make a film and to train the staff in preparing audiovisual material. The purpose of the film was to contrast life in the countryside with life in Bogota slums, where many, if not all, migrant farmers end up. It was hoped that this would enhance the cultural and working pride of the small farmers as an integrated part of their development process and that it would enable a dialogue to develop between them and the staff responsible for dissemination.



A food aid program was used as an incentive for the preschool program. (Photo: Jack Redden)

The anthropologist also worked with students setting up research on various communication problems in order to gather information about the existing communication processes in the region. Meanwhile, the other dissemination activities of the project still tended to follow the traditional "extension" pattern. Field days and meetings were organized, and a substantial number of visits were made to farmers.

Over 20 courses were run for farmers and their families. These courses were organized by the project staff but the teaching was now done by SENA personnel who specialized in running rural courses.

Sixty-four sheep were brought to the project for demonstration purposes and sold to farmers. A visit to the swine facilities at the national research station in Tibaitata (15 kms west of Bogota) was made by 60 farmers. The farmers were impressed by what they saw and a number of them decided to buy improved landrace boars and sows in order to improve their own stock.

Detailed credit plans were presented to the CAJA AGRARIA for a total amount of just over U.S. $100000. The CAJA AGRARIA approved 90% of these credits, but the disbursements were seriously delayed. Furthermore, when the money actually arrived, the CAJA AGRARIA did not have the personnel required to carry out the necessary inspections nor did it have adequate stocks of the seed and fertilizer that it was supposed to supply as part of the credit. This situation caused considerable farmer dissatisfaction. Unfortunately, since the project staff had been instructed to develop and promote the credit program and to meet a regional goal in terms of the quantity of credit to be disbursed, they were the people whom the farmers identified with the credit program and they were the ones (rather than the CAJA AGRARIA) whom the farmers blamed for the absence of the promised credit and inputs. This frustrating experience led to a substantial cooling off in the relations between the project staff and the local CAJA AGRARIA personnel, although the real cause of the problem lay at the national rather than the local level.

Two new extension programs were started with young people. One was designed to involve rural youth in activities such as raising rabbits, growing horticultural crops, etc. The second involved creating preschool centres to provide social opportunities for young children. Through the use of food aid it was planned to supply a fortified vegetable mixture that would be provided free in order to improve the nutrition of children attending these centres.

Evaluation

During 1973, very little was done to implement evaluation programs, mainly because the programmer-evaluator left the country to study abroad and his replacement was only assigned to the project on a part-time basis.

The complete baseline diagnostic study was, however, published. The limited time that the new programmer-evaluator spent in the project was used to program the project activities and to establish the credit plan, to help in the administration and organization of the cooperative, and to develop, in close collaboration with the project director and one of the IDRC advisors, a marketing program. The need to develop such a program became obvious from the results of a program to increase cabbage production in Fosca. The farmers adopted the project's recommendation for cabbage production, yields increased three- to five-fold, but there was no market available to absorb the excess production. The farmers, angered, dumped sacks of their cabbages on

the doorstep of the project's office and organized a demonstration. To solve the immediate problem the project staff contacted various wholesale markets in Bogota where they sold most of the cabbages at a price that satisfied the Fosca farmers. However, this meant that two of the staff spent 3 days as cabbage salesmen!

This experience taught the staff an elementary but important lesson, namely that increased production was not synonymous with increased income. Any increase in production had to be sold at a reasonable price for the farmer to achieve a better income. This experience resulted in the staff attempting to develop a marketing program, not only to reduce marketing costs but also to look for possible marketing channels and to better adjust crop production plans to seasonal demands. By the end of the year a marketing program had been written up and was being discussed with ICA and agencies specifically involved in marketing. It was closely related to the cooperative program, which will be discussed shortly.

Publications

The "Marching East" continued publication but only five numbers came out during 1973 due to paper shortages arising from ICA budgetary problems. These problems did not handicap the publication of research results as this was covered by the IDRC grant and with the buildup in student involvement, project staff and students published 31 manuscripts on various subjects:

- The socioeconomic diagnostic study of the project area (37);
- Four theses: one on small-farmers' mechanization (49); one on horticultural production (39); and two on the potato–bean associations (94, 116);
- Two soil-related research methodologies (73, 133);
- Three research reports and recommendations for the corn and potato association (17, 18, 43);
- Two conceptual articles about the role of research in RDPs (132, 131);
- Two training program proposals for new personnel (64, 106);
- The research needs of the project for 1973 (124) and the norms under which the research should be carried out (123);
- The description of anthropological work in RDPs (25) and the outline of an anthropological film (26);
- The justification for the farmers' cooperative (35), the first progress report of the cooperative (71), and a plan to increase the services of that cooperative from consumption alone to inputs and marketing (107);
- A report of the conditions of the "pick and shovel" roads already constructed (61) and a plan to build 12 more kilometres (67);
- A health plan for the project area (36);
- A justification and request to dedicate a full-time staff member to farm cost accounts (66);

- A description of a second bridge built in the project area (55);
- A description of the project (91), an explanation of the rural development strategy being followed (90), an activity report for 1971 and 1972 (65), and a credit plan for 1973 (62);
- A theoretical introduction to a labour study (68).

This list gives an idea of the broad range of issues with which the Caqueza Project became involved. It also indicates the continuing effort that was made to define research methodologies and action programs. However, many of the proposals never reached the implementation stage, not because of their lack of importance but because of ICA's limited capacity, as an agricultural research institution, to conduct programs that fell within the portfolio of other institutions.

Relations with Other ICA Programs

The profuse flow of documents from the project during the year appears to have had an important impact in terms of the project's relations with the regional and national offices of ICA. Some of the other RDPs, especially the newer ones, were encountering problems that were being written about in the Caqueza publications. Field staff papers on policy and conceptual issues were widely read and discussed in the other RDPs and by ICA policymakers who became more and more receptive to regarding Caqueza as a laboratory for ideas on RDP strategy. A number of the Caqueza publications resulted in policy adjustments and action programs at the national level and the project staff began to feel that the policy of planning from below upward was genuinely starting to be practiced. This was reinforced by the new way in which the project started to interact with other ICA programs.

Although cooperation with the various ICA laboratories and its Engineering and Infrastructure divisions continued as in previous years, the focus of agronomic, socioeconomic, and communication research cooperation changed substantially due to the implementation of the graduate training program.

This substantially increased the research capacity of the project at a relatively low cost and, at the same time, it reduced friction between the project's professionals and experimental station staff. Because data collection and analysis had to be done by the students with the results published by them, much of the responsibility of both the Research Department and the project staff was shifted from being "doers" to being "advisors."

Relations with Other Institutions

As already noted, the problems in the credit program led to a deterioration of relations at the local level with the CAJA AGRARIA. An unfortunate consequence of this was that as the farmers blamed the project staff for the lack of inputs and the delayed credit (which in some cases did not become available until well after the planting season), this led to a general loss of confidence of the farmers in the project. The staff understandably felt that they were being unfairly blamed for the faults of the CAJA AGRARIA and they complained strongly at the regional and the national level on this issue. It is not clear to what extent these complaints were effective but the situation did seem to improve in 1974 and 1975.

Because of the large size of the project team it had greater contacts with farmers than did any other official entity in the area. As a result of this and of the project's "integrated" attitude to development, the farmers tended to regard the project as the "image of government" and the staff were called upon to become involved in all sorts of rural issues, many of which were marginally related to agriculture. For example, in one "vereda" in which the project was working, the community was extremely interested in obtaining electricity. Irrespective of the issues raised by the project staff, the farmers and their families always brought up the subject of electrification. Finally, the project personnel contacted ICEL (Colombian Institute for Electrification) and convinced them to start an electrification program in the area. As a result of this, the community became very receptive to suggestions from project staff.

Thus, another lesson was learned, namely that the farmers' priorities were not all production oriented. Often, health, education, and public utilities (water, electricity, roads, etc.) were considered more important. By disregarding the farmers' own priorities the project risked failing in its production activities. This experience emphasized the importance of an integrated approach to rural development not only to satisfy needs other than increased agricultural production but also to gain farmers' confidence and ensure their responsiveness.

The project developed an excellent working relation with SENA during the year and an extensive program of training courses was established. The project staff helped promote, publicize, and assemble the participants for the course, and SENA provided the instructors. This scheme worked well, and more than 20 courses were taught on subjects such as agricultural production, animal health, production handicrafts, house improvement, etc.

CARE (a U.S.-sponsored food-aid program) started providing subsidized food to the workers on the pick and shovel roads, providing another incentive to this program. Unfortunately, by midyear, lack of funds at the national level caused road construction to be suspended.

INDERENA expanded its program of afforestation. This provided not only eucalyptus and pine trees but also fruit trees, mainly orange and other citrus fruits. This program was run in collaboration with a program of health delivery. A team consisting of a medical doctor, a dentist, and several nurses visited different areas of the project treating people and vaccinating the children. INDERENA then gave away trees or provided them at a nominal fee to those who received medical treatment. The Caqueza Project staff collaborated in the organization and publicity of this program.

The second of the seven school restaurants planned with PINA (National Food and Nutrition Program) and CARE was opened during 1973. The others were never started because of the same lack of funds that hampered the rural road program.

Relations with the Community

In February 1973, the cooperative opened to the public. Members of the cooperative could buy consumer products and some farm supplies such as vaccines, pesticides, fertilizers, etc. At the beginning, project personnel played a dominant role by setting up the accounting system, helping to obtain the consumer goods and organizing the store. The economic results of the first 6 months of operations were not good. The volume of sales was low and fixed costs relatively high; consequently, the balance sheet showed a slight loss. The

main reason for this was the lack of administrative skill of the management. None of them had had previous experience as shopkeepers and they had to learn through trial and error. During the last 4 months of the year there was a slight improvement in management so that the co-op broke even. At the same time a plan was formulated for linking the co-op to the new marketing plan, which is discussed later in this chapter.

The project staff made up the main group in the Caqueza Pro-Development Committee, so staff changes affected the committee and very few meetings were held during 1973. Nevertheless, since the idea was considered a good one a new committee was formed in another of the municipalities covered by the project. The town priest was named president, but only two meetings were held. The reason for the discontinuation of this committee was not clear but the answer may lie in the fact that one of its first development propositions was the embellishment of the plaza and the planting of flowers in the gardens of the church. It is possible that the farmers had other priorities in mind and, therefore, abandoned the committee.

Other Activities

The IDRC Board of Governors met in Bogota in March 1973. They visited the Caqueza Project and had the opportunity of seeing its impact and what possibilities there were for the future, not only for the area but for the whole strategy of rural development. As a result of this visit and at the request of ICA, a further phase of IDRC support for rural development in Colombia was approved for a total amount of Cdn $716 000 covering a 3-year period starting 1 September 1973. The budget included the costs of the two foreign advisors already working with the project, plus an additional agricultural economist. Although it was anticipated that these professionals would still work in the field at Caqueza, ICA requested that they should, in the future, play a fuller role at the regional and national level using Caqueza as a testing and training centre rather than as a "model" project. Funds were provided for two fellowships for study outside of Colombia at the Ph.D. level, plus fellowships in the ICA–UN graduate program and for short courses to strengthen the training program in rural development. The budget also included money to allow for interchanges of experiences between farmers through meetings, field days, etc., and to incorporate a health component into the Caqueza Project.

The Caqueza staff provided two short courses for 20 professionals and technical assistants recruited by ICA to staff the new RDPs. These courses were organized as informal workshops because the project personnel felt they did not have sufficient knowledge to give lectures but had had enough good and bad experiences to provide some orientation to new workers in rural development.

The Quality Control Division of ICA requested the project to keep records of the availability of some inputs, mainly fertilizer, in stores in the project area. Every 15 days project staff visited each store and made an inventory of certain supplies. This information was sent to a central office, which tabulated it and provided a review of the supply situation in the whole country. The inventory, although time-consuming, gave the project a useful insight into the amounts of certain supplies available in the area. Unavailability of these products had always been one of the limiting factors in the adoption of the technological package recommendations. Unfortunately, after a few months this practice was dropped and no further records were kept nor did the exercise appear to lead to any policy decisions.

Much of the farming of the area involves difficult hillside cultivation. (Photo: Ronald Duncan)

An ALADER seminar on research for rural development was held in Lima, Peru, with the participation of ICA's national director for rural development, the national director for research, the two IDRC advisors to the Caqueza Project, and representatives from other Latin American countries. This meeting preceded a much bigger seminar on rural development that was held in Chapingo, Mexico, later in the year. The director and the agronomist in charge of the crop production unit of the Caqueza Project, as well as the two IDRC advisors, attended the Chapingo meeting.

These two seminars allowed workers in rural development to interchange experiences about the various approaches being followed. The discussion on the different political, social, and economic situations confronting each rural area in each country, and the differences in project objectives and administration, were useful in generating a better understanding of the complexity and individuality of rural development.

Visits to farmers, the provision of health certificates, supervision of animal shows, etc., continued to occupy a sizeable amount of the project staff's time. Although they were learning to live with these activities not directly related to rural development, there were complaints and, as a consequence of their complaints, these activities were again substantially reduced.

Finally, after 2 years of negotiation, the construction of a project headquarters and training centre was begun on a lot 8 km from Caqueza.

Personnel, Vehicles, and Budget

The transportation problem improved during 1973. Three of the five small trucks bought as part of the ICA–IDRC Phase 1 agreement had been exchanged for jeeps in 1972 and the latter were now sold to project staff. One of the two remaining trucks was left in the project for general use and the other was used by the project advisors.

In terms of personnel, 1973 was a year of change. The agronomist in charge of the soil fertility unit left in January for postgraduate studies at Chapingo, Mexico. In June the programmer-evaluator left to do postgraduate work at Cornell University in the United States. A Peace Corps nutritionist started working in February, and a CUSO anthropologist joined the team in March.

In May, the project director, veterinarian, three technical assistants, and a secretary left the project. This massive staff removal came as a result of a major personality clash that ultimately required the intervention of the Regional Director. The details of the incident that led to this intervention have all the elements necessary for a best-selling novel. The heart of the issue was that the project staff were overworked, were subjected to pressures (such as the credit crisis), and had, in Caqueza, very little access to social or recreational activities outside of their own making. Most of the team were still in their twenties, young and active, and some of the married men had their families in Bogota whom they saw only on weekends. Inevitably, tensions built up and finally a conflict arose. The massive staff transfer that resulted disrupted the program and also the team morale, but perhaps served as a warning in terms of the need to take into account personality issues in relation to the isolation and difficult living conditions confronting staff working in RDPs. It is also important to bear in mind, in this context, that Caqueza is, perhaps, the least isolated of the 20 RDPs in Colombia.

The project only had five professionals working full time at the end of the year, as the programmer-evaluator (an agronomist) worked on a part-time

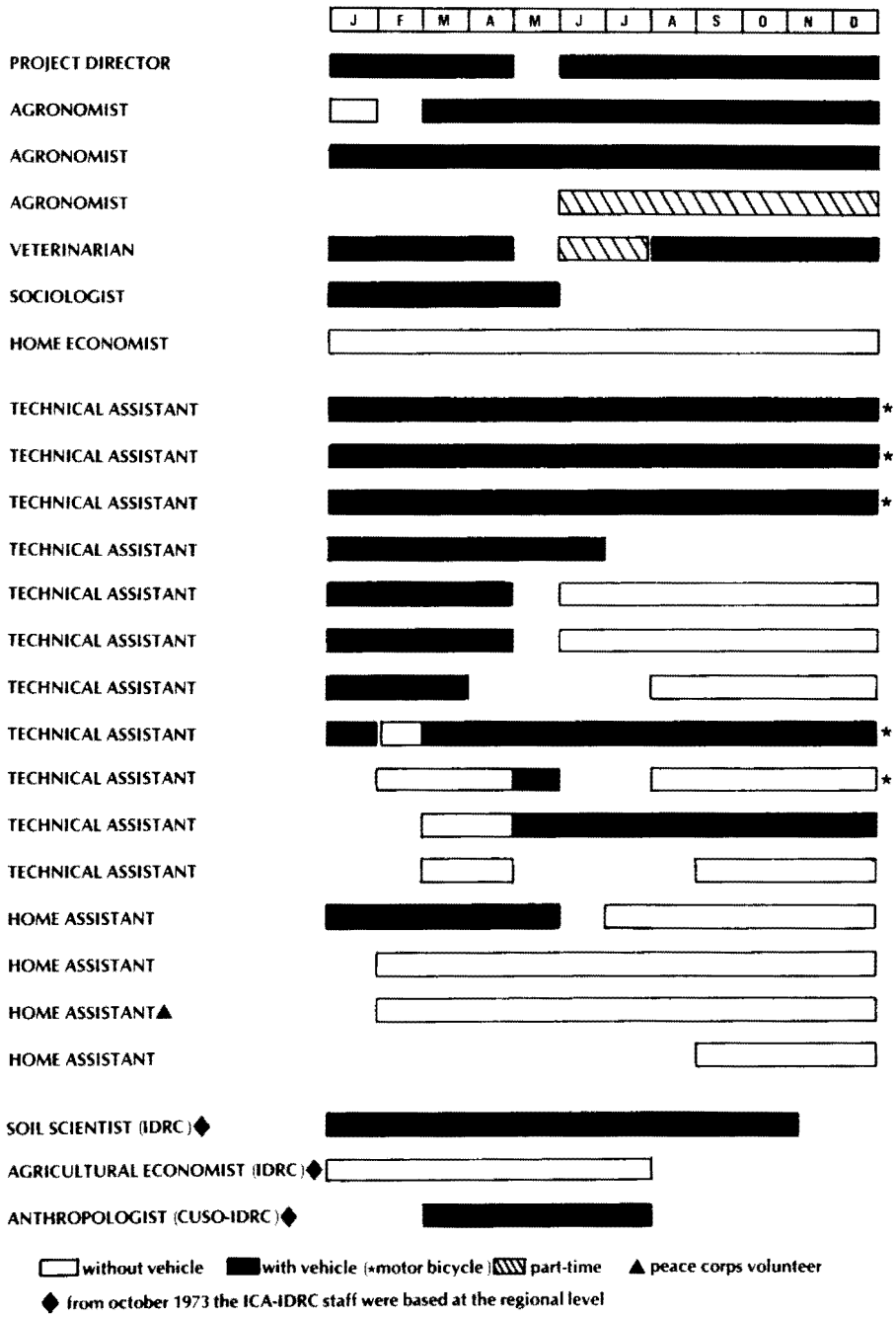


Fig. 7. Caqueza Project staff, 1973.

The second decision was one of IDEMA (Agricultural Marketing Institute) to open a store that would sell some consumer goods at subsidized prices. The project staff presented a plan trying to integrate the two ideas into one program. It was proposed that the co-op, using IDEMA credit, would serve as an outlet for its consumer goods and, using COFIAGRO credit, would provide production inputs to the farmers. In addition, the co-op would be part of an integrated marketing chain for farm production. The provision of all these services would strengthen the cooperative's position and at the same time solve some of the most urgent farmers' problems, namely the availability of inputs and the marketing of products. This proposition was well received but was not implemented until 1974. Nonetheless, the concept of providing more integrated services to the farmers was accepted as a valid one by ICA, IDEMA, and COFIAGRO. The problem was to develop appropriate ways to deliver those services.

The utilization of students to do most of the project research implied a change not only in the assignment of responsibility to project personnel and to the researchers at the experimental station level, but also in the general approach to research. The delays entailed in analyzing the very large socioeconomic baseline study caused the project staff to consider the idea of a "mosaic approach" to research. This concept involved conducting the research as a series of small well-defined projects that fitted into an overall framework. This approach had several practical advantages. The studies could be done in relatively short periods of time by small groups of people or even by one person. It allowed the inclusion of findings of previous research in the planning of future research. It simplified the data collection process and tabulation and reduced the collection of data that was never utilized. The availability of students to carry out project research made it possible to fully implement this concept, which seemed to work well in practice once the project had defined the overall package of research activities required.

The role of the foreign advisors changed during 1973 especially after the new 3-year agreement between ICA and IDRC came into effect. Contacts were maintained with the Caqueza Project through programing and research, mainly thesis research, but visits to the project were reduced as a consequence of ICA requesting that IDRC staff play a more active role in advising and training regional and national rural development staff in order to disseminate the methodologies and experiences gained at Caqueza into other RDPs. This change in role was not popular with the project staff because, as a result of the constant changes in personnel, the IDRC advisors had come to play an operational role, rather than an advisory one, largely to ensure continuity in the research. Their new function did not allow them to continue operating in this way, which meant more work and responsibility for the already overloaded project staff.

Résumé of the Year

If only one word could be used to summarize this year, it would be "change." Some of the changes that occurred in staffing, in the organization of the project, and in its research capacity were for the better. The new director proved to be a very effective leader and rapidly established a good team spirit in the project. The inclusion of postgraduate students as researchers substantially increased the research capacity of the project and at the same time helped to strengthen the relationship between ICA research and development staff. Important advances were made in project conceptualization.

basis. Nine technical assistants joined the project during the year: two were additions to the staff, and the other seven replaced the seven who left, one of whom had had a motorcycle accident and was out of work for more than a year, and another of whom had died in a motorcycle crash. Three home assistants were hired: one replaced the existing one and the other two increased the staff, as did the addition of a Peace Corps volunteer. Only two professionals, three technical assistants, a secretary, and the labourer stayed with the project the whole year (Fig. 7).

As was noted earlier, the financial problems of the government not only affected ICA as a whole but the Caqueza Project as well. The total expenditures for the year were U.S. $74 600. This was a much smaller sum than the budgeted $112 236. Salary costs were U.S. $50 700 and the rest was used for general expenses. The project learned how to work under very tight budgetary constraints and, as a result, some activities were reduced or even suspended.

Project Management

The new (third) project director spent more than a month learning, reviewing, and analyzing everything the project had done prior to his arrival. He then reorganized the project so that:

- the internal coordination of the project was to be done by the agronomist in charge of the dissemination unit under the director's supervision; the internal coordinator would have direct authority over all technical assistants, and any assignment to them had to be channeled through him;
- each professional had substantial freedom to develop his own program but this had to be approved at a general staff meeting;
- staff problems and experiences were discussed and analyzed in weekly staff meetings;
- a positive approach was taken to organizing recreational activities, and sports teams were formed and matches arranged with other institutions and local teams;
- students' theses were accepted as a means of substantially increasing the project's research capacity. From the experiences obtained with the first four theses, a set of guidelines was established.

Conceptual Developments

The cooperative was established as a means of bringing to the area the agricultural inputs required to increase production. Consumer goods were included as complementary items. As time went on, the buying and selling of consumer goods became the main activity of the cooperative because there was not enough capital available to handle the trade in agricultural supplies. This was an unsatisfactory situation because the co-op did not provide better services than did existing stores and it did not fill the gap in making agricultural supplies readily available in the area. Two decisions were made late in the year to try to rectify this situation. One was a decision by the Ministry of Agriculture to open five "Tiendas Veredales" (country stores) in the area. These stores would sell inputs and provide a marketing channel for farmers' production using COFIAGRO (Agricultural Finance Corporation) credit. The idea was interesting but it had several drawbacks. It was an isolated program without vertical integration and it did not have linkages with the project.

Unfortunately, however, not everything was for the better. The financial situation of ICA was tighter than in earlier years and this caused some activities to be reduced or suspended. The relations with the CAJA AGRARIA deteriorated as a consequence of the delayed disbursement of credit. The massive staff upheaval in May left some wounds that were slow to heal. The teething problems of the cooperative, on which high hopes had been built, were a major source of disappointment. However, overall, the strength of leadership in the project was such that, in spite of the setbacks, morale at the end of the year was good. The staff felt that they could get a sympathetic hearing at the regional and national levels and that ICA was committed to making RDPs a successful program.

Chapter 7

1974: The Fourth Year — A Year of Synthesis

ICA's activities continued to be disturbed by budgetary problems, and appropriations to the project fell below the budgeted level as the flow of funds from the Treasury to ICA was often delayed.[12] The project continued to be hampered by transportation and personnel problems (during the year the post of project director changed hands three times). Nevertheless, the field research retained the momentum of 1973 and became more action oriented as the results from earlier research began to emerge.

This action orientation represented an important conceptual change. Previously, it was thought that research was only required to gather information and that once this information had been collected and analyzed, specific action programs would immediately follow. If, for example, a new technology using fertilizer was found to be more productive and profitable to the farmers, the purpose of the action programs would be to recommend this technology and to ensure the availability of credit, thereby enabling the farmers to obtain the necessary fertilizer through the existing credit system. It was assumed that these two actions were all that would be needed to induce the small farmer to adopt the new technology. No consideration was given to the fact that the existing credit system might be inadequate, or that the required fertilizer might not be available, or that risk might prohibit adoption, etc.

However, the experiences of 1972 and 1973 threw serious doubts on the validity of these assumptions. The project staff had learned the hard way that the credit system existing in the area did not function very efficiently. They had learned that fertilizer technology was only partially accepted by the farmers and that the subject of risk was one that they had to become more familiar with. They had also recognized that marketing was an issue that influenced the acceptance of new technology.

As a result of this, the research activities were directed not only to defining the needs for higher production but also to identifying the actions required to induce farmers to adopt the project's recommendations. This meant that, in the same way that the agronomic research had had to start at the grass-roots level, the socioeconomic program had to come to grips with the farmer's concept of risk and his reasons for nonadoption of new technology in order to try to formulate an acceptable new approach.

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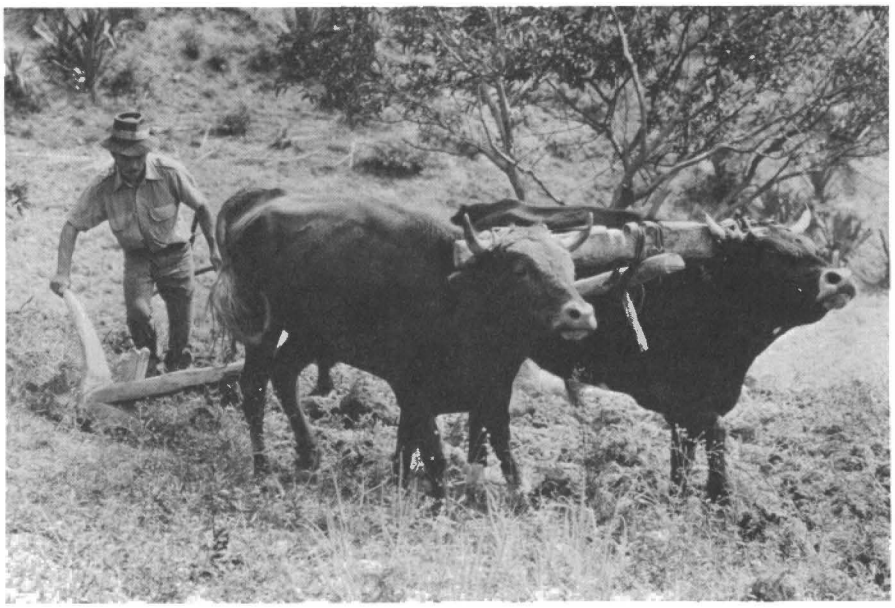
[12]ICA's short-term debt rose from 60 million Colombian pesos in 1971 to 254 million in 1974. In 1974, its receipt of funds from the Treasury for the 12 calender months (in percent of the annual total) was 0, 3, 10, 11, 20, 6, 13, 1, 0, 0, 24, and 12% respectively (i.e., for the 3 months August to October, it received only 1% of its annual subvention).



Oxen and wooden ploughs are widely used. (Photo: Ron Poling)

Organization and Programing

The organizational scheme drawn up in the latter part of 1973 was followed throughout most of 1974. However, temporary modifications were made to compensate for changes in personnel and lack of transportation. For example, for 3 months the project was run by an acting director who was, at the same time, the disseminator and the internal project coordinator.

At the end of the year, four important changes were made: (*a*) the position of internal project coordinator was not assigned to any one person but was rotated monthly among the professionals in order to share the work load; (*b*) two of the three operational vehicles were, as far as practical, allocated to different zones to optimize the distribution of field work; (*c*) the soils and fertilizer unit was renamed the "research unit"; and (*d*) the programing and evaluation unit was transferred to the Regional Office (see Fig. 8).

The program prepared at the end of the previous year was again only partially implemented because of personnel changes and lack of transportation. Moreover, tight budgetary conditions again prevailed. The action orientation developed after the year's work had been programed in 1973, and the priority given to the introduction of the preschool, marketing, and corn production plans also meant that some of the previously planned trials were not undertaken. Thus, partially as a result of the results being generated by the research program, the current activities remained in a rather more fluid state than previously. Although this "ad hoc" programing was not encouraged by ICA regional and national managers, it was recognized by them as being a realistic approach if the project was to continue as an experimental program for the other RDPs, and to incorporate its lessons of experience into ongoing research.

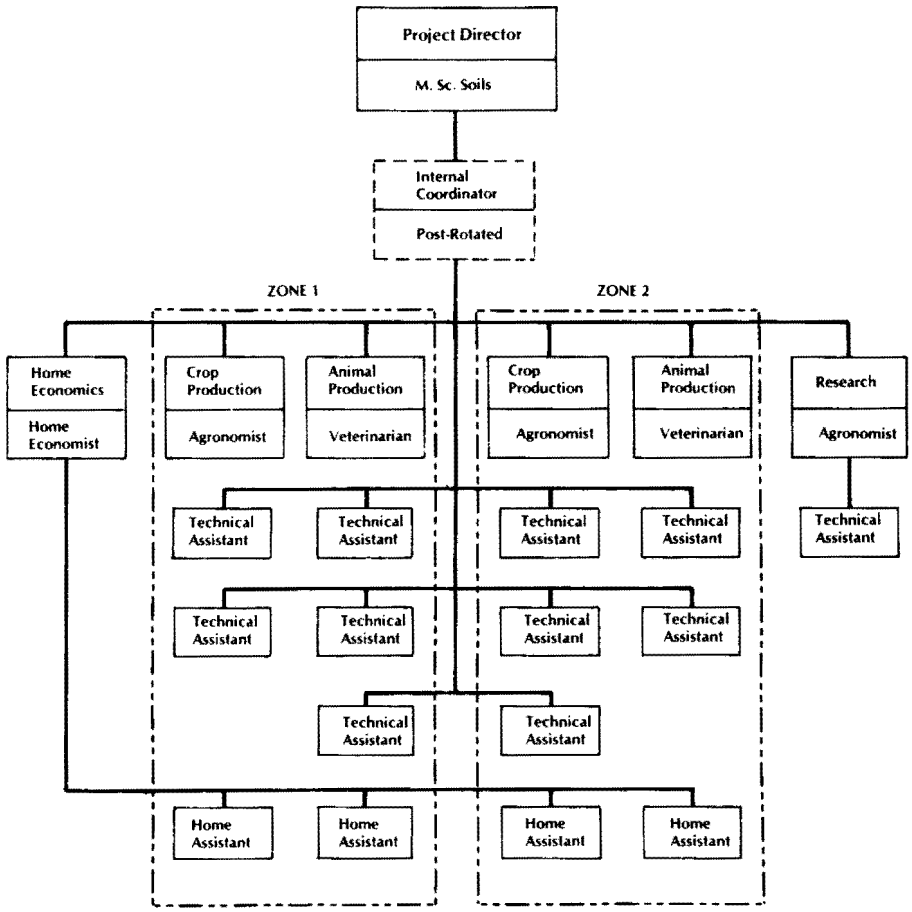


Fig. 8. *Organization of the Caqueza Project, 1974.*

Research

Three important action research programs were initiated in 1974: the corn production plan, the marketing plan, and the rural preschool centres.

The Corn Production Plan

The project staff now had behind them 3 years of experience in corn production by small farmers using ICA's improved seeds. They had at their disposal substantial information on yield responses and on adoption rates. They knew that full adoption of the new technology package tripled average yields and they knew that the adoption rate for fertilizer was low. Based on this experience, they hypothesized that low adoption was attributable to the high cost of the fertilizer and to the risk that this entailed. They were aware from earlier work that the small farmer in Caqueza adjusted his level of investment to his current asset level so that he was able to absorb losses without endangering his major assets, such as his land or his cow. Research had shown that this level of investment was well below the level required to optimize the benefits from the new technology

and that this effectively limited the small farmer's opportunity to gain from the new technology.

The project, therefore, set out to test an experimental risk-sharing program for corn. This program sought to reduce the investment risk for new technology by loaning the costs of seed and fertilizer until harvest time when they were repaid according to the results obtained. The program, which involved 22 farmers, is described more fully in Chapters 11, 12, and 15.

The Marketing Plan

Previous studies made in the project area and in other areas around Bogota had shown that marketing agents did not specialize in any one product but bought and sold a wide range of farm produce throughout the year. The marketing agents' system for obtaining price information was not very well developed and, consequently, they ran quite high risks and needed high margins to operate successfully. Furthermore, because of atomistic competition, resources, such as trucks, were seriously underutilized and this again contributed to make high overhead.

In addition, there was little market information available to producers. This resulted in excess production and very low prices during some periods of the year, and the opposite in others. Project personnel, therefore, concluded that they should explore an action program to improve the efficiency of the marketing system.

An experimental marketing plan (which is discussed in more detail in Chapter 13) was established to determine whether it was economically feasible to integrate the cycle of production–distribution–consumption through an effective plan of vertical coordination managed by a cooperative or voluntary chain.

The Rural Preschool Centres

A number of local primary school teachers claimed that grade 1 students in the Caqueza area, especially in the lower income corn zone (as opposed to the potato area, where incomes tended to be higher), showed considerable timidity and apathy. Many of these students were dropouts and there was a high degree of absenteeism and grade repeaters. The teachers felt that in this group of children there was some inability to adjust to classroom conditions and, perhaps, a fear of school.

A nutrition study carried out in 272 households by the project in 1973 indicated that severe protein–calorie malnutrition did not occur, although calcium and vitamin A intakes were subnormal. The home economists' nutrition education program, therefore, concentrated on improving calcium and vitamin A intakes. It also took account of the fact that protein intakes were low in some families but this appeared to be closely related to low incomes and thus the improvement of protein (and calorie) intakes could best be brought about by raising incomes through higher farm productivity rather than by attempting nutrition education.

In view of this information, the project decided to establish two experimental preschool centres, one each in the corn and the potato zones. The immediate objectives were threefold: (*a*) to observe the effects on school performance of exposing the preschoolers to a variety of mental, physical, and psychological stimuli; (*b*) to improve the nutrition of the children by providing them with

protein- and vitamin-rich vegetable drinks at the centre; and (c) to determine through nutrition education to the students and their parents whether these activities could be carried out by paraeducational personnel (teenage girls with at least 4 years of primary education) native to the region and society from which the preschool students emerged. A further long-range objective was to use the centres as possible vehicles for parent group formation.

After the paraeducational personnel were selected, they received a week's training course in the management of the preschool centre, in the preparation of games, stories, and arts and crafts, and in other activities appropriate for preschool children. They were also taught that these centres were an experimental means for achieving mental as well as nutritional development. When the paraeducational personnel were considered ready to start the experimental centres, they were presented to the community along with an explanation on the purpose of the preschool centres. The community then decided where the centre should be located, as well as the days and hours of operation. Each centre was open 2 days a week, 3 hours a day. The program was based on social, physical, mental, linguistic, and psychomotor development activities. At each session the children were given a snack prepared from a high nutrition food supplement donated by the Colombian Institute for Family Welfare (ICBF).

To determine the effectiveness of these centres, periodic observations were made of the children's mental, social, and psychological development, and height and weight measurements were regularly taken to evaluate nutritional status. In addition, it was planned that in 1975, elementary school teachers would compare and test the performance of the children who attended the preschool centres against those who did not. The results of this program are discussed in more detail in Chapter 15.

Other Research

Apart from these innovative action research activities, the project staff continued doing adaptive research. They concentrated their efforts on regional corn trials in the higher altitudes of the project area (the previous years' research was done mainly in the warmer and temperate zones) and on horticultural crops. Twenty-four corn trials were sown, in addition to three with wheat, seven with onions, one with cauliflower, four with beans, three with tomatoes, three with beetroot, and two with carrots.

For the fourth time in the life of the project an effort was made to collect weekly farm cost records. The approach selected involved three meetings of the project staff to discuss the need for such a system, the reasons for past failures, and the development of a viable approach. A simple account sheet was designed. It was decided that each technical assistant was to be responsible for 15 sets of farm accounts and that these would be collected at the project office each week. However, in spite of pressure by the project director the records were incomplete and poorly kept and once again a failure had to be recorded.

Thesis research continued at an increasing pace. Studies were completed on: (*a*) determining a production function for corn and its associations; (*b*) agronomic and economic analyses of potato fertilization; (*c*) an empirical predictive equation for nitrogen and phosphorus fertilization of potatoes; and (*d*) the real cost of credit. Studies were begun on: (*a*) the feasibility of irrigation; (*b*) the demand for potato seed; (*c*) the supply and demand of labour; (*d*) the economic

analysis of hog, rabbit, bee, and sheep production; (*e*) channels of communication; (*f*) evaluation of audiovisual materials; (*g*) participation by farmers in formal organizations; and (*h*) migration from the project areas.

Dissemination

The anthropologist assigned to the project continued to have problems in working with the Communication Division of ICA, which had a markedly different conceptual outlook to his. Eventually he worked largely independently of ICA. His activities included finishing the film started in the previous year, supervising thesis research by anthropology students at one of Bogota's universities, and doing anthropological research in other parts of the country. Although the results of his work were impressive on paper, in practice, because ICA was not involved in his activities, his findings had a limited impact at the national level, although within the project itself he played a role in defining the nature of the action-oriented research.

The project continued its traditional extension-type activities by sponsoring field days. A suboffice was opened in Chipaque to strengthen this latter activity. A group of farm leaders also participated in a 1-week course given by the professional staff.

The animal production unit had to deal with the control of three major disease outbreaks: Marek's disease in chickens; foot and mouth disease in cattle; and rabies in several animal species. Vaccination campaigns had to be organized in each case. During the year more improved breeding sows and ewes were brought to the area and sold to farmers. Arrangements were made with two agricultural high schools to establish small purebred swine herds on the school farms so as to increase the availability of these animals in the area.

The home economics unit continued its latrinization, home construction, home improvement, and school vegetable garden campaigns. Courses continued to be coordinated with SENA on different subjects. One of them, in weaving, led to the establishment of a women's cooperative, which started to produce blankets and ponchos out of both purchased and homespun wool.

Evaluation

Because there was no full-time evaluator on the staff at the beginning of the year, and because at the year's end the unit was eliminated, evaluation activities were again limited, although the staff identified four types of evaluation that they felt needed to be carried out. These were impact evaluation (measurement of the effects of the project's programs), efficiency analysis (the benefit/cost of activities), personnel evaluation (the impact of individual staff), and analytical evaluation (the reasons for success or failure of specific activities).

In fact, activity on the first two categories was negligible. Personnel evaluation was carried out by the project director and his superiors as part of ICA's normal personnel program. The project itself started some analytical evaluation as part of its analysis of the action programs and also to build up more information on socioeconomic problems. Within this framework, students in sociology and economics were encouraged to work in the project, and thesis research began on topics such as the real cost of credit, the relation between risk and wealth, and an analysis of the corn and preschool programs.

Publications

Attempts were made to keep the project newsletter going but the same problems encountered in previous years still prevailed. In addition, there was a personality conflict between the project staff and the person responsible for allocating paper and supplies to them and after three issues, the newsletter was discontinued. Resources for research and policy publications were not subjected to the above constraint and documents on these themes continued to be produced. Four of them were related to marketing. The first was a preliminary marketing plan for the region (113), the second an analytical justification for the plan (110), the third explained marketing problems, experiences, and research needs (111), and the fourth was a descriptive report of the first 3 months of the plan's activities (13).

Two publications explained and justified the proposed corn production plan (136, 137). Other subjects covered by publications included a nutritional study (112), a horticultural study (109), the credit program for the year (63), notes on the economic evaluation of projects (141), the expected benefits of fertilizer recommendations based on soil tests (134), a description of training programs for professionals and technicians (10), and a data management guide for the small computer in the IDRC Regional Office that was used for project research (135).

The project published a revised list of research needs (125) from which students could select thesis topics and a bibliography of all material published by the project in Spanish (57) and in English (56). The latter documents were updated on a continuing basis.

Six Master theses were finished during the year, of which two were related to corn production (48, 80) and two to potato production (44, 95). One described the relations between income, wealth, risk, and adoption (119) and the last one analyzed the "real cost" of credit in the project area (121).

Three student monographs were prepared. One analyzed the relation between field history and the level of phosphorus in the soil (72), another reviewed theories about innovations as a modernizing element in the agricultural sector (120), and the third dealt with rural credit in Colombia (122).

Four articles were presented at an IDRC symposium. The subjects covered were: information requirements for rural development (143); small farmer communication (29); different corn production systems in the Caqueza Project (138); and evaluation in rural development (108).

Two papers were given at the evaluation seminar organized by the Latin American Association for Rural Development (ALADER) held in Cali, Colombia, in October (12, 142) and two articles were written on anthropology. One described the use of photographs as a technique for visual anthropology (27) and the other dealt with living standards of small farmers (28).

Relations with Other ICA Programs

Support from ICA central laboratory services continued at a high level. The Agricultural Engineering Division continued its work on simplified corn-storage methods in the region and in collaboration with the project worked on irrigation possibilities and on methods for collecting and storing rainwater for household use in the dry season.

Another new footbridge was constructed by ICA's Infrastructure Division, and information was collected to develop electrification projects in five areas.

The digging stick is still an important piece of equipment. (Photo: Ron Poling)

The program with postgraduate National University–ICA students continued and was expanded by the postgraduate school to cover not only Caqueza but other RDPs as well.

Relations with the Animal Health Division at the regional level strengthened as a result of the need to collaborate in counteracting the epidemics previously mentioned. The Regional Veterinarian confirmed the diagnosis of these diseases and coordinated the organization of vaccination campaigns. Unfortunately, the Regional Office lacked supplies of vaccines and also funds to buy them. This meant that vaccination campaigns were not feasible unless the project veterinarian either bought the vaccines with his own money and then sold them to farmers or got the farmers to pay for vaccine in advance. In practice both procedures were used, but again at the expense of considerable time on the part of the project veterinarian.

The Communication Division of ICA supported the project with videotape equipment for use on field days and at meetings. Unfortunately, the equipment itself attracted so much attention that project personnel were never sure whether the message they were trying to transmit was really being received by the farmers or whether they were only impressed by all the gadgets being shown to them.

An excellent liaison was established with ICA's Training Division. Under the ICA/IDRC contract of 1973 both parties were to provide funds for a new training centre for RDP staff in Caqueza. The building was finished at the end of 1974 but the contractor did not comply with the building code specifications and, consequently, a time-consuming lawsuit was initiated. Because the training of rural development personnel was regarded as a top priority by ICA, the courses planned at Caqueza were given at the Rionegro project, where a nearby experimental station had some training facilities. By the end of the year, one 3-week training course had been completed and 10 more were scheduled for 1975.

Apart from these disciplinary contacts the project maintained its good relations with the National and Regional ICA offices and continued to be recognized by ICA as a source of information and methodology for rural development policymaking at the national level.

Relations with Other Institutions

Mindful of the problems with the CAJA AGRARIA in 1973, project personnel acted much more cautiously in 1974. Although they continued programing credits for farmers under the ICA–CAJA AGRARIA agreement, they did not do so as forcefully as before and they carefully explained to the farmers that the CAJA AGRARIA had the final word on every credit and that problems and delays often arose for which neither ICA nor the project were responsible.

Information collected for the Infrastructure Division of ICA in respect to rural electrification was passed on to the Colombian Institute for Electrification (ICEL) who planned to bring electricity to additional villages in the project. The staff also contacted and helped the National Institute for Special Health Programs (INPES) to develop a plan for building an aqueduct in the Caqueza area.

In collaboration with the National Pro-Rural Youth Association in Colombia 10 youth groups were formed in the region. One delegate from each group participated in a horticulture production course and the Association promised to provide credit to allow the groups to start vegetable production.

Despite efforts made to raise the required funds (including charging admission to movies shown in one of the Caqueza high schools), the school restaurant that opened in 1972 had to be closed as PINA was unable to continue supporting it.

Contacts were established between the Caqueza Project, the Javeriana University, and the Centre for Multidisciplinary Research in Rural Development (CIMDER)[13] for the purpose of adding a health component to the Caqueza Project. The idea was to make use of the experience obtained by the CIMDER in its preventive medicine training program for paramedical personnel and in its integrated health program in the North of Cauca project, and to try to duplicate these activities in the Caqueza region with the help and assistance of Javeriana University. The negotiations worked very well at the beginning, but after several meetings in which problems arose within and between the institutions, they came to a standstill.

Contacts were established with two agricultural high schools in the region to explore the possibility of using final year students as part-time project assistants in the region, and to use the farms run by both schools as research plots for some of the project's experiments. In one of the schools, an experimental corn plot was sown and a program to produce purebred swine was initiated. In the other school, a swine program was also started and the students used a socio-economic questionnaire to develop a baseline study for a small area near the school. Unfortunately both of these programs were discontinued in midyear when the project director who had initiated them was transferred.

Relations with the Community

The cooperative finally received a line of credit from the Agricultural Marketing Institute (IDEMA), which substantially increased its working capital. Moreover, the credit and inputs for the experimental corn production program were channeled through the cooperative. Nevertheless, the administrative capacity of the members was still at a very low level and accounting problems continued to exist. Apart from the poor administrative skills of the cooperative staff, there was a disappointing lack of active participation on the part of the members of the cooperative. The farmers appeared to have little desire or motivation to make the cooperative their own business and as a consequence they did not provide the support necessary for it to remain viable.

Project personnel continued to help different groups to organize animal shows, fund-raising bazaars, etc. One of the special activities during 1974 was the organization of a campaign to collect books needed to start a town library. Project funds from IDRC made it possible for farmers and youth to travel to other projects and experimental stations.

This type of involvement with the community served two purposes. Firstly, project personnel were seen as an important component of the community and, therefore, were asked to participate in almost all community affairs. Second, this involvement made the staff realize that there was more to rural development than agricultural production alone. With a steady turnover in staff it was important to continually keep sight of the fact that rural development needed to be conceptualized in terms of human development with all the social, cultural, economic, and religious components that this entailed.

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[13]A joint project of the University of the Valle, Valle del Cauca Corporation (CVC), and ICA in Cali, Colombia.

Other Activities

The range of other activities undertaken by the project staff has been discussed in previous chapters. In spite of efforts to further reduce activities not directly related to rural development, little additional progress was achieved. Animal health bills continued to be issued. Animal show authorization continued to be requested. Visitors continued to come. After 3 years of fighting the system, the staff realized that most of these activities were there to stay. They began to take a more realistic and less troublesome attitude toward them, accepting them with resignation.

Personnel, Budget, and Vehicles

Important personnel changes occurred again in 1974. Three different persons held the position of project director during the year. One of them acted for more than 3 months without being confirmed. The final director had previously been the project agronomist who returned to Colombia after finishing his postgraduate studies (M.Sc.) at Chapingo, Mexico.

Three agronomists (two full-time and one part-time) left the project at different times during the year, as did four technical assistants and one home assistant. All of them were replaced and two additional staff joined the team: a third agronomist on a full-time basis and a second veterinarian.

At the end of the year, 7 professionals, 4 agronomists (1 of them the director), 2 veterinarians, 1 home economist, 11 technical assistants, and 4 home assistants (one from the Peace Corps) were working in the project (see Fig. 9).

The professionals who left the project took their cars with them, and their replacements and the new professionals who joined the project came without vehicles. In addition, the only truck remaining for general use was involved in an accident, which kept it in the repair shop for several months. At the end of the year only two of the seven professionals had transportation. This substantially reduced the working capacity of the team. However, project morale was so good that the professionals with transportation shared it with their colleagues to keep the team as mobile as possible.

Economically, ICA still had problems and little money was available for expenses other than salaries.[14] By now the project personnel had become accustomed to this situation, although it substantially reduced their efficiency. As far as possible they operated by concentrating their efforts on activities that did not require operating costs. Amongst other things, this meant that the research costs for agronomic trials had to be borne by cooperating farmers.

Project Management

The three project directors during the year were all people with field experience. The first one, who left to take a position as a Regional Director for Rural Development, organized the project so that it was running very smoothly despite the budgetary restrictions and the large volume of research being carried out,

[14]No information on the budget and expenditure can be presented for this year because the accounting system was changed. All values were given in an aggregated form for each of the nine regional offices.

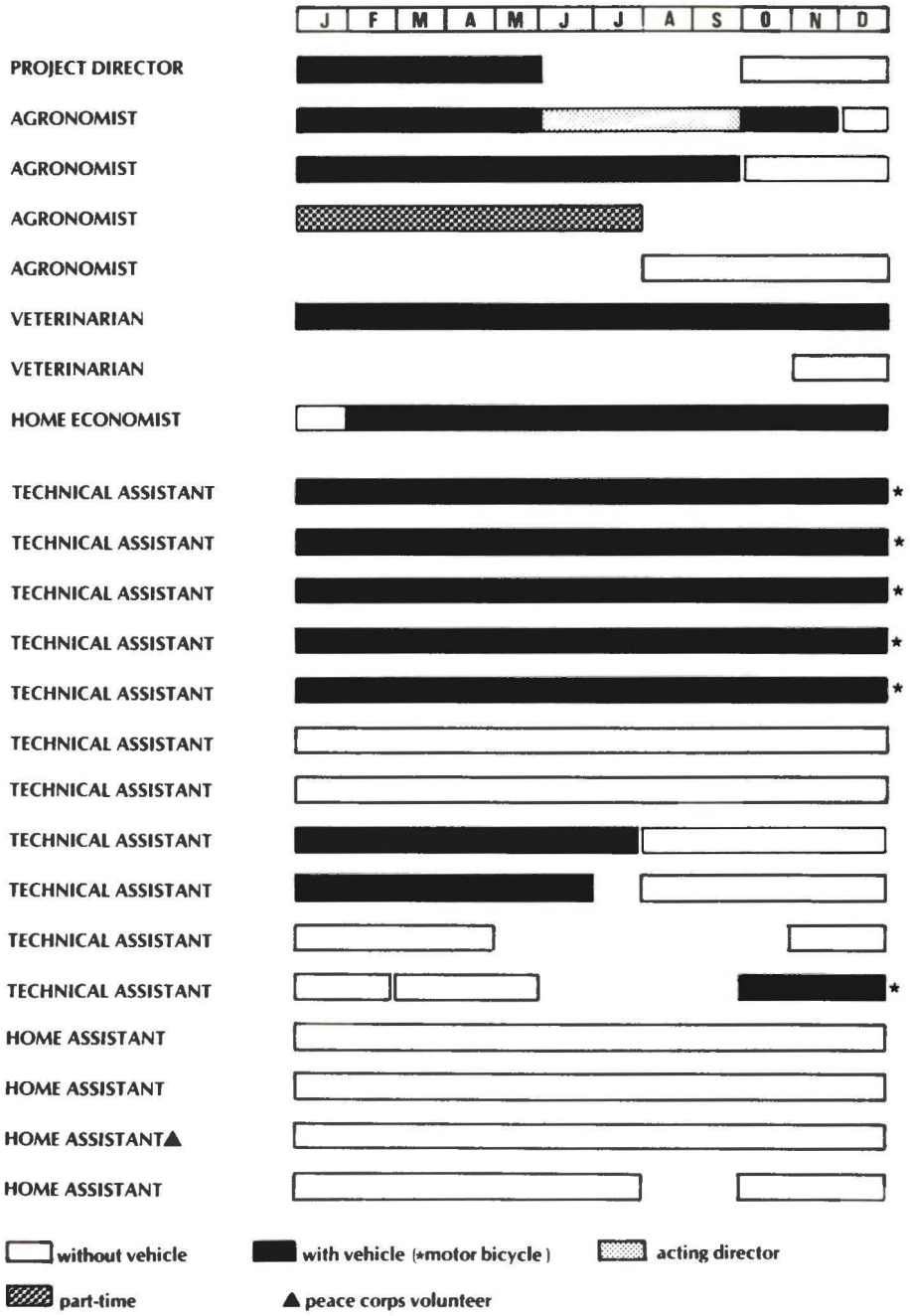


Fig. 9. Caqueza Project staff, 1974.

not only by project personnel but also by students. He was also able to effectively coordinate the work of the project with other ICA divisions and outside institutions. When he left, the internal coordinator of the project was named acting director. His work load was too heavy to be handled properly. The activities of the project itself continued at an excellent pace, but relations with other institutions suffered. In addition, and as a result of the acting director's heavy field involvement, he did not have the time to devote to establishing contacts at the ICA regional and national levels.

This situation lasted more than 3 months before a new director was named. He made some organizational changes, the most important being that the position of internal project coordinator would now rotate monthly among the professionals. This measure, and the strong personalities of both the new director and the former acting director, led to disagreements between them and ended with the transfer of the latter. Prior to this transfer, the project went through its second epoch of personality clashes, and for a few weeks the work suffered accordingly. However, by the end of the year the situation had improved substantially and the staff were working as a team again.

Conceptual Developments

During the year, the project staff realized that a process was emerging that allowed them to develop a strategy for RDPs. The basis of the strategy was building into the project operations the flexibility to develop and carry out small research studies as new information evolved regarding the limitations and requirements confronting small farmers attempting to adopt the new technology being generated. This need for flexibility was why the project did not attempt to prepare RDP manuals. Nevertheless, a general strategy could be recognized. First, agronomic research had to be carried out on the most important common crops; second, socioeconomic research was needed to identify the factors limiting the adoption of new technology; third, investigation was needed on alternative income generators; and fourth, new institutional relations had to be introduced to overcome some of the constraints on adoption.

After the ICEL experience in 1973, the farmers in the zone that benefited from electrification paid more attention to the ICA message than they had ever done before. It was quickly realized that if the project were to attend to "felt needs" first, the dissemination task might be much easier. As a result, the staff became much more involved in everyday community activities.

Evaluation continued to be a controversial issue. Political pressure mounted for an evaluation study to show the impact of RDPs after 3 years of activity. However, given the broad-based nature of the program, the problems of funding, staffing, and transportation, it seemed questionable whether an effective evaluation was practical. A lot was being learned, but the project staff, more than anyone else, recognized that it would take some years before their approach was likely to have a major impact. Given this situation, they tried to classify evaluation methodology and proposed that for the present they should stress analytical evaluation and that impact and efficiency evaluation (which we shall look at in the last part of this book) were premature after only 3 years of activity. They were supported in this view by ICA management, who gave considerable encouragement to the new action-oriented research activities.

Résumé of the Year

The project had more than its share of problems; staff turnover, lack of funds, and shortage of transport all continued to hamper progress. A number of research efforts failed to bear fruit. The farm recording system failed again, the efforts to develop a health delivery component got bogged down in institutional difficulties, the hoped-for change in dissemination approach by having an anthropologist on staff never materialized.

However, relations with the community improved considerably, as the people started to use the project as a means of access to the other public interest institutions. Thesis research expanded considerably and a number of publications were released during the year. With the new-found acceptance of the projects research approach, coordination with other ICA divisions increased.

The project's results began to be noticed and discussed outside of ICA; the National Planning Office, in particular, started to examine the project's strategies in terms of national agricultural development. After 4 years, the project was beginning to synthesize and disseminate new ideas that were having an impact at the national level.

Chapter 8

1975: The Fifth Year — A Year of Impact

During 1975 the action-oriented field programs were continued and expanded with emphasis still being placed on the preschool program, the marketing plan, and the corn plan. The latter was expanded in size and was duplicated with a program for onions. Because of the emphasis being given to these action plans, and as staff changes continued to take place, a limited amount of new research was initiated.

The project's impact was felt far beyond the confines of Caqueza for two principal reasons. The first of these was that former Caqueza staff started to become appointed to posts of regional and then national importance. Two former directors of the Caqueza Project were appointed to be directors for Rural Development in two out of nine of ICA's operational regions. One of these regional directors was later appointed National Director of Rural Development Projects and, at the end of the year, a former Regional Director who had been the recipient of an IDRC Ph.D. grant returned to Colombia and was appointed National Director of Training for Rural Development. The original project evaluator returned from doing an M.Sc. degree overseas and was appointed to ICA's Socio-Economics Division with specific responsibility for project evaluation. Another ICA staff member, who had worked in the García Rovira project and had been awarded a Ph.D. grant by the Ford Foundation, returned to ICA and late in the year was appointed Director of the Socio-Economics Division. Finally, the second project evaluator who in the previous year had been transferred to the Regional Office was seconded to work with the National Planning Office in the development of a national marketing plan.

The second important way in which the project had an impact at the national level related to the interest taken in it by the National Planning Office. In August 1974 there had been a change of government in Colombia and the new government, early in its regime, requested the Planning Office to give close attention to the potential role of the RDPs in a new national agricultural strategy. As a result of this examination, the Planning Office decided to support and expand integrated rural development and to this end, during 1975, they formulated plans for a large expansion of this program. This expansion involved the development of large credit programs with the World Bank, the Inter-American Bank, and several bilateral agencies. The total magnitude of these requests for foreign assistance exceeded U.S. $150 million. Although part of this funding was for infrastructural development, the linchpin of the program was to increase agricultural productivity by providing credit and technical assistance, based on the RDP type of approach. Because the Caqueza Project had documented far more information and research than any of the other RDPs, its staff became

heavily involved in the discussions associated with the development of the new national program. The work of the project staff received a generous tribute from the President of Colombia in his address to the Colombian Society of Agronomists in November 1975, and this had an obviously favourable effect on the morale of the staff working in rural development.

In spite of these favourable changes at the national level, the project continued to suffer from staff changes, and three different people served as project director during the year, making a total of five directors in less than 20 months. ICA itself went through a difficult year, which included a strike of many of its professional staff. As a consequence of this, it underwent a series of major organizational changes and it was during the course of these that staff previously working in Caqueza and the other RDPs were promoted to senior positions within the organization.

Organization and Programing

The fact that the project had three directors during the year meant that there was a lack of continuity in leadership. Fortunately, there were not too many changes in the rest of the professional team, which had been well organized and was functioning efficiently at the end of 1974, so that operations continued fairly well unchanged. As noted earlier, few new programs were started, and emphasis was given to concentrating on the limited number of action programs. As a result of this, these programs were properly completed and the project did not suffer from its earlier experience of starting a number of programs that it did not have the resources to carry through.

At the end of the year the organizational structure changed once again with the elimination of the research unit (see Fig. 10). This resulted from pressures from the Research Department, which claimed that RDP research was not genuine research but merely adaptation of technology. In effect this change had a limited effect on the project's "modus operandi," although it represented a setback for the group of action-oriented field personnel who were becoming rather vociferous in their criticism of the Research Department's program.

It was recognized that funds would probably continue to be limited and that transportation would continue to be a constraint. For this reason, very little time was devoted to programing in 1975 and, to a large extent, the operations were a continuation of those functioning in the previous year. Few new student programs were started, although a number were initiated in RDPs other than Caqueza.

Research

The promising results of the 1974 corn production plan encouraged the staff to continue and to expand this program. There appeared to be promising evidence that by sharing the risk of the new investment in technology with the farmer, his rate of adoption was much higher. However, the risk-sharing program still raised many administrative problems and necessitated much too much supervision for its practical use on a very wide scale. In the 1975 corn plan, a number of changes were made in both the contract and the repayment system in an effort to diminish the degree of supervision. In spite of these changes, farmer interest in the plan remained high and double the number of farmers were

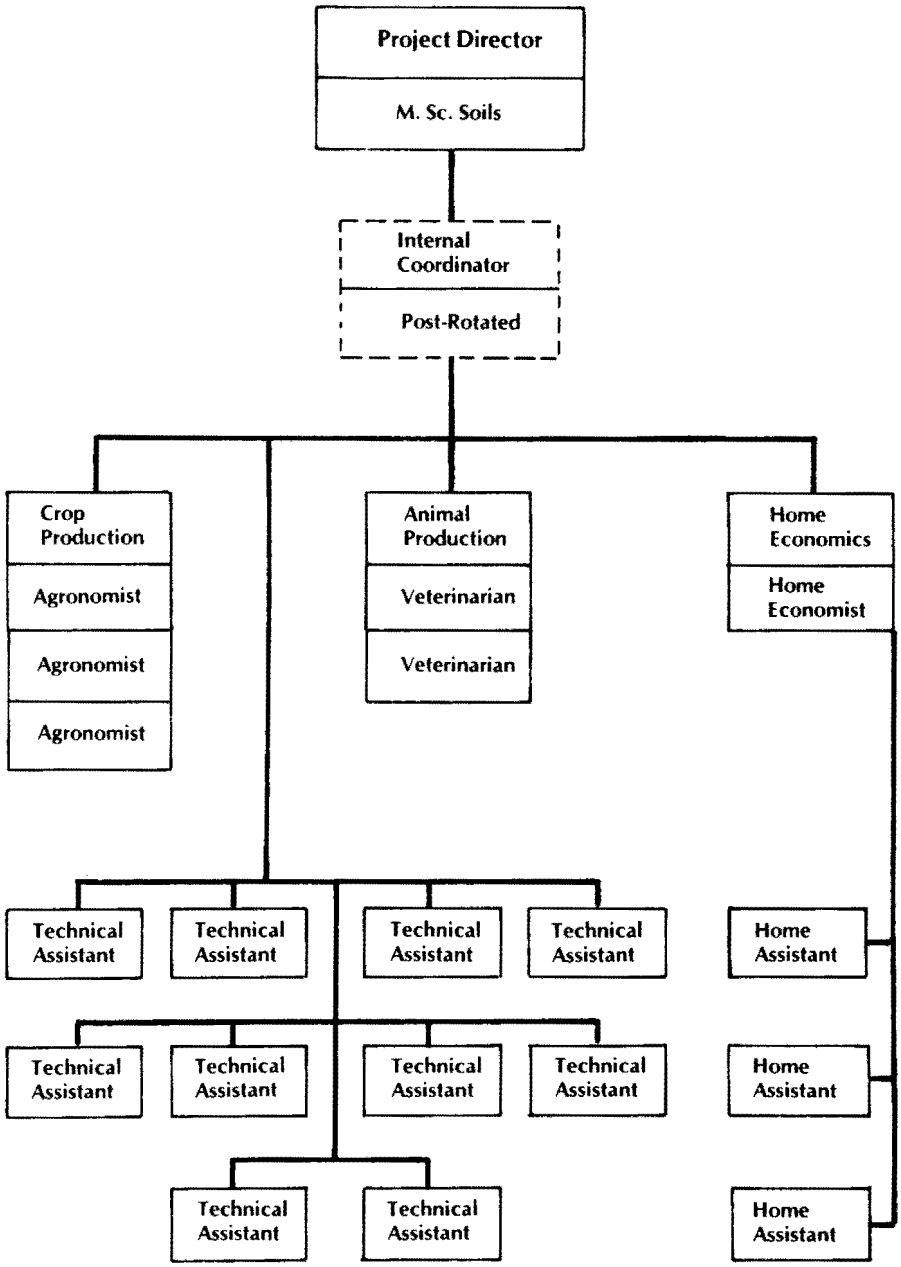


Fig. 10. *Organization of the Caqueza Project, 1975.*

included in the program for 1975. A similar program was also initiated with a group of onion producers, and plans were made for identical programs for wheat and tomatoes in the García Rovira project. However, unlike Caqueza, the García Rovira project did not have a rotating fund to finance this type of program and it was not possible to implement the wheat and tomato plans in 1975. Nevertheless, interest in this type of activity became very strong during the year. The National Planning Office accepted the need for such a strategy in the expanded

Rural Development Program. Furthermore, at least one foreign agency (CARE) made plans to provide funds for this purpose.

The marketing plan finally got off the ground during late 1975. Its success was very limited because of the small volume of products that it handled. Although the initial results were encouraging, the project was always short of working capital, largely because ICA was not in a position to provide it with more funds. This was partially due to a general shortage of funds within ICA itself and partly attributable to the fact that marketing lay largely outside of the responsibilities of ICA. Nevertheless, even the limited success of the program was sufficient to encourage the National Planning Office to decide that a marketing component of this nature should form a part of all future efforts in integrated rural development supported by international funding.

The National Planning Office also decided that the rural preschool centres warranted much more attention and during 1975 they financed 11 of these centres in the project area with the objective of gaining sufficient experience from these to use them as a basis for a national program in this field. Independently of this, the teams in two other ICA RDPs established experimental preschool centres in an effort to determine the degree to which the Caqueza experience was repeatable.

Thesis research continued to be carried out on the production systems of the small farmer, on the adjustment of technology to regional conditions, and on gaining a better understanding of the socioeconomic conditions of the farmer. The location specificity of much of this information was recognized by ICA, and many students started to do agronomic and socioeconomic research in projects other than Caqueza. Given the variety of ecological and cultural conditions encountered in the heterogeneous rural society that exists in Colombia, this appeared to be an important step forward in helping to disseminate the lessons of Caqueza and in broadening the impact of the project.

Dissemination

Dissemination activities did not change materially from previous years. The action programs on corn and onion production, marketing, and preschool; the credit supervision program with the CAJA AGRARIA; the continuation of the nutrition, home improvement, and housing activities of the home economics unit; the vaccination campaigns of the animal production unit, plus the direct requests for advice by farmers, consumed most of the available time of the project staff. The only innovation during the year was the increased emphasis given to small animal production, mainly rabbits. The staff continued to conduct field days and meetings.

Evaluation

The Caqueza Project was one of the few RDPs that ever had a permanent evaluator. However, the difficulty in finding a person to do this job and the uncertainty in definition of exactly what evaluation entailed, ultimately led ICA to eliminate the position from the staffing of the RDPs. During 1974, the evaluator position was transferred to the regional level, and in 1975 a team of people with experience in RDPs was added to the staff of the director of the Socio-Economics Division. During the year, this division decided to start a series of evaluations of the four original RDPs, commencing with García Rovira. The

objective was to try to develop a definitive evaluation methodology, but, by the end of the year, the first exercise had not been completed.

Publications

During the first 4 years of the RDPs, the ICA National Rural Development Office did not have a definitive publications policy. During 1975 the situation changed and a series of publications entitled "El Pequeño Agricultor" (The Small Farmer) was initiated. This series was intended to bridge the experiences and results already obtained or being obtained in RDPs and to emphasize the methodological approach being adopted. It was designed for both the public in general and the staff of RDPs who were in a position to implement the type of research described in this series of publications. Three issues of this series were released during 1975. They all originated from the Caqueza work and related to the research philosophy in agricultural production (45), the role of agricultural production in rural development (139), and the economics of vegetable production (114).

Eight new theses were finished in 1975: two analyzed the economics of small-scale bee (2) and pig production (47); one analyzed the effects of different levels and times of nitrogen application on corn–bean associations (101); the fourth dealt with an economic analysis of the traditional system of production compared with the system being recommended by the project (38); and another analyzed cropping frequencies in the project area (93). The three other theses dealt with social issues: the first studied the causes of migration out of the Caqueza region (118); the second dealt with the concept of welfare and the communities' desire for improvement (105); and the third discussed the ways in which farmers communicated information amongst themselves (92).

Crops are seldom grown in monoculture but usually in "association" with up to 11 crops being grown simultaneously. (Photo: Jaime Rojas)

Three reports dealt with the preschool centres and their progress (21, 22, 104). One paper described the results from onion research in 1974 and formed the basis for the onion plan (99); another provided information about the results from the corn plan during 1974 (102); and still another described the corn plan proposal for 1975 (103).

The articles presented in the IDRC meetings in late 1974 were translated and published as experiences in rural development (58).

Three papers were presented at international meetings. One dealt with relations between income and nutrition in the Caqueza area and was given at a CARE International Workshop (115). The second paper, presented at a Canadian Agricultural Economics Society meeting, described the overall results obtained in Caqueza (140); and a third paper, given at CIAT (International Centre for Tropical Agriculture) at Palmira, Colombia (144), discussed the role of economic analysis in the generation of new technology for small farmers.

Relations with Other ICA Programs

During the year, the IDRC team started to phase out and the National Director for Rural Development created a similar type of support group at the national level from Colombians at the M.Sc. level, who had either served in Caqueza or Rionegro or trained in Chapingo, Mexico, and all of whom had several years of field experience working with small farmers. The objective of this team was to provide technical as well as institutional support to the RDP's by helping them, in collaboration with the staff of local experimental stations, to develop action programs and adaptive research activities.

Before the end of the year this support group had visited a number of projects and had found that the technologies they were recommending were based on experimental station results and were not adapted to local conditions. Many of the recommended technologies had input requirements in excess of the small farmers' resources. Furthermore, some of the new varieties or hybrids being promoted were not well adapted to the whole of Colombia, with its wide range of soils, climate, slopes, etc., nor to the variable socioeconomic and cultural conditions of small farmers in different regions. For this reason, adaptive research was required in most projects, although in few but the original ones was it being carried out. Even where it was being done it covered only monoculture on the best known crops and ignored both multiple cropping, which was widely practiced, and also research on lesser known crops, some of which were of considerable local importance.

The support group's conclusions, which were not always expressed in the most diplomatic terms, led them to clash with the Research Department, and a long-standing grievance about the existence of "research units" in RDPs, which were not controlled by the Research Department, came to a head. As mentioned earlier this resulted in the abolition of the "research unit" in the Caqueza Project, although its work was merely transferred to the production units. However, the reemergence of conceptual differences between the Research and Rural Development departments staff was unfortunate.

The project relation with other ICA programs continued as in the previous year, except that the continual changes in project director created problems of continuity and meant that contacts tended to be more at the informal level.

The legal problems between ICA and the contractors who built the training centre at Caqueza remained unresolved until December 1975. As a result of this,

the Caqueza Project was not able to fulfill the training role envisaged for it in terms of the development of the National Rural Development Training Program. The nearly completed training centre remained unused throughout the year and the National Training Program continued, using the facilities of the Rionegro Project. One hundred and fifty project professionals and technical assistants from RDPs throughout the country participated in six 3-week training courses at Rionegro. As in the previous year, the staff of the Caqueza Project participated in these courses both as trainers and as trainees.

Relations with Other Institutions

The most important new relation was with the National Planning Office whose Director and staff took a very close interest in the project during the year and consulted both the project staff and the IDRC advisors regarding programs presented to the international agencies (IBRD, IDB, US-AID, CIDA) that had offered support for Colombia's new Integrated Rural Development plan.

The corn and onion production plans of the project were examined in detail by CARE, as a result of which this organization financed an onion-group credit program in one of the municipalities of the project but not directly serviced by it. Under this program the CARE credit was provided directly to the producers who, under the supervision of local RDP staff, were organized into groups to manage both the credit and the inputs for which it was used.

Activities were continued in conjunction with the National Pro-Rural Youth Association. Seven programs were carried out, two in horticulture (onions and tomatoes) and the other five in animal production (two with pigs, two with rabbits, and the fifth with sheep).

Relations with the Community

Continuous efforts of the project staff to promote community organizations were not very successful. Both prodevelopment committees (Caqueza and Chipaque) remained dormant throughout the year.

The cooperative continued to have administrative problems, and its work and capital diminished. By the end of the year both the corn and the onion producers participating in the risk-sharing plans and the project staff were concerned about the administration of the cooperative. The funds for both plans as well as the production inputs and the repayment of production in kind were all to be channeled through the cooperative. The diminution in the cooperative's working capital indicated that it might have to use the payments from the corn and onion plans to remain viable at the end of the year. In this situation the producers participating in the two plans decided to form two groups and to handle their plan credit independent of the cooperative. This was the first time in the 5-year period of project activities in which farmers themselves actually suggested some form of formal organization and it remains to be seen whether this can be implemented in 1976. Unless the cooperative is put on a sounder financial basis it appears unlikely to survive. During the first years of its existence the project staff had played a major role in management but clearly in the long term this is an untenable situation and the recognition by the community that they themselves would have to make the cooperative viable represented a major conceptual advance during the year.

Other Activities

No major changes occurred in the type of activity described under this heading during the earlier years. As was mentioned for 1974, the project staff continued to be responsible for a number of other activities that they had learnt to accept, although they impeded the development work.

Personnel, Vehicles, and Budget

As noted earlier, three persons served as project director during the year. The second veterinarian who joined during 1974 resigned and, although his replacement was rapidly appointed, he was seconded to work out of the National Office in Bogota for 3 months. A similar situation occurred in the case of the third agronomist, so that continuity during the year was provided by a staff of four professionals: two agronomists, a veterinarian, and the home economist. There were also a number of changes in technical assistants. Six of the 11 who were with the project at the start of the year left and only four were replaced during the year; however, three of the four home assistants were present for the whole year (see Fig. 11).

The transport situation was better than in previous years. During most of the year at least five professionals had their own car. One of the home assistants also bought herself a car and, at various times, between three and six of the technical assistants had motorbicycles. In addition to all this, one of the trucks that had been awaiting repair for months during the previous year was finally put on the road and returned to the project.

ICA continued to be confronted with economic problems; indeed, at one stage, demands for salary increases plus a considerable delay in payments of regular salaries were largely responsible for a general strike in the organization. As in previous years, shortages of funds late in the year necessitated budgetary cuts and, apart from staff salaries, limited funds were available to the project. Total expenditure for the year was U.S. $96000, of which U.S. $73000 was for salaries and U.S. $23000 for other expenditures (including travel, office facilities and rent, etc.).

Project Management

Because of the changes in director, the project staff worked throughout the year with rather little direction. Fortunately, there was a core of professionals who had been with the project long enough to be able to operate in this way, although some of the impetus of the earlier years was lost.

Conceptual Developments

Probably the most important aspect of the project's activities was that during the year it did succeed in defining its role more clearly than in earlier years and in convincing the planning authorities of the following three points:

(*a*) any technology, be it new or traditional, has socioeconomic as well as biophysical requirements;

(*b*) small farmers have, in themselves or in the land they farm, socioeconomic as well as biophysical limitations;

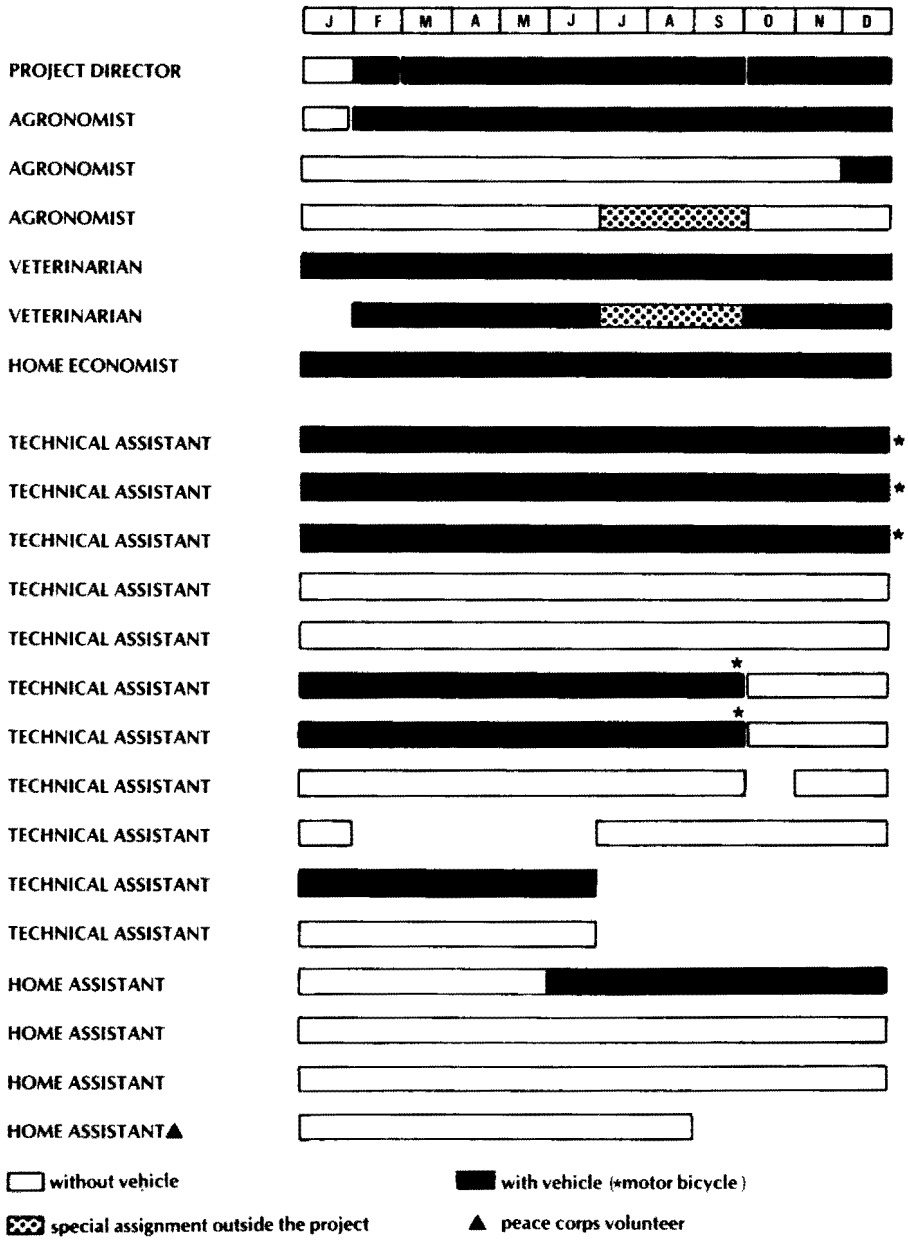


Fig. 11. Caqueza Project staff, 1975.

(c) even if a new technology is economically highly productive, the small farmer is unlikely to adopt it if it confronts him with constraints that he has difficulty in overcoming.

Within the above framework there are two possible approaches toward increasing the rate of adoption of new technology:

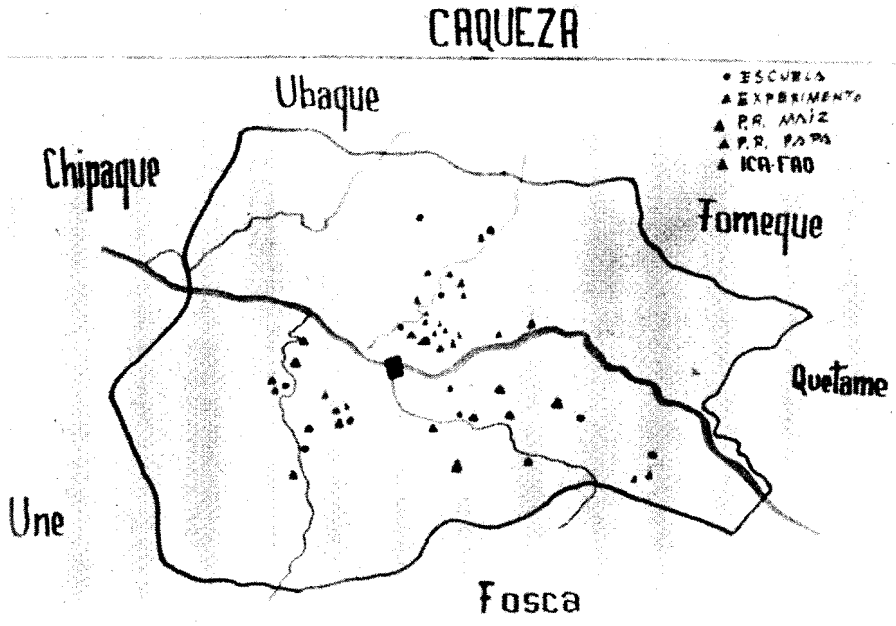
(a) by ensuring that the requirements for the new technology are within the farmer's limitations (a difficult task in most circumstances); and/or
(b) by modifying existing constraints through programs and institutions specifically established for such a purpose.

The work of the project had shown that biophysical constraints, such as rainfall, sunlight, temperature, topography, and soil fertility, were usually fairly easy to define. On the other hand, socioeconomic constraints, such as the farmer's limited assets; the availability and cost of credit; the availability and price of inputs and of labour; the instability of the market; and the ability of the farmer to assume risks were usually much more difficult to measure. Nevertheless, without a knowledge and understanding of these socioeconomic factors, the successful introduction of new technology appeared to be a difficult undertaking. The capacity to assume risk appeared to play a particularly significant role in determining whether or not a new technology was adopted.

Unfortunately, the subject of risk has been largely ignored in most small-farm development programs, and where it has been examined, much of the analysis has been theoretical. There has been little analysis of the relation of risk to the behavioural characteristics of small farmers. Indeed, the literature clearly differentiates between "risk" and "uncertainty," whereas from the project's observations it appeared that from the moment small farmers subjectively assigned any probability of occurrence to a certain event, it ceased to be "uncertainty" and became a "risk."

The project team found that the farmers considered three types of risk, namely, production, price, and institutional. Small farmers objectively assigned certain probabilities of occurrence to each type of risk and adjusted their adoption decisions to them. That is to say that each new technology involved a certain risk. This risk, according to the farmer's concepts, did not depend on the variability of the expected profits but on the probability of loss and on the possible magnitude of the loss. Their capacity for assuming risk was not related to the expected profit that might be made from the new technology, but related to the profit they had made in the previous year or to their overall wealth level. Their limited income and wealth did not enable them to take large risks and as a result they were caught in a "low-productivity trap." These circumstances implied that their behaviour was much more "risk averting" than "profit maximizing."

This situation suggested that there was a need for change in the traditional attitude toward rural development in Colombia. Hitherto research workers and planners had assumed that a good technology would sell itself. However, this clearly oversimplified the situation in terms of the farmers' behaviour toward risk. It was clear from the evidence of the early years of the project that it was unlikely that new technology could be generated that would both increase profitability and at the same time reduce the probability of loss. Because of this, the project reoriented its activities in an effort to establish institutions and programs that, by sharing the risk with the farmer, would stimulate the adoption of a technology, even though this might result in a smaller increase in profit. This philosophy led to both the corn and the onion plans and in 1974 and 1975 the



Early in the project, a series of agronomic experiments were laid out. In many cases they were located conveniently close to village schools where the trial could be explained and discussed at evening meetings. (Photo: Caqueza Project)

adoption rates in these plans were more than double those of either the new technology originally generated by the project or the technology recommended in the ICA/CAJA AGRARIA Credit Program in which the project was involved.

Although the possibility of greater adoption rates through risk reduction was recognized by the project staff as early as 1973, it was not until 1975 that this became accepted at the national level.

Résumé of the Year

This was an interesting year in that the project had a greater impact away from Caqueza than in Caqueza itself. By the end of 1974 the project appeared to have largely fulfilled its experimental role. The expatriate advisors and some key project staff were transferred to work in the National Office of ICA and with the National Planning Office to develop a national rural development strategy. This curtailed the flow of new students to Caqueza, although student research started to expand in other RDPs. The Caqueza Project itself suffered from lack of leadership during the year, but fortunately it had a core of professionals carried over from 1974 who continued the ongoing programs, supervised the students, and, with little supervision, managed the action programs.

The research arising from the project was heavily focused in the socioeconomic field, and considerable progress was made in risk analysis in terms both of understanding the farmer's attitude to this and of its influence on his decision-making. The action programs attracted widespread attention and plans were made to repeat them in other projects in 1976. The preschool program was

expanded under the auspices of the National Planning Office, funds from external agencies were provided for expansion of the corn and onion plans, and a strong team was established at the National Planning Office to develop the marketing strategy at the national level.

For the first time in Caqueza, the farmers took the initiative in trying to form a group that could handle the production plan's credit and both the project staff and the farmers appeared to realize that the cooperative could not be maintained on a long-term viable basis be being continually nursed by the project staff. As at the end of previous years, activities were in a highly fluid and dynamic state. The framework had been set for developing a national strategy even though many aspects of it had still not been fully tested at Caqueza.

In many senses the project's impact on institutional thinking within the Government had been greater than its impact on farm income and welfare. Notwithstanding this, the Government appeared to be convinced that the strategy developed by the project was one that warranted large-scale national repetition.

Part III

Research on Production Systems and the Formulation of New Technology

RESEARCH ON PRODUCTION SYSTEMS AND THE FORMULATION OF NEW TECHNOLOGY

The research that is discussed in the two following chapters resulted from ICA's decision to encourage RDPs to adjust their production recommendations to the characteristics of the area in which they were operating. Initially, this entailed conducting small plot experiments to study some major production variables such as variety, nitrogen, phosphorus, plant population, and weed control. The design and focus of the research changed over the years and ultimately resulted in an approach that combined experimental and survey activities. This evolution in approach resulted from practical experiences obtained in Caqueza and other rural development projects both in Colombia and elsewhere in Latin America (9, 76, 79).

The on-farm research procedures that were developed reflected a considerable change from the traditional approach to agricultural research in Colombia. This change took the form of more attention being paid to the small farmers' constraints, especially with respect to the limited availability of cash, to the risk-taking involved in using high input technologies, to additional labour requirements, to the need to adjust to marketing situations, and to the limited availability of agricultural inputs. It also related to the need to incorporate research results into action programs and the difficulty of bringing this about. The approach that evolved in Caqueza meant that project staff became involved in research design, extension, and interpretation, a considerable change from the centralized approach conventionally used for agricultural research in Colombia.

The shift of research premise was not immediate and did not become fully institutionalized until late in 1976. Nevertheless, a methodology gradually evolved that allowed for a continuous process of identification of improved technologies at the project level and for their incorporation into action programs.

At the project level, agricultural production research is a type of operations research that is designed to incorporate available knowledge, processes, and materials (biological, physical, human, or institutional) into the identification of action programs. When this sorting, testing, and evaluation activity was combined with the experience of farmers in the region, the project was in a position to identify recommendable production practices for the region.

Because of the operational nature of production research at the project level, projects of the Caqueza type are completely dependent on the technology available to them. They can obtain information from two major sources: experimental stations and local farmers. By pooling information from these two sources, the project staff were able to recognize the research needed to identify and evaluate production systems that were ad-

justed to structural limitations existing in the community and to the needs of the small farmers' family. It was also possible to establish ways in which different constraints could be changed to create a structural context that allowed the incorporation of higher producing technologies (45, 139).

To do this, the staff needed to be familiar with the biological and physical materials available and the actual production methods used in the region. They also needed to identify research methods that could be managed within the financial and personnel limitations of the project and that allowed for a rapid and sufficiently dependable identification of recommendable production practices.

The following two chapters describe how the research framework necessary for achieving these objectives was developed and established in the Caqueza Project. These two chapters and Chapter 11 are written at a more technical level than the other chapters in this book and parts of them will be of interest only to the more specialized reader.

Chapter 9

Research to Understand the Existing Production Systems

Developing a Research Methodology

A few months after the start of the Caqueza Project, a sociologist with the title of "evaluator-programmer" was added to the project staff and asked to design and execute a baseline "diagnostic" study that would obtain up-to-date information on family size and structure, housing conditions, production patterns, and attitudes toward change. Questions eliciting responses on family incomes were purposely avoided because of the initial rejection of project activities by some local farmers who were concerned that ICA's new RDP efforts were related to a land reform program to which they were opposed.

Notwithstanding this, the evaluator, in conjunction with the CAJA AGRARIA, developed a questionnaire that was later used to survey 646 families. He also drew up a contract for the CAJA AGRARIA and a Bogota university to carry out a geographical study of the project area to prepare topographical, hydrological, geological, and soil classification maps (5). Rainfall records were also collected and, from secondary sources, information was compiled on the population, education, health, and other public services and development programs in the region.

Farm income was estimated by collecting local average yield data, deriving net incomes per hectare per crop, and multiplying these values times 1970 census data for areas planted to these crops. Field staff surveys, based on conversations with farmers and many years of field experience, led to estimates of the degree of double cropping by crop group, which was then added to total average figures. These original income estimates were later refined with the assistance of field surveys on actual multiple cropping patterns and budget analyses of several crops.

Analytical Studies

In January of 1972, the evaluator, assisted by the second IDRC project advisor, conducted an analytical study to evaluate the project's 1971 performance in increasing farmer awareness of ICA's activities and objectives (31). This study, which has already been referred to in Chapter 5, produced an interesting by-product in gaining the better acceptance of the evaluator by ICA staff at both project and national levels. Previously, the evaluator had been heavily criticized for spending too much time in the office working on data rather than being "in the field." What seems to have induced an attitudinal change toward him was the

fact that in his evaluation study of farmer awareness he analyzed his results using a simple regression analysis of the type used by ICA's agronomic staff. Their comprehension of his methodology initiated a dialogue first on methodology and then on concepts. This led to a better, although still imperfect, working relation among the project's team members.

In March 1972, a local graduate student approached the project staff with a proposition to develop an index for measuring level-of-living conditions in Caqueza. Though the student's thesis proposal was eventually rejected by his university professors, the project staff further developed this idea, and presented a position paper hypothesizing that a broad social welfare concept should be the project's major goal, as opposed to simply using increased per capita income as the criterion of success (49). This paper was well received by ICA, who nominated the Caqueza evaluator to present it as a model of Colombia's overall objectives in rural development activities at an international seminar on RDPs sponsored by ALADER (32).

In the spring of 1972, two additional analytical studies were initiated. Twelve farmers were encouraged to keep farm records. Although the farmers themselves failed to make daily entries on production costs, this information was obtained every 2 weeks by the technical assistant in charge of the study. Nevertheless, by the end of the year, data consistency was lacking and the interest of the technical assistant had waned to a degree that the data were too incomplete to be worth analyzing. The second study involved the keeping of weekly records of the prices of the most common agricultural products sold in the Caqueza market. The same technical assistant who was in charge of the farm registers collected this price information, which was recorded for a period of nearly 2 years.

Another student approached the project for assistance in conducting a study on farmers' attitudes toward change. This type of study had been done in Colombia previously by staff of the Land Tenure Center of the University of Wisconsin, but the results had never been translated into action programs. Although it was considered doubtful that different areas in the Caqueza region would have significantly different attitudes toward change, this study failed primarily on account of the student's lack of persistence and initiative. The field work was carried out and coded, the results calculated, but the student failed to interpret and analyze them and never completed the study.

By August of 1972, the same postgraduate student who had previously suggested the level-of-living study returned with the idea of studying corn and potato production using survey techniques. The project staff helped him develop a questionnaire for use on growing intercropped corn or potatoes. Three hundred and twenty farmers were interviewed, and input–output data were obtained from 189 corn farmers and 131 potato farmers. The data were subjected to budget and production function analysis. The results were included in the diagnostic study and were used for determining the range of yields and costs encountered for corn and potatoes grown in association with other crops (37).

A marketing study was also carried out in 1972. The results showed that oligopolistic pricing behaviour was absent and that the market structure tended toward atomistic competition. These results also served as a basis for justifying the subsequent Marketing Plan (Chapter 13).

During 1972, 23 corn farmers and 23 potato farmers received credit from the ICA–CAJA AGRARIA supervised credit program in Caqueza. To receive this credit these farmers had to agree to adopt the project's technological recommendations with respect to seed variety, fertilizer, and pesticide applications

and plant population. To analyze the impact of the supervised credit in terms of the rate of technology adoption, information was collected from the farmers every time they received a supervisory visit.

When the data were analyzed at the end of the year (138), it was found that 86% of the corn producers had adopted the plant population recommendations but only 22% had adopted the fertilizer recommendation, whereas the potato farmers had adopted virtually the complete package of recommendations. Staff inquiries indicated that the corn farmers used their credit for other enterprises and that they did not apply to their corn the quantities of fertilizer and pesticide recommended for high-yielding varieties and hybrids (31).

In potatoes, however, the only major change recommended by the new "package of recommendations" was the variety of seed, the incremental cost of which was negligible (17).

In an effort to obtain more information on traditional farm production, especially from horticultural crops, a farm register program was designed for use in 1973 that was intended to include all farmers in the supervised credit program plus some others. Farm records were to be kept on all production activities on the farm. Once again, the program never got started. The technical assistant who was in charge of the first 12 farm records in 1972 went to Panama on a scholarship to study cooperatives. A second technical assistant who was responsible for the adoption study resigned.

In the first part of 1973, an undergraduate student from another local university requested ICA's assistance for him to study three horticultural crops in the Caqueza area, where his family farmed (39). His findings stimulated the evaluator to organize a larger study that included data collected from 450 producers of onions, beets, lettuce, and cabbage (114). Furthermore, the assistance given to this student encouraged two of his colleagues to become interested in working in the project area, and this resulted in a further thesis recording the frequency of land use on 450 holdings (93).

In conjunction with the evaluator and advisor, the home economics staff of the project carried out a nutrition survey to establish the nutritional status of the Caqueza population and to determine whether this might be modified by project action. The results from 289 farm family interviews showed that: (1) preschool children received diets that were better than the family average; (2) nutrition was better in higher income areas; and (3) protein and calorie intake levels were more highly correlated to expenditure (the proxy variable for income) levels than were vitamin A and calcium (112). These last two items appeared to be the ones that warranted priority action in nutrition education programs.

Prior to this study the home economics team, in collaboration with staff of the Home Economics Faculty of the University of Manizales, had carried out a "felt needs" survey with farm wives. This indicated that the poor response to the home economics program did not necessarily mean that its objectives were wrong, but that there was a lack of motivation, time, or activity attractiveness to the recipients. The survey clearly indicated that the home economics group needed to modify their approach if they were to have an impact.

The impact of the innovations introduced by the new project director in mid-1973 were considerable. A list of research needs was developed and researchers (students) from ICA's graduate school were sought. Four students in economics agreed to do theses on the project, on the "real cost of credit" (121), the relation between risk and wealth in potato production (119), milk production from units with 4–12 cows (1), and the economics of scale in egg production (16). In addition, an evaluator being trained at Caqueza for another RDP carried out a

production cost study of arrowroot (arracacha), one of the minor crops in the Caqueza area. In 1974 and in subsequent years the thesis program built up, using not only Caqueza but also other projects, and in 1976 approximately 30 M.Sc. theses a year were under way in these projects.

Methodology for Analytical Studies

The project's earliest agronomic trials showed that new technology could double potato yields and triple yields from corn. However, with horticultural crops, a number of farmers already seemed to be utilizing modern technology and the potential for yield increases appeared to be less. To test this hypothesis it was decided to conduct a comparative group analysis of farm costings using a technique developed in France by Chambart de Lauwe (19) (and known in Colombia as *Cabeza y Cola* or "Head and Tail"). The simplicity and ease of this type of analysis was quickly recognized by ICA's agricultural economists as well as by the field team, and it has since become a standard technique for production analysis in Colombian RDPs.

The essence of the method is to divide the producers into three groups based on the distribution of their net earnings from the production of a specific commodity. The first group comprises those farmers who fall into the upper 15%[15] of this distribution. This group is called the *Cabeza* (head). The second

Numerous on-farm field days were also held; the project staff had no land of their own and all trials had to be conducted on farmers' land. (Photo: ICA)

[15]The choice of 10, 15, 25, or any other percentage is somewhat arbitrary. It is desirable to have enough cases in each group to give some basis for inference, but not too many so as to decrease the likelihood of significant differences showing up between groups.

group has the lowest 15% of net earnings, and is called the *Cola* (tail). Those cases with earnings in between these two extreme groups fall into the middle group. Once the group choices have been made, the average use levels for each individual production practice are compared between groups. A statistical *t*-test is used for each variable, thereby selecting a recommended package of those items that emerge as being significantly different. This technique appears to be particularly useful for designing on-farm trials to test the adequacy of the package recommendation that emerges from the *Cabeza* group. The *Cabeza* group's average input usage level was usually used as the midpoint input level in Caqueza field trials, which also used higher and lower inputs.

Although the types of studies referred to above were useful for getting a field research program moving quickly, they did not provide information on the economic efficiency of resource use. To do this, production function analysis was included in the project's research. The first corn production study, already mentioned, developed Cobb–Douglas production functions for corn produced in association with legumes. In 1975, production function analyses were carried out on additional data. The results and interpretations are discussed later in this chapter.

The crop frequency study determined the land-use pattern found on 450 farms. These farms were located in eight of the nine municipalities in the project area. The ninth municipality (Gutierrez) was so inaccessible that it never became deeply involved in the project programs. The sample size of 450 was determined as a compromise between what was desirable statistically and what was practically feasible and it was an effort to cover about 3% of the total farms in the eight municipalities and to include at least 200 farms in both the corn and the potato zones.[16] Although this technique was imperfect, it did provide a large enough sample to discount many sources of error. For each of the two zones, average farm size and area cultivated per crop were derived, and land use patterns throughout the year were recorded. This enabled the total area under each crop to be calculated.

By combining land use data with average input information and average factor return rates per crop, it was possible to make crude calculations of regional resource demand levels and to derive family and per capita income levels.

For crops such as coffee and bananas, which formed a small part of the total acreage in Caqueza, secondary sources of data were used. Special studies for milk and egg production were used to estimate animal production returns. In most cases, the interviews to collect information for budget analyses were straightforward and the cost and yield data were derived from the responses to questionnaires. However, the "real cost of credit" study was of a much different nature and required information on savings and income behaviour. Because of this the interviewer could not present a fixed set of questions but had to spend several days with each farmer conducting in-depth interviews.

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[16]In addition to Gutierrez, the municipality of Quetame was discarded from this study because it had a very large area under upland pasture and a cropping pattern very different to the other seven municipalities. Hence, all of the land use, labour, and derived-income analyses were based on only seven of the nine municipalities in the project area. These seven do, however, appear to be characteristic of many Latin American "minifundia" areas.

Lessons Learned from the Analytical Efforts

From the inception of the project, its approach was to field-test promising technology and then to derive appropriate recommendations for the use of this technology by farmers. Although the evaluator had a key role to play in this process, most of the project staff were uneasy about his activities, which in effect required him to question the methodology being used by the project and to monitor its results in order to be able to suggest a change of focus in project activities if this appeared to be necessary. The field staff felt that the programing aspects of his work were more important and that he should program all of the project's activities. This was an unrealistic attitude because the RDP evaluators were sociologists (or economists) and were not trained for programing agronomic and animal science research nor extension activities. Nevertheless, various evaluators brought a strong analytical orientation to the Caqueza Project and therefore contributed substantially to developing overall project philosophy and action plans and to broadening the outlook of the biologically trained staff.

As more and more socioeconomic studies were completed, the role of the evaluator gained credibility. Various cost studies confirmed the conclusions reached by the agronomic research. Although the agronomists usually demanded more exactitude in their research designs, the socioeconomic work often provided information that could be used as guidelines for planning and designing future agronomic and animal science research programs. The fact that the evaluator, the agronomist, and the veterinarian lived and worked together, trying to solve mutual problems, led to the emergence of a mutual respect and to the development of a genuine multidisciplinary approach to problem solving. Two early examples stand out that clearly demonstrate this point.

The first occurred when the agronomist found that it was difficult to obtain labour to work on the project's on-farm trial plots during the corn weeding season. The evaluator hypothesized that there was full employment at that time, even though large masses of unemployed are generally reputed to reside in the rural areas of developing countries. This hypothesis was tested by conducting a series of over 2000 interviews. These indicated that there was indeed full or near-full employment in May and that there would clearly be problems in introducing a technological package that necessitated more labour use in that month. The second example relates to the overproduction of cabbages, which has already been referred to (Chapter 6), that led to the project's involvement in a marketing program.

A key point in both of these experiences, as well as in numerous others, was that when problems arose that limited the farmer's ability to adopt new technology and increase his productivity, both the social scientists and the agriculturalists were in the field living these experiences together with the farmers. Theory held no precedence; field experience held sway over theoretical expectations.

The Existing Production System

Cropping Patterns

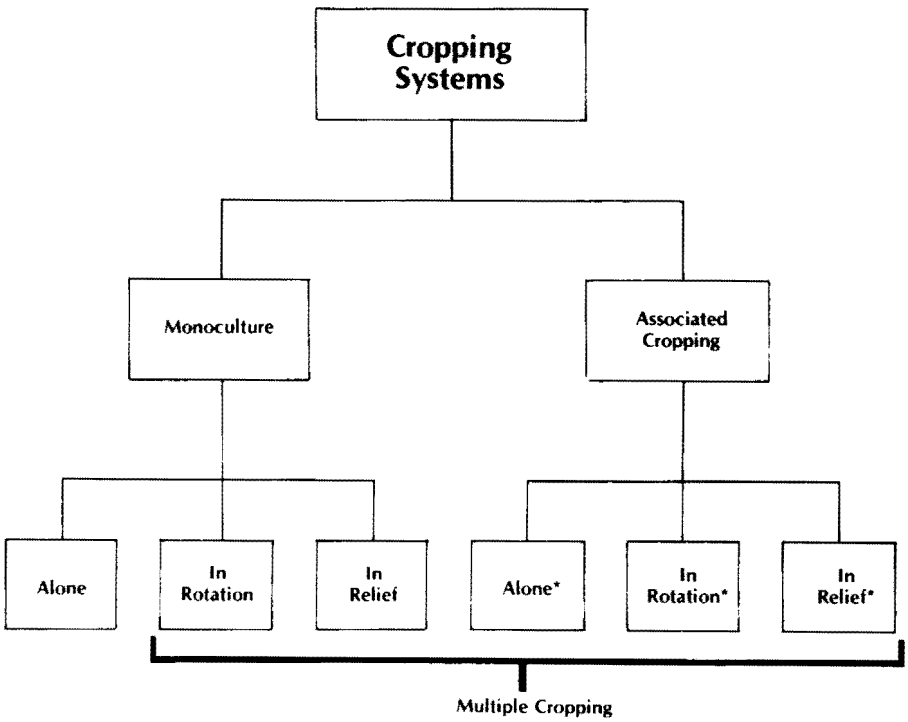
Multiple cropping, be it mixed, associated, or intercropping, is commonly practiced by small farmers around the world, yet each region combines its crops in different ways. For the purposes of this chapter, an effort will be made to break down the term "multiple cropping"[17] into its component parts in order to

[17]The type of multiple cropping used in Caqueza is referred to locally as "associated cropping," which is the term used in this text.

examine both the system as a whole and its major components in terms of their profitability, productivity, and factor returns.

Most Caqueza farmers practiced various forms of "associated" cropping in which two or more crops were cultivated at the same time, either in the same row or between rows (interrow) and occasionally (as in the case of corn and beans) even in the same hill. The farmers referred to this essentially simultaneous cropping pattern as "associated" cropping. It would involve the simultaneous production of as many as 11 crops. Superimposed on this associated (simultaneous) cultivation, they also increased the intensity of land use by: (1) planting a different crop or crop combination after the first crop combination was harvested (rotation); (2) repeating the first crop combination the same year (rotation); or (3) reintroducing the same or a different crop or crop combination before the first crop was harvested (relay cropping). Figure 12 illustrates the different cropping systems that have been found in the project area.

Associated cropping patterns were generally encountered as within-row, but interrow plantings were also common. This was true for all three systems of associated cropping. Of the three, relay associated cropping was the most common. Within this system, combinations in which corn, beans, and broad beans predominated occupied over 65% of the cultivated land. However, high value horticultural crops, such as onions, were generally grown in monoculture.



* All of these combinations can be either inter-row or within-row plantings

Fig. 12. Cropping systems used in Caqueza.

The "frequency of production" study, in addition to identifying land-use patterns, attempted to determine why farmers planted crops in association. Responses varied but were all closely related to the basic concept of resource scarcity and to the risk of investing in only one crop at a time. The farmers knew that if several crops were present in the field when a natural calamity struck, be it rain, drought, disease, or pests, not all of the crops would suffer the same degree of damage. For example, there was a fungus that reduced broad-bean production in the project area but that did no harm to the associated corn plants.

In the frequency study, 36% of the respondents reported "custom" as the reason for associated cropping. Presumably this "custom" originated as a result of other reasons for associated cropping and was a secondary response. Other reasons cited for associated cropping were risk avoidance (28%), maximizing production (19%), land shortage (9%), and subsistence consumption (9%) (Table 3).

Risk avoidance, in this specific situation, was taken to mean natural calamities. Maximizing production referred to the local Caqueza concept that because land was scarce, it must be completely covered by a producing crop so that production from the land was maximized. This was essentially the same explanation behind the land shortage response. The farmers argued that if a single crop was planted along the row, the furrow itself was left unproductive. If land was scarce, and total production failed to meet the family's food demand, all of the area needed to be made as productive as possible. Hence, plant populations (pooling all crops on the land) were high, and both the row and furrow were utilized. Subsistence consumption referred to the fact that subsistence farmers[18] usually produce most of their food needs on their own land. They try to

Table 3. Farmers' reasons for using associated cropping (93).

	Zone I[a]:	Zone II:	Total:
No. farmers interviewed:	190	225	415[b]
	%	%	%
Custom	38	35	36
Risk	31	26	28
Maximizing production	21	16	19
Scarcity of land	3	13	9
Subsistence consumption	7	10	9
Total	100	100	100

[a]Zone I is below 2200 m and Zone II is over 2200 m above sea level. Generally, corn predominates in Zone I and potatoes in Zone II; hence, these zones are referred to by project staff as the corn zone (Zone I) and the potato zone (Zone II).

[b]This number is less than the 450 referred to earlier because, as already noted, the data from the municipality of Quetame were atypical and were, therefore, discarded.

[18]Subsistence farming is usually defined in terms of the percentage of the value product produced on the farm that is consumed by the farm family. In the context of the Caqueza area, this concept is not very useful. However, all farm families produce some

grow several different crops intermittently spaced throughout the year to come closest to providing a steady, diversified diet for their family all the year round. However, as this explanation only accounted for 9% of the responses, it was apparently not the dominant reason for associated cropping in Caqueza.

One significant difference arose between the responses in the two ecological zones. Only 3% of the farmers in the "poorer" corn zone suggested that scarcity of land was the reason for associated cropping, whereas in the "richer" potato zone 13% gave this response. The difference may be attributable to the fact that "scarcity of land" and "maximizing production" really amounted to the same thing and the pooled response to these two issues was very similar for the two zones. Perhaps the two most important implications to be drawn from this survey were that the Caqueza farmer was very well aware that: (1) agriculture was a risky business; and (2) the resources at his control were scarce and limited.

Production Cycles

In parts of the project area the land is cropped for the whole year. The seasons are characteristically called "major harvest" (*Año Grande*) and "minor harvest" (*Año Mitaca*) (said to be derived from *Mitad de Carrera* or "half way"). The designation of major or minor harvest season depends on the relative importance of the crop.

The major harvest season is associated with the most important crop. Thus in the corn zone, the major harvest season begins in March or April when the corn is planted immediately after the first spring rains. This corn is not harvested until November or December. Thus the major harvest season for corn occupies 8 months. The land is then replanted in corn the following March or April. Some of the legumes or vegetables that are grown in association with the corn are, however, harvested as early as August. It is general practice to leave beans to dry on the vine with the corn until November, but broad beans, peas, and some other cash crops, especially intercropped potatoes, are harvested as soon as they mature. March to August is the major harvest season for these crops, and by planting in relay a second legume crop can be harvested before the full effects of the drier winter season are felt. Thus, the minor harvest season for the relay crops begins in September and extends until February. The legume during its minor harvest season is in relay with the corn, which is still in its major harvest season.

At higher altitudes, in the potato zone, the cropping seasons are not so dependent on the weather. Some farmers have natural irrigation from streams

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portion of their crop for their own consumption and use another portion for barter (only their home vegetable garden is kept completely for themselves). Because each and every farmer enters the market place with some commodity at some time, he becomes a "commercial farmer." To define a subsistence farmer as one who trades not more than 50% of his value produce from farming does not seem to be a satisfactory definition. All of the Caqueza farmers trade part of their production; all of them also consume part of their production. They are more aptly described as "commercial-subsistence" farmers, the trade-off being one of degree depending on their relative position on the scale of resource endowment.

It would be misleading to consider the Caqueza farmer as a commercial farmer like the Manitoba wheat farmer. But it would also be incorrect to classify the Caqueza area as a subsistence farming region. This is an area of small farms that provide up to 100% of Bogota's consumption of some commodities during certain parts of the year. The region obviously includes aspects of commercial farming. Perhaps definitions such as "commercial" and "subsistence" form the extremities of a continuum scale similar to the risk-uncertainty scale.

that flow for 9–12 months of the year, and at the equatorial latitude of the project it is possible for them to manipulate planting dates at will. This also occurs, to a lesser extent, in the predominantly horticultural area lying between 1800 and 2200 m above sea level, which is a region that tends to be intermediate between zones I and II.

Parts of Zone II have two potato crops: the first is from April to August and the second from September to January. The former is the major harvest season — when yields from traditional potato varieties run close to 14 tonnes per hectare. The second is the minor harvest season — at this time production averages about 8 tonnes per hectare. Unfortunately, these two harvests correspond to the major and minor harvest seasons of other areas surrounding the Bogota market. This results in low prices for potatoes in August, whereas prices in January are generally high. Thus, although potato production is not as high in the minor harvest, net profits may be greater than in the preceding period because of the higher prices. Potatoes are also sometimes grown in rotation or relay with corn. Because the growing period of the corn is longer and two crops cannot be taken in a 12-month period, the corn (with associations) is grown first, and then potatoes (with or without associations) are grown in rotation or relay as the minor harvest. If potato associations are grown in the spring, there is no time for corn and the minor harvest is usually a vegetable crop.

Resource Availability and Use

Land

The soils of the arable lands of the Caqueza area are classified by the USDA Soil Classification Service as being of land capability classes 3 and 4. According to this classification, these soils require careful agronomic management to produce adequately. Class 3 and 4 soils can have steep slopes and, indeed, much of the land in the Caqueza Project area is precipitous. Nevertheless, the area not only feeds its population but produces a substantial amount of farm produce for the Bogota market, thus, perhaps, demonstrating the care that needs to be given to interpreting land capability classifications in terms of defining small-farm production potentials.

The frequency study revealed that the upland farms in Zone II were on average more than 50% larger than farms in Zone I. Field sizes were recorded and used to examine the extent to which farmers diversified their cropping patterns. The average size of corn and potato fields in both zones varied from 0.75 to 1.5 hectares (ha), whereas vegetable fields averaged approximately 0.5 ha in size. In Zone I a farm consisted of about two fields and in Zone II it averaged four. The only real distinguishable difference between the two zones in terms of field size was that potato production in Zone I was more of a commercial type insofar as production in monoculture tended to be in larger fields.

Capital

Measurement of the capital resources of small farmers is a difficult task. Official or semiofficial government institutions can rarely obtain accurate responses to survey questions on the topics of incomes and wealth. Farmers are often suspicious that the information is being collected for taxation purposes. In spite of this, some of the graduate students preparing their theses in the project area made useful progress in determining farmers' capital resources either by

From the onset of the project, it received strong political backing. Here, the Colombian Minister of Agriculture (centre, in white ruana) and the Regional Director of ICA (behind the Minister), who later became Director-General of the organization, are shown visiting one of the project's earliest corn experiments. (Photo: ICA)

direct questioning or by building up this information from secondary sources of data.

One method used to determine the value of purchased inputs used per farm was to calculate the cash requirements (hired labour and purchased inputs) for producing different crops and then to combine these requirements according to the crop mix per farm. This enabled an estimate of expenditure on crop production per farm to be derived (Table 4). It was calculated that 0.6 ha on each farm was noncultivated land (houses, buildings, roads, paths, etc.).

This left 1.6 cultivated ha per farm in Zone I and 2.9 ha in Zone II, or a mean of 2.25 ha per farm for the two zones. Frequency study data were then used to calculate cash requirements per farm, which averaged U.S. $696.

A series of other studies (Table 5) was carried out to estimate farm income, land value per farm, and farm net worth. In addition to direct questioning, land values were estimated by various techniques. One was to divide *annual rental rates* by the current interest rate on savings; another was to divide *farm income* by the same denominator. The first method was not very satisfactory, because rental rates often failed to reflect the real earning power of land, which was often rented by proprietors who were short of cash for investing in crop production. Hence, there was no realistic relationship between rent and production and the landowner only had the first option. Furthermore, renting did not involve any risk, whereas crop production did.

Table 4. Annual cash requirement for crop production in Caqueza (1973) (93).

Crop	Area planted (*ha*)	Cash required per farm (*U.S. $*)
Corn and associates		
Major harvest	1.49	175
Minor harvest	.05	5
Potatoes and associates		
Major harvest	.45	239
Minor harvest	.16	84
Horticulture		
Major harvest	.32	125
Minor harvest	.18	68
Total	2.25 [a]	696

[a]Because of the complexity of the associated cropping (i.e., corn–beans), the total area exceeds the sum of the components.

Table 5. Farm income, land values, and farm net worth in the Caqueza area.

			Direct response data			
					Farm net worth (*U.S. $*)	
Source	Avg farm size (*ha*)	Net farm income (*U.S. $*)	Value of crop land (*U.S. $*)	Value of animals, equipment, & buildings (*U.S. $*)	"Direct response"	"Calculated" income/interest rate
Credit study (121)	3.05	922[a]	3096	2437	5533	7680
Nutrition study (112)	n.a.[b]	638[a]	n.a.	483	n.a.	5314
Migration study (118)	1.95 (crop land only)	612[c]	3692	1634	5325	5097
Land-use study (93)						
Zone I	2.20	539[c]	n.a.	n.a.	n.a.	4492
Zone II	3.50	978[c]	n.a.	n.a.	n.a.	8147

[a]Based on total farm income.

[b]n.a., not available.

[c]Based on crop production income only.

For example, in 1972, when land rental rates in corn-producing areas were U.S. $28 per cropping period, returns to land were roughly equal to rental rates. However, product prices have increased rapidly since that time and land rental rates have not kept pace with this rise (especially for land used for horticultural crops). For these reasons it is not very satisfactory to estimate land values from rental rates and it was decided to use estimates derived either from income calculations or from obtaining farmers' direct responses to questions on this

subject. In passing, it should be noted that land values derived by both of these approaches are much higher than those that lending institutions currently utilize for collateral purposes, especially for small farmers.

The average values for farm "net worth" derived by these various approaches ranged from U.S. $4492 to $8147. The average of the five studies was $6146. The credit and migration studies, which derived "net worth" by direct questioning, averaged about 15% less than the farm net worth value derived from fram incomes. This may be attributable to a tendency to respondents to this type of survey to deliberately deflate values that might be used for tax purposes.

The 1973 net farm income derived from these studies ranged from $539 to $992 with an average from the four studies of U.S. $708. This gave a fairly good fit with the baseline study estimate of $638 in 1972. It is of interest that the nutrition study showed that the average value of the food consumed by the farm family was $542 per annum. This suggested that the disposable income per family in 1973 was $166, a sum that had to cover purchased inputs, hired labour, health, education, and other requisites. Clearly, this situation offered the small farmer limited hope for change unless he entered the credit system.

Labour

The two preceding sections have illustrated that the small farmer in the project area was confronted by a lack of both land and capital. A number of economists have suggested that this is not true in the case of labour and that surplus labour can actually be siphoned off from the rural sector to act as a catalyst to the economic development of the nonagricultural sector. However, the results from the analysis of labour availability in Caqueza suggest that this may be an oversimplification of the situation because of fluctuations in the seasonal demand for agricultural labour. Indeed, in the project area, virtual full employment was encountered during the months of April and May.

In addition, the project's labour-use studies suggested that an equilibrium had been reached whereby the returns to agricultural labour were comparable with the returns that could be obtained by fully employing the available labour force at the minimum urban wage rate.

A total labour demand schedule was developed by combining data from the frequency study (which generated detailed land-use patterns) with production cost studies that indicated labour use per crop for each month of the year (Fig. 13).

Corn production had its peak labour demands at the times of planting, weeding, and cultivating, rather than at harvesting. This was due to the fact that all planting took place at the start of the rainy season, whereas harvesting was spread over several months, depending on the location (especially altitude). The corn labour-use pattern strongly influenced the total labour demand schedule because corn and its associates were planted on two-thirds of the cultivated land in the area.

The amount of labour employed per cropping activity, expressed as a percentage of the total labour demand each month, is shown in Fig. 14. Corn dominated labour use in April and May, but for the other months, excluding November and December, potatoes were the main user of labour. Labour use in horticulture was primarily from July through December, and was especially heavy at the beginning of the minor harvest in November and December. Of all

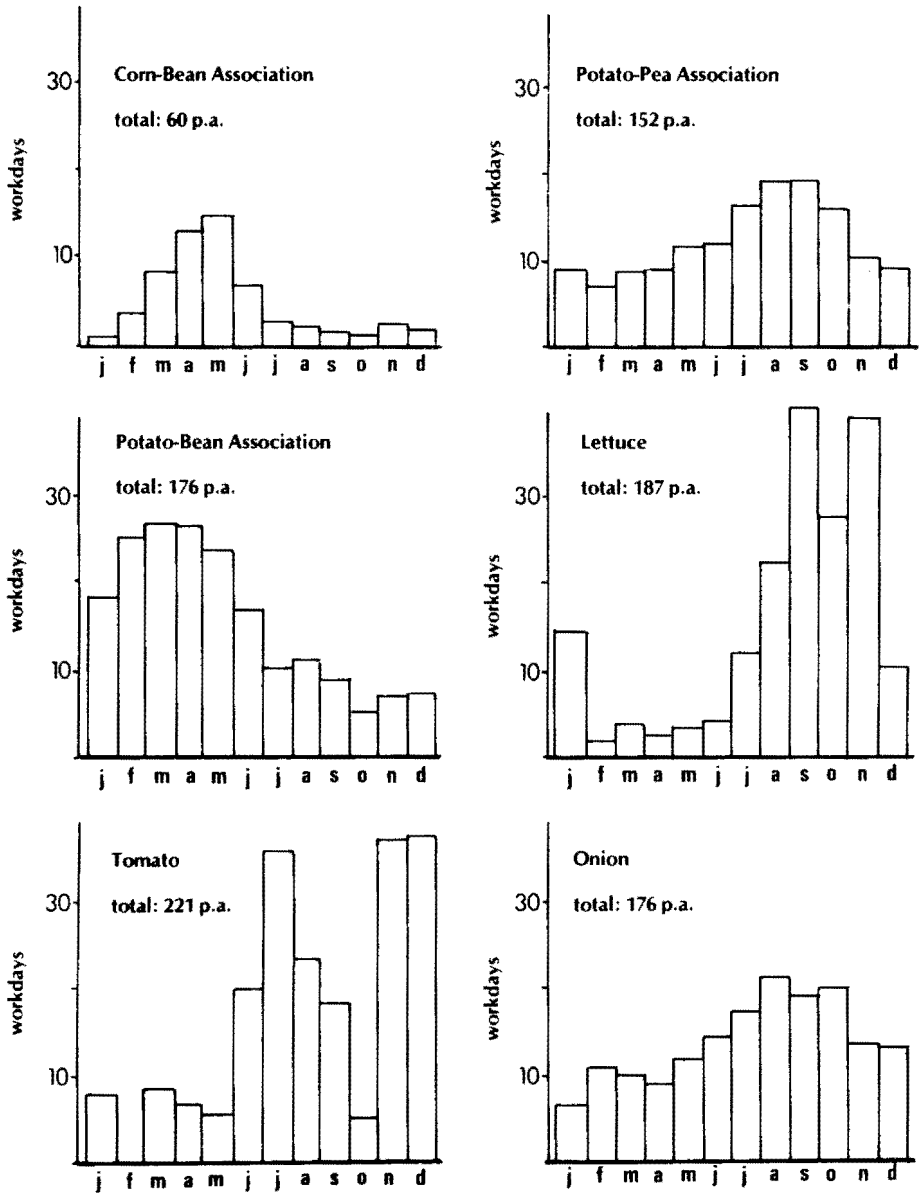


Fig. 13. Monthly labour use per hectare for various crops in Caqueza, 1973.

the labour employed throughout the year, corn and corn associations accounted for 27%, potatoes and potato associations 36%, vegetable crops 27%, and other crops 10%.

A full employment value was calculated to examine the possibilities of technological change in terms of labour availability. The available labour force in the area was derived from National Census Bureau data, which estimated the working force available for agriculture as being 26.5% of the total population. Full employment was estimated at 20.5 working days per person per month for this work force (4 days were counted as rest, 4 days for marketing, and 1½ days for

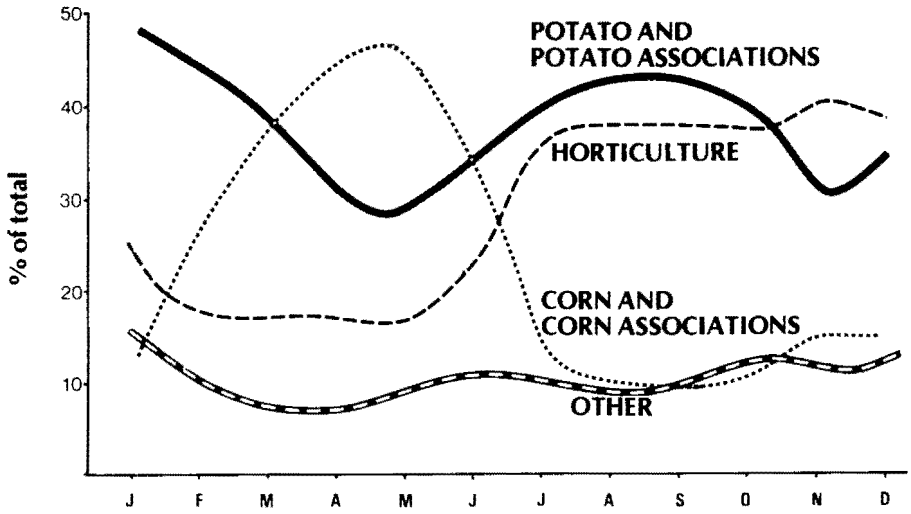


Fig. 14. Labour used each month for specific crop groupings.

public holidays or sickness). Based on these assumptions, the work force available per month was 275254 man-days.

This figure was adjusted to account for nonagricultural activities that absorbed part of the rural working force throughout the year. Some rural workers were employed in local municipal public works programs (road repairs, water works, and electrification) as well as in local food- or fiber-processing activities. According to the most recent Colombian agricultural census, rural nonagricultural occupations absorbed 11% of the available rural work force. In addition, time was spent on activities such as house repairs, looking after livestock, and fetching water, so that the available agricultural work force was somewhat less than 245000 (275254 less 11% is 244977) man-days per month. For this reason it is felt that the analysis is somewhat on the conservative side vis-a-vis full agricultural employment because the full 245000 workdays per month have been used as the base value.

Figure 15 shows labour use in crop production expressed as a percentage of full employment in this activity. Over the year as a whole, 57% of the labour resources available for agriculture were utilized.

Efficiency of Resource Use

Efficiency Criteria

When the supply of resources is unlimited, profits are maximized when the marginal value products to cost ratios are equalized for all resources. However, "unlimited supplies" of resources were not encountered in Caqueza among the small farmers studied. In such a situation, then, it became quite difficult to identify the economically optimum input level. Indeed, it appeared that the Caqueza small farmer was more worried about survival from year to year than about maximizing income in any given year. The information obtained from the various field surveys suggested that the farmers tried to ensure, if possible, that returns to "owned resources" from the activities in which they were employed were sufficient to sustain the life of the family.

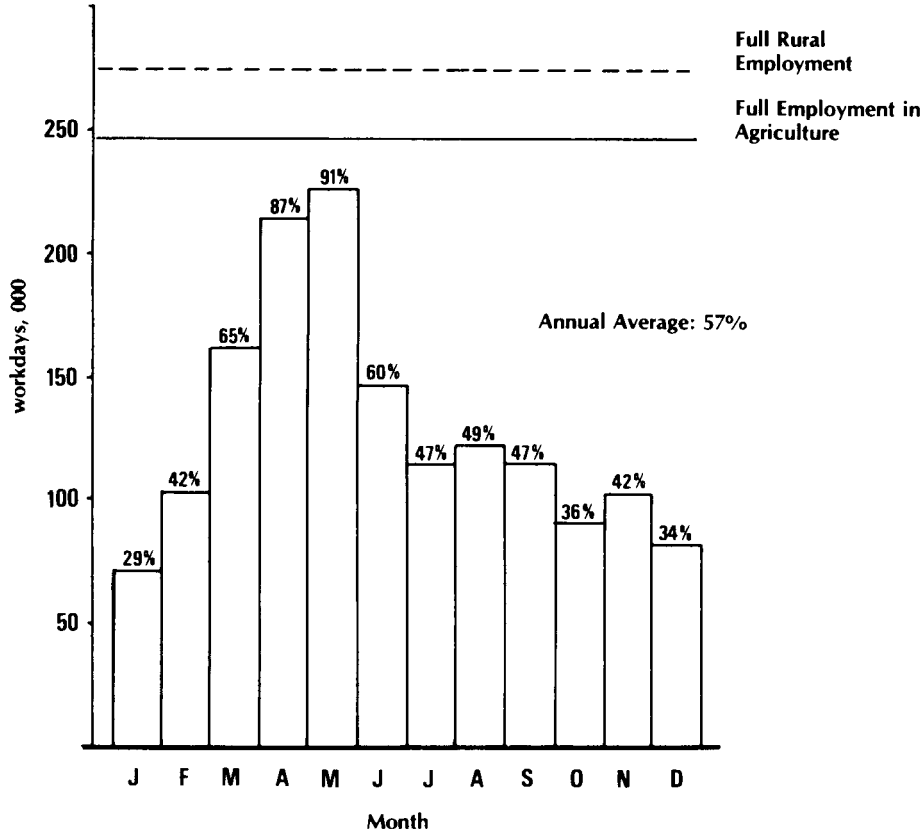
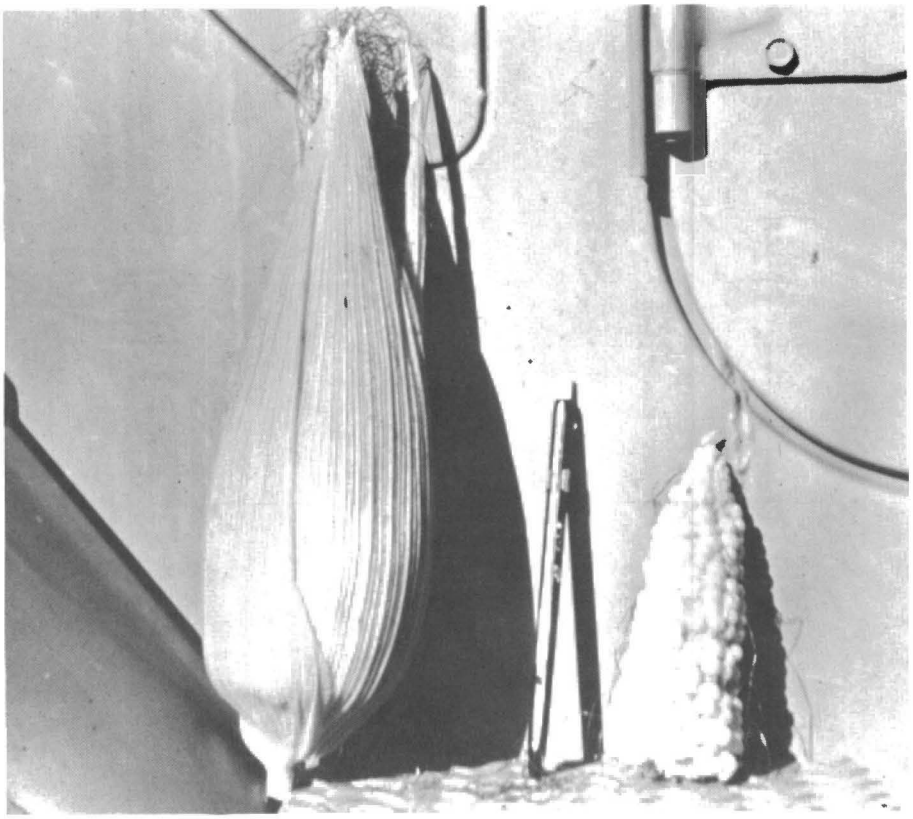


Fig. 15. Labour use for crop production in absolute workdays and as a percentage of full employment in agriculture, 1973.

Because wealth levels were also small, the farmer was not able to absorb large losses from any given production process. Hence, the more that production variance increased due to the vagaries of the weather and other uncontrollable factors, the more reluctant the farmer was to employ scarce resources in such activities. Thus, activities that required large investments were shunned. In fact, the overall analysis gave credence to the idea that the Caqueza small farmer was a risk-averter, a conservative decision-maker, and above all else, a "rational economic being." The problem in attempting to analyze this rationality in farm decision-making arises from the difficulty in understanding the real input-output relations under which the farmer operates.

The Caqueza small farmer knew that no matter which production activity he selected, its returns would need to be large enough to pay for its costs. This naturally made him cautious about changing his traditional practices. The project could find no evidence that the Caqueza farmer misallocated his resources. However, because it was so difficult to determine the real prices, costs, risks, production levels, and inputs used by the Caqueza small farmer, it was equally difficult to prove that resources were always used efficiently, even though a number of studies were directed to this end.

Information on the level of inputs used by Caqueza farmers for the major crops and associations that they produced was obtained from the cost surveys



The scope for genetic improvement of traditional corn varieties is considerable. The small cob on the right, which grows surrounded by many leaves, gives low but reliable grain yields. (Photo: Barry Nestel)

referred to earlier. These surveys employed the interview technique because the farm record system failed to generate the required data.

By adding market prices to the input and output values it was possible to derive production functions. This was done for 131 sets of data from potato and potato associations, 189 from corn and its associates, and 698 for horticultural crops. Figure 16 shows the costs of purchased inputs and total labour, and the value of production per hectare for each of the three sets of crop groupings. Purchased input costs were low for corn and associations, higher for the horticultural crops considered, and highest of all for potatoes. Labour costs, on the other hand, varied little from crop to crop, with the exception of corn, where they were very low. Land was generally owned by the farmers, rather than rented, and hence was rarely considered as a direct cost.

Returns to Land

The efficiency of land use for different crops was determined both by comparing land returns with land values and by relating the marginal value product of land to land value. For the former analysis, the value of the land was based on the imputed rental rate per harvest season. If a competitive market existed for land,

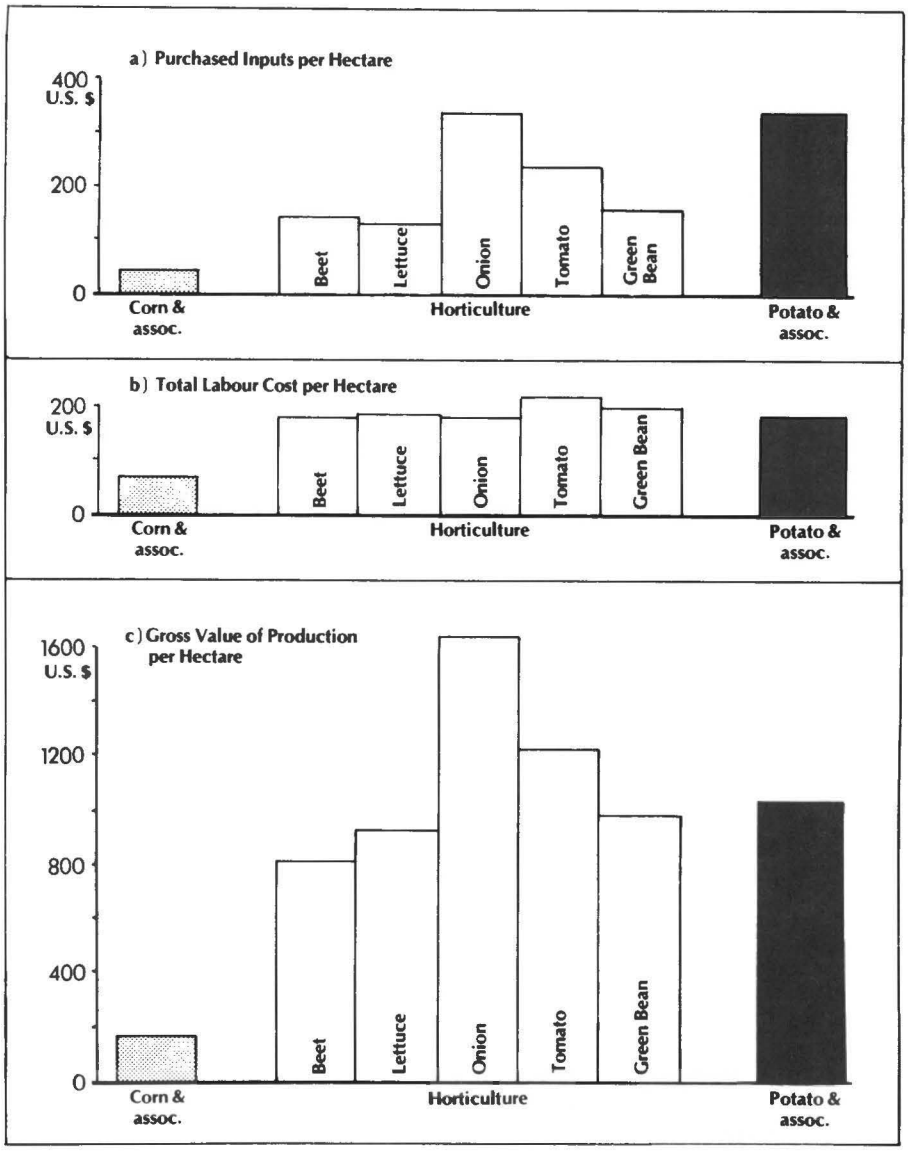


Fig. 16. *Purchased inputs, total labour cost, and gross value of production for the major crops in Caqueza, 1973.*

the rental rate would equal the opportunity cost of land. One method for determining the opportunity cost of land would be to multiply land values by the annual real interest rate on savings.

From Table 5 it is possible to calculate that in the credit study land values averaged about $1000 per ha and in the migration study $1900 per ha. The corresponding land opportunity costs, based on an interest rate of 26% (the opportunity cost of capital in the credit study), would be $260 and $494 respectively. As the land values derived in Table 5 do not distinguish between corn-producing land and horticulture or potato-producing land, and experience in the project area made it clear that these values differed substantially, an arbitrary division

was made. This allocated corn land a value of $800 per ha, with an opportunity cost of about $200, whereas for land in potatoes or horticultural crops the respective figures were $1500 and $375. Calculations of the net value of production per hectare for the major crops produced in the Caqueza area are presented in Fig. 17. This shows that all crops returned at least their rental rate and that all except corn returned as much as their opportunity costs or more.

Because of multicolinearity in the production function analyses, it was impossible to obtain accurate information on the marginal value products for

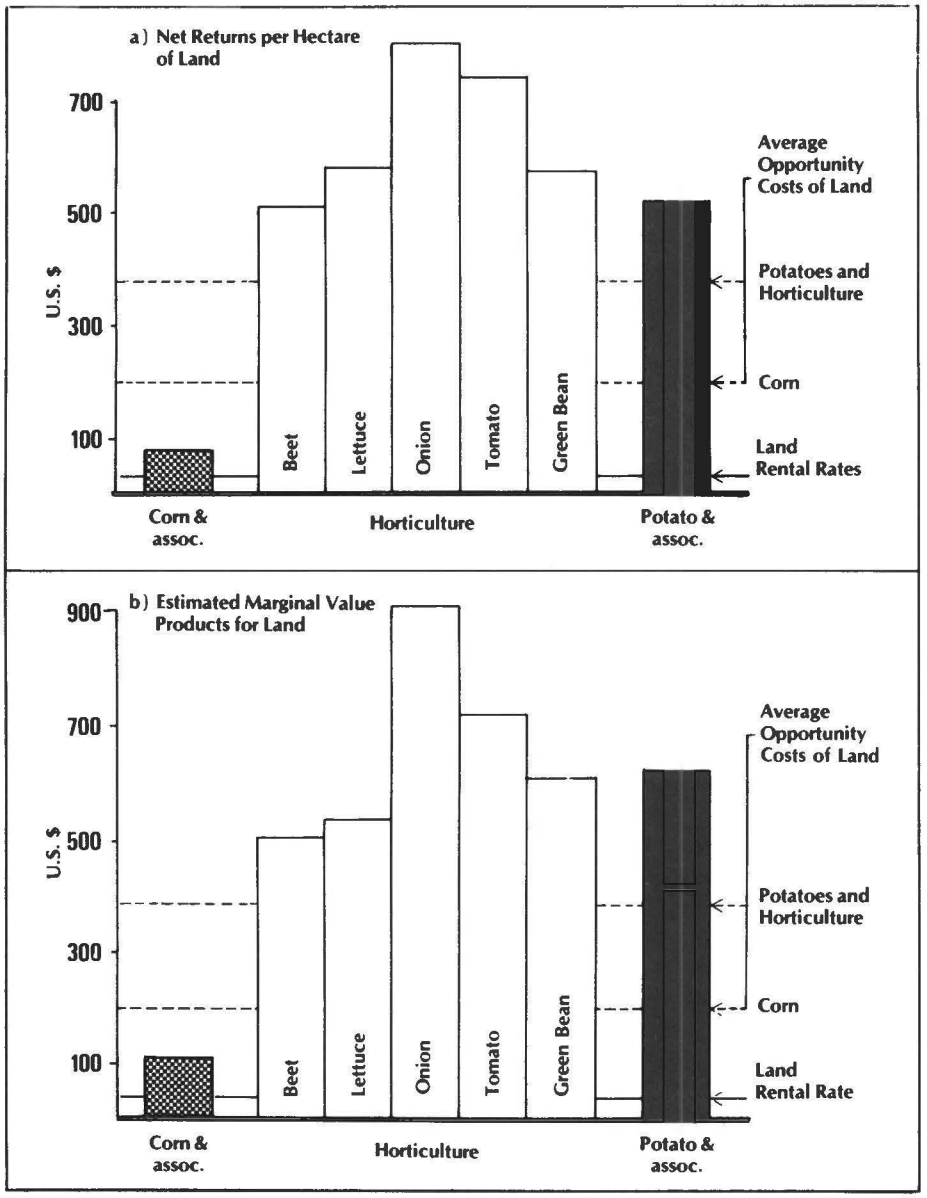


Fig. 17. Net returns per hectare of land and estimated marginal value products for land for the major crops produced in Caqueza, 1973.

land. Nevertheless, an estimate based on a regression coefficient of 0.6 in the Cobb–Douglas function could be hypothesized, giving the results shown in part (*b*) of Fig. 17. The value of 0.6 for the regression coefficient is considered to be in the range of acceptability because it is known that land does, indeed, account for a large amount of production variability in the Caqueza area.

The marginal value products depicted for land again appear to be above the rental rates and, except for corn, are also above the opportunity costs as well. Hence, land is shown to be clearly overemployed[19] when used for horticulture or potatoes but not for corn. This suggests that land was not a limiting factor in the production of corn and its associates in Caqueza.

Another method for estimating Cobb–Douglas regression coefficients for land was also used. This assumed constant returns to scale and, thus, calculated the land coefficient as the difference between the sum of the other regression coefficients and unity.

Table 6 shows the regression coefficients and the corresponding marginal value products of land for each of the two production function models used. It can be seen that land was overemployed vis-a-vis rental rates (the marginal value products were greater than the respective rental rates of $31, $37, and $42 for corn associations, potato associations, and horticultural crops), but underemployed for corn associations in terms of the opportunity cost for corn-producing land ($200). This is a significant observation, because corn land accounts for two-thirds of the planted acreage in the area, and we have suggested that the opportunity cost method for valuing land is superior to one based on rental rates. Although it was not possible to prepare production functions for potato production, the regression coefficient would have had to be less than 0.4 to

Table 6. Imputed regression coefficients and marginal value products for land under major crops in Caqueza (1973).

			Marginal value products *(U.S. $/ha)*	
	Model I[a]	Model II	Model I	Model II
Corn-bean	.45	.41	90	82
Corn-broad bean	.46	.28	91	55
Corn-broad beans-beans	.86	.83	149	144
Corn (average)	.57	.49	109	94
Beets	.56	.13	470	109
Lettuce	.74	.56	714	541
Onions	.59	.42	932	664

[a]Model I disaggregates hired and family labour, and model II uses a total labour variable, both in a Cobb-Douglas production function.

[19]For the sake of clarity in the discussion that follows, the term "overemployment" is taken to mean that a factor is used at a point where its marginal value product is greater than its price, i.e., a point to the left or less than optimum in the production function figure. This is precisely the same as underuse, suboptimal, or underutilization. "Underemployment," on the other hand, is just the opposite, referring to the use of an input excess of its optimum level, so that its marginal value product is less than its price. This means that the factor does not even earn its cost and for this reason it is underemployed. Similarly, underemployment is the same as overutilization or overuse.

produce marginal value products below $375, the opportunity cost of potato-producing land. Because only one of the sums of coefficients was below 0.4 in Table 6, presumably that for potatoes would not be so small. This tends to confirm the hypothesis that potato land is overemployed.

Returns to Cash

Over 80% of the farmers in the Caqueza area owned all or part of their land and, as noted already, rental costs were low and the farmers did not usually consider land costs when calculating their returns. Likewise, family labour costs were not usually considered in the decision-making process. The Caqueza farmer regarded his production cost as his cash outlay for hired labour and purchased inputs. On this assumption, corn and its associates yielded an average return of over 75% on cash outlays. This return was well above the opportunity cost of cash (26% per annum) in the project area.

Returns to cash for potato production were very high and those for other vegetable crops even higher. When all input costs were included, with family labour and land rent costed at market prices, the net profit from corn and associates was similar to the opportunity cost of capital. However, the net profits from potatoes and vegetable crops were well in excess of this (Fig. 18). In such circumstances, vegetable and potato production would appear to be very competitive with the nonagricultural sector in terms of the use of capital. However, there does not seem to be an increasing flow of capital for potato and vegetable production, which may suggest the existence of hidden costs that have not been taken into account. Possibly this situation is attributable to production or marketing risks, a situation that will be examined in later chapters.

Returns to Selected Inputs

The data presented earlier in this chapter were used to derive production elasticities, and from these elasticities, average and marginal value products were derived for the major crop groupings.

Corn and Associates

The traditional corn–legume production in Caqueza is generally not associated with fertilizer or pesticide use; thus, production elasticities for these inputs are negligible. However, organic fertilizer appears to be overused in economic terms. Nevertheless, it is usually produced on the farm at virtually no cost and there is little market for it.

Two major input costs in traditional corn production are seed and land preparation (using oxen). Their marginal value products are both greater than unity, so that profits could be increased by greater expenditure on both of these items. This is illustrated in Fig. 19, which shows the degree to which seeds and land preparation are underutilized. In contrast, both hired and family labour can be seen to be overused.

Because fertilizers and pesticides were not used to any extent in 1973, they are omitted from the figure. Nevertheless, the results of experiments in the project area (Chapter 10) indicated that returns would be increased by using appropriate levels of fertilizer and pesticide, increasing plant populations, using improved varieties, and improving labour efficiency (i.e., reducing labour usage). All of these recommendations agree with this analysis based on correlating marginal value products with input prices.

Potatoes and Associates

In the production of potatoes (and associates) inorganic fertilizer was the major purchased input and this was found to be employed in excess of its optimum use level, a finding that was confirmed by the agronomic trials.

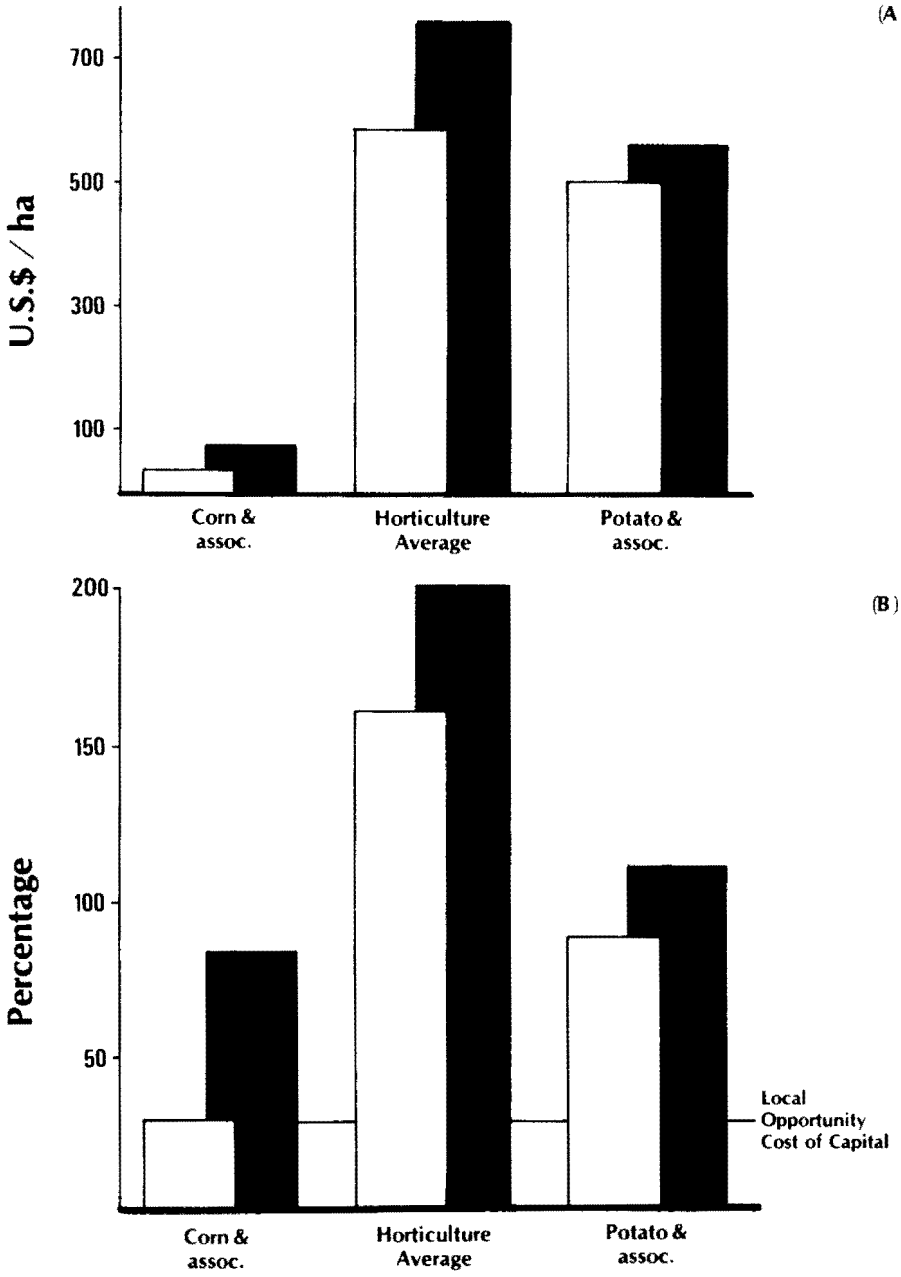


Fig. 18. (A) Returns to cash outlays (solid block) and (B) net profits (open block) for major crop groupings in Caqueza, 1973. Expressed (A) as U.S. $ per hectare and (B) as a percentage of the total investment in production.

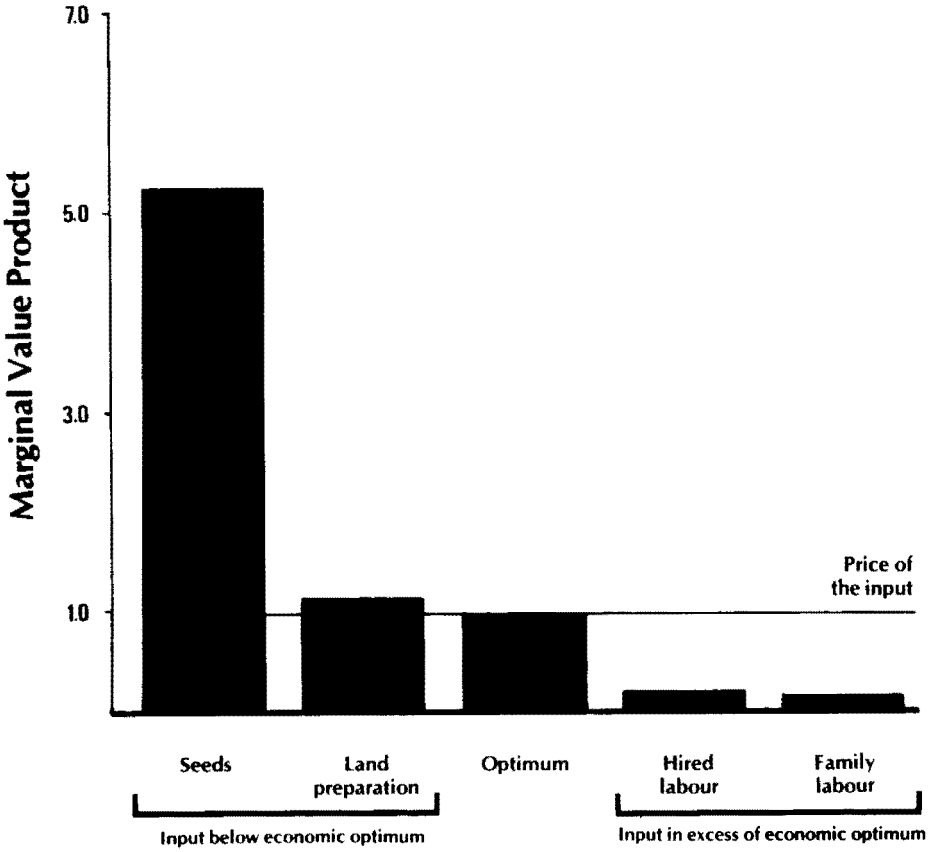


Fig. 19. Marginal value products for production inputs used for corn and associates in Caqueza, 1973.

Pesticides also appeared to be used at levels in excess of the economic optimum, either in an effort to overcome insecticide-resistant species or because farmers felt safer using more than the very small quantities needed with modern insecticides. This issue was not studied but it is one that would appear to justify closer examination.

Seed use appeared to be suboptimal, and this was in accord with the agronomic work that suggested that plant populations should be higher and seed quality improved. Finally, labour, particularly family labour, was shown to be used at a level well in excess of the economic optimum (Fig. 20).

Vegetable Crops

In vegetable production, a strange situation occurred with respect to cabbages in that farm yields averaged only 5 tonnes per ha whereas experimental yields at Tibaitata, the nearest ICA research station, were of the order of 50 tonnes per ha. Farmers appeared to be reluctant to use new technology for this crop because the market appeared to be constantly and easily saturated, and the price elasticity of demand to be very low. New technology required additional inputs, especially inorganic fertilizer, and the use of this raised production costs to a degree whereby the use of the new technology would not be economically attractive unless market prices rose something like eightfold.

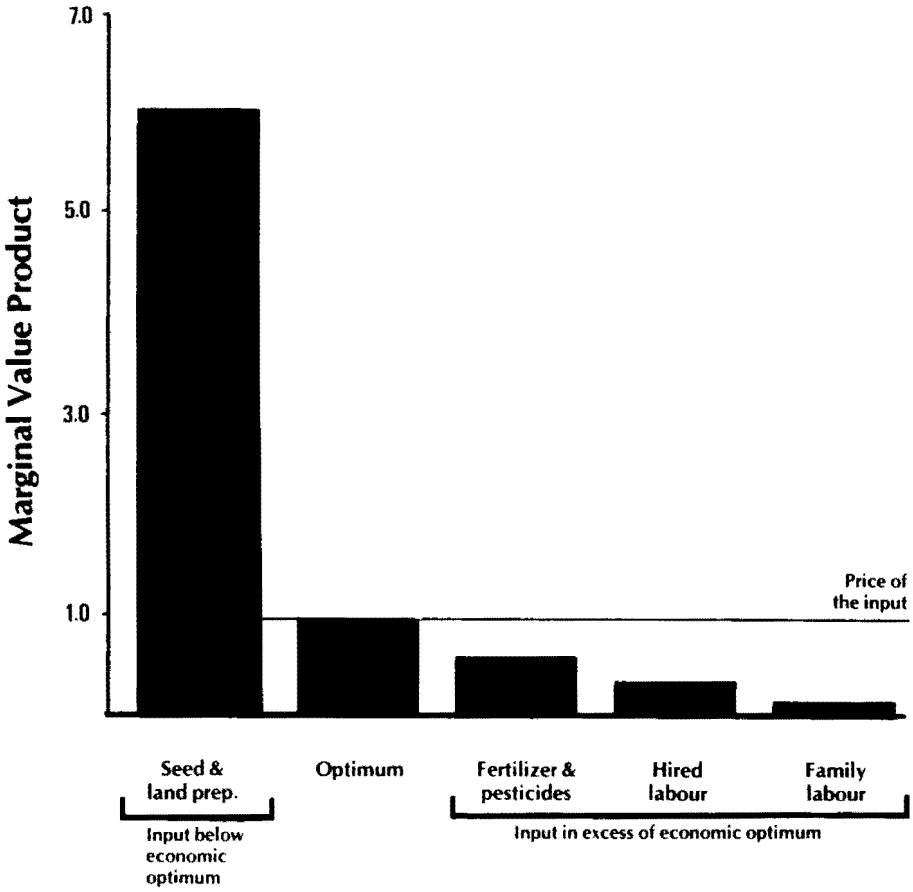


Fig. 20. Marginal value products for production inputs used for potatoes and associates in Caqueza, 1973.

Figure 21 shows that the degree of underemployment of resources was less for vegetable crops than it was for corn and potatoes. For onions, and beets, labour tended to be underutilized as did seed for all four vegetables studied. Fertilizer was, however, overused except on onions.

Labour Returns and Employment Elasticities

Although labour was overutilized in both corn and potato production, the two crops that covered over 80% of the area under cultivation, the average returns from labour use were high and sometimes reached two to three times the market wage rate (Fig. 22). For all crops except cabbage, the returns to labour exceeded labour costs and, as was the case with the purchased inputs, the returns to labour used for vegetable and potato production were more than double those of labour used for corn (Fig. 18a).

Although the field surveys obtained information on the breakdown between hired and family labour, it was felt that the farmers' distinctions in their responses between these two labour factors were less than reliable. Consequently, most of the analyses in this chapter have been made using the aggregated value for total labour. The results of disaggregated analyses are presented in some of the figures on marginal productivities, but the authors are not fully convinced that

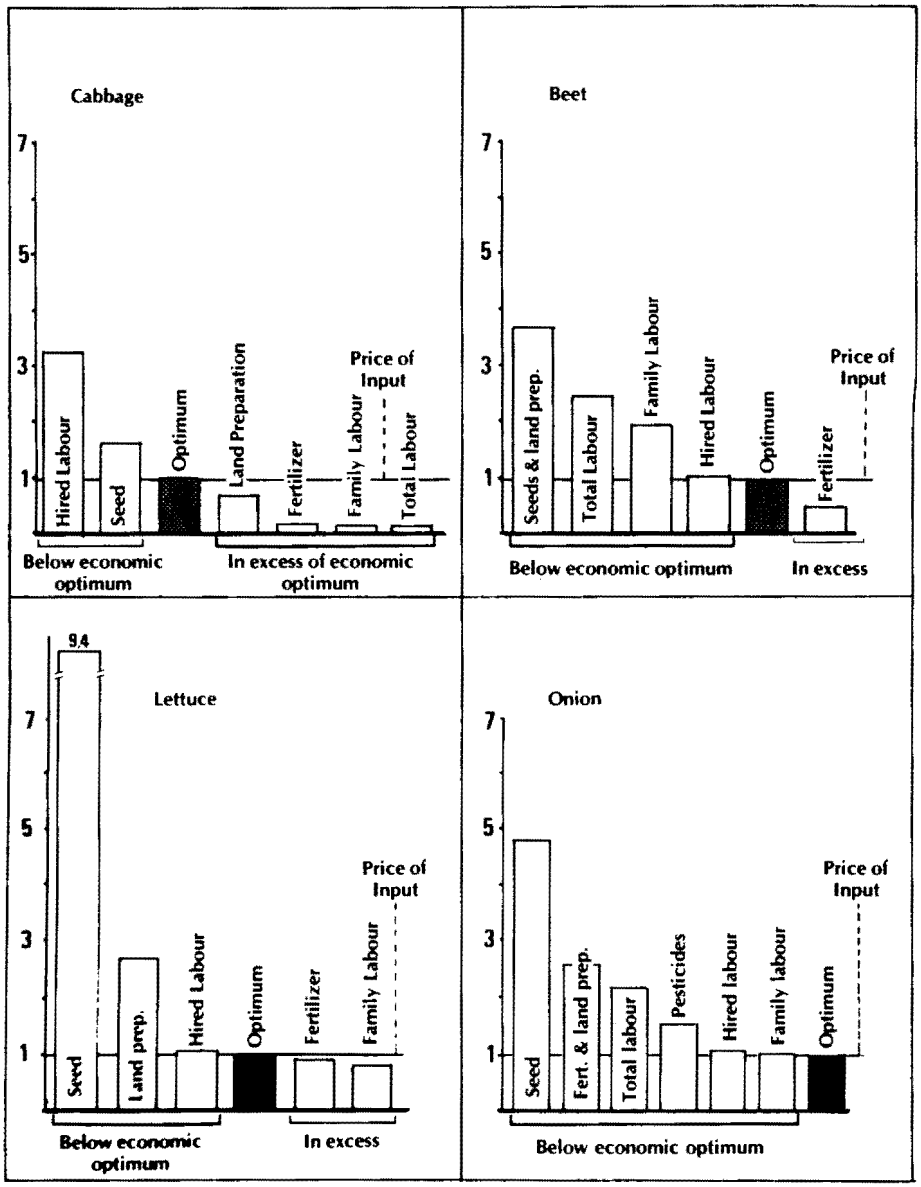


Fig. 21. Marginal value products for production inputs used for horticulture in Caqueza, 1973.

these separate values actually reflect reality. The situation is complicated even further by the existence of a third labour form, namely interchange labour. In this chapter this is treated as a form of hired labour, which is the way in which the farmers reported it.

Two studies designed to measure the differences between these three forms of labour, their use levels vis-a-vis cultural practices, both within a crop and between crops, their employment elasticities in both the traditional and modern production technologies, and how this new information modifies the full employment concept, were under way at the termination of the project.

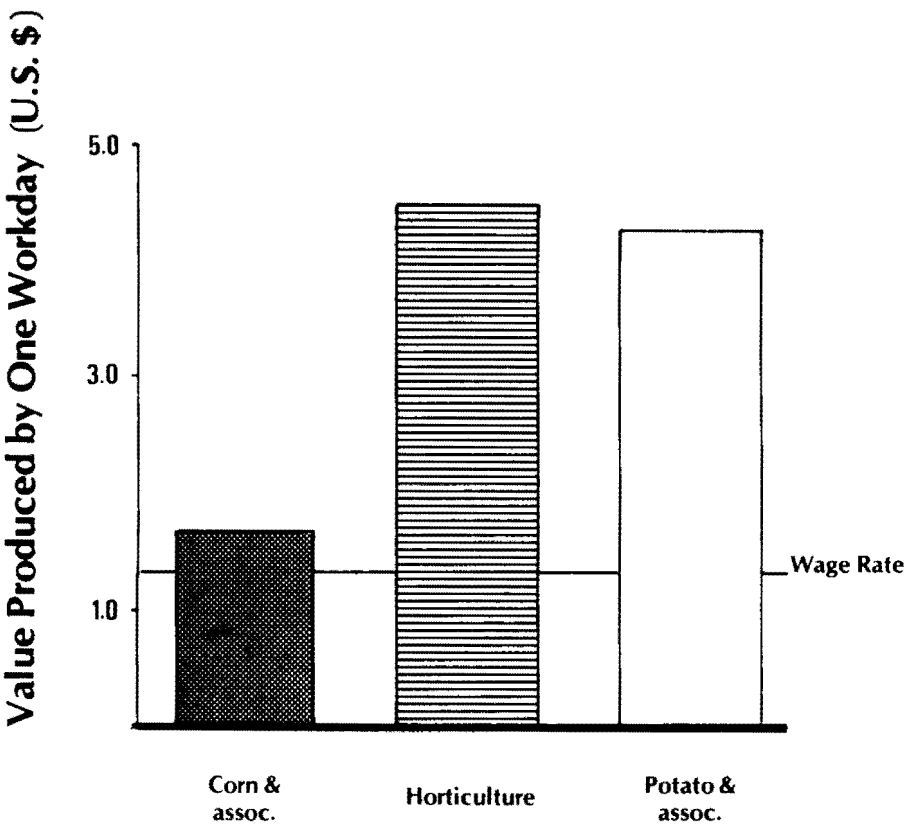


Fig. 22. Returns from labour employed in the production of major crops, Caqueza, 1973.

This analysis of labour availability and productivity does suggest that "unlimited" supplies of rural labour are not available in the Caqueza area. Nevertheless, labour is still the most abundant resource when compared with capital and land, as witnessed by its relatively lower marginal value product, and, for this reason, efforts should obviously be made to promote new production technology that has a labour-intensive bias. To determine which crops have this bias, employment elasticities were derived for the cropping activities analyzed in the preceding sections, in terms of purchased inputs, field size, and farm size (used as a surrogate value for wealth).

In analyzing these results, it was found that employment elasticities for farm size were small, negative, and seldom statistically significant. For field size, the employment elasticity was negative and significant in all cases, i.e., the smaller the farmer's field, the higher his intensity of labour use.

Three distinct patterns emerged from the employment elasticity analysis with respect to inputs. For corn production, the labour responses were low for fertilizer and pesticide, intermediate for seeds, and relatively high for land preparation. For potatoes, the labour responses to increasing levels of fertilizer and pesticide application were negative, intermediate for land preparation, and high for seeds. The only significant labour response observed in horticultural production corresponded to pesticide application. Each 10% increase in the latter resulted in a 1% increase in labour use. To interpret these findings further,

Improved varieties with larger cobs (on the left in previous photo) and much higher yields were introduced to the area and were successfully adopted by the farmers after research had been conducted to reduce some of the risks associated with these new varieties. (Photo: Luis Gabriel Bohorquez)

the elasticities have been correlated with average input use levels and marginal productivities for the three production processes studied.

Labour use in traditional corn–bean production was 62 man-days per hectare per year. The new technology package recommended by the project had an additional input cost of $77 per hectare and should, according to the employment elasticities derived, have led to an additional labour use of 53 man-days per hectare. The extra employment calculated in this way was indeed very similar to the estimates of the project staff regarding the extra labour required for fertilizer and pesticide application and for harvesting following the adoption of the new technology. Nevertheless, because it has been suggested that labour used for corn production was used excessively, that is, inefficiently, presumably part of any new technological package should embrace more efficient labour use. In fact, after analyzing the 1975 Corn Production Plan, it was observed that farmers who adopted the recommended package did employ labour more efficiently. Instead of using the predicted 115 man-days per cropping period, they used only 84 man-days, an increase of only 22 rather than 53 days.

The situation was different for potato production where the new technology required very little additional costs as its main component was a change in the variety to be planted. This action would, of course, lead to a new production function, which could be expected to change the employment elasticity. Because the improved variety was expected to lead to a yield increase of over 50%, it was expected that this would result in an extra 25 days of harvest labour (or less if a higher labour efficiency could be attained).

The data do seem to suggest that the Caqueza farmer is a rational resource user. In general, he appeared to select labour-biased technologies, as can be seen by observing the marginal rates of technical substitution of capital for labour. The marginal rate of technical substitution (MRTS) of capital for labour is the absolute value of the tangent or slope of the isoquant relating these two factors (Fig. 23). As this curve is negative, the relations can be expressed as follows:

$$MRTS = \frac{\Delta K}{\Delta L} = \frac{-MP_l}{MP_c}$$

where MP_l = marginal product labour; and MP_c = marginal product capital.

From the production function analyses, the ratio of the marginal product of hired labour to the marginal product of the capital input, for which the highest expenditures are required per hectare (fertilizer), can be calculated (Fig. 23). To support a labour-biased hypothesis, the crop with the largest acreage should have the lowest MRTS. More succinctly, this means that labour can be more readily substituted for capital inputs and still be productively efficient. This indeed is the case, as the MRTS value for corn, the most widely grown crop, is 0.24; for potatoes, the second most important crop in the area, 0.47; followed by onions 0.49; lettuce 1.08; and beets 2.73. These figures suggest that Caqueza farmers are apparently aware of the tradeoff between capital and labour-biased technology, given their resource base.

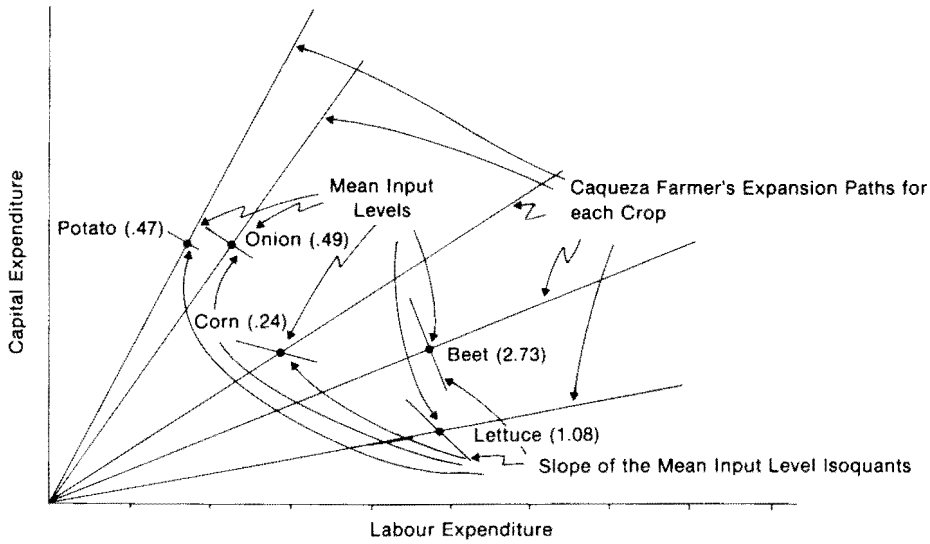
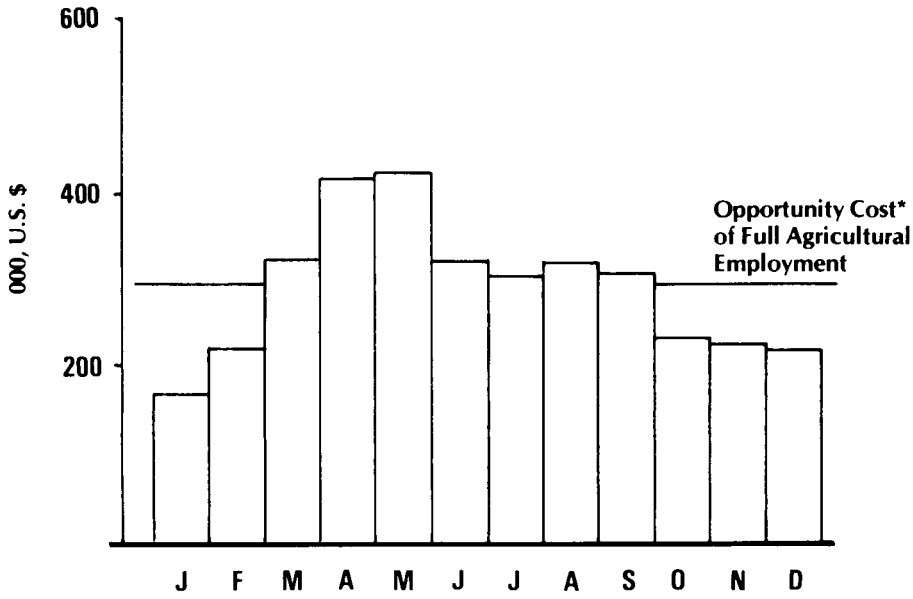


Fig. 23. *Marginal rates of technical substitution for major crops in Caqueza, 1973 (at mean input levels).*

Rural Incomes

From the data on monthly labour use for each crop, labour income in agriculture was derived on both a monthly (Fig. 24) and an annual basis (Table 7).

By calculating labour return rates per animal, the labour income attributable to livestock enterprises was also generated. These returns were based on



*Assuming opportunity cost to be equal to local agricultural wage rate for hired labour at full employment levels.

Fig. 24. Labour returns to crop production in Caqueza, 1973.

livestock numbers using the animal populations in the area listed in the 1970 Agricultural Census. Off-farm labour income was estimated from information contained in the 1973 Population Census with regard to nonagricultural rural employment in the region. It was assumed that such labour earned the equivalent of the local agricultural wage rate for hired labour (U.S. $1.21 per working day).

In addition to labour income, values for the incomes from capital and land were derived. The return to capital was derived by applying an interest rate of 26% to all cash inputs for crop and livestock production as well as to the livestock inventory. Returns to land were calculated by multiplying the average area under each crop by the appropriate land rental rate.

The figures in Table 7 suggest that agricultural labour earned for the farmer, on the average, almost twice the value of the local agricultural wage rate for hired labour. Labour used for livestock production earned at almost the same level as that for crop production. The table shows that, on a per capita basis, regional incomes were $102 from labour, $26 from capital, and $9 from rentals. The total per capita income value derived by adding these three figures was $137, a figure slightly above the value of $128 obtained in the nutrition study (112) and one that fits reasonably well with the data in Table 5, taking into account that the figures in Table 7 include capital and land income in most instances and are based on a family size of 7.5 persons.

Table 7. Returns to resources used in agriculture in Caqueza, 1973 (U.S. $).

Source	Total regional income ('000)	Labour returns/ workday[a]	Annual income per capita
Labour returns			
From crop production	3643	2.33	
From livestock production	1110	2.00	
From off-farm activities	393	1.21	
Total labour income	5146	2.11	102
Capital returns			
Interest earned on livestock capital			26
Interest earned on other capital used in agriculture	578		
Capital returns			
Interest earned on livestock capital	726		26
Interest earned on other capital used in agriculture	578		
Total capital income	1304		
Land returns			
Imputed rental income	476		9
Total income	6926		137

[a]Labour returns = value product - (cost of materials + interest + imputed rent).

Caqueza Small Farmers and Development Theory

It is often stated that small farmers in developing countries underutilize their land and capital resources and overutilize family labour. Although in general this appears to be true in the Caqueza area, this chapter suggests that the farmers there appear to have made certain adjustments to improve their resource use. For example, the production of corn and its associates in the corn zone is characterized by the underutilization of purchased inputs and the overutilization of labour with land use being close to the optimal level. These conclusions were supported by the on-farm crop-production trials that suggested that larger yields and bigger profits would result from the greater use of purchased inputs and a more efficient use of labour. In the case of potato production, the results show that resource use appears to be close to optimal. Returns would be increased slightly by reductions in labour and fertilizer use and more significantly by an increase in plant population accompanied by a change in seed variety.

The vegetable crops studied in both zones demonstrate a somewhat different adjustment pattern. Once again, purchased inputs (fertilizer, pesticides,

and seeds) appear to be often underutilized. However, in this case, labour use does not appear to be excessive but is close to the economic optimum.

For potato production, labour is once again the "abundant" resource that is overutilized in the production process. However, with this crop, fertilizer is fairly efficiently employed. This may be attributable to two facts. First, wealth levels in the potato zone are more than 20% higher than in the corn zone. Second, the CAJA AGRARIA appears to disburse more credit for potatoes than it does for corn.

It appears from this analysis that the Caqueza farmer adjusts his resource use levels rather carefully according to his resource availability schedule, factor productivities in different cropping activities, and the level of risk encountered for each crop. The excess supply of labour is used for the production of home-consumed crops such as corn and potatoes, the stable crops of the area and ones that have relatively low risk levels. For vegetable crops, which are produced mainly for the market, are more risky, and require higher cash input levels, labour and other resources appear to be used much more efficiently. In the production of these, the farmer acts much more as an entrepreneur than he does in the production of his staples, especially corn.

This chapter also illustrates the importance, when an attempt is made to generate new technology for small farmers, of giving priority to analyzing the existing input-output relations, thereby determining the existing level of economic efficiency in the employment of each production factor, and subsequently deriving the degree to which their supply is scarce or abundant. A descriptive overview has been given of how this task was approached and performed within the Caqueza Project, as well as in-depth analyses of the input-output relations encountered. The results presented set the stage for the following chapter, which records how acceptable new technology was created, given the resource limitations discussed here.

Chapter 10

Research to Test the Value of Recommended Practices

During the project's first 4 years, its staff carried out over 120 field experiments ranging from simple unreplicated variety trials on crops grown in pure stands, to replicated factorial trials with up to three variables involving associated crops (Table 8). In a number of instances, these experiments were carried out in conjunction with the socioeconomic surveys discussed in the last chapter.

Table 8. Agronomic research in the Caqueza Project (1971-74).

Year	Crop	Variable studied[a]	Experimental design	No. experimental sites	Treatments/ experiment	Replicates/ experiment
1971	Potato	V	Random	12	5	1
	Corn	V	Random	10	5-7	1
	Corn	N,P,(K)[c]	Factorial N×P	5	10	3
	Corn	N,D,V	Factorial	4	14	3
1972	Corn-(bean)[b]	N,V	Factorial	1	4	3
	Corn-(bean)	N,D	Partial factorial	2	6	3
	Corn-(bean)	N,P,D	Partial factorial	3	11,15	3
	Corn-(bean)	N,P,M	Partial factorial	1	15	3
	Corn-(bean)	N,M,D	Partial factorial	2	15	3
	Potato	V,D	Factorial	2	12	3
	Potato	N,P,D	Central composite	8	20	1
	Potato-bean	N,P,D	Central composite	3	36	1
	Potato-bean	V,D	Factorial	3	20	2
1973	Potato	N,P	Central composite	13	9	2
	Potato-bean	N,P,D	Central composite	3	36	1
	Potato-bean	V,D	Factorial	3	20	2
	Corn-bean	N,T	Partial factorial	5	13	3
	Corn	V	Random	12	3-7	1
1974	Corn-bean	N,T	Partial factorial	4	13	3
	Wheat	V,F	Factorial	1		2
	Barley	V,F	Factorial	1		2
	Onion	V,F	Factorial	2	10	3
	Other vegetables	V	Random	4	4-6	2
	Other vegetables	V	Random	7	2-5	1
	Corn	V	Random	10	4	1

[a] V = variety, N = nitrogen, P = phosphorus, K = potasssium, D = planting density, M = weed control, T = method of fertilizer application, F = composite fertilizer level.

[b] Treatment effects were only measured for corn.

[c] A single potassium treatment was added to factorial N×P design.

In this chapter the most important agronomic experiments are described and related to the project's overall strategy. In 1971 the research was confined to corn and potatoes. In 1972 attention was also given to the dominant associations, namely corn with beans and potatoes with beans. The poor farmer adoption rates for the project's 1972 recommendations led to particular emphasis being given in 1973 and 1974 to studying alternative fertilizer strategies for corn. In 1973 most of the research on potato production was focused on the identification of site variables in order to select appropriate modifications for the initial fertilizer recommendations. In 1974 some emphasis was devoted to research on alternative crops such as wheat, barley, and vegetables. In 1975 the project concentrated primarily on evaluating action programs rather than research, although the student thesis program was continued.

Research in 1971

Corn Production

A total of eight new hybrid and two improved open-pollinated varieties of corn were compared with the traditionally grown varieties at 12 on-farm sites. Only three of the hybrids, H208, H255, and H302, outperformed the traditional ones. The first two hybrids were high-lysine corns. H302, although it yielded well, was a dent type that was much harder than the normal corn used in the area, and the staff thought that this might lead to problems of consumer acceptance. Nevertheless, it was decided to include all three hybrids in further trials. Many of the other improved hybrids tested showed poor emergence. In two cases this was due to poor germination. In general it seemed that the hybrids, which had smaller seeds than traditional corn, required better soil preparation.

The 1971 corn fertilizer trials were, to a great extent, exploratory. Two experimental designs were used. The first used nitrogen[20] and phosphorus at levels of 0, 50, and 100 kg/ha in a 3×3 factorial design planted at five locations. An additional treatment evaluated the effect of 50 kg/ha of potassium in combination with 50 kg of both nitrogen and phosphorus. There was a significant yield response to nitrogen at all five sites, but to phosphorus at only two. Yield response to applied nitrogen varied from 400 to 2130 kg/ha and averaged slightly over 1000 ka/ha of corn. Phosphorus responses were considerably lower and averaged less than 100 kg/ha. Using traditional corn varieties, the level of nitrogen application that maximized the economic return to the farmer was 100 kg/ha.

The second experimental design compared the yield response to applied nitrogen used on both hybrid and traditional corn planted at populations of 30 000 and 37 500 plants per hectare. Considerable difficulties were encountered with the establishment of these experiments as the hybrid used (H401) germinated poorly and had to be replanted. This particular hybrid was not used in later years because of this. There were also problems of fertilizer burn because the fertilizer was placed too close to the seed.

These experiments showed that the traditional variety outperformed the hybrid in the absence of fertilizer. However, both traditional and hybrid varieties

[20]In this chapter the terms nitrogen, phosphorus, and potassium are used to represent levels of N, P_2O_5, and K_2O except for soil test values, which are expressed in N, P, and K.

responded to the application of 50 kg/ha nitrogen with the production of an additional 553 and 864 kg/ha of corn respectively. With 100 kg/ha nitrogen, the incremental yields were 993 and 1704 kg/ha.

Clearly, the introduction of improved varieties or of hybrids was of little benefit unless the superior seed was accompanied by nitrogenous fertilizer (Table 9). Because of the better supervision on the farms where trials were conducted, it appeared that they obtained yields on their control plots that were 22% higher than yields on neighbouring farms. This is a well-recognized phenomenon and was corrected for by deflating all experimental yields by 22% when carrying out an economic analysis of the results.

As a result of the 1971 trials, it was possible to recommend a tentative production package in 1972. This combined the information obtained from the 1971 research with general information about insect and pest control derived from ICA's research stations. The package recommendations were as follows:

(1) *Field preparation*: This should be postponed until the soil was moist. Where necessary, an increased number of ploughings was recommended (the wooden plough used in the region does not turn the soil over but merely loosens its top 10–15 cm).

(2) *Seed treatment*: Seeds should be slightly moistened and dusted with 2½% aldrin powder before planting.

(3) *Plant population*: Spacing should be 1 m between rows and 80 cm within rows; five corn seeds plus any seeds of the associated crop should be planted in each hill. Corn should be thinned when it reached between 15 and 20 cm height, leaving three plants per hill.

(4) *Fertilization*: An application of 100 kg/ha of nitrogen in the form of urea was recommended. Unless soil analyses were available, the

Table 9. The corn production recommendations used for 1972 (based on 1971 results)(43).

	Additional yield (*kg/ha*)	Additional net return to farmer($)	Net return/unit of cost
Fertilizer response			
With improved variety and pest control	1880	132	1.8
With improved variety but no pest control	1620	107	1.5
With traditional variety and no pest control	1000	45	0.7
Response to improved variety			
With fertilizer and pest control	540	56	14
With fertilizer only	480	49	12
With pest control only	0	Loss	-
Response to pest control			
With improved variety and fertilizer	300	18	1.2
With traditional variety and fertilizer	200	7	0.4
With traditional variety but no fertilizer	100	Loss	-

recommended phosphorus level was 50 kg P_2O_5/ha. The phosphorus source generally recommended was the commercially available 10-30-10 to be applied at planting time together with a third of the nitrogen, and the remaining nitrogen was to be applied at 45-50 days after planting[21], usually at the time of the second weeding.

(5) *Control of cutworms (Agrotis sp., Prodenia sp.)*: An application of 1½% lt/ha of Taxaphene was recommended for application after germination.

(6) *Control of army worms (Spodoptera frugiperda S.)*: An application of 4½% granulated CEBICID should be used as needed two or three times during the period between 50 and 130 days after planting.

(7) *Control of earworms (Heliothis zea)*: The applications of 1 kg/ha active ingredient of Sevin during the period of cob formation was recommended.

Potato Production

In 1971 potato research was confined to a study of the yields of five varieties grown at 12 sites. The traditional plant population was used, and fertilizer was applied at the levels recommended by ICA's National Potato Program. Three of the four improved varieties tested outyielded the traditional one by an average of 8 tonnes/ha (Table 10). The quality of the seed of the traditional variety used in these trials was considerably superior to the seed normally used by farmers and this, in itself, seemed to indicate a further possibility for increasing yields. Yields were also observed as being much higher at altitudes of over 2200 m.

Among the three higher yielding varieties, the highest yield was obtained by the Puracé variety, which averaged 25 t/ha, compared to 21 t/ha for the other two varieties. Unfortunately, the Puracé variety was not popular with farmers as surveys conducted in conjunction with the home economists indicated that it had poor cooking quality and an inferior taste compared to the other varieties.

Table 10. Potato yield trials 1971 (42).

	Yield (*t/ha*)	
	All altitudes (*12 sites*)	Altitudes above 2200 m (*5 sites*)
Traditional variety	10	13
Traditional variety (selected seed)	14	17
Three best improved varieties	22	29

Research in 1972

Corn Production

The experience gained in 1971 was useful in identifying a range of issues that appeared to warrant more detailed study. Amongst these were:

[21]This time of top dressing may appear to be fairly long after planting. In the Caqueza Project area, however, corn takes from 6 to 12 months to mature, depending on the altitude.

(*a*) A knowledge of the extent to which the 1971 corn results were applicable to the whole region;

(*b*) The need to explore responses of corn to nitrogen applied at levels in excess of 100 kg/ha;

(*c*) An understanding as to why responses to applied phosphorus were so low when there was no evidence of a nitrogen–phosphorus interaction and soil phosphorus levels were low (< 15 ppm by Bray II test), especially in the Caqueza and Ubaque municipalities;

(*d*) An examination as to whether extra weedings, in addition to those traditionally practiced at 30 and 60 days after planting, were justified in view of the fact that there was generally a high weed level later in the season;

(*e*) An investigation to determine whether the disappointing results from planting corn at higher populations could be improved by better weed control and(or) by using a hybrid seed with better germination. If a higher plant population could be shown to give better yields, this might be a simple and effective way of increasing small farm production;

(*f*) The need for research on beans grown in association with corn.

The factors studied in the corn research program in 1972 are shown in Table 11.

A total of nine on-farm locations were used for these experiments. To reduce the number of plots per experiment, various partial factorial designs were used, taking into account the need for knowledge about interactions of nitrogen with phosphorus, weed control, and plant population. Corn was harvested at all nine sites; however, the bean associations were only harvested from two experiments. There was an extreme variability in bean yields that gave no indication of treatment effects. Beans were not harvested from six experiments because farmers harvested the beans before maturity to sell them as "green beans." To measure the yield of these the staff would have had to harvest each bean experiment at least three times and this was beyond their resources.

Yields obtained from the nine corn experiments varied from 1.6 to 3.5 t/ha for the traditional varieties, and from 0.5 to 5.7 t/ha for the improved ones. The degree of consistency between replicates was much better than in 1971, indicating that the staff's field techniques had been improved. Yields of control plots planted in traditional varieties were considerably higher than average farmers' yields, probably due to site selection and careful plot management (insect control and P_2O_5 were applied to all plots and plant populations were carefully

Table 11. Factors studied in the 1972 corn research program.

Factor	Unit	Treatments				
		Traditional variety		Improved variety		
Nitrogen	kg N/ha	0;	70;	100;	130;	160
Phosphorus	kg P_2O_5/ha	0;	40;	80;	120;	
Spacing	meters between hills	1×1.2		1×1;	1×.8;	.8×.8
Weed control	times/crop	2	4;	6;		

The second major crop in the area is potatoes and a large number of variety and fertilizer (shown here) trials were carried out with this crop, either alone or in association with legumes. (Photo: Ron Poling)

controlled). The experiments were harvested during November and December 1972 and were analyzed in January 1973 as randomized complete block designs. This allowed the results to be expressed in graphical form. The results showed that:

(1) Yield responses to applied nitrogen differed considerably between the traditional and improved varieties with the latter responding much more strongly;

(2) The effects of changes in planting distances varied considerably between sites, the best general recommendation appearing to be that planting distances should be reduced to 1 m between rows and to 80 cm between plants in the row.

There was a consistent response to nitrogen (Table 12) and in seven of the nine trials this response was linear up to a level of 150 kg N/ha — a much higher level than had been used in the project's recommendations. There was no response to applied phosphorus in the four sites where this was tested, possibly because in all four locations the soil phosphorus level was medium or high. (Unfortunately this was not known until after the trials were started, when the results of soil analyses became available.)

At all but one site, plant density influenced yield. However, in two locations both planted with traditional varieties, closer planting decreased yield. Closer planting gave higher yields when nitrogen was used, especially when this was combined with an improved variety. Although improved weed control appeared to be beneficial visually, it had a limited impact on yields even at high levels of nitrogen application, especially using traditional varieties.

The data from all experiments were combined for regression analyses, and various models were tested to determine which variables or interactions presented significant effects on yield. The coefficients of the model showing the best fit ($r^2 = 0.97$) are presented in Table 13.

The yields and net returns predicted from this model showed higher yields than expected for the farmers' management level and to a lesser extent for the recommended practices (Table 14). This is partially due to the selection of experimental sites but mainly due to careful management, particularly at land preparation and planting time.

Table 12. Variables that significantly (+ or -) affected 1972 corn yields ($P > 0.95$) in individual regression analyses.

Site no.	Variety[a]	Variables[b]	Effect					
			N	P	D	W	ND	NV
1	T	N P D	+	ns[c]	+			
2	T	N P D	+	ns	-		+	
3	I	N P W	+	ns		ns		
4	I	N P W	+	ns		+		
5	I	N P D	+	ns	ns		-	
6	T	N A W	+		+	ns		
7	T,I	N V	+					+
8	I	N D	+		+		+	
9	T	N D	+		-		+	

[a] T = traditional; I = improved.
[b] N = nitrogen; P = phosphorus; V = variety; D = plant population; W = weed control.
[c] ns = not significant; + = $P > 0.95$; - = $P < 0.95$ (negative yield response).

Table 13. Regression coefficients and their probabilities derived from the combined analysis of corn experiments planted in 1972.

Variable	Code	Regression coefficients	Probability[a]
Intercept		2.58	0.000
Variety[b]	V	-1.49	0.005
Weed control[c]	W	-0.92	0.029
Nitrogen, linear[d]	N	1.22	0.001
Nitrogen, quadratic	N^2	-0.072	0.140
Nitrogen × population[e]	N D	1.02	0.000
Nitrogen × variety	N V	0.26	0.057
Weed control × variety	W V	0.73	0.005

[a]Of coefficient being equal to zero.

[b]Traditional = 1; improved = 2.

[c]Farmer's method (2 times) = 1; intensified method (4 times) = 2.

[d]In units of 50 kg N/ha.

[e]From 25000 to 47000 plants/ha.

Table 14. Effects of plant population, frequency of weed control, level of applied nitrogen, and variety used on yields, cost of production, and net returns from corn production in the Caqueza region (1973 prices).

Area/hill (m^2)	Weed control (*frequency*)	Nitrogen (*kg/ha*)	Variety[a]	Yield (*t/ha*)	Production costs[b] (*U.S. $*)	Net return (*U.S. $*)
1.2	2	0	T	1.96	140	175
1.2	2	75[c]	T	2.55	200	208
1.2	4	0	T	1.87	148	151
1.2	4	75[c]	T	2.46	208	181
0.8	2	0	T	1.57	141	111
0.8	2	0	I	1.25	145	55
0.8	2	153[c]	T	3.23	263	254
0.8	2	222[c]	I	3.77	322	282
0.8	4	0	T	1.48	149	87
0.8	4	0	I	1.77	154	130
0.8	4	153[c]	T	3.14	272	230
0.8	4	222[c]	I	4.30	331	358
0.8	2	100	T	2.86	221	236
0.8	4	100[d]	I	3.26	233	289

[a]T = traditional; I = improved.

[b]Costs used were as follows: land rental: U.S. $40/ha; nitrogen, including cost of application, transport, additional harvest, and its transport: 80 ¢/kg; phosphorus, including added costs: 80 ¢/kg; additional weed control: $8.40/ha; additional costs of improved seed: $4.80/ha; cost of higher plant population: 80 ¢/ha; fixed cost, including land, 50 kg P_2O_5, standard insect control, land preparation, and labour: $140/ha.

[c]Nitrogen level that results in maximum net gain.

[d]Recommendation actually given to farmers in 1972.

The combined analyses provided some quantitative information about the relation between plant spacing and fertilizer use. The increased yield per kg of nitrogen applied to traditional varieties could be raised from 5 to 13 kg of corn by decreasing the distance between hills (of three plants) within rows from 1.2 to 0.8 m. With hybrid corn, the same action resulted in responses rising from 10 to 18 kg respectively. Even greater responses were obtained when the width between rows was reduced from 1 m to 80 cm. However, this tended to smother the beans growing between the corn so that for a corn-bean association, a spacing of 1 m between rows and 80 cm within rows appeared to be the optimum planting density for the corn. Economic analysis of the results showed that the benefits from applied nitrogen were masked unless improved varieties and a denser spacing was used (Table 14).

Beneficial effects from extra weeding only occurred when improved varieties were used. This is not surprising, because traditional corn is very tall and after the first two weedings it develops a canopy well above the level of the weeds. This is not the case with improved corn varieties, which tend to be much shorter with a canopy that is invaded by the taller weeds.

These results seemed to indicate that the impact of improved seed would probably be masked unless it was associated with denser planting, higher nitrogen use, and improved weed control. At low nitrogen levels and with the traditional plant spacing, the traditional varieties were likely to outproduce the improved ones. In other words, it was not in the farmers' interest to only partially accept the technology package associated with the use of improved seed.

The economic implications of partial or complete adoption of the various components of the technological package are shown in Fig. 25. The technological package recommended for 1972 is represented by a bar and is compared to

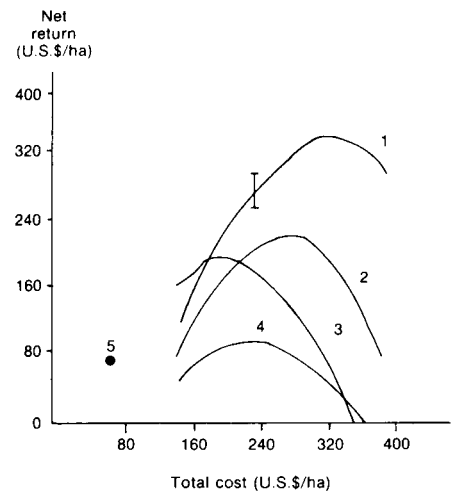


Fig. 25. *Effect of changes in variety, planting density, weeding frequency, and quantity of nitrogen applied on total costs and net returns from corn production. (The bar in curve 1 indicates the project's 1972 recommendations.)*
1, improved varieties, 37 500 plants/ha, intensified weed control; 2, as 1, using the traditional variety; 3, traditional variety at 25 000 plants/ha and farmer's system of weed control; 4, as 3, using improved varieties; 5, farmer's system, adjusting net returns 25% upward to compensate for improved management in trial plots.

the farmers' actual production system, which is represented by the dot denoted as 5.

The recommended practice of traditional weed control, 37000 plants/ha, 100 kg/ha nitrogen, 50 kg/ha P_2O_5, and pest control, resulted in new returns over costs of U.S. $289 for a total outlay of U.S. $223, indicating that there was a potential for considerable increases in net returns above those obtained by the farmers' traditional production method. The economic analysis did not take into account the benefits derived from planting beans with the corn. Bean yields at the trial sites were 260, 310, and 460 kg/ha of dry beans, but varied too much within treatments to allow for the identification of treatment effects. This occurred because bean stands were often reduced to less than 50% of the number of planted sites, as a result of diseases and insect pests. Although field observations by project personnel indicated that changes in corn variety and fertilization did not reduce bean yields, subjective analysis suggested that corn planted at 80 cm × 80 cm led to lowered bean yields.

Because neither closer planting nor better weed control significantly influenced corn yields in the absence of improved varieties and applied nitrogen, it appeared that within the technologies tested in 1972, there was no production alternative that increased either yield or income that did not also increase the costs of production. However, a comparison of the returns from various production strategies indicated that there were various alternatives that could be used to increase both yield and income.

During February and March 1973, the staff evaluated the results of the 1972 crop production research in order to formulate the research program and farmer recommendations for 1973. These recommendations differed from 1972 in their recognition of several production systems. This differentiation was largely based on field history as field observers and farmers' opinions indicated that following potato and onion crops, sufficient phosphorus remained available in the soil so that a subsequent corn crop did not require phosphatic fertilizer. Further differentiation of the corn production system was based on the considerable difference in yield potential observed between the improved varieties and traditional ones (Table 15). Both N and P_2O_5 were recommended at slightly lower levels than in 1972.

Table 15. Nitrogen and phosphorus recommendations for four corn production systems in the Caqueza Project in 1973 (43).

Corn production system	Recommendation (*kg/ha*)		
	Urea	10-30-10	N-P_2O_5-K_2O
Improved variety; last crop was potatoes or onions	200	0	92- 0- 0
Improved variety; last crop was *not* potatoes or onions	180	115	94-34-11
Traditional variety; last crop was potatoes or onions	200	0	92- 0- 0
Traditional variety; last crop was *not* potatoes or onions	185	85	93-27- 9

Potato Production

The variables studied in potato production research were nitrogen, phosphorus, plant population, and variety. Because of considerable differences in plant types, it was felt that improved varieties might tolerate higher plant

populations than would traditional ones. Two experiments were set up to study this using three varieties and four populations. A further eight trials were laid out to study fertilizer requirements. A central composite design was used, and the variables studied are tabulated in Table 16.

Yields varied between locations and varieties and ranged from 4.4 to 38.4 t/ha. Site averages ranged from 9.9 and 31.6 t/ha and treatment averages between 14.8 and 21.4 t/ha.

Response surfaces fitted to the results from each experiment showed significant effects attributable to nitrogen, phosphorus, and plant population, but nonsignificant interactions in all instances. Optimal levels for nitrogen application varied from 90 to 200 kg/ha for the different sites with an average of 130 kg/ha. For phosphorus, optimal levels varied from 125 to 300 kg/ha for the different sites, with an average of 200 kg P_2O_5/ha and the optimal plant population was 30 000 plants per ha. The results indicated site differences in responses to these three factors but further analyses (two-way variance) showed that these differences were not significant and that a general recommendation could be made to include all sites.

At high plant populations the effect of phosphatic fertilizer appeared to be reduced. Depending on the relative costs of seed and fertilizer, the most profitable practice would be to have a low plant population with a high level of phosphorus application when fertilizer prices were low (as in 1972) and a high plant density with low phosphorus use when fertilizer prices were high (as in 1974).[22]

Results of the variety × plant population trials showed that the most economical planting rate was at 25 000/ha for the ICA-Guantiva variety, 20 000 plants/ha for the Parda Pastusa variety, and 16 000 plants/ha for the traditional variety. These plant populations were associated with the use of 150 kg N/ha and 250 kg P_2O_5/ha.

In 1973 the project recommended that the amount of phosphorus to be applied should be related to the field history, assuming that lower responses to applied phosphorus would be obtained in fields in which the last crop had received a heavy treatment of phosphorus. For this reason, the P_2O_5 recommendation was reduced from 210 to 90 kg/ha for those fields in which the last crop had been either potatoes or onions (both of which are usually heavily fertilized). The level of nitrogen recommended was reduced from 150 kg/ha to 80 kg/ha for soils with visually observable high organic matter levels. The recommended plant density was increased from 25 000 plants/ha to 30 000 plants/ha for fields in which potatoes were planted in pure stand, but remained at 25 000 plants/ha for fields in pototo-bean or potato-pea associations. The project

Table 16. Factors studied in the 1972 potato production research (95).

Factor	Unit	Treatments used				
Nitrogen	kg N/ha	0	30	75	120	150
Phosphorus	kg P_2O_5/ha	0	50	125	200	250
Spacing	1000 hills/ha	16.7	20	25	30	33.3

[22]Between 1972 and 1974 the price of P_2O_5 doubled, whereas the difference in cost of planting 10 000 or 15 000 seeds/ha maintained its differential of 15% in both years.

Onions are an important crop in parts of the area and yields and incomes from this crop were increased through the introduction of both new varieties and cultural practices. (Photo: Jack Redden)

recommended that considerable attention should be devoted to selecting good seed, as farmers often consumed or sold their best seed and planted the leftovers.

The phosphorus recommendation of 210 kg/ha was below ICA's standard potato fertilizer recommendation of 300 kg P_2O_5/ha, and for the fields (approximately 30% of the total) previously sown to potatoes or onions in which the project recommendation was 90 kg, it was substantially below the ICA recommended level.

Research in 1973

Corn Production

The evaluation of farmers' adoption rates of the 1972 recommendations showed that they only applied 22% of the recommended fertilizer, and in most cases omitted the second application entirely. As possible reasons for this adoption behaviour, Escobar (31) listed the high cost of fertilizer and the novelty of a split application and suggested that the project "... study the possibility of a fertilizer recommendation which avoided multiple applications." In view of this, the 1973 corn research focused on this issue using four different fertilization treatments for the corn–bean association, varying both the method and the dates of application in a 2-year study whose design and results are discussed later in this chapter.

As a follow-up to the earlier work on phosphorus fertilization, two studies were undertaken to determine the effects of site variables on the P_2O_5 requirements of corn. The first (72) examined the relation between soil phosphorus levels (determined by Bray II extractable P) and the field history (crops

produced and fertilizer used) over the previous 3 years. The other study analyzed all available soil tests from the project area to determine the relation between location, soil type, and available soil P content. This study also analyzed the expected benefits from phosphorus treatments based on soil analysis as opposed to generalized recommendations, and it estimated the likely benefit from using field history and municipality, rather than soil analysis, as the basis for phosphorus recommendations (133, 134).

The results of analyses of the available P from samples taken from 94 fields showed that P levels averaged 14 ppm and ranged from 2 to 60 ppm (Bray II). Twenty percent of the samples were in the very low range ($<$ 6 ppm) in which substantial responses to applied phosphorus could be expected in corn production. Thirty-three percent were in the low range (6–12 ppm), where economically justifiable responses to applied phosphorus were expected from corn (72).

The data collected showed that the past levels of phosphorus application differed substantially with different crops (Table 17), suggesting that the farmer had a completely different approach to fertilizing his commercial crops (potatoes and onions) as opposed to his subsistence one (corn). These differences were not, however, reflected by the soil tests. Indeed, only in the samples taken from soils where there had been a recent onion crop was there evidence of an increased level of soil phosphorus. Even though an average of 83 kg P/ha was applied to potato crops (as opposed to only 0.9 kg P/ha to corn) the postharvest soil P levels were similar on soils producing both crops.

Regression analyses indicated that there was usually no significant relation between the amount of phosphorus applied during the previous 3 years (treating the years either separately or pooled) and current soil P levels. Only in the case of onions was there a significant relation and here higher soil P levels endured for 2 years after a fertilized onion crop.

These results showed that the field history did not provide a useful means for predicting phosphorus requirements. The project staff were not entirely convinced by these findings, as it was common knowledge in the region that corn planted after potatoes rarely responded to applied phosphorus. It was postulated that the reason for the discrepancy was that the postharvest soil sampling ignored the large quantities of P in the form of organic residue (stalks, etc.).

A second study evaluated the distribution of phosphorus fertility in different areas of the project region and examined the potential benefits to be derived

Table 17. Relation between P applied to various crops and residual soil levels of available phosphorus[a]

	P applied by farmers		Available P	
Last crop	No. of fields	kg P/ha applied	No. of fields	ppm P
Corn	80	0.9	34	11.6
Potato	87	83.2	28	11.5
Onions	44	97.5	14	19.2
Peas	15	21.9	8	12.9

[a]For purposes of comparison, both fertilizer and available phosphorus are expressed in elemental form.

from area specific P_2O_5 recommendations (133, 134). This study utilized a phosphorus-response function for corn, which was derived from the results of fertilizer experiments conducted by the Soils Division of ICA, both in the project region and in similar regions. This function indicated that no economic responses to applied phosphorus occurred when soil P levels were greater than 12 ppm. The response function was used to compare the input requirements, the expected benefit, and the risk associated with both a general phosphorus recommendation and with one based on soil tests (Table 18). This allowed the project staff to evaluate the effectiveness of alternative phosphorus recommendation strategies, using an individual soil test as the ideal.

The results indicated that the benefits from basing phosphorus recommendations on soil tests were sufficiently great to cover their costs. There was no additional benefit in classifying soil P levels into three rather than two groups, but two groups were much better than only one as it was uneconomic to apply phosphorus to fields whose soil P level was 12 ppm or more.

As it was not practical to soil test every farmer's field, an effort was also made to adjust P_2O_5 recommendations to the municipality level. Corn growers were recommended to apply 40 kg P_2O_5/ha in Ubaque, 20 kg P_2O_5/ha in Fosca, and no phosphorus in Une and Chipaque. Although this system did not produce benefits equal to those from soil testing, it gave results that were superior to using a general recommendation (Table 18).

Table 18. Comparison of a general recommendation, a soil-test-based one, and a geographically stratified recommendation for phosphorus fertilization of corn (134).

Type of recommendation	P_2O_5 recommendation (*kg/ha*)	Net returns (*U.S. $/ha*)	Weighted avg net returns (*U.S. $/ha*)	Risk[a] (*U.S. $/ha*)
General	23	15	15	11
Soil tests grouped as:				
0-8 ppm P	58	100	36	
>8 ppm P	0	0		2
Soil tests grouped as:				
0-7 ppm P	68	112		
0-11 ppm P	28	7	37	1
>11 ppm	0	0		
By municipality:				
Ubaque	41	77		
Caqueza	19	9	23	7
Une and Chipaque	0	0		

[a]Calculated as: risk = $\sum_{i=1}^{m} F_i \cdot G_i$ for $G_i < 0$,

where G_i is the net gain derived from the recommendation of the i^{th} frequency class F_i, and m is the number of classes in which $G_i < 0$.

Expected net gain = $\sum_{i=1}^{n} F_i \cdot G_i$

for all frequency classes. The study employed a class width of 1 ppm.

Potato Production

With the exception of a major study on the relation between site variables and phosphorus recommendations, the 1973 research on potato production focused on the potato-bean association. This association was commonly used in the project region, particularly during the dry season.[23]

A trial was laid down to determine whether changes in the plant population of either potatoes or beans influenced the optimal fertilizer recommendation (116). This used a central composite design studying N levels of 0–160 kg N/ha and P_2O_5 levels of 100–300 kg P_2O_5/ha. This trial was planted with three different plant populations, namely 25000–25000, 25000–50000, and 16000–50000 plants/ ha of potatoes and beans respectively. It was planted on three farms during both the dry season of 1972 and the rainy season of 1973.

A second experiment on the potato-bean association (94) focused on: (*a*) determining which of the two bean varieties commonly planted in the region performed best when grown in association with potatoes; (*b*) comparing the performance of the two potato varieties recommended for the region, when these were planted in association with beans; (*c*) understanding the economics of the potato-bean association.

A third study (44) was conducted to determine the relation of site variables to nitrogen and phosphorus requirements for pure stands of potatoes.

This study involved 13 trials, 8 laid down during the rainy season and 5 during the dry season. These trials employed a simple response surface design[24] studying five levels of N and of P_2O_5 at a plant population of 25000 plants/ha. At each site, the following variables were recorded: precipitation, altitude, depth of soil profile, slope, organic matter, Bray II extractable P, KCl extractable potassium and aluminium, soil pH in water, planting date, and last crop sown.

The study on potato-bean populations showed that changes in the fertilizer level primarily affected potato production. An examination of the economic returns from the association (Table 19) indicated that it was essentially a potato production activity and that the bean component contributed only 5–15% of the total value of production. This was considerably less than in the corn-bean association where beans contributed anywhere between 40% (farmers' methods) and 30% (recommended method) of the total value of production.

The comparison of fertilizer responses with a value product isoquant[25] showed that potato yields would be the most important determinant of the fertilizer recommendation (an example is presented in Fig. 26A). Phosphorus

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[23]In this agronomic context, the terms "wet" and "dry" season are used for the terms "major" and "minor" season respectively, which were used for the economic analyses in Chapter 9.

[24]Two replicates of a rotational central composite design with a repetition of the central treatment per replicate were planted at each site. Nitrogen levels ranged from 80 to 200 kg N/ha and phosphorus levels were from 125 to 300 kg P_2O_5/ha.

[25]Potato prices vary considerably and fluctuate rapidly in the project region. Determinants of the potato prices are: the Bogota market, which is controlled by dominant producing areas outside the project; the Villavicencio market, nearly completely satisfied from the project area; and the two harvest periods, the rainy season with high production and high acreage and the dry season with low production and acreage confined to land with irrigation possibilities. The studies reported here used a variety of prices to compare effects of price changes. Where these effects are substantial, they will be discussed. Normally, however, only the actual prices at harvest time are used in this section.

Table 19. Range of potato and dry bean yields and value of production obtained as a result of changes in fertilizer rates and plant populations of the potato-bean association (116).

Plant population ('000/ha)		Yield (range), t/ha		Value of production range ($/ha)[a]	
Potato	Bean	Potato	Bean	Potato	Bean
		1972 Dry season			
25	25	6.0–11.0	0.15–0.45	1134–2105	77–215
25	50	7.5–13.5	0.15–0.40	1417–2551	77–202
16	50	6.0– 9.0	0.35–0.40	1134–1700	178–251
		1973 Rainy season			
25	25	24.0–36.0	0.27–9.40	688–1053	73–105
25	50	23.0–35.0	0.30–0.40	648–1012	77–105
16	50	18.0–32.0	0.35–0.55	526– 931	93–145

[a]Using actual prices of 1972 dry season (potato $190/t, beans $506/t) and 1973 rainy season (potato $28/t, bean $263/t).

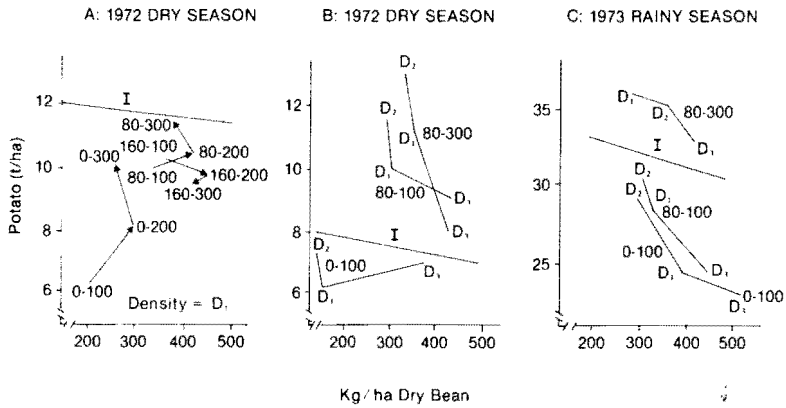

Fig. 26. Effects of selected fertilizer combinations and planting densities on yields of the potato-bean association in relation to the value-product isoquant (I) (116). D_1 = 25 000 plants/ha potatoes with 50 000 plants/ha beans; D_2 = 25 000 plants/ha potatoes with 50 000 plants/ha beans; D_3 = 16 000 plants/ha potatoes with 50 000 plants/ha beans. Fertilizer rates in kg N/ha and kg P_2O_5/ha.

responses were considerable up to a level of 300 kg P_2O_5/ha at all planting densities. Responses to high P_2O_5 levels were, however, stronger in the rainy season than in the dry season. Applications of nitrogen in excess of 130 kg N/ha led to strong yield-reducing effects in both seasons, but particularly in the 1973 rainy season.

The effects of changes in plant populations showed that a potato population of 25 000 plants/ha associated with an increase in the bean population from 25 000 to 50 000 plants/ha did not increase bean yields (Fig. 26B and 26C). It did,

however, increase average potato yields in both seasons. This occurred at all fertilizer levels in the dry season, but in the rainy season it was more strongly expressed in the low nitrogen treatments (Fig. 26C). In the dry season, reductions in the potato stand from 25 000 to 16 000 plants/ha increased bean yields by an average of 150 kg/ha, but reduced potato yields by an average of 3.2 t/ha. Given the normal price ratio of beans to potatoes in the dry season (2.7:1), this shift proved uneconomical. Results for the rainy season of 1973 were similar even though the price ratio in that season was 9.2:1.

Response functions were fitted to bean and potato yields using a quadratic model with linear interactions (116). By combining these functions with fixed and variable production costs, it was possible to derive a net gain equation as a function of nitrogen and phosphorus for each type of stand. These equations were maximized to estimate the most economic fertilizer levels (Table 20). An increase in bean density from 25 000 to 50 000 plants/ha was economic because of the higher returns obtained in the dry season and the reduced fertilizer requirement in both seasons. However, a reduction in potato density only led to an increase in bean yields in the dry season. This was not sufficient to compensate for the loss in potato yields with the potato and bean prices normally encountered.

Beans suffered considerably from soil-borne fungal diseases (particularly *Rhizotocnia solani*) during the rainy season, especially at poorly drained trial sites. Optimal levels for the potato–bean association tended to be lower in nitrogen but higher in P_2O_5 than those encountered in the work on pure potato stands (95), but the very strong yield reductions encountered at nitrogen levels above 130 kg N/ha (particularly in the rainy season) had not been encountered previously.

The second trial on potato–bean associations compared the agronomic and economic performance of two potato and two bean varieties at two planting densities of potatoes (16 700 and 25 000 plants/ha) in combination with three populations of beans (0, 25 000, and 50 000 plants/ha).

Table 20. Fertilizer rates associated with maximum returns from three potato–bean associations (116).

Plant population ('000/ha)			Optimal levels (kg/ha)[a]		Yields (t/ha)		Net returns ($/ha)
Code	Potato	Bean	N	P_2O_5	Potatoes	Beans	
			1972 Dry season[b]				
D_1	25	25	82	280	10.7	0.36	1976
D_2	25	50	71	230	11.3	0.37	2008
D_3	16.6	50	101	100	9.6	0.58	1518
			1973 Rainy season[c]				
D_1	25	25	123	297	39.0	0.33	725
D_2	25	50	91	218	35.5	0.37	623
D_3	16.6	50	113	310	33.2	0.40	559

[a] Price of P_2O_5 = $0.32/kg, price of N = $0.37/kg.

[b] Price of potato = $190/t, price of beans = $506/t.

[c] Price of potato = $28/t, price of beans = $263/t.

Five split-plot experiments (20 treatments, twice replicated) were planted, two in the dry season of 1972[26] and three in the rainy season of 1973. The potato varieties were ICA-Guantiva and ICA-Huila, and the bean varieties were Diacol Andino and Cascara Roja.

In these experiments the yields of the two potato varieties were not significantly different. Increasing the population of potatoes did not influence potato yields during the dry season (probably due to a lack of moisture) but resulted in significantly greater potato yields during the rainy season. Bean yields were not reduced by increasing the population of potatoes during either season.[27] The inclusion of beans into the potato stand, especially at a high population (50000 plants/ha), reduced potato yields significantly during both seasons (Table 21). During the dry season, beans yielded nearly 500 kg/ha more when they were grown with ICA-Huila potatoes than they did with the ICA-Guantiva variety. This was not the case during the rainy season.

Bean varieties differed significantly in their performance. The Diacol Andino variety outyielded the local Cascara Roja variety during the dry season, and most of the increase in bean yields attributable to the higher population of beans (Table 21) occurred with the former variety. Cascara Roja was, however, by far the better variety during the rainy season, particularly when planted at the higher density at which it yielded about 1 t/ha of green beans more than did the Diacol Andino variety.

An economic analysis was carried out for each of the plant densities used to calculate net returns for each cropping pattern (Table 22). It was concluded that returns were maximized when the association was planted with 25000 plants/ha of potatoes and 50000 plants/ha of beans. The association of beans with potatoes provided considerable increases in net returns during the dry season, particularly using the ICA-Huila variety of potatoes and Diacol Andino beans. The benefit from the inclusion of beans was particularly high when irrigation water

Table 21. Effect of the bean population on the yields of both green beans and potatoes grown together in association (94).

Planting density of beans ('000 plants/ha)	Yield (t/ha)[a]			
	1972 dry season		1973 rainy season	
	Potato	Bean	Potato	Bean
0	8.2	0	23.8	0
25	7.8	1.7	22.5	0.7
50	7.1	2.1	21.8	1.8

[a]Averaged to include all potato planting densities and varieties.

[26]This generally meant that the crop received inadequate irrigation as farmers rarely had a dependable water source. Farmers allocated water rights during frequent, and at times heated, meetings on the bases of traditional rights associated with the land they worked and according to social and political status and dependency relations (debts, kinship, land ownership).

[27]This result is at variance with the last trial reported, possibly due to the lack of moisture during the dry season in this trial.

Careful records were taken to establish the benefits of technological change. (Photo: Jack Redden)

Table 22. Effects of plant population and variety of beans on net returns from the potato-bean association grown during the dry season of 1972 and the rainy season of 1973 (94).

Population of beans ('000 *plants/ha*)	Net returns (*U.S. $/ha*)		
	Diacol Andino and potatoes	Potato alone	Cascara Roja and potatoes
	1972 Dry season		
0		275	
25	384		354
50	387		305
	1973 Rainy season		
0		469	
25	418		440
50	400		481

was limited. In one such situation, beans contributed more than 50% of the net gains. This led to the conclusion that the addition of beans to the stand considerably reduced the risks associated with the dry season production of potatoes. In contrast to this, during the rainy season the advantages of the potato-bean association, compared to pure potato stands, were small or nonexistent. This may have been due to a particularly wet 1973 rainy season that resulted in lower than normal bean yields. In rainy seasons, with less abundant rain and on lighter textured soils, the potato-bean association planted with the Cascara Roja variety may still be more economical than using a pure stand of potatoes.

The third set of potato experiments designed to determine the relation between site variables and fertilizer recommendations (44) pooled the results of 13 central composite trials and the measured site variables into a single prediction equation. Using stepwise regression procedures and elimination on the basis of colinearity, those variables that showed significant effects on potato yields were selected (Table 23). Planting season, exchangeable aluminium, altitude, slope, the previous crop on the land, and the organic matter content of the soil all affected yields irrespective of the level of nitrogenous and phosphatic fertilizer applied. The planting season (rainy versus dry), the previous crop (potatoes versus corn or pasture), and the slope of the field, all affected the response to applied phosphorus, whereas only the season and the previous crop affected the nitrogen responses. Available phosphorus in the soil (ranging from 3 to 48 ppm) did not appear to influence the response to applied phosphorus. [28]

The effect of exchangeable aluminium on potato yields was considerable, indicating that liming might need to be a component of fertilizer recommendations. The negative effect of aluminium on yield was, however, considerably reduced in sloping fields, in fields of higher altitudes, and in fields where the last

[28]Various models were tested, eliminating variables that showed some correlation to soil test P. Nonetheless, in no case was soil test P significantly related to yield or to yield responses to applied P.

Table 23. Variables affecting potato yields selected by stepwise regression, their regression coefficients, and the probability of these being zero (44).

Variables[a]	Regression coefficient	Probability
Intercept	102.25	
(N-80)	132.54	0.0007
$(N-80)^2$	-0.51	0.0117
$(P-125)^2$	-0.59	0.6151
Season	37016.02	0.0001
Aluminum (Al)	-34487.59	0.0001
Al × altitude	12.84	0.0001
Al × slope	426.36	0.0001
Al × crop	7450.14	0.0142
Al^2	-6173.86	0.0001
Slope × organic matter	-39.10	0.0001
Slope × season	-404.50	0.0001
Altitude × crop	10.58	0.0009
Slope × crop	-30118.96	0.0001
(N-80) × season	-38.26	0.0022
(N-80) × crop	-33.07	0.0093
(N-80) × (P-125)	0.34	0.0202
(P-125) × crop	22.86	0.0118
(P-125) × season	-22.60	0.0148
(P-125) × slope	0.58	0.0651

[a]Intercept in kg/ha; N and P_2O_5 in kg/ha; altitude in m above sea level; season: rainy = 1; dry = 2; slope in %; last crop 1, corn or pasture, 2, potatoes; organic matter in %.

crop had been fertilized. The direct effect of increased slope was to reduce yields, particularly during the dry season (possibly due to the runoff of irrigation water) and (for unknown reasons) in soils with high organic matter contents.

Of the site variables affecting yield responses to nitrogen and phosphorus, the effect of planting season was to reduce the responses to both nutrients during the dry season, a result that might be expected, given the moisture stress during that season. The effect of the previous crop (fertilized potato versus unfertilized corn or pasture) was to reduce nitrogen responses in cases where the previous crop had been potatoes. The yield increase from applied phosphorus was surprisingly larger for those sites that were fertilized during the previous crop. The coefficient for the variable (P-125) × crop indicates that responses would be higher in a potato crop grown after potatoes than in one grown after an unfertilized crop. The five sites planted during the dry season (and which had low yields because of moisture stress) had, however, in four out of the five cases been planted to corn or pasture (no fertilization during previous crop). It was concluded that much of the previous crop effect may be due to this coincidence. The linearity between site variables limited the value of this study and might have been avoided had a more careful selection of sites (to include a more complete range of site variables) and a larger number of experiments been carried out.

Probable 1974 fertilizer prices (N at U.S. \$0.55/kg and P_2O_5 at \$0.54/kg) were used to calculate optimum levels of N and P_2O_5 for the dry and the rainy seasons, assuming potato prices of \$32, \$64 and \$96/tonne (Table 24). This showed the considerable effect that slope had on the optimal P_2O_5 level. An increase of 20% in the slope of a field would increase the P_2O_5 recommendation

Table 24. Fertilizer levels recommended for potatoes disaggregated according to planting season, field history, and slope (Sl) of the field (44).

	Potato price/tonne					
	$32		$64		$96	
Situation	N	P_2O_5	N	P_2O_5	N	P_2O_5
Rainy season, last crop unfertilized	120	125	130	Sl<15%: 125 Sl>15%: 75+3.22(Sl)	134	Sl<10%: 125 Sl>10%: 93+3.22(Sl)
Rainy season, last crop fertilized	80	150+3.22(Sl)	100	198+3.22(Sl)	122	215+3.22(Sl)
Dry season, last crop unfertilized	85	125	94	125	97	125
Dry season, last crop unfertilized	80	125	80	Sl<15%: 125 Sl>15%: 75+3(Sl)	80	Sl<10%: 125 Sl>10%: 93+3.22(Sl)

by nearly 65 kg P_2O_5/ha. The effect of planting season was to reduce the N recommendation by approximately 30 kg N/ha and the P_2O_5 recommendation by more than 100 kg P_2O_5/ha (at high potato prices and for slopes above 15%).

In the case of P_2O_5 the effect of the planting season may have been overestimated because of the inclusion of the effect of the last crop on the phosphorus recommendation. This last variable considerably increased the optimal P_2O_5 level in crops planted after a fertilized potato crop. This effect was, however, not consistent with the staff's general experience in the project area, and it was not incorporated into their recommendations.

In summary, the 1973 potato production research, analyzed and completed in 1974, considerably increased the project's understanding of the potato production process in the region. Where only one fertilizer regime had been recommended in 1972, it was now possible to take into account the effect of different seasons and to obtain a reasonable estimate of the economic implications of potato production at different fertilizer levels with and without beans. As a result of this, the project staff refined the fertilizer recommendations for potatoes, with and without beans, for the 1975 crop (Table 25).

It was, however, necessary for a major effort to be made by the project's dissemination unit to make these new recommendations acceptable to farmers. In addition, the nitrogen:phosphorus ratio that the project recommended was considerably higher than that in the fertilizer traditionally used for potatoes in the area (10-30-10).

The principal findings of the research were that particular efforts needed to be made to produce improved (healthy) seed, to apply limited quantities of lime (avoiding overliming that might lead to greater disease susceptibility), and to change the level of P_2O_5 recommended. The use of potato-bean associations, particularly during the dry season or on land planted late in the rainy season, appeared to be desirable. During the rainy season, the Cascara Roja bean variety was recommended for use in association with potatoes, especially on lighter textured soils.

Table 25. 1974 Recommendations for fertilizing potatoes.

Situation	Kg P_2O_5/ha for potatoes and potato-bean association			Nitrogen (kg N/ha)	
	Slope %				
	0-10	10-25	25	Potato	Potato-bean
Rainy season, last crop potatoes, onions, or tomatoes	170	210	250	80	70
Rainy season, last crop corn or pasture	170	210	250	120	100
Dry season, last crop potatoes, onions, or tomatoes	125	140	170	70	70
Dry season, last crop corn or pasture	125	140	170	80	70

Research in 1974

The experience derived from vegetable crop production surveys and from studying farmers' adoption rates of the corn and potato production recommendations caused the staff to reexamine their research methodology in 1974. As a result of this, much less emphasis was given in that year to small-plot trials.

During 1973 the project used survey techniques (Chapter 9) to analyze farmers' production methods for vegetable production. This decision was based on the recognition that the project could not possibly establish comprehensive research programs for each one of about 10 common vegetable crops grown in the region. Project staff also felt that central experimental station recommendations were probably adequate for these crops as they were typically short-season, high-priced products. For such crops, which were usually planted on small areas that were managed intensively, the exact input requirements were less site specific,[29] and it was, therefore, considered more important to understand the economic feasibility and comparative performance of these crops. The project decided, therefore, to use the results of horticultural surveys to define which aspects of horticultural production warranted study in small experiments on farmers' fields.

Results of the 1973 corn and potato credit programs (Table 26) indicated that the application of the project's recommendations at the farm level led to yields similar to those predicted from experimental trials. The project's recommendations were well accepted in the case of potatoes. Corn producers, however, continued to apply much less nitrogen than was recommended. Compared to 1972, the adoption of the nitrogen recommendations increased from 20 to 60% of the recommended level, but the topdressing of urea continued to be poorly adopted. In addition, it appeared that some farmers were unable to differentiate between 10-30-10 and urea, as some overapplied urea at planting and then topdressed with the 10-30-10 that should have been applied at planting time. Farmers in the ICA-CAJA AGRARIA credit program used much more

[29]High fertilizer inputs and short growing seasons tend to mask comparatively small differences in soil fertility.

intensive production methods than those not participating in this program.[30] In the case of corn, their use of improved varieties (60%) and partial fertilizer application increased yields considerably. For potatoes, a 20% increase in plant population and a substantial increase in fertilizer use increased yields by 6 t/ha.

The staff decided that at this stage in time small-plot research on corn and potatoes would provide little further useful information and that project research should concentrate on studying the adoption process. This reasoning resulted in the formulation of the corn production plan. The project expected to obtain from this plan further information on corn yields and adoption rates. 1974 production research was confined to demonstration trials on crops other than corn and potatoes and to a comparison of simplified fertilizer recommendations for corn (101).

Table 26. Cultural practices used by participants in the ICA-CAJA AGRARIA supervised credit program and those used by nonparticipating farmers (1973).

	Corn		Potatoes	
	Participant	Nonparticipant	Participant	Nonparticipant
Yield (*t/ha*)	3.6	1.4	16.0	10.1
Kg seed/ha	–[a]	—	1060	840
Kg N/ha	52.2	6.6	85	50
Kg P_2O_5/ha	19.7	1	223	147

[a]A 12% increase in plant population over the nonparticipants.

Corn Production

In 1972 the recommended nitrogen application for corn grown with associates was established at approximately 100 kg N/ha. Responses obtained from applied N had been substantial and consistent, so that there appeared to be no need to differentiate this recommendation on the basis of site variables. There were, however, other problems associated with the recommendation, such as the difficulty of applying enough fertilizer at planting time,[31] the tendency of poorly placed fertilizer to cause fertilizer burn, which reduced stands of both corn and beans, and the requirements to hold back part of the credit for a second N application even though the crop had already been fertilized. Because much of the project region has moderate precipitation (1200 mm/year), which is usually evenly distributed throughout the growing season, the project staff felt that there was a need to study the possibility of using a single N application. The local custom of moulding the corn at its first two weedings led the staff to suspect that phosphorus applied to the base of the hill after the corn had emerged would still become available to the corn. Four methods of fertilization were compared:

[30]Corn growers not in the ICA-CAJA AGRARIA program planted without credit. Potato growers not in this program sometimes received credit from commercial sources, without technical assistance.

[31]Corn is traditionally planted with a stick, using three seeds per hill. Fertilizer placement required considerable additional effort, using the method applied in potato production, which consisted of making shallow holes or trenches in which fertilizer was placed.

(1) The original recommendation, applying one-third of the N requirements and all of the recommended 10–30–10 at planting. The remaining N was applied at the time of the second weeding (45–50 days after planting).
(2) Applying only the recommended 10–30–10 at planting and all of the recommended N at the time of the second weeding.
(3) Applying all the fertilizer at the time of the first weeding (about 25 days after planting).
(4) Applying all of the fertilizer at the time of the second weeding (45 days after planting).

In these experiments, the N treatments ranged from 0 to 150 kg/ha, and 50 kg P_2O_5 was applied to all plots. A total of nine experiments were laid down (five in 1973 and four in 1974), each with three replicates. The results obtained confirmed the earlier work in terms of the responses obtained from traditional and improved varieties. Table 27 shows that yield responses to the first 100 kg N/ha averaged 8.5 kg corn per kg N for traditional varieties and 15.8 kg corn per kg N for improved varieties.

The two methods (no. 3 and 4) that applied all of the fertilizer after emergence resulted in higher yields at low levels of nitrogen than did the split application (Fig. 27). It appeared that delaying fertilizer applications until 25–45 days after planting further improved yield responses at low N levels but depressed yields at higher N levels.[32] It was, therefore, concluded that delaying the fertilizer application resulted in a higher nitrogen efficiency (101).

Comparison of method 2 with method 4 showed that delayed P_2O_5 application resulted in lower yields for method 4 in only two out of nine cases. These experiments occurred on sites with very low phosphorus fertility, which are not common in the region. The yield reduction was not substantial and was not statistically significant in the combined analyses of all nine sites.

Table 27. The response of corn to different methods of nitrogen application (1971–74).

Year	Variety	Fertilization method[a]	Regression coefficients	
			Linear	Quadratic
1971	Traditional	1	12.19	-0.0226
1971	Improved	1	17.04	0
1972	Traditional	1	13.28	-0.029
1972	Improved	1	18.48	-0.029
1973/74	Traditional	Average[b]	7.10	-0.017
1973/74	Improved	Average[b]	20.8	-0.058
1973/74	Improved	1	17.27	-0.013
1973/74	Improved	3	25.88	-0.085
1973/74	Improved	4	37.12	-0.206

[a]The second method was not included individually in this comparison, as only two levels were studied.
[b]Average for four methods tested.

[32]This is to some extent an artifact of the regression model forcing all functions through the same intercept, as the average yield for method no. 4 at 150 kg N/ha was 3990 kg/ha.

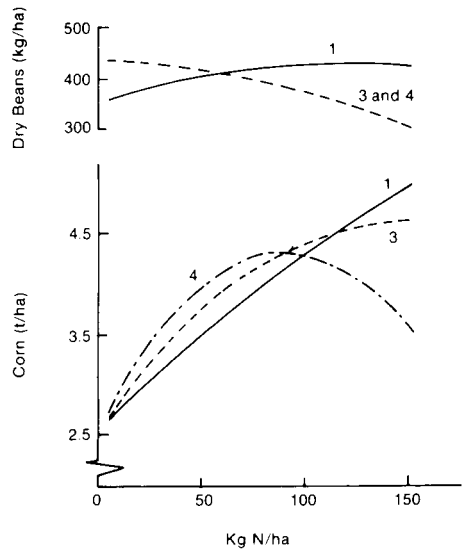

Fig. 27. *A comparison of methods of fertilizer application for corn (1973 and 1974) (nine sites). 1 = all P_2O_5 and one-third N at seeding, rest of N at 45 days; 3, all P_2O_5 and N at 25 days after planting; 4, all P_2O_5 and N at 45 days after planting.*

Beans were only harvested at six sites because of time limitations. Yields averaged 400 kg/ha but only at one of the six sites was there a significant treatment effect. The split application of nitrogen increased yields slightly, whereas a single fertilizer application reduced bean yields, particularly at the higher N levels. The bean variety *Cargamanto*, which was tested at three sites, gave better yields (440 kg/ha) than did the other varieties (340 kg/ha).

For an economic analysis of these results, a regression model was used that assumed the same quadratic response for methods 1, 3, and 4, but allowed for different coefficients for both the intercept and the linear effect of nitrogen. By combining the production functions of corn and beans, a net gain equation for each fertilizer method was derived as a function of applied N. The results of maximizing this equation (Table 28) showed that delaying the fertilizer application reduced optimal nitrogen levels and increased net gains at lower rates of nitrogen application.

On the six sites with improved varieties, a higher use of nitrogen was economic especially for the split fertilizer application (method 1). However, this method did not give a greater economic return than did single fertilizer applications unless the applied nitrogen exceeded 100 kg/ha (Table 29).

In view of the low availability of cash in the project area and in light of the experience of the 1971 adoption study, a single fertilizer application method appeared to offer the following advantages over the project's earlier recommendations:

(1) It had a lower labour requirement at planting time. Apart from seed treatment and a change in planting distance, the planting operation remained the same as the traditional one.

(2) The additional labour for fertilization was nonarduous and could be done by family members.

Table 28. Levels of nitrogen required to maximize net returns from three different systems of fertilizer application at nine sites (101).

Method[a]	Kg/ha nitrogen to maximize net gains	Maximum gain (*U.S. $/ha*)[b]		
		Corn	Beans	Total
1	139	460	218	679
3	90	395	180	575
4	52	422	222	644

[a]1 = all P_2O_5 and 1/3 N at planting, remainder of N after 45 days; 3 = all P_2O_5 and all N at 25 days after planting; 4 = all P_2O_5 and all N at 45 days after planting.
[b]Prices used (U.S. ¢/kg): corn = 15; dry beans = 61; N and P_2O_5 = 77.

Table 29. Quantity of nitrogen fertilizer required to maximize net gains using different timings of fertilizer application on improved corn varieties at six sites.

Method[a]	Kg N/ha to maximize net returns	Total cost of production	Cost of N	Net return (*U.S. $/ha*)
1	266	350	203	824
3	98	218	75	656
4	70	197	54	709
1	100	222	77	690
1	70	200	54	636

[a]See Table 28.

(3) It reduced the cash costs and risk by recommending less fertilizer than the original recommendation.
(4) It gave higher returns per unit invested in fertilizer.
(5) The use of fertilizer at post-emergence virtually eliminated fertilizer burn.
(6) The single application eliminated the problem of the tendency to omit the second fertilizer application, an omission that resulted in a sub-optimal treatment.
(7) The technical assistance supervision requirements were reduced.

The results of this study were incorporated into the credit plan for corn production in 1975 (103). This recommended the application at 40 days after planting of a quantity of P_2O_5 based on the previous crop grown (Table 16), plus 160 kg urea/ha. Subsequently, the staff refined these recommendations on a municipality basis (Table 30) after reviewing the 4 years' fertilizer work. This led to lower nitrogen recommendations at the higher altitude municipalities where yield responses to N were less substantial.

As yield responses from P_2O_5 applications had been sporadic and small, the phosphorus recommendation was held to a minimum. Because about 60% of the corn in the area is planted in Caqueza, Fosca, and Fomeque, with the remainder equally distributed among Chipaque, Choachi, and Ubaque, the expected P_2O_5 requirement of the recommendation in Table 30 is approximately 21 kg/ha. This considerable reduction from the original recommendation of 50 kg/ha (1971) was obtained by fitting the recommendation to the variation in corn P requirements that existed in the region.

Table 30. Fertilizer recommendation for corn associations in the Caqueza Project (1975.)

Municipality	10-30-10[a] (kg/ha)	Urea[a] (kg/ha)
Une	0	135
Chipaque, Choachi		
— after corn or pasture	50	135
— other	0	135
Caqueza, Fosca, Fomeque		
— after corn or pasture	100	160
— after potatoes or tomatoes	50	135
— after onions	0	135
Ubaque		
— after corn or pasture	130	135
— after potatoes or tomatoes	60	135
— after onions	0	135

[a]The time of application was recommended to be 40–45 days after planting at altitudes between 1500 and 1900 m and at 45–50 days at altitudes above 1900 m.

Other Crops

A survey of vegetable crop production was completed in January 1974 and the preliminary results were discussed at two project meetings in April to define an appropriate experimental program. Although results were hotly debated, the staff felt that there was sufficient information available on planting methods, levels, and methods of fertilization, time of planting, and insect control, and these subjects did not require a large-scale experimental program. However, they did feel that they needed to acquire more practical experience with these crops and more knowledge of the performance of different varieties.

In Table 31 the research carried out on vegetable and other crops is tabulated and the most important findings are noted. The prospects appeared to be particularly promising for onions and there appeared to be no reason why these could not become a cash crop in the corn-growing areas of Caqueza, Fosca, and Fomeque. The project compared five onion varieties at two sites using two fertilizer levels. The following results were obtained:

(1) Three of the five varieties consistently gave lower yields.
(2) Responses to higher P_2O_5 levels ranged from 1.2 to 6.5 t/ha but were closely related to the production potential of the variety and the site. It appeared to be desirable to relate P_2O_5 applications to the variety used (lower for low-yielding varieties) and to the presence or absence of irrigation (lower for sites lacking irrigation).
(3) The use of seedbeds (disinfected) resulted in considerably greater onion yields (about 5 t/ha higher) compared with the common method of buying commercially available onion setts. Fields planted with setts suffered greatly from diseases.
(4) With high fertilizer levels, the two best onion varieties produced 16 t/ha without irrigation and 33 t/ha with irrigation. This compared to an

average production of 9 t/ha for all 120 farmers surveyed and 13 t/ha for the 10 highest producers.

Tomatoes yielded between 9 and 20 t/ha but although two varieties not common to the region outyielded the local "chonto" variety and showed much better disease resistance, the local variety was preferred because its harvesting period was longer and it was not as easily damaged in handling as were the new varieties.

Colombian farmers traditionally grow leaf rather than head lettuce. The introduction of the latter into Colombia is recent and its use is still largely limited to higher income families. Because of a considerable price differential and a growing demand (detected by the project's marketing activities), the project encouraged farmers to shift over to producing head lettuce. Initially farmers were not enthusiastic, as marketing conditions in Caqueza had traditionally been unfavourable for head lettuce. As farmers became familiar with the advantages of head lettuce, which was demonstrated by the project staff earlier in 1975 (higher yields, easier packing, and more resistance to root rot), they began to include this crop in their cropping system.

Considerable differences of opinion existed among the project staff about the need to include wheat and barley in the 1974 experimental program. These crops had, at one time, been grown in the potato-growing region but subsidized imports forced wheat prices down, and wheat was replaced by potatoes. It was felt that the introduction of a cereal into the cropping cycle would lessen the incidence of soil-borne diseases and pests (*Pseudomonas solanacearum*, *Rhyzoctonia solani*, *Premnotrypex vorax*), which were considerably reducing crop yields in certain areas. However, the economists in the team claimed that with expected yield levels (2 t/ha), current prices (U.S. $0.19/kg), and total production costs (U.S. $190) these crops would not be an attractive alternative for farmers. Yields obtained using high fertilizer levels were 2.7 t/ha for wheat and 2.4 t/ha for barley. At the 1974 price level for wheat, it was not economically competitive with most vegetables as a rotation crop for potatoes. However, in 1975

Table 31. Summary of research on vegetable crops in the Caqueza Project during 1974.

Crop	No. of varieties tested	No. of sites	Preferred variety	Yield (t/ha)	Comment
Onion	5	2	Yellow Granex	24	Short growing season, lower price
			Red Creole	25	Long growing season, higher price
Tomatoes	6	2	Traditional variety	15	More primings per crop
Peppers	2	2	Yellow Wonder	11	Profitable crop
Wheat	3	2	PM-9	2.7	Low returns
Barley	3	2	ICA-Machaca	2.4	Low returns
Lettuce (leaf)	2	1	White Boston	18	Slowly being replaced by head lettuce
Lettuce (head)	3	1	Great Lakes	22	Better price, local market poor
Peas	4	2	Teusaca	2.7	Good quality, combines well with potatoes
Beets	2	1	Crosby Egyptian	17	Superior in quality and yield
Cabbage	2	1	Marion market	39	Low prices, marketing problems

An increasing number of farmers were deriving some income from poultry production, and the veterinary diagnostic service offered to them by the project assisted in developing a closer rapport with the farmers. (Photo: Ron Poling)

the removal of the import subsidy doubled wheat prices and nearly tripled expected returns so that this crop may have a role to play in the project area in the future. Barley prices also nearly doubled in 1975 but the lower price and high quality requirements of barley compared with wheat made this crop a less attractive proposition.

Part IV

Factors Influencing Adoption Rates

FACTORS INFLUENCING ADOPTION RATES

In its first 2 years, the Caqueza Project concentrated its activities on identifying and propagating new packages of technology. Only gradually did it become apparent that what the staff regarded as a good new technology was not necessarily what the farmer conceived as meeting his needs. Indeed, the acceptance of a new technology appeared to depend on a host of socioeconomic factors as well as on agronomic ones.

As knowledge about the nonagronomic characteristics of the recommended production packages built up, it changed the project staff's outlook on their own role. Initially, this was perceived as one of identifying production packages adapted to the region and extending these to farmers through the credit-related dissemination programs. In subsequent years, project action increasingly focused on the identification of institutional or infrastructural limitations and of action programs to reduce the impact of these in addition to the identification of cheap, safe, and easily applicable technological packages.

These infrastructural and institutional aspects of the incorporation of high-producing technology into the small farmer's production system are the subject of the following chapters, which discuss selective issues relating to this theme.

Chapter 11

Risk

The farmer is always confronted with a number of uncertainties that lie largely outside his control. As they relate to his production activities, these uncertainties are attributable to the unpredictability of the quantity of the product that will be obtained, to the product price at the moment of sale, and to institutional uncertainties.[33] These uncertainties are particularly hazardous to small farmers who may lack the means to continue their enterprise if they experience a serious financial setback.

Some of these uncertainties can be expressed rather succinctly in terms of probabilities. When the probability of the occurrence of a financial setback is known, the term "risk" applies; when this probability is unknown it is termed "uncertainty." However, this type of distinction between known and unknown probabilities presents a continuum that makes it difficult to determine where one ends and the other begins. Hence, in this chapter one word will be used to describe this continuum in general and that word will be "risk."

Even though risk is the word to be used, it is well worth noting the distinction between risk and uncertainty because risk-reducing plans generally attempt to move the occurrence of uncertain events into the realm of risky events. That is, by determining the probabilities for certain events, their manipulation becomes possible. Basically, they can be insured against. Among the three sources of uncertainties listed above, production and price may be regarded as "risk" in the true sense, as their probabilities can be estimated, whereas institutional issues remain definitely as "uncertainties."

The project's awareness of risk in the small farmer's production process stemmed from unpleasant experiences in all three of these areas: production, pricing, and institutional relations. The latter was epitomized by the continuing problems of obtaining credit in time to use it for purchasing seed and fertilizer for the corn crop, and by the unsuccessful efforts to obtain insecticides and fertilizer packages in quantities small enough for use by the farmer with 1 ha or less. The issue of price risk has already been referred to when cabbage prices collapsed after the project had promoted this crop.

Although these problems were clearly recognized early on by the Caqueza Project staff, and, indeed, some attempts were made to modify the impact of these risks on farmers' production practices, the project first concentrated its research effort on analyzing the consequences of production risk. This choice

[33]Institutional uncertainties include such factors as the timely availability of seed, fertilizer, and insecticides; transport for the produce; and the availability and timeliness of credit: can the farmer get technical assistance when it is needed, or will institutional regulations be changed during his production cycle?

was not guided by foresight but, on the contrary, surfaced because of the farmer's apparent rejection of a clearly superior production technology in corn compared to traditional corn practices. The new corn technology showed that production and net gains per hectare both increased severalfold over the traditional technology, yet adoption rates were very disappointing. This led the staff to suspect that only through understanding production risk, as it related to the type of technology used, would they be able to identify ways to achieve increased adoption.

The Measurement of Risk

The project initially assumed that the low corn yields found in the area were due to either a lack of knowledge of modern technology on the part of the farmer and(or) to the absence of suitable techniques for him to follow. However, after 2 years of on-farm experimental work in which the farmers cooperated and used their traditional cultivation methods, these assumptions were modified as the project staff became convinced that lack of adoption was a question of inadequate technology formulation.

This conviction was supported by the study that compared traditional corn production methods with those recommended by the project (58). This showed that the recommended technology required tripling the traditional value of inputs, with nearly all of this increase in the form of cash outlays. Related to this increase in cash costs was the fact that returns to cash spent for purchased inputs (seeds, fertilizer, and pesticides) were reduced from $3.75 to $2.44 per dollar invested. This combination of a reduction in returns to cash, coupled with a greatly increased cash requirement, suggested that one possible reason for the

Efforts were made to resuscitate the sheep industry in the upland areas by introducing improved breeds of sheep. (Photo: Jack Redden)

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farmer's rejection of the recommendation (58) was related to the cash constraint in the project area — the new technology earned relatively less than did the traditional one in terms of income per dollar spent.

However, this did not seem to be the sole reason for the low adoption rates. Although returns to cash were reduced by 58%, land returns increased by 155%, labour returns rose by 73%, and returns to total investment were up by 13%. Alongside these changes, production per hectare increased by 202% and net returns rose by 253%. Clearly the new corn technology was profitable. Even though returns per unit of cash outlay decreased, if the new technology was adopted they were still substantially higher than the local opportunity cost for capital. This suggested that the low rate of adoption required further explanation.

The next step taken was to look at the concept of production risk. This necessitated exploring different ways of measuring risk, bearing in mind that the ultimate technique chosen would have to be sufficiently simple to be applicable in an operational project; would have to avoid making excessive demands on data collection; and would need to permit an easy comparison of different levels of technology and different cropping activities. These specifications eliminated the possibility of using sophisticated estimates of utility functions or of any procedures demanding risk measurements that required complex computerized calculations.

As an alternative to utility maximization, several authors have suggested the use of decision-making rules. These minimize the probability that the net return falls below a specified disaster level; or maximize returns subject to the constraint that the probability of the returns being lower than some disaster level does not exceed a specified limit. A third type of "safety first" rule maximizes the lower confidence limit of net returns.

Experiences with the way in which farmers responded to alternative technologies indicated that the measure to be adopted would need to go beyond a mere probabilistic statement about the occurrence of a loss or a net return below some chosen disaster level. The experience gained by the project staff in preparing production credit plans with the farmers gave them considerable insight into farmers' reactions to suggested alternative production strategies. The preparation of credit questionnaires with farmers on behalf of the CAJA AGRARIA forced the project team members to explain in detail to farmers everything about the recommended production methods, including the inputs to be used, their costs, and the expected returns that they would generate. During these sessions, farmers frequently objected to the high input levels and expressed concern as to whether the yield figures suggested by project personnel would actually be attainable on the farm.

The variance observed in corn yields indicated that although there was a lower probability of obtaining yields of less than both 800 kg/ha and 500 kg/ha with the recommended production methods than with the traditional ones (Table 32), farmers still considered the possibility of losing the substantial amount of cash that was required for the corn recommendation. As a result of this, project staff were convinced that any measurement of risk would need to do more than identify the probability of a loss or a return less than any specified level and that what, in fact, was needed to express the farmers' concept of risk was some indication of the extent of the loss involved.

Although accepted decision-making rules would, indeed, allow the identification of an investment strategy that maintained risk within tolerable bounds, they would not identify a measure of risk that reflected the amount of the loss

Table 32. The probabilities of low yields for actual and recommended corn production methods in Caqueza (1974).

Yield, less than	Probability	
	Actual method	Recommended method
800 kg/ha	0.44	0.05
500 kg/ha	0.27	0.03

involved. As a facsimile of farmers' decision-making, these rules failed to take into account other aspects that often influenced farmers' acceptance of an alternative production process.

The profit of a production activity is derived from the production factors land, labour, and cash. Depending on the availability of these (as reflected by their cost), the returns to some factors may become critical in the farmer's evaluation of alternative production strategies. In this sense he may be concerned more about a reduction in returns to scarce factors than he is about overall profitability. In other words, risk aversion is only one motivating force in farmers' decision-making.

For this reason, it appeared desirable to define a measurement of risk that, taken together with other criteria such as cash and labour requirements and returns to these production factors, would provide a profile that could be used to compare various technological packages and different production activities. The measure of adequacy of this profile would be the extent to which it explained what was known from observation and measurement about small farmers' decision-making with respect to agricultural production.

Considerable discussion took place as to whether the sought-after risk measurement should also include some assessment of small farmers' risk-taking ability. Because this required a considerable degree of assumption about farmers' risk preferences, it was finally decided not to include it and to identify a yardstick that would be confined to production activities and would be an exclusive function of production methods and the costs and prices associated with them. If necessary, this measure could subsequently be looked at in terms of the individual reactions of farmers or farmer groups. These reactions might, or might not, be related to cultural, economic, or other characteristics.

The end result of the extensive dialogue on this theme was the selection of the expected value of the loss as a risk index for the comparison of production activities. This measurement allowed for a comparison of *actual values between activities*. Furthermore, it could be derived in terms of the total investment in production as well as for just the expected value of cash losses.

The following conventions and assumptions were used for calculating risk:

(1) Crop yields were considered to be normally distributed.[34]

(2) The loss function (L) for any production activity was:

$$L = C - yp \quad \text{for } 0 \leq y < C/p$$
$$L = 0 \quad \text{for } y \geq C/p$$

where y = yield, p = price of product, C = costs.

[34]For corn and potatoes, where the yield distribution was badly skewed because of few high yield values, risk was calculated using estimates of the mean and variance based on the lower half of the distribution curve, using the rationale that this would be the area pertinent to risk considerations.

(3) The expected value of the loss E(L) was defined as:

$$E(L) = E(C - p) \quad \text{for } 0 \leq y \leq C/p$$
$$E(L) = 0 \quad \text{for } y \geq C/p$$

where E stands for the expected value operator, and P for the probability of the event, in parentheses.

(4) The price of the crop and its cost of production were assumed to be independent of the yield, so that the expected value of the loss was defined as $(E(L) = C - pE(y \mid 0 < y < C/p)$.

With these assumptions, the expected value of the loss was calculated from the cost of production (C), the product price (p), and the expected value of a yield between zero and the net gain break-even point ($0 < y < C/p$). The latter value was calculated using the formulas for the calculation of the expected value of a conditional normal distribution (40, 78) given that y is between 0 and C/p. The distribution was first transformed to the standard normal distribution, as were the cutoff points (yield = 0 and C/p). Using the tabulated values of the standard normal density function (Z) and its accumulative form (P), the expected value of the yield (or net gain, as the case may be) was then calculated as:

$$E(y \mid a < y < b) = \bar{y} + \frac{Z(b) - Z(a)}{P(a) - P(b)} \cdot S_d$$

where S_d stands for standard deviation.

This method of calculation treats product prices as constant, and was therefore only suitable for the calculations of corn and potato data, where seasonally adjusted prices could be employed. This allowed the calculation of production risks based on several seasons of yield data. For horticultural crops, product prices fluctuated widely from day to day and yields changed for different planting dates throughout the year. In these circumstances, risk was calculated directly from the net returns actually obtained by the farmers. The following assumptions were used:

(1) Net gains were considered to be normally distributed.

(2) The loss function for any production activity was:

$$L = -G \quad \text{for } -C \leq G \leq 0$$
$$L = 0 \quad \text{for } G \geq 0$$

where G = net gain (value of the product less its costs), and C = costs.

(3) The expected value of the loss was therefore defined as:

$$E(L) = E(G \mid -C \leq G \leq 0),$$

which reads: The expected value of the net gain, given that the net gain is between 0 and -C. This value was then calculated using the same method as noted above (40, 78).

Calculated in this manner, the risk of production will increase with the increased cost of production and with an increased variance in the value of production obtained (Table 33).

The risk calculated on the basis of total production costs will therefore be higher than risk based only on the costs of purchased inputs. For its risk analyses, the project staff considered costs as being only those of purchased inputs, because farmers in the project area assigned little or no costs to the use of their labour or that of their family. The landowning producer also assigned little cost of the use of his land. The producer only considered costs as being

Table 33. Relation between the value and cost of production and the magnitude of the risk associated with those factors.

Value of production (VP) (*U.S. $*)	Standard deviation of VP (*U.S. $*)	Cost of production (*U.S. $*)	Risk (*U.S. $*)
640	160	320	60
640	320	320	130
640	160	480	84

those inputs for which he had to make a cash outlay, namely supplies and hired labour.

Under field conditions production risk is difficult to separate from price and institutional risks. In the above treatment of risk some assumptions had to be made about product prices and availability and input costs. Where prices and costs were treated as constants, as in the case of corn and potatoes, the stochastic component of the production risk was limited to yield variations. However, in the case of horticultural crops, actual prices were used for the risk calculations. In this way a substantial component of the *risk related to price variations* was included in the *calculated risk*.

Certain assumptions had to be made with respect to the measurement of yield variation. Yields depend on random natural events (temperature, light, water, pests), on fixed physical conditions (soils, slope, altitude), and on a controlled intervention by the farmer (as expressed by a production practice). Measurements of yield variances, therefore, need to take into account what sources of variation are to be included. If only climatic and disease factors are included, these can be measured under specified physical (soil, slope, altitude) and technical (variety, fertilization level, pest control practices) conditions. However, substantial covariances in their effects on yield obviously exist between technological levels, physical conditions, and natural events[35] so that any measurement of yield variance will depend to a great extent on the factors that are taken into account. Such factors do, therefore, need to be specified if the risk measurement is to be meaningful.

In the Caqueza Project area, staff members provided subjective estimates of the variation in yields encountered in subsistence farming. They estimated that 35% of yield differences were attributable to physical differences between fields,[36] 5% to pests and diseases, 40% to the level of technological inputs, and 20% to year-to-year climatic differences. This suggested that, at the level of technology practiced in Caqueza, climatic effects, although important, were not dominant and might not be the prime factor influencing the adoption of new technologies. This was borne out by the project's own research results (compare, for example, the yield data in Tables 9, 14, and 26, and Fig. 25 and 27). In the Caqueza area the greatest variation appeared to be related to the differential

[35]E.g., rainfall interacts with the effect of nitrogen on yields. Slope affects responses to added phosphorus.

[36]This variation is less for high value crops where greater field selection, higher fertilization, and frequent irrigation are practiced. In such fields, both physical and climatic sources of yield variation are reduced by intensive management.

performance of a given technology in different fields within a year. As demonstrated for the phosphorus fertilization component of the corn recommendation (Fig. 27), this differential performance imposes considerable risk on adopting farmers as a group.

The risk taken by an individual farmer producing corn on a given field is different to the risk for all corn produced in an area. Site-to-site differences do not affect him; only year-to-year variations are his concern. The individual farmer compares his field to those on which farm trials or demonstrations occur and, maintaining this comparison, worries about year-to-year variation. In contrast to this, the project staff needed to calculate the variance of performance of a recommendation for the whole area to judge the potential adoption role of the recommendation. To do this, they needed to include data from all types of farms. Hence, the risk measurement of a certain production technology that was meaningful for the project staff had to take into account not only year-to-year variations but site-to-site variations as well. The expected loss was, therefore, not calculated on the basis of the individual farmer, but was based on the production of a specific crop in the whole project area.

The project did not have a broad enough data base available to do this and, therefore, started its risk work by obtaining yield variations from all available sources. These included survey data, field sampling data, experimental results, and information from credit programs. Corn and potato data used covered 3 years, but for horticultural crops data were generally only available from one harvest. However, the horticultural data were collected at various times during a 3-year period and this in itself probably accounted for the major source of yield variation.

The estimates of variance were expressed in terms of the probabilities of obtaining specified high and low yield levels. These were then compared with

The introduction of improved breeds of sheep was hoped to support a local women's cooperative that made blankets and ruanas from the wool. (Photo: Neill McKee)

subjective estimates for obtaining such yields, these being based on the local experience of project staff. For all of the crops studied, particularly the horticultural ones, the project staff felt that the derived variances were too high.[37] Nevertheless, as it was considered preferable to overestimate variance, it was decided not to make any downward adjustments. The derived variance and the expected mean yields were then used together to estimate risk. As risk was estimated on the basis of net returns, all product prices and input costs were adjusted to 1973 prices. This was done by using the 1972 costs for materials and adjusting actual product prices to 1973 prices by applying a constant inflation index.

For the crops studied, the cost of purchased inputs, net returns, probability of net returns below zero and risk are presented in Table 34. Large differences were found in the probability of net returns below zero, with potatoes and corn-beans showing the highest probabilities. This was, however, not necessarily an indication of risk as it failed to take into consideration that the amounts that could be lost varied from $62/ha to $340/ha. The calculated risk showed a sensitivity to large variances of production (and hence net returns) as well as to high production costs. The risk of onion production was fairly high, not because of a high variance but rather because of high cost of purchased inputs. On the other hand, the traditional corn-bean association had a low production risk even though the variability of production (and hence net returns) was high. This was so because low production costs kept losses down.

Another crop that involved high risks was potatoes, whether grown alone or in association with peas. This was the result of high input costs and the highest production variance of all crops (Table 34). A comparison of the risks and net returns of the crop enterprises listed in Table 34 shows that the risk of potato production was very high in comparison to the net returns. This may be a distortion of reality for two reasons: first, potato prices, although seasonally adjusted in the table, were abnormally low in 1972. Second, although horticultural crops appear very attractive, marketing risks due to perishability have not

Table 34. Production risks (U.S. $) for 10 important crops in the Caqueza Project (1973 prices).

Crop	Purchased inputs ($/ha)	Net returns ($/ha)[a]		P (Net returns ≤ 0)	Risk ($/ha)	Risk per net return
		Mean	Standard deviation			
Corn (recommended technology)	118	174	110	.05	44	.25
Corn (traditional technology)	39	84	71	.12	14	.17
Corn-beans	62	138	137	.14	28	.20
Potato-peas	353	718	1020	.24	167[b]	.23
Potatoes	315	463	658	.21	145[b]	.31
Green beans	162	856	471	.04	72	.15
Tomatoes	247	1008	554	.04	108	.10
Onions	340	1241	658	.03	139	.11
Beets	143	683	433	.06	76	.11
Lettuce	132	834	435	.03	59	.07

[a] Value of production, less costs of purchased inputs.
[b] Calculated from the lower part of the distribution curve.

[37] From the very informative discussion of the estimated variances, it appeared that the project staff rejected a lot of extreme yield values as too exceptional and therefore not valid for consideration. This attitude naturally led to a reduction in the range of yield they considered for each crop.

been taken into account. These could substantially increase the total risk associated with horticultural crops, making them less attractive than appears in Table 34.

The important effect of production costs on risk was also brought out when the recommended corn production method was compared with the one actually practiced by farmers (138). Returns to purchased inputs using traditional technology had a greater probability of being less than zero (P = 0.16) than those from using the recommended technology (P = .03). The latter had, however, a substantially greater production risk ($44/ha) than did the traditional method ($14/ha).

It may well be asked if the high risk associated with the recommended corn technology was the reason for the lack of adoption observed during the first year of extension activities. The last column of Table 35 shows that the ratio of risk to net return is greater for the recommended corn technology than it is for traditional corn or for horticultural crops.[38] From the farmers' standpoint the risk of adopting the new corn technology may be even higher than that shown in the table because, as already mentioned, many farmers could not conceive a yield increase as great as that which the project staff were claiming for the recommended technology, although the corn plan results for 1975 and 1976 later showed that the project's yield predictions were attainable under most circumstances.

Table 35. Production risk and net returns from potatoes produced with different levels of cash inputs (119).

Input level	Cost of inputs[a]	Net return	Risk
At zero cash	0	-190	190
At break-even point	56	0	139
At minimum risk point	125	172	107
Poorer group of farmers (n = 46)[b]	125	172	107
Wealthier group of farmers (n = 47)[c]	186	255	121
Maximum returns excluding cost of risk	209	278	139
For maximum returns	260	297	181

[a]Value of seed and fertilizer only.

[b]With total capital of U.S. $1600 and liquid capital of $195.

[c]With total capital of U.S. $4000 and liquid capital of $840.

Farmers' Practices and Production Risk

Differences in production risk naturally influence farmers' practices with respect to their allocation of land, cash, and labour resources to a wide range of possible production activities. However, it is extremely difficult to separate the influence of risk on such allocative decisions, from factors such as resource

[38]Again, horticultural crops look very attractive, but it should be recalled that marketing risks were not reflected in the risk measure used.

availability and costs. This task is made even harder by the presence of market and institutional risks.

Risk was examined in relation to the farmer's wealth level by comparing the use of purchased inputs in two groups of farmers with different wealth levels.

The behaviour of 93 farmers was studied in relation to whether in maximizing returns they accounted for or ignored *risk* in the production of potatoes (119). Risk was calculated as the expected value of the loss, using the production of potatoes as a function of the value of seed and fertilizer and the variance of this function at different cash input levels. In this way, risk and the net returns could be evaluated at several points along the production function including those representing the input level of the two groups of farmers being studied (Table 35).

The poorer group, whose liquidity (including cash, tools, implements, and all animals) averaged less than $200 per farm and who would have had to borrow to obtain the cash required for maximizing production, invested at or near the point of minimum risk. The second group of farmers had liquid assets averaging four times those of the first group. They could, if necessary, sell some stock to pay off their debts even though their average farm size was only 2.5 ha and they were far from being wealthy. However, apparently as a result of their greater assets, they invested nearly 50% more in purchased inputs for potato production than did their poorer neighbours. Both groups invested well below the level required to obtain maximum net returns.

Even if risk were considered as an added cost, the maximization of net returns would have required input levels in excess of those practiced by the second group of farmers. Because both groups needed credit for potato production, the difference in their input levels is striking. It is possible that it was due to risk aversion rather than to difficulties in obtaining credit as, although we have shown elsewhere that credit availability (and cost) for corn production was related to wealth level, this appeared to be of less importance with potatoes where production credit was more readily available and was widely used. It is conceivable that both factors played a contributing role in explaining the behaviour of the poorer group of farmers.

The data from Table 35 also illustrate why Caqueza farmers have moved to a relatively high cash input level for potato production. Whereas corn producers in the region employ limited cash inputs ($39/ha, Table 34), potato production is simply not possible without the use of substantial inputs. Even production at the break-even point required a greater cash input than did corn. Potato production in the Caqueza region, therefore, appears to represent a situation where low productivity and high risks at low input levels have forced farmers to either increase input levels or to avoid producing the crop. This type of situation is not well documented in developing countries but may be expected to occur with other high-cost, high-input-responsive crops, such as onions, tomatoes, and lettuce. These crops appear to fall into a category in which minimum risk is not associated with very low input levels. In the case of corn, the costs of seed and of planting are low, and production without fertilizer is such that some returns can be obtained without resorting to credit. In contrast to potatoes, corn production risk is at a minimum when very low cash inputs are used. This may explain why, in the early years of the project, farmers did not normally use any type of credit for corn production. This low-risk, low-input situation also appears to explain the farmers' limited interest in credit for corn production, compared with credit for producing potatoes, vegetables, or livestock, even though more than 60% of the cultivated land was sown to corn. It also helps to explain why farmers who

did receive credit for corn production in CAJA AGRARIA programs sometimes diverted this credit for other uses (31, 121).

To further evaluate the role of risk in small farm agricultural production, a sample of 120 farms was surveyed to identify the type of production activities, the area occupied by each crop or crop combination, and the farmers' estimated wealth level. Thirty-seven farms with commercial animal production (i.e., more than 2 horses or cows, more than 3 pigs, and more than 25 fowl) were discarded from the sample because no estimates were available on the variation of net gain derived from animal production activities. Measurement of farmers' wealth levels were based on the total value of their land, installations, and liquid assets, including tools, equipment, and animals. The crop production activities on the 83 remaining farms were grouped into 13 classes (Table 36). Values for cash and labour requirements, estimates for risk, and net returns per crop per hectare were derived at the farm level using the methodology described in Chapter 9. The total risk taken by the farmers was then calculated by adding the risks of each crop production activity, after having adjusted for the area dedicated to each crop.[39]

Table 36. Per hectare cash (U.S. $) requirements, net returns, and risks for 13 crop production activities in the Caqueza Project (1973 prices).

Crop	Relative area[a] (%)	Cost of purchased inputs ($)	Risk ($)	Risk per unit of inputs	Net return[c] ($/ha)
Corn-beans-broad beans	1.2	47	21	.45	55
Corn-beans	31.8	62	28	.45	43
Corn-broad beans	5.4	67	30	.45	50
Potatoes	11.2	315	145	.46	432
Potatoes-peas	3.4	353	167	.47	396
Beets	0.1	143	76	.53	468
Green beans	0.7	162	72	.44	576
Lettuce	0.7	132	59	.37	628
Tomatoes	7.6	247	108	.44	704
Onions	3.7	340	139	.41	984
Broad beans	1.1	68	35	.51	110
Peas	2.3	68	36	.53	110
Pasture (natural)	30.4	14	5	.36	21

[a]Reflecting land allocation in 6 veredas; 2 in Une, 2 in Chipaque, and 2 in Caqueza.
[b]Including exchange labour.
[c]Value of production less cost of purchased inputs.

[39]As follows: farm risk = $a_i R_i$, where i is the i^{th} crop, a_i is the area occupied by it, and R_i is the per hectare risk associated with it. A similar procedure was used for cash requirements. This presumes independence of cash requirements as well as risks for the different production activities. Given the estimate of risk used, this assumption, although hardly accurate, allowed, at least, an approximation of the aggregate risk taken by the farmers.

The average and common range[40] of values for the total acreage cultivated, the purchased inputs, and the total risk taken by the farmers, provided an insight into the typical crop production pattern in the project area (Table 37). Although a large portion of his farm is under corn and pasture, which are low-input and low-risk crops, the average farmer invested most of his cash in high value crops with a high per hectare risk. These crops had, however, approximately the same ratio of risk to cash investment as crops with low per hectare risk (Table 36). Farmers appeared to concentrate the use of thier cash on a relatively small part of their farm in production activities that provided a high return, be it at considerable risk. They appeared to keep the total risk to which they exposed their farm enterprise in bounds by planting a large area to a low-input, low-risk crop such as corn.

Table 37. "Common ranges" and averages of selected crop production measures of a sample of Caqueza producers.[a]

		"Common range" [b]		
	Average	From	To	Frequency[c] (%)
Effective farm size (*ha*)[d]	1.95	0.4	2.0	69
Purchased input level ($)	228	42	293	75
Risk ($)	102	21	130	66
Value of product ($)	908	232	1160	68
Return to cash ($)	681	162	928	78

[a]All measures of a per farm basis for the wet season (año grande) production cycle.
[b]Excluding from the range those values occurring with low frequencies.
[c]Percent of the sample included in the common range.
[d]Sum of cropped areas.

Wealthier farmers took substantially more risks than did poorer farmers (Fig. 28A). A farmer's wealth was also correlated to his level of cash investment in crop production (Fig. 28B). As expected, cash inputs were very closely related ($R^2 = .94$) to net returns. This relation was virtually linear across the range of cash inputs encountered (Fig. 28C). Net returns per dollar of cash input were almost $3.00 again stressing the potential benefit from higher cash investments in the production process at Caqueza. To obtain high returns farmers exposed themselves to higher risk (Fig. 28D). This was primarily the effect of higher cash inputs, as evidenced by the close correlation between cash inputs and risks taken per farm ($R^2 = .99$).

Conclusions

Differences in production risks among crops were much more a function of the cost of production than of variations in yield or value products. This occurred because costs varied to a greater degree than did yield variances and because an increase in costs was generally reflected in both larger probabilities of losses as well as higher losses. At a farm level, production risks appeared to be very closely related to cash inputs.

[40]Because frequency distributions of these measures were highly skewed, "common range" was employed to present the range in which the great majority of cases was encountered.

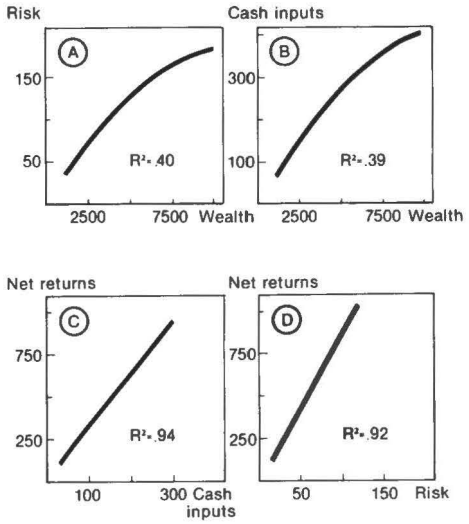

Fig. 28. *Relation of total wealth to risk and to cash inputs per farm and of risk and cash inputs to net returns per farm of Caqueza wet season crop production.*

Production risks did not increase uniformly with the cost of production when the latter was considered on single enterprise basis. As observed for potatoes and expected for onions, tomatoes, and other high-input, high-value crops, minimum risks were associated with reasonably high (compared to corn) input levels. Risks initially decrease, reach a minimum, and then increase as a function of cash inputs. For these high-value crops, farmers either apply the required

Improved housing for pigs, along with better breeds and feeding, were introduced to improve local pig production. (Photo: Ron Poling)

inputs or refrain from producing them altogether. For corn, production risks appear to be at a minimum at a very low level of purchased inputs. Beyond this point, risk increases as a function of the input level. The corn production method recommended by the project did not appear to be an attractive investment alternative as the risk per unit of net return was higher than that of most enterprises studied. It is also probable that farmers' perception of the corn recommendation is less favourable than its actual performance, which would make the recommendation appear even more risky to farmers.

Farm enterprise analysis showed that wealthier farmers used more cash inputs and took a higher risk per farm and per unit crop area. These increases were caused by increased use of production inputs, particularly for the cash crop enterprises, and by a shift of acreage from low-input, low-return crops to high-input, high-return crops. The second factor was a more important contributor to increased risk than the first.

The close relation between farm level production risk and cash input levels makes it difficult to separate risk from cash availability in their effect on farmers' decision-making in a situation where production capital is lacking. In the following chapter we will discuss the availability and cost of credit in the Caqueza area and describe the credit risk-sharing production plans that the project experimented with in its efforts to reduce the risk element associated with the introduction of new technology.

Chapter 12

Credit

Earlier chapters have indicated that throughout most of the year labour is not a limiting resource in the project area. They have also shown that the prospects for making more land available are limited by the high population density and the paucity of cultivatable land. Thus the prospects for increasing the resource base of the small farmer by giving him more labour or land are limited. The remaining major production factor is capital in the form of purchased inputs, particularly seeds, fertilizers, and pesticides.

Capital can be generated by savings or by using income to purchase investments, which, in turn, can be used as leverage to borrow capital. As traditional incomes from small farm agriculture barely meet consumption requirements, the provision of a surplus for savings or for investment is not readily forthcoming. The solution appears to be to redesign the mechanism for providing credit. This chapter discusses how this decision was arrived at and what steps were taken to evolve a new credit system.

Credit Requirements in Caqueza

Traditional corn-legume associations require very little in the way of purchased inputs. Although the production of this association has a nominal cost of U.S. $108 per hectare, much of this need not be in the form of cash as the hired labour can be "interchanged" (where the farmers work each other's fields as payment to each other), the seed can be held over from last year's production, and the fertilizer is often ash, chicken manure, or compost, all of which are produced on the farm. After deducting the imputed value of these inputs from the total costs of production, the residual "cash" outlay averaged only U.S. $22.

In the Caqueza area the corn-legume association is the production activity with the lowest capital requirement. Other crops required two to five times as much capital (Table 38). The smallest increase was for the production of improved corn that had just under double the cost of the traditional association. However, in terms of the minimum cash cost referred to above, traditional corn produced by the new technology (if covered entirely by purchased inputs) costs nine times as much ($208). Much of the new technology (especially the fertilizer) had to be purchased; thus, innovation forced the small farmer into the credit market. He had to borrow to become an innovator.

Table 38. Production costs for various crops in the Caqueza area (U.S. $/ha).

	Purchased inputs	Hired labour	Total cost	% increase over traditional corn-legumes: Purchased inputs	% increase over traditional corn-legumes: Total cost
Traditional corn associated with legumes	48	60	108		
Improved corn	128	80	208	167	93
Potatoes with legumes	348	161	509	625	371
Red beet	143	125	268	198	148
Leaf lettuce	132	133	265	175	145
Onions	340	132	472	608	337
Tomato	247	177	424	414	294

Credit in Small Farm Agriculture

The data presented in Chapter 9 showed that a traditional corn and legume crop barely paid for the opportunity costs of its production, although other vegetable crops and potatoes did do so. Indeed the returns from crops other than corn do suggest that the agricultural sector can compete with industry in terms of the effective utilization of capital. They indicate that subsidized credit for small farmers may be an unnecessary luxury in Colombia. This view lends support to those critics of subsidized credit who hold that it may be no more than a token mechanism, designed to promote income distribution, which in fact only serves to misallocate scarce capital resources away from the more productive sectors. This subject has been examined in great depth in the US-AID Small Farm Credit Review held in 1973 (81). The findings of this review indicated that:

(1) Subsidized credit, that is, credit with interest rates less than the sum of the real interest rate on capital plus the inflation rate, runs the risk of decapitalizing the lending institution, and thereby causing eventual bankruptcy.

(2) Low interest rates from the government bank discourage commercial banks from seeking a small farmer clientele. Small loans are more costly and riskier than larger loans, and hence, commercial banks are not apt to raise the proportion of small loans in their portfolios.

(3) Subsidized credit leads to the concentration of credit in the hands of the large farmers. As interest rates fall below equilibrium (opportunity cost) levels, demand exceeds supply and an informal form of credit rationing emerges, based on the lending institution's financial criteria, namely, land titles, larger farms, better credit history, large sums to reduce management costs, the best producers, etc., all factors that work against the small farmer.

Juxtaposed with these criticisms against low interest rates are social justifications in favour of low interest rates. The first is that "infant industries" must be protected, which implies that the small farmers cannot initially compete at the opportunity cost level of capital. Second, because the demand for credit is relatively elastic, a lower price would ensure a larger market for it. And third, low interest credit is politically used as an income transfer program, a gift to the rural poor. However, none of these arguments in favour of low interest rates appears

to be substantiated in economic terms. As we have mentioned earlier, returns to capital employed by the small farmer can be adequate vis-a-vis the free market price of capital; the demand for credit in small farm regions has not been found to be highly price-elastic; income transfers can be much more efficiently accomplished through other means; and lastly, political tokens (gifts to the rural poor) may be effective only for a short time (when the facade is penetrated, the program backfires).

On the other hand, it has been argued that these subsidized credit systems may function as leverage to attract the small farmer's owned resources as counterpart funding in situations that would otherwise suboptimally employ such resources. Farm credit programs with low interest rates may mobilize greater capital investment levels than would be the case if interest rates were at the level of the opportunity cost of capital.

An argument for "cheap" credit, which has not really been considered in this presentation, emerges from the discussions on risk in earlier chapters. If the small farmer treats risk as a cost premium (Table 33) to which he adds the cost of other inputs, profit-maximizing behaviour that sets the marginal value product equal to the price will result in an optimum input level substantially below that which considers the real price to be equal to the market price (risk premium = 0). Given this situation, a credit program that provides capital at a lower cost may function as a program that, at least to some extent, ensures against risk. Nevertheless, a credit program with what would be in effect a negative interest rate (if this were to be the Colombian case), would be hard to maintain in the long run and would clearly decapitalize the lending institution involved.

When it became apparent to the Caqueza team that credit was a major constraint on the adoption of technology, they set out to examine this subject and in the course of doing so shed significant light on the subject of credit costs (74).

Credit Studies in Caqueza

Sixty-three farmers in the Caqueza area were interviewed during the first half of 1974 regarding their credit behaviour. The interviews took place over a 2-day period in each case and involved detailed questions to establish the farmer's financial status and his use of capital. All interviews were conducted by the same graduate student.

Source of Credit

Four different sources of credit were identified: institutional (government or private banks); relatives; friends (including the local moneylender, the small farmer's "best" friend); and local tradesmen. Institutional credit had the lowest nominal interest rate but accounted for only 30% of loans in 1973. Relatives supplied 27%, friends 34%, and tradesmen 9%. Loans from institutions and tradesmen had average values of more than double the values of loans obtained from relatives and friends. Although individual loans averaged only U.S. $334 in 1973, the average family indebtedness was 39% larger than the average cash requirement ($700) for crop production in the project area, as credit was used for livestock production as well as for consumption.

Farmers questioned in the credit survey were asked about their credit requirements for their next (1974) crop. Loans expected from relatives, friends, and tradesmen were similar in value to those received in 1973, but borrowing

from institutional sources was expected to rise dramatically with loans averaging 69% more than in 1973.

The principal institution lending to small farmers in the Caqueza area was the CAJA AGRARIA. The CAJA offers supervised credit to small farmers through an interagency agreement with ICA in which ICA supplies technical assistance and production planning. The criteria for loaning to small farmers are based on his credit rating (morality in his business relations) and his productive capacity (to assure the generation of sufficient funds to repay the loan). However, the process for obtaining a loan is tedious and cumbersome, and usually involves several visits to the local CAJA office. If the farmer had never had a loan before, an analysis of his farm's balance sheet and a personal visit by a CAJA inspector had to be done. These inspectors handle a large number of loan requests and have to rely on public transport to move around. As a result of this, and the bureaucratic nature of loan processing, credit is often not available at the exact time when the farmer needs it for purchasing seed or fertilizer. Thus, even though farmers recognize that the CAJA's credit comes at a relatively low cost, its unreliability tends to make them establish credit relations with relatives, friends, or tradesmen, all of which tend to be much more flexible. Local moneylenders are regarded as "great friends and magnificent collaborators" because they always have a supply of ready cash that they will lend at planting time when the farmers' needs are greatest. Moneylenders often obtain their cash from the CAJA by borrowing production credit for large units of land. They then rent this land or farm it in partnership, and use the borrowed cash for loaning to others at higher interest rates than those at which it was borrowed from the CAJA. The small farmer is aware of this but does not complain because it provides him with his only certain source of ready cash, even if its cost is high. There is another advantage to borrowing from moneylenders: they are more tolerable about slow repayments after a bad harvest than is the CAJA.

There is a complex interrelation between the credit sources in the Caqueza area: often one loan simply pays off another. In particular, loans from relatives tend to be used for this purpose and were the smallest ($146) and the shortest (1–6 months) of all loans. Loans from friends were somewhat larger and of longer duration. Credit from tradesmen was generally for 90–180 days and had higher interest rates than other credit. Institutional loans were generally the largest and usually had a duration that covered the life cycle of a corn crop, which was 8–9 months in Caqueza.

Farmers were questioned about the quantity of credit available in relation to local needs and also about the ease of obtaining credit. The responses indicated that 18% felt that credit was scarce and 71% that it was "very limited." Only 19% obtained their credit easily and 52% found it very difficult.

Credit Costs

The credit study also determined the additional costs associated with loans received during 1973. For each of the four credit sources, costs in addition to the nominal stipulated rate were established for (1) processing and legal charges; (2) opportunity costs for time lost by not receiving the loan when requested; (3) overpricing; (4) cost of travel required to obtain the loan; (5) gifts to codebtors; (6) gifts to inspectors; and (7) other charges.

The method used for transforming these costs into annual interest rates was:

$$i = \frac{C}{V} \times \frac{(TP)}{12} \qquad (1)$$

where i = annual imputed value of the interest rate; C = imputed cost or payment of the activity; V = total value of the loan; TP = time period of the loan (months).

At the time of this study the nominal rate for institutional credit was 13% (1% of this being a life insurance premium). In reality this situtation represented a negative real interest rate, as inflation at that time was 20% per annum. Furthermore, much of the institutional credit for agricultural development in Colombia is derived from dollar sources and the devaluation of the peso against the dollar was 8% in 1973. Bearing in mind inflation and devaluation, it is obvious that the Colombian small farm section was being subsidized through the institutional credit system in 1973. However, Table 39 shows that very little credit at 13% reached the farmer. The average cost of loans was 35% using institutional credit; 43% borrowing from relatives; 44% from "friends" (the moneylenders); and 50% from tradesmen.[41] The average interest rate on all loans was 42% by number or 47% by value.

Table 39. Real interest rates of credit from various sources (Caqueza 1973).

Source of funds	% of total no. loans	Nominal (stipulated) rate	Processing and legal costs	Over pricing	Gifts		Travel cost	Opportunity cost	Other costs	Total
					Co-debtor	In-spector				
Institutional	31	13.2	6.0	-	0.4	2.3	4.8	8.1	0.1	34.9
Relatives	25	24.0	3.4	0.1	-	-	7.2	8.4	0.3	43.4
Friends	36	25.2	4.4	0.1	-	-	7.0	6.9	0.1	43.7
Shopkeepers	9	2.4	-	45.9	-	-	0.2	1.6	-	50.1
Weighted average	(100)	19.4	4.3	4.2	0.1	0.7	5.8	7.2	0.1	41.8

Although these "real" interest rates are very high, they must be interpreted with caution, as some of the imputed credit costs can be interpreted in different ways. For example, travel costs were calculated on the assumption that a half-day spent negotiating a loan cost the farmer a half-day of farm wages. This is not strictly the case, as many loan negotiations take place on holidays or prior to the growing season at a time when there is a large measure of unemployment. The "operating cost" charge, which refers to the earnings lost from not being able to put the capital to "work" from the time the credit was solicited to the moment when the credit was actually received by the farmer, also needs careful interpretation as such delays occur with all farm credit negotiations.

Apart from travel and opportunity costs, the cost of credit includes nominal costs, legal processing fees, charges due to overpricing, and the cost of gifts (which are unavoidable in most instances).

Correlation between Interest Levels, Wealth, and Incomes

An attempt was made to relate interest levels to various socioeconomic indicators. The most important conclusion arising from this analysis was that the interest rate was negatively correlated with wealth and income levels. The poor paid more, the rich less. To a certain extent, this was because it costs just as much to process a small loan as it does a large one. As will be discussed later, the

[41] In the nonformal credit market, the more distant the personal ties between lender and borrower, the higher the interest rates.

smaller farmers (by definition possessing less wealth and having lower incomes) borrowed smaller sums.

The duration of loans was directly related to their size, bigger loans generally having a longer duration than smaller ones. This factor, combined with the inverse relation between interest rates and loan values, led to longer-term loans having slightly lower interest rates. There was a difference in total interest in terms of wealth levels, with wealthier farmers paying as much as 12% per annum less interest than poorer ones. A similar situation existed in terms of interest rates and farmers' incomes. To examine the relation between the socioeconomic characteristics of the farmer and his access to credit, the debt-equity ratio was related to farmers' income and wealth, their age, and the interest they paid on their loans. There were significant effects of age (negative) and interest rates (positive) as well as of wealth (negative) and income (positive), but the effect of income was not significant. However, the sizes of all coefficients for these variables were so close to zero that the debt-equity ratio remained constant in the population sampled. The average debt-equity ratio was 22%.

In addition, regressions were used to compare wealth and income with the nominal interest rate and the extra costs required to obtain credit. Wealth and income were not related to the nominal interest rate, but were related to the extra costs in a way similar to that identified for the total cost of credit (nominal plus extra costs). In fact, lenders did not overtly charge higher rates to poor borrowers. Instead, by failing to attend to their requests with due process and by procrastinating delivery of the credit, they forced the poorer borrower into feeling that he must "entertain" the moneylender more, in the sense of gifts, drinks, transportation, etc., thereby raising imputed costs. Also, the poor creditor borrowed small amounts. Because the opportunity cost for travel and time spent is the same for borrowing $100 as it is for $1000, the costs per dollar borrowed were greater for small loans. For these reasons, the imputed costs, when translated into an interest rate, contributed significantly toward creating a situation whereby total interest rates were higher for poorer borrowers.

Further regression analyses showed a good correlation between the sizes of loans and the farmers' wealth level and credit worthiness. Credit worthiness as obtained from the CAJA was to a certain extent related to age and education, with the better ratings corresponding to younger but more educated farmers.

These results indicated that the lower income third of the farmers, who primarily grew low input corn–beans, could obtain $300–600 credit per year at an interest rate of 40% (i.e., a cost of $120–240 per year). With an effective farm size of 2 ha, the traditional corn–bean production would require from $50 to $220 in total production costs and from virtually nothing to $100 in purchased inputs. Two hectares of improved corn would require $420 in total costs, of which $260 would be for purchased inputs.

Loan Programs in Caqueza

During the 5 years covered by this book, considerable changes took place in Colombia in conceptions about agricultural production credit. Before the RDPs came into existence, very little credit was focused on the small farmer who had to compete for his production credit with more educated and politically powerful large farmers. During the first year of the project, the Colombian government developed a loan agreement that provided funds to the CAJA

A simple brick-making machine was used to make blocks. (Photo: Jack Redden)

AGRARIA specifically for small farmer credit. However, the first year of the project's credit program activities (1972) indicated that changes in the availability of credit to small farmers, and the allocative flexibility that was required, were not going to be achieved rapidly. It became apparent that although a good start had been made by the CAJA, its operations at the local branch level were still based on traditional banking procedures. The project staff felt that the lack of success of the credit-assisted technical assistance was to a great extent due to a lack of farmers' comprehension of the credit system and to their concern about the high risks involved in utilizing more cash-intensive production methods.

There was, however, no proof that a restructuring of credit would achieve greater adoption of improved technology. There was no concrete information with which to provide planners and administrators with at least an idea of the potential that existed for alternative formulations of small farmers' credit. This led the project to develop and test the alternative credit scheme that is described in the following pages.

The ICA-CAJA AGRARIA Credit Program

After the first year of adaptive research had provided new information on potato and corn production, a loan agreement was established whereby the CAJA AGRARIA would provide loans equal to the value of purchased inputs for small farmers who agreed to apply ICA's "package" of technological recommendations. In turn, ICA was responsible for supervising the field application of this package.

In practice, the system proved difficult to control. ICA project staff were responsible for identifying farmers for the credit program and assisting these farmers in developing their production plans. The CAJA AGRARIA, however, reserved the right to make the final selection of loan candidates. This selection was based on credit worthiness, a previous connection with the CAJA, an

inspection of their farms, and the ownership of a title to sufficient land to form a reasonably sized production unit. This left out a large number of farmers who had been actively cooperating with the project in its on-farm research and extension programs. In addition, ICA's staff objected to the role of policing the farmer's credit utilization, as they rightly felt that this would compromise their role as champions of the farmers' cause. As a result, planned supervisory visits at the time of planting, weeding, or fertilizing did not always take place. Instead, orientation meetings were held at which farmers receiving credit and their neighbours discussed ICA's recommendations.

The project staff felt that the key to increased agricultural production was to change corn production methods in the region. They hoped that by increasing the productivity of corn, the area planted under this crop could be reduced, thereby allowing expansion of the acreage under high value crops such as onions and tomatoes. To achieve this goal, corn production credit was a must.

In response to this situation, the project developed an experimental credit program that was managed through the local cooperative. Sensitive to earlier failures of adoption of the corn recommendation, the project staff carefully evaluated the economic merits of their past recommendations (Fig. 29), and concluded that the lack of acceptance was due to (1) the high cash requirement; (2) the low return to cash; and (3) the high risk involved (80). The new credit program formulated by the project staff set out to remove these limitations.

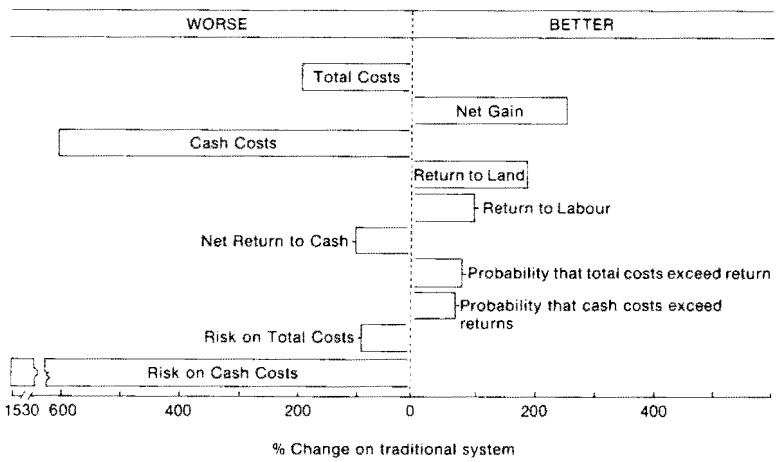

Fig. 29. *Costs, productivity, and risk of the corn production method recommended for 1974 (58, 138).*

The 1974 Corn Production Plan

The project staff examined two strategies for risk reduction in corn production. The first was a crop insurance plan. This would insure production against the hazards of weather and other identifiable yield-reducing factors, but within the framework of an operational project it was not possible to devise a comprehensive crop insurance scheme. The alternative strategy, which was the one adopted, was to test the hypothesis that production risk was a major constraint to technology adoption by developing an experimental risk-sharing plan that would actually reduce production risk. It was recognized that because of its

nature, this plan would have to operate somewhat on a trial and error basis, both of its value to the farmer and of its operational nature on a large scale.

Because of these limitations, the original goals of the ICA-CAJA AGRARIA loan arrangement in the corn program were only partially achieved. The first study of adoption rates by the participants in the ICA-CAJA AGRARIA program showed that the adoption of the corn production technology was much less than expected. It was evident that much of the credit was invested in consumption or different production activities.

The second year's operation of the ICA-CAJA AGRARIA agreement was somewhat more successful from the point of view of adoption rates. Considerable administration problems, however, continued to prevent the smooth operation of the program. These problems included the inspector's lack of time and mobility. This was compounded by a late allocation of the corn credit quota to the CAJA branches in the project area. In 1974, credit for corn under the ICA-CAJA agreement was discontinued, basically because the CAJA considered that the failure to allocate the credit assigned to Caqueza in the previous year meant that corn credit was not necessary. They failed to realize that the late release of credit had inhibited the allocation of 1973 loans. This type of problem lay outside of the control of either the farmer or of ICA, but both suffered from the occurrence. However, instead of lending to the earlier provision of corn credit in 1974, all such credit was cut off.[42]

The plan was formulated in such a way that farmers would not have to pay the additional costs of the new technology if for any reason they incurred losses through its use.

The plan was based on a yield estimate of 2740 kg/ha for the recommended technology. This average yield estimate was derived from all measured yield data obtained by the project. Experimental yields were deflated by 20% for yields up to 3000 kg/ha; and by 30% for yields of 3000–3500 kg/ha; the maximum yield (experimental or farmers' fields) allowed was 3500 kg/ha. Farmers were exempted from paying any of the purchased input costs for the new technology if the yield did not exceed 800 kg/ha (the yield level they normally obtained). Any yield above 800 kg/ha was to be divided equally between the farmer and the project. In this manner, the farmer whose crop yielded the target 2740 kg/ha could expect to retain 1770 kg/ha after payment of 970 kg/ha to the cooperative.

The plan provided credit in the form of fertilizer, improved seed, and insecticide, at the exact level that was recommended by the project staff, provided that the farmer agreed to the risk-sharing contract. This contract stipulated (*a*) that the farmer should identify the plot he was going to plant so that the project agronomist could adjust the level of inputs according to the soil type and plot history; *(b)* that the farmer should adhere to the agronomist's recommendations. The farmer's credit worthiness was not examined — and after one visit to the project's office, followed by signing of the contract and paying a fee of $10, the farmer was able to receive his inputs from the local cooperative, which acted as the exchange agent for the corn plan.

Project staff visited approximately 80% of participating farmers at planting time and a similar number at the time of their second application of fertilizer. Before harvest time, yields were estimated by sampling three to five areas of 10 m^2 on each farm. Farmers shelled the corn with small single cob shellers loaned

[42]It should be noted that a good portion of this problem was based on the fact that the relation between the CAJA AGRARIA and ICA at the local level was competitive and not complementary.

to them by the project. The project helped the farmers transport their grain to the cooperative. They moved approximately 60% of the grain and retained the residue. The cooperative sold the grain belonging to the corn plan as well as any surplus belonging to the farmers.

There were considerable difficulties with the operation of the corn plan in 1974. The plan was formulated in some haste at the end of February, when it became known that no corn credits would be available from the CAJA AGRARIA. The plan was approved and funds for it were made available by ICA barely a month later, in early April. Farmers had already planted most of their corn by that time. For this reason, the project was only able to place credits worth $1300 out of the $2000 allotted for the plan. These credits were placed with 27 farmers, and covered a total of 12 ha (or just under 0.5 ha per farm). Most of the farmers participating were from the drier area of the project where corn is planted later than in the rest of the project area, and where yields tend to be low in dry years. Unfortunately, 1974 was exceptionally dry during the later part of the year and the farmers' yields of traditional corn were estimated to be only 600 kg/ha rather than the normal 800 kg/ha. However, participants in the plan did not suffer unduly from the drought because of earlier maturing varieties and better fertilization.

Some yield reduction did occur, however. Yields under the plan were also reduced through an organizational mix-up. There was no clear agreement about who would harvest the share of the cooperative, who would provide packing and transport of produce, and who would receive the damaged corn not suitable for marketing. To convince the farmers to harvest their share of the cooperative, the project allowed them to keep the damaged corn.

The results of the plan (Table 40) show that yields estimated by field sampling were consistently higher than yields reported by farmers. There were

Table 40. Yields, costs (U.S. $), and returns of the 1974 corn production plan (planned and actual), compared with data from farmers not participating in the plan.

	Corn plan (/ha)		
	Planned	Obtained	Nonplan farmers (/ha)
Entry fee ($)	10	10	
Land, labour, and land preparation ($)	102	102	102
Cost of purchased inputs ($)	106	109	22
Average yield (kg/ha)	2740	2030(2650)[a]	600
Yield paid to the plan (kg/ha)	970	450(615)[b]	-
Corn retained by farmer (kg/ha)	1770	1580	600
Corn price (¢/kg)	15.8	17.4	17.4
Net earnings of the farmer ($)[c]	168	163	-20
Net earnings of the plan ($)	48	-24(6)[d]	

[a] Estimate of actual yield in parentheses (as opposed to yield declared by farmers).

[b] The amount farmers should have given to the plan, based on the project's estimate of actual yields (2650 kg/ha), is given in parentheses.

[c] Value of production less cash, labour (including family labour), and land costs. Earnings to farm enterprise are higher by $70/ha.

[d] Net earnings, based on the 615 kg/ha that should have been received, are in parentheses.

several cases in which farmers harvested part of their corn as green corn. Two cases were documented in which farmers withheld a sizeable part of their produce at the time of yield estimation. The plan, in addition, had not considered the 5–7% loss in yield due to damaged corn, which it gave away to the farmers.

Further losses occurred after the time when yields were agreed upon with farmers. The cooperative did not receive the amount it should have because it did not weigh produce received, but rather estimated weights by the number of bags. A combination of various factors, as well as handling losses, resulted in the plan losing 165 kg/ha or 17% of its expected returns. Without such losses, the plan would have come close to its target. Farmers participating fared much better than the corn plan sponsors (Table 40). Even with the farmers' reported yields (undoubtedly below the actual yields obtained), plan participants earned nearly as much as planned for in the design of the plan. Their net return was over $170/ha above that obtained by nonparticipant farmers during the same year. Whereas at least half of nonparticipant farmers obtained negative net returns (after deducting total costs), no participant farmers had negative net returns and the lowest yield obtained was 1140 kg/ha, which netted that farmer $57/ha.

An evaluation of the 1974 plan results led the project staff to conclude (102) that:

(1) The productivity of their recommendation was essentially as expected.
(2) The plan had been inadequately managed because of lack of familiarity with all aspects of the production system.
(3) The plan required too much time for field visits, particularly at harvest time.
(4) It was necessary to devise a system other than yield estimation for calculating repayments to the plan.
(5) Farmer-reported yields — even with inspection — should be expected to run 15–20% below the actual yield.
(6) The corn plan could increase its capital base substantially if the project were to impose even a light field selection, avoiding the farmer's choice of the poorest field. The project discussed various ways to overcome the drawbacks of the 1974 plan, but refused to resort to the selection of better fields as a means to improve the economic viability of the plan. They felt that the farmers in the drier parts of the project might suffer from this decision and these were precisely the farmers who need the most help.

The 1975 Corn Production Plan

An alternative design was used for the corn plan in 1975. This allowed the project to reduce the amount of staff time spent per farmer cooperator. The first measure was to change the yield-sharing arrangement in the following manner:

(1) Farmers obtaining yields below 800 kg/ha did not have to repay anything for the inputs received.
(2) Farmers with yields above 1700 kg/ha would deliver to the plan 900 kg/ha of shelled and bagged corn before 10 January 1976, to a specified pickup point in their area.
(3) Farmers with estimated yields between 800 and 1700 kg/ha were responsible for requesting, well before harvest time, an inspection of their field at harvest time. The expected yield would be agreed upon,

and the farmer would return any yield above 800 kg/ha to the cooperative. Project calculations (103) showed that yields between 800 and 1800 kg/ha would occur in only 20–25% of the fields, so that yield inspection at harvest time would be necessary for only a quarter of the farmers involved in the plan.

The second new measure was to simplify the production recommendations. Results from 2 years of study of the time and methods of fertilization had shown that 80 kg N/ha applied 35 days after planting gave the same or a better yield as the split application of 100 kg N/ha. The phosphorus fertilization could also be reduced in certain municipalities or, if the field had been heavily fertilized (onions or potatoes) the year before. This change in the fertilizer recommendations made crop establishment a much less critical time for field visits and allowed for a bigger spread in the time of visits for fertilizer application. The reduced supervision required during the crop growth period in addition to the reduced need for harvest inspection and yield estimation, cut supervision time per farmer to one-third of that in 1974. The reduced fertilizer inputs also allowed the plan to keep its input cost at the same level of the 1974 plan, even though fertilizer prices had increased substantially.

The plan organized the following sequence of activities in 1975:

(1) Farmers registered their desire to obtain credit with the cooperative or with project staff.
(2) Project staff carried out a field inspection, measurement and agronomic classification of the field, selection of the recommendation, and drafting of the contract with the farmer.
(3) Contracts were prepared at the project office.
(4) The staff met with cooperating farmers to explain the operation of the corn plan and the contract that was necessary. Farmers paid entry fees, signed their contract, fixed planting dates, and obtained authorization to withdraw the required inputs from the cooperative. Farmers were told that most of them would be visited at planting time, but that they should not wait for the visit of project staff but should plant when planned and as appropriate.
(5) Staff carried out trouble-shooting field visits to 30% of the farmers at planting time.
(6) Staff visited all farmers at or shortly after the time of fertilization, to ensure correct application.
(7) Staff carried out periodic visits to cooperating farmers as part of the general activities of the project. Field days were held on selected farms. In conjunction with these activities, project staff identified, in consultation with the farmers, those fields that would need to be inspected because yields appeared likely to be below 1700 kg/ha. Farmers were discouraged from requesting yield inspections at harvest time on fields with yields over 1700 kg/ha by charging for such visits.
(8) Corn shellers were distributed to farmer groups.
(9) A yield determination was done of fields with yields below 1700 kg/ha.
(10) Produce was collected to be sold by the cooperative.

The plan was undoubtedly less favourable than the one of 1974 to farmers with yields between 800 and 1700 kg/ha, as they would not benefit from the plan. In 1974, farmers obtained benefits at the intermediate yields (Fig. 30). Only farmers with yields over 2600 kg/ha would receive more corn under the 1975 plan. Theoretically, this would be more than half the farmers. The 1975 plan was, however, much more advantageous to the project than was the 1974 plan.

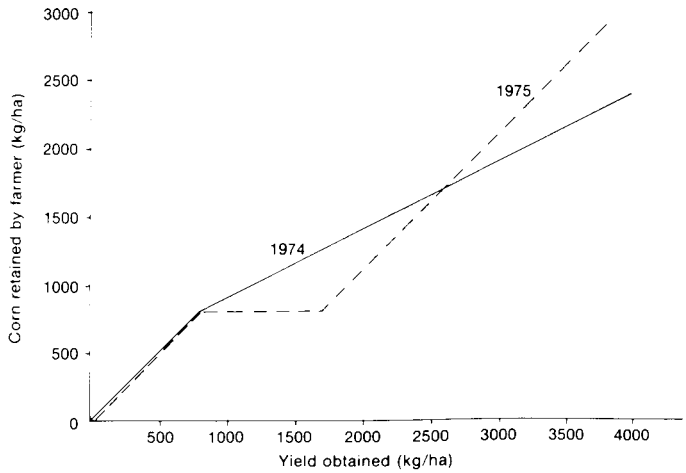

Fig. 30. *Corn to be retained by farmer according to 1974 and 1975 corn plans.*

In 1975, the project's income from the plan was derived entirely from yields between 800 and 1600 kg/ha, whereas in 1974, part of this income had to be derived from yields above 2700 kg/ha. The project's risk was therefore reduced. More important, however, the number of project-to-farmer interactions required for the execution of the plan was reduced to one-third of the 1974 level. Without the tedious and time-consuming yield estimation for three-quarters of the farmers, the project technicians were able to handle a much larger number of farmers in the long run.

Another advantage to the plan was that the range of yields in which farmers had been withholding part of their yields (over 2000 kg/ha) would no longer affect the income of the plan. This enabled the project to allow farmers who were not going to request inspection (expected yields above 1700 kg/ha) to sell part of their corn as green corn (a substantial advantage for the farmer).

The 1975 corn plan included an item for miscellaneous costs to the plan. This was included to allow for unforeseen costs such as packing materials and repairs to corn shellers and to allow a larger margin of error in the execution of the plan.

The execution of the 1975 corn production plan suffered from some of the same weaknesses as in 1974. Farmers reported yields that were higher than in 1974 (Table 41), indicating, as did experimental results, that the change in recommendation had paid off well. There were 37 farmers in the plan, planting a total of 16.5 ha of corn. Of these, 11 (30%) requested inspection because yields were expected to be below 1700 kg/ha.

Certain farmers did not pay the entry fees or paid them only partially. The farmers payments in kind, after harvest, to the plan fell considerably short of the amount agreed upon. This yield loss was mostly due to the management of the plan, as the produce was again not weighed at the collection points. Instead, farmers left the number of bags they felt would be adequate to cover the amount they owed, and the project did not inspect this amount until the time of sale at which time it was too late to make any corrections.

Net earnings of the farmers were higher in 1975 than in 1974 because of the higher yields obtained. Earnings again increased because the farmers did not meet their full obligations to the cooperative. Had farmers done this, their net

Table 41. Yields, costs (U.S. $), and returns of the 1975 corn production plan (planned and actual) compared with data from farmers not participating in the plan.

	Corn plan (/ha)		
	Planned	Obtained	Nonplan farmers (/ha)
Entry fee ($)	10	7.50	-
Land, labour, and land preparation ($)	102	102	102
Cost of purchased inputs ($)	93	92	32
Other costs of the plan	13	6	-
Average yield (kg/ha)	2740	2370[a]	1000
Yield paid to the plan (kg/ha)	813	549(804)[b]	-
Corn retained by farmer	1890	1821	1000
Corn price (¢/kg)	16.8	16.7	16.7
Net earnings of the farmer ($)[c]	205	195	33
Net earnings of the plan ($)	47	-5.80(36)[d]	

[a]Farmers' reported yields.

[b]The amount farmers should have given to the plan, based on the project's estimate of actual yields (804 kg/ha), is given in parentheses.

[c]Value of production less cash, labour (including family labour), and land costs. Earnings to farm enterprise are higher by $70/ha.

[d]Net earnings, based on the 804 kg/ha that should have been received, are in parentheses.

earnings would have been $152/ha rather than the $195 that they actually obtained. In fact, the cooperative sustained a loss of $6 per participant because of its poor management in claiming the corn due to it.

The 1975 Onion Production Plan

Surveys of farmers had shown that onion yields in the project area averaged 8.8 t/ha (114), with two-thirds of the farmers' fields yielding between 3 and 13 t/ha. This compared with experimental results of between 25 and 30 t/ha. The difference between these two production systems were essentially the higher use of fertilizer and the use of a disinfected seedbed method (as opposed to the onion sets) for crop establishment in the experimental trials. The project's research had stratified fertilizer recommendation on the basis of the production potential of the field (irrigated vs nonirrigated, type of crop previously grown, and wet vs dry season). The expected yields and the estimated standard deviations were such that a great potential existed for a self-financing credit scheme.

An onion credit plan was, therefore, established using a similar model to that of the 1975 corn plan (Table 42). Farmers obtaining yields below 8 t/ha paid nothing to the cooperative; farmers with yields between 8 and 12 t/ha were required to ask for an inspection of their fields and had to return any yields above 8 t/ha to the cooperative; and farmers with yields over 12 t/ha had to return 4 t/ha of dried, cleaned, and bagged bulbs to the collection points agreed upon. The cooperative provided the marketing services.

In the case of onions, the high return to cash used made the formulation of the plan a simple matter. No experimental yields below 15 t/ha had been observed so that the number of fields with yields below 12 t/ha was expected to be

Table 42. Yields, costs (U.S. $), and earnings of the 1975 onion production plan (planned and actual) compared with data from farmers not participating in the plan.

	Production plan (/ha)		Nonplan[a] farmers (/ha)
	Planned	Obtained	
Entry fee ($)	10	10	-
Land, labour, land preparation, bags, & rope ($)	300	300	272
Cost of purchased inputs ($)	385	384	351
Average yield (t/ha)	20.0	22.6	9.2
Yield paid to the plan (t/ha)	4.0	4.0	-
Yield retained by farmer (t/ha)	16.0	18.6	9.2
Price ($/t)	130	106	106
Net earnings of the farmer ($)	1770[b]	1660	488
Net earnings of the plan ($)	135	40	-
Interest on credit of Plan	35%	10%	

[a]Based on yield and expenditures of intermediate group onion growers (horticultural production survey, 114).
[b]Value of production less total costs.

minimal. In addition, even though the project assumed 55% of the production costs (seed, fertilizer, insecticides, fungicides), the farmer still had a sizeable investment in his onion fields. This meant that field selection proved to be no problem, as farmers supplied their choice of field for the onion plan.

There was $1660 available for the onion plan, which was entirely committed and spent on 35 farmers' fields, covering a total of 4.15 ha, with an average plot size of 0.12 ha. The project selected farmers who were unable to obtain the large amount of production credit required for onion production from other sources, many of whom had not been growing onions before. The average yield obtained was 22.6 t/ha, which was above the 20 t/ha yield used for the calculation of the plan. No farmer had yields below 12 t/ha.

The disappointing feature of the plan was the price obtained for the onions. Prices varied from $87/t to $132/t, but the average of $106/t was well below the lowest 1974 price on which the plan was based. Onion prices in 1974 ranged from $150/t to $230/t. The low price greatly reduced the return obtained by the plan from its investment. Overall, the results were clearly rewarding for the project staff. Farmers were very enthusiastic and expressed their desire to continue with the plan. Through field days, many onion growers in the project region became convinced of the use of seed beds as a high-yield-producing technology. There were, however, still difficulties with delivery of the farmers' contribution to the cooperative. The project staff had to follow up a number of farmers to obtain the produce that they owed the cooperative. Farmers did not object to being told that their delivery was short of the required amount, as they candidly admitted that they had difficulties estimating this amount correctly.[43]

[43]On a .12-ha lot, the total amount owed to the cooperative would be 480 kg. This modest amount readily lends itself to estimation error.

General Comments on the Experimental Production Plans

The production plans changed the project staff's attitude toward extension. They now had a close interest in the economic adequacy of their recommendations, as they had to have an immediate concern for the availability of both the required inputs and the necessary markets. Needless to say, corn and onion price changes were closely followed by the project staff. The production plans clearly established the superiority of the recommended practices and proved a valuable extension tool for the adoption of the recommendation (see next section of this chapter). Farmers who had participated in the 1974 corn production plan generally continued to apply the recommended practices even though 20 of 27 did not receive support from the plan in 1975, as the project had decided to work as much as possible with new farmers to obtain a greater extension effect. They also gave preference to smaller farmers in the less productive regions of the project.

There appeared to be some desire on the part of the project staff to bias the production programs in favour of the farmers. The staff refused to exclude farmers from the poorer corn-producing regions of the project and a disappropriate number of fields from this region were included in 1975. This probably biased yields downward. In the case of the onion program, the project could easily have charged a return of 5 t/ha by placing the cutoff point at 13 t/ha instead of 12 t/ha. This was not done because the project staff considered the production programs to be more of an extension tool than a program that would eventually lead to a strong capital-accumulating local action program.

The result from the production plans showed that credit could be effectively linked to technical assistance. The following features of the plan appeared to be important:

(1) It required careful evaluation of the expected returns from the recommended practices;
(2) Responsibility for credit, inputs, technical assistance, and marketing were combined in one program;
(3) The efficiency of the technical assistance component could be analyzed and evaluated. In 1975 the corn program reduced its man-hour/farmer requirement to one-third of the 1974 level. It also considerably reduced travel costs associated with technical assistance.
(4) Precise goals were formulated in terms of number of farmers, amount of credit lent, inputs to be applied, practices to be followed by farmers, and yields to be obtained. This gave the project a much stronger focus in its action programs.
(5) A definite evaluation of the program's effectiveness was built in as the amount of cash necessary after a year of operation had to be accounted for.
(6) Farmers' adoption and the performance of recommended practices could easily be evaluated by follow-up studies.

These advantages were widely recognized by rural development directors in ICA, and several production plans (wheat, onions, tomatoes) were decided on for 1976 in Caqueza or related projects. These plans involved a limited number of farmers and were essentially considered as extension tools.

The inclusion of the principles of risk sharing and technical assistance into large-scale credit programs will require further experimentation. This should further reduce the technician's time required per farmer by reducing the time required for the field identification and by relaxing the number of inspection

The blocks produced by the simple brick-making machine could be cemented together by the farmer himself. (Photo: Jack Redden)

visits at fertilizer application time. For the 1975 corn production program, one field technician coped with 35 farmers, the limiting effect being the requirement to measure and inspect the field to formulate the recommendation and draft the contract. The onion production program, which had the advantage of a wide distribution of planting dates, was handled by one professional and two field assistants, all on a part-time basis.

Adoption of Technology in Caqueza Credit Programs

In the Caqueza area, technology adoption in corn without credit or supervision was minimal. The weighted average of the partial adoption rates of the specific components of the recommended package in programs without formal credit or supervision reached only 15% by 1975. Adoption rates in credit programs with supervision were slightly higher (20%). Credit programs that included supervision attained higher adoption levels (42% in 1973), but, only when risk-sharing components were included, were very high adoption rates obtained. Table 43 gives the weighted average adoption rates for specific practices for farmers growing corn (*a*) without credit or direct technical assistance[44]; (*b*) with ICA-CAJA credit; and (*c*) with ICA-Cooperative risk-sharing credit.

Under the ICA-CAJA AGRARIA supervised credit program of 1972, improved seed was only partially adopted, even though it was readily available.

Table 43. Adoption rates (%) of the new corn technology under different credit programs in the Caqueza Project.

	Weighting (%)[a]	ICA-CAJA		No formal credit	ICA-Corn Plan		CAJA unsupervised	No formal credit
		1972	1973	1973	1974	1975	1975	1975
Variety								
Improved	(30)	53	18	0	100	100	2	3
Fertilization								
Nitrogen	(20)	43	55	7	100	91	2	2
Phosphorus	(20)	81	22	1	99	93	39	18
Distance between plants	(20)	89	61	40	95	91	45	47
Pest control	(10)							
Cutworm (Troz)		87	86	10	70	48	4	3
Earworm (Gus)		0	0	0		0	0	
Armyworm (Cog)		78	100	20	100	100	35	6
Corn ants (Hormiga)					100	58	18	
Weighted average value for total adoption rate[a]		66	42	11	98	91	20	15

[a] Weightings suggested by the project's agronomist on the basis of their impact on yields.

[44]All farmers in the area had access to the "new" information. These farmers were identified as farmers who made no verbal or visual commitment to adopt the recommended package.

Fertilizer adoption rates were very high for the first application of nitrogen and phosphorus but much lower for the second application of nitrogen. The recommendation for planting distance was followed quite well and the pesticide recommendations were fairly well adopted considering that no pesticides had been used in the traditional system.

In the same program in 1973, the situation changed slightly. Nitrogen adoption rates improved but the plant populations used were less than in 1972 and the use of recommended phosphorus levels was much less. Pesticide use was once again relatively high, but the use of improved varieties declined considerably. Two reasons could be suggested for this. First, with low fertilization rates in the previous year, the added yield from the improved seed was not observed, and, hence, the farmer did not feel this component of the package was relevant; or second, that improved seed was not available on time in 1973. One farmer commented that with traditional seed, he could save some seeds from his harvest for next year's seeding, but with the improved seed (a hybrid), he would have to rely on the market for new seeds, a situation that he felt to be too risky.

Farmers not using credit in 1973 used virtually no fertilizer and used traditional seed. In addition, they used too wide a plant spacing and did not control pests. Compared with these nonusers of credit, the participants in the ICA–CAJA AGRARIA supervised credit program in 1973 (a good corn year) obtained an increase in yields of 174%.

Compared with the ICA–CAJA AGRARIA program from the point of view of technology adoption, the 1974 Caqueza corn plan was an astounding success. All of the components of the recommended package were adopted. In spite of the fact that 1974 was an extremely poor year for corn production, the plan participants had yields nearly four times those of nonparticipants. Two major differences between adoption rates under the ICA–CAJA AGRARIA supervised credit scheme and the ICA–Cooperative risk-sharing plan were the adoption of improved varieties and a more complete fertilization. The recurrent problem of the unavailability of improved seed created a substantial negative influence on adoption rates in the ICA–CAJA plan of 1973, whereas when ICA provided the seed to the cooperative, this problem was eliminated.

Adoption rates with the Caqueza plan in 1975 were again high and the average production level in the corn plan for 1975 was 2.3 t/ha compared to 1 t/ha for nonparticipants.

In 1975, farmers with CAJA unsupervised corn credit had lower adoption rates than those under the ICA-CAJA (supervised) credit plan of 1972 and 1973, particularly with respect to fertilization. In 1975, new seeds were, however, available. It is known that the CAJA AGRARIA sold 3 t of new seed in the area in 1975, yet the impact of these seeds did not show up in the evaluation of unsupervised credit or in the yields of the noncredit corn producers.

An examination of the 1975 practices of farmers without formal credit shows that few of them used improved seed, nitrogen, or pesticides.

The adoption of potato technology showed a completely different pattern to that for corn. In 1972, farmers with supervised credit for potatoes used the recommended level of fertilizer. However, this was not really considered as the adoption of a new technology, as the traditional level of fertilizer use was in fact about 50 kg/ha higher than the recommended level. Pest control practices were somewhat variable, but some measure of pest control was carried out under traditional conditions.

The only recommendation that specifically involved the introduction of new technology was improved seed, changing from Pardo Pastusa to ICA–Guantiva.

This change did not occur in 1972 due largely to a lack of available seed in the area. When this seed was made available in 1973, adoption rates for all recommendations were observed to be higher than before. However, there was very little difference between adoption rates for the ICA-CAJA AGRARIA supervised credit program, the CAJA's regular credit program, and those of farmers with no formal credit from 1973 to 1975 (Table 44).

Caqueza farmers appear to apply adequate fertilizer and pest control measures in their traditional systems. As far as plant population is concerned, the adoption rate is difficult to interpret because of the effects of associated cropping and because the use of improved varieties reduced planting density. However, improved seed was accepted when available, regardless of whether or not agronomic supervision was received.

The adoption data were obtained from programs that did not include any risk-sharing component, suggesting that access to capital for potato production is not seriously limited, and that the adoption of improved varieties carries little risk.

Adoption rates were also evaluated in the onion production plan in which 35 farmers participated. The adoption rates in this plan were over 95%, and production increased by 145% over the average production in the area.

These results do seem to indicate that scarcity of capital does limit adoption rates, and that access to capital is limited because of the low levels of collateral available associated with low wealth levels. This is particularly true in the case of low-income corn producers. Experience with these producers in the project indicates that if they are given credit and technical assistance, as well as the security that they will not become liable for their losses, most of them will not hesitate to increase their production.

Table 44. Adoption rates (%) of the new potato technology under different credit programs in the Caqueza Project.

	Weighting (%)	ICA-CAJA 1972	ICA-CAJA 1973	No formal credit 1973	ICA-CAJA 1975	CAJA unsupervised 1975	No formal credit 1975
Variety							
Improved	(30)	38	64	100	64	78	62
Fertilization							
Nitrogen	(20)	100	96	56	88	100	95
Phosphorus	(20)	100	83	54	92	100	100
Distance between plant or	(20)						
Density		66	72	76			
Pest control	(10)						
Cutworm		6	100	80			
Flea beetle		5	93	90	100	98	88
Late blight		94	100	100			
Weighted average value for total adoption rate [a]		68	79	76	80	89	84

[a] Weightings suggested by the project's agronomist on the basis of their impact on yields.

Chapter 13

Marketing

The emphasis expressed by the farmers themselves on "marketing"[45] and the experience gained by the project trying to understand the farmer's production system indicated that the process that transferred produce from small farmers to urban consumers was of considerable importance. Because little detailed information existed regarding this marketing system, a number of studies were initiated to gain a better understanding of it (14). These included securing information on (1) the quantity and seasonality of product marketed; (2) the marketing channels; (3) the interrelations between marketing institutions with respect to their functions; (4) the cost of providing marketing services; and (5) the marketing risks, both institutional and those due to price fluctuations. These analyses were used to try to change the marketing system to respond more readily to small farmers' needs and to act as a catalyst to increase agricultural production and productivity.

The first study conducted was to record on a weekly basis, for a period of 2 years, the prices paid to farmers by middlemen purchasing a wide range of products in the weekly Caqueza market. A further study was conducted on the activities of these middlemen from the time they purchased Caqueza produce until they disposed of it. The seasonality of product availability was also recorded and seasonal price trends were mapped over a period of years for the main items supplied by the Caqueza area to the Bogota market. This information enabled risk values for price variation to be calculated in a similar way to that in which production risk was derived.

Market Prices

During the early years of the project, two major crises were associated with the rapid adoption of new technology. The first, involving cabbages, was a classic case of overproduction of a crop with a relatively inelastic demand. Severe overproduction led to farm gate prices falling to U.S. $0.25 a sack when production costs were almost four times this amount. Although the project staff were attempting to help cabbage producers (as the use of improved seed and fertilizer could double or triple yields), the farmers who adopted their technological recommendations ended up financially worse off than if they had left their land in traditional corn production. Not surprisingly, this led to heavy criticism of the

[45]Without knowing the technical definition of "marketing," the farmers use it very loosely to cover almost anything that happens after production.

project by the farmers, and the project staff became acutely conscious of the importance of nonbiological factors in relation to their work.

The second crisis occurred in the potato-producing zone of Caqueza in August 1973 when potato prices fell to U.S. $0.03 a kilo at a time when the cost of production was about 33% higher than this. This fall in price resulted from an increase in the total area planted under potatoes as well as to productivity increases attributable to improved technology and favourable weather within the Bogota marketshed. This led to a saturation of the Bogota market with potatoes, and the benefits to the farmers in the project area due to higher yields were wiped out by the price decline. Consequently, the adoption rate for new potato technology declined in the following year (1974).

These two experiences made project personnel pay particular attention to both long-term and seasonal price trends. Both they and the farmers were aware of the tendency for prices to decline seasonally during the major harvest periods. However, they were not conscious of the magnitude of this decline nor of the possible impact on it of the widespread adoption of new technology (albeit at a very localized level). Furthermore, no price-elasticity information was available to the project at the time when they first started to promote new potato technology.

The situation was exacerbated by the fact that at the time when potato prices fell in absolute terms, Colombia was undergoing a rather rapid period of inflation, so that the real return to the farmers was reduced even further. This situation was difficult for the farmer to comprehend and to adjust to rapidly, and understandably he related the price decline (which was national) with the new technology (whose introduction was still very localized).

To examine price trends in more detail, a 28-year series of weekly retail prices in the Bogota market was collected for a number of major crops produced in the Caqueza area. A selection of the findings is presented in Fig. 31, which shows prices both in actual terms and in terms of 1970 prices. The data show that both corn and potato prices have remained relatively stable through three decades, although there has been a tendency for pea prices to rise and for onion (and other) vegetable crop prices to fall. When the data are disaggregated to separate major and minor harvest prices (Fig. 32), slight differences in the seasonal trends show up for each crop. The data do seem to suggest that on a long-term basis, production of the basic staples has been increasing at the same rate as demand. On the other hand, the increase in food legume production has not kept pace with demand, whereas vegetable production (possibly because of the high returns that it provides) is running ahead of it.

Marketing Channels

A study of market channels indicated that although Bogota was a major market, over 30% of the produce sold in the Caqueza market was transported to Villavicencio, a major city in the lowland plains to the east of Caqueza. Figure 33 illustrates the market flow for produce leaving the Caqueza producing area. One interesting feature of the product flow is that the terminal wholesale market in Bogota is not a major resale area for the Bogota truckers who purchase in Caqueza, but serves more as a market for farmers who contract transportation from Caqueza to Bogota to sell their produce at the wholesale price instead of the assembly point or farm gate price.

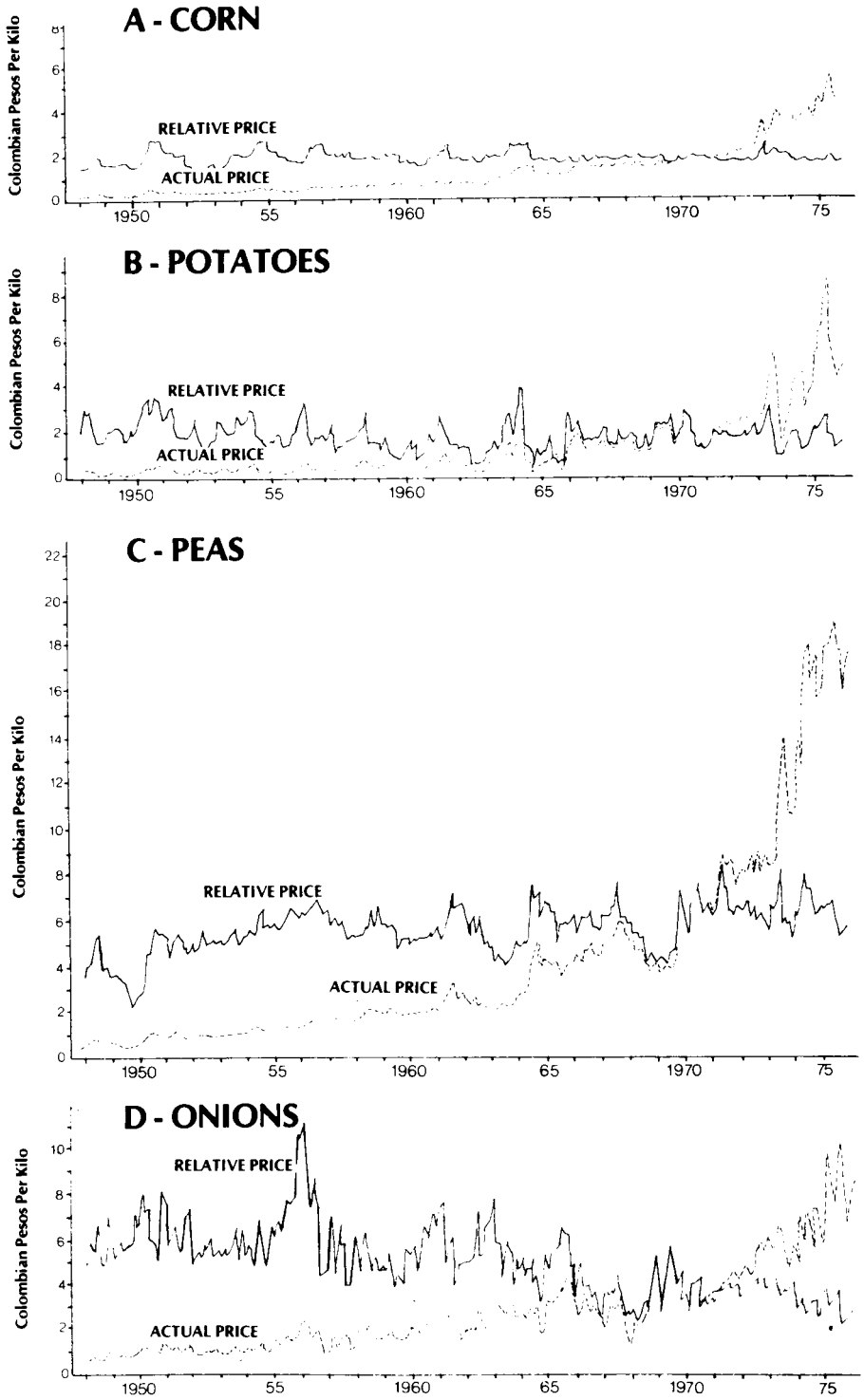

Fig. 31. Actual and relative (1970 = 1) Bogota retail market prices for selected commodities 1948–76.

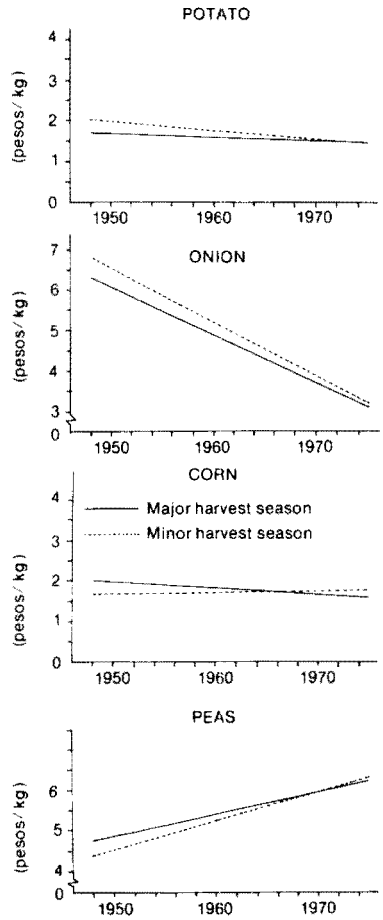

Fig. 32. Historical tendencies (deflated prices) for major and minor harvests of selected crops (Bogota market 1948–76).

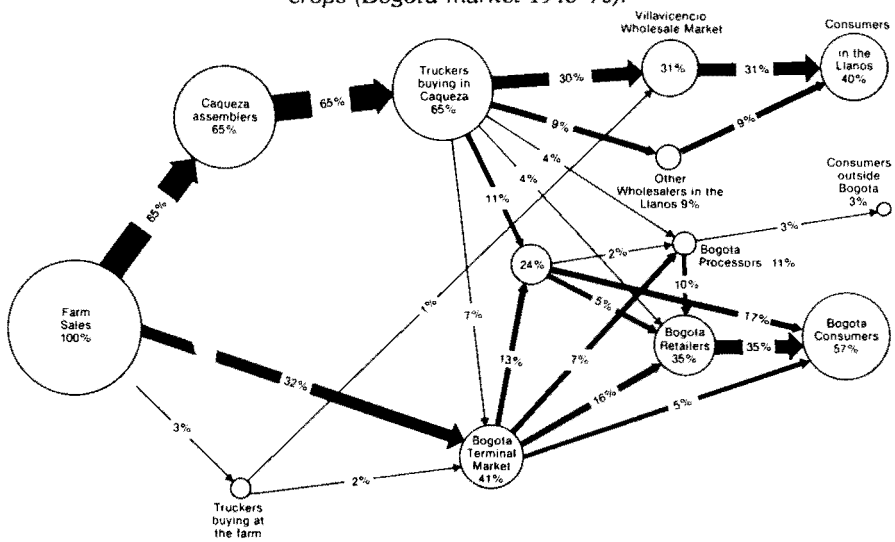

Fig. 33. Market channels for farm produce leaving the Caqueza region, 1972.

Although this action makes sense economically, the price spread between the Bogota terminal market and the Caqueza assembly point market was extremely narrow for most crops. Indeed, the price spread between consumers and producers was generally less than 25%. The largest part of this margin lay between the terminal wholesale market and the retailers.

Figure 34 shows the different types of market channels for Caqueza produce; the information is based on their level of complexity. The two middle channels shown accounted for over 70% of the fresh produce from Caqueza consumed in Bogota.

Another aspect of market channel analysis related to product flow. When the amount of a specific product marketed from Caqueza to Bogota during a given period formed a substantial part of Bogota supplies of that product, it might be expected that changes in the supply provided by Caqueza would cause significant price variations in the market area. To examine this hypothesis, the overall contribution of the Caqueza area to the Bogota market was studied.

Figure 35 presents the results of this analysis with respect to several crops produced in Caqueza during two periods: firstly in May when there was a relative scarcity of harvestable produce; and secondly in August, at the time of the major harvest season for a number of crops. The data show for example that beets from Caqueza accounted for a major part of the Bogota supply in August, but potatoes, although an important Caqueza crop, provided only a small part of Bogota's total supply.

This point was taken into account in the onion production plan, in which producers were asked to stagger their planting dates instead of all planting at the same time, to avoid a conflict with the major harvest season for onions in the Bogota marketshed.

This was but one of several findings from the market channel analysis that was used in the formulation of the marketing plan. Another useful finding was that although Bogota was the principal market, it was not the only one. Hence, at certain times, Caqueza market prices were not based purely on Bogota prices. The fact that produce was handled by several intermediaries in the process of transferring the product from the farm gate to the consumer meant that from a least-cost physical handling point of view, there were possibilities for improving

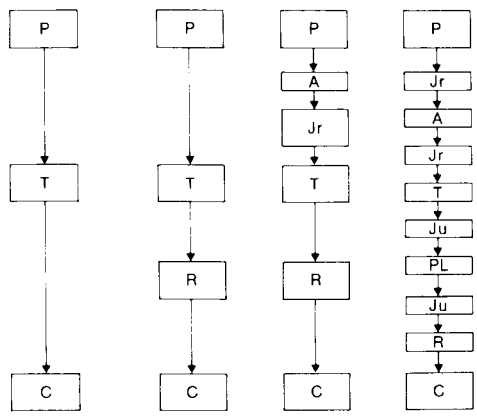

Fig. 34. *Market channels in Caqueza, 1972. P, producer; T, terminal market; C, consumer; A, Caqueza market wholesaler (trucker); R, retail outlet; PL, urban market; Jr, rural jobber; Ju, urban jobber.*

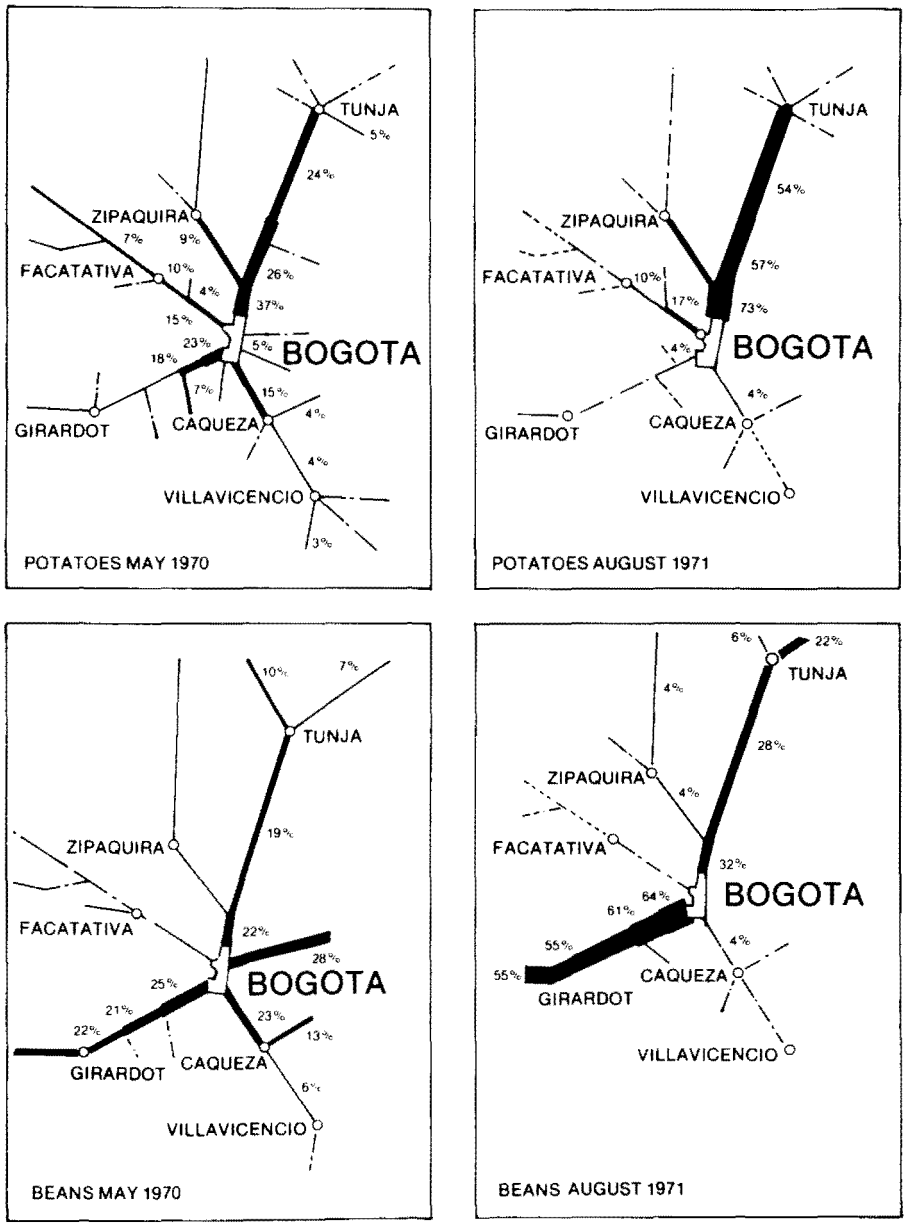

Fig. 35. *Point of origin marketing channels for produce, Bogota marketshed. (Note: Width of band and percentage corresponds to proportion of total product entering Bogota.)*

the existing system. The price-spread analysis showed that the margins between the Caqueza market and the terminal wholesale centre were small, but those between wholesalers and retailers were substantial.

Finally, the point-of-origin study of the total amount of produce marketed in Bogota pointed out the importance of seasonal and crop interactions with prices. Thus, in August, prices for beets in Bogota were strongly influenced by Caqueza

supplies whereas, at the same time, the Caqueza area had no influence on potato prices because it accounted for only 4% of potatoes marketed in Bogota in that month. Clearly this had implications in terms of production planning.

Market Structure

When potato and cabbage prices fell in Caqueza both the farmers and the project staff initially attributed this situation to exploitation by the marketing agents. However, an examination of marketing margins failed to support this view. In fact, it was found that with over 40 marketing agents serving the area (a number that seemed to be excessive), each agent's profit turned out to be extremely modest.

Nevertheless, the farmers felt that all intermediaries were unnecessary and were charging excessive costs for their services. There was a general failure to realize that whoever performs the marketing role conducts a number of activities and only rarely is a single marketing institution (assembler, trucker, wholesaler, retailer, financier, etc.) capable of performing all of them.

The specific activities associated with the marketing of produce from Caqueza were identified as: (1) interpreting and estimating demand and supply relations; (2) collection; (3) transportation; (4) classifying, sorting, and repacking; (5) finding buyers; (6) financing transactions; (7) short-term storage; and (8) absorbing risks.

Some of these activities were performed by producers themselves as it was shown that 32% of the Caqueza produce was moved directly from the producers to the Bogota terminal market. But some of these activities were beyond the capacity of the producer to comprehend or perform. For example, it is extremely difficult for an individual small farmer to assemble a truckload of produce on

The blocks were used to improve the quality of the farmer's housing.
(Photo: Jack Redden)

any specific day. Similarly, he is not in a strong position to estimate demand, nor is he likely to want to wait very long for final payment. Finally, price risk is his nemesis.

These observations and hypotheses suggest that if the existing marketing system could be shown to be inefficient, due to either oligopoly or excessive competition, the introduction of a new and more efficient system would be beneficial. This could be done by either modifying or replacing the existing system. However, either approach clearly needs to take into account that the farmers themselves have very little experience in marketing, and the existing system, whilst perhaps imperfect, is far from inefficient in many respects. Given this situation, an effort was devoted to devising a program that would supplement the existing system without destroying it.

The interviews with marketing agents revealed that the number of trucks regularly servicing the Caqueza area was between 40 and 50, each with a capacity of from 4 to 6 t. This capacity was about 60% utilized throughout the year, and this fact, plus the low margins on which the marketing agents worked, suggested that the system was highly competitive, to the point where it could be described as "atomistic." In essence, atomistic competition is excessive competition to the stage where too many marketing agents compete for a share of the marketing margin. The identification of the existence of an atomistic marketing structure led to the following conclusions.

First, because of the overcapacity of marketing agents and transport equipment, resources were underutilized and unit transfer costs were relatively high. As a corollary to this, the returns to the marketing agents were below the opportunity cost for the value of the services that they rendered. Once again, this was due principally to overcapacity of labour and equipment.

Second, imperfect knowledge led to high risks being associated with each marketing decision. This meant higher costs in the form of risk premiums, that is, each marketing agent had to hedge a little more when setting his price levels.

Third, in addition to the low utilization of the existing capacity, a high number of interchanges occurred in the marketing channel between the farm gate and the ultimate consumer. A reduction in this number offered a possible way to reduce costs.

Fourth, the lack of a standardized system for sorting and packaging resulted in relatively large losses due to handling damage.

Fifth, the atomistic nature of produce purveying, with little crop specialization by region and with all sales being in small lots, meant that producer market-price power was nonexistent. Although this is generally a sign of a healthy, competitive market performance, in this case it tended to eliminate the possibility for innovative behaviour directed toward improving marketing services. It also tended to reduce the opportunity for developing market segmentation with different qualities of produce.

Lastly, as a result of the atomistic marketing system, the knowledge of true demand was poorly transferred from consumer to producer, so that the farmer's production responses to demand shifts were not as marked as they might have been had the marketing system operated in a more streamlined manner.

Table 45 shows the salient features of both atomistic and oligopolistic marketing structures and highlights some of the weaknesses of the marketing system in Caqueza.

In an effort to overcome these disadvantages, an attempt was made to improve market knowledge and to facilitate production planning through the establishment of a voluntary vertically coordinated marketing system. It was

Table 45. Critical characteristics of atomistic and oligopolistic markets.

Criteria	Atomistic	Oligopolistic
Number of marketing agents	Extremely high	Very low
Collusive pricing	Impossible	Prevalent
Entry barriers		
(a) initial capital	Very little necessary	Large amounts required
(b) time to establish	Immediate operation possible	Substantial time required
(c) set trading patterns	None discernible	Well developed
Market knowledge	Imperfect	Input-output prices known and(or) fixed
Demand adjustment	"Sticky," chronic, nonadjusted	Buying and selling controlled, therefore immediately adjusted
Absorption of unemployed	The atomistic marketing system is a dumping ground for the unemployed	Few new employees or agents are allowed to penetrate an oligopolistic structure
Marketing margins	Low for each agent	High for each agent

hoped that this would provide better market information with regard to immediate and long-range prices and would convince collaborating producer groups to stagger their production schedules so as to provide a steady flow of produce to the affiliated retailers. It was also hoped that through economies of scale, the new scheme would reduce market transfer and handling as well as marketing risks, thereby improving marketing margins. However, as we shall see later, this proved difficult to achieve in practice due largely to the risk element.

Marketing Risk

Two types of marketing risks were identified in the Caqueza Project. The first was market risk caused by the price fluctuation. The second is referred to as institutional marketing risk and includes such elements as the risk that the necessary quantity of inputs will arrive at the right time or the risk that marketing agents will be present at the time of harvest of perishable crops. Although some of these risks can only be measured by the assignment of subjective probabilities, others can be dealt with quantitatively using the type of loss functions used to calculate production risks in Chapter 11.

For these calculations, net returns to cash with their corresponding variances were used (Table 46). However, instead of basing the risk calculation on yield variance with a constant price (as in the corn and potato risk analysis of Chapter 11) to calculate marketing risks, yields were held constant and prices allowed to vary. Hence, the net profit variance used was the mean yield times the price variance.

The price variance used for this analysis was based on a 28-year series of peak harvest prices deflated to 1973 prices. The results of this showed that the absolute value of the expected loss function calculated in this way was low for corn and high for horticultural crops. It is interesting to observe that whereas the

Table 46. Risk associated with crop production in Caqueza (1973).

Crop	Coefficient [a] of variation	Risk in terms of net profit [b]	Risk [c] ($/ha)
Corn	74	.09	11
Potatoes	42	.13	83
Tomato	60	.10	109
Onion	34	.06	118

[a]Standard error of net profit as a percentage of the mean.
[b]Risk (last column) divided by net profit.
[c]Expected value of the loss function.

previous risk calculation for potatoes showed them to be the highest risk crop, when risk was calculated using price variance, potatoes came out to be a lower risk crop than did horticultural crops.

This new hierarchy of risk values seemed to further explain why corn is planted on 63% of the cultivated area in Caqueza, potatoes on 28%, and horticulture on only 13%. If a premium "perishability" risk factor could be added to this analysis the increased correlation between production area and *total* risk should become even more acute, because perishability risk would be negligible for corn, low for potatoes, and extremely high for horticulture.

In addition to deriving the expected values of the loss, E(L), as described above, the coefficients of variation were also calculated. Risk was also expressed in terms of E(L) per unit net profit. These last two comparisons showed no relation between risk measures and cropping frequencies observed. Of the

A major effort was made to promote a latrine-building program as few houses possessed sanitation facilities. (Photo: Barry Nestel)

market risk indices examined, the most useful appeared to be the expected value of the loss. The area devoted to a specific crop was most closely related to the market risk measured in this way.

Some thought was given to the question of institutional risk. An effort was made to develop a crop perishability index as a proxy variable for the institutional risk associated with the use of disposal of any crop at harvest time. However, this idea was not pursued seriously for lack of a clear understanding of how it would operate. Similarly the institutional risk associated with the reliability of inputs being available when needed was not quantified, although considerable efforts were devoted toward ensuring the timely arrival of such inputs. This was facilitated by the fact that ICA was able to influence the major supplier of fertilizer in Caqueza, the CAJA AGRARIA. In addition, three of the new buffer institutions associated with the project directed their attention toward assuring the timely supply of inputs. The first two were the corn and onion plan programs, which actually provided the inputs "in kind" for those farmers entering these programs. The third (albeit not very successful) was the local cooperative whose marketing plan services included the supply of inputs as well as the marketing of produce.

The Marketing Plan

In the spring of 1973, the Ministry of Agriculture, in conjunction with IDEAM and COFIAGRO, launched its rural stores pilot project in the Caqueza area. Five rural storekeepers were each loaned $4000 (Cdn.) credit as working capital so that they could expand their operations to include farm input and produce marketing services. The project staff put the storekeepers in contact with farm input suppliers and wholesale merchants in Bogota to create vertical linkages. However, this program was not very successful, as the local storekeepers were found to be very much at the mercy of the Bogota wholesalers. The project staff, therefore, devised an alternative plan that involved the rural stores in a cooperative enterprise. The basic concept of this plan was the creation of a Federation of Cooperatives in which producer cooperatives and retail outlets would be linked together in a chain that would plan and coordinate marketing activities through a central distribution warehouse in Bogota.

In a further approach to the marketing angle, the Caqueza pro-development committee created a local cooperative using as working capital the proceeds from the raffle of a cow. The organizing committee attempted to popularize the cooperative by using it as a supplier of staple foods as well as animal feeds, veterinary medicines, and fertilizer. These activities functioned from January 1973 until August of that year, when the overproduction of cabbages occurred. At this point, the project staff concluded that produce marketing should be added to the cooperative's services.

As a result of both this and the difficulties encountered by the rural stores, the project's Marketing Plan was brought into existence on a trial basis. Produce was marketed directly from the cooperative to a group of retail stores in Bogota, who were members of a voluntary chain called CORATIENDAS. The retail store owners were interested in the vertical coordination plan, but unfortunately the farmers were unable to provide them with a steady supply of produce after their major harvest had been completed. Nevertheless, the exercise served to demonstrate the feasibility of direct marketing from a producer cooperative to retail outlets, provided that a steady supply of produce was available.

The next stage in the development of the marketing plan was the expansion of the supply source to include other RDPs in the Bogota marketshed. In September 1974, the expanded marketing plan began its operations. It now had a small warehouse in Bogota and a small amount of working capital loaned from the project's IDRC funds. Operations continued until January when the scale of operations was such that it was decided to increase the level of working capital fourfold. However, procedural difficulties arising from the fact that marketing was not a prime responsibility of ICA prevented the designated funds from being released, and the plan entered a moratorium phase until early 1976. In spite of its disappointing results the marketing plan appeared to have fulfilled a useful role in demonstrating to ICA and the National Planning Office both the importance of the marketing constraint and the type of innovative approach that was needed to overcome it. As a result, the National Planning Office decided that in the expanded national Rural Development Program that they were planning to pursue in conjunction with several bi- and multilateral agencies, each project would include a marketing component. Early in 1976 the staff associated with the Caqueza marketing plan were seconded to the National Planning Office to assist in programing this activity.

The first action taken in this direction was the identification of CECORA, a semiautonomous, centrally operated cooperative originally created by the land reform agency (INCORA), which had affiliates throughout the country, as the institution that would be the focus of the marketing activities for the new national integrated rural development program. CECORA's marketing activities were to include: (1) the collection of price information; (2) the formation of demand projections; (3) the stimulation of producer groups to form new marketing cooperatives; (4) the financing of marketing infrastructure; and (5) the provision of assistance in making market contacts by affiliated cooperative branches.

The philosophy behind the national marketing plan was based on the concept of countervailing power. It was recognized that the small farmers were at the mercy of the market and therefore it was postulated that their position could be strengthened and marketing costs reduced overall by developing new market structures in which the farmers would plan a more active role and the number of marketing institutions would be reduced. This situation was to be brought about by assisting existing as well as new cooperatives in becoming efficient produce marketing agents by providing them with price and marketing services originating from a central market intelligence unit. Although the idea is undoubtedly a sound one, the history of cooperatives in Colombia has been extremely chequered and the CECORA program will need careful implementation.

Chapter 14

Training[46]

ICA's Training Program prior to the RDPs

In Chapter 2, reference was made to the fact that ICA's responsibilities in the agricultural sector involved research, extension, and education. Subsequent chapters have discussed in detail how the first two of these activities related to the RDPs. In the field of education, ICA's mandate lies principally in the realm of postgraduate agricultural training. This chapter will examine how such training related to the Caqueza Project.

From its inception, ICA has focused its training program on three main activities. The first of these was to increase its cadre of personnel trained at the postgraduate level; by 1975 ICA had trained over 70 people to the Ph.D. level and nearly 400 to the M.Sc. level, although at that time a number of these people were no longer on its staff and had joined other national or international organizations or were working in the private sector.[47] Part of this higher degree training was financed domestically and part of it was sponsored by aid programs with a particularly strong influence in the 1960's coming from US-AID. Some of the M.Sc. training was carried out in Colombia but nearly all of the Ph.D. training was carried out in the United States, with an occasional student returning to Colombia to do the field work for his thesis. In addition to postgraduate training for higher degrees, a number of ICA senior staff were also sent abroad for short courses at the postgraduate level.

The second major component of the training program commenced in 1967 when the graduate school of the National University of Colombia established an agricultural campus at ICA's Central Research Station at Tibaitata. The objective of this program was to provide graduate training to the Master's level in Colombia to increase the number of people trained at this level and to avoid the necessity for such training overseas. By the mid-1970s nearly all Colombian agricultural graduates being trained to the Master's level were utilizing this course. Most of the academic staff conducting the course are senior members of ICA's staff who have obtained postgraduate qualifications overseas and who

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[46]This chapter was written by Ester Zulberti of Argentina who is a specialist in adult education. From 1974 to 1976 she worked as a consultant to the Colombian Agricultural Institute (ICA) in the formulation of the rural development staff training program.

[47]In the period 1970–75, 33 Ph.D.s and 62 M.Sc.s left ICA, leaving the organization with 43 Ph.D.s and 326 M.Sc.s in mid-1976. This occurred in spite of the fact that many graduates were "bonded" for a period after overseas training.

hold honorary faculty status at the National University. Some full-time professors from the National University also teach these courses, although, in the main, the teaching at the University, where little research is done, tends to be theoretical rather than applied.

The third component of the ICA training program involved in-service programs, which provided short and specialized courses given by ICA staff. The participants on these courses came not only from ICA but also from sister institutions such as the CAJA AGRARIA and INDERENA and the objective of the courses was to improve the quality of the work of the research and field staff.

Training for Rural Development Programs

ICA has used all three of these techniques in training personnel for staffing its rural development projects. The initial action in this field took place during 1970 and 1971 when 16 professionals were sent in small groups to the Puebla Project in Mexico to familiarize them with the approach that has been adopted there. Seven of these professionals remained in Mexico for about 2 years and graduated with M.Sc.s from the Chapingo Graduate School of the National University of Mexico. The others remained for shorter periods, obtaining in-service training with the Puebla team. In addition to this graduate training, a number of Colombian professionals already abroad and destined to go abroad, principally to the United States, to study for higher degrees in areas such as agricultural economics, rural sociology, communications, and agricultural extension, were specifically destined to return to participate in activities closely associated with the rural development program.

Because a high percentage of ICA's senior staff had been trained in the biological sciences, the emphasis in postgraduate training during the 1970s was strongly focused on socioeconomic studies rather than on biological ones. This training in the biological sciences had come about as a result of the Rockefeller Foundation, with its very strong interest in cereal breeding, being closely associated with the creation and development of the DIA and later ICA. Most of the first Colombian agriculturalists sent abroad for higher degree training in the 1950s were sponsored by the Foundation and were trained in plant production and protection. On their return to Colombia these scientists made significant contributions to developments in agricultural technology but by the late 1960s and early 1970s the bottlenecks in rural development were increasingly seen as relating to the transmission of technology with all of its socioeconomic ramifications rather than to the creation of technology itself. Hence, a tremendous emphasis was given at this time to training people in fields that related to technology transfer.

As a direct result of the creation of RDPs, two rather important changes took place in the training program of ICA itself. The first of these occurred in 1973 when the postgraduate program, conducted jointly with the National University, commenced courses that led to the granting of a Master's degree in Rural Development. This decision was strongly contested in some quarters where it was argued that a rural development degree was a general degree and a Master's degree should be a specialized one in which the theme was a recognized discipline such as soil science or animal science.

The logic behind a generalized M.Sc., in which students studied not one discipline but the whole range of disciplines involved in rural development activities, including sociology and home economics, was that the ability to handle

these types of interdisciplinary linkages was an aspect of the Rural Development Program that urgently required strengthening. Most of the staff coordinating and involved in rural development activities had tended to think of themselves very much in a disciplinary vein prior to the creation of the RDPs. None of the series of project directors at Caqueza had ever been confronted with problems in home economics or in creating credit plans. A project director who was an agronomist often had little familiarity with the training or problems that confront the animal scientist in the project. After 2 years of operation of the RDPs, it became apparent that a new type of professional would need to be created to lead and participate in these projects in the future. In this context the majority of the students doing their Masters in Rural Development have been and are professionals who already have experience working in one of ICA's rural development projects. The new emphasis on rural development training becomes evident from the total number of M.Sc. students in this option. This number was 5 from 1970 to 1975, but 17, 12, and 32 in 1976, 1977 and 1978, respectively. The students were primarily drawn from the agronomy, animal science, and agricultural economics areas.

A second major change in the training program was the creation of a special National Training Program, which provided short courses for rural development staff. This program provided in-service training initially at Rionegro, and later at Rionegro and Caqueza. This training was offered not only to ICA personnel but also to personnel from other agencies involved in rural development activities in Colombia.

Although the Caqueza Project was only indirectly involved with these training programs, its staff played a considerable role in helping to identify the needs of these programs and the type of orientation that should be given to them. Caqueza staff were heavily involved as graduate students in the M.Sc. program and as teachers in the National Training Program.

Specialized Training for Caqueza Staff

Overseas Training

IDRC funding was used to enable six of the project staff to visit other rural development projects in Latin America and to enable four Colombians to study overseas for higher degrees.

For 5 weeks during 1971, the project's agronomist took part in an intensive agricultural research course carried out by the Puebla Project in Mexico. Subsequently, during the same year, two technical assistants visited the Puebla Project for 4 weeks. In 1972, the project sociologist visited Puebla for 2 months, having been accompanied by the project's director and one of the project's advisors. The three visited several other projects in Mexico, Guatemala, and El Salvador. This same year, the veterinarian visited Puerto Rico for several weeks to attend an intensive course on animal production in tropical zones.

Two scholarships for higher degree training were granted to project staff in 1973. One went to the agronomist in charge of field research to follow M.Sc. studies at the Chapingo Graduate School in Mexico, and the other to the sociologist who was in charge of the programing/evaluation unit to do an M.Sc. in Agricultural Economics at Cornell University. Upon their return to Colombia, the first became director of the Caqueza Project and subsequently Regional Director of Rural Development. The economist was appointed to ICA's Socio-Economics Division, and temporarily assigned to the National Planning Office to

assist in the design of a national evaluation system of Integrated Rural Development Projects.[48]

In the second stage of IDRC's support, three Ph.D. training scholarships were granted, not to Caqueza personnel, but to ICA staff working elsewhere in Colombia. The first of these scholars studied adult education in Texas and on his return to Colombia in 1975 was placed in charge of the National Training Program for Rural Development. A second scholar studied soil science in California and did not return to Colombia until mid-1976. Finally, at the very end of the project, a scholarship was given to the man who was the third project director, later a Regional Director for Rural Development, and finally National Director for RDPs, to enable him to take a Ph.D. in adult education.

In Colombia

One of the specific objectives of the second phase of the agreement between ICA and IDRC was the establishment of an integrated system of rural development, research, and training. One means of achieving this appeared to be by strengthening the graduate study program of the National University. In this way an opportunity was provided to bring field staff associated with the rural development program into closer contact with the main research and training programs of ICA. To assist in achieving this, the second IDRC grant provided support over a 3-year period for 40 students majoring in rural development in the M.Sc. program. This support was specifically used to support the research work of the students while they were preparing their theses, providing that the theses were related to the problems of rural development, not only in Caqueza but also in other RDPs. The financial support covered expenses for traveling, survey staff, seeds and fertilizers, office expenses, and the preparation of theses. The system was not limited strictly to the program at the National University but was also extended to include students from other universities. Although most of the financial support was used for graduate work, it was not restricted to this and some students doing appropriate undergraduate theses were also supported. In this way students from eight different Colombian universities were related to the RDP program and its problems.[49] Table 47 shows a listing of theses completed by mid-1976. At this time a further 12 PEG (see footnote a, Table 47) theses (due for completion in March 1977) were in preparation and it was decided to allocate funds from the project's contingencies budget for an additional 32 theses due for completion in March 1978. Thus the total number of theses supported by the program is expected to be 4 Ph.D., 67 M.Sc., and 11 B.Sc.

Apart from the financial benefits of participating in this program, it contained three other attractive elements from the students' standpoint. First, many young professionals in Colombia have a social conscience. They are frequently critical of traditional efforts at agricultural development that have largely bypassed the peasant farmer. As in many countries, young graduates are often somewhat idealistic and in this sense many of them had a strong interest in getting to grips with the "real" problems of the small farmer. Secondly, one of the weaknesses of the postgraduate program of ICA was that most of its teachers

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[48]In Colombia Integrated Rural Development is the official name for the Multidisciplinary Action Programs (not only agricultural) that the country is carrying out with financial assistance from abroad.

[49]In Colombia practically all universities require that students present a thesis for both graduate and postgraduate degrees.

Table 47. Thesis dissertations conducted in the Caqueza Project.

Subject of thesis	University	Degree
Frequency of associated croppings in Caqueza	INCCA	B.Sc.
Factor productivity in corn production	IICA-CIPA	M.Sc.
Mechanization in Caqueza	PEGa	M.Sc.
Optimum rates of application of nitrogen and phosphorus for potatoes in Caqueza	Nacional (Mexico)	M.Sc.
A comparative economic analysis of various production systems in Caqueza	Cornell (USA)	M.Sc.
The role of the Project Director in Rural Development Programs	Texas A&M (USA)	Ph.D.
Horticultural crop costs and returns	INCCA	B.Sc.
Egg production costs and returns	PEG	M.Sc.
Milk production costs and returns	PEG	M.Sc.
The relationship between wealth levels and risk	PEG	M.Sc.
The real cost of credit in Caqueza	PEG	M.Sc.
The correlation between field history and soil phosphorus requirements	PEG	M.Sc.
Adjusting fertilizer applications for corn-bean associations	PEG	M.Sc.
Density, fertilizer, and variety trails with potatoes	PEG	M.Sc.
Nitrogen and phosphorus requirements for potatoes and beans	PEG	M.Sc.
Feasibility study for pork production	St. Tomas	B.Sc.
Feasibility study for rabbit production	St. Tomas	B.Sc.
Feasibility study for honey production	St. Tomas	B.Sc.
The impact of technological change on employment, production, and income	Cornell (USA)	Ph.D.
A comparison of two credit systems	PEG	M.Sc.
Variety trials with potatoes and beans	PEG	M.Sc.
Tomato, bean, and cucumber production in Arbelaez	PEG	M.Sc.
The analysis of Caqueza soils	PEG	M.Sc.
A survey of existing irrigation systems	PEG	M.Sc.
Chemical and hydraulic study	PEG	M.Sc.
The designing and construction of rain water collection systems	PEG	M.Sc.
Pepper and tomato production	INCCA	B.Sc.
Price histories in Bogota	CEIMA	M.Sc.
Visual-kinetic information	Los Andes	B.Sc.
Migration from Caqueza	La Salle	B.Sc.
The fertilizer requirements of corn	PEG	M.Sc.
Benefit/cost analysis of 'Pick and Shovel' roads	Nacional	B.Sc.
Corn credit systems and adoption rates in Caqueza	PEG	M.Sc.
Women's role in the rural economy	St. Tomas	B.Sc.
The methodology for calculating adoption rates	Los Andes	B.Sc.

[a]Postgraduate program of the National University/ICA in Colombia.

had other responsibilities and worked only part-time in the program. As a result of this they were not able to devote very much time to supervising students' theses. On the other hand, the three IDRC advisors were able to do this and to actively participate with the students in the design of their research and the analysis of their results. As the program built up in size, the number of students participating became too large for the three IDRC staff to supervise and gradually the supervision responsibilities were transferred to the graduate school faculty. However, this transfer has been slow, and is only partially effective, as the Tibaitata staff are evaluated on their research paper output rather than on their teaching effectiveness.

The third attraction of participating in this program was the availability of a Hewlett-Packard 9830A desk computer and a programmer at the IDRC Regional Office. Free access to this was given to all students working on an approved thesis. The alternative was to have thesis data processed on the large computer of the National Statistics Department. This machine was in very heavy use by many groups and student theses warranted a very low priority.

The computer served as a useful tool in bringing the RDP data from all different sources to one focal point where it was put on magnetic tape. As the volume of information on tape accumulated, the tapes became in constant use by the National Planning Office and by ICA's Planning Office and they provided sources of information for the development of the National Integrated Rural Development Plan that was due to start in 1977. The tape data were also made available to the graduate training program and were used as source material for the National Training Program in Rural Development.

Over 30 students processed the data for their theses on the computer. This involved establishing 20 programs, all of which were prepared in a sufficiently general form that they could be used subsequently for other analyses. In addition to the thesis programs, the research activities of the ICA–IDRC staff led to the preparation of another 10 programs on data management, one program of parametric and nonparametric analysis, and a program for cyclical analysis. All together these programs brought about the preparation of 36 cassette tapes, copies of which were made available to governmental organizations and to other agency personnel working on rural development.

The National Training Program for Rural Development

The experiences related in Chapters 3–8 indicate that the traditional approach to agricultural extension to serve the small farmer in Colombia had not proved very successful, nor had much of the experimental station agricultural research produced a significant impact on small farm production. The trials and tribulations of the Caqueza Project suggest that it was not too difficult to develop a mechanism for adapting technology but the achievement of high adoption rates was much more difficult. An important component of this difficulty appears to have been the lack of knowledge of the project staff regarding the detailed production systems of small farmers. Furthermore, the staff had little training or knowledge of the farmers' economic, social, cultural, political, and religious environments and the interactions of these with the production process.

There appeared to be a clear need to provide some sort of training in these activities to enable project staff to develop a philosophy of work that was based on a close interaction with the small farmer. In this way project staff could become acquainted more closely with the farmers' problems and could learn to develop the ability to analyze these problems critically and to suggest possible

solutions to them. Clearly such a training program needed to capitalize on the experiences already obtained at Caqueza and other RDPs so that these experiences could be transmitted, analyzed, discussed, and interpreted.

In an attempt to satisfy this need, the National Training Program for Rural Development (PNCDR) was established. This program commenced operations in June 1974 as a component not of ICA's Rural Development Department, but as a part of its Education Division in the Research Department.[50]

The main objective of this program was to train field staff to understand the overall concept of agricultural development and its interrelation with the agricultural production systems used by small farmers. The trainees included not only personnel currently working in rural development but also those destined to staff new RDPs. The training courses involved both professionals and technicians from all of the different disciplines associated with the RDPs. The courses were planned to familiarize these participants with the social, cultural, political, economic, and production environments of the small farmers and to learn how to relate with them in a way that they could make a positive contribution toward improving the production and well-being of the farmers.

Because ICA already had 21 RDPs at the time when the program was instituted and because there was strong political pressure to increase this number substantially, the PNCDR's initial target was to provide training courses for 1000 field staff. To meet this goal it was necessary to create both the physical and the human infrastructure.

Physical Resources

Because of the strong field orientation of this program, it was decided that training should be located in on-going rural development projects so that the trainees could readily carry out practical field work.

In the original agreement signed in 1971 between ICA and IDRC it was visualized that a small training centre would be established in Caqueza where up to 20 trainees could be housed. For a variety of reasons, which have been referred to in earlier chapters, the completion of this training centre was delayed until the end of 1975. However, while it was being built, the lessons of Caqueza and the other RDPs did not fall on barren soil and ICA's policymakers decided that a somewhat larger centre would be needed, so that by the time the centre actually became operative in early 1976 it was practically double the size originally planned. However, the delays at Caqueza meant that the centre there could not be used as the initial focus of the PNCDR training program. For this reason, during 1974 modifications were made to a building on the La Selva experimental station in Rionegro. This station also served as the headquarters location for the Rionegro RDP project staff so that this project acted as the location for the first PNCDR training course that commenced in November 1974.

By the spring of 1976, both training centres, Caqueza and Rionegro, were fully functional. They were able to accommodate between 30 and 36 trainees each and included facilities for meetings and conferences as well as library, recreation, and dining facilities.

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[50]In the short term this decision delayed the onset of the program because of the different outlooks between the two departments, but in the long term it helped to establish a closer dialogue that contributed substantially to the overall effectiveness of this program.

Human Resources

The PNCDR program was regarded as supplementary to the existing programs of ICA, who appointed a national coordinator (assisted by a foreign advisor) to design the administrative and academic policies and the strategies to be followed by the PNCDR. The initial courses given in La Selva were organized and directed by the national coordinator. However, it was soon recognized that the task of organizing these courses and selecting the trainees plus running the courses themselves, with one course following another in short succession, was too much for one person. After a year of operating in this manner, ICA appointed a national coordinator for the whole program who was assisted by two regional coordinators located at the training centres. Recognizing that these courses were innovative in nature, staff appointed as coordinators were not senior research or academic personnel but younger professionals with a strong rural development bias.

Course Curricula

The specific program for each course was defined during a series of seminars carried out about 10 days before the start of each course. The participants in these seminars included staff who had either taught or monitored previous courses plus the PNCDR coordinators who made available an evaluation questionnaire completed by the students at the termination of earlier courses. In addition, staff from other ICA divisions and guests from other agencies were invited to participate in these structural seminars.

The early courses lasted 3 weeks and focused on three themes. The first of these was a conceptual one of rural development that examined the history and background of rural development in both Latin America in general and Colombia specifically. The policy and objectives of the Colombian RDPs sponsored by ICA were examined in depth, and their planning, programing, and implementation were discussed. Finally, the concept of evaluating these projects was examined.

During the second week of the course the principal emphasis related to the methodology for rural development studies. The main objective of this was to teach the trainees how to identify the priorities to which they should devote attention and how they should plan investigations to resolve particular problems in the project to which they were attached.

The final week of the course had a strong practical bias and had the objective of giving the trainees the opportunity to apply in the field some of the methodologies discussed and analyzed during the previous 2 weeks. To this end the trainees divided into small groups, each of which was given a specific practical problem to deal with during the week. At the end of the course, each group made a short presentation of its problem and the way they would resolve it and this was discussed critically by the group as a whole.

These courses relied heavily on educational techniques that led to interactions between the teachers and the students. Formal lectures were only given when it appeared desirable to transmit specific information or when a visiting specialist was present. The general approach was to use case studies or simulated studies introduced into round table or group discussions. This approach allowed the course participants to play an extremely active role in feeding their own experiences into the general pool of information that emerged from this approach.

To make this technique viable, particular care was exercised in the selection of instructors. Apart from academic competence, priority was given to selecting personnel who had field experience in rural development activities. For example, the Rionegro RDP's project staff played an important role in the Rionegro training program, as did some of the professionals from the University of Medellin, which is located not very far away. This approach had a spin-off effect in that it meant that the faculty of the university and other agricultural institutions began to get closely associated with the Rionegro RDP. As a result of this, they started to make an input to the project and the project was able to draw upon a much larger pool of local expertise than just the ICA project staff.

The selection of personnel to participate in the RDP's courses presented some logistic problems in that, when the courses started, ICA had 21 RDPs and 50 extension agencies, with a total field staff of over 1000. The Rionegro centre was capable of housing 30 trainees and the Caqueza one, which was not operational until 1976, was able to cope with 36. In view of this situation, a strategy was developed that attempted to balance the participation between professionals and technicians and between RDPs and extension agencies. Initially each course at La Selva had 25 participants, about a third of them being professionals and two-thirds technicians, with half of the participants coming from RDPs and half from extension agencies. This gave a good professional mix and allowed for a favourable exchange of experiences among personnel from throughout the country. By the time the first four courses had been completed at La Selva, at least two participants had come from each RDP and one had come from most of the extension agencies in the country.

Table 48 shows the model for the selection of trainees that was used for the first four courses at La Selva. A similar model was used later in Caqueza. Between November 1974 and December 1975, six courses were given at La Selva and 144 ICA field staff participated. Table 49 shows further details of the participants. It should be noted that the model presented in Table 48 was not strictly adhered to, especially in the first course when the numbers were deliberately reduced as the structural work of the training centre had not been completed.

During 1976 the training program gathered considerably more momentum and by the end of that year 697 field personnel had participated in a total of 28 courses at La Selva and Caqueza. During this year the duration of the courses was shortened to 2 weeks and less emphasis was devoted to the work on methodology for rural development studies. It was decided that this subject needed a

Table 48. Planned method for the selection of projects, agencies, and number of participants for the PNCDR course.

Courses	RDPs[a]	Total participants from projects[b]	Total participants from agencies	Total participants/course
1	6	12	13	25
2	7	14	11	25
3	6	12	13	25
4	7	14	11	25
Total	26	52	48	100

[a] Selected at random by PNCDR national coordinator.

[b] Selected in the projects and agencies by personnel and directors of same.

Table 49. Distribution of participants according to technical preparation, and number of projects and extension agencies participating in six courses.

No. courses:	1	2	3	4	5	6	Total [a]
No. participants	19	23	25	25	27	25	144
Agronomists	3	4	4	4	4	4	23
Veterinarians	1	1	1	2	1	1	7
Technical assistants	13	17	16	14	13	17	90
Home economists	1	-	-	-	2	-	3
Home economics assistants	1	1	3	3	7	3	18
Participants from other institutions	-	-	1	2	-	-	3
No. projects with participants	5	6	5	6	7	7	*
No. extension agencies with participants	9	11	14	13	12	12	*

[a] The total is less than the sum of the individual courses because some projects and agencies had participants on more than one course; however, by the end of the sixth course, every project and extension agency in the country had had at least one of its staff attend one of these courses.

longer period of training and in 1977 it was planned to reduce the 2-week courses and to hold eight 6-week courses that would focus on the methodology for identifying field priorities and conducting rural development studies.

Course Evaluation

Because these training courses represented an innovation, an effort was made to assess the reaction of the participants to evaluate both the academic and the administrative aspects of the courses. This evaluative process was carried out with the objective of maintaining a dynamic program so that deficiencies in the courses, as identified by the participants, could be discussed, analyzed, and when necessary, rectified. Each week the students were asked to complete an evaluative questionnaire that covered both the academic aspects and the administrative aspects of the course. At the end of each course the participants were invited to express their opinions and formulate constructive criticism and suggestions regarding the structure of the course. The very informal nature of these courses, although the content of some was controversial, led to an open dialogue that encouraged the participants to express their views very freely.

An important feature of the evaluation process was that it gave the students the opportunity to feel that they were participating. Indeed this was an underlying theme running throughout the whole approach to this training, as all of the trainees had varying degrees of experience in the field and had something to contribute. The training coordinators recognized this and tried to draw upon it to the full.

The trainees' evaluation indicated a steady improvement in the degree of satisfaction with both the administrative and academic aspects of the courses. Average scores for administrative performance increased from 1.8 to 2.2 and those for academic performance from 2.0 to 2.15 during the first six courses. Both changes were statistically significant and are based on a scoring scale from 0 for deficient to 3 for excellent (Fig. 36).

Clearly student satisfaction is a highly subjective way on which to evaluate this type of course. However, it would be even more difficult to attempt to do so

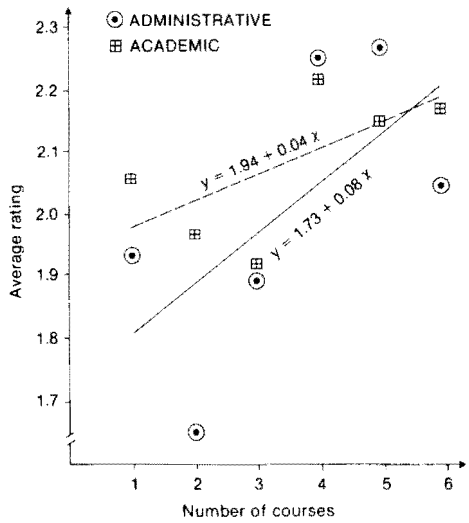


Fig. 36. Relation between the points obtained per course and the sequence of the courses in the Caqueza training program.

on the basis of subsequent performance. The underlying theme behind this evaluation was: "This is your course, it is for your benefit, please tell us if you think you are getting anything useful out of it."

Apart from the trainees' satisfaction with the courses, the instructors formed the impression that the opportunity for dialogue between middle level professionals, many of whom spent all their working lives in isolated field locations, had very positive benefits in terms of broadening the outlook of many of the course participants. At the same time a great deal of useful information was contributed by people who did not normally have the opportunity to contribute with their knowledge, to the central administrative pool from which policy-making decisions eventually emerge. Thus the courses seemed to serve as two-way channels of information.

Conclusions

The experiences from Caqueza related in earlier chapters indicated that there was not only a need for more knowledge but a need for improving the techniques of getting existing knowledge through to the farmer. This chapter has discussed how ICA went about training its staff to do this. A particularly interesting feature of this training philosophy has been the way in which it operated at various levels.

At the postgraduate level particular emphasis was devoted to strengthening ICA's staff in the nonbiological fields, particularly in communications and education. It was recognized that expertise in agricultural technology alone was insufficient to enable ICA to meet its newer and broader goals. Secondly, it was recognized that at the project level where multidisciplinary groups were operating, it was important that these groups contain professionals who could communicate with their colleagues even though their disciplinary backgrounds were very different. For this reason more emphasis was given to leadership training through strong M.Sc. programs that concentrated in training to give a broad approach.

Communal efforts were used to improve a number of bridges... (Photo: ICA)

... that provided more isolated areas with access to markets. (Photo: ICA)

Finally, through the development of the PNCDR, an opportunity was presented to all levels of ICA staff to come together periodically to share experiences. In this way the lessons of experience from the more successful ongoing RDPs helped to assist in the training of field personnel and also in the orientation of research programs. Because of the linkages with the central research staff who were teaching in the postgraduate course, the research implications extended beyond the degree theses and involved central research activities. Thus, multiple cropping research, which the RDPs showed to be important in terms of rural development, but was a negligible part of ICA's 1971 program, was a major activity of the research department by 1976. Thus a major effort has been carried out to integrate the training, research, and development activities throughout ICA's whole program.

Chapter 15

Buffer Institutions

The experience of the Caqueza Project in attempting to modernize traditional production systems and(or) to improve social welfare has shown that both technological and socioeconomic changes were constrained, not so much by lack of knowledge as by weaknesses in the existing institutional structure. The successful introduction of new activities usually necessitated the interjection of institutional changes given the fact that the current institutional structure in the area was geared to traditional resource endowments and change involved breaking down the constraints imposed by these endowments. The important factor in the change process was the creation of new institutional forms or "buffer institutions" designed to facilitate the transitional phase between traditional and modern technology.

The term "buffer institution" is an expression that attempts to catch the essence of the dynamic absorptive nature of the new transitional institutions being created. An important factor of the project was the need to ensure a high degree of flexibility in the approach to institutional change as this is a field in which successes are poorly documented and often closely related to socioeconomic and cultural factors that may be extremely localized. For this reason we have chosen to discuss the concept of institutional changes in the Caqueza Project under the specific title of "buffer institutions."

In this chapter we will describe the nature of certain buffer institutions created by the project, some of which were successful and others that failed. However, perhaps of more importance than the specific merits or demerits of any particular institutional change is the underlying philosophy developed within the project that an appropriate institutional change needed to be an integral part of any effort by the project to bring about technological or socioeconomic change. Indeed one of the most important long-term benefits of the Caqueza Project may well be attributable to the way in which the National Planning Office and the Planning Units in both the Ministry of Agriculture and ICA utilized the experiences with buffer institutions gained in Caqueza to develop and rationalize long-term national rural development strategy.

What are Buffer Institutions?

When any new activity, be it an agricultural technique, a health service, or an educational program, is introduced to a peasant community in a developing country, new demands are made on that community. The equilibrium attained before the introduction of the new activity is disturbed. Because new activities are generally based on ideas and experiences generated from outside the peas-

ant community, an adjustment and adaptation period is usually required to determine what changes are required by the introduction of the new technology. It is then possible to examine these changes in the context of the resources available to the peasant community. This makes it possible to judge whether or not the new activity is practical and feasible without introducing a change in the existing institutional structure. If it is not, it will be necessary to design and create a buffer institution to achieve the adoption of the new activity. In this sense, a buffer institution is a new structure that operates in the void lying between existing institutions and their clients. The new institution acts as a *buffer* to absorb some of the requirements or to soften some of the constraints that limit the adoption of new activities. The buffer institution can be formal or informal in nature, and may or may not be ultimately transposed into a permanent entity, depending on the nature of the change that brought it into being. Often buffer institutions fade away as their tasks get taken up by existing line organizations because the usefulness of the activities of the buffer institutions has become widely recognized.

The concept of buffer institutions may be illustrated by referring to the generation of agricultural technology. Researchers seldom can identify techniques leading to substantial production improvements while operating entirely within the limitations of the small farmer. Generally, the rate of production increase is related to the extent to which the researcher allows himself to move beyond these limitations. This relation forces agricultural researchers to decide for which level of institutional support their technology is to be formulated. They either fix the level of productivity increase required and face the institutional consequences as they arise, or they estimate an achievable level of institutional support and design the improved technology within those constraints. These strategies can be called the interventionist's approach to technology development. Alternatively, they can limit their research to technologies that fit entirely within the existing constraints of the farmers — the submissive approach to technology development. This approach generally requires more sophisticated and longer term research, lacks backup of basic research, and tends to limit short-term gains in production.

In the context of rapid rural development, therefore, the adoption of new agricultural technology by farmers usually necessitates an increase in the use of one or more production factors, namely, land, labour, and capital. Because additional land is usually not available to peasant farmers in areas such as Caqueza, whereas surplus rural labour often is, new agricultural technology is generally geared to increasing productivity per hectare through the use of fertilizers, improved seeds, or pesticides, thereby emerging as *land-augmenting* technology. In situations where periodic labour shortages occur, mechanization or herbicide use may also be introduced. All of the technologies referred to above require an increase in capital resources that, if the farmer is already operating at the limit of his cash resources, will mean that a credit system must be available to him. There will also be a need for an effective marketing system to ensure the repayment of loan capital. Thus the successful introduction of a new agricultural technology involves a complex series of institutional issues. Some of the most important of these are shown in Table 50, which illustrates the relation between the adoption of new technology and the farmer's constraints.

From the concepts presented in Table 50 it is possible to establish a tentative typology for new agricultural technologies. Each new technology has certain biophysical as well as socioeconomic requirements and each farmer likewise has biophysical and socioeconomic constraints. These typologies are categorized

Table 50. Some of the requirements for the adoption of new agricultural technology, and some factors that constrain adoption rates by small farmers.

Factors associated with the adoption of new technology	Factors that constrain adoption by small farmers
Land	Availability
Capital	Farmer's wealth Availability of credit Real cost of credit
Purchased inputs	Availability Costs
Labour	Availability (throughout the year) Cost
Markets and marketing	Existing markets Demand for product
Risk	Capacity to assume risk

into classes in Fig. 37. Technologies of Type I are not constrained by either the socioeconomic or the biophysical resources available to the small farmer. Type II technologies are technologies possible but not feasible within the socioeconomic structure of the target group. Type III technologies are feasible socioeconomically but not biophysically, and Type IV technologies are not feasible, either biophysically or socioeconomically.

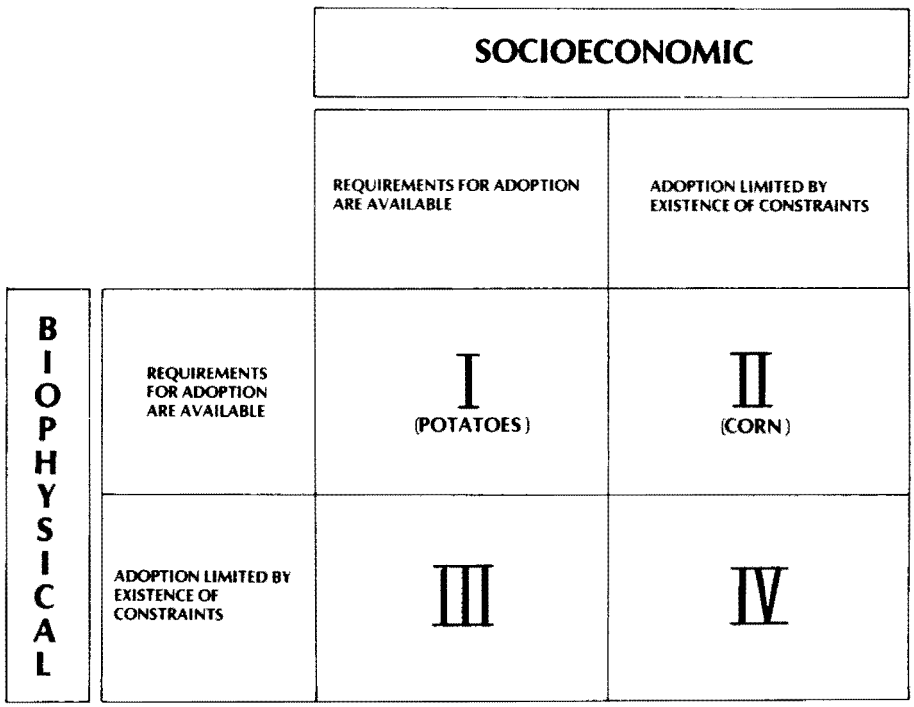


Fig. 37. Typology of adoption rates for new agricultural technology according to socioeconomic and biophysical factors.

An examination of the new technologies introduced in the Caqueza Project serves to illustrate all four types. An example of Type I can be drawn from the potato variety trials referred to in Chapter 10 (42) where the new variety ICA-Guantiva was shown to give an increase in production of 51% and an income of 30%, associated with a cost increase only 12%, most of which was for labour and none of which was for fertilizer. The major requirements for the new technology were, therefore, knowledge about and access to seed of the new variety (which was initially made available by ICA in small quantities at no charge). In essence, the requirements for the change fell within the farmers' existing constraints and, not surprisingly, adoption rates reached the high level of 77% in the first year of recommending the use of ICA-Guantiva.

A Type II technology is illustrated by the efforts to promote an improved corn variety (ICA-H302). Regional trials with this variety had shown promising yields using traditional cultivation practices. However, as has been discussed in the description of the corn plan, the total cost of production with hybrid seed and fertilizers was three times that of the traditional system and the risk entailed in its use was more than three times as great as that of the traditionally grown variety. The Caqueza farmer's shortage of cash and inability and unwillingness to assume an increase in risk of this order of magnitude resulted in widespread rejection of the new hybrid. Where the seed was adopted there was a tendency to underapply fertilizer as an economy measure but, as has been discussed in Chapter 10, this sometimes resulted in the hybrid yielding even less than traditional varieties and bringing about a Type IV situation in which the change in technology is constrained at both the biophysical and socioeconomic levels.

Another example of a Type II situation is illustrated by the potato variety ICA-Purace, which outproduced ICA-Guantiva with the same inputs. However, the Purace potato is larger than housewives like and has an unpopular taste and texture so that it is difficult to market, and for this reason it was not taken up by farmers in spite of its high yield.

The Type III technology is illustrated by the new varieties that failed to outyield the traditional ones in the various crop variety trials but with which there were no obvious socioeconomic constraints to adoption, e.g., some of the potato varieties under trial.

Where both biophysical and socioeconomic constraints occurred together, as in the case of some costly corn hybrids that did not produce well in Caqueza, the final, or Type IV, technology was observed.

The experience of the Caqueza Project was that on-farm agronomic research was essential to determine the biophysical requirements at the district level of the new technologies developed by the agricultural research stations. On-farm research indicated that certain technologies could definitely be categorized as types III or IV and clearly it was important not to recommend these to the small farmer. In the case of technologies categorized as types I or II, the on-farm research did answer questions about biophysical issues without necessarily resolving whether or not the new technology was likely to run into socioeconomic constraints.

However, it did appear that an understanding of the nonbiological implications of new technological recommendations in relation to the nonbiological (socioeconomic) constraints faced by the small farmer, was just as necessary as a knowledge of the biophysical issues. By identifying the socioeconomic requirements for new technology and the factors limiting adoption, it was possible to identify whether new technologies were of Type I or Type II. In the case of the

former, the adoption of the technology by small farmers was fairly straightforward. For Type II it may be necessary to design buffer institutions (as was done for corn in Caqueza) to improve adoption rates. If this is not done, the Type II technologies are likely to be adopted only by those farmers with lower socioeconomic constraints, namely the larger and wealthier ones, and the new technology may exacerbate rather than diminish income differentials, as has occurred in a number of areas seeking to introduce *green revolution* technology.

Figure 38 shows the relation and parallelism between the socioeconomic and the biophysical requirements of new technologies and the socioeconomic and biophysical constraints confronting the small farmers. In most instances the requirements exceeded the constraints and adoption did not take place. It was necessary to either reduce the requirements or to overcome the constraints. Such changes were made possible by the introduction of buffer institutions.

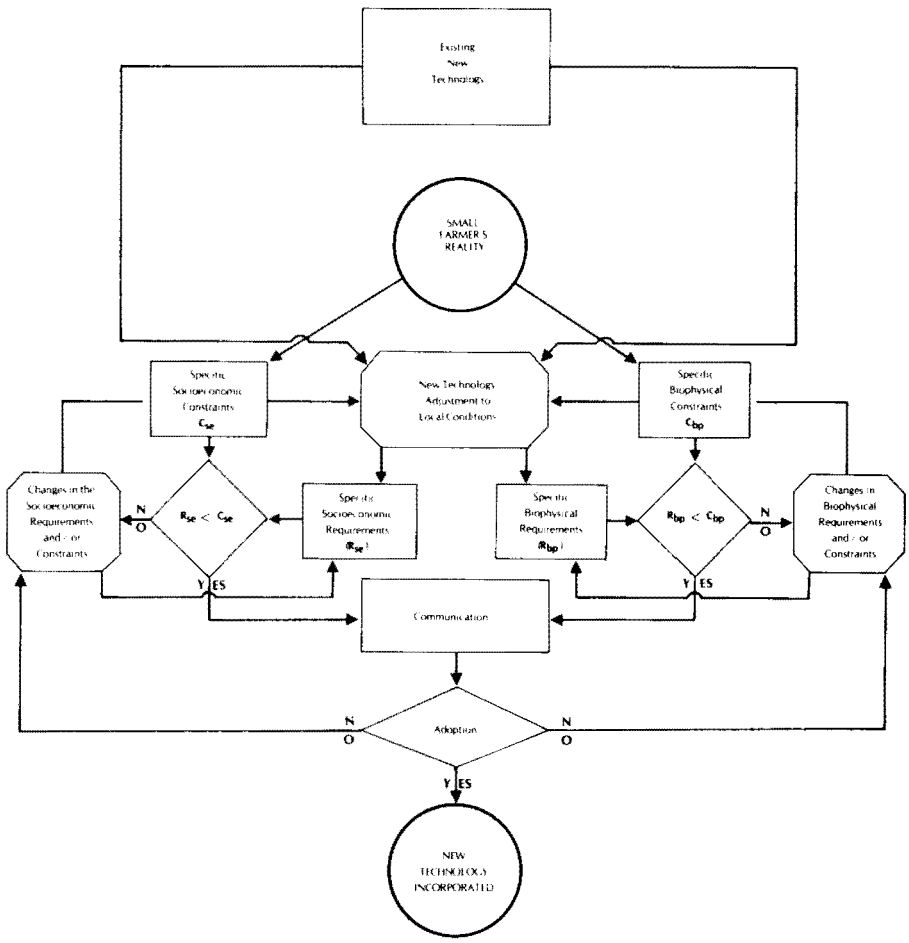


Fig. 38. *Socioeconomic and biophysical analysis in the adoption of new technology.*

Buffer Institutions in Caqueza

(a) The ICA–CAJA AGRARIA Credit Program

In 1971, a joint Colombian Government/US-AID loan was used for a new supervised credit program whereby the CAJA AGRARIA would make low-interest credit available to small farmers who would be supervised by ICA staff in the application of new production technologies that had been developed by ICA. The results of this program have already been discussed in Chapter 12, where the disappointing credit adoption rates were commented on. However, the concept of supervised credit did involve an institutional change that was brought into existence by the recognition of the cash shortage and low input technology of the small farmer, so in this sense the loan program did represent an early effort at creating a buffer institution in Caqueza.

Although the success of this program was limited, it represented a distinct change compared to many earlier credit programs in that the money and technology were specifically channeled to the small farmer. The fact that the results, in terms of both adoption and yield, were less than expected also led to some rethinking on credit policy. As a result, more emphasis is now being given to allocating small-farm credit on the basis of credit rating (debt status) rather than on the size of landholding. This has the effect of channeling more funding to the very small holder, a policy that coincides with the Government's social goals but that was not really practical within the traditional credit system.

The influence of the Caqueza Project in bringing about these changes appears to have been quite substantial as the project has played a key role in measuring adoption. Prior to 1970 (and subsequently in many schemes) credit programs were always evaluated in terms of the magnitude of disbursements or the number of participants rather than in terms of their impact on production. The collection of data on adoption rates led to an important change in outlook with respect to evaluating the success of agricultural credit programs and it provided the planning authorities with a much more meaningful tool.

(b) The Caqueza Project

The RDPs, of which Caqueza was one, were generally derived from extension agencies and as such were a form of buffer institution. They were staffed in a way that recognized the need to supply small farmers with different types of agricultural expertise. Probably the most notable aspect of their structure, as exemplified by the Caqueza Project, was their very flexible nature. The other buffer institutions described in this chapter emerged largely as a result of this flexibility and an overall concern for tackling the whole complex of problems confronting the small farmer rather than working on a narrow front. This can be illustrated by the fact that the project had personnel working specifically with the rural women, which led to the establishment of close ties with the farm families, which, in turn, strongly influenced the orientation of the project's work in that deliberate efforts were made to identify and fulfill the "felt needs" of the family, even when this involved nonagricultural activities such as the access road and the rural latrine programs.

This type of action sometimes had an important spin-off effect, as is illustrated by the project's successful efforts at helping rural electrification programs, as a result of which the staff finally gained the complete confidence of certain communities who were not originally receptive to trying out project ideas and

recommendations. In this sense the project itself acted as a buffer institution, always seeking new methods for helping the community to identify and attain its own goals, rather than just those goals that the staff felt to be desirable. This technique of building from below as well as above is one that is not normally adopted in traditional extension programs.

(c) Prodevelopment Committees

From the earliest stages of the project, the staff were concerned that most of the direction of its activities was controlled by the central offices of the participating institutions, and there was little formal opportunity for a local input other than through the personal contacts of the project staff. This, however, did not necessarily give the project acceptance by local leaders, some of whom felt that they were being bypassed or even challenged. In late 1972, the project team decided to establish a local committee so that project decisions could be guided by the community in which the project functioned. This led to the creation of the Caqueza Prodevelopment Committee. Its members consisted of eight farmers (four each from the two farmers' organizations), the Community Action Group (Accion Comunal), and the Farmers' Association (Usuarios). The remainder of the committee was formed by representatives of ICA, CAJA AGRARIA, INDERENA, a local doctor, and two teachers, with the mayor and priest as honorary nonvoting members. Several subcommittees were formed to deal with different aspects of development. The Prodevelopment Committee was not particularly successful, for reasons that have been discussed in Chapter 6. The whole process and concept of local decision-making in integrated rural development activities is obviously very delicate from the political standpoint, and for an organization like ICA, let alone a foreign group such as IDRC, to indulge in activities that attempt to influence local power structures, is obviously fraught with danger. Nevertheless, since the Government defined *increased local participation* as one of the goals of the Caqueza Project, this issue needs more attention and analysis if political decision-making is to receive any meaningful influence from the local community.

(d) Cooperatives

Although the Prodevelopment Committee failed to act on most fronts, it was responsible for the creation of COAGRIGAN, a cooperative of farmers and livestock producers in Eastern Cundinamarca. This cooperative was established early in 1973 after the raffle of a cow at Christmas 1972 had provided $300 for working capital.

The original idea of the cooperative was to provide, at discount prices, the farm supplies required by the new technology, such as fertilizers, animal feed, and veterinary products. The Prodevelopment Committee felt that local shopkeepers were charging exorbitant prices for these products and that the Government bank (CAJA AGRARIA) was unreliable in the availability of its funds at the precise time that they were needed. However, to attract a large number of participants to the cooperative, ICA suggested linking the provision of consumer goods services to agricultural supplies. It was recognized in principal that margins on consumer goods sales were very small, but it was hoped that with the expected economies of scale due to combining services, such as input supplies, marketing, and eventually credit, as well as by conducting joint purchasing and sales with affiliates' cooperatives in adjoining municipalities, the lack of earnings from consumer goods sales would be offset by the profits generated by the other

activities. Although the overall concept appeared to warrant testing, two major obstacles eventually prevented its success.

The first obstacle was faulty management. Because ICA staff on the Pro-development Committee spearheaded the cooperative idea, they felt responsible for guiding and training the cooperative management. Unfortunately, the staff available were neither qualified nor experienced in establishing cooperatives. Instead of creating a solid, farmer-represented management team, the ICA staff ended up doing the management themselves. Because of the high ICA staff turnover, even this method failed. Though it is possible to criticize the fact that management responsibility rested with nonmembers, this should be viewed in the light of the accepted Colombian cooperative policy, whereby central cooperatives normally employ local managers.

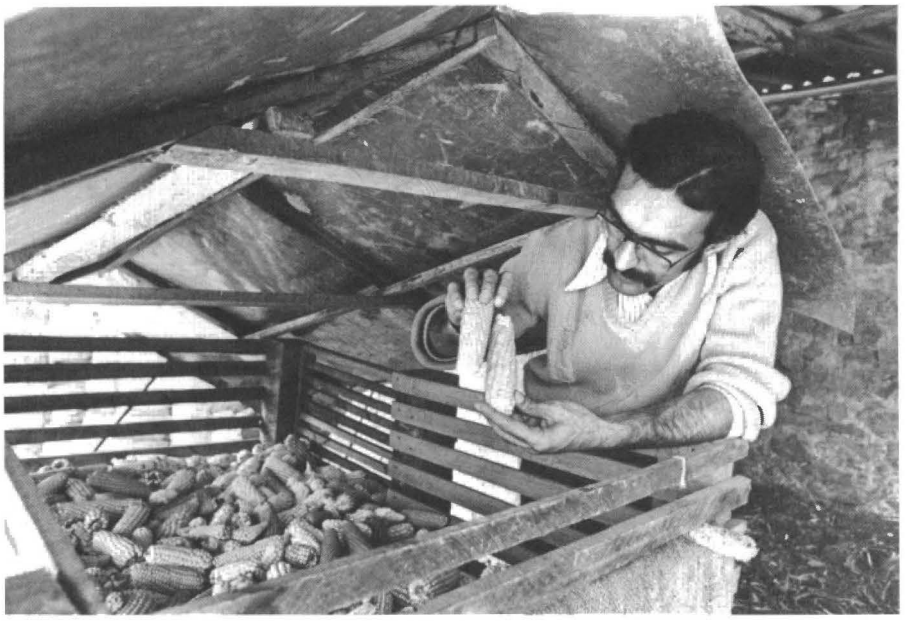
The second obstacle arose because the complementary activities failed to materialize and the consumer goods services had to stand on their own for over 2½ years, during which time there were only sporadic inputs from the farm supply activities. Given this situation, it was not surprising that the cooperatives decapitalized. During this period unsuccessful efforts were made to provide supplies of animal feed and veterinary drugs. Two efforts were also made to provide marketing services. Because of this lack of its profit-making complementary operations, the cooperative can be considered to have failed even though the farmers, ICA, IDRC, and IDEMA all tried to prolong its life by underwriting its losses.

However, the cooperative movement was not written off entirely and it provided the basis for the thinking behind the rural store concept, which was discussed in Chapter 13. This concept led to the emergence of a coordinated voluntary chain of stores. Both private and cooperative ownership was considered for this chain, and both ICA and the National Planning Office opted for the latter. But in this case, the initiative lay in Bogota from where the complementary activities were to be centred.

The reason for persevering with the cooperative was due to the fact that the largest and most successful governmentally supported marketing organization was CECORA, a central second-grade cooperative. It was felt that as this organization included rural affiliates with histories of economic success and viability, expanding their services would be more feasible than creating a new marketing institution. Whether or not COAGRIGAN will ever play a role in formulating these activities through participation in the ICA-stimulated marketing plan described in section (g) of this chapter, and which was planned as the forerunner for the overall CECORA marketing scheme, remains to be seen. Possibly, insufficient attention has been given to the fact that cooperative development requires not only management but profit-making activities, and any cooperative lacking in either of these elements probably faces collapse.

(e) The Dissemination Program

The traditional approach to extension in Colombia has been to take new technologies from research stations and "extend" them to farmers in the rural areas. In Chapter I we reviewed some RDPs that modified and broadened this approach to adapt it more closely to local conditions. However, it was not until the time of the Puebla Project that this technique really became well known as a new philosophy for extension. The fact that the ICA rural development program adopted this new methodology from the onset of its activities was undoubtedly related to the fact that a number of the ICA staff associated with the Rural Development Program from its inception either had been, or would be, trained in the



A simple new storage technique was introduced to reduce the losses in stored corn. (Photo: Ron Poling)

Puebla Project or in the Chapingo Graduate School that was closely associated with it. Furthermore, the Rionegro project, which slightly predated Caqueza, received advice in its early years from the Puebla Project's CIMMYT advisors and this too tended to popularize the Mexican approach in Colombia.

The philosophy behind this approach was that because new agricultural technologies generally originate from experimental stations where soil, water, and microclimatic conditions are usually known and fairly well controlled, these same technologies are not necessarily suited to the heterogeneous conditions encountered on small farms where within-field soil variations can be very large, land preparation techniques are often crude, water is usually entirely dependent upon natural rainfall, and microclimates, within even a small field, can vary considerably due to uneven terrain and steep slopes leading to large differences in the incidence of solar radiation. As a result of this, a sometimes lengthy process of adaptation and adjustments may be required before a new technology can justifiably be recommended to the small farmer. It appeared that at least one season of regional on-farm trials was necessary and, depending upon the nature of the results, these trials may need repeating for 3 or 4 years before an adequately adapted technology can be achieved.

Whether this adaptation process should be considered research per se or should be regarded as a development activity is a subject that generated much controversy in Colombia (Chapter 8). The findings of the Caqueza Project suggested that it is, nevertheless, a necessary component of the risk-reducing process, which itself is an essential factor in increasing the adoption rate for new technology. In the early years of the Caqueza Project, the approach to on-farm research was restricted to variety trials and fertilizer experiments measuring only corn and potato yields, even though these crops were grown in association. During the second and third year, the scope of the research was broadened to include measurements of all crop yields in associated cropping trials. However,

it was not until the fourth year that the project began to clearly understand the interrelation between factors such as the yields of associated crops and the number of weedings they were subjected to. The lessons derived from this experience have now been carefully built into ICA's technology dissemination activities and its new risk-sharing production plans.

(f) The Corn Plan

Earlier chapters have dealt with this program in some depth and the only further comments offered here will be with respect to considering the plan as a buffer institution. In the first phase, the plan arose from a gradual understanding by the project staff that the low adoption rates for corn were not associated with poor technology but were principally due to problems of risk and credit. The 1974 plan sought and partially achieved ways of overcoming these constraints. However, the plan was awkward to administer and late in starting. In 1975 it was modified in an effort to overcome these shortcomings and an appreciable degree of success appears to have been achieved. Scope for further change still appears to exist before the plan justifies institutionalizing in a more formal way. Because of the considerable flow of international funding for this type of program, it appears that some form of institutionalization of the plan will be necessary in the fairly near future.

(g) The Marketing Plan

Chapter 13 has already discussed the marketing activities of the project and has drawn attention to the role played by the rural store program and the "cabbage crisis" in initiating these activities. The marketing plan served as a buffer institution for the collection and distribution of both farm inputs and produce. In 1974 its collection system was restricted to the Caqueza area, which led to a very seasonal pattern of supply that was not well received by the retail outlets. In 1975 the supply base was broadened to include other ICA RDPs with access to the Bogota market. This meant that the plan involved far more than the Caqueza area and staff. This understandably led to management problems as product procurement, retail outlet promotion, and establishing a system for pricing all had to be dealt with. But the small volume of sales due largely to the small amount of working capital originally allocated to the plan, plus the unexpected occurrence of a bad debt from one of the founding retail affiliates, created a working capital crisis after only 4 months of operation. Because of the considerable flow of international funding for this type of program, further research on the structuring and management of such plans needs to be carried out.

However, although the plan met a much-felt need of the farmers, its day-to-day management consumed a substantial amount of ICA staff time and involved them in issues that ICA was not set up to handle. The need for the buffer institution is not doubted; serious doubts do exist as to whether an organization such as ICA can and should take the lead in developing and managing such an institution. This is an issue that we will be returning to in more detail in Chapter 17. Nevertheless, the key point here is that the Caqueza Project observed a much felt need, and created a buffer institution to deal with it. The Caqueza Project had the necessary built-in flexibility to accomplish this task. Whether or not ICA continues to manage this institution is not at issue. In fact, the plans afoot for a new internationally financed national integrated Rural Development Program will shift this management task to CECORA.

(h) The Preschool Program

The pilot preschool program was initiated in 1974 with the opening of one centre in the corn zone and one in the potato zone. During the year, the home economics staff of the project visited each centre regularly and confirmed their original hypothesis that the social capacity of the children was much greater in the higher income potato zone than in the lower income corn zone. At the centre in the potato zone the children began playing and relating among themselves and suggesting social activities that required social interaction such as games and play activities, immediately after they arrived at the school.

In contrast, the children in the lower income pilot centre were more timid and inactive, and showed fear of playing together. However, after a year at the centre, with two 1-hour sessions weekly, these children improved considerably in their social consciousness and almost reached the level of those in the other centre. Indeed, in 1975, one of the teachers in the lower income centre observed that the most wide-awake, mature, and active students in her first grade were the four who had attended a preschool centre in the previous year. These children adapted quickly to the school environment and demonstrated a greater capacity to concentrate and became the "best students" in their class.

The parents of the preschool students expressed equal enthusiasm for the program, as a result of which the National Planning Department, which had followed this program with close attention, decided to finance 11 new centres in the low-income corn zone. Each centre had an average of 15 pupils and, apart from the social and educational aspects of the program, the children received a high-protein vegetable juice, and their parents were given talks on nutrition at twice-weekly classes. Perhaps the most promising feature of this program was the fact that the National Planning Agency followed up the initiative of the project staff and took responsibility for a buffer institution (like the Marketing Plan) that the Caqueza team could not have funded by itself, let alone expanded and managed on a broader scale. This, too, appears to have important implications for national rural development strategy, which will be discussed at greater length in the final chapter.

The intervention of the National Planning Agency is also noteworthy in that, because of their interest in possibly extending this program at the national level, they are organizing a far more detailed evaluation of the program than the Caqueza project would have been likely to or capable of carrying out on its own.

(i) The Onion Plan

The promising results of the 1974 corn plan, and the knowledge gained from farm interviews, revealed that the acreage devoted to onions was very limited, even though on-farm trials showed that returns from this crop were far superior to those from corn production. This situation led to the development of an onion plan modeled on the one for corn.

This plan operated alongside the 1975 corn plan with the only difference being that onion plantings were staggered to avoid saturating the local market at harvest time. The adoption rates were over 90% and farmers' returns were very high, averaging about $1200 net per hectare (as opposed to $200 from the corn plan). Yields in the plan rose from the traditional average of 10 t/ha to 22 t/ha. Because of unusually low onion prices during the year, the returns to the plan (as opposed to those to the farmers) did not reach a satisfactory level, indicating the need for more adjustment in the balance of plan/farmer returns to put the plan on a sounder long-term financial footing. To demonstrate the impact of this

particular buffer institution, it is useful to compare the plan's results with those obtained by a group of Caqueza farmers associated with a CARE community action program. CARE granted this community a loan for constructing pipelines. However, instead of repaying the loan to CARE, the reimbursements were put into a revolving fund that was used to purchase inputs for onion production. Fifteen farmers participated in the program, and the Caqueza agronomist responsible for the onion plan acted as advisor to it. In spite of the fact that these farmers had been advised to purchase improved onion seed and plant it in nurseries prior to transplanting it, they all purchased and planted unimproved onion bulbs from another part of the country. In doing this they not only risked the introduction of disease but also increased their production costs. The risk-sharing plan that linked credit to specific inputs and repayments achieved virtually full adoption, whereas the supervised credit system, which was less rigidly structured, only achieved partial adoption.

(j) Pick and Shovel Roads

Another US-AID loan, this time to the Ministry of Public Works, created another buffer institution, the "pick and shovel" road program. This program operated in the following way. The trajectory of the proposed road was established by the Rural Road Program (CAMINOS VECINALES). The local residents were then offered payment for each cubic meter of earth excavated. Different extraction rates applied to sand, dirt, gravel, and rock. No heavy machinery was introduced except when special circumstances justified this, the idea being to maximize labour use whenever this was practical. Although 15 km of new roads have been built in this manner in the Caqueza area during the project's life span, it has not been possible to evaluate this program by comparing induced benefits to costs. It is known, however, that labourers commute several kilometers per day to work in this program and that the new roads are well used. Clearly it has put extra money into the area and, through the project's involvement in helping to organize the program, it has come to be regarded as part of the project's overall activities.

(k) Animal Health Programs

The farmers used virtually no prophylactic veterinary measures for their livestock unless vaccines or anthelmintics were provided free by the Government, in which case very high adoption rates were common. The reason for this appeared to be that the average farmer had only a very small number of stock (sometimes one cow or two or three pigs) and he was reluctant to invest in a syringe and needles. Furthermore, most drugs and vaccines came in multidose packs (foot and mouth vaccine is manufactured locally in 50-dose bottles) so that there was considerable wastage unless large-scale campaigns were organized.

The presence of an ICA veterinarian in the project and the fact that he was well supported by a central diagnostic laboratory meant that the diagnosis of disease outbreaks and the organization of vaccination campaigns were carried out promptly. Problems arose because the supply of vaccine in the project area was inadequate and the project did not have the authority or the funds to purchase vaccine. Vaccine purchase, therefore, entailed having the project veterinarian collect the vaccine costs in advance from the farmers and then organize (or himself collect) a supply of vaccine from Bogota. In an effort to streamline the procedure, he purchased a vaccine supply from his own pocket, investing a

month's salary in the process, and sold this vaccine directly to the farmers. This system worked until the veterinarian was advised to discontinue it on the grounds that it was illegal.

In 1975 the project staff decided to allocate a small portion of the IDRC research funds for a fund for the purchase of vaccines and anthelmintics. This fund was managed jointly by the farmers and the project veterinarian and operated smoothly and efficiently in its first year when it appeared to represent a useful innovation. However, it was only practical through having untied foreign funds for research and calling the revolving fund a "research" project. To institutionalize this more formally, it will be necessary for ICA regulations to be altered so that this type of funding can be made available from local sources through RDPs.

Conclusions

The concept of buffer institutions was one that emerged out of the frustrations of the project staff in their efforts to get a higher rate of adoption of new technology. The realization that the impact of technological change was likely to be very limited unless it was closely associated with institutional change did not occur until the project had suffered its share of failures. The built-in flexibility given to it by ICA's managers through their receptivity in allowing the project to innovate, and the fact that IDRC funds were available for testing such innovations, meant that the project was in a position to experiment with institutional change. As a result of this, largely through a trial-and-error process, a series of buffer institutions emerged.

There would appear to be considerable scope for further research on such institutions, particularly in terms of their management costs and benefits.

Part V

Measuring Achievements

MEASURING ACHIEVEMENTS

Although measuring the changes in the community and its income that resulted from the Caqueza Project was the fourth of the stated objectives of the project, no formal mechanism for critical evaluation was ever established. Part of the reason for this was that the constant changes in the senior staff of ICA resulted in constant changes in ideas about what the project was really setting out to achieve. The political pressure for action and achievement downgraded the priority of the benchmark study, whose publication was much delayed. In retrospect, the design of this study also left much to be desired and was, perhaps, indicative of ICA's overall weakness in the socioeconomics field in 1970.

As a result of this situation, Chapter 16, whilst valid in its description of evaluation efforts, needs to be interpreted very cautiously in its efforts to evaluate the project as an investment. This exercise has necessitated some heroic assumptions. However, even if a large element of error does exist in the data, the results are sufficiently promising as to suggest that the methodology used in the project warrants closer study.

Chapter 17 is on a firmer footing in that it takes a qualitative overview of achievements and highlights the institution-building elements of the project. This chapter also analyzes in some depth the role of a foreign agency in a rural development program. The views expressed, though highly subjective, are offered as a contribution to the development literature.

Chapter 16

Evaluation in Caqueza

In Part II of this book, when discussing the chronological emergence of ideas and concepts during the years 1971–75, a number of references were made both to evaluation and to the changing role of the evaluator. In subsequent chapters the subject of evaluation has been touched upon on a number of occasions, during the course of which the "impact" of project activities has been discussed. In this chapter, an attempt is made to bring together these various references to evaluation and to identify the extent to which the project was able to identify and measure its achievements.

These evaluation activities, carried out in an operational action program, represent an interesting contribution to socioeconomic research. They also had an innovative role in leading to the creation of new institutional approaches (buffer institutions) designed to overcome constraints identified by the evaluation procedure.

The first project programmer/evaluator started at a disadvantage compared with the agronomist and the veterinarian. The former had undergone special training in conducting on-farm trials and in "extension" techniques. The veterinarian had been taught to diagnose and treat animal disorders and in doing so was able to establish a direct and easy relation with the farmers. In contrast to this, the evaluator was a "new species" of animal without a clearly identifiable discipline. In the Colombian RDPs he was usually an agricultural economist or a sociologist, but neither discipline specifically prepared its professionals for project evaluation — a task that few development agencies, either national or international, have made much progress with. In these circumstances, it is hardly surprising that the project's evaluation activities did not follow a prearranged plan but emerged as an ad hoc flow of ideas that often followed heated discussions amongst the project team. During these discussions the evaluator was often on the defensive, as he had nothing to show comparable to the "x" trial plots of the agronomist, the "y" vaccinations of the veterinarian, or the "z" advisory visits of the technical assistants.

His first assignment was to design and supervise the implementation of the baseline "diagnostic" study that ICA had requested. This was to record farmers' production and incomes and to identify the availability of infrastructural services. The study involved a survey of over 600 households, and it included a geographic description of the project area; information on family structure and size, farm size and land use, and housing conditions; notes on the status of social services, such as schools and hospitals; an estimate of productivity and farm incomes; and a description of agricultural sector infrastructure. The results of this study were heavily criticized by the project staff because it took almost 2 years to complete and publish, as the evaluator had to do virtually all the work

and analysis himself and had started the task with a very ambitious questionnaire. Further criticism arose from the fact that when the other team members questioned how the voluminous final report would improve their performance and impact, they received the answer that "a diagnostic study was requested, so here it is."

In retrospect, the attitude of the team toward their evaluator does seem rather harsh and there can be little doubt that the baseline study did produce a lot of valuable information that acted as the forerunner of a number of project ideas and activities. It also collected a lot of interesting but unusable information and illustrated to the team how much forethought was necessary before embarking on large surveys.

Well before the baseline study was completed, the evaluator had commenced work on other activities. One of the earliest of these was an effort to survey the farmers who had attended project field days in 1971 to see to what extent these farmers knew what the project was trying to achieve. The results indicated that although the total number of attendees at project meetings was large, many were repeat visitors, the project was reaching only a small number of farmers, and many of these came more for the social contact than for learning new technology.

The evaluator was initially hesitant to present these disappointing results (which did not make him popular with his team colleagues) to the senior management of ICA. When he did so, to his surprise, his report was well received, partly because ICA's management was itself beginning to question some of the traditional bases for evaluating its extension program and partly because the evaluator presented his data using a statistical regression model of a type that was widely used by ICA in its analyses of crop trials. By using a statistical technique that was a standard working tool of ICA's agricultural researchers, the evaluator established his credibility as a "scientist" in the ICA group responsible for rural development policy. Although this may seem a small point, it must be appreciated that very few indigenous social scientists in Colombia had previously worked in or tried to establish a dialogue with an agricultural development team. All too often ICA was criticized by social scientists using jargon rather than hard facts. ICA now had, from one of their own professionals, a study that they could understand and accept that indicated that the early efforts in Caqueza were having a limited impact.

At about this time the project team was beginning to focus its goals (Chapter 5) and was discussing the concept of a measurable "level of living" index as the definition of RDP objectives in Colombia. Considerable work was done in developing a model that was later discarded as part of the project activities but was developed and successfully defended as a Ph.D. thesis by a Colombian economist on ICA's staff. However, from the standpoint of the development of both the Caqueza Project and RDP philosophy in Colombia, the fact that the discussions on a "level of living" index and the establishment of the Caqueza evaluator's credibility in ICA more or less coincided, were of considerable interest. This is due to the fact that in 1972, when this situation occurred, the first ALADER meeting took place in Bogota. At this meeting, representatives from several Latin American countries tried to define precisely what were their RDP goals. To highlight the fact that the Colombian concept of RDP envisaged *social welfare* as well as *production*, the Deputy Director General of ICA asked the Caqueza Project evaluator to present the draft Caqueza paper on a "level of living" index as the best approximation of the Colombian RDP concept at that time.

A number of studies were made on ways of improving the local marketing system. One suggestion, which had limited success, was to transport produce to town markets by donkey or mule. (Photo: Carlos Zulberti)

This public recognition of the evaluator's role played an important part in both building the confidence and self-respect of the evaluator and in establishing Caqueza as a "living" laboratory for testing new ideas in rural development. Nevertheless the evaluator continued to come in for criticism from his colleagues in Caqueza who felt that he could only do good work if he regularly visited farmers. They did not readily accept the fact that it was equally important for the evaluator to organize ideas, write reports and proposals, discuss research concepts, and supervise field enumerators rather than to spend all his time with farmers.

In November of each year the "evaluator" took 2 months off to become the project "programmer." In conjunction with the other team members he helped prepare a complete report of the past year's activities and a program for the ensuing year. This annual reporting served the purpose of requiring each team member to list his past activities and to make a schedule for the future. However, it did not contain any evaluation element but was simply a statement of what had taken place and what was proposed for the future.

During the 3rd year of the project it became apparent to the staff that without a clear understanding of the small farmer's agroeconomic environment, realistic goal setting was impossible. A new series of analytical evaluation exercises were initiated as an attempt to gain such an understanding in relation to certain important production factors. In retrospect it would appear that more emphasis should have been given to this type of analytical evaluation of the *constraints to change* in the earlier years of the project and that evaluation of the *impact of change* was unlikely to be a productive exercise until and unless the constraints were understood. This differentiation between types of evaluation appears to have been an important aspect of the project's learning process, and

before trying to measure change it may be useful to discuss this issue in more detail.

Different Types of Evaluation Techniques

Traditional Extension Program Evaluation

Reference has already been made to the annual reporting exercise carried out by each project. At the political level such reports were of importance in illustrating governmental activity in the small farm sector. In the early 1970s, these project annual reports were used by ICA as the basis for comparing the activities of different RDPs. It was considered that those projects that visited and demonstrated to the largest number of farmers, and in whose area the greatest number of credits were authorized were the most successful. However, the discussions on social welfare goals led to the recognition by ICA that these criteria were not necessarily related to whether the new technology being proposed was appropriate, whether or not the farmer had the additional resources to accept it, or whether or not the farmer received any economic benefits from applying the recommendations associated with new credit; indeed none of these questions were usually asked. To rate high on this evaluation system, project personnel needed to run hither and yon, talking and shaking hands, and often ignoring the real objectives of rural development. In certain circumstances this type of evaluation could give misleading results. For example, in 1972 the Caqueza Project utilized less credit than other RDPs did, not because the staff lacked competence or energy but because the farmers themselves were refusing supervised credit because their previous experience had given them some understanding of the risks involved in such a program (Chapter 5) and they were reluctant to be burnt twice.

Personnel Evaluation

Most civil service organizations have a mechanism for evaluating their personnel. Often this involves no more than an annual assessment by the staff member's immediate superior. This was the case in Colombia where one component of the project coordinator's task was to make an annual evaluation of the performance of each member of the project team. This was obviously an extremely difficult and subjective task, given the high degree of interaction between team members and the diffuse nature and definition of their duties, plus the constant reorganization in project structure due to personnel changes. At no time was the project evaluator involved in this task.

Although the subject of personnel evaluation is, therefore, not covered in this chapter, it is an important issue in terms of project success. During the 5 years reported on in this book, over 50 people worked in the project with quite markedly different impacts, both on other project personnel and on the farmers. As mentioned in the Introduction, project staff were largely isolated from professional contacts, and social contacts in Caqueza were limited, thus tending to force the team together in their nonworking as well as in their working time. This tended to accentuate problems, especially at times when the project lacked strong leadership. The whole subject of staffing this type of project, particularly from the standpoints of creating motivation and developing leadership, is only briefly touched upon in Chapter 14, which deals with training, and would appear to warrant much more study.

Baseline (Diagnostic) Evaluation

Development programs are frequently funded by donor agencies. From time to time these agencies may need to demonstrate to their domestic taxpayers what is the impact of their overseas activities. One way to do this is to quantify a number of variables at the start of a project and to repeat this exercise some years later. This has been done successfully in Puebla but at considerable effort and expense. A great deal of effort went into the baseline study in Caqueza: it took 2 years to publish and much of its data covered nonagricultural aspects that are unlikely to be influenced by ICA's activities. Furthermore, the data that did relate to agriculture often involved sensitive issues, such as production levels and incomes, and such data can often only be derived by time-consuming processes of cross-checking. The baseline study thus provided a useful benchmark but was costly to produce and even then may be of dubious accuracy.

Impact Evaluation

Project *impact* was defined as *change attributable to project activities*. To measure such impact it is essential to first define what changes the project is trying to induce. Some examples will help to illustrate this, particularly from the standpoint of faulty goal setting. For example, one of the objectives of the Colombian RDP program was to increase employment. Therefore, when a proposed new technology showed a large increase in labour demand, e.g., for fertilizer application, such a technology was regarded as consistent with the employment goal. Subsequently, it was found that full employment occurred in April and May, the precise months when the additional work generated by the new technology would take place. The original employment objective clearly needed to be changed to take account of seasonal factors.

A similar example related to the provision of credit offered irrespective of the risks associated with its use. The objective of "providing more small farm credit" although undoubtedly a valuable part of the development package, is in itself only a half measure. It is a component of an institutional package that facilitates farmers moving from their existing welfare level to a higher one through the provision of factors such as: (1) credit; (2) a package of new technologies; (3) production risk-sharing; (4) marketing services, etc. Thus, evaluating success or failure of the provision of credit per se serves as a very limited indicator, or even a false one, of program merit.

Such examples illustrate how crucial "goal" or "objective" setting is to good impact evaluation. The more precisely the goal or objective is stated, and the constraints identified, the more valuable the impact analysis is likely to be.

To set goals and objectives at the beginning of a project, a certain amount of information must be available, even if it is of only a preliminary nature. Without this information, it is almost impossible to make sensible goal judgments. However, because evaluators are usually not involved when goals and objectives are set, these goals and objectives are all too often set in vague general terms, such as "improvement of the farmers' welfare." A term like "welfare" is highly subjective and can turn into a Pandora's box unless it is clearly defined. Generalized goals may be acceptable at the very start when it is not possible to be precise, but they will remain of limited value unless modified to take account of new information flowing in from the project.

Financial Evaluation

Because Caqueza was one of the first Colombian RDPs, there was little knowledge available on which to base any ex-ante analysis of benefit–cost ratio or internal rates of return. Obviously, such techniques are desirable in terms of the formulation of development policy, and later in this chapter we have attempted to discuss a very preliminary financial evaluation of the project.

Analytical Evaluation

Chapter 9 has discussed in some detail the project staff's concept of "analytical" evaluation, which subjected the ongoing activities of the project to a socioeconomic examination to determine cause and effect relations. The major evaluation work of the project took place in this sphere and focused on the issue of constraints to change. Much of this work has already been described in earlier chapters, which have covered the following subjects:

(*a*) Adoption Studies (Chapters 9, 11, 12)
(*b*) Productivity Analysis (Chapters 8 and 9)
(*c*) Risk Analysis (Chapter 11)
(*d*) Agronomic Analysis (Chapter 10)
(*e*) Labour Use and Response to New Technology (Chapter 9)
(*f*) Credit (Chapter 12)
(*g*) Marketing and Prices (Chapter 13)
(*h*) Nutrition (Chapter 15)

Managing the Evaluation Process

Evaluating a development project is a sensitive issue in that it can demonstrate how successful a project is or it can show how it has failed. Unless the objectives and the method for measuring the impact are very clearly defined, it is not difficult for an evaluator to bias his results. For this reason, evaluators are often viewed with suspicion or even antagonism. The suspicion arises because their biases are unknown, and the antagonism because they may wield an undue degree of power and influence. Thus, managing the evaluation of a development project is a delicate task, which can be undertaken in various ways.

One approach is to recruit outside consultants who specialize in evaluation. Although this may eliminate any biases due to "vested interests" (if the consultant is not tied to supporting or justifying a donor's investment in the project), the difference in attitude toward a local situation between the consultants and the project staff may be so large that the staff fail to pay any attention to the consultants' recommendations. They may even feel that the consultants are so far removed from the real "happenings" within the project that their analyses are invalid. This may be true when the experience of the consultants is restricted to different cultures to the project and when they are working against contractual time constraints.

The Caqueza Project was, in fact, one of 36 RDPs evaluated on behalf of US-AID by Development Alternatives, a North American consultant firm (24). Their findings highlighted two aspects of Caqueza activities. The first was to support the project's efforts to involve the farmer in the decision-making process through a thorough analysis of his situation and through the creation of new institutions in which the farmer participated. Secondly, they concluded that the Caqueza Project was virtually the only one of the 36 they examined that was

consciously and systematically looking at the production and institutional risk factors.

Their recommendations were not used by the project as a basis for modifying its activities. However, ICA did use their favourable report to successfully obtain US-AID support for financing other RDP projects. Thus, the consultants' report was used for justifying donor agency investment but was not used as an in-project management aid.

A second technique for evaluation incorporates the evaluators within the project team, as was done initially in Caqueza. The major advantage of this approach is that the evaluator can act as a "devil's advocate" within the project team itself by bringing to the team a different type of approach and different analytical tools. He is not dependent upon the success of the program for career advancement, and has less "vested interest" in making the results appear favourable. The disadvantage of this approach is that the evaluator is put in the position of auditing his colleagues' performance including that of his immediate superior, the project director. This can easily lead to personality clashes, as it did from time to time in Caqueza. However, the advantage of an internal evaluator was that when he was able to come to terms with his colleagues, his analyses tended to be a joint effort whose results were much more readily understood and accepted by other team members.

This approach was initially adopted by ICA, but was later abandoned as an economy measure and the evaluator was transferred to the Regional Office to serve several projects. At the same time, an Evaluation Division was created at ICA's central research and training station at Tibaitata. This division never really got off the ground and after a year of defining their role, they were redesignated as a Rural Development Studies section in ICA's Socio-Economic Studies Division. The concept of regional evaluators never materialized into a functional activity, although this is clearly a feasible approach. Its advantage would be the provision of comparable data from different projects in a region; the disadvantage would be lack of identification and participation of the evaluator with each individual project team.

A fourth possible approach is to have a national evaluation team who could simultaneously carry out evaluations throughout the whole country or systematically and sequentially identify projects for in-depth evaluation. This approach was initiated in Colombia in 1976 and met with a fair measure of success. The two ICA staff members responsible for designing this approach were the first evaluator and an excoordinator of the Caqueza Project. Nevertheless, the approach suffered from the fact that the evaluators were "outsiders" in the sense that they came from ICA's Socio-Economic Studies Division rather than the Rural Development Division to which the projects were responsible. However, the evaluators did have first-hand experience of the type of work that they were evaluating. In 1977 the third and fourth approaches were pooled by the creation of regional "Technical Support Group" (TSG) teams, which evolved from the national evaluation team concept. In the process of evolution, the role of these teams broadened and rather than being evaluators of performance, they became evaluators of knowledge in a project area, so that their main task became one of setting the technical framework for individual project action. The Regional TSGs were, however, placed in ICA's Rural Development Department rather than in the research one. The actual evaluation of technology remained, however, in the Socio-Economic Studies Division of the Research Department where it operated on a *project* rather than a *program* basis.

The Cost of the Caqueza Project

At the beginning of 1971, ICA's rural development activities were based upon 59 extension agency offices, each of which was usually staffed with two professionals and six technical assistants who received administrative support from ICA's regional and central offices. By the end of 1975, 49 of these extension offices were still in existence and the other 10 had been superseded by 20 RDPs each staffed with 6 professionals and 14 technical assistants. The human and financial resources allocated to the national rural development program are given in Table 51. The direct costs of the Caqueza Project are given in Table 52.

During 1971, the Caqueza Project cost was similar to that of a 1970 extension agency, as the RDPs were not included in ICA's original 1971 budget and in 1971 the extra staff for them had to be limited in number and to be financed by budgetary savings elsewhere. By 1975, the annual operational cost of Caqueza had risen to U.S. $96000, plus an unrecorded allocation for supporting activities from ICA's regional and central services.

IDRC contributed U.S. $908000 to the project over the quinquennium but, in the sense that Caqueza was a training ground for all 20 RDPs (and later 86 Technology Transfer Districts (TTDs)) it does not seem appropriate to charge the IDRC input directly against the Caqueza Project; IDRC inputs ceased in 1976.

The 1973 project cost of U.S. $74600 is of particular interest because in that year efforts were made to estimate the value of agricultural production in the Caqueza area. One such estimate (Table 7) put on-farm income in the project area at U.S. $6.5 million. Others (Table 5) tend to support this figure based on an average farm income of U.S. $708 from a series of studies (that usually excluded

Table 51. National Rural Development Program cost 1970 and 1975.

	1970	1975
Extension offices	59	49
RDPs	0	20
Professional staff	111	235
Technical assistants	380	598
Administrative and manual staff	118	218
Annual cost (U.S. $millions)	2.4	4.0

Table 52. Costs (U.S. $) of the Caqueza Project 1971-75.

	Salaries	Other Costs	Total Costs
1971	30000	(13000)[a]	(43000)
1972	45700	23700	69400
1973	50700	24600	74600
1974	(60000)	(30000)	(90000)
1975	73000	23000	96000

[a] Figures in parentheses are estimates where accounting system changes made exact costs difficult to pick out.

livestock income) of 7000 families in the project area (exclusive of the municipalities of Guttierez and Quetame). These figures imply that the operating cost of the project in 1973 was equivalent to about 1.1% of the value of agricultural production from the project area.

In 1977, ICA expanded the staffing of the TTDs, which superseded its former RDPs, and also created nine regional TSGs. These changes represented an effective cost increase of about 50% for each project, the increase being mainly in personnel costs. In fact, in the period 1973–77, crop prices and farm incomes rose to a greater extent than did ICA salaries, so the overall effect of the new ICA staffing would appear to put project costs in 1977 at about 1.5% of farm income (or U.S. $100000 at 1973 prices) in a typical Caqueza-sized TTD.

Because the main direct farmer contacts in these projects are the technical assistants, it is of interest to examine the number of farmers theoretically assigned to each technical assistant (Table 53).

The intensity of farmer coverage, even before 1977, contrasts starkly with the 1970 figure referred to earlier, of 380 technical assistants in 59 extension agencies serving about 1.8 million small farmers in all of Colombia. To achieve a coverage of 300 farmers per agent in terms of 30 agents per project will require about 200 TTDs and 6000 agents, or about double the number in the Government's 1977 plans, which already represent a fourfold increase over 1975.

The total area under corn in 1973 was 9086 ha and there is no indication that this figure has changed significantly since that time. The average corn land per corn farm was very close to 1.5 ha (Table 4), thus about 6000 or two-thirds of the farmers in the total project area (nine municipalities) were corn producers. Those who participated in the corn plan in 1974 had an additional income of U.S. $183 per ha and the 1975 participants outproduced nonparticipants by U.S. $162 per ha.

If we assume that plan participation benefited the farmer by the mean figure of $172 per ha it would require 581 ha (7% of the corn land) or 390 farmers each with 1.5 ha of corn (7% of the corn farmers or under 5% of all farmers) to adopt the plan in order to produce sufficient additional net income from corn to match the cost of the project (about $100 000 in 1977).

Similar figures can be derived for the onion plan, where the added income from participation was U.S. $1172 per ha and only 85 ha in onions or 5% of the 1713 ha in vegetable crops would meet the project's costs. The average area under onions on individual farms was not recorded; in the onion plan the plots averaged 0.12 ha and it would require 708 farms (8% of the total) with plots of this size to provide an extra net return value of $100000.

These calculations totally disregard any social benefits from the project, any benefits from other crops, or any corn or onion benefits for nonplan users

Table 53. Farmers served by each technical assistant in a typical RDP.

Year	No. technical assistants/RDP	Farmers/technical assistant
1971	7	1300
1972	9	1000
1973	14	650
1974	14	650
1975	14	650
(1977)	(30)	(300)

who do adopt the use of improved seed, fertilizer, or a supervised credit package rather than the project's plan.

They indicate that the adoption of either the corn or the onion plan recommendations by about 7% of the producers in the project area would give a value of increased production approximately equal to the total project cost.

The experience of both plans was that participants adopted the recommendations virtually completely. However, for the sake of argument, let us suppose that the plan results were only half as remunerative as in 1974 and 1975 and that it would require a 14% farmer participation to meet the project costs. This would mean that 1260 farmers would need to participate, i.e., with 30 technical assistants in a project, each one would need to work with 42 adopters. This is a long way from the corn plan of 27 farmers in 1974 or the combined total of 74 farmers in the corn and onion plans of 1975, although in that year the two programs were handled by two staff members each covering 37 farmers. By 1977, a number of staff had been trained to manage such programs in other projects and almost unlimited credit was available to support this type of activity nationwide. Thus, the prospects for expanding this approach in the second half of the 1970s appear to be very promising.

Clearly this type of analysis is a very crude way of looking at potential benefits and does no more than indicate that a true potential does exist. This is even more apparent if we recognize that prior to 1970, extension efforts, other than for export crops such as coffee and rice, had had very limited success with small farmers in Colombia and that by 1970 both major political parties were heavily committed to raising small farm incomes. The more sophisticated analysis of the final part of this chapter, although still based upon somewhat presumptuous data, does seem to indicate that the Caqueza-type approach may well do this.

Evaluating the Project as an Investment

The effort and expense dedicated to adapting new technology to local conditions and to disseminating this technology through demonstrations, supervised credit, and risk-sharing plans, can be viewed as a public investment designed to increase local production and productivity. In order to determine whether or not this investment justified the allocation of the country's scarce capital resources, the economic benefits generated by the technology need to be evaluated. However, the benefits of a rural development program should not only be considered in terms of net economic benefits but should also take into account other national or regional criteria, such as income distribution and employment. The employment implications of the project have been examined in some depth in Chapter 9, and various later chapters have touched on the subject of income distribution. The following section will discuss the achievements of the project viewed in terms of the return to an investment in research and dissemination.

Adoption Rates for New Technology

Regardless of how good a new technology may be, small farmers will not usually adopt it immediately. The credit chapter of this book presented the partial and overall adoption rates for new corn, potato, and horticultural technology incorporated into different project activities with several different types of institutional support. The farmers responded differently to each program,

depending upon the degree to which the new technology reduced the requirement-limitation gap facing them. The smaller the gap, the more rapidly the adoption rate increased. This type of response to new innovations follows the pattern hypothesized by Rogers (96) and Ruthenberg (97). The initial response is slow, then the rate picks up, and as the majority of the farmers begin practicing the new technologies, the rate of adoption levels off.

Although the numbers of direct project participants under the supervised credit schemes or the risk-sharing credit programs were not large, the project's recommendations were used by many more farmers. The latter adopted the new technologies at a slower rate than the direct project participants, but they nevertheless must be considered as having been influenced by project activities, and their yield and income increases contributed to overall project benefits. These farmers were identified as *indirect* project participants. Because their numbers were extremely large compared to the *direct* project participants, they strongly influenced the overall benefit derived from the project.

Measurement of the adoption rates of *direct* and *indirect* project participants allows for the calculation of net income increments attributable to the project. Care has to be taken in making this calculation because, if the project had not been initiated, the extension services would have continued to introduce new technologies being developed at research stations. As these latter technologies would not be specifically adjusted to local conditions, their expected benefits would be somewhat less than those from using project technology. Nevertheless, these benefits would have led to what has been described as *autonomous* adoption (97). This can be quantified in the same way as the adoption rate for project technology if data points are obtained from a control group of farmers.

Unfortunately, this was not possible because the RDP concept received so much attention and publicity and expanded so rapidly that a truly controlled situation within the Colombian context was difficult to find. All that could be done was to build up a picture based upon a patchwork of previous adoption studies in Colombia and elsewhere (Fig. 39). Because of this and because so

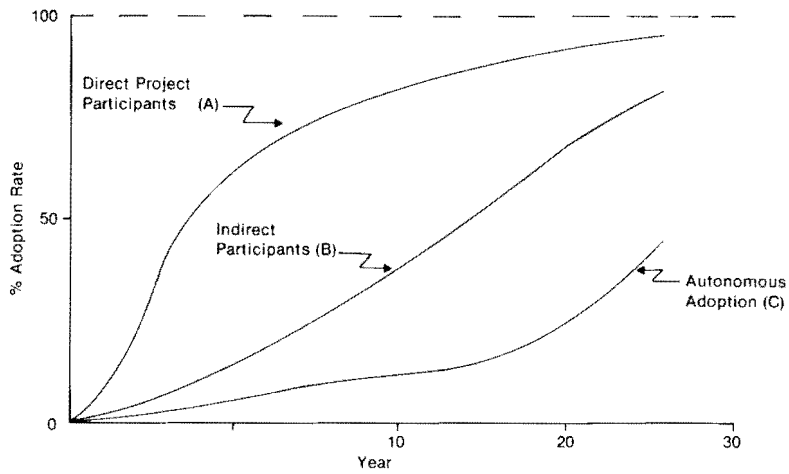


Fig. 39. *New technology adoption rates.*

much of the analysis proposed for this section is dependent upon what economists label "heroic assumptions," a sensitivity analysis has been used in the examination of the data. In this way, a range of probable impacts is shown rather than a single figure.

A graphic representation of the three different adoption processes is depicted in Fig. 39.

Curve (A) demonstrates the rapid adoption rate of direct participants (risk sharing and supervised credit). Curve (B) shows the lagged effect of diffusion through mass communication and word-of-mouth (unsupervised credit). Curve (C) estimates the impact that would have occurred without the project's implementation. The calculation of net benefits was derived by adding each year's net benefits from curves (A) and (B) and subtracting the benefits accumulating from curve (C). Net benefits for each group were calculated by multiplying the net income increment for total adoption by the percentage adoption rate and multiplying the resulting sum by the total number of participants in that group.

Because one of the basic premises emerging from the analyses of chapters 5–15 was that the intensity of the "extension" effort did not have a significant effect on the rate of adoption of new technology, but rather that the adaptability of the new technology was the most important element in the process of adoption, the rates of adoption within the different participating groups of farmers are unlikely to be influenced by the number of disseminators. Either a farmer adopts virtually completely or not at all. However, the number of disseminators is likely to influence the number of farmers reached by the project.

It is difficult, based on the results obtained in the period 1972–75, to predict the likely adoption rates in the following decade and thereafter. In Table 54, we have tried to do this using three different assumptions about adoption. In each case, we have tried to err on the conservative side assuming only modest increases in adoption in the next decade.

The first of the three alternative adoption rates considered is based upon the government's 1977 plans and assumes that the more concentrated dissemination efforts from 1977 onward would increase the participation rates in the risk-sharing plans and supervised credit programs and also lead to a greater spin-off in adoption by nonparticipants due to increases in the number of field days, demonstrations, and general publicity during the intensified period. These higher numbers are reflected in Table 54 by the *high participant rate*. The *medium participant rate* is based upon holding staffing at the 1977 level for a further 5 years and then phasing down (Fig. 42) and implies a continuation of the growth of the program of recent years. The *low participant rate* is what is assumed to occur if the government were to cut back immediately on the TTD effort. All of these cases are possible; the medium participant rate seems to be the most probable given the present build up and success of the RDP program but if the government is able to meet its latest manning target of 30 technical assistants per project then the high rate may be attained.

Early in 1978 we were granted access to the results of the 1976 and 1977 credit programs and were able to compare these with Table 54. In 1976, both risk sharing and supervised credit programs for all these commodities were at the *high* participant rate except for supervised corn credit, which was at the *low* level. In 1977 there were staff changes in the risk sharing programs and only 18 corn and 32 onion farmers participated (*medium* level targets for participants were 50 and 60 respectively) but this problem is reported to be resolved and targets set exceed the *high* level for 1978. For supervised credits in corn and

Produce would then be collected by trucks in the weekly markets and transported mainly to the cities of Bogota and Villavicencio. (Photo: Jaime Rojas)

Table 54. Assumptions regarding future participation in selected programs.*

	Corn producers															Potato producers									Horticulture producers		
	Risk-Sharing			Drop-Outs			Supervised			Unsupervised			No credit[a]			Supervised			Unsupervised			No Credit			Horticulturists		
Year	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
72	0	0	0	0	0	0		25		50	50	50	1375	4375	4375	25	25	25	100	100	100	3336	3336	3336	0	0	0
73	0	0	0	0	0	0		50		100	100	100	4300	4300	4300	50	50	50	100	100	100	3311	3311	3311	0	0	0
74	40	40	40	0	0	0		-		150	150	100	4260	4260	4310	75	75	75	150	150	150	3236	3236	3236	0	0	0
75	40	40	40	15	15	15		-		200	200	100	4195	4195	4295	75	75	75	150	150	150	3236	3236	3236	0	0	0
76	40	40	40	20	20	20	50	50	50	250	250	100	4090	4090	4240	75	75	75	200	200	150	3186	3186	3236	28	28	14
77	60	50	40	20	25	30	85	75	50	300	300	100	3985	4000	4230	100	100	75	225	200	150	3136	3161	3236	56	56	23
78	60	50	40	20	30	40	125	100	75	350	300	125	3895	3970	4170	100	100	75	250	250	150	3111	3111	3236	84	84	42
79	100	60	30	25	35	50	150	125	75	400	300	125	3775	4450	4170	125	100	75	275	250	150	3061	3111	3236	112	112	66
80	100	60	30	25	40	60	175	150	75	400	350	175	3750	3850	4110	125	100	50	300	300	100	3036	3061	3311	140	140	70
81	100	70	30	25	45	70	200	175	100	400	350	175	3725	3819	4075	150	100	50	325	300	100	2986	3061	3311	168	168	84
82	100	70	30	30	50	80	225	200	100	450	350	175	3645	3780	4065	150	75	50	350	300	100	2961	3086	3311	196	196	98
83	100	80	0	30	55	90	250	225	100	450	400	100	3620	3690	4060	150	75	50	375	300	100	2936	3086	3311	252	252	126
84	100	80	0	30	60	100	275	250	100	450	400	200	3595	3660	4050	150	50	25	400	300	50	2911	3111	3386	280	280	140
85	100	90	0	35	65	110	300	275	100	500	400	200	3515	3620	4040	150	50	25	400	300	50	2911	3111	3386	336	336	168
86	100	90	0	35	70	120	325	300	100	500	400	200	3490	3590	4030	150	25	25	400	300	50	2911	3136	3386	420	420	210

[a]The number of no credits is simply the total number of corn farmers less the other four groups. Figures up to 1967 are based on recorded data, except for unsupervised ICA credits.

***Note:** The H, M, and L notations refer to H, high direct-participant rate estimates; M, original average estimate or medium participant rate estimate; and L, low direct-participant rate estimate. For horticulture, only the M and L rates are estimated; H is entered the same as M.

potatoes, respectively, the 1977 participants were 71 and 301 (*high* targets 85 and 100), putting the overall program in the *medium plus* participant range.

Rural development experience elsewhere in Latin America (117) suggests that autonomous adoption, resulting from typical extension programs, has not been very successful. For the purposes of the present analysis we have assumed that in the period 1972–1986 the autonomous adoption rate will be half of the indirect adoption rate for corn and somewhat higher for potatoes where some newer technology is already practiced.

Table 54 quantifies the assumptions made regarding the number of adopters in different corn, potato, and horticulture programs. The various groups of corn and potato producers have already been discussed in Chapter 12, with the exception of the "dropouts" from the corn risk sharing plan whose behaviour was analyzed by Escobar (personal communication) in 1977.

The adoption rate for the horticulture group was calculated somewhat differently than that used for the corn or potato groups. In general, farmers knew how to grow horticultural crops at fairly high levels of technology, and so the concept of an adoption rate was not meaningful in this respect. Thus, an alternative method has been derived to estimate the project's likely benefit to producers of horticultural crops. It was assumed that the project's efforts will contribute to stimulate an increase in the area under horticultural crops (Fig. 40). From 1975, when the horticultural program began in earnest, to the year 2000, it is estimated that the horticultural acreage with increse 50%, 50%, and 25% respectively, for the three assumed participant rates. Although some of this acreage is expected to be at the expense of corn or potato land, it is probable that most of it will arise from increasing the cropping intensity in mixed and multiple cropping systems.

The total number of producers shown in Table 54 is 4450 for corn, 3461 for potatoes, and 2802 for horticulture. These numbers were derived by an extrapolation from the labour study referred to in Chapter 9 and indicate that about two-thirds of the farmers grew corn, 50% produced potatoes, and 40% horticultural crops.

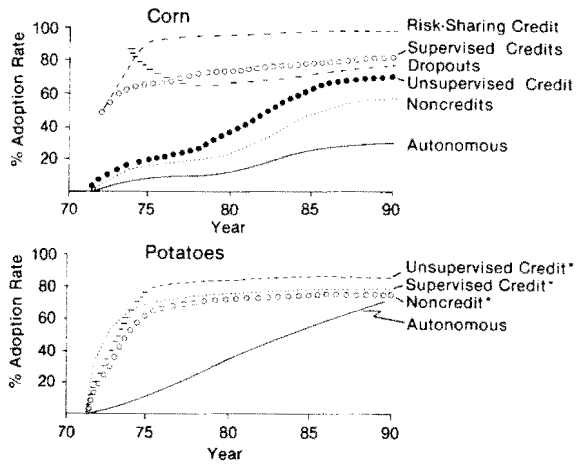


Fig. 40. *Estimated adoption rates in different corn and potato programs (*these adoption rates for potato technology are not significantly different).*

Participant rates and adoption rates per program can be aggregated to derive the overall adoption rate for the period 1972 through 1986. By using a logistic function, an extrapolation can be made to the year 2001. This would account for an effective project life span of 30 years. The logistic function used (97) was:

$$p = \frac{1}{1 + \exp(-(\alpha + \beta t))} \quad (1)$$

where p = adoption rate of innovators; t = time variable (yearly); exp = natural logarithmic base; α, β = coefficients to estimate.
The linearized form is:

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \beta t \quad (2)$$

Note that mathematically the net benefits could be calculated as follows:

$$\text{Net benefits} = \int_{1972}^{2001} \ln\left(\frac{P_1}{1-P_1}\right)\delta t - \int_{1972}^{2001} \ln\left(\frac{P_2}{1-P_2}\right)\delta t \quad (3)$$

or

$$\int_{1972}^{2001} \left[\ln\left(\frac{P_1}{1-P_1}\right) - \ln\left(\frac{P_2}{1-P_2}\right)\right]\delta t \quad (4)$$

where P_1 = adoption rate of innovators; and P_2 = the autonomous adoption rate.

The resulting curve for the medium participant rate is plotted in Fig. 41, for both corn and potatoes.

Project Costs

Project costs have been discussed earlier in this chapter. The emphasis has been placed upon technical staff costs as staff and their support represent the major cost of the RDP/TTD approach and few other costs were incurred by the government, and farmer costs have been taken into account in the benefit calculations.

Because the TTDs of 1977 are scheduled to continue the earlier RDP activities, it can be assumed that total costs will remain relatively constant for some years after 1977. Nevertheless, at some point, the intensity of the dissemination process probably could, and probably should, be reduced, as the number of adopters increases. Project costs would fall at such a time. Two estimates of future project costs are presented (Fig. 42): (A) assumes that the intensive dissemination program would continue at the 1977 level until the late 1980s; (B) assumes that the staffing intensity in the project would start to decline after 1980 and level off at much below the peak level by the mid-1990s.

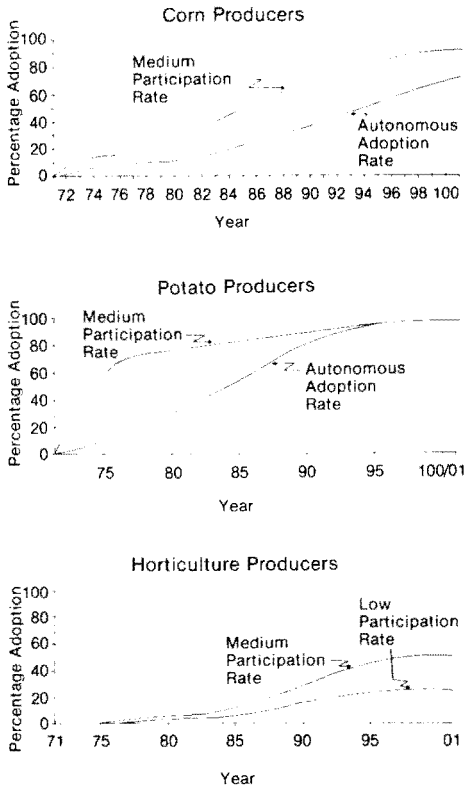


Fig. 41. *Weighted average medium participant and autonomous adoption rates for the project commodity activities.*

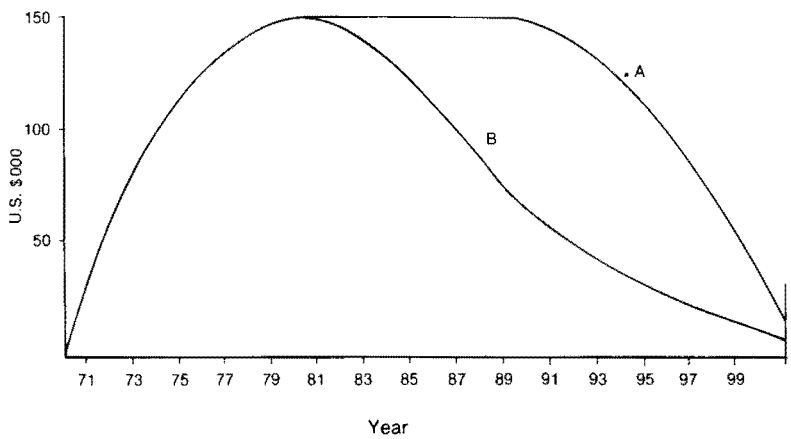


Fig. 42. *Two projections of the project costs in the future (at constant 1975 prices).*

Project Benefits

The value of net benefits per hectare of corn was, as referred to earlier in this chapter, $172. For potatoes, a figure of $93 was derived, and for horticultural crops, of which onions is one of the more profitable, a value of $500 per ha was selected.

Net benefits in terms of income increases were calculated on a per farm basis with full adoption and multiplied by the aggregate adoption curve. This value was then subtracted from the costs in a particular year and subsequently discounted by 12% (the cost of Caja credit) or by 26% (the opportunity cost of credit in the region).[51] This yielded three benefit streams at each discount rate for each commodity program. Each of these three benefit streams (high, medium, and low) was then aggregated for all three programs (corn, potatoes, horticulture) to give a total benefit that in Table 55 is shown alongside the two alternate cost assumptions. The data were extrapolated to the year 2001 using the logistic function.

In addition to the benefits according to its major crop programs, it is reasonable to presume that some benefits arose from the activities of the veterinarian and the home economics group working in the project. Likewise, we may presume some social benefits from programs such as the preschool and rural electrification activities. The fact that the new TTD program in Caqueza has funding for infrastructure, public works, social services, and agricultural credit can be partially attributed to the project's initial success in developing an acceptable and beneficial rural development strategy. No attempt has been made to assign values to these benefits; they are mentioned merely to endorse the observation that the net benefit values presented in this section do appear to be conservative figures by all accounts and the true benefits from the project may be somewhat greater than is indicated in Tables 55 and 56.

Financial Evaluation of the Project

In Table 56 data analyzing the project from the standpoint of benefit-cost ratios, net present values, and internal rates of return are shown. Even when the 26% discount rate is used, benefit-cost ratios are 1.6 or above, looked at over either 20 or 30 years. The lowest ratio is one of 1.65 for the low participant adoption rate over 20 years using the 26% discount rate.

The analysis shows that the benefit-cost ratio is not very sensitive to the number of years for which the analysis is run, or, stated in another way, the longevity or duration of the project's benefits. Nor is it very sensitive to the discount rate or the cost curve used. The reason for this insensitivity is that the returns are so high. The internal rate of return of 116% is so high that small differences in net cash flows do not show up. It is strongly influenced by the results of the early years and because these are similar with all three levels of participation, each of which assumes a large number of nonadopters, the benefit-cost ratios and the internal rate of return (IROR) are similar at all three participation levels (Table 56). This suggests that a strong initial effort is desirable but that the impetus can be reduced after a period of years (particularly as the credit dropouts appeared to continue to adopt the new technology). In such circumstances, the strategy implied by cost curve B would appear preferable and the big buildup in field staff numbers proposed by ICA in

[51]We recognize that this figure can be challenged on the grounds that it has not been discounted for inflation and we have therefore also used 12%.

Table 55. Discounted benefits and costs for the project over 30 years ('000 U.S. $).

Program participation rates:	Discounted benefits						Discounted costs			
	High		Medium		Low		Cost curve A		Cost curve B	
Discount rate:	12%	26%	12%	26%	12%	26%	12%	26%	12%	26%
Corn producers	2421	792	2397	788	1994	713	n.a.		n.a.	
Potato producers	501	256	500	256	494	255	n.a.		n.a.	
Hort. producers	437	65	437	65	28	33	n.a.		n.a.	
Total programed	3359	1113	3334	1109	2516	1001	636	346	758	366

Table 56. Analysis of project benefits and costs.

Participation rate	Discount rate	Cost curve	Benefit/cost		Net present value		Internal rate of return
			20 yrs	30 yrs	20 yrs	30 yrs	
High	12%	A	2.23	2.50	1121	1453	116%
		B	2.41	2.83	1190	1565	
	26%	A	1.82	1.85	346	365	
		B	1.86	1.91	356	378	
Medium	12%	A	2.21	2.48	1102	1429	116%
		B	2.39	2.80	1171	1541	
	26%	A	1.81	1.85	342	361	
		B	1.85	1.90	352	374	
Low	12%	A	1.89	2.06	814	1026	115%
		B	2.05	2.33	883	1138	
	26%	A	1.65	1.67	274	286	
		B	1.69	1.72	289	299	

1977 may only need to be a medium term measure. Indeed, creating a permanent field staff:farmer ratio as high as that shown in Table 53 may prove to be too costly a strategy for the long term.

In Fig. 43 we have superimposed the alternative cost curves (A and B) on top of the commodity adoption curves (Fig. 41). This suggests that in the early years of the project, adoption may have been influenced by the rapid buildup in research and extension activities, but after a decade of the project the potential benefits per unit of expenditure become relatively less, thus supporting the hypothesis that efforts could be gradually phased down after a decade. A decision as to whether or not the intensity of the program should be reduced after 10 or 20 years will depend on the slope of the three adoption curves. If adoption occurs quickly, an early cutback may be merited. If adoption lags, an extension of the effort would be justifiable. Some further years of experience will be needed before such an analysis can give clear-cut answers to decision-makers. However, the data presented here do provide a preliminary framework

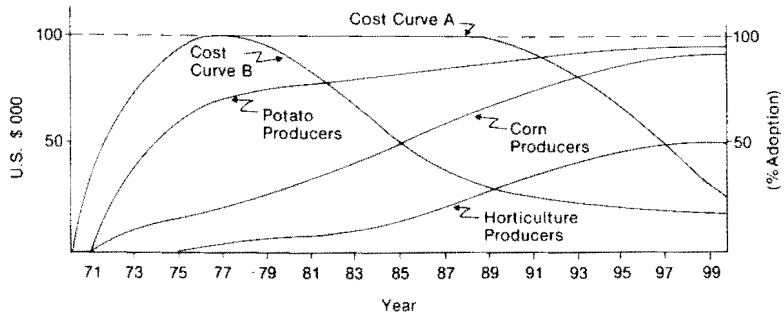


Fig. 43. *Comparison of the dissemination effort with the adoption rate.*

for an analysis that can be applied and monitored to assist in making decisions about staffing levels. This may be useful in that staff comprise the major public sector component of project costs.

In the discussion above no account has been taken of the IDRC input of nearly $1 million because as discussed earlier, this has been treated as an input to the national RDP program. Had the IDRC input been treated entirely as a Caqueza input, the project would give a negative rate of return at the local opportunity cost of capital but a positive one at a cost of capital of 12% — a realistic figure in the Canadian market of the early 1970s. With all the IDRC inputs charged to the project, the IROR drops to 16% and the benefit–cost ratio lies between 1.4 (curve A high participation discounted over 30 years) and 1.0 (curve A low participation discounted over 20 years). Clearly, inputs of the magnitude put in by IDRC are marginally attractive if devoted to one project of limited size but if their benefits are spread between 20 (and potentially over 80) projects and these projects can achieve the sort of results obtained in Caqueza, then such an approach would seem to be a very positive development assistance strategy.

Chapter 17

An Overview of the First Five Years

"Integrated Rural Development" has become a fashionable catchword in the development literature of the 1970s, particularly since the World Bank identified it as a priority for lending activity in its quinquennial program for 1975-79. This concern with integrated rural development results partially from the failure of other developmental strategies in Third World agriculture. Integrated rural development is heavily supported by foreign aid programs, many of which have given widespread publicity to their efforts in this field. Such publicity may serve a stronger role in generating domestic support for an aid program rather than in representing a realistic appraisal of its achievements. Indeed, two of the most comprehensive reviews of recent RDPs (24, 70) have stressed the limited effectiveness of most of the rural development programs that they studied. One of these reviews (24) has commented favourably on the Caqueza Project, largely on the grounds of its research style and of its attempts to evaluate its own performance. However, this review, like most other, particularly comparative reviews, was carried out by personnel from a developed country who, notwithstanding their analytical and evaluative skills, did not have extensive experience as practitioners of rural development. Indeed to find such experience it is usually necessary to draw upon the reports of those who have spent a lengthy duration working in a specific project and are, therefore, subjected to all the biases that this involvement entails. The authors of this book are only too conscious of this fact and it should be borne in mind by the reader.

In one of the best recent critiques of integrated rural development, Ruttan (98) has drawn attention to the fact that a basic weakness of the integrated rural development approach is "that policy or programme objectives are adopted for which no readily available closed system technology or programme methodologies are available. Integrated rural development can be described, perhaps not too inaccurately, as an ideology in search of a methodology or a technology." Unfortunately, all too often this ideology is defined by those coming from or trained in economic and development theory in a relatively small number of institutions in the Western world. Even more unfortunate is that this ideology is frequently based on the achievement of "targets" or "goals" of planners and rarely relates to the needs or desires of the small farmers who are the supposed beneficiaries of integrated rural development.

The Caqueza story is atypical in that it records an era in which agricultural planning in Colombia attempted to give a place to planning from the bottom upward rather than from the top downward. The experiences described in this book represent, to a large extent, a description of a methodological exercise. The authors would be the last to claim that this was an unqualified success. However, a series of major institutional changes now in progress is based upon

the experiences of this exercise. These changes, when fully implemented, may well lead to significant alterations in the structure of rural production and organization in Colombia. The story in the previous chapters described how these changes evolved. In this chapter, we shall try to recapitulate some of the lessons learned during the period 1971–75.

As a starting point, it may be useful to refer again briefly to the original objectives at Caqueza, namely:

"(1) to develop and prove a strategy for the transference of technical, economic, and social knowledge to small farmers that would promote their active participation in matters such as the use of credit and purchased inputs, the sale of their products, and the betterment of their social conditions;

(2) to use this strategy to bring about higher crop and animal yields, improved economic returns, and better family living in the project area;

(3) to establish a system whereby the farmers of the project area assumed increasing responsibility for the execution and expansion of this strategy using their own initiative; and

(4) to measure the changes in the community and in its incomes that resulted from the project."

As the project developed, the first two of these objectives became closely interwoven with the strategy being developed, tested, and propagated on farmer's lands. The project staff never had experimental lands at their disposal and all research had to be conducted at the farm level. To bring this about a new approach to production research was developed. This approach seems likely to have important long-term effects on Colombian agricultural policy as it has been adopted at the national level.

Fitting Agricultural Research Results into a Rural Framework

The research strategy that emerged at Caqueza resulted from ICA's decision to encourage RDPs to adjust their production recommendations to the characteristics of the area in which they were operating. Initially, this entailed small plot experiments to study selected key production variables such as variety, nitrogen, phosphorus, plant population, and weed control. The design and focus of the research changed over the years, and ultimately resulted in an approach that combined experimental and survey activities. This evolution in approach resulted from practical experiences obtained both in Caqueza and in other RDPs in Colombia as well as elsewhere in Latin America (9, 76, 79).

The on-farm research procedures that were developed reflected a considerable change from the traditional approach to agricultural research in Colombia. This change took the form of more attention being paid to the small farmers' constraints (especially with respect to the limited availability of cash); to the risk-taking involved in using high input technologies; to additional labour requirements; to the need to adjust to marketing situations; and to the limited availability of agricultural inputs. It also related to the difficult task of

incorporating research results into action programs. The approach that finally evolved in Caqueza entailed project staff becoming involved in research design, extension, and interpretation, a considerable change from the centralized approach conventionally used for agricultural research.

This shift of research premise was not immediate and is still not completely institutionalized as conceptual adjustments continue to be made. Nevertheless, a methodology is emerging that does allow for a continuous process of identification of improved technologies at the project level and the incorporation of these technologies into action programs.

The Caqueza experience suggested that an effective RDP had to have at its disposal a considerable amount of information about the region, about the actual production systems practiced, and about the potential of new production technologies. However, the time available for research by the project staff had to be kept in reasonable balance with the time that they dedicated to action programs in agricultural production and family welfare. The project did, therefore, need to limit its research activities to a few priority areas.

Because of the variety of crops being grown and the range of production practices encountered, it also needed to select rather carefully both the most promising crops and the production factors to be studied.

A criterion commonly used for allocating priorities in production research is the *expected benefit* to be derived from the research. In Caqueza, this benefit was usually difficult to estimate. It depended on a considerable number of variables, such as the area in which the technology could be applied, the additional cost involved in the application of the technology, the commodity price, the per hectare increase in production, the expected rate of adoption of the technology, and the elasticity of demand. The adoption rate itself also depended on the expected increase in yield. Both yield and adoption rate depended to a great extent on ecological factors such as climate and soil. The expected increase in production per hectare from the introduction of new technology was, therefore, a function of both the potential production and the actual production encountered in the region.

The *expected benefit* criterion favours commodities with actual production levels that are low relative to the technological potential for change. Such commodities, however, often serve as subsistence crops for the small farmer. They tend to have a low market price, which reduces the expected benefit of change when compared to commerical crops. They do, however, occupy a considerable part of the cultivatable area in small farm regions. The experience gained in Caqueza suggested that the complexity of the *expected benefit* criterion, as well as the large amount of information required for its application, made it of limited practical use as a criterion of priority for research in Colombian RDPs. In addition, this concept does not take into account many of the processes involved in agricultural development. It may, for example, be evident that the optimal production pattern for a certain region should be one of high value product crops and it may, therefore, be concluded that the highest *expected benefit* of project research would be derived from research on these crops. This reasoning, however, ignores the fact that the small farmer needs to have an adequate marketing structure for his produce, and that he must be able to buy the staple crops required for farm family consumption if he is to shift his cropping pattern to other agricultural products.

Given this situation, the strategy adopted at Caqueza was, in the first instance, to give priority to increasing the yields of subsistence crops, thereby

making it possible to reduce the area under these crops and to make more land available for cash crop production without reducing the overall supply of staple crops.

In addition to differentiating between subsistence and cash crops, the work at Caqueza indicated that two other criteria warranted consideration when assigning priorities for project research. The first was to select activities that were likely to benefit a majority of the farm families in the region rather than any selected group. Because of differential responses received from farmers, there is a common tendency in development projects to concentrate project activities gradually on a limited group of farmers, sometimes those of a certain political or religious conviction or those located in a village with strong and cooperative leadership. Although these active groups obviously need to be encouraged, it was found at Caqueza that too close a link with such groups did limit the project's impact.

The second important criterion for defining agricultural research priorities was to be in possession of an adequate understanding of the crop production process: such an understanding was usually built up from a series of agro-economic surveys that described each component of the production process: its time span, its labour and input requirements, their cost, the yield, the product price obtained, and the sales method and(or) product use. In addition, information was obtained on the incidence of pests and diseases, the source of seed, storage and packing methods, the amount of irrigation used, the source and cost of credit, etc. It was essential to include the most important site variables (including cropping sequence) in such surveys to be able to differentiate between various possible production strategies. Experience indicated that such surveys should not attempt to be all-embracing, but should focus in depth on selected subsistence and cash crops.

In some cases, survey results in Caqueza indicated that current production systems were similar to those being recommended by the central research station (e.g., for beets and onions). In such circumstances the project attempted to identify the production practices of the best producers in the survey (in terms of both modifiable and site variables). This allowed a comparison to be made of the relative influence of various production factors, such as the level of fertilizer used, the quality of the seed, the method or date of planting, the number of weedings, the use of insecticides, etc., in relation to the returns obtained by the farmer. Such information, combined with current recommendations from central research stations and general agronomic principles, provided a basis for establishing revised production recommendations. These a priori recommendations then formed the starting point for small plot research to explore the responses to variations in those factors found to be of importance in the agro-economic survey.

Where farmers' traditional production methods showed little similarity with what appeared to be the production potential from using improved technology, as in the case of corn, the project research strategy had to use as its starting point the production information available from research stations. This had to be interpreted carefully as it did not always take into account all of the variables encountered on the small farm.

The Caqueza Project focused its initial research on the most common subsistence crop, corn, and on the dominant commercial crop, potatoes. Traditional corn yields, achieved with virtually no purchased inputs, were about one-third of the yields attainable from using modern technology. Potato yields (which did involve purchased inputs) were little more than half of those achieved

with modern technology. In contrast to this, the technology used for certain vegetable crops was highly sophisticated and at times approximated technologies used by large commercial farmers or those recommended by research stations.

This extraordinary combination of the most rudimentary production methods for the major subsistence crop of the region, with a complex and, at times, advanced production method used for cash crops, raised a number of questions regarding the role of agricultural technology and communication in agricultural development. These questions ultimately led to the work on risk and credit that is described in more detail elsewhere in this book.

The Interpretation of Experimental Results

Most Colombian RDPs, including the Caqueza Project, had difficulties in the areas of data collection and analysis and in the reporting of results. This has sometimes been interpreted as an indication that production research at the project level is not practical. However, the major reason for the problem was the lack of time, because the interpretation of results, as well as the design and organization of the following year's research, all had to be carried out in a period of about 3 months during the winter. Although there was a constant backlog in analytical and reporting work immediately after harvesting experiments, most of the agronomic information obtained from each trial was incorporated into the project's understanding of that particular production process. RDPs characteristically have a high internal level of communication. In the Caqueza Project this was, in addition, formalized through weekly or biweekly meetings, student presentations of their results, and special meetings for the purpose of programing activities and interpreting data. Because of this, experimental results were extensively discussed and rapidly incorporated into project action.

Although the handling of agronomic data was generally fairly satisfactory, the economic interpretation of the data left a lot to be desired. This was to a large extent a consequence of the fact that most of ICA's staff were trained as biologists (agronomists or veterinarians). In addition, there were difficulties in deciding which economic criteria to apply. Simple cost analysis was the commonest economic technique used. Recommended treatments were generally those combinations that maximized net returns. Work by students and project advisors also utilized more complex analyses to include economic criteria such as returns to factors, cash and labour requirements, and risk. Such analyses really require inputs from trained economists and as such are not normally suitable for work at the project level. In Caqueza, this situation was overcome by the provision of two expatriates and, initially, a Colombian evaluator. Later, ICA regionalized the evaluation post and still later incorporated it into the Technical Support Group structure. In this way, the need for an economic input has been recognized and an effort made to optimize the use of this scarce resource within ICA.

As knowledge about the nonagronomic characteristics of the recommended production packages built up, it changed the project staff's outlook on their own role. During the early years of the project they perceived their task as one of identifying production packages adapted to the region and extending these to farmers through the credit-related dissemination programs. In subsequent years, project action was increasingly perceived as involving the identification of institutional or infrastructural constraints and of action

programs to reduce the impact of these constraints by using cheap, safe, and easily applicable technological packages.

The research strategy developed focused on identifying the constraints to production and on developing means to overcome these. Early on in its life the project found that technology per se was not a constraint. The small farmers in the project area were very efficient operators, given the resource base within which they had to work. In interpreting this resource base it was necessary to recognize that the farmers themselves did not consider their land or their family labour as being costs in the production process. Only the variable costs of purchased inputs and, to a lesser extent, hired labour, figured in the farmers' interpretation of production costs. Because purchased inputs were very limited in the traditional production system, particularly for corn, the relative magnitude of the additional costs attributable to the use of new technology were conceived by the farmer in very different terms to those in which they were understood by his technical advisors. This difference in interpretation did not relate only to the foreign advisors but was also reflected in the attitude of most of the Colombian professionals, particularly those with advanced training overseas. Thus to transfer new technology to the small Colombian farmer necessitated a careful reassessment of the system of values assigned to the production inputs of land, labour, and capital. We can quantify this by considering the corn plan in 1974 (Table 40). Nonparticipants spent U.S. $124 per hectare on corn production and of this sum, $22 was for purchased inputs. The plan called for a total expenditure of U.S. $208 per hectare of which $106 was for purchases. In the eyes of the professional agriculturalist, costs rose by U.S. $84 per hectare, or 68%, but to the farmer, who ignored the virtually constant land and labour costs, participation in the plan would increase costs from $22 to $106, a rise of 382%.

An understanding of the small farmer's attitude toward resources also related to his attitude toward motivation. Whereas most of the technical advisors and particularly the central planners, conceived of production objectives in terms of *maximizing profitability*, this was often a goal of limited importance to the farmer living at the subsistence level where *risk aversion* was of much more importance.

The work at Caqueza showed that a close relation existed between resource use and risk. Money was the limited resource constraining the use of new technology but money could be borrowed by taking credit. However, the only thing that the farmer could use as security for credit was his land and if he lost that he would have nothing. Thus, in a society where risk aversion plays an important role, there was an understandable hesitancy toward the adoption of credit unless this could be taken up without incurring greater risks. The work of the project showed this to be the case, indeed although high-yielding corn technology increased yields and incomes for most of the population adopting them, the few who did not achieve success failed much more dramatically than they would have failed under the traditional system with its low level of inputs, where the cost of any credit used would have been small enough to have been absorbed by further borrowings against the next year's crop.

One of the important measurements taken by the project was that associated with risks of new technology in corn production. The research showed that although the new technology could, and indeed did, triple yields and double incomes, it increased the risk 15-fold. The work of the project led to a recognition of the concept of risk by professionals at all levels in the planning and implementation processes. Indeed, in the 2nd year of the project, this fact led to

there being a slower disbursement of credits in Caqueza than in the other RDPs because a consciousness of risk (partially associated with the overproduction of cabbages) led to project staff becoming very cautious in their credit recommendations.

At the end of the fifth year of the project, ICA established a Technical Support Group for Rural Development (TSG), which undertook the specific task of adjusting technological recommendations in individual RDPs to the specific production situation in each project area. This was a somewhat subjective activity but the TSG was composed of people who had been closely associated with the initial RDPs, particularly Caqueza, and these people were extremely conscious of technological change in relation to socioeconomic factors. Within this framework the technology that they recommended was tailored to each individual project's environment, looked at in the broadest possible terms.

The Project and the Community

The present international interest in rural development lays great stress on local participation. This implies a reversal of the usual decision-making process, i.e., a switch from centralized to decentralized systems of project planning and implementation. This situation is unlikely to come into being unless small farmers, either through their own organizations, or through other institutions, can freely express their views and get a sympathetic hearing during the formulation of rural development plans and projects (127). Such a philosophy is specified in the third of the objectives of the Caqueza project, namely:

> *"to establish a system whereby the farmers of the project area assume increasing responsibility for the execution and expansion of (the) strategy, using their own initiative."*

This objective may, to some degree, have been presumptuous in that previous community development efforts initiated in many Latin American countries in the 1950s were probably least successful in their efforts to introduce changes in farming practices that were capable of increasing agricultural productivity, or in generating employment and income through expansion of village industries. Ruttan (98) suggested that this situation was attributable to the absence, both in the communities and in the village level workers, of the materials necessary for high productivity technologies, or the knowledge and authority to realize more efficient institutional performance. These constraints only existed to a limited extent in Caqueza where the technology and the resources required to implement it were made available and the institutional services, although far from efficient, improved considerably during the first 5 years of the project. Nevertheless, community involvement in the project was always somewhat marginal and usually originated on the initiative of the project staff rather than on that of the farmers.

A number of the original project staff had trained at Puebla in Mexico, where considerable success had been achieved in the use of group credits. This concept was never utilized in the Colombian RDPs because it was strongly opposed by the credit agency, the CAJA AGRARIA, who distrusted village action groups of any kind because of prior experiences with some groups that had turned out to be politically oriented. This undoubtedly hindered the development in Colombia of the type of village leadership that had been so successful in Mexico.

The project's disappointing experiences with its two prodevelopment committees led to the early demise of these committees. It was found that the traditional hierarchy tended to dominate such committees and this militated against any change. Where farmers did want to upset the status quo they did not have sufficient confidence to challenge it themselves but instead elected project staff on to the committees. This effectively stifled staff efforts and limited community involvement and also put project staff into a position that could be politically controversial. In fact, it seemed that the farmers were neither politically nor economically confident enough to want to challenge the existing leadership in the rural areas. The project staff, likewise, had to tread carefully: many previously publicized efforts at agricultural development in Colombia had had limited success, there was much initial cynicism about the RDPs, and farmer confidence had to be built up slowly.

The situation was further complicated in Colombia by the existence of a "National Front" between the two main political parties with all senior government posts equally divided at both civil service and political levels. Although the RDPs were started under a Conservative president and continued by his Liberal successor, credit for them at the local level was often claimed by one party or other and where one party was very strong in an area, project staff had to be extremely careful that any effort to encourage farmer leadership was not seen as a challenge to the reigning politicians. The whole concept of developing community involvement was, therefore, a delicate one fraught with danger.

Somewhat greater success was achieved in the involvement of the community in the cooperative. This got off to a very shaky start even though one of the project staff was specially trained in cooperative management. The farmers were willing to purchase supplies from the co-op, but were reluctant to sell produce to it unless paid a higher price than the local market. In theory, the co-op should have been able to supply inputs at less than store prices due to bulk purchases; in practice, its turnover was not great enough to get bulk discounts and it had to pay salaries that family-operated stores did not. Thus the co-op got caught in a squeeze on both purchases and sales and by 1974 its finances were in a parlous state.

It was hoped that the profits from the corn and onion plans, which were originally underwritten by IDRC, would generate new capital for the co-op, but in 1974 and 1975 this did not occur. However, in 1976, these plans functioned on target and the co-op generated U.S. $1300 of new capital through them. Whereas at the end of 1975 the co-op was being regarded as a failure, by mid-1977 it was standing on its own feet completely independently of ICA. Through its links with the CAJA AGRARIA and its underwriting of the production plans, it was servicing a community that, after 5 years of trial and error had learnt how to use it effectively. However, it still remains to be seen whether the co-op has adequate reserves to withstand a severe drought year in terms of its production plan commitments.

The co-op has also served as a valuable feedback mechanism to national planners who appear to have responded to the problems associated with the delayed credits in the corn plan of 1974 and in the supervised credit of 1972. Since 1975, delays in the arrival of credit in Caqueza have been less and the organization of credit seems to have improved, a matter of some significance in view of the large increase in funds now available for RDPs.

In certain of its community development activities, the project was overambitious in attempting to do things at the local level that really required national action. However, in some instances, national action followed on the project's

pioneering activities. Examples are the preschool plan and the nutritional studies, both of which have now been built up into national activities coordinated by the National Planning Office. At the project level, the impact of both of these programs was rather limited, but they provided the staff with information and generated some local goodwill. But both activities lay more in the realm of social welfare than agriculture. Within the concept of integrated rural development, both were valid concepts but neither really lay within ICA's area of responsibility.

By getting involved in such activities the project did, however, open a dialogue with the National Planning Office, which, in consultation with donor agencies, was anxious to see rural development in terms of more than just agricultural productivity. In 1975, project staff were seconded to the National Planning Office to help formulate a National Nutrition Plan into which a number of the experiences gained in Caqueza and related RDPs were built. Planning was being done not from an ivory tower in Bogota but with a major input from professional field staff in day-to-day communication with the farmers. The Minister of Planning himself made several field trips to the Caqueza area in 1974–75 and the President of Colombia took a keen personal interest in project publications and strongly supported the work and approach in a major public speech.

There is one other general problem with which the project concerned itself, largely by default, but where it had a limited impact, namely in produce marketing. Considerable time was spent on this and a lot of valuable information collected but it is not really the role of agricultural extension officers to market farm produce. The proximity of the project to Bogota also meant that any work on marketing in Caqueza had a limited application at the national level since many RDPs do not have easy access to a large city market.

The Caqueza Project got involved in marketing after its production efforts had led to a local cabbage surplus and after it started to collect price information series for some of the vegetable crops that it was promoting. To a certain degree the marketing activities were designed to provide some security for vegetable production, which was shown to be a high-risk activity. However, real progress on this front, with a spinoff effect right back to the producer may be a *national* rather than a *local* activity and the project's marketing work probably had little permanent impact on the community although it did highlight the marketing problem to the National Planning Office.

At the strictly local level the project's contacts with the community were various and manifold. In some instances, such as with the veterinarian, a long-standing community service was continued by the provision of animal health certificates and clinical assistance. Because these activities were time-consuming and because no real new technology or approach was developed for animal production in the project, the project veterinarians never really adopted a change in their traditional approach. They were, however, excellent public relations personnel for the project and were able to introduce the staff to new areas and to key farmers in them.

The project did break new ground in its work on organizing people for rural electrification schemes and for pick-and-shovel roads and, in the process, it discovered that by serving the felt needs of the community it sometimes opened the door for people to seek advice on agricultural production. The time spent for the rural electrification program was more than repaid by the receptivity of the community so helped when it came to adopting new agricultural technology.

There is one part of the community that, in retrospect, might have received more consideration from the project, namely the farmers' wives. In the Caqueza

area women work alongside their menfolk on the land. If the man migrates to the rice fields of the llanos or to the city of Bogota, the women run the farm and they are usually as knowledgable about farming as are the men. The wife also controls the household finances, sells produce in the market, buys other foodstuffs, and allocates money for family nonfood expenditure. This is a skillful task in a family of seven where the total average annual disposable income for nonfood purchases is of the order of only U.S. $150–170.

The project staff's main contact with the women was through the home economics program. This program appears to be modeled on the North American pattern that was used to establish Colombia's one Home Economics Faculty. Not without reason did the project's male staff accuse their female colleagues of trying to impose middle-class North American values on Colombian peasant women. This is not to say that the home economics staff were not consciencious and hard working, often under conditions of extreme difficulty. However, it can be questioned whether some of their major activities, such as cooking and dressmaking, served as other than a focus for social gatherings.

There appears to be an urgent need to devote more study to the role of the Colombian rural housewife in the decision-making process, especially with respect to financial decisions. A closer look might also be taken at the role being played by the home economics programs of both ICA and other institutions in terms of the potential for tailoring these more closely to economic rather than social activities. For example, if the women control family finances, ought they not to be brought into discussions regarding the acquisition and use of credit? Such issues were frequently discussed by project staff but little concrete action ensued.

In summary, the project staff were more successful in involving themselves in community affairs than in getting the community itself involved in the development process. The progress with the cooperative suggested that community involvement may be largely a matter of time. However, a lot more thought may need to go into defining which specific community activities the farmers, the project staff, the National Planning Office, and other agencies should involve themselves in rather than in having the project staff try to do everything themselves as they did in the period 1971–75. In addition, there is an overall need to define the specific responsibilities of the regional representatives of other organizations operating in RDP areas and to relate these to interagency activities designed to serve the rural population.

ICA and Caqueza

Earlier chapters have referred to the fact that some problems occurred with the Research Department of ICA because at Caqueza research was being carried out in an on-going development project. Most of ICA's senior research workers had received their higher training in the USA and until the early 1970s the focus of the Institute's research centred on commercial agriculture and large farms. It was assumed that research findings were not size-specific and would be suitable for small farmers too, but the early experiences of the RDPs showed that this was not necessarily the case and much of the technology developed by ICA was shown to be inappropriate for the small farmer.

The Rural Development Department sought to overcome this situation by asking for a reorientation in research policy but it met with limited success. Researchers preferred to work on experimental stations where they had a much

tighter control and far fewer "lost" experiments than on farmers' fields. The response of the Rural Development Department was to take the law into their own hands, emulating the Puebla Project and carrying out their own research program, in conjunction with ICA's Research Department wherever such co-operation was possible on a personal basis.

This was an unhappy situation, which led in 1975 to a nominal ban on research by RDP staff (Chapter 8). This ruling was reversed in 1976 when ICA, then headed by one of the pioneers of the RDP program, was restructured to give more emphasis toward serving the small farmer. By mid-1977 the country had been organized in 86 RDP-like areas (now called Technology Transfer Districts or TTDs). These are slightly smaller than the original RDPs, consisting of five to seven municipalities (the "effective" size of the Caqueza Project, although it actually contained nine municipalities). Each TTD was staffed by 7 professionals and 30 technical assistants. The TTDs were, by now, backed up by nine TSGs, one for each of ICA's regions, with each TSG supporting about 10 TTDs.

This system is designed for the TSG groups to identify technological gaps and major ecological and structural constraints so that this information can be fed back to the research stations, which can then build up new programs based on the identified needs of the farmers.

The Research Department itself has now been reorganized into commodity and multiple cropping programs rather than into disciplinary ones as hitherto, so that a genuine iterative process between research and development can emerge. In the process a very radical change in the whole approach to agricultural research in Colombia has taken place. The research philosophy is now one of endogenous service to the small farmer rather than of exogenous elitism. The research workers are coming to terms with identifying the clients for their research rather than trying to emulate the sophistication of the foreign institutions where they did their postgraduate training. At the same time the National University is developing a higher degree training program that caters to the need to develop more broadly based research-dissemination-administration type personnel (TTD coordinators) rather than highly specialized discipline-oriented scientists. (Colombia is somewhat unique in this respect for a developing country in that there are some 100 Ph.D. and over 200 M.Sc. graduates in agricultural science.)

It is still too soon to identify the impact of these changes. In Colombia, they represent, perhaps, the first real attempt to come to grips with conducting reseach for the very small farmer.

ICA is in somewhat of a unique position to further this approach through having responsibilities for research, extension (dissemination), and postgraduate agricultural education. By using project problems as subjects for research theses and by locating training centres in the Caqueza and Rionegro projects and using project staff there as teachers, ICA has skillfully integrated research, extension, and training in TTD locations. The individual student research theses in themselves deal with relatively small segments of information but cover a very wide range of disciplines. As such they may be compared to individual tiles in an information mosaic of project information.

These changes induced by ICA could not have been brought about in the rather traditionalistic society of Colombia had there not been a strong national commitment to rural development emanating from the Office of the President of the country and disseminated through the National Planning Office to the senior management of ICA. Without strong support from these three quarters, the

research, the foreign technical assistance, and the dedication of the project staff would have been unlikely to have brought about any more change than in previous efforts of this nature in Latin America (117).

It is interesting to note how flexible ICA has been in this program and, after the first year, how prepared it was to delegate authority to the project staff. A good example of this was the constantly changing organizational structure of the project as different coordinators tried out different lines of communication within the project (chapters 4–8).

In one respect, ICA does, however, lack flexibility and that is in financial administration. We have noted in Part II how in 1972 and again in 1973 the project's operational budget was arbitrarily reduced during the year (by 21% and 33%, respectively) and in Chapter 7 we have indicated the irregular nature of ICA's receipt of funds from the Treasury. The impact of these financial problems was to delay salary and travel payments and to curtail (sometimes at very short notice) funds for gasoline and for inputs for experiments.

Although these problems were not of ICA's doing, they all caused sharp drops in the morale of the staff and are mentioned to illustrate the very sensitive relation between ICA and other government departments in terms of ICA's operational activities and achievements. The strong involvement of the National Planning Office in RDP coordination and strategy from about 1974 onward does offer a hopeful indication that a mechanism for avoiding such problems may be established in the future. Only when this is done (possibly in conjunction with the establishment of some sort of performance bonus) is ICA staff morale likely to improve and the constant turnover in staff likely to be reduced.

It is not possible to identify what impact staff turnover, of the order indicated in chapters 4–8, had on project performance. Every time a new professional joined the project, work in his field of activity slowed down for up to 6 months. At the same time most people who left the project did not leave the RDP program entirely, so that what the Caqueza Project lost the national RDP gained. Indeed, by 1976, a number of ICA regional offices and RDPs and non-ICA institutions such as the CAJA AGRARIA had former Caqueza staff and Caqueza trainees in key posts. To some extent this seems to have been a deliberate strategy on the part of ICA: it effectively prevented Caqueza becoming an elite *model* project and essentially turned it into a training ground with a constantly rotating staff. As a result of this, it is questionable whether the project ever had the strongest RDP team in Colombia, although there is little doubt that it had the strongest impact of any RDP on national thinking and strategy; it certainly never came near to being a *model* project.

IDRC and Caqueza

The International Development Research Centre (IDRC) was established by the Canadian Government in August 1970 and started to function in November of that year. IDRC is a semiautonomous Canadian Public Corporation established to manage the development research components of Canadian aid. During the very first week of its existence IDRC became engaged in discussions with the Colombian Embassy in Ottawa regarding a possible IDRC contribution toward the development of a viable strategy for the Colombian RDPs whose creation was then under discussion.

IDRC provided two, and later a third, expatriate advisors to the Caqueza Project. They worked first at the project level, later at the regional, and finally at

the national level. Canadian funds were also provided for overseas degree training and for internal training at various levels up to the M.Sc. Some capital support was provided by way of vehicles, a desk-top computer, and part of the cost of a new training centre. In the following pages, we will examine the contribution of this Canadian input to the project and discuss the role of a foreign agency, such as IDRC, in this type of development activity.

It is important to note that IDRC was a new agency when the project started. It was established with a mandate to be flexible and to focus on developing the indigenous resources of the local agencies that it disbursed its funds to. As a deliberate policy, IDRC recruited field staff for this program who were young and well trained and had Latin American experience but who lacked the seniority arising from many years of field experience. It was felt that the type of methodology that Caqueza was seeking to develop would have to be created largely from scratch (or at least using Puebla as a point of takeoff) and that it would not be possible to identify expatriates with a lot of experience in the area that ICA was seeking to develop. IDRC felt that senior expatriates might be counterproductive if they came with preconceived ideas. Furthermore, there was a risk that very senior personnel would assume or try to assume the role of project management. Both IDRC and ICA felt that a farmer-oriented methodology had to be developed *in the field* and this meant that, in the first instance, the IDRC advisors had to be advisors to the project director. Later, as the project developed, they became regional and national advisors, although even then they maintained close links with the Caqueza field staff.

The IDRC staff were of a similar age group to the project staff. They did not necessarily have the field experience of the latter but they had all done postgraduate studies in Latin America and had Ph.D. degrees. The latter was an essential qualification for talking to ICA's management and research staff on equal terms. However, unlike many rural development activities in African countries, the foreign advisors in ICA's program were very much "advisors" and had no formal "executive" responsibility. They had direct control of only a very small part of their agency's contribution to the project budget, although this sum (about $10 000 a year) played an important role in the project.

The subject of responsibility was a delicate one insofar as the Colombian field staff were concerned. The project staff respected the higher academic qualifications of the IDRC personnel and the ready access that they had to ICA management and were often pressuring for the advisors to play a *decision-making* rather than an *advisory* role. When, after 2 years, ICA transferred the advisors' base from the project to the regional office, the project staff complained forcefully that the Canadian team was "walking out on them." Although this was a positive indication of how the Colombians identified the IDRC group as part of their team, it also indicated the tendency, so common in many aid programs, for the recipients to lean too heavily on the donor. All too often this results in a program that fades away when donor assistance ceases and this was not what the Colombian government was seeking in Caqueza.

The management of ICA recognized that the IDRC team had the training and approach to help develop a new methodology at Caqueza. It allowed them 2 years of field experience at the grass roots level; saw the development of a working relation between the ICA and IDRC staff and the emergence of a new approach to small farm development; and then moved the advisors to a level where they could influence a region rather than just one project. At the same time, Caqueza was retained as a testing and training ground and the project continued to be staffed and directed by a series of able young Colombians.

Even after they had left the project, the IDRC staff were still consulted by Caqueza and other RDP project staff. In the fifth year of the project, IDRC staff were advising the Planning Bureau of ICA and the National Planning Office.

Some of the innovative ideas of these institutions, and of IDRC, especially in the field of institutional reorganization and research strategy, were opposed by other local institutions and from time to time IDRC staff were involved in local controversies. Both ICA and IDRC recognized the delicacy of this situation as rural development was an important political issue. However, it was also recognized that there was a need to continue the work of analyzing the results in the RDPs and adjusting their methodologies to the peculiarities of local circumstances. This situation led to the creation of the Technical Support Groups (TSG), which were staffed entirely by Colombians. The first TSG was composed of ICA personnel employed in the different RDPs or at ICA regional and national offices. They knew each other personally and defined their original task as being to support project staff technically and to stimulate morale. They developed a group analysis method that used juxtaposition of inconsistencies as a driving force for interpreting the production systems in a project's area; defining the performance of tested technology; identifying information requirements and the needed experiments or surveys and communicating research and extension philosophy.

The staff of each project visited were made aware that their problems were not unique, that they knew their region (but had not known how to translate this factual knowledge into action guidelines), that the complexity of their task could be reduced to "known" and "unknown" issues, that the research that they were conducting could, indeed, help them to interpret the production systems of the region and to improve their current recommendations. This approach proved to be a tremendous stimulus to project staff, particularly those in isolated locations.

In retrospect, it seems that the first TSG had more impact at the national level in 1976–77 than the IDRC group did in 1975. This was partially a result of the development of ideas but also appeared to be attributable to the fact that the TSG were Colombians (albeit mainly former trainees and disciples of Caqueza). Indeed, it does seem that rural development needs to be coordinated and implemented by nationals if it is going to have a long-term national, rather than merely a short-term local, impact.

Many efforts at rural development are costly and complex and are heavily financed by donor agencies who often provide many of the ideas and inputs and carry the local agencies along with them regardless. Attempts to bring about rapid rural change all too often disregard the fact that the small farmer is a very rational man given his resources and his limited ability to absorb risks. To change him requires a large pool of trained field advisors who understand his constraints and his concepts of risk and are capable either of inducing changes within the framework in which the farmer has to work, or of suggesting institutional changes that will alter this framework. In this concept, true rural development is a gradual process involving an understanding and partnership between planners, agricultural technicians, and farmers. It is not something that an overnight crash program, based on a planner's dream and adequate foreign funds, but without farmer consultation or extensive intermediate level training, can bring about.

The recognition of this situation by ICA and the emphasis given by both ICA and IDRC to staff training (Chapter 14) led to the Colombian TTD (RDP) program in 1977 being on a firmer footing without expatriate advisors than it was with such personnel two years earlier. To bring this about, virtually all of ICA's

field staff and many from related agencies underwent special training in the Rionegro and Caqueza centres during the years 1975–77.

It is a matter of some interest that IDRC did not try to dictate how their funds should be used nor did they retain their involvement beyond a period of 5 years. IDRC's original hope of seeing a widespread impact and large farmer involvement within 5 years had to be modified as ICA clearly decided that what was important to them was not to have Caqueza as a high-input, nonrepeatable model project, but to concentrate on institution building and to train a large number of staff and to modify its research strategy so that by 1980 there would be a large number of projects that had made substantial progress rather than one or two that made outstanding progress very rapidly.

In this sense, the Caqueza Project became much more of an institution-building exercise than was originally envisaged. IDRC's impact appears to have reached its peak in 4–5 years and, apart from utilizing unused funds for the M.Sc. training program, it is doubtful whether much would have been gained by Colombia had the Canadian program been extended after 5 years (other, perhaps, than an international training focus).

The extent to which this time factor is relevant for other countries is questionable in view of the quality and quantity of the human resource pool in the Colombian agricultural sector. It is feasible that foreign assistance of the nature described here would be needed for a longer period in a country with fewer trained agriculturalists, especially at the policymaking level. Indeed, the quality of ICA leadership, as already mentioned, has been an outstanding feature of the Colombian RDP story.

Mention has been made of the fact that the IDRC staff were young Ph.D. graduates who all spoke Spanish and had done thesis research in Latin America. Notwithstanding this, there are obvious dangers in committing young expatriate professionals to a complex and controversial program such as rural development. Young doctoral graduates are trained to specialize in one discipline and feel a need to practice it. They do not necessarily have the maturity, diplomatic skills, and political finesse that may be required for some of the situations we have described in chapters 4–8. Furthermore, young graduates, trained in the "publish or perish" system, are keen to get research results published.

Caqueza did not provide an ideal location for sophisticated and controlled experiments with results suitable for publication (hence the reluctance of ICA's own research staff to work there). Rather than this, it gave opportunities for conducting a mosaic of small trials that together presented a picture of the complex network of interrelationships between technical, social, and economic factors involved in changing the rural scene. The results from such trials, although important pieces in the development jigsaw puzzle, were not suitable for publication in prestigious journals. Furthermore, as an intentional facet of IDRC policy, its advisors were asked to encourage results to be published under Colombian authorship rather than under their own names, to build leadership and professional reputations in the Colombian staff. The result of this policy was a smaller published output from the IDRC staff than what would have been expected of them had they worked in conventional research institutes, and this could be a career handicap. There are, therefore, risks to all parties in selecting young expatriate professionals for this type of work. Nevertheless, the Caqueza experience suggests that in a given set of circumstances such an approach may be more useful than importing very senior expatriates who may have passed the stage of being prepared to learn at the grassroots level.

To some degree the IDRC staff were supported by the fact that in the second year of the project IDRC opened a Latin American Regional Office in Bogota, directed by an experienced Colombian educationist and with the IDRC Associate Director responsible for its Caqueza involvement on its staff. These two experienced professionals were able to assist in the dialogue at the senior ICA and Planning Office levels, which left the field staff fairly free to concentrate on the technical aspects of their work. This two-level input was deliberately kept at a low key in an effort to float IDRC's ideas at various levels of ICA management without trying to impose them.

So far we have discussed personnel issues at some length and the reader may, with justification, ask why expatriates were asked for at all if Colombia had such a strong pool of agricultural scientists of its own and, as in the Caqueza Project, personnel costs comprised over half of the IDRC input. The initial ICA request stemmed from their wish to formulate a new development research strategy and to get problem-oriented research onto the small farm. In 1970 this was difficult to do within ICA where the Research Department was both powerful and strongly discipline oriented and where most research was conducted on experimental farms. ICA had a small and weak socioeconomics section with only one professional trained to the doctorate level. It recognized the need for a much greater understanding of socioeconomic issues on small farms and asked for one, and later a second, IDRC advisor to assist in this field.

However, in retrospect, this filling of gaps in personnel would not seem to be IDRC's principal contribution to the project. The most important personnel activity provided by IDRC was that of continuity. We need only look at the bar charts in chapters 4–8 to recognize the phenomenal rate of turnover in project personnel. Part of this was a deliberate training and promotion policy and part was the natural attrition that occurs due to the poor terms of service offered by many government institutions in Colombia. Even at the policymaking level in ICA there were three or four incumbents of most key posts during the 5 years under discussion. The only two Colombians closely associated with the project for the whole of this time were one technical assistant and the current Director General of ICA who was formerly Deputy Director for Development and before that (in 1970) Regional Director for the region that includes Caqueza.

Neither of these people were in a position to be familiar with the day-to-day detailed activities, research, and institutional linkages of the project nor to be able to fully brief each of the six project directors who sequentially replaced the original one. The only persons in such a position were the IDRC team, particularly its coordinator. As a result of this, IDRC did provide an important role in the continuity of the project and every time key personnel changes took place both in the project itself and in national and regional management activities relating to it, a great deal of IDRC staff effort went into background briefing and into trying to ensure that the new broom did not sweep all past achievements and activities away.

The subject of continuity of policy, effort, and leadership is one that has plagued very many efforts in rural development elsewhere in the world. Some of the most successful programs have, through the long-term input of one leader, been able to keep on a flexible but consistent course. In this respect we can cite Amir Khan's input at Comilla, Kurien's at Anand, and Virone's at Borgo a Mozzano. At Puebla, a team rather than one man provided the continuity and in Colombia the same pattern has emerged, initially with IDRC filling this role at the local level and then with the TSG performing it, first nationally and then regionally. The continuity provided by IDRC was not only in the presence of its

personnel; it also provided funds for transport, research, and training throughout its 5-year association with Caqueza. Unlike ICA funds for these purposes, which sometimes became unavailable at short notice, the IDRC budget was always accessible. This meant that at those times when ICA was unable to fulfill its plans for providing inputs for crop trials or even gasoline for travel to harvest experiments, the project had a kitty into which it could dip. In some cases this dipping was for the IDRC share of a joint activity, in others funds were borrowed (often without the knowledge of either IDRC or ICA's central management) until the ICA funding came through and they could be reimbursed. In this way the staff and the research programs were able to operate continuously without interruption.

The project was always chronically short of transport and when the IDRC advisors started to work at the regional level the three of them shared one vehicle and lent to ICA the other four purchased by IDRC. This type of logistic support was somewhat unique in Colombia's RDPs and did contribute to the large output of work from the project. IDRC money also paid for student research. The research program was established with the project director who had to approve the work done and certify the students' expenses, which were then paid immediately (or even in advance), initially by the IDRC coordinator. Most student support for travel, per diem, and survey assistants cost about U.S. $200 per student but to recuperate such funds through ICA's financial system would be such a lengthy procedure that most students would not be interested. Computer support for students was also provided by IDRC who established a tape library containing all Caqueza thesis data. This was later passed over to ICA's computer department who were able to use it as a basis for a national data bank for RDP research data. At the start of the training program most student theses committees contained one IDRC advisor to help ensure continuity should other advisors change jobs. By 1975 this program was well built into the ICA–University PEG program and it was possible to phase out inputs from IDRC staff.

IDRC's role was, therefore, in one word *catalytic.*

Its staff helped generate and test ideas and provided continuity at Caqueza, while ICA, notwithstanding its constant changes of personnel, built up a core of professionals to take over IDRC's role and to formulate a nationwide rural development strategy. The fact that this is definitely an ICA strategy built up from the grassroots within ICA and not imposed from outside, offers hope that it will be practiced with some continuity over the next few years.

A Look at Caqueza and the Colombian RDPs in 1977

In Chapter 16 we discussed the different approaches to evaluation adopted by the project and the emphasis given to analytical evaluation at the expense of traditional criteria, such as the amount of credit disbursed or the number of farmers visited. We indicated that the government was enthusiastic about the impact of the RDPs, as a result of which there is now a national policy to develop 86 projects of this nature covering the whole country.

Although this book details the experiences of the years 1971–75, before completing it we have had the opportunity to revisit Colombia and Caqueza 18 months later — in mid-1977. At that time, Caqueza was not a particularly strongly staffed RDP, as so many of its former staff were found as Regional Directors for Rural Development or in national or regional Technical Support Groups. The day-to-day activities of the project had continued along the lines

practiced in 1975 but the corn plan had been expanded as had the onion plan, and one professional staff member now managed both of these programs working in conjunction with the cooperative. The amount of improved corn varieties grown in the area had increased. Farmers were buying considerable quantities of hybrid seed from the CAJA AGRARIA, something they had not done before. With the advent of international funding for RDPs, new corn credit programs have been initiated and Caqueza farmers are now not as hesitant to accept corn credit as they were in the early 1970s. A recent study by ICA indicated that over 80% of the farmers who had participated at some time in the corn production plan and had subsequently ceased to draw credit from it were continuing to apply its recommendations to their corn crop.

The training centre that was built with IDRC support is fully booked throughout the year. It is used for training TTD staff, for meetings defining rural development research methodologies, and for meetings on credit programs in the TTDs.

The Caqueza Project has played a dominant role in gaining recognition for on-farm research as an established activity in ICA and in defining the present institutional structure of the TTDs and of the regional level TSGs that support them. Other products of the Caqueza Project that have had a national impact are certain of the research methodologies and survey techniques and the national involvement in preschool and marketing activities. The corn and onion plan approach has been widely adopted and used for other crops and far more small farm credit is now granted without the farmer having to pledge his land. A number of the original Caqueza publications have been revised and updated and now serve as training manuals. Much of the national training program can be related to the early efforts at Caqueza and Rionegro.

The Caqueza Project was far from being the only factor in these developments. It is important not to underestimate the impact of the training that ICA personnel received at Chapingo in Mexico where the seeds of the Colombian program were first planted. The Colombian program really took off in 1975 when a former Caqueza project director became national Director of Rural Development and created the first TSG. This group began to visit project after project sorting out the results that had been obtained, how they should be interpreted, and how they should be used in the dissemination program. This group also provided training and analytical backup for the interpretation of research results and the design of new experiments. It acted as the engine that made it possible to put into operation Colombia's internationally backed integrated Rural Development Program (DRI).

The 5-year DRI plan was originally budgeted at U.S. $355 million, half of which was to be contributed by foreign organizations. Although investment requirements may have been overestimated, foreign loans to the program by mid-1977 included $64 million from IDB, $52 m from IBRD, $13.5 m from Canadian aid, $4 m from US-AID, and $0.1 m (specifically for risk-sharing programs) from CARE. Of this money, 54% is scheduled for a credit plus technical assistance program for agriculture. In 1976, the first year of the program, 70% of the credits granted went to farmers who had never previously had credit or technical assistance, as credit was granted on production potential, such as the Caqueza corn plan, rather than against the security of a land title.

The DRI program is specifically tied in to the new National Nutrition Plan, which is designed to produce the food required to bring about an overall rise in dietary standards. It is also designed to improve rural infrastructure (roads, education, health, electricity) and, hopefully, to increase rural employment and

reduce migration. All of these goals relate to what Caqueza set out to achieve and are indicative of the dialogue between the project and the Planning Office. It would clearly be unfair, both to other RDPs and to the Planning Office, to attempt to quantify the role of Caqueza in this dialogue. What did occur was that Caqueza started to test a strategy at about the time the national planners started to discuss such a strategy so that the project was able to provide answers and experiences at the time when the Colombian Government and donor agencies were posing questions. It is not easy in such circumstances to define just how significant Caqueza's contribution was. Suffice to say that all of the donors to the DRI spent considerable time with Caqueza staff and documents during their loan preparation work.

A feature of the DRI that warrants comment is that only 54% of its funds were specifically allocated for agriculture. It is, in fact, a multisectorial integrated rural development program whereas the original ICA RDPs were, by virtue of ICA's mandate, *agricultural* development programs — the distinction is important, particularly from the standpoint of organization and administration. Rural development cuts across many sectors of government activity, as we have seen from the list of agencies referred to in this book. Even in the agricultural sector itself, credit, marketing, and production are often handled, as in Colombia, by different agencies. Furthermore, the credit agency may have links with the Finance Ministry and the marketing agency with the Trade Ministry as well as with Agriculture.

Issues such as the financial, technical, and administrative efforts, which need to be related to specific aspects of the program, the areas of major concentration, and the timing of inputs, all call for a very high degree of planning and coordination. Historically, in Colombia, central planning has been a feature of government policy for some time but once the planning exercise was completed the implementation was left to individual agencies and the National Planning Office had no further inputs.

The Colombian RDP effort of the early 1970s was closely followed by the National Planning Office, because at this time a political commitment was made to the RDP program. The Planning Office came to the conclusion that there was a need for much stronger central coordination and that this should be implemented by the Planning Office seconding a senior official to each major DRI Region as coordinator of the regional program. Such coordination was designed not to undertake or to duplicate the work of the specialized agencies but to identify bottlenecks and to get agency headquarters to pressure local officials who were impeding progress.

Had such coordination been operative in Caqueza from the start of the project, progress might have been expected earlier in the timely arrival of credit and in the cooperative and marketing activities. Closer links with rural education and health service delivery programs might also have been attempted. In retrospect, ICA was not the best agency to spearhead a rural development effort; its mandate is too narrow and it is not in a position to exert pressure on other agencies. The agency that has been designated to coordinate the DRI is the CAJA AGRARIA, which has the advantage over ICA in that it will control the DRI finances. Although this is a step forward, it may still be difficult for the CAJA as a component of the Ministry of Agriculture to exert much control over sectors such as Education and Health, and to make the DRI really effective may ultimately require the National Planning Office to take an even more active role in the implementation process. However, allocating this role to the CAJA is a step forward and is indicative of the Colombian government's dynamic

approach to this problem. That ICA made as much progress as it did in attempting intersectorial coordination during the period 1971–75 is to a large extent a reflection on the strength of leadership and professionalism enjoyed by ICA during these years.

Five years is a short time in the life of a complex development strategy. Caqueza left many questions unanswered but it did engage in research, training, dissemination, credit, and coordination activities that were all associated with changes in national policy. The project had a considerable impact on a few hundred farmers and a limited impact on, perhaps, 5000 or 6000. But these constitute a very small part of Colombia's small farmer population.

Where the influence of Caqueza was strongest was in the training of ICA staff and in the altering of research policy. The wealth of information brought in from the field led to considerable institutional changes within ICA and these influenced agricultural planning in the National Planning Office. Many of the key personnel in both agencies now practice as well as preach planning from below. Caqueza is the closest that Colombia has yet come to an open and frank dialogue between planners, agriculturalists, and farmers. It contributed to the development and testing of a new agricultural strategy, to the field training of many people, to some major institutional reforms, and to the provision of large sums of government and external funds for using the trained people and the institutional changes to implement the new strategy. Whether change can be brought about on the scale envisaged by the DRI and with the resources available in the time proposed, only time can tell. Given the funds available, the calibre of the professional staff involved (and this includes those in other sectors, such as health and education, where parallel new philosophies are emerging) and the existing political commitment and support for rural development, there is every reason to anticipate that the DRI will have a major impact in Colombia's rural areas.

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This is a book about *people*: three groups of people. The largest group consists of Colombian small farmers with limited capital resources and educational backgrounds, trying to make a dignified living out of 2–4 hectares of parceled hillside land. The smallest group, which remains largely in the background of this story, is made up of politicians and planners formulating a national agricultural development policy whose objective is to improve the lot of these small farmers. Between these two groups of people are the agricultural technicians who are attempting to bridge the gap between farmers and planners by developing production strategies that the farmers are able and willing to use and that will enable the planner's goals of higher production and incomes from the small farm sector to be met.

This book tells the story of the relationships between these groups of people in Colombia throughout a 5-year period during which the National Government gave considerable priority to the small farm sector. It is *not* a text book on rural development but rather a case history describing the successes and failures associated with the process of establishing a flexible methodology for the development of a fairly typical Andean agricultural area, specifically the region in the East of Cundinamarca known as Caqueza.

The story told in this book raises at least as many questions as it answers but it makes it very clear that if small farmers are to be able to realize the benefits of new agricultural production technology, this technology must be based on an understanding of their real needs and constraints and not on what outsiders consider these needs to be.