**Participatory Approxhes to Agricultural Research and Development: A State of the Art Paoer**

by William F. Whyte

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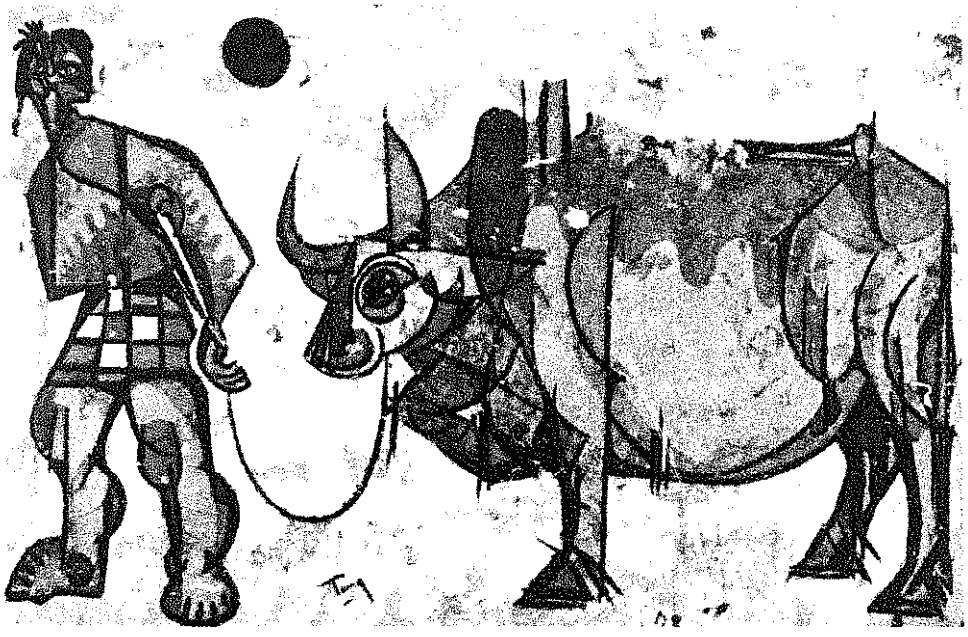

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# Participatory Approaches to Agricultural Research and Development:

## A State-of-the-Art Paper

William F. Whyte

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# PARTICIPATORY APPROACHES TO AGRICULTURAL RESEARCH AND DEVELOPMENT:

## A State-of-the-Art Paper

**William F. Whyte**

**Cornell University**

**Rural Development Committee**
**Center for International Studies**
**Cornell University**

This paper was prepared for the Rural Development Participation 'Project under a cooperative agreement between USAID (Office of Rural- Development and Development Administration) and Cornell University (Rural Development Committee, Center for International Studies) under Basic Memorandum of Agreement AID/ta/BMA/8.



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# FOREWORD

Recent developments in the poorer countries point to the need for evolving new strategies in agricultural research and development (R&D). The target group in this important transformation is the millions of small farmers who have remained in poverty because they have not participated in the agricultural modernization process.

This state-of-the-art paper documents what is increasingly appreciated, that small farmers generally act rationally in the use of the limited resources available to them. But beyond this, it shows how emerging new models for organization of agriculture1 R&D hold the key to advancement of production and well-being for the rural majority.

Case studies and observations in numerous developing countries supply strong evidence that the small farmer is not locked into the passive peasant role long assumed to be the norm. He responds to improved ways of farming, provided he has had a hand in evolving and adapting the innovations. This means that the professional must be astute enough to learn from farmers.

This is a dramatic departure from the standard top-down method whereby experiment station recommendations were passed down through official channels. 'The local extension agent was directed by his superiors to convince the farmers to adopt the new technology. Since the technology had not been tested on local farms, however, it was often not suited to the farmers' circumstances.

This state-of-the-art paper analysis takes note of the major contributions which collaborative efforts of the international crop research institutes and national research programs in a few select countries have made to increase production of wheat, rice and maize in the late 1960s and 1970s. This has added enormous quantities of food grains in food deficit countries.

This breakthrough technology was ideally suited to limited areas, however--those with good soil and water resources and where farm size was adequate for farmers themselves to make the needed investments. Where such areas were backed with good infrastructure, including research, extension and supporting services, substantial progress could be made quickly. In a number of countries, there have also been less dramatic but nevertheless noticeable increases in production on medium-sized and smaller farms

But these gains have been offset by population increases, and production and income improvement have varied tremendously between and within countries. For most parts of the developing world where land and water resources are not ample, there has been little or no improvement. This presents the major challenge to plant and animal scientists, plus planners and administrators, technicians and social scientists, to invent and extend new technology that can alter production possibilities across a much wider spectrum of rural producers.

The organization and operation of an emerging new model for agricultural R&D are described in thii monograph. Work in the countryside is interdisciplinary, with small teams varying in make-up depending on the local situation. There is usually representation from the social, economic and natural science disciplines. Local extension agents participate in selecting the problem area and in encouraging farmer participation.

These groups, with farmers, scientists and extension agents, work as a team. Emphasis is on mutual learning. On-farm testing of selected combinations of local practices and scientific findings from the research station are carried out on representative farms. Planning, implementation, interpretation and evaluation involve the whole team. Test results become the basis for new farming recommendations. Credibility is enhanced because the work is done locally. The leading farmers indeed become de facto paraprofessionals in diffusing the new findings.

This new strategy is a dramatic departure from the traditional relationship among research station, extension service, farmer and supporting services. This approach focuses on searching out what the small farmer needs and can use. In this process, scientists must and can learn much from the small farmer. By using on-farm research to determine what will work, scientists and extension agents will be in a position to carry out the diffusion process, through group action, more readily reaching the rank-and-file small farmer.

While the emphasis in on-farm R&D programs is on farming systems, it should not be overlooked that single commodities or appropriate monoculture will need to be developed further. Likewise, the scientific disciplines attached to the research station have a crucial role to play in this enterprise. Unsolved technical problems found by the teams on farms are relayed to the scientists for advice. Research station scientists in turn make new knowledge available to the on-farm R&D program.

This analysis by William F. Whyte is a unique contribution to the literature on agricultural R&D in developing countries. On the one hand, it is a well-grounded scholarly work, as one would expect of the immediate past president of the American Sociological Association. On the other hand, it is written in an easily understood style. Documentation is provided from a number of interesting case studies. The paper spans the disciplines of the natural sciences, economics and sociology, with deep insights and probing analysis.

Useful guidelines are outlined for working more effectively to develop appropriate packages of technology that can make better use of small farmers' land and labor. This makes the monograph priority reading for researchers, extension workers, administrators, politicians, local leaders and a large lay public.

My observations on the monograph are based on some 20 years as an agricultural scientist, professor and administrator, plus 14 years of work on agricultural R&D in some 10 developing countries, with most extensive involvement in India for the Ford Foundation. It is gratifying to see the fruits of many agricultural professionals' experience "harvested" in this way to lay the groundwork for further advance in research and application.

A. A. (Al) Johnson
July 1981

## PREFACE

This state-of-the-art paper has grown cut of varicus materials and ideas acquired from my own field work and from my students and colleagues. I have tried tokeepup with the rapidly growing literature and also with ideas and information not vet in print as these come to the campus through visits of agricultural and social scientists invited here by the Rural Development Committee of the Center for International Studies or by the International Agriculture Program of the College of Agriculture and Life Sciences.

This analysis draws on a larger project in which my colleagues and 1 are engaged: a book describing and evaluating interdisciplinary efforts to stimulate rural development for the special benefit of small farmers. Cornell, and especially its Rural Development Committee, have provided opportunities for the interchange of ideas among natural scientists and social scientists interested in agricultural research and development. My debt to my colleagues across a broad range of disciplines is best illustrated through a simple listing of the names and disciplines of those who have participated in this collective effort jointly organized by Damon Boynton, a horticulturalist, and myself:

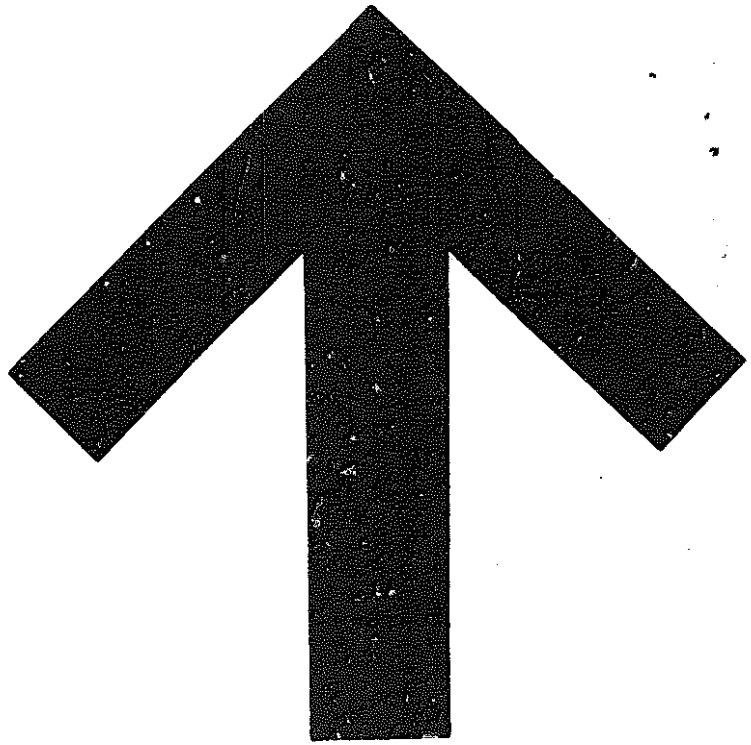
Randolph Barker (Agricultural Economics), Milton Barnett (Anthropology), Joseph Campbell (Agricultural Engineering), C. Walter Coward, Jr. (Rural Sociology), Loy Crowder (Plant Breeding and Biometry), Matthew Drosdoff (Soil Science), Rada Dyson-Hudson (Anthropology), Milton Esman (Political Science), Davydd Greenwood and Billie Jean Isbell (Anthropology), Alvin Johnson (Plant Breeding), Gilbert Levine (Agricultural Engineering), Robert McDowell (Animal Science!, Daniel Sisler (Agricultural Economics), Benedict Stavis (Political Science – now with Michigan State University), H. David Thurston (Plant Pathology), and Norman Uphoff (Political Science).

These colleagues have provided a considerable range of contributions, from reading and criticizing draft chapters, to writing chapter drafts themselves. Even those not able to participate fully in the writing project have given invaluable help in pointing out factual errors or drawing attention toprojectreports and publications not in general circulation. I am indebted to Matt Drosdoff, Al Johnson and Frank Casey for helpful suggestions in the final stages of revision of this manuscript.

I appreciate particularly the contributions of Damon Boynton and Norman Uphoff to this monograph and to the book on which we are still working. Since cur joint efforts involved an attempt to integrate information and ideas across an extraordinarily wide range of disciplines, I have been exceedingly fortunate in having a natural scientist, Damon Boynton, as co-coordinator of the book project. Beyond his important writing contributions, he has helped greatly in making social science ideas accessible to natural scientists and interpreting to me information and ideas coming out of the natural sciences. As chairman of the Rural Development Committee, Norman Uphoff has been a key figure in organizing and facilitating the broadest interdisciplinary discussion and collaboration that I have ever experienced. His criticisms and suggestions on earlier drafts of this manuscript have been invaluable.

William Foote Whyte
Professor Emeritus of
Industrial and Labor
Relations and Sociology

May, I981



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## Introduction:
## THE NEED FOR A NEW STRATEGY

The organizational framework for agricultural research and development which has evolved over the past century, into the 1970s, has worked reasonably well for the now-industrialized nations. Students of agricultural development in increasing numbers, however, are coming to believe that this approach is not working and will not work so well any more in the developing nations. This conclusion has prompted a search for new agricultural R and D models of organization especially designed to improve the productivity and well-being of the rural majority who have so far been by-passed.

The plant breeding breakthroughs of the "green revolution" of the 1960s, which produced new high-yielding grain varieties, supported some enormous advances in food production in a number of countries. Yet as many critics have noted, the new technology has tended to favor those rural producers already in relatively advantageous positions, doing much less to improve the lot of the rural majority, even in some cases having negative effects by spurring labor displacement or land concentration.

This uneven impact of the new technology has not been a consequence simply of different sizes of landholdings. While on the average, larger farmers have benefited from it more than smaller farmers, studies sponsored by the International Rice Research Institute in Asia have found that where small farmers were cultivating irrigated land, they tended to adopt the new technology about as rapidly as the larger farmers and to reap substantial benefits. Indeed, their more intensive use of labor produced higher yields per acre than on larger, less intensively-cultivated farms.

The new technology, however, by concentrating on achieving the largest possible increases in yield required good water control, application of chemical fertilizer, herbicides, pesticides, etc., even in some instances, mechanical power. Such conditions could not be generally met by smaller, poorer farmers. Indeed, worldwide we find that only about 15% of land under cultivation is served by irrigation systems, so this means that farmers on about 85% of the total area will benefit much less from innovations developed for irrigated land.

Some of the agricultural research programs are broadening the objectives in their plant breeding programs. We find IRRI, CIMMYT and other international research centers, as well as their national agricultural research counterparts, increasingly working on upland crops and on improvements like inbred pest and disease resistance, nitrogen fixation, etc. Yet even as these laudable new efforts are launched, there is

reason to be concerned that the very style and organization of most current agricultural R and D will not adequately take account of the circumstances of small farmers and improve their productivity, for reasons discussed later.

We do not wish to discount the great achievements in agricultural science and technology to date or to underestimate the potential for economic and social gains through agricultural research in the future. We begin our review with a recognition that the agricultural sciences have been enormously successful in some important respects. Without the advance of the so-called "green revolution," worldwide production of cereal grains would be far less than it is today, and the brunt of shortfalls would surely faii on the poorest sectors of society.

Existing agricultural R and D strategies have not given much direct support to those farmers who struggle to survive under conditions of climate, soil and water which are much iess favorable than assumed by the "green revolution" technology. Moreover, they labor and produce within systems of agricultural production far more complex than the "primitive" stereotype we usually have of "peasant" farming. (Harwood, 1979; also Wharton, 1969; Loomis, 1976; Scrimshaw and Taylor, 1980: 86-88.) We need to come to terms with these circumstances if agricultural R and D is to assist the poor rural majority as LDC governments and donor agencies intend. Such a reorientation in organizational capacity is the central focus of this paper.

This state-of-the-art paper addresses these problems in three stages. First, it presents an overview of some major past efforts involving agricultural research and development. After examining limitations in these past efforts and what can be learned from them, it describes the evolving new participatory agricultural research and development strategy to be found in a number of countries. This emphasizes on-farm research with the active collaboration of small farmers in the R and D process. Finally, we examine efforts, particularly in Latin America, to build this new participatory research strategy into national R and D programs, because such a strategy needs concrete incorporation into organizational structures and practices.

Before proceeding with our discussion, we should indicate some limitations on its scope. We do not assume that a new agricultural R and D model will be able to transform all rural people into productive farmers able to feed their own families and have some surplus to sell for cash income. In the first place, there are many millions of landless rural families. Among those who own no land at all, a substantial part of the rural population has access to land only under highly oppressive conditions of tenancy. (Esman, 1978; Rosenberg and Rosenberg, 1978; Lassen, 1979; Harik, 1979.) Research in

the plant and animal sciences can hardly be expected to benefit them substantially unless land tenure conditions are changed. In the second place, there are millions of near landless households--minifundistas as they are called in Latin America--who own so little land that they have no possibility of growing enough food to feed their families, let alone having any surplus to market. Improvements in their well-being will also depend in large measure on the generation of new employment opportunities.

While most of our attention here is focused on small farmers who are the next level up, owning enough land to have a possibility of becoming self-sufficient in food production and even producing a small surplus, we are also concerned with these minifundistas. While it may be impossible for this category to make their small farms produce enough to feed their families and also bring in a small cash income, we should not conclude that plant and animal sciences can do nothing for them. Around the world, there are millions of minifundistas who are at least able to meet some of their families' food consumption needs through their own farm work and at the same time have members of their families work off their own farms, either for larger farmers elsewhere or in non-agricultural occupations, thus bringing in some income to buy food and some of the other necessities of life.

Such families might profit significantly from increases in the efficiency of their farms; but changes in their practices which would require substantially more farm work (when they are already working a great deal off the farm) or a substantially greater expenditure on inputs (when cash is very scarce) might involve sacrifices of opportunities for off-farm employment or of consumption that would make the changes seem impractical to such farmers. This fact means that researchers and extensionists must go beyond dealing with one crop at a time, rather considering the pattern of the farming system as a whole and relating that farming system to the total economic and social environment of the rural family.

Having opened up far larger problems than we can deal with in an introduction, we must defer them to later chapters. We begin the first chapter with a discussion of deficiencies in conventional agricultural research and development strategies. Our purpose is not to make negative arguments but rather to determine what lessons can be learned from past experience for deriving more fruitful R and D models for the future. Later chapters discuss experimentation with new R and D programs with farmer participation that promise to provide better models for agricultural research in other developing countries. A bibliography at the end presents some of the literature which supports the reorientation of agricultural R and D to involve more farmer participation.

## chapter I:

## RECOGNIZING SHORTCOMINGS IN CONVENTIONAL. STRATEGIES

Agricultural research and development models have mostly been created in industrialized nations and then have been introduced into developing nations. Although some simplication is involved, it is instructive to consider two general types of models that have been transferred. The first type, the European colonial model, was already introduced before World War II in the African and Asian colonies. The second type was developed after 1945 through U.S. technical and financial assistance in Latin America and some Middle Eastern and Asian nations.

The European colonial model was based primarily upon large-scale plantations devoted to production of crops for export--and particularly for export to the mother country. In some cases, these plantations developed a high degree of productivity and efficiency, based on thorough farm management backed up by high quality research in the plant sciences. Until shortly before the end of the colonial period, however, such research was concentrated largely upon export crops, thus providing little or no technical assistance to the small farmers who were raising crops for home consumption and for local marketing. When researchers finally began experimentation on domestically consumed crops, the plantation system did not lend itself to effective work with small farmers. Thus, the Europeans and their African and Asian research counterparts were in need of a new agricultural research and development model.

The structure of the European model, in its initial conception and supporting philosophy, was distinctly "vertical," as suggested in Figure 1 (page 3). Research was carried out in the laboratories and sent "down" to the plantation, where production could be closely supervised and controlled, as in a traditional industrial organization. Any feedback was definitely "upwards" to the scientist who guided the operation. Naturally, adapting this model for work with small farmers proved difficult.

With the passing of the colonial era, the U.S. model of agricultural research and extension gained in popularity and influence. Indeed, in the late 1940s, many U.S. experts assumed that transplantation of their model to developing nations could result in the same increase in productivity and farmer income as had occurred in the United States. The Point IV program, designed to bring technological and financial assistance to agriculture in developing nations, carried with it the model of American "land grant" universities linked to an extension service taking the results of university-based research 'out" to farmers. If the system worked as intended, it brought farmers'

experience and probiems "back" to the researchers at the university or experiment station. This model was intended to be "horizontal," as shown in Figure 2 on the next page, although in practice this second model can resemble the first by having essentially a one-way flow of initiatives and information.

In Figures 1 and 2, the solid lines indicate a high frequency of communication and initiation of action, whereas the dotted lines indicate relatively lower frequencies of communication and initiation. As is well known in studies of industry and government, in a vertical organization it is much easier to transmit information accurately downward than upward, and initiation of changes from below is likely to be especially difficult. The horizontal mode! was intrnded to overcome this imbalance in flow of communication and exercise of influence, but the dotted lines in Figure 2 going from farmers to extension service and to university research programs indicate a continuing inbalance which we need to explore.

> In the 1950s and 1960s, the United States spent millions of dollars to expand and strengthen agricultural extension in Latin America and also in some Middle Eastern and Asian nations. Toward the end of this period, AID commissioned an evaluation (Rice, 1971) to determine the effects of these expenditures in the Andean nations. The study sought evidence in concrete terms of increased yields or other quantitative induces of improvement. The author was not seeking to discredit agricultural extension. On the contrary, he made an exhaustive search for any solid indications that this enormous expenditure by the U.S. and by the host nations had produced measurable benefits, but with no success.

As we examine the factors underlying the failure of the attempted U.S. transplant to become broadly effective, we should recognize that program planners focused mostly on one part of the model--agricultural extension. Unti! the failure of this partial transplant became evident, they did not undertake to build in developing countries (or were not able to build) the other components, particularly the university and experiment station-based research programs, which were vital features of the U.S. model. The failure of the agricultural extension system to produce expected benefits cannot be attributed to any single cause. It will be instructive to describe some of the main factors that were involved, however.

### Limitations in Research Strategy

In the first place, designers of the transplant grossly underestimated the importance of research in the developing countries. They initially assumed that the

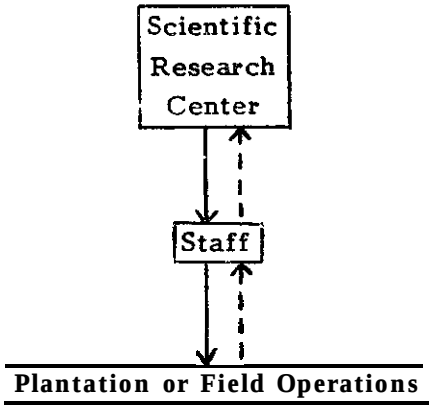



**Figure 1: The Vertical' Model of Agricultural R & D**

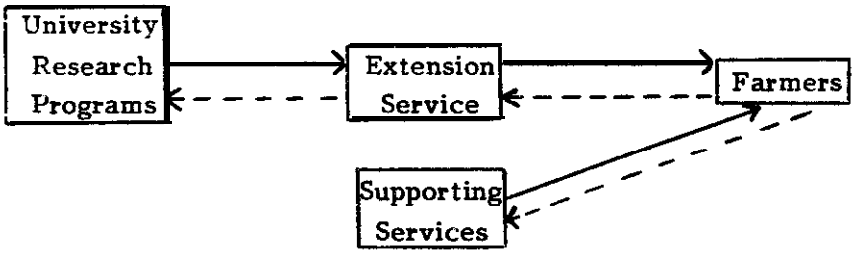



**Figure 2: The "Horizontal" Model of Agricultural R & D**

research results achieved in the United States and in other developed nations could be extrapolated to the developing nations, that recommendations emerging out of research in the U.S. would apply not only to the U.S. but also to Peru, Cameroon, or wherever. This assumption involved a great overestimation of the transferability of agricultural knowledge and of materials such as seed varieties. The problem is not simply that Peru is different from the United States but further that even within small areas of Peru and any other developing country, there can be enormous variability of conditions of soil, climate and water. Therefore, general recommendations for a country or a region are rarely valid for all farmers and may lead some or many of them into economic disaster.

It is now clear that a model which consigns basic research to the industrialized countries and only application of that research knowledge to developing countries, can make little contribution to the welfare of those developing countries. There is within any developing country an obvious need at least for adaptive research in which, for example, plant scientists test out plant varieties and other inputs developed abroad under varying conditions in their own countries. But beyond this, few scientists in developing nations would be content simply with testing the local adaptability of scientific and technological innovations developed abroad. Above and beyond understandable feelings of national pride, they recognize that there are problems of major importance in their nation which wili hardly be studied at all if national researchers leave all innovative lines of investigation to foreign researchers.

Although some massive increases in yields of wheat and rice came with suddenness in the 1960s, leading to the popularization of the term "green revolution", we should recognize that these increases were derived from the implementation and diffusion of research results based upon many decades of study and experimentation. The process of linking research to development was intensified in the late 1940s particularly through Rockefeller Foundation-supported programs in Mexico and Ford-Rockefeller programs in the Philippines. The experience of these programs and of the international research centers growing out of them makes it clear that we cannot expect quick leaps from research to implementation. Yield increases in a country depend as much upon information and genetic materials developed or adapted within tbat country as they do upon information and materials from international sources.

## Limitations in Extension Strategy

The strategy employed in agricultural extension also involved the now discredited assumption still implicit in the commonly used phrase, "transfer of technology." The

term is seriously misleading because it implies that small farmers have such inadequate knowledge about agriculture that they must depend upon the professionals to provide them with the information and ideas to improve production.

We find many common deficiencies in knowledge and ability on the part of extension agents. In most developing countries, college education and even high school education had been confined largely to persons coming from urban families. Men of such background employed as extension agents often had little or no actual farming experience, and, furthermore, their education had been largely a matter of book learning. Therefore, one usually had a young and inexperienced extension agent dealing with a middle-aged farmer. That farmer was likely to discover rather quickly that the agent was without practical experience and might not know what he was talking about. The agent, lacking confidence in his own farming ability, would be inclined to compensate for his insecurity by emphasizing the superior importance of his book learning. Relationships built upon such a foundation could hardly lead to constructive outcomes.

Even when the extension agent has been able to combine some practical knowledge with his formal learning, and has learned to relate well to peasant farmers, his effectiveness can be undermined by the scope of work he is expected to cover in tasks, territory and population. In a study of the extension of high-yielding rice varieties in Tamil Nadu State of India, agents were responsible for supervising 30 or more other schemes, many of which had multiple operational components (one included promotion of five varieties, a loan program and fertilizer distribution). In addition, the extension agent was to submit a 21-page monthly report which could take up to a week to complete. (Heginbotham, 1975: 107-108) Superiors freely demanded stiil other reports and soil samples from hundreds of randomly-selected locations, setting "targets" beyond any human capability to achieve (pp. 112-119). That the HYV program did not make more progress was at least partly due to the irrationality of extension administration, though the top administrators could blithely insist that all targets were "rationally decided."

In neighboring Andhra Pradesh State, a study found extension officers spending 19 to 44 percent of their time in preparing and maintaining reports and returns, and that District Agricultural Officers had about 125 reports (weekly, monthly, quarterly, half-yearly and annual) to submit. (Reddy, 1981: 103). In Kenya, where monthly workloads of extension staff were analyzed in terms of the targets already set, meeting all of them would require as much as 474 percent of the available staff time. (Chambers, 1974: 66)

In such situations, it becomes "rational" for the agents themselves to adopt strategies vis-a-vis farmers that protect their careers, giving precedence to reports over field work, or in their field work, focusing on richer farmers who are more inclined to cooperate and who have larger holdings so they can take more of the proferred seeds and fertilizer and thereby make the agent's performance record look better.

> In a study of the Kenyan extension service's performance, it turned out to be "rational" for agents--unable to serve all the hundreds of farmers in their assigned area-to serve the richer, more "progressive" farmers disproportionately. Indeed such farmers were 42 times more likely to receive a visit from an extension agent during the year than a farmer who was not already using hybrid corn seed and raising a cash crop. This "bias" in extension services would minimize the likelihood of complaints against the agent by influential people which would make his personnel record look bad. (Leonard, 1977)

The scope of the agent's responsibilities-the number of activities and the number of farmers assigned to him--thus often prevented him from undertaking the kind of followup on the results of his recommendations that would enable him to be a more effective change agent-or they would keep him from engaging himself with the problems which face small farmers not yet part of a commercial system of production and marketing, If farmers did not accept the agent's recommendations or did not get the promised results, this should raise a number of questions, seldom answered:

Did the farmer adopt the recommendations exactly as proposed by the agent? If not, why not? Because he did not understand the agent's explanations? Because he understood but did not believe that the recommendations would yield good results? Because he could not afford the cost of the necessary inputs? Or because the inputs were not available?

If the farmer did attempt to apply the recommendations but achieved poor results, the following questions suggest themselves. Did he apply the recommendations in accordance with the directions of the agent? If not, why not? This leads back to the questions raised above. If he did apply the recommendations faithfully, but still results were poor, were the recommendations simply wrong? None of these questions can be answered by the agent who works in the traditional top-down style of field operations.

If an extension agent works closely with farmers throughout the agricultural cycle, he will have a good chance of learning the answers to most or all of these questions, and those answers will greatly &rich his learning and increase his

effectiveness. However, such an intensive relationship cannot be developed and maintained if the agent is responsible for a large territory and a large number of farmers, as usually is the case.

This might lead us to the conclusion that agricultural ministries should multiply the number of agents so as to achieve more intensive relations between agents and farmers. Even if there were no other reasons to argue against this conclusion--and indeed there are-it is obvious that developing countries simply lack the money and the professional talent to provide for this more intense technical assistance relatirnsbip. Such a conclusion must lead us to recognize that the basic design of the relationship is faulty: if we think only in terms of a one-cn-one relationship between the extension agent and the farmer, then it is impossible to develop a cost-effective system of agricultural research and extension We therefore need to think of organizational strategies which will not only provide more useful information but will channel it more effectively and economically to those who need to use it.

We also find almost universally a lack of integration among the various government agencies which have official responsibilities of serving the small farmers. It is rare indeed to find a country where there is an effective collaborative relationship between research and extension. We commonly find that research people look down upon extension agents, considering them incompetent and poorly trained. On the other hand, extension agents are often inclined to think that research people are out of touch with the practical realities of farming and simply pursuing esoteric projects designed to lend them professional prestige.

The problems are compounded by difficulties with agricultural credit and marketing. As various studies have shown, credit tends to go predominantly to the more affluent farmers. This bias cannot be explained in terms of credit risk, for research suggests that the failure of repayment is higher among large farmers, whose social position and political connections help them to avoid penalties for defaulting on their obligations. This social class bias in the channeling of credit has been documented in various parts of the world. (For Latin America, see Donald, 1976; for India, see Ames, 1975; for Bangladesh, see Blair, 1978.)

The cost of credit for small farmers is also likely to be a major problem. In order to protect poor people from the exorbitant rates of money lenders, many governments have established special credit programs for small farmers. However, even if such programs do provide money at lower nominal interest rates than private lenders, the de facto rates may still be so high as to discourage borrowers. Or the cost, in terms of

time, to obtain necessary certificates and signatures may be substantial and detract from the value of the loan. It is not just a question of the availability or unavailability of credit or even of rates of interest so high that loans are not attractive to farmers. There are problems in getting authorized credit to farmers in time for them to make the optimum use of that credit.

> ". . . now, more than ten years after the beginning of Project Puebla (in 1967) it is still impossible to get credit in the hands of the small farmers of Puebla earlier than one month after they need it to achieve best results." (Antonio Turrent, personal communication.)

Further, in industrialized nations, many farm families own trucks or pickups that they use to get their produce to the market. Few small farmers in developing countries can afford such vehicles. Unless they band together to form a cooperative--a possibility we will discuss later-they are at the mercy of their more affluent neighbors or of intermediaries from elsewhere for getting their produce to the market. The poor farmer often finds that he has to sell his produce on the spot at a fraction of what he could get for it if he himself were able to put it in the market.

To deal with this marketing problem, some governments have established buying organizations, guaranteeing to buy what the farmer produces at prices designed to provide him a reasonable income. However, such government organizations often are so inefficient that they fall to provide help to small farmers. Nor is it just a matter of the difference in efficiency between the independent entrepreneur and the government agency. Even if he offers the farmer a price substantially below the government guarantee, the entrepreneur makes his decisions and pays cash on the spot. The driver of the government truck has no such freedom. Since he is dealing with money of the state, he can only weigh the produce and give the farmer a receipt for the amount he has delivered. The farmer then may have to wait several months before collecting in cash from the government agency and, even at that time, he may be disappointed in finding that the amount he had expected to receive has been reduced because of reported deficiencies in quality or presence of impurities. Such discounts, based upon judgments and calculations made behind the scenes (and possibly incorrect) are beyond his control. Furthermore, sometimes a bribe must be paid to an official to redeem the receipt issued for the produce, a complaint among cocoa farmers in Ghana (Beckman, 1976) and smell farmers selling export crops in Jamaica (Goldsmith and Blustain, 1980).

Then, too, there may be serious storage problems for the small farmer. If he must sell his produce at the time of harvest, he finds himself going into the market when

supplies are most bountiful and prices lowest. He knows he could get a substantially higher price if he could hold his produce off the market for several weeks or months, but, even if he could afford to delay the sale, his ability to do that depends upon having his own storage facilities or having access at reasonable cost to other facilities in his neighborhood. Without such support, the farmer is constantly entering the market under disadvantageous conditions.

Finally there is the sex bias that has been built into agricultural R and D organizations from the beginning but which only recently has come to be recognized as a problem (Staudt, 1975, 1978). In the past all over the world, agricultural extension has been a job for men. The extension activities provided for women have traditionally centered around the homemaker functions of cooking, sewing, and so on. This division of labor is based upon the implicit and incorrect assumption that farm women only take care of home and family.

In many parts of the developing world, women are actively engaged in agricultural production. In fact, in some countries in Africa it is estimated that women do 70% of the farm work (E. Boulding, 1977). Even in countries where most of the farm work is carried on by males, women participate at critical points. Then there is always a large number of farm households (20 to 30% in many countries) headed by widows or by women whose husbands are away seasonally or for extended periods in urban employment. In such cases, women can be severely disadvantaged if they receive no assistance from the agricultural professionals. Furthermore, even when the extension agent recognizes the woman's involvement in agricultural production, he is likely to find it difficult to work effectively with her because of communication problems or suspicions that would be aroused in some cultures by the outside professional spending time alone with the farm woman.

While all of these factors add up to a genera; explanation of the ineffectiveness of the traditional agricultural extension system, we gain a more systematic picture of the problem if we place it in the context of the socio-economic structure of a developing nation, compared to the United States. The U.S. model of land grant university and extension system fits into a socio-economic structure of relatively ample landholdings, of an affluent farm population with a high level of education so that farmers are able to read and study published material, and all of this set in a democratic culture which deemphasizes status differences and promotes free exchange of opinion and ideas. Furthermore, the U.S. farmer is supported by a modern infrastructure for communication and transportation. There are many farmers who earn more money than

do extension agents and many have had as much education as the agents themselves. The more successful farmers do not hesitate to bypass the extension agent to go to talk to a researcher in the university or seek out a specialist in a private company to get advice on their problems. The farmers also have a social position and organizational base which enables them to put pressure on the R and D system to respond to their interests. To be sure, all of this has led to what is coming to be recognized as a bias in the system in favor of serving the larger farmers and agri-business, but still the system has served a much broader base in the United States than in developing countries.

In the latter countries, there may be such a gap in social status, education, and income between peasant farmers and extension agents that the farmers are hesitant to express their opinions and make demands upon the agent, while at the same time the difference in social positions tends to lead tbe agent to underestimate the intelligence and competence of peasant farmers. The gap between the two may be further accentuated by major differences in language and culture. In many countries, there are large populations of peasant peoples who speak an indigenous language and speak and understand the national language poorly if at all.

> "Language difficulties reinforce the negative view agents hold toward small farmers. That is, the small farmer may he fluent and eloquent in his indigenous language and yet be able to speak only at a primitive or crude level in the national language. Being addressed at this "childish" level, the agent often unconsciously assumes that the farmer has a childish mentality and limited intelligence. Such a demeaning view presents a major barrier against the building of mutual respect upon which satisfactory cooperation depends.
>
> "When the extension agent does speak the indigenous language, as is sometimes the case, this helps him to cross the communication barrier. But rarely is much competence in an indigenous language considered in making appointments of extension agents, so often we find communication problems between "two cultures" compounded by the language barrier. The basic differences in social status, education, affluence, language and culture do not make it impossible to establish effective communication between the professionals and farmers, but they do present formidable barriers which will not be overcome simply by applying a U.S. model of agricultural research and development." (Norman Uphoff, personal communication.)

## Conclusions

We can sum up the main points in this chapter in terms of the following general propositions:

1. Both the European colonial model and the U.S. agricultural extension model were based upon the implicit assumption characterized elsewhere as "the myth of the passive peasant" (Whyte, 1975).

2. More effective organizational models must be based upon the assumption that the poor farmer is an intelligent individual, interested in changes that may improve the standard of living of his family, within the limits of his resources and the information available to him and taking into account the risks that may accompany change.

3. A one-on-one relationship between the small farmer and extension agent will not be cost-effective. More effective organizational models will link agricultural professionals with organized groups of farmers, with farmers participating actively in change programs.

4. Small farmers face major problems in the number of uncoordinated agencies with which they must deal if they are to get help from the state. Therefore, more effective organizational models will have to provide better coordination among these agriculture-related agencies.

5. Communication and cooperation between small farmers and agricultural professionals are influenced by the culture and social structure of the country in which they live and work. In the next chapter, we will find examples of these impacts.

## Chapter II:
## MAJOR AGRICULTURAL RESEARCH AND DEVELOPMENT PROJECTS

Here we review briefly four important projects involving agricultural research and development: Comilla in East Pakistan (now Bangladesh); CADU in Ethiopia; Puebla in Mexico; and Caqueza in Colombia. Each of these projects was important in its own right, but we need not give a full description and evaluation here. Rather, we will concentrate on the lessons that can be drawn from successes and failures of the projects, which attempted to integrate a number of development efforts in a focused geographical area.

Such projects came into being from the late 1950s into the 1970s because of growing recognition of the inability of existing agricultural development programs to deal effectively with the problems of small farmers and the rural poor.

This conclusion suggested the need to establish pilot projects. If a pilot model proved successful, development planners would still face the task of integrating it into the activities of a national program, of course. As Korten (1980) shows, the very concept of developing organizational "blueprints" through pilot projects which will then be replicated is likely to be unsuccessful. But attention can and should be focused on the substance of what was attempted and learned. This we will do with regard to the four selected agricultural R and D projects.

We devote more space to Puebla and Caqueza since the lessons they produced, as will be seen, are affecting the shape of new R and D strategies, especially in Latin America. The designers and leaders of Caqueza had substantial personal exposure to Puebla and make clear what they learned from Puebla's successes and also from Puebla's limitations. Through linking Puebla experience to that of Caqueza, and both projects to later emerging national programs, we will be able to trace the evolution of thinking about building new models of agricultural research and development.

### Comilla

Comilla was the earliest of the four projects, being organized in 1959 with support from the Ford Foundation and the government of Pakistan. The project area was located in a thana (sub-district) with a population of 200,000 crowded into an area of approximately 100 square miles. While the average land holding of farmers in East Pakistan was 1.5 hectares, in Comilla the average dropped to .7 hectares, and there was less variation around this mean than elsewhere in the region. This is to say that

planners started with an area very poor in terms of lend per family but relatively homogeneous.

Rice was the principal crop in Comilla. Where an effective system of irrigation was available, farmers could grow up to three crops of rice a year, but generally the poor conditions of irrigation limited them to two.

The project began with an extraordinary period of nine months for overseas study and planning on the part of members of its entirely Pakistani staff. During the study/planning period provided at Michigan State University, the Comilla staff were fully exposed to the development ideas available in the United States, but nevertheless the basic decisions remained under the control of the Pakistanis.

The project organizers agreed on three principles that appear remarkably modern in terms of present day thinking regarding agricultural R and D:

1. They would establish locally an academy for research on agricultural and community development end for the training of local leaders.

2. Research designed to discover the interests and needs of the farmers and also to understand their agricultural practices was to be carried out before any decision would be made regarding the nature of the interventions to be undertaken.

3. Comilla's farmers would be active participants in decision making and in the total development process.

The research highlighted important bio-physical and socio-economic problems. The Comilla area was subject to periodic floods and drought. Small farmers had no access to credit. There was also no effective extension service providing them with information and ideas.

The project acted first to organize credit cooperatives. The project staff then served as intermediaries between the banking system, which provided the credit in a lump sum, and the credit cooperatives. These received the credit required by their members and thereby assumed a collective responsibility for repayment. Comilla staff members then worked with the credit cooperatives to make them channels of information on farming and marketing and also conduits for the inputs that the farmers would otherwise have had to purchase on an individual basis.

Each credit cooperative elected a manager for credit and collections, and a model farmer for conveying technical assistance to fellow members. These paraprofessionals received training at the academy regularly one day per week.

The results were impressive, both in terms of increased yields of rice end in organizational activity. In Comilla generally, between the crop years 196243 and

1970-71, rice yields increased by 20 percent. In a shorter period (1963-64 to 1969-70), cooperative members increased their yields by nearly 100 percent.

At the start of the project, only about one percent of the land in Comilla was served by dependable irrigation. The academy organized a public works project for the improvement and extension of the irrigation system. In addition to organizing project committees, the academy provided management training in the planning, implementation, and fiscal control of the project. Local people working on the project were compensated in kind with wheat purchased by the government of Pakistan in local currency from the United States under its P.L. 480 program. During the first year, 45,000 man-days of labor resulted in saving 6,000 acres of rice land from flooding.

As a means of increasing rice production during the winter dry season, the academy stimulated the formation of "pump groups". Each pump group contributed its own labor and was provided with a low-diesel pump, subsidies for fuel, fertilizers and seeds. The manager of the pump group and the pump operator also received training at the academy once a week.

As the project impact expanded beyond its original area, by 1973, 32,924 pumps were irrigating slightly over a half a million hectares. As planting a third crop now became possible for almost 850,000 farmers, the dry season crop production rose from 830,000 tons in 1966-67 to more than 2 million tons in 1972-73 (Blair, 1974:71).

Impressed by the success of the Comilla project, government officials were determined to extend the project to the entire province. Academy officials argued that expansion should come slowly in stages as the academy developed the people and organizations to manage the increasing responsibilities. As is too often the case, government officials were determined to go in one jump from a pilot project to a massive application of the new model. Furthermore, they did not extend the entire model but rather emphasized the pump groups, leaving behind the research base and the capacity to train and supervise this greatly expanded organization.

The results should have been predictable. Later research found that the local elites had taken control of most of the new pump groups and had managed to take the lion's share of the benefits for themselves. For example, on the average, pump group managers owned three times as much land as the members, and members serving on the managing committee for the pump groups received fifteen times as much money in loans as the rank and file. Furthermore, this distribution of loans cannot be explained in terms of the presumed credit worthiness of the borrowers since Blair (1974:58) found a direct correlation between the size of the loans and the failure in repayment.

> "The maldistribution of both loans and overdues (at Comilla)...is the result of the same factor: control of the cooperative structure by the large farmers, who appear to be tied into the traditional leadership structure and who stay in power year after year, despite the requirement for yearly election of a manager and a model farmer?' (Blair 1974:60; see also 1978)

The spread and use of the technological innovation foundered on the rocks of adverse social stratification and political influence. The agricultural R and D effort could not be carried through without regard for the ways communities were structured and opportunities allocated.

## CADU

The Chilalo Agricultural Development Unit (CADU) began in 1967 as a project between the Swedish International Development Authority (SIDA) and the Imperial Ethiopian Government. The project emerged out of the relationship between Sweden and Ethiopia, begun in the 1860s by missionaries and later reinforced by various government projects, focusing first on communication, education, and health.

CADU was intended to benefit the subsistence farmers and tenant farmers of Chilalo Awraja (sub-province'. Two years of agricultural and economic studies, leading to the selection of Chilalo as the project area, had preceded the launching of the project.

As all of the top level professional staff were expatriates at the start of the project, this was the most foreign-dominated project among the four here considered. However, it should be noted that Ethiopia at the time was far behind the other project countries (Pakistan, Mexico, and Colombia) in the availability of national professionals in agriculture, so such a project could not have been launched without heavy infusion of foreign professionals.

This was also a project dominated by economists, all of the nine social scientists at top levels of the program coming from that discipline. The project designers settled upon a "package" program: introduction of high yielding varieties of wheat in combination with fertilizer, pesticides, and technical assistance in farming methods. The project redesigned simple farm tools.

In 1967, subsistence farmers in Ethiopia, constituting a large majority of the rural population, were dominated by a rural elite which controlled large land

holdings and the political system. Subsistence farmers also suffered from lack of roads, access to markets and educational facilities, and there was no effective agricultural research or extension service anywhere in Ethiopia. The physical and economic infrastructure therefore was also far inferior to that available in the other countries whose projects are discussed here.

Project planners recognized that the conditions of land tenure would severely limit the benefits they could provide to subsistence farmers, but they proceeded with only the government's promise to carry out a major land reform campaign. Since the government was then controlled by a cohesive rural and urban elite, it proved politically impossible for Ethiopia to honor this undertaking-until the violent revolution of 1974.

CADU planners gave their first emphasis to marketing, establishing 33 marketing centers through which materials and information could be distributed in an effort to assure small farmers a fair price for the increased production to be expected. These marketing centers gradually expanded their activities, including the sale of high yielding seeds, fertilizers, and other inputs recommended by CADU.

CADU placed a major emphasis upon research for the development and adaptation of high yielding wheat varieties and to determine the local recommendations for chemical fertilizers and pesticides.

CADU also provided 62 extension agents who worked through "model farmers" in participating communities. (The project had some links with Comilla through exchange of staff visits.) Each model farmer came from an area of approximately 100 farm families, who collectively nominated five candidates. Final selection from among the five was made by the CADU staff. The model farmer role was limited to local full-time farmers who cultivated lands of average size for the community. Under the guidance of the extension agent, the model farmer used a portion of his holdings as a demonstration plot.

Up to 1967, small farmers had been unable to get any credit from banks and had been paying up to 400 percent on money borrowed from landlords and local money lenders. CADU negotiated with the government bank a large loan for CADU at 10 percent interest. CADU then administered its own credit program to farmers charging them 12 percent. Along with this credit came supervision in the planning of the farming operation. With this program CADU was able to increase the number of small farmers receiving credit from 868 in 1968-69 to 14,146 in 1970-71.

The program was intended for farmers holding 25 hectares or less. In the first period, large farmers were able to secure 35 percent of the credit issued, but, in

response to SIDA's urgings, the government agreed to restrictions against larger farmers so that by 1970-71 only two percent of all loans went to farmers outside of the target population.

The great increase in wheat yields made possible by the new technology played into the hands of the large land owners. Since Ethiopia imposed no tariffs on imported tractors or fuel, they now found it profitable to dispossess their tenants and mechanize their operations. By 1974 5,000 tenant families or about 30,000 total population had been pushed off the land (Cohen, 1975). Although they constituted 46 percent of farm families in 1968, tenants were down to 12 percent by 1972.

While the impact on tenants was catastrophic, we should not assume that the long run impact of SIDA was entirely negative in terms of agricultural research and rural development. The SIDA project did result in the training of a greatly expanded corps of Ethiopian agriculture professionals, who increasingly took over the direction and staffing of agricultural projects. Furthermore, lessons learned by SIDA and its Ethiopian counterparts served to redesign R and D strategy in terms of a mini-package program (high yielding seeds, credit, and extension) which began to have broader impacts on the countryside. (Lele, 1975.) Finally, the violent revolution of 1974 precipitated a drastic land reform program, eliminating the large land holders and distributing land to the peasant farmers. While the disturbances following the revolution made it difficult to develop any stable program in Ethiopia, the drastic shift in land tenure appears to have provided a foundation upon which agricultural research and extension activities stimulated by SIDA may have far-reaching positive effects upon the lot of the rural poor.

## Puebla

The Puebla project in Mexico grew out of the work of CIMMYT, the international wheat and maize improvement center, whose international program in turn had grown out of a Rockefeller Foundation-supported project begun in 1943. It was the contrast between CIMMYT's spectacular success in raising wheat yields and its failure to accomplish any comparable gains in maize which inspired some of the leaders of CIMMYT to undertake an intensive project with maize, beginning in 1967 (CIMMYT, 1974).

Project planners recognized that the contrasting experience with the two crops could be explained in large measure by differences in land tenure and access to irrigation. The most impressive gains in wheat had been achieved in northwestern

Mexico on large land holdings effectively served by modern irrigation systems in which the government had invested millions of pesos. Then as now, maize, however, was grown primarily by small farmers on rain-fed lands. The challenge to the Puebla project was to devise a method of improving the profitability of maize for thousands of small farmers who did not have the advantage of irrigation.

The first requirement for location of the project was an area where maize was the principal crop grown. Planners found this in one large area of the state of Puebla. The project offices were located in the City of Puebla, less than a two-hour drive from CIMMYT and similar distance from the graduate school of agriculture at Chapingo, which itself is only a fifteen-minute drive from CIMMYT. The location had the further advantage in that it was the native state of the then-president of Mexico, and this served to win the enthusiastic endorsement of the president. However, CIMMYT did not work out any collaborative arrangements with INIA, the government agricultural research institute, or with the extension service. Its only link to Mexican institutions was through the university at Chapingo. The university provided the field staff and implemented the design largely formulated by CIMMYT.

Although, according to a project survey in 1967, 69 percent of the cultivated land in the area was devoted to maize, that crop only accounted for 21 percent of total family income. Beans were the second most important crop, and surprisingly, all crops together accounted for only 30 percent of the income of the Puebla farmers. Animals accounted for 28 percent, and off-farm income from labor and other activities accounted for 40 percent.

These figures indicated that the problem of raising family incomes was much more than a maize production problem. Nevertheless, maize was a major focus of research and development for CIMMYT, and the planners were determined to demonstrate what could be done in improving maize yields for the small farmers.

> "...the action program of the Puebla Project was organized initially to include four major components: (a) varietal improvement of maize, (b) research to develop efficient recommendations on maize production practices, (c) assistance to farmers in proper use of new recommendations, and (d) coordination of the activities of the service agencies, the project team and the farmers. Another component—socio-economic evaluation-was added during the first year." (CIMMYT, 1974)

Project planners discovered in the course of the project that they would have to abandon the first objective of varietal improvement. Under the land and water

conditions at Puebla, the native (or criollo) varieties did about as well as the improved varieties that CNMYT was seeking to introduce. Furthermore, the native varieties had an important advantage over hybrids. Farmers would have to buy hybrid seeds in the market each year whereas they simply could retain enough seeds from their own harvest of criollo maize one year to plant the next year.

Having decided to drop a line of activity which represented the greatest strength for an international research institution, project planners concentrated on the coordination of services, helping farmers to secure credit and to get the fertilizer needed as well as to provide the instruction and the recommendations for cultivation provided by CIMMYT.

CIMMYT reports an increase in average yield of maize among project participants of 30 percent between 1969 and 1972. While this increase can be considered substantial, it is hardly spectacular, compared to the much higher increases achieved from high yielding varieties of wheat or rice as part of new technological packages.

Further, CIMMYT used as a measure of adoption of project recommendations the number of farmers securing credit for farm inputs through the project, a rough measure at best. A large portion of those using Puebla credit to buy fertilizer did not actually apply the fertilizer according to project recommendations (Gladwin, 1979). This is hardly surprising in view of wha? other researchers have observed among small farmers in Central and South America. Where maize is grown primarily for family consumption, there is a tendency to use fertilizer primarily on crops which they sell in the market.

Even assuming that the CIMMYT measures of adoption were valid, results disappointed CIMMYT planners. Those securing credit through Puebla did indeed increase rapidly in numbers in the first several years, but the rate of increase then slowed down markedly. By 1973, CIMMYT estimated that only 26 percent of the land used for maize was covered by the Puebla program.

Disappointed by the declining rate of increase, Mexican professionals fortunately were not satisfied with the traditional answer that slow progress was due to traditional farmers' "resistance to change." They discovered that some farmers who had rejected the Puebla recommendations were doing better than some farmers who had fallen in step with the Project. Out of their study of the more successful non-adopters sprang the discovery or rediscovery of peasant rationality.

A veteran agronomist with the Project described in this way how the revelation came to him:

> "I was talking with a farmer who interplanted squash and maize. I told him that was the wrong way to farm, that he should concentrate on maize. He argued with me, claiming that he would be better off with his own svstem. I couldn't believe him, but finally he proposed that we test his system against mine. He marked out two plots of equal size on his land. On one plot, he planted maize and also squash between the rows. On the other plot, he planted maize according to the recommendations I had given him. At harvest time we got together to evaluate the results. My plot did indeed look much neater than his, but when we came to measure the yield of maize, we found that there was no difference between the two plots. In his plot he had the additional yield of squash. That convinced me." (Alierso Caetano, personal communication.1

To state simply a complex set of findings, the researchers discovered two agricultural production systems among the more successful non-adopters, one involving the rotation of corn and beans, the other involving the interplanting of crops.

In the rotational system, the farmer began with the planting of corn supported by a rather heavy application of chicken manure. The second year, the farmer planted beans without any fertilizer at all. For the third year, the farmer reverted to corn but this time applied a small amount of chemical fertilizer-or else he shifted back to the first year practice, with another generous application of chicken manure.

In the inter-planting system, the farmer planted beans between the rows of corn, either at the same time or several weeks after he had the corn in. With this system, the bean plants used the corn stalks to climb on (thereby getting better exposure to the sun) and, by approximately doubling the intensity of use of a small plot of land, the farmer was able to increase his returns from the land very substantially.

The Project's general coordinator (1970-1973) offered this insight:

> "In Mexico we had been mentally deformed by our professional education. Without realizing what was happening to us, in the classroom and in the laboratories we were learning that scientists knew all that had so far been learned about agriculture and that the small farmers did not know an-ything. Finally we bad to realize tbat there was much we could learn from the small farmers." (Mauro Gomez, personal communication.)

Inter-planting of corn and beans was against the recommendations of the planners of the Puebla project. Struck by the obvious success of this violation of their rules, the researchers asked themselves: "Why have we been telling people they should not inter-plant corn and beans?" When they were unable to discover a solid rationale for the

advice against inter-planting, the researchers came upon the real source of that doctrine: "That is not the way the corn farmers do it in Iowa." In the U.S. corn belt, most of the work is done with tractors, which require planting in rows. The Puebla planners were not trying to introduce tractors. however. They simply followed the customary planting practices without recognizing that the logic of the U.S.-style row spacing without interplanting depended upon the use of the tractor, which was not appropriate for small farmers with little capital and ample labor.

> A similar mistaken transposition of "scientific" knowledge was found in East Africa. Empirical testing of indigenous practices of inter-cropping there has showed these to be superior in productivity to the practices being recommended by agricultural scientists. (Belshaw, i 1979.)

This revelation had a dramatic effect upon the direction of the Puebla project. Now the field staff began to learn from the farmers. By the fourth year of the project CIMMYT had discovered that studies of the maize-bean association demonstrated that net income from the association was approximately double that obtained with either maize or beans alone. Still, it was not until the sixth year of the project (1973) that CIMMYT was able to offer farmers recommendations which included packages of production practices for the maize-pole bean association. In the same year CIMMYT finally adapted its organizational strategy to this combination, stimulating the formation of a Union of Progressive Maize and Bean Farmers.

By this time, following a vigorous internal debate, CIMMYT had decided to withdraw from the Puebla project. Its own report provides his rationale:

> "CIMMYT decided in early 1972 to terminate its participation in the Puebla project at the end of 1973. The project had begun in 1967 as an experiment to learn how to rapidly increase maize production among small, low income farmers. As the project evolved, however, it became clear that the project's objectives would shift to more efficient strategies for increasing production, net income, and the general welfare of small farmers in rain fed areas. CIMMYT felt that its mandate was not broad enough to encompass all the activities that clearly should be incorporated in so extensive an undertaking. This position was made known to the Governor of Puebla and the Secretary of Agriculture, making clear CIMMYT's reasons for withdrawing support, as well as the conviction that the project should continue."

In other words, CIMMYT came to recognize thst its single track strategy, concentrating on maize, was inadequate for dealing with the complex and interrelated problems of small farmers in Puebla. The lesson was important. Staff writers seem not to have grasped another major lesson indicated by their experience, however. The project report concluded with this statement:

> "...the job of adjusting and delivering adequate technology, as well as that of inducing farmers to use the recommended technology is very difficult and it is far from being accomplished in the Puebla area."

Of course it is difficult to get farmers to adopt "modern methods" when they can make twice as much money with their own methods. The paragraph quoted makes it clear that the principal authors of the project report were still locked into the conventional definition of the problem of introducing change to small farmers: the problem was still seen as how to transfer to those farmers a teclmology developed by the professional experts. Fortunately, some of the leading Mexicans involved in the Puebla project broke out of that conventional definition of the problem and used what they had learned in Puebla to organize a more creative and efficient system of stimulating agricultural and rural development among small farmers. But that is a story to be told later.

## Caqueza

The Caqueza project in Colombia is notable for several reasons:

1. Of all large research and development projects, this may well be the one that has been most thoroughly documented, not only through agronomic and plant science research but also through sscio-economic research (Zandstra et al, 1979). The authors are extraordinarily conscientious in describing failures as well as successes. Furthermore, they concentrate particular attention on the social and political processes involved in launching and developing the project.

2. While the authors credit the Puebla project with being their principal inspiration, they make it clear at the outset that they were not simply following the Puebla design. In effect, they were taking advantage of the unforeseen lessons that had emerged as Puebia faiied to reach its expected potential. 4s often happens in the history of scientific development,* even though the official findings reported in the

*For example, the case of the Western Electric Company research program as interpreted by Whyte, 1978.

Puebla project are now subject to serious criticism, nevertheless that project had an enormously stimulating effect in leading researchers away from experiment stations and large farms toward an exploratory strategy with the involvement of small farmers.

3. Caqueza planners started with the conclusion to which planners of Puebla ultimately came: that agricultural and rural development for small farmers must be based upon a broad and integrated approach. As in Puebla, maize was here a major crop, but from the outset the planners thought in terms of a variety of crops and of experimenting with inter-cropping. Beyond providing credit for agriculture, the planners were also concerned with helping local people meet their needs in education and health. In these nonagricultural fields, Caqueza was not to provide services directly but to help link small farmers with agencies having those responsibilities.

4. Caqueza planners sought to fit their project into the framework of agricultural R and D agencies in Colombia, working particularly with ICA, Colombia's institute for agricultural research. While it would have been easier to accomplish local objectives if the project had been carried out independently of government programs, the initial and continual involvement of Caqueza with the national government helped to build the new strategies developed in the project into governmental programs.

5. Caqueza developed an active program of collaboration with universities, encouraging students and professors to carry out research of interest to Caqueza and providing some support for such research.

Caqueza was supported by the International Development Research Centre of Canada and by the government of Colombia. The project was placed administratively within ICA, which then defined its rural development goals as being to

> "...generate and develop strategies to attack the restraints to social and economic 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."

While these objectives appear to be narrowly based upon agriculture, the authors describe a much broader set of objectives for particular rural development projects such as Caqueza:

> "(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 market facilities; and (4) to encourage and obtain the integration of subsistence farmers' populations into associations and groups." (Zandstra et al., 1979:31)

The project was launched in 1970 in an area containing between 10 and 15 thousand farm families. Most of the farmers were small operators, although a small minority held a large percentage of the land. Sixty-five percent of the farmers held land under 5 hectares, with the total of these holdings amounting to only 28.5 percent of the cultivated area. Twenty-two percent of the farmers operated farms between 5 and 10 hectares, with their total coming to 11 percent of the area. At the other extreme, 4 percent of the farmers with holdings beyond 30 hectares accounted for 42 percent of the cultivated area. The cultivated areas ranged over three zones: below 1,800 meters in altitude, 1,800 to 2,300, and above 2,300.

> While Colombia was far ahead of most developing countries in the number of people professionally trained in agriculture, this educational background provided obstacles as well as advantages:
>
> "During the first two years of the project a number of unforeseen problems became apparent. Paramount among these was the fact that most professional agriculturists 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 graduate training took place in the United States and involved studying the problems of 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." (Zandstra et al., 1979:10)

The project professionals devoted most of the first year to research on the actual farming practices and problems of the small farmers. In marked contrast to the original design of Puebla, the staff did not assume at the outset that they knew what would benefit the small farmers and had simply to adapt this known technology to local conditions. This exploratory research produced a number of important findings that shaped the future project activities. For example, they found that 67 percent of the farmers already used credit for the purchase of fertilizer, but hardly any of them applied this fertilizer to corn or beans. They used the fertilizer primarily for potatoes and also for vegetables and tomatoes.

The researchers recognized that these decisions on fertilizer use were economically rational, given the scarce resources of the farmers. They raised corn and

beans primarily for family consumption, and these crops would produce all or most of what they needed without fertilizer. On the other hand, fertilizer enormously increased the yields of potatoes, vegetables and tomatoes--crops which they produced mainly for sale. While they recognized that they could increase their yields of maize and beans substantially through application of fertilizer, the payoffs for fertilizer were much higher for the other crops. Furthermore, potatoes would hardly thrive at all in this area without substantial fertilizer.

The farmers also recognized the great advantages of inter-cropping. For example, the researchers reported that beans grown with potatoes yielded three rimes as well as those grown with corn since fertilizer is always used with potatoes. (p. 42)

The first year of research led to important conclusions paralleling those in Puebla, regarding maize.

> "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 and certain diseases....New problems of post-harvest storage occurred because the hybrid grain was more susceptible to certain insects."

For farmers not accustomed to using fertilizer at all on their corn, the project leaders recognized, that it would be a serious mistake to try to promote hybrid corn varieties that would only pay off with very substantial fertilization and with better ecological conditions and better cultivation and storage practices than were likely to prevail in that area.

> "The old extension approach that considered communication of the new technology to farmers as the only activity required was being forgotten (by the end of the first year) 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; socio-economic knowledge was required as well." (p. 64)

During the second year, Caqueza professionals found themselves grappling with major problems of linking the local farmers with the market for needed inputs and with the banking system. The authors describe the problems in this way:

> "They soon discovered the administrative problems associated with credit programs and the difficulties small farmers had in obtaining the required amount of credit on time. The project staff were also confronted with the problem of insuring the supply of inputs specified in the loan Programs. All too often these inputs were unavailable or did not arrive on time....They also had to change their recommendations because the types of fertilizer and insecticide that they recommended were not available in the area." (p. 76i

The project also encountered a crisis in marketing, arising out of its very success in increasing yields. With commendable frankness they report:

> "The farmers adopted the project's recommendations for cabbage production, yields increased 3 to 5 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." (pp. 87-88)

Project staff people responded to the cabbage crisis by contacting wholesale markets in Bogota, and two staff members spent three days as cabbage salesmen, trucking the produce into the Bogota market in project vehicles. The cabbage crisis led Caqueza to increase its emphasis on marketing research.

In the early stages of Caqueza there was considerable friction between project leadership and the central administration of ICA. While the intensity of the friction varied according to the personalities in the key positions of both organizations, this was basically a structural problem. Project design called for a great deal more local authonomy for Caqueza than had been customary within ICA. Particularly leaders of ICA were accustomed to directing the research from the central office, whereas Caqueza people insisted upon the need for local and flexible planning.

The progress of the project was also severely hampered at times by sudden budget cuts imposed by the national government. There was a good deal of turnover among project professionals, but this should not be viewed as entirely negative, since many of those who left the Caqueza project moved into important positions in XCA or in other agricultural agencies of the national government, thus helping to spread some of the new understandings arising from the project.

> Events led project leaders to recognize the interrelation of a wide range of community interests and needs:
>
> "For example, in one (place) 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 (Columbian 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 risks failing in its production activities." (p. 90)

The project leaders recognized the importance of farmer organizations, but efforts in this direction were generally unsuccessful. A cooperative sponsored by Caqueza did not gain strong popular support or develop an effective administrative organization. The Caqueza pro-development committee was similarly unsuccessful, perhaps because it fell into the hands of traditional leadership. The town priest became head of the organization and led it into projects for embellishing the town plaza and for flower-planting around the church. Such projects apparently did not meet the felt needs in the community, and the organization disintegrated.

Caqueza gave special attention to research on risk and the methods of measuring risk. This research led the staff to make an important distinction between risks of production and price, which could be compensated for in insurance schemes, and institutional risks, which do not lend themselves to such treatment. Tha? is, the production risk for a farmer trying out a new variety of seed could be covered by guaranteeing him compensation equal to the amount he lost through the innovation, if it did not prove as profitable as his traditional method.

Similarly, a price drop can be insured against by having the government guarantee a certain level of support prices. While such measures can indeed involve costs too high for a developing country to afford, in principle such problems of risk have an economic solution. This was not the case with institutional risks, as the report states:

> The latter were epitomized by the continuing problems of obtaining credit in time to use it for purchasing seed and fertilizer for the corn crops, and by the unsuccessful efforts to obtain insecticides and fertilizer packages in quantities small enough for use by the farmer with one hectare or less. (p. 195)

In other words, when considering the recommendations of the agricultural professional, the farmer needs to consider not only production and price risks but also

institutional risks: that he will not be able to put the whole package together at the right time in order to get a hoped-for result. This analysis led professionals to give attention to the organizational and inter-organizational problems giving rise to institutional risks.

Project leaders discovered that the Caqueza farmers used quite sophisticated judgments in balancing risks with investments. This was not simply a question of whether to use much or little fertilizer but on which crops to use it.

> "Whereas corn producers in the region employed limited cash inputs...potato production is simply not possible without the use of substantial inputs."
>
> "Farmers appeared to concentrate the use of their cash on a reiatively small part of their farms 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 balance by planting a large area to a low-input, low-risk crop such as corn." (p. 204)

While the Caqueza report provides evidence of yield increases in some of its applied crop research and demonstration projects, the important outcomes were the reorientation of the national agricultural research, development and teaching programs. The report states that multiple cropping research, a negligible part of ICA's program in 1971, had by 1976 become a major activity. The project also served to strengthen the agronomic and socio-economic research base necessary for work with small farmers.

The project played an essential role in the creation in the national university of a new master's degree program in rural development, in collaboration between the university and ICA. Up to this time, agricultural degree programs in Colombia had been specialized in terms of particular academic disciplines. Now some of those who had participated in research with Caqueza worked together to establish the new master's program which provided a major concentration upon socio-economic theory and methods. As the Caqueza project had continuing and profound effects upon the organization of agricultural research development in Colombia and in the teaching and research in agriculture in the universities, it becomes impossible to trace the specific impacts of Caqueza, since they extended far beyond the original area and became the resultants of actions taken by people and organizations far beyond the project area.

For agriculture, Caqueza is an unusual case of a phenomenon much more common in modern industry: a successful pilot project gradually expands its influence until it has had a major impact upon the total program of the company.

## Conclusions

What general conclusions may be drawn from studying these four cases? The lessons to be learned fall under the following headings:

Dominance of the socio-economic structure. All four projects were designed to aid small farmers. Whatever the differences in strategies and tactics among them, the distribution of resulting benefits received can be explained in large measure in terms of the differing socio-economic structures in the project areas.

CADU was operating in an area of gross inequality in land holdings, in the distribution of wealth, and in political power. Under these conditions, the more affluent and powerful people are bound to absorb a lion's share of the benefits. While large numbers of small farmers did undoubtedly benefit from the CADU materials, credit, recommendations, and marketing assistance, those who were most disadvantaged at the start of the project, the tenants, suffered disastrously as they were evicted from their holdings. [Cohen, 1975.)

In Comilla, the differences in wealth, power, and size of land holdings were rot nearly so extreme as in CADU. Here we see nevertheless that the more affluent and politically powerful people benefited disproportionately, once the project leadship's efforts to achieve equitable distribution slackened. It should be said that the small farmers did benefit substantially, and we have no record of tenant dispossession.

In Puebla, we have no record regarding the equality or inequality of benefits according to size of land holdings. It may be that the land holding pattern there was sufficiently uniform so that these problems of inequity did not assume importance. In an area where there were indeed large differences in the size of land holdings, as reported above, the Caqueza report does not tell us whether large land owners benefited even more than small farmers. However, Caqueza does indeed document substantial benefits received by small farmers.

It can be generalized from these cases, we conclude, that the more unequal the distribution of wealth and land holdings, the more inequitable will be the distribution of benefits even from projects designed to aid the small farmers. However, the Comilla and Caqueza cases suggest that as long as there is effective local administration of an R and D project intended to benefit small farmers, inequitable outcomes can be reduced.

Content of research and balance between research and demonstration. The projects differed markedly in the content of research carried out and in the balance between research and demonstration. As originally designed, Puebla could hardly be

regarded as a research project at all. The underlying assumption was that the designers of the program already knew what was required to increase maize yields and that such an increase would benefit the farmers. To be sure, the project designers recognized that, even within the narrow design of their program, a certain amount of adaptive research was needed in order to determine what varieties of maize would be best and what recommendations regarding inputs and methods of cultivation should be made. From this adaptive research it was seen that the maize varieties developed at CIMMYT offered no advantages over the native varieties under local conditions.

Still, this discovery, so surprising to the professionals, did not at first lead them toward greater interest in learning the elements of the indigenous farming system. They simply shifted their plans so as to abandon the introduction of new genetic materials and concentrated instead on making agronomic recommendations about spacing of seeds, amounts of fertilizer to be used, frequency of application, use of pesticides, and so on, supported by credit to allow the farmers to purchase the recommended inputs. Socio-economic research was added to the plan in the early stages as something of an afterthought and it only assumed importance as the Mexican leaders of the program recognized the importance of studying the indigenous farming system.

The basic problem here was that Puebla was originally designed as a demonstration project. The planners were not really seeking new knowledge. Rather they were trying to prove that poor Mexican farmers could increase their maize yields by following project instructions. The research operations initially planned were simply designed to establish a base line and then to document the rate of adoption and the yield improvements. It was only when the project leaders came to recognize that the demonstration_ was falling far short of their hopes that they shifted into reserach on the nature of the indigenous farming system. It was that shift which led to the theoretical and practical breakthrough already described.

CADU necessarily had to depend more heavily upon research in early stages of the program, for Ethiopia had no institutions comparable to CIMMYT or the Mexican national agricultural research program to provide improved genetic materials and the findings of agronomic research. In effect, CADU had to make a major investment in building an agricultural research program for Ethiopia. Beyond the plant sciences, research was concentrated on economics, while studies of social structure and political power were neglected. To be sure, the economists recognized the extreme inequality in the distribution of land and political influence; they could hardly fail to recognize this

as a problem. Yet they seriously underestimated the effects this problem would have upon their efforts to bring benefits to the rural poor.

Comilla represents a sharp contrast to CIMMYT and Puebla in its initial emphasis upon socio-economic research. The planners of Comilla did not start out to conduct a demonstration project because they recognized that they did not know enough about the area in which they were to intervene so as to have any confidence in what they would be able to demonstrate. it was only after they had carried out extensive research, including many interviews and group discussions with local farmers and community leaders that the leaders of Comilla began to design the interventions. Here also their strategy contrasted with that of the other two projects in placing primary emphasis upon the organizational aspects of rural and agricultural development. According to the diagnosis of the project leaders, the poor farmers would need to organize themselves more effectively before they would be in a position to gain the full benefits of the high yielding varieties, fertilizers and pesticides, and particularly improvement of the irrigation system.

Caqueza provided the broadest base of systematic research in the social and plant sciences.

Production emphasis. The projects differed also in the degree of production emphasis. In the beginning, Puebla was focused exclusively upon increasing maize yields. That is, the planners did indeed intervene to facilitate the furnishing of credit and extension services, but those were justified simply as being indispensable for achieving the goal of a maximum increase in maize yield.

CADU concentrated much of its program upon the increase of wheat yields, but nevertheless that was not the focus of the initial activities. CADU leaders sought first to intervene in improving the marketing system so that the poor farmers would gain more benefits from the yield improvements that were expected to follow. Comilla was the least oriented to a production emphasis, though the investment through groups in tubewells paid off quickly in increased production. The planners did indeed hope to increase crop yields, but they saw this not as a primary objective but rather as an outcome that would follow upon the building of a solid base of social organization, supported by physical improvements, And indeed the production increases we have noted were impressive.

Caqueza began with a substantial production emphasis but across a broader range of crops than the other projects. Furthermore, Caqueza gave more attention to marketing problems than the other projects except CADU, and Caqueza went farther in

analyzing and attempting to deal with the socio-economic infrastructure affecting local farmers.

Farmer participation in decision making. Here the contrast is between Puebla and CADU on the one hand and Comilla and Caqueza on the other. Puebla was designed as a unidirectional intervention in which small farmers were to be persuaded to accept the recommendations of the project. It was only as the leading Mexican members of the project recognized there was a slowing down of adoption rates and turned to studying the indigenous farming systems that the Mexicans came to realize the importance of small farmer participation in decision making.

When CADU was launched, it was not only small farmers who were excluded from participating in decision making; co Ethiopians of any status or discipline contributed toward shaping the project plan. It was only after some months that Ethiopians trained by or through CADU began to play significant roles in the project. Furthermore, until the revolution, there is no evidence that SIDA made any systematic efforts to involve small farmers in decision making. To be sure, SIDA professionals must have learned things from talking with small farmers--directly or through interpreters--but this is quite a different thing from having plans specifically designed to provide for and stimulate small farmer initiative. It was only after the revolution, when small farmers became much more active in organizing themselves and demanding assistance that SIDA people came to adapt their plans to peasant initiatives.

In Comilla, peasant participation in discussion and decision making was sought and secured from the very beginning. In fact, the very design of the project in terms of needs, priorities, and sequencing of activities was developed out of active discussion of professionals with the small farmers. Leaders of Caqueza similarly recognized the importance of peasant participation at the outset and made various efforts at involving peasants in decision making and at stimulating the development of farmer organizations. However, they themselves acknowledge a lack of success in this field.

Specialization. While only Puebla was designed so as to promote a single crop, in effect CADU and Comilla came to concentrate on the major single crop in their areas. It is noteworthy that the project which began with the strongest monocultural emphasis evolved away from such specialization and into intercropping. In this regard Caqueza benefited from Puebla's experience and pursued a cropping system strategy from the outset.

From pilot project to regional or national program. When a pilot project appears to be successful, political leaders naturally want to extend its benefits as rapidly as

possible over as wide an area as possible. Leaders of the pilot project may well caution against such a policy, but they are likely to be overruled by the national policy makers. As we have seen in the case of Comilla, such rapid expansion of a project designed to aid poor farmers tends to allow the richer and more powerful to appropriate the major share of the benefits.

In the case of CADU, the underdeveloped state of Ethiopian human and material resources imposed a healthy restraining influence against too rapid expansion. Furthermore, here Ethiopia had the "advantage" of not needing to impose a new model for agricultural research and development upon an entrenched bureaucratic structure, for no such structure had previously existed.

Two developments favored an effective expansion program. Recognizing that it would be impossible to duplicate CADU throughout the country, SIDA and the government settled for a minimum package program. Then the 1974 revolution removed the socio-economic and political barriers preventing the rural poor from fully enjoying the fruits of the research and extension program. Following land reform, the benefits received by the rural poor depended upon the ability of the new agricultural research and development organizations to provide them with useful information and economic and technical assistance. (It should be added that as yet we know little about the performance of these organizations foliowing the revolution.)

The further development of the Mexican program, along lines growing out of the Puebla experience, will be discussed in a later chapter.

In contrast to the other projects, whose relations with national programs were exceedingly weak, Caqueza began as a recognized part of ICA, the national agricultural research organization. This structural position presented many problems in project implementation, and yet it provided channels through which Caqueza was able to gain important influence in reshaping the national program.

Linking research and education. CADU and Comilla appeared to have no formal linkages with the national systems of university education. Puebla began with a base in the Colegio de Postgraduados at Chapingo as well as in CIMMYT. The university involvement here seems to have developed for the purpose of assisting in the scientific direction of the project, with only incidental attention to the opportunities the project could provide in the enrichment of the education of students and professors.

Here Caqueza shows a marked contrast. In the early stages, project leaders recognized the mutual advantages of involving university students and professors in research on problems of interest to Caqueza. The policy of fostering research

opportunities for university people through Caqeuza had two important advantages for Colombia. The policy secured a broader range of research than project personnel could have carried out by themselves. Also the involvement of students and professors in such studies provided some of the future leaders of Colombian agricultural education and administration with an understanding of the emerging strategy of involving small farmers in agricultural research and development.

Need for linking organization. Leaders of all four projects came to recognize the great difficulties small farmers faced in seeking to cope with the forces and organizations in the socio-economic environment beyond the village boundaries. To some extent, officials of each project organization sought to perform some of these functions of linking small farmers with the outside world. Caqueza went farthest in this direction-if only on the conceptual level. The authors of the Caqueza report stress as one of their major conclusions the need to develop what they call a "buffer organization." While the underlying idea is important, the naming of the concept is unfortunate. The dictionary definition describes a buffer as an object which cushions the shock as two other objects collide. What is clearly needed is not so much a defensive and protective unit but rather an organization which takes the initiative to help farmers work out more effective relations with external markets and with government agricultural agencies. In fact, as A. A. Johnson points but (personal communication), one of the most important contributions of the first generation of U.S. extension agents was to link our farmers to the world beyond the farm. Later we will examine cases illustrating this linking function in developing nations.

Need for inter-disciplinary research. The projects clearly demonstrate the need for inter-disciplinary research that transcends the traditional barriers between the agricultural sciences and the social sciences. A project that is built upon too narrow a research base (as became especially evident in the Puc[illegible] case) is bound to encounter problems that can only be resolved through broadening the disciplinary scope of research. This is especially true as the task of agricultural R and D moves beyond separate focuses on individual crops and takes in actual farming systems, which include people as well as plants and animals. This expanding focus needs some elaboration to make clear why new, more participatory approaches to agricultural R and D are so important in the contemporary world.

## Chapter III:

## THE FARMING SYSTEMS RESEARCH APPROACH: THE REDISCOVERY OF PEASANT RATIONALITY

Analysis of the Puebla project points to increasing appreciation of peasant rationality as the key in the new approach to agricultural research and development. The stereotyped view of the tradition-bound passive peasant contrasted with the rational agricultural scientist falls apart as we see small farmers making choices based upon observation and experimentation while agricultural scientists often seek to impose upon them the "traditional" style of farming characteristic of the Iowa corn belt. This is not to say that we should regard the small farmer as rational and the scientists as tradition-bound. Each party brings to the encounter the insights and the blinders encouraged by his cultural background. Since blinders, conceptions, and personal experience are different in the two cases, each party has much to learn from the other.

Modern agricultural professionals would do well to follow some of the lines of research appreciated at the turn of the century. Consider this introductory statement to a book written by a scientist seven decades ago, Farmers of Forty Centuries:

> We had long desired to stand face to face with Chinese and Japanese farmers...to walk through their fields and to learn by seeing some of their methods, appliances and practices which centuries of stress and experience have led them to adopt. We desire to learn how it is possible after twenty and perhaps thirty or even forty centuries, for their soils to be made to produce sufficiently for the maintenance of such dense populations as are living now in these...countries. We have now had this opportunity and almost every day we were instructed in the ways and extent to which these nations for centuries have been conserving and utilizing their natural resources; we were surprised at the magnitude of the returns they are getting from their fields.... (King: 1911)

This desire to learn from farmers-and even small farmers--was not limited to scientists who travelled abroad. In the late 19th and early 20th centuries, many agricultural scientists in the U.S. and Europe spent much of their time out on farmers' fields, observing and interviewing farmers. In this early period, scientists recognized that whatever they might be able to contribute would have to be based upon an intimate knowledge of farming systems actually in use. Furthermore, since most of them had grown up on farms, it was natural for them to value what they could learn from experienced farmers.

In our admiration for the feats of biological and chemical science in recent decades, we are inclined to overlook the fact that it was not until the 1930s that scientists bad acquired the knowledge, experience, and genetic materials necessary to help already efficient farmers to increase their yield per unit of land. To be sure, it was no mean feat to hold yields steady over decades in the face of crop pests, soil erosion, weeds, and other problems, and the new science contributed to this achievement. However, in the United States up to that time the major advances in agriculture had been derived largely from increasing the productivity of labor through mechanization which enabled farmers to expand the land area they cultivated without corresponding changes in labor input.

As agricultural scientists came to concentrate their activities increasingly in laboratories and on experiment stations, on-farm research and inquiry tended to receive less emphasis. Agricultural scientists in the U.S. did not lose contact with farmers, but there was a tendency for the professionals to interact particularly with the larger and more successful farmers. This concentration was rationalized at the time by the "trickle down" theory: the poorer farmers would observe the methods practiced by their betters and modify their own practices accordingly.

The spectacular biological successes of the high-yielding varieties created in the 1960s, in what came to be called the Green Revolution, raised hopes that such technologies would prove so efficient and profitable as to usher in a generally higher standard of living for all the farm population. By the 1970s, observers were coming to recognize that the benefits of the Green Revolution had been very unevenly distributed and that the majority of small farmers, cultivating rain-fed areas, had received reiatively little benefit. In some cases, smaller farmers had even lost ground as the larger and more favored farmers had prospered.

According to a theory widely held in the 1950s and 1960s, movement of "surplus" rural population to the cities in developing countries was a welcome phenomenon. Industrial expansion would provide urban employment for the migrants, while the reduction of the rural population, it was thought, would lead to larger and therefore more efficient farming operations.

By the 1970s it was apparent that the course of change had departed drastically from the theory. Heavy urban migration indeed continued, but in general, urban employment was expanding far too slowly to absorb the influx of potential workers. Furthermore, rural birth rates remained high enough to counterbalance the outmigration and generally maintained the preexisting level of rural population.

Whether a trend toward larger farms with less labor input would have increased total agricultural output-an hypothesis which most empirical studies seem to contradict--became a moot question as the predicted trend failed to materialize.

In many countries, traditionally large farms had been devoted to export crops, with smaller farms primarily producing food for the rural and urban population. As -urban population expanded and domestic food production failed to keep pace, food imports created increasingly serious foreign exchange problems in many countries. Such economic problems tended to push the policy makers toward a reexamination of their agricultural development strategies.

As researchers came to recognize that the benefits of the new technologies were not trickling down to the small farmers, they focused attention upon presumed barriers to the "transfer of technology." In past decades, social scientists had contributed to a monumental misunderstanding of this problem-an erroneous diagnosis which is implicit in the very concept of "transfer of technology." Perhaps because they were trying to convince plant scientists of the value of social research, social scientists simply assumed that the recommendations the agricultural researcher or extension agent gave to peasant farmers were bound to be economically beneficial to them and their families. Since, more often than not, they failed to adopt these recommendations, it was assumed that the problem must be a cultural one: the peasant farmer was locked into the traditional system of beliefs and practices. Therefore, the problem was one of "overcoming resistance to change."

Social science views were characterized in the following way at an interdisciplinary conference on agricultural development in the 1960s:

"The behavioral scientists had their various special diagnoses, but were, after the habit of their kind, less positive as to solutions. They accused the first two groups (agronomists and economists! of neglecting the special values held by the traditional peasant and overrating the importance of technical knowledge and economic incentives. The rural villager, they said, is a prisoner of his culture and his history, suspicious of change or innovation, not accustomed to taking the risks involved in producing for market, and is, therefore, differently motivated from the commercial farmer. They tended tc take the gloomy view that there was not much hope until the whole structure of rural society was radically altered and its values changed through fundamental education, a breakup of the extended family: and the spread of mass communications."* (Millikan and Hapgood, 1967)

As we abandon what we now call "the myth of the passive peasant," we view the small farmer as a rational being who seeks to balance gains and losses and to minimize risks. We do not assume that he always makes the correct decisions in his own interests in adjusting to the particular conditions he faces. But we do assume that 20 to 40 years or more of experience in farming in a given area has given the farmer an intimate, practical knowledge of behavior of plants and animals in that area under varying conditions, and that furthermore the agricultural scientist needs to gain access to the information and ideas of the small farmer if he is to be able to make any useful contribution to that farmer and his farm. We are now coming to recognize that the knowledge of small farmers is more than the accumulation of experience, handed down from generation to generation. Indeed, social scientists have discovered farmers carrying out their own indigenous experiments.

Consider, for example, the following case from Nigeria:

"...In one case, people experimented with cassava when it was first introduced. As cassava can be poisonous, it was important to establish the conditions in which it could safely be eaten. The procedure adopted was to feed it first to goats and dogs. In another case, a scientist believed he had made a breakthrough when he found a way of breeding yams from seed, propagation normally being vegetative. A farmer was casually encountered, however, who bad not only himself succeeded in doing this, but had also discovered that whereas the first generation tubers were abnormally small, the second and subsequent generations were of normal size. The scientist reportedly exclaimed, 'Thank God these farmers don't write scientific papers. It was also noted, in support of the prevalence of experimentation by farmers, that there is a Yoruba word for 'experiment'." (Howes and Chambers, 1979)

The emerging new research strategy involved two principal elements: (1) a shift in emphasis away from monocultural or single crop research toward research in crowing systems especially adapted to the needs and interests of small farmers, and (2) a shift in emphasis away from the experiment station and toward on-farm research with active participation of small farmers.

Agricultural scientists came. to recognize that farming in the tropics provided complexities but also opportunities beyond those found in temperate zones where there is generally only one growing season (except for winter wheat). This means that where the climate is warm enough and where rainfall is adequate year around, or where irrigation can compensate for dry seasons, agricultural activities can develop into 2, 3

or even 4 cycles (or 2½ or 3½, with cropping periods not following the calendar year). This opens the possibility for much more complex interrelations of plants than in temperate zone agriculture.

It seems useful for representing the increasing complexities of cropping systems to divide them into three categories (Harwood, 1979): (1) sequencing, in which one crop is planted immediately following the harvest of another; (2) relay planting, in which one crop is planted sometime after planting of a previous crop but well before its harvest; and (3) intercropping, in which two or more crops are planted together in the same space. Increasingly research has concentrated on intercropping, as scientists have recognized that where land is scarce and labor relatively plentiful, it is important to maximize the efficiency of the scarcest resource, land. Even where labor is more scarce than land, as in some parts of Africa, research has shown the potential for complex cropping patterns to enhance the efficiency of labor (Grove and Klein, 1979).

## New Directions for Research in Asia and Africa

A pioneer in this new line of research was Richard Bradfield, a scientist who had been a key figure in the 1940s in launching the Office of Special Studies for the Rockefeller Foundation, which led to the development of high yielding varieties of wheat in Mexico and to the creation of CIMMYT. In the 1960s when he became particularly concerned about the productivity of small farms (especially under tropical conditions), Bradfield was working with IRRI (International Rice Research Institute) in the Philippines. There he devised a system characterized by an extraordinarily intensive use of land through intercropping, relay planting, and sequencing of planting so as to get three to four full growing seasons within a given year.

Since the Bradfield system required an extraordinarily high level of farm management skills and very large expenditures for inputs and use of machines, plus abundant irrigation water, the system itself was not directly applicable to the conditions of small farmers. However, the enormous yields achieved by Bradfield impressed many scientists with the potential for improving the income of small farmers through more intensive utilization of their land.

Also working in Asia, Richard Harwood took the essential step in moving from the Bradfield type of experiment station project into the farmers' fields and began developing the kind of participatory experiments with farmers that have largely provided material for his important recent book (Harwood, 1979). In Africa, David Norman took the leadership in "investigating mixed cropping under indigenous

conditions" (see Norman, 1973) and a number of others began to give increasing attention to the indigenous cropping systems of Africa.

> An example of the reorientation of research can be seen in the fact that researchers have begun to question the value of plowing tropical soils in the way traditionally done in temperate climates. Tropical soils often give better results if not disturbed by plowing. This discovery has led to a growing number of experiments in "minimum tillage"--a fancy new name for a very old principle. Ironically, scientists have been finding that, in some conditions, the "primitive" digging stick is a more useful tool than anything provided by "modern" technology. (Now many farmers even in temperate zones are experimenting with "minimum tillage.")

We will review in more detail some of the important research on indigenous farming systems that was going on in Latin America during the same time period.

## Cropping Systems Research in Latin America

As early as 1971-72, CATIE (the Tropical Agronomy Center for Research and Training) had begun experimentation to develop its own adaptations of the IRRI multiple-cropping strategy. Beyond operating its experiment station at Turrialba in Costa Rica, CATIE maintains agricultural scientists in other Latin American countries where they work with national programs, expecially providing technical assistance on intercropping research. While the work of Bradfield and others at IRRI was known to some agricultural scientists in Latin American at the time they began work on indigenous cropping systems, it seems likely that the major impetus there came from the discovery in the Puebla Project that farmers interplanting maize and beans were getting much more value from their fields than those who practiced the monocultural system originally recommended to them by the professionals. By all accounts, the man most influential in gaining acceptance of this reinterpretation was Leobardo Jimenez, who had been the first field director of Puebla, and who later became dean of the Colegio de Postgraduados at Chapingo, and subsequently Deputy Director of the National Agricultural Extension Service in Mexico.

Having played an important role in the Puebla Project himself, Antonio Turrent was one of the first scientists to grasp the significance of intercropping for small farmers and to pursue systematic research in this field. In one experiment, Turrent compared yields of maize and beans separately with yields of the interplanted crops, using the same patterns of fertilization in each case. He found that beans yielded just

as much interplanted as when planted alone, and the maize yield in association with beans was approximately 70 percent of the yield achieved in monocultural planting. At prices then prevailing in the area for the inputs used and for the produce sold, Turrent found that the maize-bean asociation yielded 54 percent greater net income than maize alone and 113 percent greater income than beans alone. (Turrent, 1978)

> In Guatemala, experiments showed that the maize-bean association not only yielded the same amount of beans as monocultural planting of that crop but also yielded somewhat more maize than when maize was planted alone. The explanation for this difference in results between Turrent and Kass is found in the pattern of fertilizer use in the two cases. True to the traditions of agronomic research, Turrent made his comparisons between monocultural and intercropping patterns using exactly the same amount of fertilizer in each experiment. Kass followed the customary practices of Guatemalan small farmers. They were not accustomed to using fertilizer on maize, which they grew primarily for home consumption. They did customarily use fertilizer on beans, some of which they expected to sell in the market. When maize and beans were interplanted, the maize picked up some of the fertilizer laid down for the beans and thus naturally yielded better than when maize was planted alone, without any fertilizer. (Donald Kass, personal communication. 1978.)

Turrent was particularly impressed with a farming system developed by the small farmers of Oaxaca, which made extraordinarily efficient use of scarce water. Furthermore the system he observed had not gradually evolved over centuries of trial and error, as might be assumed in the case of the maize-polebean association. The castor bean plant grown in Oaxaca had been introduced in Mexico in response to the World War II demand for its oil, which was then especially valuable in certain industrial operations. After the end of World War II, the government no longer promoted the growth of the castor bean plant, but many of the small farmers found that they still had an attractive market.

The advantage of the castor bean plant in Oaxaca is that it has exceptionally deep roots. In a maize-castor bean association, the two plant species are planted at the same time just at the start of the rainy season, which provides light rains over a period of six months. The corn is harvested at the end of the rainy season, and the castor plant is left standing. By this time its roots have extended deeply enough to continue to absorb moisture, and the plant continues to grow for another six months. At the end of that time, farmers cut down the plants which have now grown quite large, gather the beans for sale, use the castor stalks for firewood, and use the leaves as cattle fodder.

Turrent's experiments, again with identical treatment of fertilizer. show that maize planted alone yields somewhat more than when planted in the most dense pattern of the castor bean, but the most profitable interplanting combination yields 2 to 6.7 times as much income, depending upon the market price of castor beans. It should be added that this income advantage of the combination does not take into account the value of the leaves as cattle fodder or of the plant stalk as firewood in an area that has little firewood available.

Stillman Bradfieid adds these comments upon the Oaxaca interplanting system:

"I did a small study of the maize-castor bean association and found that there are a number of other advantages....The castor bean can be harvested over a very long period of time, then stored for a long time in the house, without deterioriation, allowing children, old folks, etc., to crack open the pods to get the seeds out as needed for cash. It apparently does not spoil so it permits them a marvelous spread of farm labor throughout the year, utilizes household labor, and generates cash whenever needed." (Personal communication, 1980.)

Bradfield added that the Mexican government has been contemplating establishing a guaranteed price of at least 9 pesos per kilo for castor beans. Turrent noted that the advantage of the maize-bean association over maize alone ranged widely, due to the widely fluctuating price of castor beans-from 2 pesos to 10 pesos per kilo. If indeed the government fixes a castor bean price close to the top of this range, the small farmers of Oaxaca stand to gain substantial benefits.

The new orientation involved a shift in emphasis in experimentation away from the experiment station and on to farmers' fields. By 1979, official reports of the MIA (the Mexican government agricultural research institute) showed that 56 percent of all experiments were carried out on the fields of small farmers.

As experiments on farmers' fields proceeded, several Mexican scientists recognized that the full potential of the integration of indigenous agriculture with the modern agricultural sciences could not be gained simply through multiplying the number of on-farm experiments. To go beyond the simple determination of what works and what does not work, scientists needed to discover the underlying logic of the farmers' systems of cropping developed under diverse ecological, cultural, and economic conditions. Etlmo-botanist Efrain Hernandez X., also with the Colegio do Postgraduados, has been directing an ambitious study of indigenous cropping systems in three areas of Mexico. In this project, supported by the Mexican government,

Hernandez has worked with six anthropologists, four hiologists, and three agronomists. This selection of personnel illustrates another important lesson of Project Puebla; if you are going to study indigenous cropping systems, you are necessarily embarked upon an interdisciplinary enterprise.

The areas selected for study represent a wide range of agricultural conditions and systems in Mexico. Southern Yucatan is characterized by slash-and-burn or swidden agriculture. Oaxaca is a very dry and poor agricultural area but one in which settled agriculture is practiced. El Bajio, to the north of Mexico City, is regarded as the bread basket of the capitol district. That area is favored by rich soil, and much of the land is irrigated so that farmers can produce under more favorable conditions.

By the late 1970s scientists were ready to draw general conclusions regarding the advantages and limitations of intercropping. Turrent puts it this way:

> "...the patterns of cultivation that form parts of the system of peasant agriculture are rational and, while there exists an ample opportunity to improve them, as a general rule the productivity of the land under these patterns of cultivation is potentially greater than that which is achieved with monocultural systems." (Turrent, 1978)

Donald Q. Innis, pointing to a bibliography of one thousand intercropping experiments, arrives at the following conclusion:

> "There is an enormous body of evidence...that shows that a suitable combination of intercrops will always produce a greater total yield then only one crop in a field." (Innis, 1980)

In any case, we believe it would be more accurate to substitute usually or very often for always in the Innes statement. The combination of crops must be "suitable," for we cannot assume that any random combination of crops will do better than monoculture. This means that researchers should study the various intercropping patterns in common use and experiment with these and other patterns.

Beyond yield increases, scientists have been finding other advantages of intercropping:

> "Intercropping reduces loss of nutrients from leaching because numerous root systems of varying depths intercept downward percolating water and retrieve dissolved nutrients which would

> otherwise be carried out of the root zone. Such rapid leaching is very common in the tropics, where many small farmers have declined to adopt modern methods." (Innis, 1980)

Various researchers have noted another important advantage of intercropping: improvement in pest, disease, and weed control. By more completely covering the ground with a variety of crops, interplanting inhibits the growth of weeds. Particular pests often specialize on one species of plants. They tend to multiply when they encounter a monocultural stand of the crop particularly suited to them, whereas they cause less damage where the plant species of their choice is interspersed with one or more other crops. With disease resistance, it may be that there is no direct advantage in intercropping for the particular plant species affected, but few plant diseases are likely to attack simultaneously all of the crops grown on an intercropped field. Thus, even if the farmer looses heavily on one plant species infected, the other crops continue to provide him with some of his subsistance. If he were to rely on a single crop which was attacked by a disease, he might be completely wiped out.

Of course, intercropping provides a major barrier to mechanization. The farmer may freely use the tractor for plowing and harrowing before he does any planting, but he cannot take the tractor through a densely interplanted field after the plants have begun to grow. The severity of this limitation, of course, depends upon the total farming system being practiced and upon the household economy of the farm family, a subject we will consider later.

The new approach to on-farm research is well stated by one of the pioneers in this area:

> "...the planning process involves the scientist with the farmer in deciding what modifications and innovations to try. Each brings to the planning process his own perspective and his own wisdom. The farmer contributes his intimate, often tacit, understanding of his own situation and the factors that influence his productivity. The scientist has the objective information derived from his measurements and observations, plus a familiarity with alternative production technologies from other areas. The scientist and the farmer collaborate on planning and implementing changes, and the results are measured against mutually agreed-upon goals. The careful documentation of their experience with new technologies and systems in well-defined environments makes it possible to extrapolate their results to other, similar situations in any part of the world.
>
> "This approach depends to a great extent on teamwork among scientists whose disciplines are highly specialized and insular and who

> are unaccustomed to working together on common problems. The process proposed in this book requires agronomists to work with crop and soil scientists, animal specialists, agricultural economists, nutritionists, and educators. Interdisciplinary collaboration is crucial to the process, and the team includes a coordinator whose special function is to bring the disparate insights and skills of the various scientific specialists into focus on the problem of increasing the small farmer's production." (Harwood, 1979, pp. 7-8)

Harwood recognizes that it is not sufficient to locate research on farmers' fields:

> "The farmer's actual participation in the planning, execution, and evaluation of research should be clearly distinguished from mere research in farmers' fields initiated and controlled completely by scientists. The latter approach simply provides a test of technological components in various actual farm environments. The results may be valuable to the scientists, but they do not show how well the new technology performs under the farmer's management, nor how it integrates into his farming system. And they do not encourage the adoption of successful innovations by the farmer-participant.
>
> "It is crucial that the research organization appreciate the value of joint farmer-scientist planning, testing, and evaluation of technological changes. The farmer's criticism or rejection of the researcher's favorite methods or new varieties is often difficult for the researcher to accept. It involves both his personal and his professional pride. But if the farmer's opinion is ignored, discounted, or even ridiculed, the fragile connection between farmer and researchers on which this entire system depends will be broken." (Harwood, ibid)

## Farming Systems Research

Although this chapter aims to highlight farming systems, so far we have dealt only with cropping systems, that is, with the interactions of plants, soil, and water. This focus neglects, certainly, a crucially important element in farming systems: animals. As we saw in the case of Puebla, animals are as important a source of income, if not of total sustenance, as plants. The initial focus on plants and little attention to animals in technical assistance programs reflects the history of plant and animal husbandry research, since until very recently plant and animal scientists have pursued their respective research separately.

Of course, simply adding animals to cropping systems does not give us farming systems. The problem is not simply to add animals to a pattern already established.

Human beings and family households are at the center of the farming system, so we need to examine not only how plants and animals relate to each other but also how people deal with these complex interactions.

Although there is still little systematic research available dealing with animals as an integrated part of small farming systems, we do find a growing recognition of the importance of animals in most such systems and of the need therefore to achieve such an integration of knowledge about socio-economic factors, plants, and animals in a farming systems framework. Even lacking more systematic knowledge, we can at least point out certain important aspects of the interrelation of animals, plants, and humans in a farming system.

We should correct a common misconception that cattle and humans are in competition for the same food, so that food fed to the animals is food that humans might otherwise eat. To a considerable extent this may be true in the United States and other industrialized nations, where much of the cattle fattening is carried cut on feed lots, or poultry are fed grains. It is rarely tr.e in developing nations where cattle graze freely and consume crop residues which cannot be utilized by humans. In fact, worldwide estimates indicate that only about five percent of food consumed by cattle could be eaten by humans. Therefore, unless he uses all of his land at all times to grow crops, it is highly efficient for the farmer to have cattle that feed on land allowed to lie fallow or on land that is not fit for cultivation. Furthermore, of course, humans eat only parts of the plants the farmer grows, and the animals can consume much that remains (corn stalks, for example). If we recognize the inter-relations of plants and animals, it follows that a given 'improvement' in a particular plant may not be adopted by small farmers if it would reduce the value of that plant for animal fodder.

> Consider the effort of plant scientists to develop a variety of maize which would have tougher stalks to resist the corn borer and shorter stalks to concentrate more of the plant's energy into the production of the ears of corn. This may be a real improvement for the farmer who has no cattle but a disadvantage for the farmer with cattle. The short, tough stalks have a higher lignin content than native varieties, resulting in low nutritional value for the animals. The smaller stalk also reduces the total fodder available. Because of this reduction of feed supplies for animals, the farmer with cattle has reason to reject the use of the higher yielding varieties.

This does not mean that no such maize improvement project should be attempted. It does point to the necessity of considering the place of animals in the farming system

even in evaluating the applicability of advances in the plant sciences for the benefit of the small farmer.

The same point can be illustrated from Asian experience.

The shorter-stalk rice varieties originally developed by IRRI in Asia to maximize grain yields were too high in lignin content for suitable feed for water buffaloes or cattle. This innovation was often rejected by farmers who needed to feed their animals on rice straw. Similarly, farmers in African countries where cowpeas were grown for fodder rather than the grain did not accept the new high yielding variety--high yielding in one respect (grain) but not another (fodder).

In a Rockefeller Foundation-sponsored conference on "Integrated Crop and Animal Production to Optimize Resource Utilization on Small Farms in Developing Countries:" scientists reached the following conclusions:

> "1. In addition to growing crops, the majority of small farms maintain animals. Excepting a few of the developing countries, 85 percent or more of the ruminants (buffalos, cattle, goats, sheep) and even a higher proportion of the donkeys and horses are on small farms.
>
> "2. Animals play both economic and non-economic roles in small farm systems. Economic returns are derived from manure, traction, transport, investment, insurance, fuel, by-products, skins and hides. The proportion of income derived from livestock can be substantial, a fact too often overlooked (as in the Puebla case-author's note.)
>
> "3. In addition to numerous economic uses of livestock in small farm systems, animals become a thread in cultural patterns. Animals are a source of identity and prestige for the families and a means of forming social ties through gifts and exchange with others. Another non-economic return characteristic of many animals is companionship." (McDowell and Hildebrand, 1980)

In order to visualize the interrelations of animals and crops in the household economy of the small farmer, McDowell and Hildebrand (1980) have diagrammed eleven agricultural systems that are found in various parts of the world. To illustrate their methodology, we show two as presenting a useful way of visualizing the interrelations of parts within a farming system and the marked differences observed in comparing one system with another!. The McDowell-Hildebrand diagrams shown on pages 49 and 50 are for the "Honduran System," characteristic of much of Central America, and the "Lowland Rice System" in Asia. In these diagrams, the solid line arrows represent

major flows of activities and resources, the dotted lines represent less important flows--under about 20 percent. Any local area study would work out these relationships with more quantitative precision, but rough diagrams can serve as a useful approximation.

In the Honduran System, we see that less than 20 percent of the inputs for crops are purchased and less than 20 percent are sold in the market. For animals, less than 20 percent of the inputs are purchased and more than 20 percent of the value of the animals is marketed. In Lowland Rice we see both animals and crops more importantly linked to the market economy, and fuel is bought in the market, whereas Honduran System farmers get their fuel from forests and natural pastures. Comparison of the diagrams also shows that mulching plays an important role in Lowland Rice cultivation and does not appear in the Honduran system. Other contrasts could be noted, but our purpose here is not to describe either system in detail but rather to illustrate how farming systems can be analyzed.

## Conclusions

The chapter has pointed cut the importance of abandoning an exclusive monocultural strategy in research and of devoting increasing attention to the study of systems of inter-cropping. We have also noted the need for integrating animals with plants in improving farming systems for small farmers. For many years, animals were the missing element in research and writing on farming systems, but in recent years there has been rapidly increasing interest in the important role of animals in such systems. The establishment of the International Livestock Center for Africa at Addis Ababa, Ethiopia has especially stimulated this interest. Furthermore, the International Institute for Tropical Agriculture at Ibadan, Nigeria, having encountered serious problems of soil depletion in its cropping research, is now pushing the integration of animals into its program. Both at ILCA and IITA, we also find a strong interdisciplinary emphasis, with plant, animal, and social scientists working on the same teams. Since no professional is an expert across the total range of plants and animals involved in the farming systems he studies, the emerging new R and D strategy clearly requires inter-disciplinary collaboration among professionals as well as active participation of small farmers, who are the indispensable informants and advisors regarding the complex of soils, water, plants, and animals involved in their farming systems.

In the following chapters, we will indicate how conceptualization of a farming system needs to be fitted into a broader framework relating farmers and their families to the market and to local and national political and administrative organization;.

**Figure 3: Honduran System**

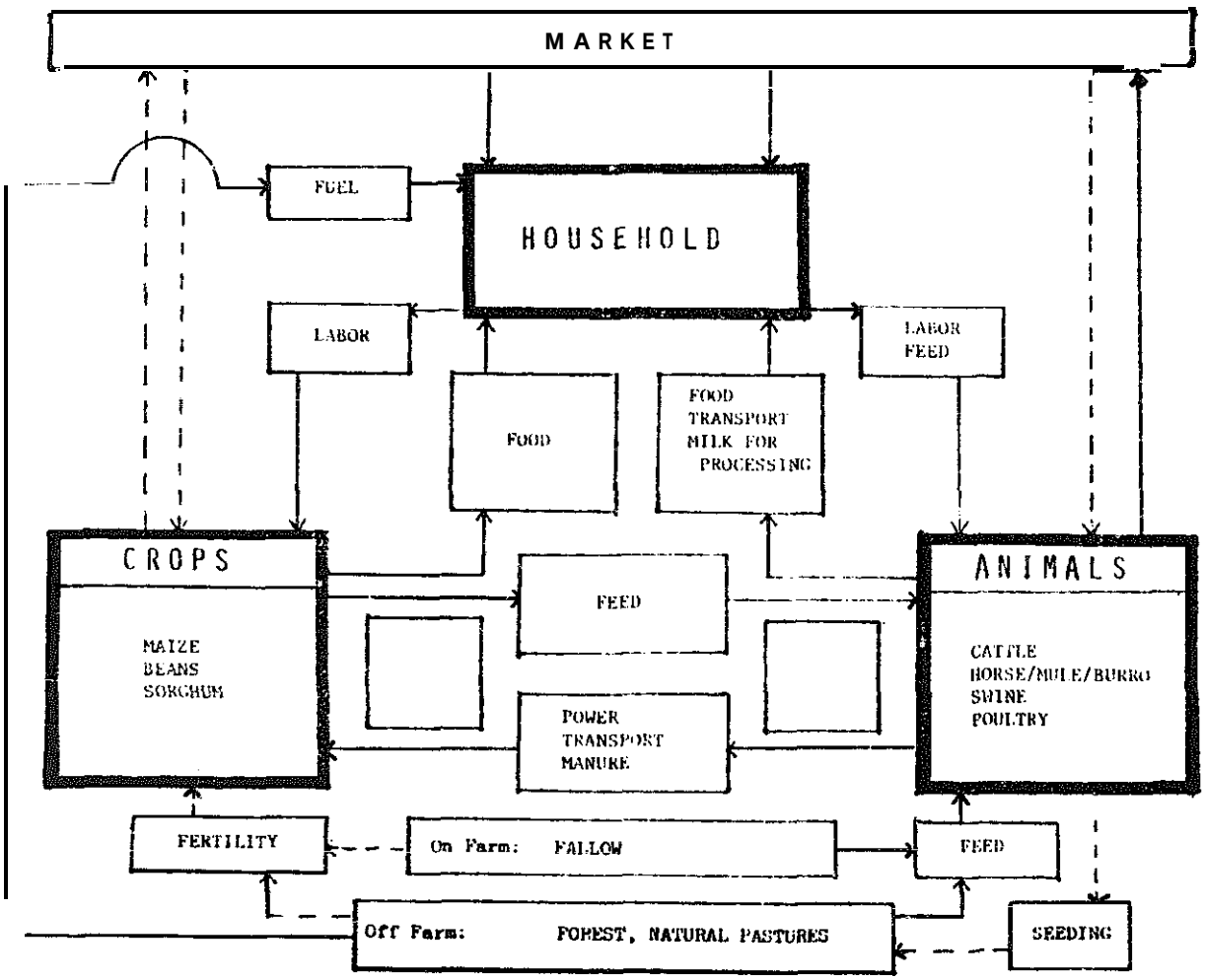
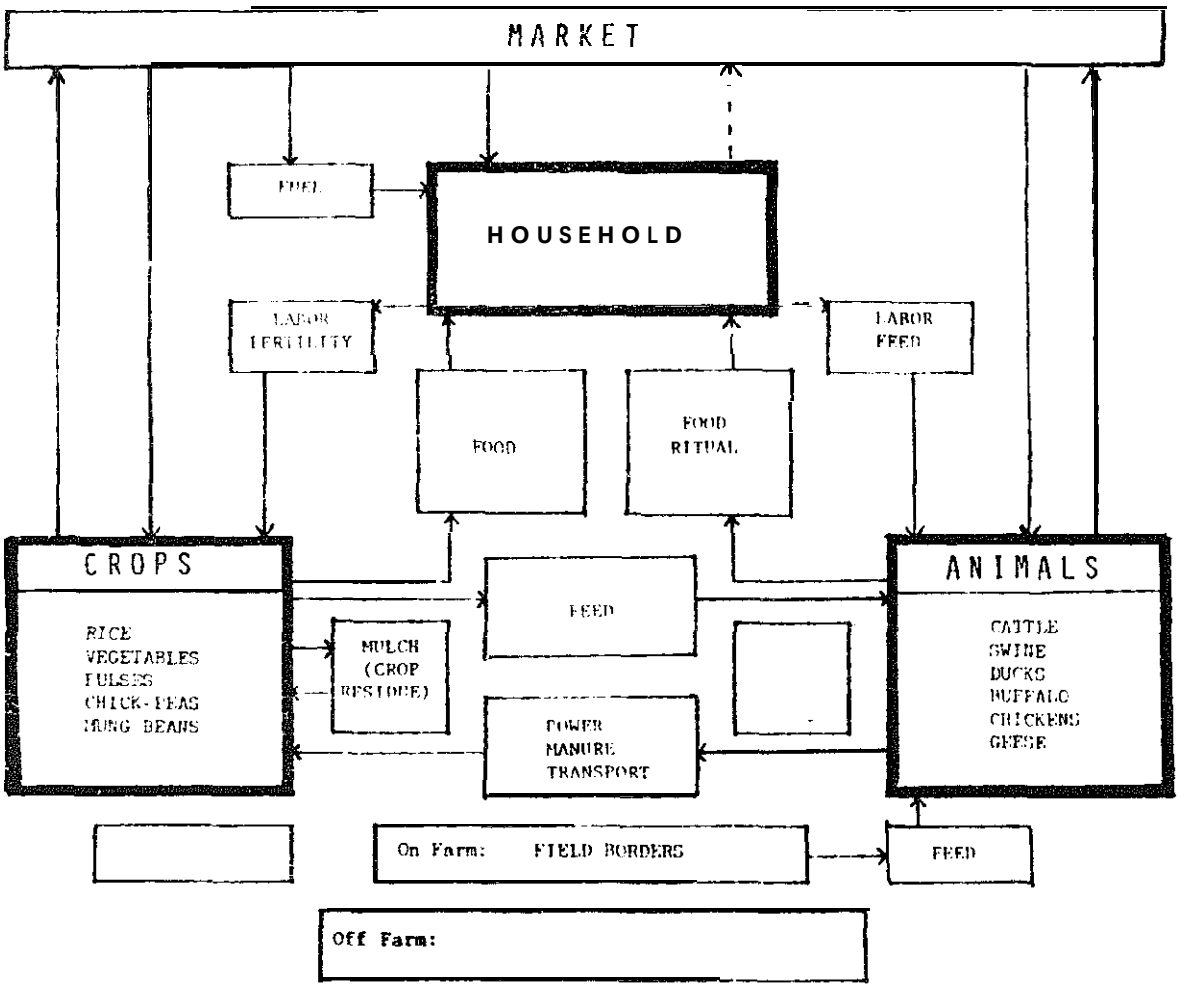


**Figure 4: Lowland Rice System**



## Chapter IV:

## TOWARD NEW MODELS OF AGRICULTURAL RESEARCH AND DEVELOPMENT

Preceding chapters have described the evolution of thinking regarding the integration of small farmers into programs for agricultural research and development. This chapter focuses on ways in which these ideas are being implemented in emerging new organizational models. Such models must be designed to solve two problems:

1. To devise a system of on-farm research built upon the participation of small farmers. It is not enough to demonstrate that, in one experimental project on fields of small farmers, encouraging results were achieved. To convert isolated cases into a systematic regional or national program, planners need to specify a set of procedures for professionals and farmers working together and then go on to develop an organization to carry cut these procedures.

2. To integrate the on-farm research program into the already established national programs of experiment stations, extension, credit, and marketing. It is not enough simply to add on-farm research to the other pre-existing programs. Unless on-farm research can be linked effectively with the well established components of the national program, the new element will come to be seen as a fad to be abandoned when other new ideas come along.

Here we concentrate on the shaping of new organizational models in Guatemala and Honduras. Guatemala is interesting to us because its Institute of Agricultural Science and Technology (ICTA) provides one of the most clearcut examples of a new organizational model for agricultural research. However, ICTA has had problems in integrating this new research model with the other components of the national agricultural program. Honduras adopted essential elements of the ICTA research model and at the same time achieved a more effective integration of research with extension and other agricultural programs. Thus our Honduras case will show how one nation learned from another and then improved upon the organizational model it adopted.

### ICTA in Guatemala*

Guatemala entered the 1970s with a history of about 50 years of agricultural research and development, but up to that time it was hardly accurate to speak of a

*For a detailed presentation of the evolution of ICTA, see Gostyla and Whyte (1980). ICTA is one of several national research institutes that are innovating along the same lines. We concentrate on ICTA because we are able to provide a detailed account of its evolution, based largely on field work.

national program. Activities were fragmented among agencies with little coordination among them. As the 1960s came to an end, government leaders and agricultural professionals were concerned about the rising tide of imports of food. This drain on the national economy served to focus high- level attention upon the need to build up agricultural production. An important feature of the five-year development plan for agriculture (1971-75) was the government's creation of ICTA as a relatively autonomous research institute but still (at the outset) operating within the large existing organization devoted primarily to extension (DIGESA).

The principal planners and organizers of ICTA were agronomists Mario A. Martinez, then Vice-Minister of Agriculture, and Astolfo Fumigalli, the new Director of Research for ICTA. They agreed upon a two-point program. If the research institute was to fulfill its mission, it must be separated from DIGESA and become a really autonomous research institute. (While they were probably correct in asssuming that ICTA required substantial autonomy in order to develop an innovative research program, its complete separation from DIGESA led to problems which became apparent in later stages.) They also saw the importance of linking ICTA with international centers and with foundations supporting agricultural research and development.

The Guatemalan planners were successful particularly in interesting the Rockefeller Foundation in their new program. The Foundation supported a planning conference and then agreed to assign Robert Waugh, an animal scientist with rich experience in developing countries, to ICTA as consultant. ICTA began operations in early 1973 as an autonomous unit and independent of DIGESA, under the joint direction of Martinez and Fumigalli.

At the outset, the planners had a clear conception of ICTA's objectives but no more than a general sense of direction. It is important to observe how this sense of direction was translated into methodology, organization structure, and social processes.

While the early plans for ICTA called for on-farm research focusing particularly on the needs and interests of small farmers, the methodology for implementing such a program remained to be worked out. There was a growing amount of research activity carried out beyond the experiment station, but no clear methodology had been developed at the outset. It was the creation and evolution of a Socio-Economic Unit in ICTA that stimulated the development of what we now consider the distinctive ICTA organizational model for agricultural research.

The Socio-Economic Unit was established in 1975 under the direction of agricultural economist Peter Hildebrand, who came to Guatemala after several years of

experience in El Salvador, where he developed a highly innovative and productive research program based upon systems of intercropping and close collaboration with peasant farmers. ICTA first conceived the role of the Socio-Economic Unit (SE) in terms of evaluating the impact of current research and development activities. This led to one of SE's first assignments: evaluating complaints of farmers in one area against the imposition of certain recommendations on them as a condition for receiving bank loans from DIGESA end BANDESA, the Agricultural Development Bank. In order for farmers to receive loans in La Maquina they had to participate in a supervised credit program and use the credit to buy substantial amounts of fertilizer recommended by DIGESA and BANDESA. Farmers had been complaining that the fertilizer had a negligible effect upon yields in their particular area.

Observations by members of a technology testing unit in La Maquina had indicated that the farmers might well be right, but it remained for SE to analyze the costs and yields of cooperating farmers to substantiate that conclusion. After some study, ICTA reported that in La Maquina, fertilizer had such a slight effect upon yields that the expenditure was not worth the cost.

This report led to an important change in the policies of DIGESA and BANDESA: the farmers were now no longer required to use any of their loan money for the purchase of fertilizer. (To be sure, some extension agents still continued to advise the use of fertilizer, almost as an act of faith, but it was no longer compulsory.)

While this case demonstrated the potential usefulness of socio-economic research, it could hardly serve as a model for the development of a program to fit into the activities of the other units in the Ministry of Agriculture. Evaluative research would inevitabiy place SE in the position of criticizing the work of professionals in other disciplines, other parts of ICTA, or other agencies of the Ministry.

Hildebrand and his associates therefore sought to get started in a way which would involve them in the early stages of the research process instead of simply coming in to evaluate the work done by others. Finding the necessary starting point was not easy. Hildebrand was impressed with the enormous gap between conditions on experiment stations and those outside the station on the peasant farms. Invariably, the stations had been laid out and developed in the most favorable conditions for obtaining maximum farm yields. The land was relatively flat and fertile and amply supplied with water. Farm machinery of various types was available and there was an ample supply of the inputs scientists considered necessary to obtain maximum yields. Not far from the experiment stations, the small farmers were struggling to eke out an existence on

hillsides, on rocky terrain of low fertility; they were using bullocks for plowing and were able to afford far fewer inputs than recommended by plant scientists based on their experiment station program.

Hildebrand sought to persuade one experiment station director to substitute bullocks for tractors and move most of his experimental program off the station and onto the hillsides typical of peasant farming. The proposal provoked an indignant rejection. In fact, in the early months, members of the Socio-Economic Unit were seen by the plant scientists on experiment stations as unreasonable and aggressive cranks, end SE was unable to get any cooperation from the established experimental program. Finding itself blocked in fitting its program into the established structures, SE won top-level approval to go off and seek to develop its own methods of on-farm research.

The social scientists began by making a study to delimit an area where the farming system practiced by small farmers was relatively homogeneous. The purpose of this survey was to make sure that successful experiments would provide conclusions fairly applicable throughout the area. At the same time, in order to get systematic information on indigenous farming systems, SE developed a program of registros, simple farm management records, to be filled out daily by the farmer or a member of his family, recording the amount and type of labor, the tools and power sources used, the amounts of fertilizer, pesticides, or other inputs applied, and so on. Members of the Socio-Economic Unit worked with the farmers to develop a balance between the researcher's desire to have a highly detailed quantitative record of farming practices and expenditures and the need of the small farmers to work with a system that was simple enough for them to understand and might perhaps even be more helpful than burdensome to them.

Not having access to land on experiment stations, SE started by renting small plots from local farmers. SE also paid the farmer whose land they rented for the labor he provided in the experimental process. The aim was not to use the small farmer as a hired hand but to involve him as a consultant (asesor) and participant in the research planning process. SE proposed to try only those innovations that its farmer-consultants considered reasonable and promising. The rationale for this decision was that any innovation that seemed impractical to local farmers was not likely to gain acceptance.

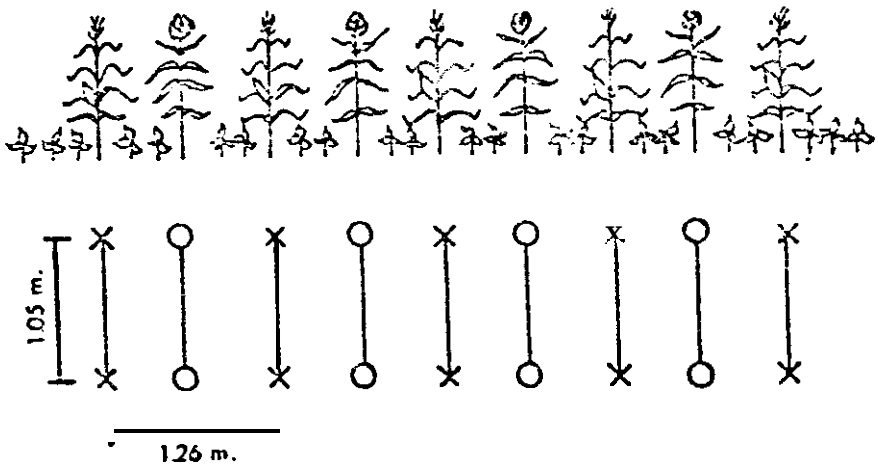
The SE strategy was to start with minor *changes* and especially those changes that required little or no additional expenditure for inputs, compared to the farmer's traditional practices. If such a modest experiment yielded concrete benefits, then the farmer would be encouraged to undertake further and more far-reaching changes.

The first on-farm experiments were carried out under the direction and control of the professional. Any innovation that did not work out at this stage was referred -back to the plant scientists on experiment stations and in the regional organizations for advice and further study. The innovations that yielded good results moved into the second stage of farmer field trials. At this stage SE gave up control and shifted into the role of consultant and observer. Farmers now tried out on their own fields, with their own money and their own unpaid labor, the innovation in whose experimentatl testing they had participated earlier. What did not work in the farmer field trial stage was again referred back to the plant science professionals for advice end further study. What did work was assumed to be ready for diffusion and general adoption throughout the farming area. In this stage, SE had become in effect involved in the diffusion process, which is normally thought to be the jurisdiction of the extension service.

In order to avoid innovations requiring inputs beyond the means of small farmers, SE concentrated upon developing new patterns of interplanting and utilization of space. For example, in one location in eastern Guatemala, SE studied farmers' traditional milpa system of maize, sorghum, and bean interplanting, discovering two factors that were the most serious limits on production: quantity of bean seed, and labor during the planting season, which in this area was limited to the dry period of two or three weeks following the first rains end before the onset of the heavy and continuing rains of the rainy season. Here, lend was not a limiting factor; constraints of labor and available bean seed prevented farmers from fully utilizing the land they owned.

The farmers' traditional system is illustrated in Figure 5; it was used as a control for all other experiments. In the traditional system, farmers planted maize and sorghum in alternate rows about .63 meters apart, with beans intercropped at random between the rows. The system devised by SE adapted the traditional pattern by introducing alternative population and spacing patterns. Maize and sorghum were planted in double rows at a distance of .315 meters. Maize seedlings were placed diagonally between sorghum seedlings in the parallel row, in a chain-like effect as illustrated in Figure 6. The diagonal planting pattern allowed for adequate sunlight to penetrate through to both crops. Within rows, populations of both maize and sorghum were increased relative to the traditional system. The distance between the centers of the double rows was 1.68 meters. This left ample space to plant three rows of beans at a population density of 48% of the traditional system. The double row arrangement allowed more open space for beans at the same time that it increased maize and sorghum populations.

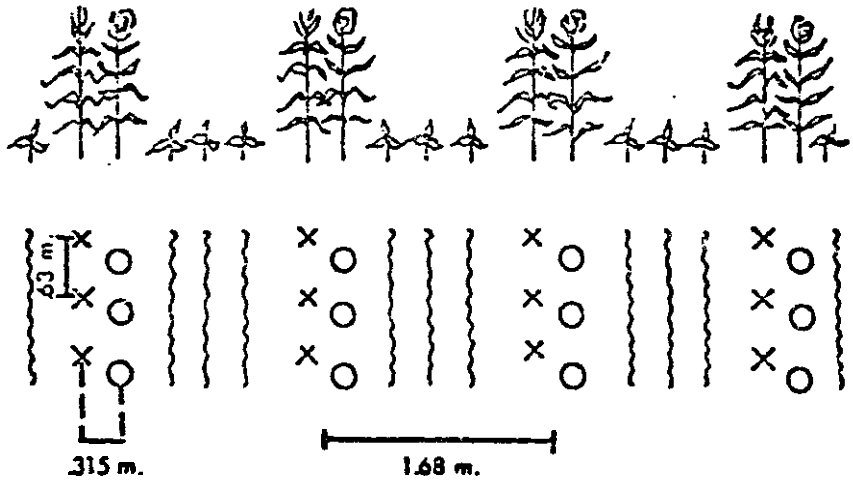
## MAIZE-SORGHUM-BEAN ASSOCIATIONS




X = maize, 0 = sorghum

(beans intercropped at random)

**Figure 5: Traditional System**




X = maize, 0 = sorghum

**Figure 6: ICTA SE System**

In the traditional system, beans consumed the majority of farmers' planting time. In the new system, with the reduced bean population, farmers were allowed additional time in planting. in which they could extend the area under cultivation onto land traditionally left fallow. The new system allowed the farmer to plant 40% more land than before, with the same amount of planting labor, and with less bean seed, yet bean production was held stable. From the additional land under cultivation, the farmer produced 75% more maize, 40% more sorghum, and 33% more income. Productivity of both been seed and labor at plating was therefore increased relative to the traditional system. SE claimed furthermore that the new system offered these advantages with minimal risks to the farmer. There was no additional requirement of fertilizer or pesticide beyond what he had been using traditionally.

In another area of Guatemala, SE studies revealed that land was the most severely limiting factor, and capital was also relatively scarce. SE identified three strata of farmers and then devised a production system suitable to the financial capacity of each stratum. Each system was designed to increase productivity per unit of land.

In Guatemala, maize is the most important staple in the diet, and the farmer's first concern is to raise enough to feed his family. For the farmer in the lowest stratum, first priority was to achieve self-sufficiency in the production of maize, while having little or no investment capacity. SE devised a system of production that simply replaced single rows of maize with double rows (in a zig-zag pattern to allow for air circulation and ample sunlight). Tbe system called for the use of 50% more maize seeds on the same area of land. Trial results indicated that the system could produce 45% more maize, allowing farmers in the lowest stratum to reach self-sufficiency in maize.

A farmer in the middle stratum usually was able to produce enough to fill his family subsistence needs, and he might sell small amounts to provide modest capital for new ventures. Here SE devised a system involving double rows of maize now two meters apart, or twice the space allowed in the traditional system. In this open space, farmers planted wheat. Maize production did drop slightly with this system, but farmers were rewarded with a crop of wheat that sold at an attractive support price established by the government.

A farmer in the top stratum had no trouble producing enough maize for family consumption and had higher levels of capital to invest in improving his production system. Here SE experimented with the maize-wheat combination just described but also introduced cabbages within the wheat stand. Trials showed that almost 14,000 cabbages per hectare could be grown without appreciably decreasing wheat production.

While refining its methodology for on-farm experiments and field trials, SE was also improving and speeding up its system for making base-line studies of farming systems in an area.

In the past, the traditional style of doing social science research has been an obstacle to its integration within agricultural R and D programs. Such research takes so much time that conclusions are reached after planners wish to act upon them, while action implications of such research are often difficult for the administrator to discern.

At first, SE conducted exploratory research, depicting the major agronomic and socio-economic features of the area; results were made available to other programs immediately for planning purposes. SE then would proceed to study the area more in depth, and final recommendations would be ready for publication a year later. Eventually, ICTA leaders decided that the longer range study was too costly and not necessary for planning. SE has come to concentrate on improving its capacity to carry out exploratory research that can be quickly applied by agronomists.

At present, SE does a reconnaissance of an area in one or two weeks' time. SE has become more familiar with the general characteristics of farming systems used by farmers; this knowledge facilitates the survey process by directing interviewers' attention toward key aspects of the farmers' practices.

Now agronomists from the regional team are participating with SE in the survey process. Researchers are organized in pairs consisting of one natural scientist and one social scientist; members are rotated daily within pairs to control against interviewing bias. At the end of each day, the members meet to discuss their work. They try to identify common patterns in their findings, and reorient themselves to fill in weak spots by following up upon particular themes the next day. This type of activity provides valuable cross fertilization of information between disciplines.

The reports that SE produces from these activities are available almost immediately upon completion of the field work, and they are written in clear and precise form that natural scientists can understand. The participation of agronomists in the surveys *has* helped SE direct its research to areas that are of technical concern to the rest of the institute, at the same time that it has put technical people more in touch with farmers' problems. These reports are becoming increasingly useful in regional planning processes.

So far we have described the evolution of the SE methodology and given some indications of its contribution to ICTA but have not focused upon the problems of integrating SE into a research organization dominated by plant scientists and organized

according to two structural principles: crop specialization and regional decentralization. Directors of crop improvement programs (maize, beans, sorghum, and so on) worked in the central office, guiding experimentation in their particular crops in the seven regions. The headquarters of each region were located on an experiment station, now renamed "production center". It was the responsibility of the regional director to coordinate the activities of his various specialists and to develop research on cropping systems and to conduct on-farm experiments as well as at the production center. How coordination and these new lines of research were to be carried out had to be discovered in practice.

> At first, many regional professionals reacted negatively to the on-farm experiments carried out by social scientists. Hildebrand describes in this way these early reactions:
>
> "The year was very dry and had two prolonged periods without any rain....Visitors...were surprised if not appalled to see field trials under such conditions, and the crops demonstrated the extreme stress under which they were growing. But it was also evident that these conditions were the reality under which the farmers of the Ladera lived and produced. Aside from the comments that it looked just like a trial being run by social scientists and that it was a good thing it was well off the road, the most usual comment was that it was obviously not worthwhile to work under these conditions because nothing could be accomplished." (Hildebrand, 1976.)

Unless they are deliberately testing the impact of particular insects or plant diseases, the training and experience of plant scientists naturally lead them to take pride in growing plants that look healthy and promise high yields. They were naturally shocked at the shoddy appearance of the SE trial plots. This reaction indicates why it was necessary to allow SE to go its own way at first 'in order to develop its methodology, but it also indicates the difficulties SE was to experience in seeking to integrate its program into regional structures.

Leaders of the central organization facilitated the communication of SE findings and procedures in central and regional meetings, and here and there a regional director began to take an interest in SE farming system surveys, farm records, and on-farm experimentation. Still, it was not until SE was formally incorporated into regional structures that a full integration of SE activities and procedures became possible,

In 1977, the ICTA administration decided that a member of SE should be assigned to each regional production center. This was an important step toward integration, but problems still remained. In the first place, SE was not fully enough staffed in order to

be able to place university graduate economists in the regional centers and therefore had to send out peritos (agricultural high school graduates) whose lower status placed them at a disadvantage in dealing with the university graduate ingenieros agronomos. Being especially qualified through experience in working closely with farmers, the peritos were expected to guide the professionals in developing farmer records and in carrying out on-farm inter-cropping experiments according to the SE methodology, but university graduates did not respond readily to the guidance of high school graduates.

In this case, there was more than a status problem involved. In general, the crop improvement program heads in the central office and the regional directors had not made any adjustments in work loads to allow for the inclusion of farmer record-collecting and for expansion of the on-farm research within what work they already had in progress. The professionals naturally tended to accomplish their accustomed tasks first and put aside the new responsibilities being brought to them by the peritos.

In the course of a year, ICTA leaders noted a marked improvement in regional response to these new responsibilities initiated by SE as SE professionals from the central office were able to spend more time in the field with regional directors and their staffs. SE professionals were able to help peritos in the regions to fit their work into the established programs and to demonstrate further how SE projects could strengthen these programs. Furthermore, the new methodology for field surveys had a major influence in strengthening SE's relations with plant and soil scientists in the regions. Since the surveys were carried out by pairs consisting of a social scientist and an agronomist from the regional organization, the success of this program helped representatives of the two units to appreciate the values each unit was bringing to the joint effort. By 1979 regional directors were generally reporting in their annual planning meetings that farmer records and area agro-socio-economic surveys had become basic elements in their programs.

The improved internal integration of ICTA, however, did nothing to improve its relationship to DIGESA, which continued to operate under a model imported much earlier from the United States. The two agencies hold incompatible assumptions regarding the nature of small farmers. ICTA assumes that the farmer is a thoughtful individual, who adapts more or iess successfully to the difficult conditions under which he farms. As professionals attempt to develop technology appropriate to these conditions, they have much to learn from the farmer's past experience and ideas. Research and development must therefore be a process in which the farmer participates in developing new technology.

DIGESA continues to operate according to more traditional assumptions. The farmer is still seen as an irrational individual who cannot be trusted to further his own best interests. He therefore needs direction and close supervision by technicians who propose the type of farming practices that will benefit him. DIGESA's orientation is illustrated by its role in the supervision of BANDESA's credit program. In order for a farmer to qualify for credit, be must sign a contract to follow a plan worked out for him by a DIGESA agent. The DIGESA agent helps the farmer deal with BANDESA, and then proceeds to supervise his work to make sure that he sticks to the plan.

DIGESA does most of its extension work with farmers on a one-to-one basis. This type of extension model necessarily limits the number of farmers reached with technical assistance. In administering and supervising BANDESA's loan program, a DIGESA agent can only serve 45 or 50 farmers a year. With approximately 500 agents, DIGESA can only serve about 25,000 farm families in one year. To reach even half the number of farm families in Guatemala, this model would require 5,000 agents--and that is obviously beyond the financial and managerial capacity of Guatemala. Furthermore we hear complaints that DIGESA's agents give so much attention to credit that they have little time to attend to the technical needs of the farmers they are serving.

Recognizing the need to develop a new extension model to link up effectively with its new research model, ICTA began small scale research-extension projects of its own. The village of San Martín Jilotepeque, near Chimaltenango, provided the first site for this new thrust. World Neighbors, an international self-help organization, had begun a project in San Martín in the early 1970s following a disastrous earthquake. By the time ICTA came in contact with the project, farmers were already working in organized groups and experimenting with agricultural innovations on their own. They had begun to increase production through the use of soil and water management practices that World Neighbors had introduced.

ICTA and World Neighbors farmers came to an agreement in 1974 to cooperate in testing some of ICTA's technology in the community. Organizational arrangements for implementing the research were not clear at first, but they have gradually been solidified and formalized. Three informal farm leaders from the World Neighbors group were put on ICTA's payroll, to collaborate with an ICTA technician assigned to the project in managing agronomic trials throughout the community.

This arrangement overcomes the limitation of extending technology to farmers on a one-to-one basis. Professionals can deal with farm leaders, and the farm leaders themselves take responsibility for communicating information and managing

experiments with organized groups and communities. Farm leaders in the San Martín project have been able to manage approximately 60 field trials a year. This compares very favorably with the average of 25 for the professional ingeniero agronomists in the ICTA program. Of course, these trials are not as neat and scientific as ICTA's more controlled experimental work, but they provide data to the research program, and they are of high credibility to the farmers who participate in them. The farmer paraprofessionals working with ICTA went on to extend their work into 11 villages, providing one-on-one technical assistance and holding regular instruction and discussion meetings with the villagers. By 1979 the paraprofessionals in this area were working actively with two large farmer cooperatives, thus further extending their out-reach through linking up with indigenous organizations.

Stimulated by the success of tbe San Martín program, two ICTA peritos in the region of Quetzaltenango took steps to recruit andtrain local farmers in the planning and implementation of on-farm experiments. Working with six paraprofessionals in an adult education program financed by the Ministry of Education, one perito directed a program of 141 on-farm experiments in a single year. Working with six unpaid leaders of a cooperative, the other perito managed a program of 119 such experiments.

This sudden expansion grew beyond the capacity of ICTA to make sysiemaiic observations and measurements of yields in all cases. However, ICTA leaders are enthusiastic over the value of the data acquired and regard the experience as a challenge to ICTA to develop methods of observation and measurement to cope with the expended volume of experiments, which promise to shape the pattern of field activities.

The cost-effectiveness of these perito and paraprofessional projects is impressive. ICTA was paying the San Martín community leaders less than one-half of a perito's starting salary and less than a quarter of that paid the ingeniero. A skillful combination of professionals, technicians, and paraprofessionals makes it possible to multiply on-farm experiments while adding little to the cost of the program. Furthermore, no one who visited San Martín Jilotepeque would fail to be impressed with the enthusiasm and sense of mission displayed by the community leaders working for ICTA. Similarly, the two peritos in Quetzaltenango reported that the paraprofessionals working with them responded with great pride and dedication.

In some countries, agricultural ministry planners have been devising systems of "hardship pay" bonuses to lure professionals and technicians into areas far from the conveniences of modern city life. These ICTA paraprofessionals require no such inducements. They are working where they went to work. They are respected by their

fellow villagers, by whom they are selected, end they gain the satisfaction of enhancing that respect as they serve their community. (Esman et al., 1980.)

In effect, with such programs ICTA was by-passing DIGESA and justifying its activities in terms of its legal mandate to promote the use of new technologies it developed. Whatever the legal justification, this apparent duplication of extension activities raised basic policy questions regarding the responsibilities of the two organizations.

Early in 1978 the directors of ICTA and DIGESA signed a "letter of understanding" laying out general guidelines for cooperation between the two agencies. By the middle of that year the cooperation in two regions had assumed the form of having ICTA offer classes to DIGESA agents. The curriculum, developed jointly by ICTA and DIGESA coordinators, trained extensionists in the practical aspects of conducting experiments with farmers. By 1980 ICTA leaders reported that several ICTA professionals had been appointed to positions as regional directors of DIGESA. Especially in these regions they found evidence of improvement in the relations between the two organizations.

So far such improvements have depended upon the informal initiatives of individuals on both sides. It now seems clear that no resolution of the problems between research and extension can be achieved short of a basic structural change which brings ICTA and DIGESA under the same leadership. Furthermore, although many DIGESA agents should be able to learn how to carry out on-farm experiments with active participation of farmers, as long as they carry the responsibility for the supervised credit program, they will only be able to make token efforts in the new direction laid out by ICTA.

PNIA in Honduras

The Programa Nacional de Investigación Agropecuario (PNIA) in Honduras is noteworthy for the following reasons:

1. PNIA is developing a strong interdisciplinary program with major emphasis given to on-farm research with the active participation of small farmers.

2. PNIA is building its program with substantial influence from other national and international programs and with the active collaboration of professionals of foreign agencies, but nevertheless with its own strong leadership it is developing a distinctive Honduran model.

3. The research program of PNIA has been influenced by ICTA, but PNIA has gone beyond ICTA in developing effective relations between research end extension.

4. In Honduras research and extension are working closely with effective peasant movements. Honduras therefore has a much stronger base among organized peasants than is the case in Guatemala.

Honduras is the poorest country in Central America, yet it may have certain compensating advantages facilitating the development of PNIA. Honduras has a smaller and politically weaker elite of large rural landowners, so that the discrepancies in the distribution of income are not so marked as in the other Central American countries (the comparison here with Nicaragua applied before that country's revolution). At the time the new direction for PNIA was established, Honduras was much poorer in terms of trained professionals in agriculture than other Central American countries, but this lack of enough personnel to establish a strong agricultural bureaucracy seems, at the same time, to have made it easier to strike out in new directions. Finally, Honduras presents an unusual case of highly mobilized peasant movements, thus providing a strong base for a participatory agricultural research end development strategy.

Recent developments in PNIA's strategy have been strengthened by:

1. A major land reform program, responding to the growth of strong peasant organizations which developed particularly under a military but nonrepressive government.

2. A 1974 decision to decentralize the research organization and build up regional units.

3. A CIMMYT-Cornell graduate fellowship program, emphasizing inter-disciplinary research.

Land Reform and Peasant Organization. The Honduran program of land reform followed shortly after the Punta Del Este meeting at which all of the representatives of Latin American governments pledged themselves to land reform at U.S. urging-but only Honduras responded very seriously. Beginning in 1962, the program built up to a substantial rate of distribution by 1964-65. Fifteen years later, 185,000 hectares had been distributed to approximately 30,000 families of peasant farmers. To be sure, peasant organizations are demanding that the government still continue the land reform distributions, but their claims only call for distribution of en additional 30,000 hectares, about one-sixth of the area already distributed. This indicates that the government has already gone a long distance toward realization of a comprehensive national land distribution program.

The peasant movements had their origin in nationwide strikes against the U.S. fruit companies in 1954. Up to this time, strikes had been illegal, but this conflict of

Honduran workers against the foreign companies excited broad popular support and brought about the legalization of strikes. While the strike leaders sounded radical to their conservative observers, they phrased their demands in terms of indigenous populism, rather than in terms of foreign ideologies. This in turn made it easier to integrate the fruit company workers' unions and the peasant movements into the fabric of Honduran society.

According to an AID agricultural sector assessment in 1978, the Asociación Nacional de Campesinos Hondureños (ANACH) claimed to have 80,000 members. The Unión Nacional de Campesinos (UNC) claimed 30,000 and the Federación de Cooperativas de Honduras (FECORAH) claimed 6,000. In addition, an estimated 18,000 to 22,000 workers on banana and sugar plantations were unionized and naturally sympathetic to the peasant organizations. Some indication of the power of the peasant organizations is illustrated by the political elite's response to peasant expressions of concern that the land reform program was being slowed down. In 1972, the peasant organizations carried out a massive campesino march on Tegucigalpa; this precipitated a military takeover of the government. Since the military leaders had come to power in response to the peasant movements, they sought to work out a way of working with peasant organizations.

1974 Regionalization of PNIA. Up to 1974, the agricultural research program had been highly centralized, and many of its critics, including influential people within PNIA, were convinced that it was doing little to help the small farmers. This conviction led to a reorganization of PNIA in terms of regional production centers, much as in the Guatemalan case. The 1974 regionalization thus placed PNIA in a position to work more directly with small farmers, but the methodology for carrying out such on-farm research remained to be worked out.

Interdisciplinary Research. An unusual interdisciplinary research program which contributed to PNIA's evolution stemmed from the conviction of the Director of CIMMYT's Maize Program, Ernest Sprague, that conventional graduate education programs in agriculture failed to equip professionals with the ability to work together across disciplinary lines. Since he believed this ability essential to the success of his own program and to doing good work in international research centers generally, he persuaded the Rockefeller Foundation to support an experimental doctoral thesis research program for half a dozen students, ranging across a number of different specialties. Sprague undertook to interest several U.S. universities in this program, at first without success. He found a generally disinterested reaction, with the professors

refusing to believe that it would be possible to provide really solid education in their specialty if the student also had to get involved in activities carried on by other specialists. Sprague found this negative reaction initially among several professors at Cornell, but there was sufficient support for the idea to overcome this resistance, and a CIMMYT-Cornell program was set up on an experimental basis.

The six graduate students receiving the fellowships ranged across disciplinary lines from entomology, plant pathology, biometry, and agronomy to agricultural economics. Each student spent 18 months in field work at CIMMYT, concentrating upon research in his particular specialty but meeting regularly with other members of the group to discuss their work and thus gain an understanding of the way the various disciplines related to one another and might indeed complement each other in their thesis work and as professionals in a national or international research project in the future. The plan also called for bringing each student's major professor to CIMMYT for joint discussion with CIMMYT staff members and students regarding the group thesis research project on various aspects of maize.*

Following the completion of their thesis research in Mexico, and before returning to Cornell, the six students traveled through several Central American countries. When they visited the Minister of Natural Resources in Honduras, he became convinced that this kind of interdisciplinary collaboration was essential to the research program he was seeking to develop. On the spot, he offered positions to all of the team members. Three of them accepted, and Mario Contreras returned to his native Honduras after completing a doctorate in plant pathology at Cornell to become director of PNIA.

Integrated Rural Development with PRODERO. Discussing the Programa de Desarrollo Rural Occidente (PRODERO) serves two purposes in this chapter. On the one hand, it is an interesting case of integrated rural development, and furthermore it provides us with illustrations of the integration of research and extension. Our interpretation of PRODERO is based upon field work carried out by Lynn Gostyla in July and August 1979.

PRODERO began operation in 1978 in the western region of Honduras, bordering on Guatemala and El Salvador. There seem to be two main reasons that led the government to give special attention to this region. The war with El Salvador in i969

*This aspect of the program seems to have had a very constructive effect on the Cornell campus. Some of the professors reported that they had to travel to Mexico to really gain an understanding and appreciation of the work that their colleagues in other disciplines were carrying on.

created a serious concern for the security of that border. Honduran leaders recognized the dangers of an underpopulated and underdeveloped area that was losing population right next to an overpopulated neighboring country. Furthermore, any government dedicated to rural development could not. fail to recognize the long-standing neglect of this region, which had far less in government services and in physical infrastructure than most other regions of Honduras.

PRODERO is financed in large part by a $20 million grant from FIDA (Fondo Internacional de Desarrollo Agrícola). Plans called for a five-year program, guided for the first two years by an international OAS team collaborating with Honduran counterparts. OAS personnel are plannned to phase out of the project, to move on to a similarly conceived integrated rural development program in another region of the country, so that CONSUPLANE, the national planning agency of the government, progressively assumes responsibility for the program.

PRODERO is an unusally broad-based and encompassing program. While agricultural organizations play leading roles, regional representatives of the Ministries of Public Works, Health, and Education are also fully involved. PRODERO has its own headquarters where leaders of various governmental agricultural and non-agricultural organizations work and have their offices. Since these Honduran counterparts continue to carry certain responsibilities within their Ministries for the region, considerable coordination efforts are required to maintain the integration of the program.

The executive force behind the coordination is the Junta de Desarrollo Regional (JDR) which is headed by a military officer, who, under this military government, has tbe authority to resolve disputes among the agencies involved in PRODERO.

PRODERO aimed to work with and through the local social structure. Although PRODERO, in collaboration with the land regorm agency (INA), has done work with the "reform sector' of asentamientos controlled by the two peasant organizations, ANACH and UNC, PRODERO has been able to move faster outside this reform sector, working with villages as natural social units. This means working with agricultural committees (Comités Agrícolas) where they exist and stimulating their organization elsewhere.

The main emphasis of PRODERO has been raising agricultural productivity. To support this goal, there is a regional agricultural committee (Comité Agrícola Regional) composed of representatives of the various agricultural agencies of the Ministry of Natural Resources.

The OAS person responsible for the research program was Robert Hudgens, a plant scientist, who previously had experience with the Interamerican Center for

Tropical Agriculture (CIAT) in Colombia. Since the only previous research in this region had been done in conjunction with soil surveys carried out in 1977, the research program had to be built almost from scratch. Hudgens was at work for six months before it became possible to place a Honduran counterpart with him. He was then able to bring in two Hondurans who had been working with PROMYFSA (the national maize and bean program), but this background was not all positive. PROMYFSA had been operating more or less independently from the Ministry and had been developing a high input-cost production program appropriate for fertile valley land, but which was incompatible with the long-term farming systems strategy being developed by the National Research Program and preferred by Hudgens for the western part of the country. By August of 1979, Hudgens had seven Hondurans working with him, all ingenieros agrónomos who had completed university instruction but had yet to finish their theses.

One of Hudgens' first priorities was establishing an experiment station. He recognized the danger of creating a situation in which research would center on the station at the expense of collaborative and participatory research with farmers on their own fields. But he believed that an experiment station was necessary in order to carry out certain important research projects requiring a degree of control that could not be achieved on farmers' fields. He also believed that there would be less tendency for the government to abandon agriculture research in this region if the government had a physical structure, with personnel assigned to it, to be financed and maintained.

How elaborate should such an experiment station be? The National Research Program favored a small station with minimum physical investment, while the earlier plans of FIDA favored a larger and better equipped center. Hudgens' plan, being implemented, represented a compromise between these two positions.

We will describe the on-farm research process later, since that discussion can best be understood following presentation of the new role of extension. In ICTA in Guatemala, the surveys, or sondeos, designed to provide agro-socio-economic information about the area in which agricultural research is to be carried out, are implemented directly by research personnel of ICTA. In Honduras, extension staff have taken over this responsibility.

While these surveys have clearly been influenced by the ICTA model, Honduran extensionists have taken quite a different approach to information gathering. ICTA sondeos are carried out in a *given* farming area by teams *of* agronomists and social scientists. Team members go out into the field in pairs, each pair consisting of an

agronomist and a social scientist, and they gather their information through interviews with individual farmers. Team members meet each evening to compare notes on what they have found and to discuss problems and procedures.

In Honduras, for a sondeo of six villages in the same valley, for example, the extension service would send teams of four to six members, with each team being responsible for a particular village. The team would meet with groups of villagers--presumably members of the local Comité Agrícola--to go over the schedule of items on a group basis. The Honduran sondeo is problem-centered, in that it provides little agricultural production information but rather gives a quick overview of the principal problems seen by the villagers. Furthermore, the Honduran sondeo goes further than the ICTA model in gathering information beyond agriculture. The Honduran model is designed to provide demographic information (population, number of farms, number of houses), health information (presence or absence of a local clinic, most common diseases), education (presence or absence of a school building, presence or absence of a teacher, condition of the school building and furniture--if any), local organizations, offices of government agencies, as well as a listing of needs and problems in agriculture. The survey also gathers information on local infrastructure (presence or absence of access road, electricity, potable water, and latrines).

Apparently the field team is able to fill out this schedule inventory a couple of hours of discussion with the local farmers. Each team then prepares a written report. Then the regional director calls the teams together to meet with key research and extension staff and communication media officials. In the area of La Empalizada, for which we have the summary report of the field teams, the oral discussion of each village report was led by team members, in a meeting attended by 13 officials in agricultural research and in extension.

What did extension and research planners learn from such a meeting? They learned, for example, that only one of the six villages had a problem of lack of sufficient land for maize whereas all six villages had serious problems with slugs in growing beans. In other words, the summary report tells the planner what problems are general throughout the area. This type of information helps extension and research to determine priorities in their programs. In this case, if a treatment of the slug problem is known and available in Honduras, extension can seek to provide the farmers of this valley with the needed information and try to help them to acquire the materials to be used. If a method for effective treatment is not known, at least for this particular area, that prompts research planners to give serious consideration to this problem.

Before research activities were begun in the western region, extension people had been frustrated, finding that their traditional approaches were not effective. They came to recognize that they were working in a region quite different *from* those areas from which the standard recommendations for raising corn, beans and other crops had come. The western region is very hilly, with many farms located on land with a 30% grade. These lands also suffered severely from erosion. This meant that the application of fertilizer and other modern inputs generally was a waste of money, as the rains would wash the fertilizer away.

Two of the extension agents in the western region had previously attended seminars conducted by Marcos Orozco, a Guatemalan specialist in soil conservation. The Honduran agents now decided that in this particular region, soil conservation must be the foundation *for* any agricultural production program. They sought out a farmer who was working land on a 30% slope next to a main road, which would make any change highly visible. They persuaded him to work with them in applying the Orozco conservation methods to part of his land. The results were spectacular. The experimental plot yielded ten times the production of the control plot. The farmer and his friends were i npressed, and the word began to spread.

The extension agents went on to organize small independent farmers into committees for the conservation of soil and water. They invited Orozco back to teach farmers his simple but effective methods. They also arranged to have groups of farmers travel to Guatemala to visit the World Neighbors project being carried out under the direction of ICTA by paraprofesionasls in San Martín de Jilotepeque. The farmers returned from San Martín with enthusiasm, and the word continued to spread.

The next step involved a distribution *of* fertilizer and improved seeds. Following Hurricane Fifi, Honduras received substantial disaster aid for agriculture *from* 1974 on into 1976. Some of this material was still available in early 1978. In the past, the extension procedure had been to give away the inputs, thus providing the favored farmers with a benefit for one year but leaving them dependent upon credit and the availability of supplies if they wanted to use the same level of inputs the following year. In the western region, apparently stimulated by the leaders of PRODERO, extension carried out a different plan.

The cooperating soil conservation committees were renamed Comités Agrícolas to indicate their broader scope. Inputs were not distributed to individual farmers but were given out in each village to its own Agricultural Committee. Extension also announced that new committees could be organized in order to get these inputs.

Extension laid down three conditions for receiving this benefit:

1. All members of each committee must enroll in a one-week course on conservation methods and agricultural practices.

2. The inputs were to be used only on land where the methods being learned were to be applied.

3. At harvest time, members would pay back to their own group an equal amount or greater amount of the value of the inputs they had received. They would then be in a position to purchase the necessary inputs for next season. (The money was deposited in the agricultural bank for the period between harvesting and planting.)

The results were impressive. The ten extensionists operating at the start of the program could not keep up with the demand. (Their number was to be doubled the following year.) Demand was so high that the inputs ran out. Robert Hudgens was able to get $3,000 from CATIE to purchase more inputs. When that additional supply ran out, Hudgens and the extension officials prevailed upon AID to put up $15,000. The money came too late for that planting season but was in place for the next one.

Extension had planned to work with or organize 20 groups the first year and ended up with 38, each group having 15 to 40 members. By the second year, extension expected to work with 52 groups, but, being handicapped by the late arrival of money for inputs, ended up with 42.

Extension is now planning to extend its own reach through working with paraprofessionals, known as auxiliares, local farmers chosen by the groups themselves, with each one working with a number of farmer groups. According to the new plans the extension agents will meet with their village groups, one day for each, Monday through Thursday, and have training sessions with the auxiliares on Fridays. The auxiliares are not to be paid a salary but are to be compensated for time lost from their own farm work. It should be noted that some of the auxiliares are already functioning informally, as they emerge out of the group discussion and training sessions. Extension is now developing the same methodology on the asentamientos of the reformed sector, grouping several asentamientos together and having them organize their own agricultural committees.

PRODERO has also worked out new arrangements for farm credit. Previously small farmers in this region could not get credit on a group basis without having legal recognition of their group, without personal identification papers for all members (many have no birth certificate or similar paper), and without a guarantee of the land as collateral. PRODERO has persuaded the bank to abandon all of these requirements and

simply use the prospective crop as collateral. The groups are now putting their money in the bank. The bank loans its own funds at 6% interest to groups which in turn lend to their members at 11%. If all members pay back the money, this 5% difference will become part of a rotating fond, which can be used to install a supply store, a dryer, milling equipment, and so on. The idea is to have the group own such facilities and rent them at a low rate to members and at a higher rate to non-members.

The Research-Extension Process. Since no agricultural experiment station is yet available, research in the western region necessarily begins with farm trials. The first trials were carried out on fields of small farmers, the principal target population for PRODERO. However, Hudgens concluded that it was not feasible on very small *farms* to carry out the variety of treatments planned for a given location. The process now moves through the following steps:

1. Farm trials on fields of the larger farmers.

2. Preparation of packages for maize and beans at three levels of input technology.

3. Passing the package on to extension agents for work with the agricultural committees.

4. Planting the packages in small plots by members of the agricultural committees, with the guidance of extension agents. Since small amounts of material are involved, with a number of farmers working together, this part of the process only takes about a half hour of work in the field.

5. Weekly meetings of each agricultural committee with its extension agent to check on progress and discuss problems.

6. Research people come in, especially toward the end of the growing season and at harvest time, to check on results and to discuss them with farmers and the extension agents.

7. The experiments carried out so far with maize and beans have involved comparisons between the native or criollo varieties with six treatments for each at three levels of inputs.

Farmer Participation. While our field work has not been extensive enough to estimate the extent of participation of small farmers in the Honduran program, the interviews and observations Gostyla was able to carry out suggest a very active level of participation. Even in activities under the direction of a professional, the aim is to achieve a balance in the presentation of information by the professional and the farmers reporting and discussing their respective experiences. For example, extension

communication conducts a radio program every morning from 5:45 to 6:15. A part of this program is devoted to interviews with farmers. Going into the field with a man in extension communication, Gostyla was surprised to find herself participating in the next morning's radio program, as the extension man recorded her interview of a farmer.

Twenty-four farmers were present at the meeting Gostyla was abie to attend of an extension agent with an agricultural committee. Since they represented different levels of education and length of experience with the agricultural committee, it was not an easy task to achieve full and free communication, but the extension agent was able to stimulate such participation. Furthermore, the focus of this meeting was on presentation and discussion by group members of successful and unsuccessful techniques they had used during the past agricultural cycle.

The agent took pains to move the participants beyond general statements that might simply reflect what they took to be the accepted extension doctrine. He emphasized that he wanted them to report their real experiences. At the close of the meeting, the agent promised to write up what they had reported to him and come back for the next meeting with a draft of such a report. After they had discussed it and he had made revisions on the basis of this discussion, he would come back again with a mimeographed report so that each member could have a copy of what had been learned in these sessions.

Gostyla found a high degree of activity among farmers in learning from other farmers and from professionals in other countries. One older farmer, a member of the committee whose meeting Gostyla observed, reported that he had been to San Martín Jilotepeque and had returned very impressed. What had impressed him particularly was the demonstration that there were real and attractive alternatives to traditional practices. Gostyla also encountered a 16year-old farmer who claimed he was getting impressive results with what he had learned locally and in Guatemala. Again the San Mart& visit seemed to have an important consciousness-raising function. The young farmer reported that he had learned much from his father and was now able to teach his father some things too. Gostyla was also impressed with the knowledge these farmers have of the logic of the experiments in which they had participated. She interviewed one member of an agricultural committee that had started with 18 members and now has 38. At the time, he was filling out papers to go on a trip arranged by extension to the Instituto de Agricultura Indígena (Institute of Indigenous Agriculture) in Mexico.

This farmer said that he had earlier used fertilizer but had abandoned it when he felt that it was not working for him. Now he reported that combining fertilizer with

the conservation methods he had learned had more than tripled his yield of maize. The farmer was able to explain in detail the six treatments of maize end of beans in the experiments on his land, not only in terms of the procedures followed but also in terms of the logic underlying each step. He added that so far he was getting better yields with his criollo maize with all inputs than he had achieved with the improved maize under the same conditions, but he was planning to do further testing in order to make sure he came out with the best combination.

Problems of Inter-Organizational Relations. The success of the Honduran program depends in large measure upon development of effective relations between international agencies and local agencies and also upon the coordination of agencies in Honduras. In the early months, PRODERO experienced some difficulties in gaining the collaboration of personnel from various ministries. CONSUPLANE, the national planning agency, had overall responsibility for guidance of this development program, but CONSUPLANE is not an operating agency with an active presence in the region. When inter-agency disputes arose, it was sometimes necessary to appeal to the military governor of the region or to Tegucigalpa for decisions. As the project progressed, such outside appeals for collaboration became increasingly less necessary.

The withdrawal of the international professionals of PRODERO after late 1979 and the expected ending of military rule in 1981 naturally raise the question of whether the pre-existing level of inter-agency collaboration can be maintained or whether each agency will simply go its own way. Since the Ministry of Natural Resources is now more strongly represented in both research end extension in the western region, the government has decided that MNR will assume the leadership and coordination responsibility.

Linking Farmer Organizations with Government Agencies. In recent years, Honduras has moved rapidly in a program of linking farmer organizations with government agencies having responsibilities in agricultural development. The initiative on the government side was in the hands of Rolando Vallani of FAO, working with a small group of Hondurans. They started in 1975 visiting 40 to 45 production cooperatives that were based upon peasant organizations, seeking to determine the factors associated with success or failure of the cooperatives. As they interviewed farmers and attended cooperative meetings, they came to recognize that, although ecological conditions were of some importance in the effectiveness of the organizations, they did not seem to be the determining factor. Some cooperatives enjoying very good ecological conditions seemed to be failing whereas others struggling

under poor conditions were succeeding. They found that the skill of organizational leaders in the internal administration of the cooperative and in its external relations were of great importance. This suggested that they give special attention to ways of developing effective relations with government agencies since this was a factor that was most markedly lacking in general throughout Honduras. If they were able to link cooperatives more effectively with government agencies, the relations between government and the cooperatives could open the way to technical assistance in which government officials could help cooperative leaders to improve the internal administration.

Over a period of two years, Vallani and his group worked closely with seven cooperatives in the area of Los Almendros. This experience further convinced them of the importance of external institutional factors. For example, they found that farmers had great difficulty in getting credit in time to make optimum use of the inputs they purchased.

During this period, leaders of the seven cooperatives began to meet monthly at Los Almendros to discuss credit, production, and internal management problems. In February 1979, these cooperative leaders invited Vallani and his associates to help them plan production for a newly-formed regional agricultural and cattle cooperative, which joined together 18 to 20 local organizations. Vallani accepted this invitation for his own group and also arranged for regular Monday meetings of the regional cooperative leaders with the regional heads of agriculture-related agencies: the Ministry of Natural Resources, the agricultural bank, the Instituto Nacional Agraria (the land reform agency), and INFOCOOP (the government agency charged with assisting cooperative development). The production plan for the first year covered 700 hectares to be planted to maize and beans (beans taking up about 210 hectares of this area). Interestingly, they did not at this stage work out an intercropping program but planted each crop separately.

On the basis of information locally available from agricultural researchers in the Ministry of Natural Resources, Vallani and the regional leaders worked out a production plan to present to the bank. They figured the costs of improved seeds, herbicides, fertilizer and chemicals to combat plant diseases. They also estimated what they would need from the bank for purchase of tractors and their attached implements, to be owned by the regional cooperative. The regional cooperative now has its own pool of machines, hires its own mechanics, and has trained tractor drivers. Each individual cooperative contracts with the regional cooperative for services of tractor and driver.

The first regional cooperative arranged to finance its crops with a $250,000 bank loan, an amount ten times what any local cooperative previously had been able to secure-and the loan money this time was available when needed. It also arranged a $250,000 bank loan for the purchase of equipment. The regional cooperative then constructed a building for the machines and also for crop storage.

It is now becoming a policy that one or two percent of the amount borrowed by the regional cooperative for inputs and equipment would be added to the loan to cover costs of administration. In the regional cooperative, administrative costs are kept at a minimum, since most of the administrative services are performed by unpaid officers, but there is of course a need to compensate the regional leaders for travel and living expenses as they move around for their cooperative meetings and for their consultations with government officials.

When we visited Honduras in early 1980, the Vallani group had not yet finished analysis of the results of the previous crop year, but preliminary indications pointed to a yield of maize more than double what had been secured during the previous year. Vallani reported that the weather conditions and especially the amount of rainfall had been practically identical for the two years.

The success of thii first regional cooperative effort attracted widespread attention as news of this spread rapidly through the ANACH organization. By early 1980, six other regional cooperatives had been formed, and Vallani noted growing interest throughout the countryside in moving beyond the local cooperative base toward regional organizations.

February 1980 marked another major step forward organizationally as ANACH and the government began regular monthly meetings in Tegucigalpa between the operating heads of all agriculture-related agencies and the leaders of the regional cooperatives in various parts of the country. If we consider the formation of a local cooperative as a first-level organization, and the organization of a regional cooperative as a second-level organization, then we note that this program of monthly meetings constitutes a third-level of organization. The farm leader involvement at this third level provides the organized smell farmers with channels of influence on broad questions of agricultural policy and on administrative problems of government agencies serving the rural population.

Vallani emphasizes the importance of the production plan as a basis for economic advance and organizational development. Working out the production plan gives the regional cooperative leaders and the Vallani group valuable experience in gathering and

interpreting information and developing the organizational base for the utilization of that information. The successful execution of the production plan provides the financial reward that strengthens the commitment of members to their local and regional cooperatives and gives the regional leaders the sense of success that encourages their further work.

The organizational development described here seems of particular significance in building linkages between the small farmers and government agencies and in securing accountability of those agencies to the base organizations they are expected to serve. This three-level organization of cooperatives, linked with government officials at every level, helps to secure coordination of action on the part of the bureaucracy in relation to the needs end interests of the peasants. The organization also provides pressures toward government accountability, as local and regional leaders push for service improvement in all fields.

Vallani has observed a rapidly growing demand for training being voiced by regional cooperative leaders. Furthermore, contrary to the situation that traditionally prevails in which government bureaucrats themselves decide what training peasants need, and then go out and try to persuade peasants to submit themselves to such training, in Honduras regional cooperative leaders articulate the needs that they and their members feel. This provides some assurance that the training the government offers will meet really felt needs. Therefore it is likely to be more valuable to the farmers than any training that government officials simply tried to sell them.

In this situation also the open and active expression of needs on the part of local and regional leaders provides valuable guidance to government officials in planning ways in which to develop its own training programs. For example, the farmer leaders have made it clear that they and their members have been persuaded of the advantages of cooperation and do not need further emphasis upon the philosophy and ideology of cooperation. They are more interested in training in accounting and record keeping, in production planning, and other technical subjects directly related to production planning.

It is important to note also that this three-level organization has enabled the small farmers to achieve enormous economies of scale at minimal cost to the government. The cooperatives manage themselves and operate with their own funds. The cost of administering the regional cooperatives and of financing the meetings of their leaders in Tegucigalpa is covered by bank loans, which the regional cooperatives repay to the bank.

Economies of scale are also offered to the government through its dealings with the organized farmers. To be sure, the effectiveness of the farmer organizations may require government to make expenditures and undertake activities beyond those planned in a traditional organization. But these additional expenditures are more than counterbalanced by substantial economies of scale achieved as research, extension, and the agricultural bank no longer have to deal with individuals or small groups. In those regions where cooperative organizations are strong, they now deal principally with the regional cooperative leaders who aggregate the information and interests of their members for consideration of government officials, while the government in turn provides information, financing, and technical assistance to the regional leaders, who in turn manage the physical facilities and human activities required for efficient farm production and marketing.

If the government were required to hire and train its own employees to perform all of the functions performed by local and regional cooperative leaders, the costs would be enormous, and we can be sure that the results would be far less satisfactory to the people being served. Furthermore, the experience local and regional leaders are gaining constitutes an impressive enrichment in the human resources developing in the countryside, as the peasants organize to meet their own needs instead of depending on paternalistic government.

## Conclusions

Having traced in earlier chapters the evolution of some of the basic ideas underlying participatory strategies for agricultural research and development, in this chapter we have examined the implementation of such strategies in two national programs. As noted, implementation requires solving two basic problems of organization structure and social process:

1. To devise a system of on-farm research built upon the active participation of small farmers, and

2. To integrate the on-farm research program into the already established national programs of experiment stations, extension, credit, and marketing.

In Guatemala, ICTA developed a promising new system of on-farm participatory research with smell farmers. As we have seen, this new approach was not invented all at once and then applied in the field. ICTA people began with a general sense of direction and then designed and redesigned the system on the basis of active involvement with small farmers.

The ICTA system has proven innovative by adopting a "non-traditional" starting point for on-farm research. Instead of starting by trying out on farmer fields the ideas and technologies developed on experiment stations, ICTA staff began with intensive field studies of the farming system currently being practiced by small farmers in the area of research.

The utilization of such research by staff outside of the Socio-Economic Unit was initially held back by two factors:

1. The studies were at first carried out entirely by social scientists organizationally separate from the plant scientists. This naturally reduced their credibility with plant scientists, who dominated ICTA.

2. At first SE took a full year to get from the beginning of its farming system studies of an area to the submission of its final report. Therefore, plant scientists could argue tbat, even if they accepted the scientific soundness of the SE studies, the methods used were too slow and not cost-effective.

ICTA resolved both problems by forming integrated survey teams of social and natural scientists to work together in the field and also by developing an abbreviated methodology that provided area data from a two-week field work period. Leaders of ICTA concluded that the short-cut method produced data quite adequate for project and program planning.

We have also traced the sometimes difficult and awkward process of fitting this new element of on-farm participatory and interdisciplinary research into the previously established national programs. To achieve its full potential, this new style of research had to progress through a series of organizational changes, with SE beginning as a unit attached only to national headquarters and then fitting itself also into the regional level of organization.

Concluding our study of experience in Guatemala, we have noted one major unresolved problem: the ineffective relationship between an innovative research organization and a traditional extension organization, although it should be said that such ineffective relations are all too common elsewhere in developing nations. This problem was addressed differently and resolved in the Honduras case, where the parties have made great progress in improving the research-extension relationship.

The leaders of PNIA profited greatly from their study of the ICTA model, but they did not simply copy that model. Well aware of the deficiencies in the research-extension relations in Guatemala, PNIA leaders developed field operations in which extension agents were no longer passive recipients of ideas and information furnished to

them by researchers but rather they became active participants themselves--together with farmers-in the area farming system surveys. Furthermore, in examining PRODERO, we have seen Honduras carrying out an integrated rural development program, within which agricultural research and extension play prominent roles but also work closely with regional officials and active villagers on problems of credit, marketing, health, and education.

The two cases also demonstrate the importance of local-level farmer organization in agricultural R and D. Regardless of the quality of the interpersonal relations involved, a one-on-one relationship between the agricultural professional and the small farmer is inherently inefficient. It is far more cost-effective for the agricultural professional to work with and through an organized body of small farmers. ICTA took important steps in this direction but was limited by the jurisdictional claims of DIGESA for responsibility for diffusion of innovations. Leaders in Honduras profited both by a much more effective research-extension relationship and by local organization based upon widespread and active peasant movements. Instead of regarding such peasant organizations as threats to government--a view common in other countries-Honduran leaders chose to work with and through these grass roots organizations. Furthermore, we have seen Honduras taking important steps to link these peasant organizations with government agriculture-related agencies at regional and national levels. Instead of limiting agricultural planning to national officials, Honduran officials are beginning to work on collaborative planning with officers of regional cooperatives.

In emphasizing the importance of active farmer participation *in* the R and D process, we do not mean to exaggerate the capacities of the small farmer or to minimize the potential contributions of the professional. The farmer is not likely to know what new genetic materials or other new inputs may be available or which might be provided through further research. But, with regard to his own farming system and the conditions affecting it and the needs and interests of his family, he is the resident expert. The professional can bring to the attention of the farmer new materials and new ideas, but they will be useful contributions only insofar as he learns from the farmer how to fit them into the agro-socio-economic system of the farm and the community of farmers. Furthermore, the participatory approach requires the professional to abandon efforts to "sell" new ideas to small farmers. The professional can serve the smell farmer best insofar as they can work together to devise and define new options among which the farmer does the choosing.

## Chapter V:

## FARMER ORGANIZATION AND PARTICIPATION AS KEYS TO AGRICULTURAL RESEARCH AND DEVELOPMENT

Our review of experience leads us to underscore the special importance of organization and participation as keys to development. At the lowest level of organization, this implies a focus upon the rural family and household as the basic unit rather than upon the individual farmer. Conventionally, economic analysis deals with the interrelations of land, capital and labor, with the latter viewed in terms of separate, individual units-an unrealistic view of the world of small farmer families.

If we are to understand the behavior of farmers, we must view the community and the world as they do. We find that small farmers tend to think not simply in terms of individual material gains or losses but in terms of the economy of family and household. To understand the social economy of the household, we need to know, among other things, the number of people potentially available for agricultural and other work, and their ages and sexes, which tend to determine what kinds of work are possible and appropriate. We also need to recognize that, for many small farmers, income is not limited to what they produce on the farm. Many work part-time on the family land, while other members of the family may have sources of income entirely off the farm.

Within the limits of strength and endurance, farmers tend not to give great weight to the cost of labor which family members put in on their own farms--except when providing additional labor on the farm would mean giving up other earning opportunities or would require hiring non-family members to accomplish the additional tasks. If a change in the management of the farming system would require substantially more labor than has been customary in order to achieve increased yields and income from the farming activity, we need to consider whether there would bc enough family labor to do the additional work required. One needs to consider whether, in order to provide this extra labor, family members would have to give up earning opportunities off the farm. Of course, much will depend upon the timing of the additional labor requirement, but farm families cannot rearrange work schedules simply at will.

It has been commonly assumed that in many developing countries there exists a large pool of labor not fully utilized on the farms so that farm families can readily increase their incomes through taking on additional tasks that would increase production. While this situation varies from country to country and from region to region, various studies have indicated that the notion of surplus labor on the

farms may be largely a myth invented by city people (Norman, Pryor and Gibbs, 1979, and Cleave, 1977). To be sure we often find slack work periods when family members have little necessary work to do on the farm, but the potential for introducing changes should not be judged according to the availability of labor in slack periods. It may be that while the family has more then enough labor available for much of the year, its members are fully occupied and must even bring in additional labor to work during peak periods such as planting and harvesting.

Agricultural economists have usually been inclined to assess the feasibility of employing additional labor for an innovation by looking at the increase in yields and income that might come from that innovation. They are then often puzzled when farmers fail to adopt an innovation that would seem to offer a marked increase in their income from the farm. However, it may be quite rational economically for the farmer to reject a particular innovation if it means giving up comparable or better earning opportunities in other activities, if it means extra costs in time and money for hiring and managing non-family labor, or if it involves serious sacrifices of rest or leisure.

We need to address issues of availability of labor and potential labor shortages because these questions have so often been overlooked. The capital shortage question is much more commonly recognized *and* therefore needs little discussion. As we have seen, this is not only a question of the availability of capital, where the small farmer is generally at a distinct disadvantage, but it also involves the timeliness of delivery of credit. So often one hears farmers complain that the money they need is available only a month or so after they can make best use of it, that one wonders whether agricultural credit agencies have a system that guarantees the late arrival of loan money.

We must also consider the factor of risk when studying farmer behavior in relation to credit. Most advances in agricultural technology require expenditures beyond the farmer's customary level, and some require very substantial additional amounts of money. In evaluating the cost relative to benefits of new agricultural technology, it is not enough to demonstrate that the farmer who adopts the technology will be substantially better off financially on the average. As the importance of risk has come to be more fully recognized, agricultural economists now attach importance to the deviation of income from year to year as a way of assessing risk, in addition to calculating average yields and incomes.

When a small farmer is operating without credit, he may grow enough in a good year to feed his family and have a small surplus to sell in the market. In a bad year, he may be hard pressed to feed his family and has no surplus to sell; but still he can adjust

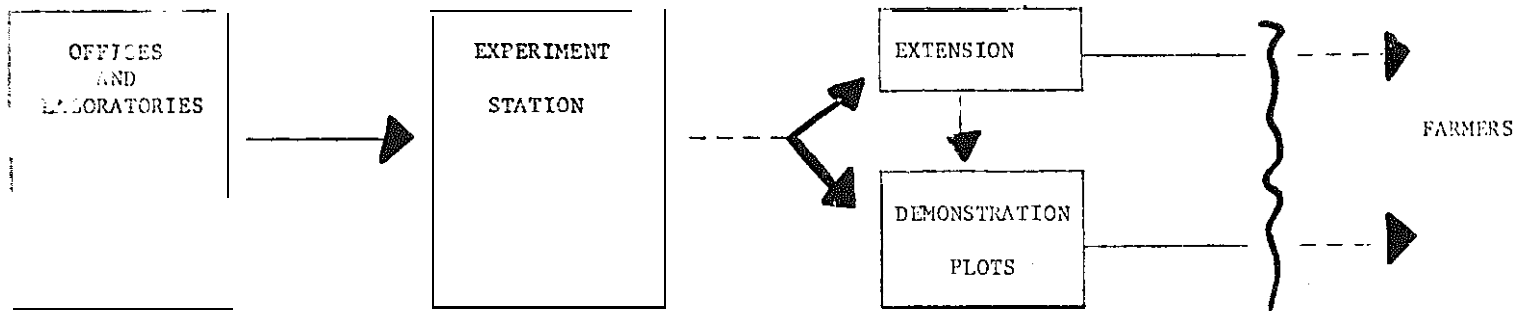
to that adversity as his father and grandfather before him did, by reducing consumption or getting consumption loans. If he borrows money to improve production, he may come out substantially ahead financially in a good year, but a bad year wi!! leave him with little or nothing to sell in the market and therefore unable to repay the loan. If he has pledged his land as collateral, he runs the risk of forcing himself (and future generations) into the class of landless laborers.

Recognizing the importance of the family and household as the smallest organized unit of rural society, we need to consider how that smallest unit can be linked more effectively with the socio-economic and political structures of the area, region and nation. Our principal concern here has been to discover how small farmers can be better integrated into the social process of agricultural research and development. We have argued that top-down, paternalistic programs are not likely to be successful for assisting small farmers and for benefiting small farm families, no matter how benevolent the intentions of the planners and administrators. Farming systems are so complex and the constraints which farm families need to work within so numerous that relevant research findings and effective extension advice are unlikely to be forthcoming unless intimately related to the experience, perceptions and realities of small farmers.

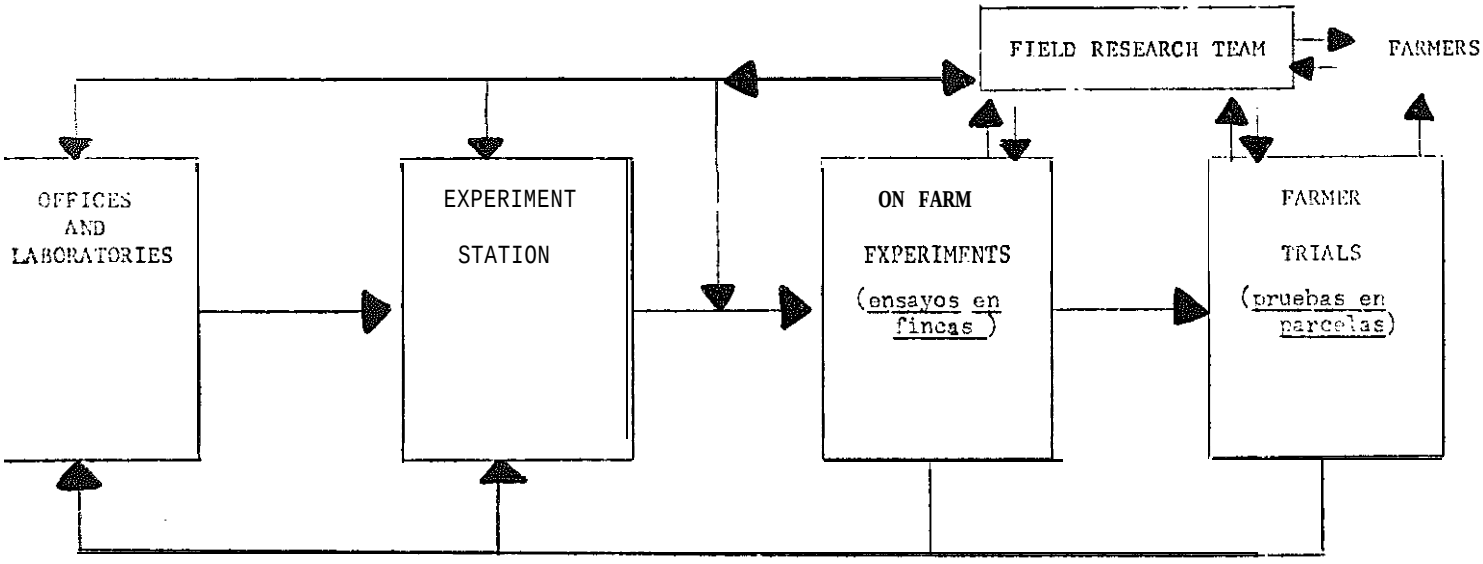
We therefore need to re-conceptualize the organizational approach to agricultural research and extension. The accompanying diagram on page 84 illustrates the structure and social processes of agricultural R and D under a conventional system and contrasts it with emerging new systems. The second diagram is based upon the ICTA model in Guatemala, but the principles involved would be the same in all emerging systems involving on-farm research with active participation by the small farmer.

These diagrams indicate how government programs can be restructured so as to facilitate peasant participation. This is indeed an important advance over traditional bureaucratic systems, but let us not think that this restructuring of the research and extension activities of government is sufficient to provide small farmers with the help they need. Such restructuring of research activities, based upon the voluntary decisions of high officials to allow peasants to get into the act of agricultural research and development, may not have profound effects by itself. The officials who initially developed such a system of participatory research with the farmers might later be supplanted by other officials whose interests are linked with those of large farmers and agri-business or who see small farmer development problems stil! in traditional trickle-down terms. In such an event, the agricultural and social scientists in the field would lack the support needed to sustain the participatory program.

Figure 7




**Traditional Agricultural Research and Development Model**




**Evolving New Agricultural Research and Development Model**

Whatever the rhetoric of its spokesman, in a traditional bureaucratic organization the official in the field is really accountable to his superiors; how well or poorly he meets the needs of the farmers he is supposed to serve may have little bearing upon his career. Those who please superiors and do not run afoul of powerful interests do the best in career terms. If farmer participation is to fulfill its potential for contributing to social development and economic growth, it must be supported by a major shift in accountability so that the staff in the field are accountable for their performance to farmers as well as to their superiors.

How is that shift in accountability to be accomplished? Most significantly through organization and increasing the resource base on which peasants act. If the small farmers gain more resources, they become less dependent upon others, including government, and gain more influence when acting toward government agencies. Land reform provides one major avenue toward increasing the peasant resource base. This has been an important factor in Honduras. Land reform is such a large subject in itself, however, that we cannot deal with it at any length here. While land reform may be a necessary condition for the improvment of the lot of the rural poor in many developing countries, it will rarely be a sufficient condition. Without access to land, there is of course no way that one can be a farmer. Still, making a living for one's self and family largely or entirely on the land requires other resources besides land. If the rural poor are to benefit from land reform, the change in land titles must be accompanied by an improvement in access to the other resources needed to make the land fruitful.

We should recognize that organization is also an element of rural infrastructure, as important as roads or markets, potentially offering economies of scale and mobilization of resources. An effective organization can provide its members with access to credit more efficiently and on a more timely basis than would be possible for the individual members. By pooling members' purchases and sales, the organization can buy more cheaply and market more efficiently end profitably. Organization also makes possible investments in machines, equipment, and buildings that would be beyond the reach of individual members or small groups.

On the other hand, as small farmers organize, the problems they face grow in complexity, end many cooperatives have failed because of inability to manage this increasing complexity. The management of cooperatives therefore requires an increase in the quality of the human resources charged with cooperative administration-in other words, members and particularly organizational leaders need to learn new skills, and the organization needs to fiid ways of training its members.

We have traced the evolution of ICTA from its on-farm experimentation with small farmers to paraprofessionals working on research end development with cooperative organizations. With PRODERO in Honduras, we have described the growth of village associations based upon the management of an agricultural credit program. Also in Honduras, we have considered the development of the peasant movement known as ANACH and shown how its local base organizations are being linked together in regional cooperatives and how the officers of those regional cooperatives have established a third-level organization, effectively linking them with government officials at the regional level and also at the national level. Small farmers are collectively gaining access to power end resources out of their reach as individuals.

in Honduras, we have seen how government officials are able to facilitate the organization of small farmers and aid in linking them with government agencies. However, the national organization of the peasant movement already existed in Honduras, quite independent of government support and assistance.

We recognize that peasant organizations may be seen by many politicians and government administrators as a two-edged sword. The leaders of non-participatory governments may indeed recognize the economies of scale made possible by peasant organization but *will be apprehensive about the political potential of such movements. They recognize that an organization formed by peasants primarily to pursue economic goals will make various demands upon government and may become a potent political force. Even if government leaders are prepared to accept the political potential of peasant organizations, they may not find it easy to intervene in such a way as to stimulate and support this type of development. One of the key problems involves learning how to assist and facilitate without creating dependency. Let us consider here several cases that suggest at least partial answers.

The FORUSA (Fomentadora Rural S.A.) model of rural development corporations provides an interesting test of the possibility of stimulating agricultural development through the private sector. This grew out of experimental work by the U.S. agriculturist, Simon Williams, in Mexico and particularly in the Guadalajara region. Having shown promising results from his small-scale experimental work with small farmers, Williams persuaded the leaders of the ICA group, a large Mexican engineering, manufacturing, and construction corporation, to finance a prog. am designed to discover whether it would be possible for a rural development corporation to work with small farmers in ejidos and improve their yields and incomes to such an extent that the farmers would ultimately be willing to pay enough for the technical assistance to cover

its costs.* Those establishing the FORUSA model recognized that it would not be possible to cover any more than a small fraction of the annual cost of the technical assistance in the first years cf a given project but hoped that the increasing success of the project would eventually generate income to cover its costs.

FORUSA is involved in projects in three communities in the rural area around Guadalajara. In the project most successful there so far, five years after the project had begun, 89 families (out of about 250 families of the ejido) had a functioning cooperative which was served by one agronomist full time. The three projects jointly were served by an agricultural engineer responsible for development and improvement of irrigation and by an accountant responsible for providing instruction and technical assistance in record keeping and financial management, plus a program manager. The cooperative we visited, Zacotipán, had been able to purchase and manage eight tractors, two threshing machines, two large trucks, and two pickup trucks. The purchases were financed by loans from a private bank, arranged with the assistance of FORUSA, with the final payment on the loans to be made in 1980.

The farmers in this community, with the guidance of FORUSA, are concentrating particularly on raising sorghum. Each family farms eight hectares and pays approximately $10 per year per hectare for the technical assistance it receives through FORUSA and its cooperative society. Before the start of the agricultural cycle each year, the farmer works out a production plan, with the advice of the FORUSA agronomist. The plan provides in detail for the amount of seed, fertilizer, insecticides, and other inputs to be purchased and also for the number of days of machine work to be contracted for with the society. The total of these figures, plus the technical assistance charge, with the subtraction of the cash the farmer is able to put up, yields the amount the farmer will borrow from the bank that year.

Throughout the growing season, the agronomist is in the village every day observing and consulting with the farmers. When he is called upon to give advice on a particular problem, he not only presents the advice orally but also writes it out and gives the farmer a copy for his record. These technical assistance records, together with the annual record of expenditures and yield and income from the farm, provide the basis for systematic farm production records. With leaders of the cooperative society, the agronomist visits the market and makes arrangements for delivery and sale of the

*An ejido is a rural settlement in which families control and farm roughly equal parcels of laud. The family can pass the farm down from generation to generation, but it cannot (legally) be sold to outsiders.

produce. Each farmer accompanies the truck with his produce to the market and observes the process of weighing his crop and calculating the yield per hectare and the amount of money he receives.

When we visited in early 1980, the cooperative was taking the next steps to intensify its economic activities. Members were establishing a feed lot for the fattening of cattle on the basis of their large production of sorghum. They reported that they had more than doubled the sorghum yield and that they now found it more profitable to invest a portion of this yield into animals rather than sell the crop wholly to the market. FORUSA had also worked out with the cooperative leaders an *arrangement* whereby a manufacturer of trousers would set up a small plant in the village, provide machines and instruction in their operation, plus the materials. The workers in the plant were to be mainly women, wives and children of the co-op farmers. The cooperative was also about to establish a bee and honey production project.

At the time of our visit, when the income to the farmers was limited to the crops they grew, the technical assistance payments farmers made to FORUSA appeared to cover less than the salary of the full-time agronomist allocated to that rillage. Tbus FORUSA was in effect subsidizing them to the extent of one-third of the time of the three additional officials, the accountant, the agricultural engineer, and the Guadalajara FORUSA manager, plus their share of additional expenses for transportation of staff members, secretarial expense, and office operation in Guadalajara. FORUSA officials expected that the additional economic activities stimulated and guided by FORUSA would steadily narrow the gap between expenses and income, though clearly by mid-1980 they were still far from their goal in the Guadalajara area.

FORUSA officials report that within four years of the establishment of projects in the area of Tampico in the tropical lowlands, they have been able to reach a point of covering 50 percent of their expenses from technical assistance fees. They explain the more rapid progress in this area in terms of several factors. In the Guadalajara region, they were dealing with established communities where the poorer villagers have long been dependent upon their more affluent neighbors for loans and other favors. This naturally created a situation in which the freeing of the villagers from dependence upon traditional leaders represented a threat to those leaders and generated considerable opposition. By contrast, the projects in the Tampico area served a new colonization area where the families settling there were newcomers, not yet tied in with economic relations of domination and dependency within their own community. Probably still

more important is the fact that in the Tampico area each family has 20 hectares. Furthermore, since the Tampico farmers can fit in two agricultural cycles a year, whereas around Guadalajara only one is possible, it is as if the farmers in the lowlands were farming 40 hectares, compared to 8 for the farmers in the Guadalajara region.

When we consider the number of hectares involved in the Guadalajara region, we recognize the limitations of the FORUSA strategy. In fact, FORUSA spokesmen themselves do not argue that their strategy will work with the poorest farmers. What is the minimum size farm that would support a FORUSA model, under varying ecological conditions, remains to be seen. One should not rule out the FORUSA model for smaller farmers but rather recognize that in some situations, if the model is to be successfully applied, the rural development corporation must have some kind of subsidy. Such a subsidy can only be expected to come from government. In fact, in 1980 ITCO, the Costa Rican land tenure and colonization agency, was planning to start an experimental project whereby the government agency would set up its own rural development corporation, and that corporation would provide technical assistance to communities of farmers in an area where a large dam and irrigation project was to increase substantially the agricultural potential of a wide area.

Let us consider another example, a government-sponsored project at Zacapoaxtla in Mexico which grew out of the original Puebla project. The officials there had started agronomic experiments but discovered that the farmers had so much practical knowledge that the experiments could only provide them with marginal assistance. The officials then shifted their attention to organization. This led them to work out a strategy of linking together consumers and marketing cooperative activities. In the process they built support and capacity which could promote improvement in agricultural technology. Farmers in this area were having to pay up to 11 pesos for a kilo of sugar in private stores. Project leaders were able to work out a program to purchase sugar in bulk from a state organization at a price close to two pesos per kilo. The attraction of a much cheaper price for this staple provided the basis for consumer cooperatives. Project personnel then helped the cooperatives to contract with a state agency that provides other staple goods and canned produce at prices designed to favor people of low incomes. With the attraction of the substantial savings on essential food and household products, the cooperatives were able to expand their membership rapidly. Project officials then helped the villagers to plan and organize their agricultural production, pooling their needs and interests so that they could bargain more effectively in the market. This movement grew rapidly. The first ten cooperatives

were organized largely by staff people but after that the idea spread, and other cooperatives were formed, often having only casual contact with staff members.

Project staff then helped get leaders of the various cooperatives together in regular meetings to discuss and plan their purchases and sales. We attended one of these meetings in 1980 in which representatives of over 40 cooperatives engaged in an active discussion regarding the chemical composition of the fertilizer they needed, 'how much was needed in each village at what time, and so on. Project officials explained that before the regional cooperative was organized, small farmers were at the mercy of the state and private organizations producing and selling fertilizer., They had to take whatever chemical composition of fertilizer was most convenient for the companies to supply and to take delivery when it was most convenient for the companies to deliver it. Now, since they could purchase in large volume, they could specify exactly the chemical composition that they bad found most effective for each area and also negotiate the date of delivery for each village. With the organization thus providing major economies of scale, the farmers in these villages were rapidly increasing their yields and incomes.

The farmers' associations created in Taiwan represent a more comprehensive organizational strategy. Under this system, the rural community becomes in effect a cooperative organization along lines structured by government. The Ministry of Agriculture supports the system by channeling supplies of fertilizer, seeds, tools, machines, etc. to the farmers through the farmers' association and purchasing their crops through the association. Officially, membership is not compulsory, but the induce- ents are such that nearly all farm families do in fact join (e.g., they could not buy fertilizer unless members). This gives the association a much broader and stronger base than found in the case of the FORUSA-sponsored society, in which membership is entirely voluntary. The buying and selling transactions of the farmers' association provide the association with resources for operating its own physical facilities (warehouse, store, etc.) and for employing at least a manager and an agricultural production professional While government establishes qualifications for the agricultural production professional, members of the society have had power through their officers to appoint him and discharge him. Under this system the extension agent becomes accountable to farmers through their organization (Stavis, 1974).

With practically all farmers in the community as members, the association can manage public works for the benefit of agriculture. For example, the development and improvement of irrigation systems under the FORUSA model necessarily involved

negotiating delicate arrangements with nonmembers so that irrigation channels could cross their lands to reach the lands of the members. Under the farmers' association system, the total agricultural area of the community can be treated as a single unit. This larger membership also gives the farmers' association a greater investment capacity than is likely to be found in a comparable agricultural area where cooperative membership is voluntary. Also, of special relevance for our review here, the FAs conduct local trials and experiments to establish what are the best crops, varieties and practices for agriculture in their locality.

Students of Taiwan generally credit the farmers' association with having played an important role in the extraordinary progress in agricultural development achieved in Taiwan. Planners impressed with that system have attempted to adapt the model for use elsewhere. For a time it was the favored model in agricultural development in Malaysia and gave some good initial results. However, the government took measures to secure more direct control of the associations than has been the case in Taiwan. This change appears to have robbed the associations of much of the strength of farmer participation that led to early signs of progress.

It is not our purpose to present any ideal model for peasant participation in development. What is best for any country and task depends in part upon the nature of the organization but also upon the culture and social and political relations of that country. Here we are concerned with identifying the general principles involved in the organization and stimulation of peasant participation.

All these cases suggest the importance of changing the usual accountability relationships so that professionals are responsible to farmers as well as to their administrative supervisors. As long as staff in the field are accountable only to their organizational superiors, peasant participation in the process will depend upon the good will of those superiors and upon staff skill in stimulating and guiding activities providing for peasant participation. Given the rapid turnover of higher level agricultural ministry officials in many countries, a leading official who has promoted a program of peasant participation will often be followed by an official who is indifferent to that objective or actively opposed. In such a situation, government-stimulated peasant participation is bound to wither away.

Accordingly, if agricultural R & D programs are to be the mainspring of accelerated progress involving small farmers, policy makers must make some changes which give small farmers as a group greater control over productive and organizational resources. In this way they can help to hold government staff accountable for

performance in the interest of small farmers. This should be seen in the broader context of local organizations and local governments generally. Many developing countries have highly centralized governments. In these situations, important regional and local officials may be appointed directly by the central government. Even their being elected does not always assure their accountability to local residents because of socio-economic biases. In some countries local governments have no taxing power beyond small fees collected for local services. For any major effort, therefore, they are dependent upon funds from the central government. This situation favors the advancement of local officials who can claim to be able to cultivate the friendship and support of officials in the central government and therefore to bring government handouts to their community. Our analysis thus suggests that where such a dependency situation prevails, agricultural and rural development for small farmers will be slow and their incomes will lag far behind those of other segments of the population.*

## Conclusions

As we have seen, a one-on-one relationship between agricultural professionals and small farmers can hardly be cost-effective. The conventional research-extension model presents a dual problem. On the one hand, it is inordinately expensive to get technical assistance to small farmers on an individual basis. On the other hand, the difference in status and power between the professional and the small farmer is so great that communication is impaired and professionals are not responsible to farmers for their performance anyway. This leads to less conscientious and responsive assistance than is needed to produce widespread agricultural innovation.

Farmer organization can change this situation in basic ways. Working with organizational leaders, the agent can greatly extend the impact of his work. Furthermore, collective organization changes the distribution of power substantially. The small farmer is no longer simply the passive recipient of the initiatives of the professional. He now has some organizational leverage to initiate action with the professional. And if that official does not respond, and if other farmers share his views,

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*This proposition is supported by studies conducted by the Cornell Rural Development Committee of local organizations and rural progress in Asian developing countries. They found that in general the countries having the strongest and most active systems of local organization were those which were progressing most rapidly in rural and agricultural development. (Uphoff and Esman, 1974.) A state-of-the-art paper in preparation by Esman and Uphoff is examining in more detail the organizational dynamics and requisites for involving and assisting rural communities.

the small farmer can use his organization to bring pressure to bear upon the superiors of the local staff. This makes possible (though it does not guarantee) the development of a collaborative relationship between small farmers and government officials.

To be sure, local organization is not a sufficient condition for the progress of small farmers. Government bureaucracies are often so complex and their power centers so far from the local scene that local organizational leaders may be frustrated constantly unless they are able to establish linkages with intermediate power centers that can help them to reach decision makers and to secure coordinated action on the part of the various government agencies which are involved in rural development. In our discussion of Honduras in Chapter 4, we examined a case in which a peasant movement organized local cooperatives and those cooperatives joined together to form a regional cooperative, and, finally, the regional cooperatives joined together to gain a voice in agricultural policy-making nationally. We have seen also how technical assistance by government officials played a vital role in helping the cooperative movements to establish the coordinating linkages with government at regional and national levels. Such an organizational evolution greatly strengthens the capacity of a national system of agricultural research and development.

## Chapter VI:
## ASSESSMENT OF EXPERIENCE

In reviewing the emergence of new models for agricultural research and development, we have noted some impressive indications of progress, but there is still much to be done if the lessons learned from decades of research and experience are to be put fully into practice. Let us here take stock of both problems and progress, first placing our studies in the context of agricultural and general economic development strategies practiced over the last half century.* We will then summarize the principal features of the emerging new models we have studied, and finally, consider the major problems to be overcome if those new models are to develop to their full potential.

One of the most encouraging aspects of the trends we see has been the convergence of thinking of plant and animal scientists, on the one hand, and social scientists, on the other. Fifty years ago there was a clear separation between agricultural development policy, on the one hand, and socio-economic policies, on the other. While European agricultural production efforts in the colonies had concentrated upon monocultural projects based upon plantation agriculture oriented principally toward the export market, in the U.S. agricultural development planners had little involvement in developing countries. They were concerned particularly with helping U.S. farmers to overcome the impact of the great depression. Domestically, government planners and social scientists alike were concerned with policies and programs to improve the welfare of the rural population. In practice, this meant moving into price supports and acreage limitation policies designed to avoid over-production and maintain prices in order to offer farmers a standard of living comparable to that of the urban population. Compared to later decades, there was relatively little official concern for direct productive assistance to poor farmers. The prevailing theory followed the trickle-down model. Extension agents would bring the benefits of research to the "progressive farmers," and the others were expected to adopt an innovation when the "progressive farmers" had demonstrated its value.

The post-World War II period (1945 through 1960s) ushered in major changes in international agricultural development programs. Recognizing that the colonies were moving toward independence, European agricultural researchers and development planners began to shift emphasis toward crops to be produced primarily for domestic

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*This line of interpretation was suggested to me by Damon Boynton.

consumption. However, the prevailing pattern of research continued to show a strong monocultural emphasis, and the plantation experiment station was ill-adapted to any program of active involvement with small farmers.

'This period witnessed a surge of U.S. activities in international agriculture, stimulated first by cold war political concerns regarding competition with communism and supported by the great success of the Marshall Plan in the rebuilding of European industry. In agriculture development, planners pursued a technology-transfer model, assuming that technologies developed in the United States were directly applicable in developing countries and furthermore that the U.S. extension service model was the essential vehicle for accomplishing this transfer. Agricultural research in the United States and in developing countries continued in the monocultural mode, culminating in what we have come to call the green revolution, which came into use around the world in the 1960s and 1970s. This involved the development of high yielding varieties along with use of fertilizers, pesticides, herbicides and improved agronomic practices.

Meanwhile, socio-economic planners were developing a competing strategy known as community development. In the early years of this period, community development was promoted as the answer to problems of rural and agricultural development. This strategy represented progress in one respect, in that it explicitly recognized the importance of popular participation in development efforts in contrast to top-down planning and implementation by government agencies. The basic idea was that a professional, from outside the community, would come in and discuss with villagers their problems, help them to focus on their "felt needs," and then help them to organize themselves so as to meet these needs. The outside professional was also expected to link the community with the government agencies that had the expertise and the funds that might be needed to meet the problems focused upon by the villagers. Note that the participative aspects of this strategy were limited to encouraging the farmers to voice their "felt needs". The professionals were then to provide farmers with the expertise needed to meet these needs. There was no place in the strategy for participative on-farm experimentation.

The community development strategy was practiced on a wide scale in various developing countries, being emphasized particularly in India, where the movement had strong support both from the Indian government and from the Ford Foundation. It was here that development planners articulated a new role, that of the village level worker: a person who had some training and orientation in a training center and who then became responsible for working with a number of villages (Heginbotham, 1975).

Toward the end of this period, the community development strategy and ideology seemed to be losing its appeal. This is not the place for a detailed analysis of this deterioration, but we may point to some of the major limitations that prevented community development from maintaining acceptance among policy makers and researchers.* In the first place, it was not clear where community development would fit *into* the governmental *structure.* If it was established as an independent ministry, as in the early stages of community development in India, this position precipitated problems of jurisdictional rights; community development seemed to be competing with the Ministry of Agriculture in particular and with other agencies also. While the rhetoric of government leaders at times emphasized grass roots participation, in fact government planning through agricultural and rural development agencies tended to follow the objectives and formulations established at the top levels; staff in the field then were held responsible for somehow persuading the villagers that the government programs met locally-felt needs. Besides being in the middle, between the villagers who were expected to articulate their felt needs and government bureaucrats who demanded progress on governmental-imposed programs, the village level worker had no clear line for career development. The position itself appeared to be a dead-end job, offering the village level worker little immediate material reward and also denying him much hope for career progress.

It now seems clear also that the chief spokesmen for community development failed to take into account the distribution of power in the communities to be served and also the nature of agricultural technologies. The rhetoric of community development tended to be based implicitly upon a harmonious community model, assuming that it was possible to mobilize all of the villagers toward the satisfaction of particular needs that they mutually felt. Writers in this field gave very little attention to problems of conflicting interests among various segments of a community and of differences in political power and economic resources among villagers.

The community development movement also seemed to deal with human relations within an economic and technological vacuum. To be sure, villagers might be encouraged to express felt needs for innovations in agricultural technology, but because of inter-ministerial jurisdiction problems, agricultural technology was left largely outside the community development approach. Furthermore, adherents of community

*A more extensive analysis of experience with community development is given in Blair (1981).

development strategy tended to assume that agricultural researcher; and extensionists had the technical answers for village agricultural development problems, so that progress in the village depended upon getting the villagers organized so that they could take advantage of the innovations that could be offered to them.

The decade of the 1970s has produced a convergence of thinking, across a range of disciplines, toward integrated systems of rural development. Those who approach development problems from plant, animal and soil science perspectives have come to recognize the importance of research and experimentation on cropping systems and even going beyond that, to get into farming systems research. Furthermore, natural scientists have come to recognize increasingly the importance of active participation by small farmers in any effective program of agricultural research and development.

In the same period, social scientists have been abandoning the "myth of the passive peasant," recognizing that small farmers reject innovations offered them by professionals often because those innovations would yield poor results in their particular situation or because they do not have the resources to make it possible to follow the recommendations. This realization has led to increasing interest in studies of what may be called the social organization of agriculture: a field in which the social scientist needs to have a grasp of some of the key elements of the plant, animal and soil sciences far beyond that possessed by proponents of community development. Researchers and socio-economic planners have come to recognize not only the need for small farmer participation in agricultural R & D programs, but also the importance of small farmer organizations to give individual farmers an effective voice in R & D programs.

Poth natural and social scientists have recognized the importance of an interdisciplinary approach to agricultural research. While it is still easier to visualize the need for interdisciplinary collaboration among plant pathologists, plant breeders, and agronomists, for example, those doing research in the biological aspects of agriculture now recognize the need for integrating their work in the field with that of social scientists. It is important both for biological and social scientists studying village-level phenomena to be aware of the ways in which the political, administrative, and commercial environment affects the local agro-socio-economic system.

## On the Need for a New Conceptual Framework

We have seen that promising new models of agricultural research and development are now emerging in various parts of the world. It is important to recognize that the now well-documented problems inherent in traditional models of agricultural R & D

cannot be resolved simply by tinkering with parts of those systems. Nor can we expect major improvements in performance in traditional agricultural R & D models simply through the recruitment and deployment of professionals who are more highly trained than in the past--but along traditional lines.

Agricultural research and development should be visualized in terms of the total social system in which each part must be fitted together effectively with other parts, if the system is to function effectively. In earlier chapters, we have undertaken to describe and to sketch some of the main outlines of promising organizational social systems now developing, and we have given detailed attention to some of the key parts of these systems.

We see the following as key parts of any new R & D model built upon the fruits of agricultural and social science research:

1. Research must be carried out on the fields of small farmers as well as in the agricultural experiment station.

2. Small farmers must actively participate in the research and extension activities carried out in their area, helping to identify problems and set criteria as well as judge results. They can no longer be considered the passive recipients of material and information handed down to them by the professionals.

3. The research program must include a major emphasis upon cropping and farming systems, field studies and experiments. This does not mean that monocultural research must be abandoned but rather suggests that cropping systems and farming systems research are essential for meeting the needs of small farmers.

4. The research program should involve a strong emphasis upon interdisciplinary collaboration, especially in its field operations. This emphasis upon an interdisciplinary team does not eliminate the need for specialization in research and for specialists who do not regularly function as members of a field team. For example, the interdisciplinary team may encounter a plant disease that presents a severe problem in the area under study. If no member of the team has the necesary knowledge and skills in plant pathology, it is necessary for the team to be able to call upon a specialist in plant pathology for consultation. Such a specialist may not be needed as a regular member of the team, and in fact he may not have to have any skills or inclination for interdisciplinary collaboration. As along as he is willing and able to take on specialized assignments in plant pathology in the laboratory and in the field, upon the invitation of members of the interdisciplinary field team, he can be an invaluable member of the R & D organization.

Researchers themselves must be trained for work as members of interdisciplinary teams, which means that they must learn to respond to ideas and information provided by professionals from other disciplines.

5. People with special responsibilities in extension and local economic development should not be isolated from the research process. In Honduras especially, we have seen how extension agents and local citizens as paraprofessionals have been actively participating in the research process and in the utilization of research findings in the communities.

The emerging new organizational model is based upon a major shift in conceptions of the peasant or small farmer. Professionals are now increasingly recognizing that the small farmer must be visualized as an active individual, fully capable of making rational decisions, based upon assessing the total costs and benefits of change to himself and to his family. Students in this field are also increasingly recognizing the importance of an organizational base for small farmers both to provide them with a more cost-effective means for plugging into the R & D system and in order to gain some influence on decisions affecting their productivity and welfare.

Our studies also point to the importance of government programs designed to enhance the quality of human resources among small farmers and to build material resources into the organizational base of that community and under the control of the community. This approach has been described in the working papers of the USAID Technical Program Committee on Agriculture (TPCA, 1981) as "human and institutional resource development" as it would apply to the local level.

Our analysis has important implications for education in all fields related to agricultural research and development. If the undergraduate and graduate education of students is to provide them with the understanding and skill they need to develop further in field experience, his academic education must include some interdisciplinary project experience and also substantial emphasis upon field work.

We see a need for integrating government agriculture-related activities at area and regional levels. As progress is gained in coordination among government bureaucracies, government officials can reach out to help link local-level farmer organizations with government bureaucracies at area, regional, and national levels.

## Obstacles Still to be Overcome

We have found many promising developments here and there around the world, but still most agricultural R & D activities follow traditional lines. If the fruits of learning

about innovative new models are to be used more generally, a number of obstacles must be overcome.

Lack of political and administrative continuity is one major obstacle to progress. In many countries, there is a high rate of turnover among the top officials in activities related to agricultural R & D. For example, in recent decades we know of one nation that bad 16 Ministers of Agriculture within an 11-year period, with the resultant confusion of political orientations and program priorities that one would expect. Similar turnover can be seen at top and middle levels of many ministries. Some nations have attempted to shelter agricultural research from this leadership instability by creating semi-autonomous research institutes. While this may be constructive in the planning and administration of research, if the extension organization is left out of the institute, as in the case of Guatemala, the insulation of research from politics leaves unresolved the problems of research-extension relations.

Developing countries continue to face severe problems of coordination among the various agencies having an impact upon agriculture and rural development. Scarce resources are fruitlessly expended in uncoordinated activities that cannot bear fruit until they become linked together in a comprehensive organization system.

International agencies have enormous potential for contributing to agricultural research and development and have many great achievements to their credit, but too often we find them engaged in selling their particular programs rather than trying to fit their activities into a coherent scheme of nationally-planned development. When the host country is intelligently selective in the international assistance it will seek and accept, international bilateral or multilateral programs can contribute more effectively than in the past to agricultural and rural development. Since less developed nations tend to accept whatever help they can get, international donors must assume more responsibility for offering compatible types of aid.

Developing nations have severe problems in the economic and cultural gulf separating agricultural professionals from poor farmers. We have explored ways in which professionals and paraprofessionals working together can bridge this gulf, but nevertheless there is a tendency for planners in some countries to fall victim to credential&n, judging the quality of their programs in terms of the percentage of Ph.D.s, Masters degrees and university graduates holding positions in their organization.

Progress is held back by "traditional" orientations in the education and training of agricultural staff. The predominant mode of instruction continues to carry heavy emphasis upon specialization and is shaped by an elitist orientation that tends to

exaggerate the knowledge and ability of professionals and to downgrade the knowledge and abilities of small farmers. Traditional higher education also tends to emphasize individualism and provides no psychological or material support for collaborative and interdisciplinary projects.

Finally, we find in many developing countries, opposition or ambivalence among some political leaders, toward the grass roots organization of small farmers, fearing it might provide a political base for challenging their leadership. Even when high government officials wish to encourage the development of grass roots rural organizations, tbey often find it difficult to distinguish between stimulating and dominating.

In other words, there remain many difficulties still to be resolved if the fruits of research and experimentation along new participatory lines of agricultural and rural development are to be more broadly utilized. Nevertheless, we are encouraged by finding so many indications of movement in new and promising directions in many countries of the world.

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One of the factors which has encouraged research scientists to take a more realistic view of farmers' participation in the research process is a growing appreciation of the complexity of farmers' (particularly small farmers') systems of production. Research of this type has been termed "farming systems research" and there is a growing literature on it. Some of the contributors to it have been cited in the state-of-the-art paper, and a number of citations are already in the list of references (pages 103-106).

Because an appreciation of farming systems' complexity, and of the requirements for careful research on them, is central to devising a more participatory strategy of agricultural research, we have included below a selected bibliography, compiled from a longer bibliography prepared by Professor Randy Barker and Frank Casey of the Department of Agricultural Economics at Cornell, for an interdisciplinary course coordinated by Professor Barker during Fall 1980. Unfortunately some of the papers are not available in published form, but that reflects the early and emergent state of knowledge in this field.


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