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Chapter 12

Sociocultural Factors in Multiple Cropping

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A computer-assisted library search on "sociocultural factors in multiple cropping" produces no results. Even changing "multiple cropping" to "cropping systems" doesn't improve the yield. Yet, in fact, there is a large amount of literature in the social sciences having to do with sociocultural factors in multiple cropping. In anthropology, one can find ethnographies of societies all over the world that are engaged in multiple cropping. Some of the most interesting include studies by Carneiro (1961), Conklin (1957), and Rappaport (1968) on slash-and-burn horticulture in the tropics. One of the advantages of reading ethnographies of peoples in an area of interest to agricultural researchers is they not only provide descriptions of the farming systems, but attempt to provide a functional analysis of different aspects of the system. Usually, the ethnographer tries to get the farmer's point of view as to why he or she makes certain decisions.

There is another large body of literature in the behavioral sciences that deals with peasant cultures in many parts of the world. Peasants are usually considered to be a different population from slash-and-burn horticulturalists, in that peasants by definition are part of a larger state and produce a surplus for market and are subject to taxation by outsiders. While sociologists and anthropologists have predominated in their descriptions of peasant societies, others such as the political scientist Banfield (1958) have also provided valuable descriptions of peasant

society. The relatively small number of behavioral scientists working in this area in this century has led them to spread out to many different areas of the world in order to record indigenous cultures before they have been radically altered by contact with the rest of the world. One unfortunate side effect of this tendency is that we do not have many cases where we have either continuous observation and recording or repeated revisits to the same village. Exceptions to this rule are Foster's (1967) work in Tzintzuntzan in Mexico, and Robert Redfield (1930) and his student Oscar Lewis (1960) who studied Tepoztlan in Mexico some years apart and provided very different interpretations of the village.

One of the key differences between behavioral sciences and physical sciences lies in the inability of behavioral scientists to keep any type of controlled experiments with people going over a considerable period of time. Therefore, we will never be able to produce a social science equivalent of the Rothamsted Experimental Station (1981) experiments in England where, every year since 1843, wheat (*Triticum* sp.) has been sown and harvested on all or part of the same field. Their continuous evaluation of organic vs. inorganic fertilization and other treatments simply has no parallel in social science. Perhaps the most important pioneer work in multiple cropping where we have good descriptive accounts as well as photographs is that contained in F. H. King, *Farmers of Forty Centuries* (1911). King toured China, Manchuria, Korea, and Japan in 1908 and recorded his observations on multiple cropping at that time. Apparently, this book is ancestral to all modern multiple cropping research. It would be fascinating if a team consisting of an agronomist and a social scientist were to retrace King's journey and bring his descriptions up to date.

Most of the early collaboration between behavioral scientists and agriculturalists was achieved through the extension services of various countries. Since the extension services were focused mainly on monocrop agriculture, there was little if any impact of this collaboration on multiple cropping work. After World War II, there was a considerable movement to integrate both cropping research and the work of social scientists interested in cultural change through what was then called the community development programs, particularly in the 1950s and 1960s. Systematic research in multiple cropping was started at the International Rice Research Institute (IRRI) in the 1960s and has subsequently spread to some of the other international centers such as Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) and some of those in the Consultative Group in International Agricultural Research (CGIAR) network. By the 1970s, some national research organizations such as ICTA in Guatemala had also moved in this direction.

Once multiple cropping research was moved from the experiment stations to farmers' fields, social scientists began to be incorporated into the research process. In some places, this emphasis has been dropped, and in others has been expanded as a result of the successful collaboration between social scientists and agricultural scientists in these teams. For example, Hildebrand's (1978) work at ICTA in Guatemala yielded a number of novel approaches to research with farmers, including the *sondeo*, a joint reconnaissance survey carried out by teams consisting of one agricultural scientist and one social scientist. Perhaps the most

successful and consistent collaboration between social scientists and agricultural scientists has been at the International Potato Center (CIP) in Peru, where Horton (1984) has recently summarized the impact of the social sciences on agricultural research.

In addition to reports published at the various centers where multiple cropping research is going on, reports by social scientists can also be found in some of the newer journals and newletters, such as *Culture and Agriculture*, published by the Department of Anthropology at the University of Arizona, and a new journal, *Mountain Research and Development*. Topics of special interest to social scientists are now being collected into edited volumes such as that by Barlett (1980) on agricultural decision making. Other volumes such as those by Whyte and Boynton (1983), Wagley (1974), and Moran (1981) pull together the work of both social scientists and agricultural scientists working on the same project or in the same area. Similarly, there are a number of detailed accounts of some of the better-known development programs such as Comilla, the Puebla Project, and the Caqueza Project.

BACKGROUND OF COLLABORATION BETWEEN SOCIAL AND AGRICULTURAL SCIENTISTS

There appear to be two main forces responsible for the incorporation of social scientists into agricultural development since the 1970s. The first of these is the Foreign Assistance Act of 1974, variously known as "New Directions" or "Congressional Mandate," which requires the Agency for International Development (AID) to "conduct its programs as if poor people mattered," to paraphrase E. F. Schumaker (Steinburg, 1980–1981). AID is now required to consider the effects of its programs on the lives of the people in the affected area. Social analyses are required of every project, and social science participation in the Country Development Strategy Statement and Project Evaluation is also built in. Apparently, by law, social scientists will have to be involved from the earliest planning stages of a project right through to evaluation. In the past, social scientists were frequently brought in to do a postmortem after everything had gone wrong with a project, or at best to help write the final reports and recommendations that had already been decided by specialists in biological sciences.

The second main thrust has been a Rockefeller Foundation postdoctoral research program in agricultural and rural development for the social sciences, also started in 1974. After completing their program, some of these fellows have accepted employment at the CGIAR centers but few, if any, are in core staff positions which are permanently funded.

DIFFICULTIES OF COLLABORATION BETWEEN SOCIAL AND AGRICULTURAL SCIENCES

At first blush, it would appear that all sciences should be able to collaborate easily with one another since they are all concerned with the same two basic

sorts of questions. The first of these could be called static analysis, having to do with issues of structure and function. That is, all sciences are concerned with explaining the relationship between different parts of a system, and all are concerned with explaining how any given part contributes to the maintenance of the system. The second question has to do with dynamic analysis, or how systems or phenomena change over time. However, in the real world multidisciplinary research teams have a great deal of trouble starting with the most basic problem of defining the role and purpose of the team.

Even such apparently simple goals as increasing productivity can have many meanings. Does the team wish to increase productivity per unit of land? This is usually readily attainable by lavishing more labor on small plots of land. Although economists may argue that it pays to increase the amount of labor until the marginal product falls to zero, most people don't want to earn zero wages for their efforts. On the other hand, W. Arthur Lewis (1977) argued that none of the industrialized countries achieved industrialization without a prior increase in productivity in agriculture. He pointed out that human productivity in agriculture must increase in order to raise the real wages of farmers and thereby provide a market for the products of industry. Should, therefore, the research team be concerned with increasing the productivity of labor? If so, should we be trying to raise the productivity of labor only on a particular crop for a particular season or should we be looking at the productivity of labor of the entire farm family throughout the year? If the latter is the case, then we would have to consider not only off-farm labor, but modifications in the production system that would smooth out the peaks and valleys of labor demand on the farm to enable family members to optimize their productivity over the full agricultural cycle.

In the past, most commodity programs have emphasized increasing the productivity per acre of that commodity. Clearly, in multiple cropping research, one is constantly thinking of the productivity of the total system and not of a single commodity. But even when the systematic approach is taken, are we still to be mainly concerned with productivity either measured in terms of land or labor, or should we also be thinking about the profitability of the system? At a time of sharply rising input prices and relatively constant product prices, there should be a search for systems of production that use less in the way of purchased inputs in order to improve profitability, even if production declines. Harwood and Banta (1974) called this "substitutive technology" and argued that it would be appropriate for small farmers who could not afford the cash outlays required to adopt high technology.

Beyond the problem of defining the general goals of the research program, we find that team ideas as to how to best realize these goals will be at least as varied as the number of disciplines represented on the team. Disciplinary training sharpens the sensitivities of its members to the existence of certain problems and possibly supplies blinders that makes it difficult to recognize other problems. A weed specialist visiting a farm sees weeds and thinks of ways to control them, whereas a plant breeder thinks in terms of genetic improvements that can be made in the crop of his or her specialty. Social scientists, on the other hand,

have a much wider and less specific area of focus, and are inclined to see more problems than other members of the team really want to hear about. Moreover, the most intractible of these problems frequently are in the areas of social institutions, where a research team has little or no influence. Quantitatively oriented scientists are particularly frustrated when many of the most serious problems prove difficult, if not impossible, to quantify in terms of their existing models or computer programs. Scientists used to having tight control over experimental procedures find it difficult to deal with all of the factors that affect a farmer's decisions with respect to technology. Similarly, the considerations a farmer has to keep in mind with respect to all of his or her various crops and animals are far more numerous than the considerations occupying the mind of a maize (*Zea mays* L.) specialist who is accustomed to thinking only of the variables that affect the physical production of one crop of interest.

Economists were the first of the social scientists to be fitted into multidisciplinary agricultural teams, probably because of their quantitative orientation and ability to provide useful techniques of analysis which incorporated both the physical and the economic factors. Hildebrand (1977) summarized the dilemma as follows:

> The problem stems from having most top level technology 'generators' who are agriculturally trained and 'product'-oriented, working on experiment stations or other highly controlled conditions where they consider only a limited number of variables; most of the 'transfer-mechanism generators', who are trained in the social sciences are not 'cause' but product oriented, struggling with the vast quantity of variables which condition acceptance or rejection of the technology at the farm level; and 'goal'-oriented agricultural economists in the middle complaining that the agricultural scientists do not consider enough of the variables in their work, but ignoring the pleas of the social scientists that including just the quantifiable variables is not sufficient either.

Once the goals of the multiple cropping team have been adequately defined, new problems of research methodology immediately appear. CGIAR, which now has 13 widely scattered research stations, has organized most of its work on a commodity (crop or animal) program basis. Focusing the work of many disciplines on the problems of a particular crop or animal has found increasing acceptance in agricultural research both at the international level and in national agricultural research programs. The model is a direct outgrowth of its successful application in the Rockefeller Foundation program on maize and wheat in Mexico where both the International Center for the Improvement of Maize and Wheat and the National Institute for Agricultural Research continue this emphasis today. Much of the success of the so-called green revolution is traceable to this concentration of effort on a particular commodity. No doubt the methodology will continue to be of great value for the study of certain kinds of problems. However, the strategy is based on fairly traditional reductionist thinking, which seeks to limit the variables under consideration to as few as possible, and to those most amenable to control by the various disciplines involved. The procedure requires

identification of one or more limiting factors which, at a given point in time, are preventing productivity increases. As one limiting factor is overcome, another is identified, and the research proceeds in an orderly, linear fashion. The remarkable advances in wheat and rice breeding in recent years indicate that the tool is indeed powerful.

However, those teams that are now beginning to focus on multiple cropping research are finding the model not to be transferable to their concerns. Work on whole-farm systems requires holistic thinking of the ecology or systems theory type which, rather than proceeding linearly takes account of positive and negative feedback and multiple causation, and represents a very different way of thinking about agricultural production. One of the most serious problems of any multidisciplinary team is trying to get everybody on the team thinking in terms of the entire system, and not just the components they are used to dealing with. Economists have proven themselves useful in both kinds of research effort, but I suspect that interest by sociologists and anthropologists in national and international centers will be focused more on whole-farm systems programs. Nevertheless, the International Potato Center has recently reported on cases where consultations between potato storage specialists and anthropologists led to radical changes in the definition of technical problems. Similar stories have been coming out of IRRI since it acquired its first anthropologist.

Agronomists have always recognized the need to adapt general crop recommendations to such local conditions as variations in soil conditions, slope, and distribution of rainfall. They have not always recognized the simplifying and homogenizing effects of tractor-based technology on farming systems. Large-scale production for the market leads to specialization in one or at best a few commodities.

By way of contrast, small farms in the Third World are generally not mechanized, are not exclusively oriented to the market, and therefore grow many commodities in multiple cropping combinations throughout the year. Their systems are complicated from an agronomic point of view, and the constraints affecting farmers' decisions are not simply removed. For example, when most of the work is done by the farm family without mechanical help, the number, age, and sex composition of the family is a crucial limiting factor which changes slowly through time, necessitating periodic adjustments in the farming system. A farmer with a mechanized, commercial farm in the American Midwest can decide to double or halve the acreage in maize without changes in the labor force or in equipment. The small, nonmechanized farmer in the Third World has to deal with a more complex set of trade-offs when considering changes in the farming system. Social scientists have made substantial contributions toward understanding these systems (e.g., see Barlett, 1980; Roumasset et al., 1979.)

Another consequence of the commodity-based research organization is that the scientist's attention is focused on the plant itself and the problem in overcoming obstacles to increasing the productivity of that plant. Thus it is possible to have a very successful commodity program in terms of increasing genetic capacity, breeding for resistance to pests or disease, and still have little or no

effect on production in a given area because the plants developed simply do not fit into the multiple cropping systems of small farmers. A very sophisticated maize breeding program in Mexico for the past 40 years has had very little impact on the small-farm sector. On the other hand, the wheat program was very similar in its basic strategies but was spectacularly successful, in large part because Mexican wheat farmers were large-scale commercial farmers with all the necessary infrastructure support to take advantage of the new wheat. Similar cases of a lack of fit, or of a spectacular fit, have been noted in India and other parts of the Far East.

The multiple cropping approach, on the other hand, requires that problems be defined in terms of a whole production system and not simply one crop. Moreover it requires realistic attention to constraints on labor, financial resources, input availability, markets, and problems of this sort which are not considered in traditional experiment station work. Indeed one of the most vexing aspects of multiple cropping research on the farm is the lack of control by either the farmer or the researcher over crucial variables that limit production.

One of the first requests that the social scientist is likely to get from an agricultural research team is to get out to the villages and find out what the farmers are doing and why they are doing it. Scientists want to know why the superior technological packages developed over the past few decades have not been acceptable to small farmers. If the economic benefits of the technological package have also been proven to the scientist's satisfaction, why are the farmers not adopting the recommended technology? This is certainly a legitimate request, and it would be easy for the social scientist to become isolated from the rest of the team and occupy all of the time doing field studies of this sort, as well as studies of the impact of outside institutions, such as credit agencies, input suppliers, and marketing organizations, on farmers' decisions. In many cases, this could well be the major contribution of the behavioral scientist. However, the danger of succumbing to this temptation is that the social scientist would probably not have very much impact on the decisions made by the rest of the team. It is essential that multidisciplinary teams consist not only of specialists in various disciplines, but that each member of the team perform as a multidisciplinary person, with primary responsibility in one particular area, but with rights and obligations to participate in the disciplines of others. If this does not happen, the team will not develop the esprit de corps and loyalty to the team objectives that is required. Hildebrand (1977) has found it most useful to send an agronomist and social scientist out together to interview farmers. This ensures not only that members of different disciplines are getting the same information from farmers, but also that questions relevant to each discipline get asked. Moreover, no team is going to include all possible specialities within agricultural research, so various members are going to have to risk opinions in areas where they have no formal training. For example, none of the international centers has poultry specialists on its staff, yet small farmers all over the world raise poultry as an integral part of their farm operations.

Since World War II, behavioral scientists have been involved in programs

of culture change and development, with one of their main tasks being the identification of cultural constraints that hinder change. At times, they have been justly accused of showing how all sorts of exotic behaviors were functional in a particular society. This kind of emphasis led to a long list of possible constraints with which change agents must deal. Some anthropologists have argued that in many cases a culture should not be tampered with at all for fear that changing cultural traits in one area might lead to the disruption of functional linkages that would bring on a total social collapse.

Rather than present a list of individual cultural factors that should be taken into account in attempting to bring about agricultural development (Foster, 1973), we may simply group them into three major categories in order to examine the kinds of problems these present to the change agent. Since our final goal involves changing human behavior, our immediate task must be to ask the question, "How do we explain human behavior?"

PSYCHOLOGICAL FACTORS

The study of diffusion of culture traits has always been a favorite topic of the social sciences. Similarly, this discipline has given a great deal of attention to the processes of invention and innovation in general. Barnett (1953) presents a thorough synthesis of this research. What are the conditions that favor adoption of new technology from other areas, or the development of new technology within a given culture (Rogers and Shoemaker, 1971)? Many researchers have sought the explanation of human behavior by looking to the internal states of the individual, viewing behavior as a function of attitudes, values, beliefs, and knowledge. This being the case, if behavioral change were to take place, changes would have to be sought in these mental states.

This was the approach of many social scientists during the community development phase of international development in the 1950s. It has always been the strategy of missionaries and other agents of change who find themselves in a rather powerless position. The general assumption is that, since people are not doing those things that lead to optimal rates of development, and since they act according to their state of knowledge, attitudes, beliefs, values, etc., these psychological or mental factors must be changed first in order to change behavior.

The appeal of this strategy to relatively powerless change agents lies in its rational approach to individuals and groups and the fact that it does not require institutional change. It appeared reasonable at the time, yet we found in the massive community development program that it was not very effective. Later, psychologist David McClelland (1961) sought to explain differences in rates of development in terms of the amount of need-achievement which had been inculcated into individuals as small children. This approach also was found to have rather hopeless policy conclusions and has been largely abandoned. We now suspect that the reason it did not work is that people's behavior is in fact normally quite rational, given the circumstances of their lives. New behaviors that lack the institutional and environmental supports to make them pay off will not be

adopted, or if adopted will not persist for lack of support. This realization has led some behavioral scientists to concentrate their attention in other areas.

INSTITUTIONAL CONSTRAINTS

The assumption here is that behavior is rewarded or punished by a system of incentives built into the basic institutions of the society. If behavior does not lead to optimal development, it must be because the institutional structure encourages less than optimal behaviors. This realization led to the institution-building phase in development work. Sometimes, it may be that a simple restructuring of the price system is all that is needed to reward newly desired practices and/or to punish old practices. Other approaches require a massive overhauling of virtually all of the social institutions impinging on farmers' behavior (Mosher, 1969). This approach is more attuned to behavioral psychology, whereas the emphasis on internal states elaborated above is associated with the psychodynamic theories of psychology. The principal problems of trying to pursue the behavioral approach derive from the outsider's lack of power to change the institutions that shape the behaviors of farmers. Moreover, since the structure of advantage has built up winning groups who have been able to rise to the top and stay there, vested interests are normally arrayed against changes that would jeopardize their favored position. Although this is sometimes interpreted as the inherent conservatism of Third World societies, except under extreme circumstances, life under the present institutional structure is predictable and the rewards are reasonably certain. Most people have some hope of being able to achieve satisfactorily within the system and therefore are not ordinarily inclined toward revolutionary change. If most behavior makes sense most of the time, we must look at some other factors that may explain why people do what they do.

ECOLOGICAL AND ENVIRONMENTAL FACTORS

Marvin Harris (1979) calls this strategy "cultural materialism," and argues for focusing attention first on basic infrastructural variables such as climate, resource base, and population characteristics. Theorists using this approach also include technology as part of the basic infrastructure as technology shapes the institutional structure of the society. Harris argues that in order to understand the constraints on development, one must look first at the infrastructural level since, "It's a good bet that these constraints are passed on to the structural and superstructural components."

All three of these strategies have some validity and are therefore useful. Many of our past failures are due to our tendency to quickly identify one or a few components in a problem and to seek a solution based on dealing with those particular components, while simply assuming away the relevance of other variables, or assuming that factors required in the other two strategies are in place, when in fact they are not. For example, we might recommend a new practice, including a particular seed variety plus cultivation practices while overlooking

the absence of the necessary institutional structure to deliver the inputs and credit needed to apply that particular technology. Or, we might ignore tastes and other market considerations that might affect the adoption of new varieties.

We have found that little can be assumed to be in place, and that we have failed regularly in the Third World whenever we allow ourselves the luxury of the unconscious assumption that the requisite institutions function there as they do in the United States. For example, an extension agent may feel that the physical conditons warrant specific soil conservation practices, or a particular cropping pattern or technology, and make recommendations accordingly. But such things as land ownership patterns, tenancy conditions, lack of credit, markets, and other necessary institutional supports may be lacking to the point where such advice is useless. Therefore, we may assume, with Schultz (1964), that farmers usually make efficient use of the combination of resources that are available to them in the institutional climate in which they operate. To make sense of farmer behavior we need to be much more specific as to how these environmental, institutional, and psychological variables shape their decisions on how to manage their farms.

It is not surprising that people from different disciplines would have difficulty in communicating with one another, nor is it surprising that their priorities may differ considerably. It may be surprising to some, however, to learn that people within the same discipline frequently differ markedly in their approach to any given problem. Pablo Gonzalez Casanova (cited by Kahl, 1976) has made the claim that, generally speaking, quantitatively oriented sociologists tend to be conservative in their outlook, whereas qualitatively oriented sociologists tend to be more radical. This seems to fit with the experience of many American sociologists in Latin America where the North Americans find themselves out of tune with Latin American sociologists who are more qualitatively and historically oriented.

The new technological advances represented by the term "green revolution" were presented to the public as "scale-neutral." That is, since the technology consisted of new genetic material plus chemical inputs, but did not require mechanization on any particular scale, it was argued that it was scale-neutral and would be just as useful for small farmers as for large farmers. In practice, of course, it didn't work out that way. As is normally the case, those farmers with the most land, machinery, capital, and knowledge were those best able to take advantage of the new technology. Moreover, in many areas, farmers who used to rent their land out to small farmers found that it was economically worth while to take over all of the production themselves. So scale-neutrality did not prove to be the boon for small farmers that it was hoped to be. Now, with multiple cropping research to update many of the primitive small-scale systems of production that have been around for thousands of years, we do have a possibility of a "scale-specific" technology for small farmers. To the extent that the multiple cropping involves growing two or more plant species in the field at the same time, mechanization will be difficult at best, and small farmers using

hand tools and/or small cultivation machinery should not be at a disadvantage when compared to large farmers.

Even if researchers recognized that the large farmers would be the first to benefit from the new green revolution technology, it was hoped that the benefits of this technology would "trickle down" to the smaller farmers. In retrospect, we apparently had the wrong hydraulic metaphor. Rather than trickle down, wealth and power seemed to move by "capillary action" in an upward direction. As with most technological change, those who are in the best position to take advantage of innovation can increase the gap between themselves and their poorer colleagues.

Although in general multiple cropping research seems to be most adapted to the small farm, there are some intriguing possibilities of combining multiple cropping technology on large commercial estates. Plucknett (1979) has pulled together the evidence for cattle raising under coconut (*Coco* sp.) trees in the tropics. Presumably one could have a large coconut plantation with individual workers having pastorage rights under the trees. Similarly, it has been known for some time that in many areas where sugarcane (*Saccharum spontaneum*) is grown, it is possible to interplant maize right after the cane is cut in order to take off a crop of maize before the cane ratoons back. During the early 1970s, technicians in the Peruvian ministry of agriculture carried out some experiments on 300 ha on large sugarcane plantations on the Peruvian coast. They reported getting a 1½ t crop of "free" maize per hectare with no influence on sugar yields. The fertilizer and crop protection chemicals applied to the sugarcane also benefitted the maize. They were not interested, however, in allowing plantation workers to enjoy private interplanting rights on the cooperative cane fields, as the military government of the time did not favor individual initiative. Similarly, in countries where sugarcane plantations are in the hands of large private companies or individuals, these landowners see intercropping rights by labor as a dangerous first step toward land reform. Some multiple cropping techniques, such as those mentioned above, may be technically possible and are certainly desirable from the point of view of farm labor, but they may be politically inconvenient from both the left and right ends of the political spectrum.

ROLE OF SOCIAL SCIENCE IN FUTURE MULTIPLE CROPPING RESEARCH

There are a number of works published in recent years that detail specific contributions to be made by social scientists in working with small farmers in the Third World that apply directly to any future research on multiple cropping. Shaner et al. (1982) provide a condensed list of information factors affecting small farmers that need to be investigated. Some of the topics fall clearly within the traditional interests of economists, whereas others are of economic importance but are not necessarily investigated only by economists. In any multiple cropping system we would have to know what commodities are traded in the market and

which ones are primarily for home consumption. Can farmers sell their products directly, or must they go through intermediaries? If market prices are satisfactory and they normally sell to truckers at the farm gate, when prices drop can they do some of the processing, such as washing potatoes, or carrots, and sell directly to the consumer? What is the nature of the contract between the farmer and the intermediary: does the intermediary pay cash on delivery, or after he or she in turn has sold the produce? Are there government purchasing agents for some commodities that tend to put a floor under the market price, and are these used by farmers in the region? These are just some of the marketing questions that affect what kinds of crops are raised for sale.

Transportation facilities and costs are another major factor affecting which crops are feasible in a given area. Quite typically, if roads are either unavailable or passable only at certain seasons of the year, farmers may adapt their cropping system to crops that mature during the dry period of the year when the roads are passable. If there are no roads at all, the farmer usually opts for a combination of subsistence crops plus animals that can be walked out to the nearest road. If transportation is relatively good and the farms are near urban markets, then more perishable products can be incorporated into the cropping system. Availability of storage and processing facilities both on and off the farm both have a direct effect as to what is feasible to include in a cropping system.

The national government frequently provides some information about market conditions and frequently establishes regulations having to do with weights and measures and acceptable grades for certain commodities. Many governments in Latin America have their own purchasing agencies for basic grains and other storable commodities such as beans. This enables them to establish a floor under the prices of these commodities for the entire market, even if their own purchases are relatively small.

Information that is always urgently needed by any research team in agriculture has to do with those things that are directly needed by farmers, such as all purchased inputs, tools, equipment, and credit. Investigators frequently find that while, in principle, all of these things are available in a country, there may be large areas of the country that are not well served in any sense. Starting with credit, the official conditions may appear quite reasonable both in terms of interest rate and the size of the loans. Yet these may fail in practice because of the red tape involved that requires that a farmer make a number of trips to the bank, thereby incurring transportation costs as well as lost labor time, only to find that the loan becomes available too late in the cropping cycle to be of any use.

More general cultural traits that are frequently cited as worthy of investigation would include any kinds of norms and customs, whether religiously based or not, that define what is proper behavior. Religion in most societies affects farming systems directly by both taboos against certain kinds of activities, as well as taking time and resources away from the farm operations in order to carry out required religious obligations, such as service on various committees or accepting posts that require considerable expenditure of personal resources. Where heavy ceremonial expenditures are required, religion serves as a leveling

device to convert dangerous economic power into harmless social prestige. Whether or not redistribution is affected by religious institutions, there is usually a certain movement of both commodities and labor outside market channels in any village as people help each other out when the need arises, and pay back obligations for help received in the past.

Most authors would agree that one of the main tasks of social scientists working in agriculture would be to study various aspects of the social structure. Starting at the level of the individual household, social scientists could produce a good estimate of the range in household size and the customary division of labor by sex and age. A brief census of a village done with village leaders can provide a lot of information not only on the families in the village, but on the size of their holdings, conditions of land tenure, and crops grown.

We always need to understand the land tenure system with its different categories, such as full title to land, working family-owned land or lineage-owned land, communally owned land that may be assigned to a particular family for an indefinite period, renting, or sharecropping. The land tenure system is particularly important for any multiple cropping research team because the varying conditions have markedly different effects on the incentives of farmers to invest inputs as well as labor. Where a farmer has secure title, tenure is not a limiting factor for what is possible to do. At the other extreme, there are systems of tenure that provide powerful disincentives on the part of the renter. For example, I have found systems in eastern El Salvador where the owner of a large amount of scrub pasture would rent out small parcels to landless farmers with the rent paid in cash in advance. The motives of the landowner are several, in addition to the cash payment. First, he wants to get the land cleared of scrub and the soil loosened so that it can be reestablished in pasture after one cropping cycle. Second, he will rent only a small patch in order to establish an obligation on the part of the small farmer to work for him when needed. Third, renting the land to a small farmer does not deprive the owner's cattle of forage, since the farmer is allowed to take only the grain, leaving all stalks for the owner's animals. In this particular village, there were 3 years of almost total crop failure in maize and beans. As a result, the only product the renter could get out of the land to compensate for the rent payment was to take whatever soil he could and make adobe bricks out of it and haul it away. Under such extreme conditions of tenancy, it is difficult to see how cropping research can make much of an improvement since the disincentives for investment by small farmers are so strong. CENTA, the National Agricultural Research Institute, had done the only feasible thing by showing that a sorghum (*Sorghum bicolor*)/pigeon pea (*Cajanus cajan*) association produced better than the preferred maize/bean association under drought conditions.

Inheritance patterns and family organization also have considerable effect on farming systems. For example, do parents hold title to all of their land up to their death, or do they distribute land to their children when the children begin to establish their own families? Is farm land divided equally among all descendants, whether or not they are farmers, male or female, or is it kept in viable

farm units for one or a few of the descendants? In cases where a father or mother holds title to all lands up to the time of death, does he or she also try to retain all authority with respect to the farming operations?

Social classes are frequently delineated partly on the basis of land ownership, but education and nonfarm occupations also play a large part in the layering of rural society. Wealth differences, as well as power differences, are important determinants of access to credit and inputs, and therefore must be thoroughly understood.

Whyte and Boynton (1983) stress the need to study formal organizations. At the local level, local government and particularly any organization, such as a cooperative, which deals directly with agriculture should be thoroughly investigated not only to understand the capabilities it may have in promoting a research project, but also to see if it constitutes an obstacle to research and development activities in an area. The role of the ministry of agriculture in general and its extension services in particular, requires some study. In some areas extension agents have proven to be effective in the provision of credit and inputs, whereas in other areas they may be regarded as completely useless by local farmers.

In order to understand the present land tenure system and the farming system, it is necessary to see present practices and conditions in historical context. We cannot understand "what is" without understanding the process of how it came into being. Even if the data are only oral history from some of the older farmers in the area, it is extremely important to understand what changes have taken place over time as access to roads and markets have led to changes in the cropping system. The present-day situation needs to be seen as part of a continuous process of change that is going on in a given area. In areas where there has been a recent land reform or any substantial change in land ownership patterns, it is common to see a general evolutionary process in which farmers go first into crops to help sustain themselves and pay debts, and later move more into livestock and tree crops as their accumulation of capital permits.

Multiple cropping is often practiced on slopes that are too steep for large-scale cultivation with machinery. Where minor differences in altitude provide significant differences in microclimates, it is common for farmers to try to have plots at varying altitudes, which help to safeguard against losses due to climate in one area and provide a more varied calendar of planting and harvesting dates, thereby spreading family labor and permitting a wider association of crops (Mayer, 1979).

A survey research team with behavioral scientists could be used in a variety of ways. For example, periodic small-scale surveys could be taken to monitor the reaction of farmers to the research and extension efforts of the multiple cropping research program. Similarly, sometime after the conclusion of any experimental intervention, a survey would help to evaluate the impact of the research program.

Before beginning active experimentation in farmers' fields, it might be well

to conduct a series of small group meetings with farmers and their spouses to get their reactions to the research plans. Researchers would be expected to spell out in considerable detail what they plan to do and what results they hope for. An economic analysis of those results in relationship to costs should be presented even though at this stage it is understood by all that it is clearly hypothetical. The reaction of farmers and their families to these various alternatives could be assessed with a view to choosing to begin with those alternatives that appear most feasible and most important to the farmers. As a result of these meetings, the team will know which of the proposed innovations are of interest and the reasons for that interest. Farmers expressing most interest in particular experiments will in all probability be the cooperators who will want to see those experiments done on their fields. From the team point of view, time and resources will not be wasted on trials that are of no interest to the local farmers. In this kind of experimental design, rather than carrying out a matrix type experiment on experiment fields, the selection of experiments is done at the mental level through joint farmer-researcher discussion.

FUTURE DILEMMAS IN MULTIPLE CROPPING RESEARCH

Multiple cropping research has been complicated from the outset, and appears to grow more complicated with each new step toward realism. The tremendous potential of multiple cropping was demonstrated conclusively on the fields of IRRI (Streeter, 1972). The emphasis there was in finding the right combinations of crops that would yield well and produce a reasonably well-balanced diet. No attempt was made to measure the costs of production under this system either in labor or monetary terms. When the research was subsequently moved off the experimental fields and onto farmers' fields, new methodologies had to be invented to cope with farmer-managed experiments (Harwood, 1979). Under these circumstances, not only did researchers have to consider the interests of the farmer, but also the real limitations in terms of labor and capital that could be invested in the experimental program.

The next logical step in achieving the maximum realism in multiple cropping research would be to move toward some form of complete experimental farm. I have heard agronomists talk about this possibility for many years, but at this point I don't know of any cases where it has been carried out. One design involved an agronomist who intended to retire to the tropics, buy a small farm, and hire a farm family to manage it with a view to optimizing production. A second version by another agronomist involved establishing one or more experimental farms each with its own family within the confines of one of the CGIAR stations in the tropics. This idea presented the opportunity of optimal access by the research staff but a rather unsatisfactory life for the farm families who would be living in a "zoo" rather than in a village. Other possibilities would include purchasing a small farm near a research station and renting it at zero or nominal rent to a young farmer on the condition that he or she keep accurate records of

all operations. Other variations on this theme include having a cooperative or the extension service own the land. As agricultural research moves further from the tightly controlled manipulation of a relatively few experimental variables in the laboratory or on the experimental field toward the more realistic conditions of small farmers in the Third World, the question comes up, "Where do we stop?" Is there a point beyond which agricultural researcners can and should say that it is now up to the extension service or farmer organizations or some other group to take over? To what extent is this experimental farm also a demonstration farm?

Moving beyond the individual farm level to that of the local farmer organization or cooperative, should we be content with an assessment of the problems faced by these organizations, or should we, as Whyte and Boynton (1983) argue, get actively involved in finding ways to make these otganizations more effective in promoting agricultural development in their spheres of influence? As we move up the line toward the national structure, we face the same kinds of dilemmas. Should we simply recognize an inadequate extension service when we see it and avoid it, or should we be trying to find ways to improve its performance?

McDermott (1982) has argued that we need to look at various governmental and market structures in order to find blockages to development. Should we merely identify these blockages in our reports or should we be trying to find ways to improve the functioning of these various institutions? If we choose to do the latter we will necessarily wind up paying some attention to national policy and planning efforts. This is not to say that each multiple cropping research team should have a representative in the capital city trying to infiltrate the highest policy and planning groups. However, major research institutions could benefit by having detailed knowledge of, and contact with, these agencies in the hopes of influencing them as new policy is put into effect.

There is a considerable body of research indicating that the principal constraints limiting agricultural production in the Third World are those of a social, political, and economic nature. Biological research will not remove those constraints. As long as these constraints are operating, the biological potential of multiple cropping research will be severely limited. Arnon (1981) points out that planners have always had the dilemma of choosing policies somewhere between two extremes. At one extreme the goal is economic efficiency, and limited resources are invested in those sectors of agriculture that are already commercialized, mechanized, and best able to take advantage of the resources. At the other extreme is a goal of increasing equity, which would argue for focusing on small farmers, assuming that the large commerical farmers can look after themselves. The evidence from multiple cropping research to date suggests that the most efficient farmers, as measured by productivity per hectare, are those practicing multiple cropping on small-scale farms. This being the case, it could be argued that efficiency in the use of land resources as well as greater social equity could be best served by focusing more national attention on the small-farm sector in agriculture. Proving this point through intellectual debate does little to win power struggles (or change priorities) at the national level.

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