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GENERATING TECHNOLOGY FOR TRADITIONAL FARMERS:

A MULTI-DISCIPLINARY METHODOLOGY

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GENERATING TECHNOLOGY FOR TRADITIONAL FARMERS:

A MULTI-DISCIPLINARY METHODOLOGY

Does ICTA deal only with Guatemala?

Peter E. Hildebrand [1]

The Guatemalan Institute of Agricultural Science and Technology -ICTA- is a new entity having been created by law in October, 1972, and formally inaugurated on May 10, 1973, to generate and promote agricultural technology.[2] Agricultural research was not new to Guatemala at that time, rather ICTA was created to attempt to correct the deficiencies of the traditional research system which had not provided sufficient, appropriate technology to increase production of basic grains in the quantities required. In general, it was believed that the major faults of the traditional research system lay in the fractionated steps of:

Should be unlinked in the research

1. Identifying the problems of the farmer,

2. Identifying and developing technology,

3. Testing of technology at the farm level and adapting it to farmers' conditions,

4. Evaluating the technology when managed by farmers,

5. Evaluating the acceptance of the technology, and

6. The general promotion of its use, along with assurance of availability of inputs and services (Waugh, 1975, p. 17).

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1 Agricultural Economist, The Rockefeller Foundation, assigned as Coordinador de Socioeconomía Rural, Instituto de Ciencia y Tecnología Agrícolas (ICTA), Guatemala.

2 Extension, as differentiated from promotion, was not included as an activity of ICTA. This remains in DIGESA, another entity within the Sector Público Agrícola.

With special reference to the small farmer, Waugh continues that past research has failed because:

1. The researcher has not taken into consideration the problem of the small farmer and his systems of farming,

2. The researcher is not competent as an agriculturist as practiced by the small farmer,

3. The researcher has not tested the technology at the farm level, under conditions of the small farmer, because he has not mastered his system, and has not truly felt the responsibility to do so, and

4. Acceptance by the small farmer has not been a part of the evaluation of the technology (Waugh, 1975, p.17).

why not include risk? uncertainty?

THE ICTA METHODOLOGY

In order to meet the challenge of generating technology for the small, traditional farmer of Guatemala, ICTA has been developing a methodology in which the social sciences play an integrated role. The methodology reflects the need for rapid results from low budget research. To speed up adoption and help reduce cost, farmers are involved in all phases of the research process and play a key role in decisions. The methodology leads to technologies for precisely specified agronomic and socioeconomic conditions (which vary widely in Guatemala) and minimizes the possibility of recommending technologies which are inappropriate and high-risk to the farmers, and hence, technologies which they resist, or ultimately do not adopt.

how!

Sketched in Figure 1 is a model of the methodology which has four characteristics valuable to the conditions in Guatemala as well as other developing countries:

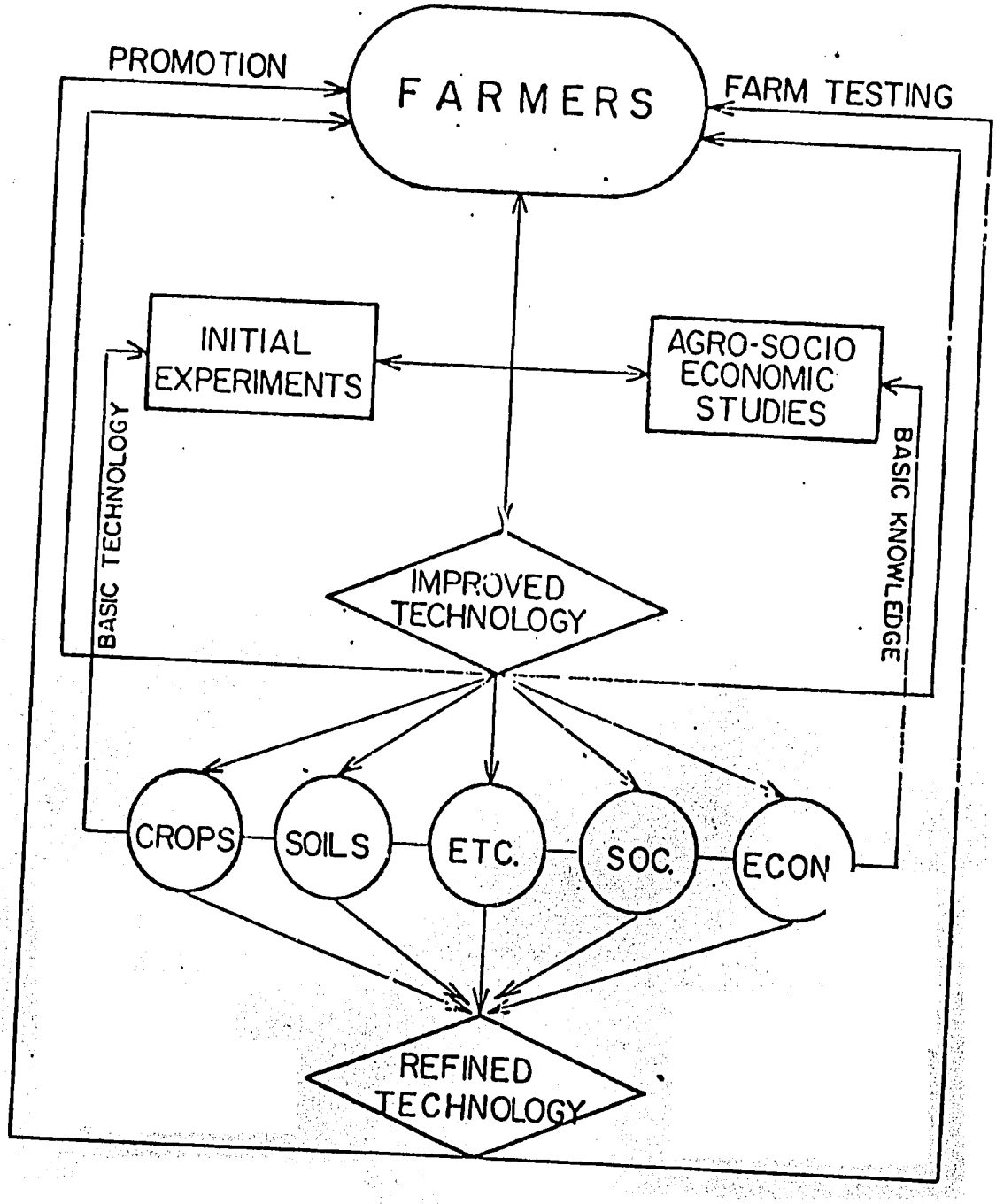

FIGURE 1

METHODOLOGY FOR GENERATING TECHNOLOGY FOR SMALL TRADITIONAL FARMERS

Where do we start?

1. It rapidly generates technologies which are immediately available and appropriate to a selected target group; why?

2. This improved technology, in turn provides orientation for more detailed research to follow;

3. It utilizes farmers in the development process to help eliminate high risk technology which they could not or would not adopt and to provide feedback to the technology development unit, and

4. It creates a multidisciplinary environment essential for generating successful technologies for small, traditional farmers.

The focus is on those many farmers who have been bypassed by most or all modern technology. Within a project area, a target group is sought whose socioeconomic conditions and agricultural situation are sufficiently homogeneous that their needs, constraints and capabilities can be specified readily. The homogeneity criterion on which the group is selected is the cropping system and technology being used. In stable, traditional agriculture, farmers tend to achieve a highly efficient equilibrium with respect to the agro-socioeconomic factors they recognize as scarcest and most critical (Schultz, 1964). Hence, selecting a group with a common cropping system is a relatively simple means of selecting a homogeneous group with respect to the important factors that influence the technology they use. And it is these factors which must be understood if research to generate appropriate technology is to be effective. selection?

The methodology has four basic and identifiable, though highly interrelated components:

1. Description and analysis of the traditional farmer with an orientation toward an understanding of the factors which have prevented

his benefiting from modern technology;

2. Adaptive research to generate new technology appropriate to him;

3. Farm testing (and promotion) to assure, early in the process that the technology being developed is satisfactory from the target group farmer's point of view; and

4. Evaluation of the technology generated.

Each of these four components requires sources of basic technology and scientific knowledge, which in the case of ICTA are primarily (i) internal, (ii) international centers, (iii) universities, and (iv) private industry.

But what are the objectives involved in an attempted in introducing this technology? Why introduce tech in the first place?

THE FIRST COMPONENT: DESCRIPTION AND ANALYSIS

The first component includes an agro-socioeconomic survey of the target farmers to determine in detail:

1. What they are doing;

2. How they are doing it; and

3. Why they are doing it the way they are.

The purpose is to define the factors which influence their choice of farming systems so the improved systems can be designed in an applicable framework. In order to define these factors it is necessary to understand economic and cultural as well as agronomic restrictions which condition their cropping patterns and practices.

The first step is a non-structured reconnaissance which

may last from several days to a few weeks depending on size and complexity of the region. Both social and agricultural scientists should form the nucleus of the study team for the area. Having been armed previously with secondary information, the team will use the reconnaissance to obtain first hand information to help interpret the secondary data and to identify, in general terms, some of the more important agro-socioeconomic factors which influence the systems of small farmers in the area. One of the most important goals of the reconnaissance is to identify the most common farming system (or systems) and delineate the general geographical area in which it is important. This early reconnaissance also provides the team an opportunity to learn the agricultural vocabulary and terms of measurement peculiar to the region, both important in structuring the questionnaire which will be used to obtain detailed information on the most common system or systems in a more formal survey.

The formal survey requires intuition and depth interviewing; hence, quality is more important than quantity. Size of sample is also less important than representativeness of the sample because the information is used to design experimental treatments in the second or adaptive research component, and much of it is difficult to analyze statistically. The formal survey (as well as the reconnaissance) is also a valuable means of locating potential paraprofessionals and farmer collaborators who may be willing to participate in keeping farm records and in following phases of the program.

A number of farmers falling in the target group should be selected to begin keeping farm records in order to:

1. Provide more accurate information than is available from a survey,

2. Verify components of the survey,

3. Serve as continual contacts throughout that technology generation process, and

4. Aid in evaluating the technology. good concept

The number of farmers in this activity will vary with the size of the area and the resources available. For each person working with records, we have been trying for 25 to 30 farmers the first year and 50 in the second and succeeding years.

Excluding the farm records, the time-span for completing this first component should be no more than 3 months in each area and is preferably carried out in the slack period between crop years.

THE SECOND COMPONENT: ADAPTIVE RESEARCH

There are two distinct phases in the second component of the technology development process. The first is experimentation designed to familiarize the researchers more fully with the traditional technology of the target group and to improve on it in the short run. This phase is conducted primarily by the same teams which carried out the survey. The second, and longer run phase is a continuum of the first and involves the refinement of the improved technology developed previously. It is more traditional in research format and requires personnel in addition to the original survey team.

The first phase requires an orientation that differs most drastically from traditional research procedures and can prove to be

as much an art as a science.[3] The team responsible for these experimental systems should be small in order to have maximum interaction -just two people may be optimum- though in ICTA, three to four may be the most usual number. Because the conditions of the small farmer are so different and difficult to understand by the traditional researcher, it is necessary in this phase to work in the conditions and on the land of the target group of farmers -- that is, the research team in this phase must adapt itself to the conditions of the farmers so the results are directly applicable to them because the farmers cannot change their conditions to those ideal for the researchers.

how are these defined and reported?

The selection or design of the treatments in the first phase is probably the most difficult part of the team's task and depends heavily on their depth of understanding of the target group farmers. Economic and risk factors are given special attention. Each treatment in the experimental (including the "check") which is a duplication of the traditional system of technology of the target group) should be considered as a "system" rather than as the more traditional fertilizer levels or applications of insecticides for an individual crop. The treatments also should fit within the capabilities of the farmers to carry out in the short run. That is, they should not depend on a non-existing infrastructure such as a credit program or the development of new markets, etc. The object is to produce an improved technology which can be put into practice immediately by the farmers so they can begin benefiting from the program even while variety development or

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3 The participation of social scientists in what is normally considered biological research is still controversial even though ICTA is unique in the way in which the social sciences have been incorporated into the technology development process. For a fuller discussion of this point, see the Appendix.

testing and fertilizer response studies and the like are being initiated. Hence, the researchers must be acutely aware of the resource restrictions as well as the socio-cultural factors which influence what the farmers can and will do.

Carrying out this phase in close proximity to the target group farmers and considering them as "advisors" as well as utilizing them for laborers, foments a constant contact both on the experimental plots and on the farmers' fields. In this way and through close observation of the "check" treatment, the researchers continue to learn about conditions of the farmers and listen to their opinions about the research while it is underway. In order to benefit from this interchange, the design of the experiment (as well as the treatments) should be sufficiently flexible that changes can be made during the growing season if there seems to be justification for doing so. Statistical control must take a back seat to common sense because the goals of this part of the process are to help understand the farmer and the traditional system, to test ideas and to produce improved technology within a one or two year period. Publication of the results in journals is not the primary objective even if it is possible from time to time.

Another important aspect of the ICTA technology is that the technicians generally live in the area where work. This is the best way to gain the confidence of a suspicious and cautious rural population. Because of the close contact with farmers it is also important that the researcher not loose the farmers' confidence and ruin the image of the program. For this reason, the researchers must not only be well trained, but also have first hand knowledge of farming as well as experimentation.

The product of the first phase of the experimentation

component has two uses. First, if a promising technology has appeared, it can be incorporated immediately in a farm testing program (part of the third component) and second, it serves as orientation for the second phase, or more traditional experimentation, to refine the system.

Examples of the research need of the second phase are variety development, fertilizer reponse and disease or pest control. Although personnel from outside the basic research team are needed in the second phase, these researchers should not loose sight of the clientele for whom the work is being carried out. As results which look promising are available, they should immediately enter into the farm testing component, so they can be judged by the farmers as soon as possible. Number of personnel and time requirements for the second phase experimentation program vary and will depend on budget, goals and objectives, but this phase should be considered relatively long run in nature.

THE THIRD COMPONENT: FARM TESTING AND PROMOTION

In the third component, the distinction between testing new technology and promoting it is not clear cut because one phases gradually into the other. The testing program which requires additional personnel (but should include the basic team), is carried out on farms with the farmer. Technology which appears feasible in the experimental stage is tested on plots sufficiently large to be significant within the farmer's total production volume in order to insure his interest and critical participation.

ICTA has defined two types of farm trials, each with different goals and operational procedures. Following the generation of a "technology" either on the experiment station or on rented farm

land, this is tested at the farm level under a variety of realistic conditions. These so-called "farm experiments" are designed to assure that farmers can manage the technology or study how the technology must be modified to conform with farmer needs. In this type of trial, used primarily with second phase research activities, ICTA generally furnishes all inputs excepts land and the farmer's labor.

The second type of farm trial is the "farmer's tests" where the farmer, himself, tests the technology and compares it with his own traditional technology. This process of testing directly with the farmer provides a means by which the farmers participate in the evaluation. If they approve of the technology, they can immediately begin to use it because they have already been introduce to it on a first hand basis. Promotion, as such, is simplified because the farm test program also serves as "demonstration" plots. For this reason, as well as for more thorough testing, "farmer's tests" should be distributed throughout the area.

The key in the "farmer's tests" is that the farmer pays all costs except the technical assistance required to incorporate the technology in his system and he provides all the labor. This is the critical stage because if the farmer conceives of the new technology as too difficult, costly or risky, it is automatically screened out as being unacceptable to him. This reduces the tendency to recommend technologies that are not appropriate for the target group-a tendency that has plagued most efforts to work with small, traditional farmers. In many farm test plots, the technicians maintain records of inputs, labor use and production to help in the evaluation of the technology. One of the plots, the present system of the farmer, provides an immediate comparison both for the farmer and for the development team of the potential benefits of the technology to the farm and to the area.

THE FOURTH COMPONENT: EVALUATION

In keeping with the philosophy on which the Institute was organized, the technology generated in the process described above, is not considered as successful unless and until it is being adopted on a large scale by the target farmers. Some built-in evaluative procedures which aim to increase the probability that the technology will be attractive to the target group, and therefore adopted by them, have been described. These include the farm records, the records kept by the technicians and the comparisons available to the farmers for evaluation purposes from the farmers' tests.

In addition, three other procedures are being used to monitor longer range adoption of technology. Through a continuation of the farm record project, a long-term trend in type of technology used by the collaborators is available. A continuation of this component not only provides data, but also insures a continuing dialogue by which the technicians are able to follow the farmers' thinking, needs and desires.

A shorter run procedure is being initiated at the present time in one area, and if it appears useful, will be expanded to all the regions in which ICTA operates. This is to make a follow-up survey of the farms which were included in farmer's tests in preceeding years. The purpose is to determine what recommended practices are being used and on what proportion of the crop. Farmers will also be asked why they are or are not using each of the practices which were recommended as a result of the tests on their own farms.

Occasionally, a special study is undertaken to evaluate certain specific aspects of a technology being introduced. One of these involved the yield potential of some new sorghum varieties (Reiche, 1975)

and another, the opinion of farmers regarding a new corn hybrid (Busto Brol, 1975).

The ultimate evaluation of the success of the technology -to determine the effect on production of basic grains- is not incorporated in the methodology. In part, this is because other entities within the Sector Público Agrícola and elsewhere in the government are charged with estimating agricultural production. Also, to determine the effect of technology on production separately from the effect of other factors is well-nigh impossible even in countries with highly developed statistical reporting services. Finally, an advance in corn production technology, for example, may not increase corn production in the region for which it was generated but rather pave the way for an increase in the production of other crops as land is withdrawn from corn by farmers interested in that crop mainly for family subsistence (Ruano, 1975).

EXAMPLES FROM THE METHODOLOGY DEVELOPMENT PROCESS

In the three year growth of the Institute, this methodology has not yet been used completely in any one place, although each element has been initiated in at least one of the three regions where ICTA is active within the country. It is being approximated most closely this year in the Central Highlands in the Department of Chimaltenango although all aspects are still not complete even there. However, it is worth noting that even parts of the whole can have an important impact on technology generation so utilization in each region will be described to show how the different components contribute.

LA MAQUINA, A LAND PARCELIZATION PROJECT ON THE PACIFIC COAST.

This is not an area of small, traditional farmers, but

rather of relatively large (20 hectare) holdings where, because of their recent creation, no long-term traditions exist. CIAT had initiated a large scale study of the farmers in the area (Santa María, 1976), so ICTA chose not to use its scarce resources on this phase of methodology. Also, the cropping systems being used were relatively simple and lent themselves to modification by the second phase of the adoptive research and farm testing components. Hence, the program of ICTA was basically variety trials, fertilizer experiments and herbicide studies (Crisóstomo, 1976) plus a farm record-keeping project (Busto Brol, 1976).

In 1975, widespread farmers' tests of the most promising practices and varieties were conducted and on most of them records were kept by the technicians. One of the most interesting situations involved fertilizer use on corn. The national extension service (DIGESA) and the small farmer credit bank (BANDESA) recommended rather large doses of fertilizer in their technology packages relying primarily on conventional wisdom as a guide. But many farmers did not use fertilizer and others complained of little or no response. Because prior research on fertilizer had been inconclusive, much attention was given this factor of production by ICTA. The conclusions from 96 farm trials on corn indicate that under most conditions fertilizer use does not pay in this area at the present time. This important conclusion, combined with other practices which were incorporated in the trials, allowed ICTA to recommend shifts in the use of resources, particularly capital, and increase production while at the same time lowering costs to below that being loaned by BANDESA for corn production in the area. In Table I is a summary of the comparison between the technology being recommended by ICTA with that used for loan purposes by BANDESA and with the average of the 23 farmer collaborators in the record keeping project. In 1976, the ICTA recommendation was accepted and new loans are being made on that basis.

TABLE 1

CORN PRODUCTION COSTS AND INCOME IN DOLLARS PER HECTARE. PARCELAMIENTO LA MAQUINA GUATEMALA

ITEM	DIGESA 1975		ICTA Technology		Farm Record Keepers	
Cultural practices		117		130		110
Land preparation	34		34		34	
Planting	16		9		7	
Cultivations	36		34		40	
Harvest	31		53		29	
Inputs		126		39		10
Seed	14		13		9	
Fertilizer	76		--		--	
Pesticides	36		26		1	
Total Costs		243		169		120
Yield Kg/ha	2,730		3,310		1,950	
Gross income ($ 154/m.t.)	420		510		300	
Net income	177		341		180	
Rate of return (net) %	73		202		150	

Source: (Busto Brol, 1976)

THE ORIENTE: A DUALISTIC REGION

The ICTA program in the Department of Jutiapa in the southeastern part of the country has two distinctly different groups of clients. Those farmers who own or rent flat (or relatively flat) land, although classed as small, and medium in size, generally plow (many with tractors), utilize fertilizers and insecticides and many are incorporated in the DIGESA / BANDESA technical assistance and credit program. Multiple or associated cropping is still common on these lands but some farmers are utilizing relay monoculture including inter-planting, while others practice monoculture in rotation.

A very distinctive type of agriculture is practiced on the sloping to steep hillsides where much of the land is rocky and eroded and very little is plowed. Here, with very few exceptions associated cropping is practiced and very little fertilizer and virtually no pesticides are used. These farms are mostly small, subsistence types with few exceeding 3.5 hectares.

The production team[4] in the Oriente is conducting farmer's tests and farm experiments based on previous knowledge rather than on the survey component of the methodology. To date their work has been almost entirely in monoculture designed for the farmers on better land and who are clients of the DIGESA/BANDESA programs.

In 48 farm experiments and 20 farmer's tests on corn (Waugh, 1975) covering seven "municipios" a great deal of information on yield components was obtained to help speed up the process of technology development and superior varieties were identified. Results from 31 farm experiments and 8 farmer's tests on beans were less conclusive leading to the suggestion that much more work needs to be done on this grain. For grain sorghum and corn, packages of recommendations were made which should be of great help to the credit program (Plant, 1976).

Very little information was available on the farmers who till the rolling to steep land which abounds in the area. Because they are in the majority, this was the group chosen for the agro-socioeconomic survey which was conducted in early 1975. The most common systems in the area corn-sorghum or corn-bean-sorghum

4 The "production teams" in ICTA are in charge of part of the farm experiments and most of the farmers' tests.

all planted at the same time. The two systems are essentially different parts of the same system in that it is common for a farmer to plant part of his land to corn-beans-sorghum and when he uses all his bean seed (which is very scarce and expensive) he continues planting only corn and sorghum on the remaining land.

Based on the survey, (Reiche, 1976) which identified bean seed and labor at planting time as the most limiting controlable factors (excluding rainfall) several experimental cropping systems were planted in May, 1975. In one promising system using local varieties and no fertilizer nor insecticide because the majority of farmers do not use them, production of corn and sorghum were increased and bean production was held constant (Hildebrand, 1976). However, the amount of bean seed used was reduced 44% and only 71% of the amount of labor was required at planting time compared with the "check" or common system. The increase in production and decrease in labor, greatly increases the productivity of time spent in planting which may be the single most important consideration in the mind of these farmers.

The system requires nothing different from what the farmer normally uses, and indeed, less of some critically scarce resources. The primary change is in form of planting. This system has now been incorporated in farmers' tests, skipping the farm experiment stage because it was developed under farm conditions. Also, new experiments have been initiated which include variety trials, spacing and fertilizer use with which it is hoped to increase productivity even more without exceeding the capabilities of the farmers to adopt the technology.

THE HIGHLANDS

Some of the most advanced research in the country, particularly in wheat and to a lesser extent in corn and potatoes, was underway in the Western Highlands at the time the new institute was established. The production team in this region was organized barely in time to initiate planting in 1975 and relied heavily on available sources of information to establish farm experiments and farmers' tests in Quezaltenango (Schmoock, 1976). Meanwhile, another experimental methodology was underway in two other locations using cooperatives with minimum ICTA investment, to conduct farmers' trials, primarily with new varieties of corn and wheat (Corisco, 1975).

In order to initiate the complete technology generation methodology, an agro-socioeconomic survey was conducted in early 1976 in another region, Chimaltenango, in the Central Highlands, so that appropriate information on traditional agriculture in that area would be available for the arrival of the production team in 1977. A member of the production team from Quezaltenango and one from the national bean program participated in the reconnaissance and the survey. The reconnaissance located an area in western Chimaltenango centering around Tecpán with a widespread, traditional technology. The survey was underway at the time of the recent earthquake at which point 40 questionnaires of the 60 programmed had been completed, and analysis was undertaken on these.

Unlike the Oriente, labor is no serious problem for the small farmer of this area even in the seasons of most work. In part, this is because the rains are better distributed and the growing season is longer, but mostly because the population pressure is so great that holdings are very small (1.4 hectares average in the survey).

Historically, the Highland farmer has had to migrate to other areas looking for work in order to supplement the production on his own farm even to achieve self sufficiency. Therefore, land is considered as one of the most limiting resources.

The Highlands is a productive area with many crop alternatives, but the small farmer, in general, produces corn, beans and "haba" (European broad bean) to insure his family at least a minimum diet. Only those who have more land or become more productive corn producers and surpass subsistence production begin to experiment with other crops. The first crop to be tried is usually wheat, a cash crop, then potatoes and/or cabbage. Accordingly, the crop systems experiment is designed primarily to increase corn, bean and haba productivity, but also includes wheat and cabbage. Potatoes will be incorporated next year.

A total of 18 different neighbors, all of whom are in the target group have been working in the crop systems experiment and all serve as "advisors" as well as laborers. Four of these same men are keeping records as part of the group of 25 farmers in that activity. Three wheat and five corn varieties are included in the trial and the bean program is screening several hundred for adaptation.

Altogether, a large amount of information will be available for the use of the production team from the survey, the farm records and the crop experiments, but the procedure still is not achieving its full potential. The author and an anthropologist, along with two Perito Agrónomos[5] are conducting the experiment. Owing to the press of work in the Western Highlands, the member from that production team was not able to participate in the analysis of the survey data nor in planning and conducting the crop systems experiment. Personnel from the bean program have been available for

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5 A Perito Agrónomo is a graduate of the National Agricultural School which provides 3 year's course work and practical experience beyond the high school level.

advising when necessary, but ideally they, the corn program, and specially, the production team should be participating in the day to day work, the decision making and the learning activities. This will probably be the case during the second year of the trials in 1977, but because the budget was not sufficient this year, the complete methodology could not be put into practice.

SUMMARY

Described in this paper is a multi-disciplinary methodology for generating new technology for small, traditional farmers as it has developed over the first three years of operation of the Institute of Agricultural Science and Technology, ICTA, of Guatemala. Although we know how all four components (description and analysis; adaptive research; farm testing and promotion; evaluation) fit together, the methodology still has not been used as an integrated whole in any one place. Rather, components have been developed and used on a regional basis as need and budget permitted. These separate components, however, provide very useful information even when not part of a complete system and may be adapted to the varying conditions found in any region as well as to a growing budget and staff.

Perhaps the most unique socioeconomic feature is the method used to select homogeneous target groups. Instead of attempting to define and select the group on the basis of resource characteristicts, a common cropping system is sought. Then a highly integrated combination of surveys, record keeping, experiments, farm tests, promotion and evaluation are used to generate technology for the specific conditions of those farmers who practice this cropping system and, hence, become the target group. The high proportion of work done on farms and with farmers is probably the most unique and importante agronomic feature.

The methodology depends on a well coordinated, multi-disciplinary effort, but it is precisely this characteristic which is necessary to reach a type of farmer who has yet to benefit from the vast investments being made in the world to develop improved agricultural technology.

Alg.

APPENDIX

THE SOCIAL SCIENTIST IN "BIOLOGICAL" RESEARCH

The participation of social scientists in the first phase of adaptive research is the most controversial aspect of the entire methodology. It is difficult for a biological scientist to believe that an economist or an anthropologist can contribute to crop research. In all candor, this judgment is not without some strong foundation. In most organization when scientists (usually agricultural economists) are incorporated into technology generation teams, the role most often assigned them by the biological scientists (invariably the project leaders) is that of accountant --to determine cost and return-- a task necessary in applied research but one not savored by most biological scientists. The social scientist, while disagreeing with this role, usually comes no closer by insisting on model building either at the macro level to show the general importance of, or to justify the project, or at the micro level, frequently to show how the biological scientist is erring by not considering economic or other social factors in his work. In either case, life is much less complicated by letting the two types of technicians drift apart, each doing his own thing in the comfort of being watched over only by his own kind.

In ICTA, the primary role of the social sciences as recognized by other personnel (including managment) is that of providing information about the small farmers and their systems of production to the biological scientists. There is little controversy over our ability to do this, particularly as long as we stay in the realm of farm surveys. But when we venture into the first phase of the adaptive research component in order to continue the process of learning about the farmer and his cropping systems, and particularly to initiate technology development, the biological scientists raise their concern.

A factor of utmost importance if this procedure is to function as it should is the understanding that in applied research oriented toward generating technology for a particular group of traditional farmers, economic and social factors are equally as important as biological factors in determining a technology appropriate for the client. A second factor is to recognize that a social scientist is as capable of learning the basics of biological resarch as the biological scientist is of making his own basic economic analysis. Obviously, the training and orientation of the social scientist is critical both with respect to his capability to contribute to biological research and to his acceptance in this role by the biological scientist. A fourth necessary ingredient is that the biological scientist has an inclination toward applied research and understands the importance of orienting his work toward specific clients.

Though the first and second phases of the adaptive research component are highly interrelated there is an important distinction. The first phase is largely farm management research, broadly defined, and is conducted to study the influence of social and economic factors on the potential for increasing farm productivity in the target group. The second phase is primarily biological research which strives to increase productivity within the capabilities of the target group. Hence, there is no need for competition or concern over usurping prerogatives in either phase of the component. The active participation of biological scientists in the first phase helps them identify with the target group and understand their problems, and improves the techniques used in conducting the research. The participation of the first phase technicians --both social and biological-- in the second phase research helps maintain the orientation toward the specific target group.

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