Optimizing the process of making farmer recommendations in developing countries[1]

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ABSTRACT

Many development projects have failed because of unsound recommendations. This paper looks at how the process of making farmer recommendations can be improved in the small farm sector of developing countries. The examples provided suggest (a) the need to conduct ex-ante evaluations, (b) the necessity of a multidisciplinary team working in an interdisciplinary manner with both biological and social scientists involved during all phases of the project, and (c) the importance of developing technology which is based on the small farmer's goals and farming system, including his resources and constraints. Farming systems research is proposed as the appropriate framework conducive to meet the challenge of optimizing the process of making farmer recommendations in developing countries.

Additional index words: **Farming systems research, Interdisciplinary research, Ex-ante evaluations.**

SINCE the end of World War II, increasing attention has been given to the process of economic development of the less developed countries. There exists a consensus on the need for sustained growth to bridge the gap that separates the developing countries from the industrialized nations. Although the issue of overall development strategies is still under debate, the key role that the agricultural sector has to play is today widely accepted.

The efforts of almost four decades, however, have not been very successful. In his farewell speech to the World Bank on 30 Sept. 1980, Robert S. McNamara stated:

> Widespread poverty is an open insult to the human dignity of us all. For we have collectively had it in our power to do more to fight poverty, and we have failed to do so. Sustaining the attack on poverty is not an economic luxury, something affordable when times are easy and superfluous when times become troublesome. It is a continuing social and moral responsibility, and an economic imperative and its need now is greater than ever (The Palm Beach Post, 1980).

Agricultural professionals from the United States have always been concerned with the development process. Just 5 years ago, the theme for the annual meetings of ASA-CSSA-SSSA was "Agronomists and Food: Contributions and Challenges," intended to "serve as an inspiration and a stimulus to all who are truly concerned about adequate food for the people of the world" (Thorne, 1977). In terms of contributions, it was said that "... The agronomists, crop scientists, and soil scientists who have contributed to so many past successes in achieving greater food production should feel justifiable pride" (Wharton, 1977). Concerning the challenges, and anticipating McNamara's words and the central theme of the 1981 Meetings, Wharton, (1977) added: "When looking to the future and the role of agricultural professionals, it is clear that the challenges remain and may well become greater." It thus becomes obvious that agricultural scientists, including those in the biological and social disciplines, must share the responsibility of optimizing the process of making recommendations for farmers in developing countries to bring about the growth needed to alleviate widespread poverty and accelerate the narrowing of the gap between the industrialized and the underdeveloped nations of the world.

This is an economically slanted paper dealing with the small farm sector. It describes the importance of a multidisciplinary approach within the "farming systems research" framework. The examples provided are intended to illustrate how agricultural scientists from several disciplines can work together, in an interdisciplinary manner, to optimize the process of making management rcommendations.

THE INTERDISCIPLINARY APPROACH

There is no doubt that the solutions to most of the agricultural problems faced by developing nations have to be the result of multidisciplinary efforts; i.e., agricultural professionals from several disciplines working on the same problem. Figure 1 outlines the steps of the interdisciplinary approach (a method that integrates all appropriate disciplines). The figure includes some useful references for biological scientists working with agricultural economists, since the author is an economist.

Initiating the Research

The ultimate objective of any applied research project is the development of recommendations for farmers. Making farm recommendations is sometimes a difficult task. Perrin et al. (1976) have developed a comprehensive publication intended for use by agronomists as they make recommendations from agronomic data. It explains how to:

[1] Contribution of the Univ. of Florida, Inst. of Food and Agric. Sci., Gainesville, FL 32611. Florida Agric. Exp. Stn. Journal Series No. 3569. Invited paper for the 1981 annual meetings of ASA-CSSA-SSSA on "Agronomy: increasing food—conserving resources, a worldwide responsibility," Atlanta, Ga., 2 Dec. 1981.

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1. Identify the benefits associated with treatment alternatives, and place values on the alternatives that match farmers' goals.
2. Identify those inputs that change from treatment to treatment and place values on those which match farmers' goals.
3. Identify sources of variability which will make the farmer uncertain about the net benefits he will get from each treatment.
4. Derive recommendations from cost, benefit and variability data that are consistent with the farmers' desire to increase average income, with the farmers' desire to avoid risks, and with the scarcity of investment capital which is typical of most farm situations.

Although obviously written from an economic bias, those four objectives identify, explicitly and implicitly, the important categories before beginning any project where a multidisciplinary team is going to work in an interdisciplinary manner. They include the problems to be analyzed, the individuals involved, and the research environment.

Research in developing countries is typically problem-oriented, falling in the category that Johnson (1954) called "service research." Topics holding most promise for a successful completion include those in which all scientists involved identify the existence of a problem that could be solved by their individual contributions to the analysis.

The individuals involved are an important factor in interdisciplinary research. They must be problem oriented, highly qualified in their own fields, and able to communicate with the rest of the team during all phases of the research. All disciplines relevant to the project should participate from the beginning. Including economists, sociologists, anthropologists, or other social scientists throughout the entire process can avoid serious problems at the time of extending the results. The Plan Puebla in Mexico illustrates this point: the social scientists were called when administrators realized that the farmers were not adopting some of the recommendations included in the technological "package."

The success or failure of any research project is highly correlated with the environment provided by administrators. Support must go beyond "lip service." The degree of complexity varies when the project takes a product oriented (or sub-sectorial) approach, a functional approach (extension or credit), a regional or national approach. The bureaucracy also tends to increase with the degree of sophistication of the project. When the administrators do not deliver the needed support when most necessary, the researchers feel frustrated and disappointed. The development literature is full of dramatic descriptions of project failures due to a lack of a sound research environment.

The recipe for alleviating these problems must vary from country to country. However, it is necessary to train more individuals in administration, to minimize red tape, to develop systematic operational methods, and to decentralize the programs' administration (to take into account both local capabilities and constraints) while keeping a certain degree of control at a higher level.

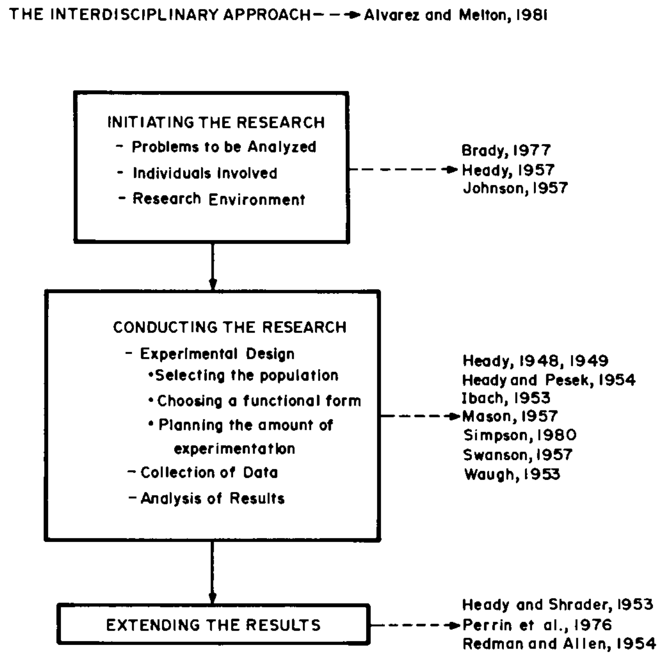

Fig. 1. The interdisciplinary research approach, with references mainly related to the work between economists and biological scientists.

Conducting the Research

Three areas deserve special attention here. They are: the design of the experiment or research project, the collection of suitable data, and the analysis of the results.

All members of the research team should participate in the design of the experiment or project. Careful consideration should be given to the understanding of the underlying socioeconomic and physical relationships; when ignored or separated, erroneous courses of action could be taken. The plan and design of an experiment determines the form of the statistical analysis. Three problem areas here include the selection of the population over which inferences are to be made, the choice of a proper functional model to describe the form of the response, and the planning of the economic amount of experimentation.

Data problems encountered at the time of fitting a model or analyzing the results are a consequence of badly planned experimental designs. By working together from the early conceptualization of a project, scientists are less likely to encounter data problems than those working independently.

The author's experience a few years ago illustrates this fact. For an Economics Handbook intended for County Extension staff, I was assigned the section on marginal anaysis. It was frustrating to look at response studies in Florida for the past 20 or more years and being able to find only two or three good cases that would help explain the theory with real world examples. The reason was that the agronomists designing the experiments were more interested in variance-type studies than in determining the marginal quantities and the economic optimal input use.

Figure 2 portrays a good example. In the upper

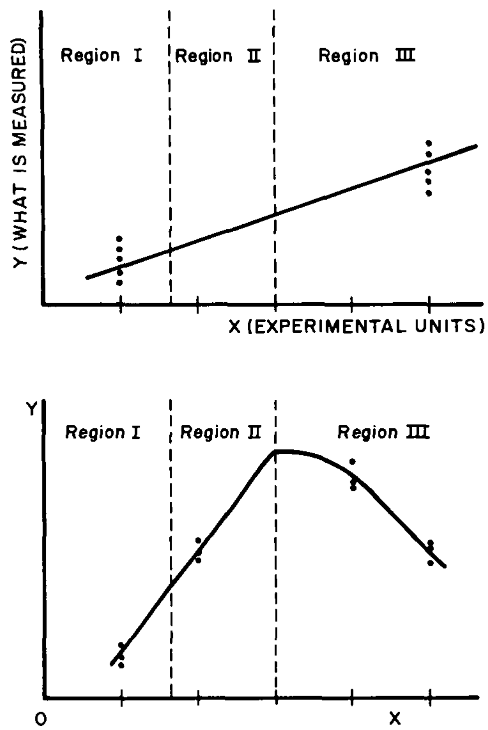

Fig. 2. Changes in an experimental design that would yield data suitable for an economic analysis.

graph, the results of two treatments with five replications are shown. Since the treatments cover the three regions of the production function, these data are worthless to the economist. However, in the lower graph (which is drawn using the same scale), we see that, by adding treatments and reducing replications, the economist can perform an economic analysis.

Extending the Results

The primary goal of applied research is the making of farm recommendations from the data collected. A good farm recommendation could be defined as a choice the farmer himself would make if he had all the information available to the scientists. When the new practice has to show potential profits to be adopted, the input of the economist is of utmost importance. It is not enough to tell farmers in a particular region that they should use 200 kg of 6-8-6 fertilizer on their corn without considering the expected yield and the cost-price relationships. The farmers would have no basis for determining whether or not that is the most profitable amount to use.

Therefore, when potential profitability is the only remaining factor that could impede adoption (once the sociological, anthropological, and other important aspects have been considered), farmer recommendations should be the result of both statistical and economic analyses. Most biological scientists are familiar with the techniques available to determine whether or not the means from two treatments in an experiment are significantly different from one another. Some scientists argue that non-significance eliminates the need for an economic analysis. Perrin et al. (1976) gave exceptions. First, most statistical tests are geared to the 0.05 or 0.01 levels of significance. But farmers may be willing to accept lower levels of significance. For example, if variety A yields 30 kg in an experiment, while variety B yields 40 kg, farmers may be quite happy to choose variety B, because of the economics involved, even though this yield difference is statistically significant only at the 0.15 level. Second, in some cases two treatment means are not significantly different at any of several trial sites, but the treatment means are different at the 0.01 level when the data are pooled. Furthermore, if the treatment means are not significantly different, but an economic analysis shows that one treatment is a better recommendation than other, then a more careful analysis of the recommendation, using net benefit curves and marginal analysis, is in order. Thus, the greatest value of statistical analysis is not in deriving recommendations but in determining what is happening, biologically, in the experiments.

A good example to summarize this section is found in Savoie and Kabay (1980). The authors state that farmer recommendations should be preceded by thorough agronomic research and economic analysis. Using a production function approach with agronomic data (from experimental plots and peasants' fields), simple statistics, and elementary economic theory they estimated the probability of success or failure for different seed densities of 'Saxa' dwarf beans in Rwanda—a country in east central Africa.

Their results show that, if actual seeding practice is 40 kg/ha, a recommendation to increase seed density to 90 kg/ha would have a good chance of succeeding: the probability of achieving a greater profit than the maximum lower 95% confidence bound at 40 kg/ha is 92%, while the likelihood of exceeding the expected profit at 40 kg/ha using 90 kg/ha is 69%. Furthermore, 71% is the probability that profits at 90 kg/ha will be greater than the expected profits at 140 kg/ha. Since these confidence bounds were calculated for individual farmers and not for the mean profit group of farmers, the authors believe them to be conservative because the average profit will have tighter confidence bounds. Barring extraordinarily bad climatic conditions, the farmers would quickly be convinced of the value of the proposed seed density. This methodology also can be applied to other crops and treatments such as fertilizers and pesticides.

THE NEED FOR EX-ANTE EVALUATIONS[3]

The existence of a multidisciplinary team working in an interdisciplinary manner is not sufficient for the success of a research project. Although the following section emphasizes the need for ex-ante evaluations at the farm level, the following two examples illustrate the need to investigate the feasibility and implications of

[3] Ex-ante evaluations are those conducted before a large research project is undertaken. The main objective is to try to determine the probability of success of that project. These evaluations should be of a short-term nature. Data are sometimes available, or could be generated by simulating farm conditions or by conducting farm trials on a small scale.

new agricultural policies at the regional and national levels.

Guatemala's Basic Grain Policy

On 20 Jan. 1976, the Minister of Agriculture of Guatemala announced that the Government was launching a program to increase agricultural production with special emphasis on basic grains (Diario La Tarde, 1976). The Institute of Agricultural Science and Technology (ICTA) of Guatemala was already working on developing new technologies intended to generate increases in productivity. The main objective was to augment the country's total supply of basic grains without expanding the area committed to production.

A research project was developed.[4] It was focused on the traditional small farmer. Their contribution to overall production of basic grain was relatively important since 55% came from farms under 7 ha (Waugh, 1975). Since traditional farmers devote most of their basic production to family consumption, a potential problem could develop if these farmers used the new technology to produce the same or even a smaller amount of grains on less land, while diverting the newly available land to the production of commercial crops. The investigation of traditional and commercial supply response became of utmost importance.[5]

The authors' research objectives were to estimate market supply functions for each basic grain (wheat, corn, rice, beans, and sorghum) or association (mixed crops such as corn-bean) in the different regions of the country; and to compute the corresponding income, farm size, and price elasticities of market supply.[6] A model conceptualizing the small farmer's basic economic system was developed. A surplus-output ratio was estimated as a function of the product's farmgate price, education of household head, total farm size, distance to the nearest market, quantity of the product demanded on the farm, total family income, and a relative profitability ratio for all grains produced. Data used came from a small farmer credit survey conducted by the Guatemalan Government and U.S. Agency for International Development in 1974. The results of the regression equations supported the conceptual model (Fig. 3).

Traditional crops generally appear at near zero income and farm size levels, while commercial crops are cultivated when higher levels of income and farm size have been attained. Elasticities of market supply for traditional and commercial crops are high at low levels of income and farm size. However, while commercial crops still show some responsiveness at higher income and farm size levels, the traditional crop response becomes almost perfectly inelastic. This behavior is the result of farmers becoming involved in the activities of the market economy, once self-sufficiency has been secured, and shifting into commercial crop production at higher levels of income and farm size.

Thus, since traditional crops pervade the basic grains production system in Guatemalan agriculture, little hope prevails for the attainment of massive increases in supply of basic grains. Although corn and rice seem to have a slight potential for increased production in two regions of the country, the resulting increases would fall far behind the goal of the Guatemalan Government.

New Sorghum Technology in Northeast Brazil

To assess the adoption potential of new sorghum varieties in the northeast region of Brazil, Goodwin et al. (1980) analyzed the relative importance of three variables (credit; policies to affect risk through reduction in the income variance; and increased information to improve perception of the distribution of returns from new

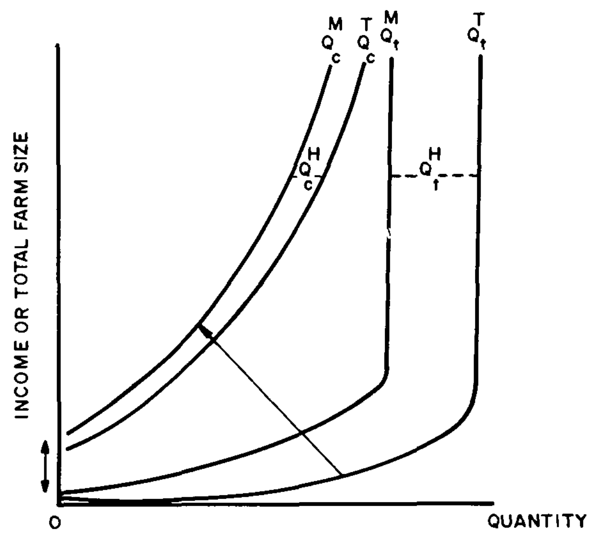

Fig. 3. Traditional and commercial income and farm size-quantity relationships in developing agriculture. Q^T, Q^M, and Q^H represent total quantity produced, marketed and consumed at home, respectively, while c and t represent commercial and traditional crops, respectively.

[4] For detailed descriptions of the conceptual and statistical models and results, the interested reader is referred to Alvarez (1977) and Alvarez and Andrew (1977b). This section is mainly based on Alvarez and Andrew (1977a).

[5] The term traditional farmer is used to designate farmers who historically ignore market stimuli and are not prepared to shift from one crop to another; in general, the term traditional means any system which has been used for "a long time" and has not been "modernized" particularly in the use of petroleum based products. The commercial farmer is price responsive and has the means to shift between crops; his farming is a business and he responds to market stimuli. The difference between traditional and commercial crops is based on the destination of the product and the utilization of labor in its production. In traditional crops farmers tend to use about 80 percent family labor and 20% contract or hired labor and, although some output may be sold when a surplus occurs, production is mainly devoted to family consumption. In commercial crops the characteristics are almost exactly the reverse (The discussion is based on personal communication with Peter E. Hildebrand, Coordinator, Socioeconomics Program, ICTA-Guatemala, 1976).

[6] The term elasticity refers to the responsiveness of a dependent variable to changes in an independent variable. For example, (dq/df) (f/q), where dq/df is the derivative of surplus/output with respect to farm size at a point on the surplus/output curve, gives the farm size elasticity of market supply.

technology) on the small farmers' decisions. A linear programming model was developed for a representative small farm of the region using data from a 1973 survey and complemented with subsequent field interviewing.

The objective was to simulate the choice of cropping activities and evaluate the effect of a new sorghum technology. Results from the simulation model showed that new technology should be adopted by farmers highly averse to risk, even with an overestimation of the variance of returns. (Overestimation in the model resulted when farmers were assumed to over-estimate the downside risk and the extension agent to overstate the potential profitability.) For nonadopters, improved estimates of the distribution of returns will occur over time from the demonstration effect. Therefore, the authors concluded that crop research programs may need to consider several alternative technologies, as the model results for the sorghum technology adopted were highly influenced by the farmers' risk-aversion coefficient. In summary, "ex-ante technology evaluation by simulating farm conditions appear to be useful for ascertaining the feasibility of new technology and the farm level constraints to its introduction" (Goodwin et al., 1980).

The first of the former examples identified the need for a "bottom-up" approach while the second one pointed out the necessity to consider several alternative technologies. The following section describes an appropriate framework for dealing with these and other problems in the small farm sector.

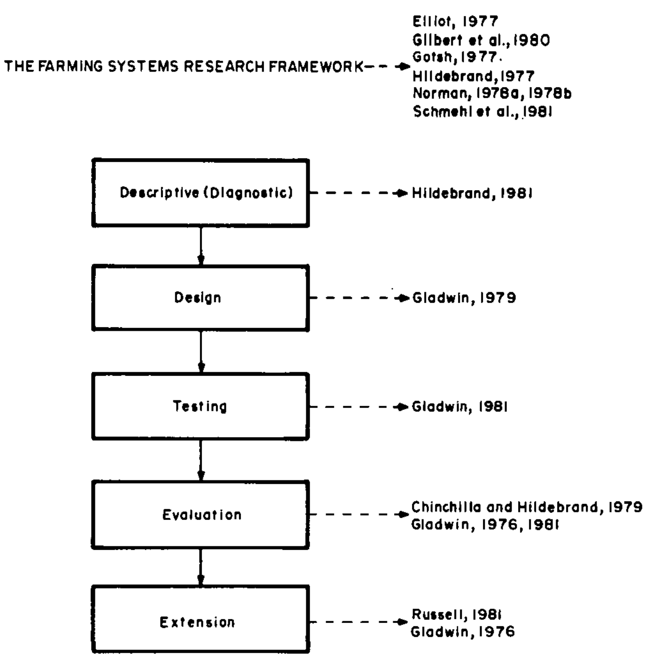

Fig. 4. The five successive stages of the farming systems research approach, with references describing the framework and the appropriate methodologies at each stage.

THE FARMING SYSTEMS RESEARCH FRAMEWORK

Experience has shown that it is ill-advised to assume a standard pattern of development for all countries and that trying to directly transfer technology from the developed countries to the developing world does not render satisfactory results. Dictating development strategies from the top levels of government has also proved unsuccessful. Furthermore, solutions for large farms frequently do not work for small farms. Some development specialists have devised a new way to deal with agricultural development. A new context was outlined during the 1970's and is being presently applied in many countries. Mainly aimed at the small farmer, it has been broadly defined as one "of developing technology that not only provides for increases in productivity but does so in a way that is wholly useful, usable, and acceptable to the small farmer, given his goals and farming system, and including the resources and constraints he faces" (Norman, 1978b).

Farming systems research identifies the contributions of both biological and social scientists as a sine qua non for its success. It has been stated that "the necessity of recognizing and focusing on the interaction of the technical and human elements requires a multidisciplinary team working in an interdisciplinary manner, with the social scientist playing an ex ante rather than simply the traditional ex post role characteristic of the 'top down' approach" (Norman, 1978b). Five successive stages have been identified (Fig. 4).

The Descriptive (Diagnostic) Stage

The purpose of this stage is to unveil the farming system practiced by the farmers in an area where new technology or cultural practices are being considered. Emphasis falls on the farmers' goals as well as the constraints they face.

A very useful methodology for this phase has been devised. The "sondeo" (a team rapid survey approach) has been defined as "a modified survey technique developed by the Guatemalan Institute of Agricultural Science and Technology (ICTA) as a response to budget restrictions, time requirements, and the other methodology utilized to augment information in a region where agricultural technology generation and promotion is being initiated" (Hildebrand, 1981). Its purpose is "to provide the information required to orient the work of the technology-generating team. The cropping or farming systems are described, the agro-socioeconomic situation of the farmers is determined and the restrictions they face are defined so that any proposed modifications of their present technology are appropriate to their conditions" (Hildebrand, 1981).

The sondeo is usually a 6-day operation by the team as a unit, generally a 10-person team composed of different biological and social scientists. The objective is to determine the most important cropping or farming system and begin to search out the limits of the

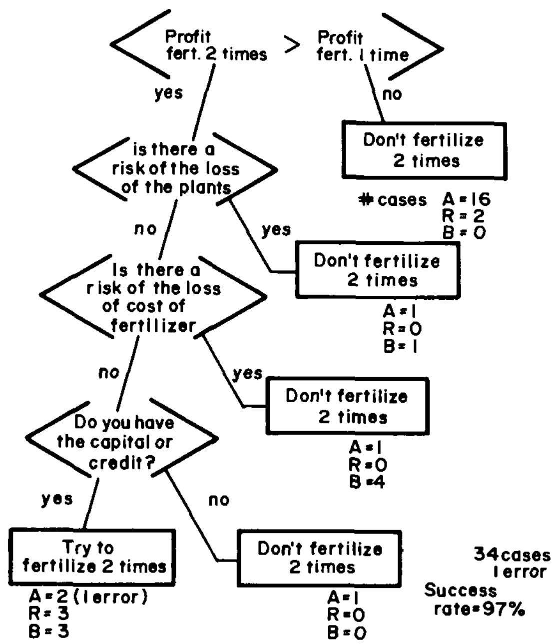

Fig. 5. Decision to fertilize twice, at planting and the second weeding, in the Plan Puebla, Mexico. Source: Gladwin (1976).

homogeneous system. (Delimiting a homogeneous area to develop farmer recommendations cannot be done without agronomists working with anthropologists, agricultural economists, and other social scientists.) Perhaps the most important aspect of the sondeo report is to orient the first year's research and to locate future collaborators for the farm trials and for the farm record projects where "hard" data will be generated. A detailed description of this methodology can be found in Hildebrand (1981).

The Design Stage

During this stage, the information collected during the descriptive (diagnostic) stage is analyzed while designing the experiments. Final decisions about the experimental design are made after considering the range of alternatives available given the constraints that have been identified. The most promising strategies are then selected. The next step consists of conducting the experiments.

The Testing Stage

The testing of the new strategies should be conducted in two parts. The first one, defined by Gladwin (1981) as "the generation-of-technology stage", consists of experiments conducted by the technical team mostly on farmers' fields, although some experiments of the commodity programs are highly controlled trials on the regional experiment stations. The second part is a repetition of the first but in this case the farmers themselves are entirely responsible for the experiments. This is very important since farmers frequently refuse adopting a new practice recommended by agricultural experiment stations arguing that conditions on the farm are sufficiently different from experimental conditions. The new practice, of course, is compared to check plots by researchers and farmers.

Gladwin has correctly identified this phase as the starting of the process of technology diffusion and transference. Data gathered during the two parts of this phase provide valuable information to the team and the farmers about traditional versus new technology. At this point, decision "tree" methodology can be used to look at the decision process of early adopters with the objective of evaluating the probability of success of the new technology. A decision tree is "a sequence or series of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice" (Gladwin, 1979). An example will be used later in this paper.

The Evaluation Stage

Evaluation takes place one year after the farmers have tested the new technology. The purpose is to check if farmers are still using it, and if not, why not. The ICTA has developed an "index of acceptability" which is computed *for each recommendation* in the technological "package" (Chinchilla and Hildebrand, 1979). When the figure is low, the technical team may drop one or more recommendations of the new technology before they become "official" recommendations of the institute.

The above procedure, however, is not sufficient. Program planners need to know why farmers are doing what they are doing or why they are *not* doing what the technical team recommends (Gladwin, 1981). Based on her vast experience with modeling small farmers' decision processes, Gladwin (1976) has used decision "tree" methodology to elicit farmers' reasons for non-adoption of new "improved" technology.

This methodology was used to elucidate why farmers were not adopting some of the four recommendations included in the technological "package" of the Plan Puebla in Mexico during 1973–1974. By developing and testing a decision "tree" for each of the recommendations (which included profit, risk, capital, and knowledge as decision criteria) the author was able to pinpoint the main factor limiting adoption of each recommendation.

Figure 5 depicts the decision "tree" model tested for one of the recommendations in the existing soil types.[7] Although farmers in the area fertilize only at the first weeding, the recommendation included fertilizing both at planting and at the second weeding. The decision model states that two applications can occur if farmers

[7] Soils type A include fields without irrigation but with enough moisture in the soil if plowed correctly after the preceding harvest so that the farmer can plant early in April. Type R represents fields with irrigation. Type B includes fields without irrigation and without moisture in April so that the farmer must wait for the first "regular" rain to plant, which may occur in April or May or as late as June.

[8] The one error means one farmer who passed all the criteria on the path but did not fertilize twice.

consider that fertilizing at planting is profitable and they can pass the following constraints: risk of loss of plants, risk of loss of costs of fertilizer, capital, and credit. The sample included 34 farmers. The results identified the main factors limiting adoption with a 97% of success in predicting farmers' decisions concerning the recommendation.[8] In this case, the reason was non-profitability on type A soils. The obvious policy decision is to drop the recommendation on those soils.

The Extension Stage

Agricultural extension can be defined as "the provision of increased knowledge and skills necessary for farmers to be able to adopt and apply more efficient crop and animal production methods to improve their productivity and living standards" (Russell, 1981). The main objective of extension work is to help traditional farmers to progress beyond subsistence farming by becoming more productive and therefore more involved in the activities of the market. In a recent article, Russell (1981) puts it in a farming systems research framework when he states that

> . . .the solution rests largely in gearing local agricultural research to develop inputs and practices that are acceptable and usable in a particular context. This comes down to working with the local people to produce local answers to local questions.

It has been stated in this paper that the process of technology diffusion and transference really starts during the testing stage. Once a new technology is evaluated and recommended, it will have more chances of being adopted since it has been built with the farmers' cooperation and based on their resources and constraints. An important characteristic of the farming systems research approach is that of maintaining a constant feedback to and from research. This two-way flow of information helps make the system dynamic during all stages.

How the former is done will depend on many factors. Setting aside other relevant factors (like developing effective or using effective marketing channels), the extension work will have to be adapted to local conditions. The structure of the administration, the characteristics of the area where the extension specialist is going to work, the number of visits, etc., are variables to consider if the extension stage is to be successful. But it is necessary to emphasize again the "need to combine the difficult study of farm systems with the longer iterative approach of greater participation by farmers in planning and evaluating as well as implementing further improved practices that are already being developed (Russell, 1981).

CONCLUSIONS

Emphasis in this paper falls on small, traditional farmers because the development literature, after years of indifference, is now focusing on them. Several factors that would help optimizing the process of making recommendations for small farmers in developing countries have been identified. They are:

1. *The relevance of the farming systems research approach.* Although there are still implementation problems (Norman, 1978b), this approach appears to be an appropriate framework to generate solutions since it has been successfully tested in many areas of the world. It allows a multidisciplinary team to work in an interdisciplinary manner with all scientists involved during all phases of the project.

It is necessary to emphasize that the existence of a farming systems research program is not going to generate successful solutions by itself. Other factors (like credit, marketing channels, land availability, etc.) also need to be present for the recommended practices to be adopted and farmers' income to be increased.

2. *The need for ex-ante evaluations.* A few examples have been provided. Several methodologies are appropriate, depending on data availability and the objective of the evaluation. Even when some time must be spent on data collection, it is a worthwhile investment when compared to the years involved in doing research with little or no probability of adoption of new practices.

Ex-ante evaluations are particularly important because they may point out the direction the research should take, or identify a complete reorientation of efforts where the probabilities of success are greatest. In plain words, they can serve the purpose of telling researchers whether or not the derived recommendation "will fly."

3. *The importance of the extension stage.* A farmer recommendation derived from a farming systems research approach contains the input of all scientists involved. It is tailored to the farmers' goals and the constraints they face since it has been previously tested by the farmers themselves. During the extension stage it is extremely important to treat each recommendation separately. The critical factor or intervention point in the decision to adopt one recommendation in the "package" is not necessarily the factor limiting adoption of another recommendation.

Two decades ago, a development specialist wrote

> . . . What we tend to forget, however, is that the essential aspect of an "underdeveloped" economy and the factor the absence of which keeps it "underdeveloped" is the ability to organize economic efforts and energies, bring together resources, wants, and capacities, and so to convert a self-limiting static system into creative, self-generating organic growth (Drucker, 1964).

That challenge is still there for all agricultural scientists interested in the developing world. It has been recently stated that

> The worldwide food crisis is real. It is serious, and it will probably worsen. Worldwide famine in all probability will be a recurring theme in our lifetime. But it is not inescapable, provided we hold fast to the following article of faith: While the world's resources may be limited, we have yet to discover the bounds of human creativity (Wharton, Jr., 1977).

By working together, development scientists can play a major role in getting closer to the bounds of human creativity. Optimizing the process of making farmer recommendations will help the self-generating growth become a reality in the developing countries.

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