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The role of a cognitive anthropologist in a farming systems program that has everything

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What can an anthropologist-agricultural economist add to a center or institute that has everything: a farming systems program aimed at increasing the yields of food grains on small farms; a methodology to design, test, and evaluate site-specific technology appropriate for small farmers; technicians trained to listen to farmers and respect their beliefs and culture; and a socioeconomic team actively involved in the design of new technology? Unbelievable as it may seem, that was the case at the Guatemalan Institute of Agricultural Science and Technology (ICTA) in June 1978.

ICTA in 1978 was different from the other centers or projects discussed in this volume. It was a national center run by nationals (aided by several Rockefeller Foundation field staff) who were committed to increasing yields of the basic food commodities: maize, wheat, rice, sorghum, sesame, beans, fruits, and swine. It had a farming systems program that had been operating in five regions of Guatemala since 1973. Actively involved in the program was a socioeconomic team led by Peter Hildebrand, an agricultural economist. The team included two anthropologists, one agricultural economist, one sociologist, and one statistician. The social scientists on the team were all Guatemalans. Although they were stationed in Guatemala City each was responsible for a specific region and frequently spent time interviewing farmers in the region. There were also one or two technicians at the regional experiment stations who were trained by and worked with the socioeconomic team under the supervision of the technical director.

Besides having an active social science unit, ICTA had many dedicated technicians, some with university training as well as training at an agricultural secondary school. By 1978, almost all agronomic experiments and farmers' tests were conducted in farmers' fields in the villages, often an hour and a half away from the regional experiment station. By their having been pushed out to the farmers' fields and having been subjected to some consciousness-raising by the socioeconomic team, many of the technicians I met in 1978-79 had been trained to listen to farmers,

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not preach to them or order them about. Most, although not certainly all, ICTA technicians realized that the success of the farming systems programs required good communication with the farmers who loaned their land to ICTA for experiments.

More important to ICTA's success than the presence of either a socioeconomic team or sensitive technicians, however, was its development of an innovative farming systems program. In general, a farming systems program treats each farm as a unique system of interrelated activities: crops, livestock, forest, pasture, off-farm labor, etc. Within that system each farmer uses a set of resources (land, capital, time, energy) and faces a physical and social-cultural-economic environment that imposes certain constraints on his farming operation. (The pronoun "he" includes both male farmers and female farmers.) Given the physical and socioeconomic environmental constraints, the farmer makes management decisions, integrating his set of available resources and the environment (Hansen et al 1981). The farming systems approach starts with the farmers' constraints as givens and develops, through experiments on his fields, recommendations to improve his family's standard of living. Most farming systems programs accomplish this aim via a multidisciplinary team that

- diagnoses farmers' problems, goals, and constraints;
- identifies new technologies or strategies to deal with or alleviate farmers' constraints;
- tests the promising technologies or strategies by experiment-station and on-farm trials; and
- diffuses or extends the new tested technologies or strategies to the local farmers (Gilbert et al 1980).

ICTA'S FARMING SYSTEMS PROGRAM

ICTA's farming systems program is a five-stage, multidisciplinary effort, summarized as: 1) *sondeo* (survey), 2) generation of technology, 3) testing, 4) evaluation, and 5) extension. Because they are described in detail elsewhere (Fumagalli and Waugh 1977; Hildebrand 1977, 1979, 1981; ICTA 1977; Ortiz 1979), only brief descriptions of each stage are given here.

Sondeo

A multidisciplinary team of plant breeders, pathologists, agronomists, agricultural economists, and sociologists informally gather information about farmers' cropping systems, socioeconomic conditions, and constraints in the area where technology generation is proposed. The information is summarized and conclusions and recommendations are written up all within 6 days. In most cases the technical team that will conduct the farm trials also participate in the initial sondeo. This gives the biological scientists on the technical team a chance to see the area and traditional technology, and talk to the farmers themselves before the farm trials are planned. It also gives the social scientists an input into the planning of the farm trials through the written recommendations and the three-way direct communication between biological scientist, social scientist, and farmer. The importance of the three-way communication cannot be overemphasized. The social scientist learns first-hand about the physical constraints imposed on the farmer and the biological scientist hears the

farmer talking about socioeconomic constraints in response to the social scientist's questions. While the farmer is educating biological and social scientists, they are educating each other about their respective expertise and their solutions to the farmer's problems (Hildebrand 1979).

Generation of technology

The technical team tries a new technology. Some experiments of the commodity programs (maize, bean, sorghum, etc.) are highly controlled trials on regional experiment stations. The majority of experiments, however, are conducted on land the farmer has loaned to ICTA. Typically, technicians perform the work, holding constant the farmers' levels of inputs and traditional cultural practices, manipulating only the experimental variable such as crop variety or plant population (ICTA 1977). Farm budget data are also collected at this stage to add to ICTA's knowledge about traditional technologies.

The test stage

The farmers themselves test the technology. Volunteer farmers perform the work on their own fields, pay all input costs, and typically plant half of one field to ICTA's technology and the other half to their own in a contest to see which does better (Ortiz 1979). Data concerning the time and capital requirements of ICTA's technology vs the traditional technology are gathered. Because farmer cooperatives or informal groups of farmers often attend the planting, fertilizing, and harvesting of the contest field, the farmers' tests often start the process of technology diffusion and transfer.

The evaluation stage

The socioeconomic team returns to the farmer one year after he has tested ICTA's technology to see if he is still using (has adopted) the new technology. An *index of acceptability* is calculated for each ICTA recommendation (Chincilla and Hildebrand 1979). If acceptability is low, the technical team will reconsider the benefits of the improved technology and may even drop it.

The extension stage

ICTA promotes the use of the acceptable new technology in collaboration with the extension service Direccion General de Servicios Agricolas (DIGESA). ICTA and DIGESA technicians work with farmer groups, cooperatives, and paraprofessionals working with farmer groups such as promoters of Escuela Extra-Escolar (Adult Education) or World Neighbors (ICTA 1977, Fumagalli and Waugh 1977).

The success of ICTA's program in the Altiplano of Guatemala, an area of about 22,000 km^2 including the States of Chimaltenango, Sololá, Totonicapán, Quezaltenango, San Marcos, Huehuetenango, and El Quiché, can be seen by the diffusion of several technologies:

- San Marceno, an improved maize variety, adopted in many parts of Quezaltenango (especially the subregion of Llanos de Pinal);
- Chivito, an improved wheat variety, adopted in parts of Quezaltenango and Totonicapán;
- urea as a second application of fertilizer for both maize and wheat; and

- the introduction of vegetable production in irrigated, terraced parts of San Marcos.

Although agricultural production in the Altiplano still has a long way to go to keep up with population increases, the methodology to generate production increases is clearly there.

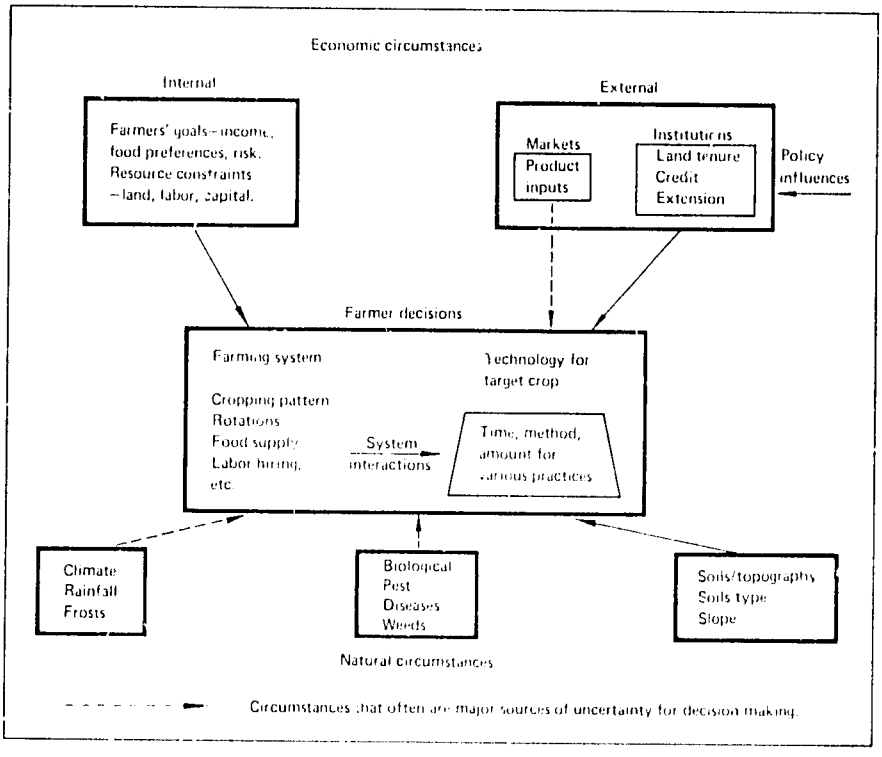
Given the integrated methodology of ICTA and an outstanding socioeconomic team actively involved in the design of new technology, I questioned whether or not my contribution would be marginal. ICTA technicians in 1978 did not often go to the farmer with a good answer to the wrong question. They knew one had to talk and listen to the farmers before coming up with a new variety of food grain or a new storage facility or a new way to teach integrated pest management to small farmers. In regions where they didn't know this, Hildebrand would quickly inform them. As head of the socioeconomic unit, he waged the primary battles. For example, in the case of one sondeo in Zacapa, Eastern Guatemala, most of the regional technicians refused to participate in the interviewing. When two of them finally did, after a half day of arguing on Hildebrand's part, they brought back incredible stories about what "the communists" on the socioeconomic team said to the farmers. Fortunately, Hildebrand was not deterred much by controversy or constructive conflict and, under the direction of the technical director, continued to involve the socioeconomic unit in the design, testing, and evaluation of ICTA's methodology. However, the reader should not get the impression that biological and social scientists in ICTA were always in agreement. Both during and after my stay in Guatemala, serious disagreements arose regularly, and the status of the socioeconomic unit was always in question with the biological scientists questioning its role, influence, and budget.

FOCUSING ON THE FARMER AS DECISION MAKER

I knew that I, or any cognitive anthropologist-agricultural economist, had something to offer a farming systems program that has everything. I knew that a farming systems program cannot do anything without first identifying the problems and constraints the farmer is operating under. The focus of a farming systems program is on the farmer, rather than on the plant, a new technology, or on the environment (Fig. 1). Given that farm trials and farmers' tests are on farmers' fields, and the farmer is consulted during both the diagnostic and evaluation stages, the farmer is clearly at the center of the program. With this focus on the farmer whose adoption or rejection of the new technology can make or break a farming systems project, the program staff should know:

- what decisions the farmer is making,
- what alternative he is considering in each decision context, and
- why he chooses a particular outcome.

Why farmers do what they traditionally do must be understood by the multidisciplinary team before cultural practices can be improved. Fortunately, I had a methodology which did just that in a systematic, replicable, and scientific way.



1. Various circumstances that affect farmers' choice of a crop technology (CIMMYT Economic Program 1980, reprinted with permission).

DECISION-TREE METHODOLOGY

During the past decade anthropologists in several cultures have used natural process or hierarchical decision-tree models to predict the actual choices of individuals. Decision trees have predicted with a high degree of accuracy selling decisions made by Ghanaian fish sellers (H. Gladwin 1971, C. Gladwin 1975, Quinn 1978), farmers' adoption decisions in Puebla, Mexico (C. Gladwin 1976, 1979a), farmers' land use patterns in Costa Rica (Barlett 1977), and farm families' choice of treatment for illness in Pichatero, Mexico (Young 1980). The predictability has been as high as 85 to 95% of the actual choice data used to test the model. These success rates are remarkable, however, only because most studies of economic decision making do not test the model against actual choice data (Anderson 1974, Benito 1976, Moscardi and de Janvry 1977).

More recently the decision-tree method has been shown to be generalizable to a wider geographic region than a village or town, because some agricultural production decision rules are shared by farmers who live in different agroclimatic, socioeconomic zones (C. Gladwin 1979c). Moreover, a consumer decision process model based on in-depth interviews with decision makers in one region (car buyers in Orange County, California, USA) was tested, with 70% reliability against choices

made by individuals selected at random in a national survey (H. Gladwin 1980, Murtaugh and H. Gladwin 1980).

The form of a hierarchical decision-tree model is simple, with decision criteria at the nodes or diamonds of the tree, and decision outcomes or choices at the ends of the branches. The decision criteria can be orderings of alternatives on some aspect of the alternatives (Is profitability of potatoes > profitability of maize?), or they can be constraints that must be passed or satisfied (Do you know how to plant potatoes?). In either case, the criteria or constraints are discrete; the alternative "potatoes" either passes the criteria or constraints or it does not. A decision tree then is a sequence of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice. Figure 2 is a hypothetical model of a farmer's decision of whether or not to plant potatoes. "Potatoes" must pass profitability, knowledge, and capital constraints for the farmer to choose the outcome "plant potatoes." If potatoes fail any one of these criteria, the model predicts that the farmer will not plant potatoes.

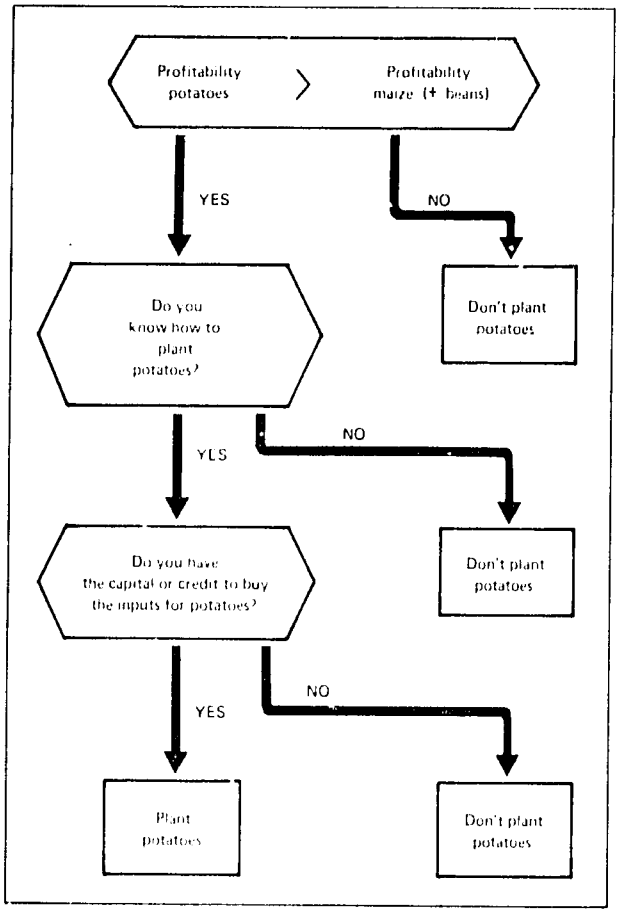
HOW TO BUILD A DECISION MODEL

Given a form of decision model, the researcher must select the decision criteria or constraints to use. He must decide which information is actually considered by farmers when they make a particular decision, and discard information that might be interesting, but which farmers don't seem to use. In-depth interviews with decision makers are necessary to build the model. Only the decision makers are the experts on how they make their decisions; only they process the information that the researcher wants to represent in his model.

Eliciting techniques and ethnoscience ethnographies are uniquely anthropological inventions (Spradley 1979, Werner and Schoepfle 1979). Although some anthropologists question the reliability of decision criteria that are elicited from the decision maker (Barlett 1977; Chibnik 1980; Cancian 1972, 1980; De Walt 1979), most accept the need for ethnographically valid, inductively built, testable decision models. To test an inductively based decision-tree model, one must collect actual choice data from a second, independent sample of decision makers whose data were not used to build the model.

Decision-tree studies, although relatively easy to apply, have not yet been used regularly by national or international agricultural research centers. The reason is that the decision-tree tool presupposes a farming systems research and extension (FSR/E) program in which the farmer as decision maker is directing the program. Decision-tree research fits naturally in that kind of program, although it may be a luxury to an agricultural program that talks about, but has little interaction with the farmer.

The methodology is most appropriately used at the diagnostic stage and the evaluation stage. (For applications of adoption of decision trees, see Gladwin 1976, 1977, 1979a, 1980.) Finally, while adoption decision models are most common in the evaluation stage, in an international research center it is useful to evaluate experimental technology before its transfer to a national research-extension center. Ashby and de Jong (1980) give an excellent example of how to use decision models in this way.



2. Hypothetical example of a farmer's decision whether or not to plant potatoes.

FARMERS' CROPPING DECISIONS IN THE ALTIPLANO

The farmer's cropping decision is a two-stage choice process. In stage 1 he first narrows the range of possible crops to a feasible subset that satisfies minimal conditions. For example, given 8 to 10 possible crops, a farmer may rapidly, often unconsciously, eliminate vegetables because of lack of irrigation. He might not consider planting potatoes because he doesn't know how to plant them or apply pesticides. Alternatively, he might not even think of growing coffee because the land is at too high an altitude.

With the smaller subset of feasible crops that emerges from this *elimination-by-aspects* stage (Tversky 1972), the farmer proceeds to stage 2, the hard-core part of the decision process (Gladwin 1980). Stage 2 allocates the farmer's available land to the crops that pass stage 1 constraints. If the farmer has a lot of land, stage 2 is a simple decision process; he will plant all the crops that pass stage 1 constraints. If, however, the farmer does not own or operate much land, the crops that pass stage 1

constraints compete for the little land there is, and the decision process and model become more complicated.

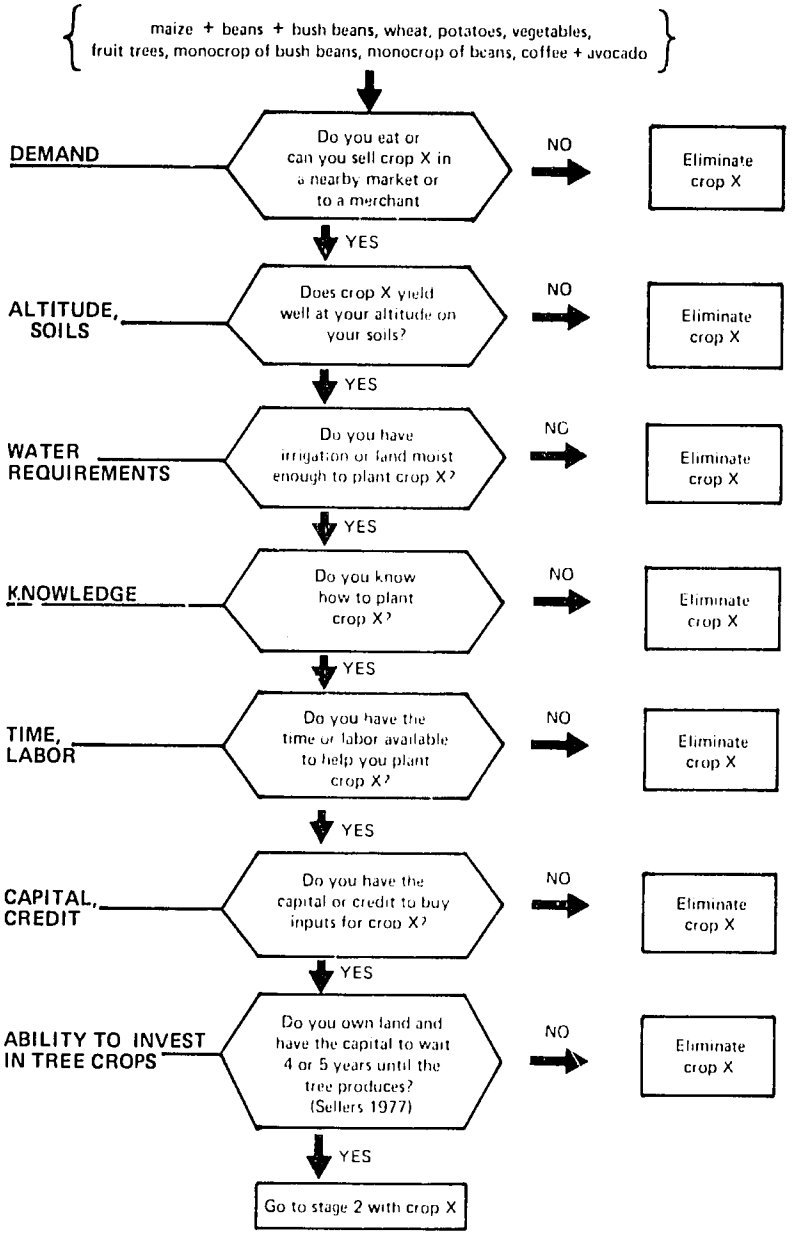
In the most general terms, stage 2 of the model proposes that farmers in the Altiplano give first priority to crops or systems of crops that are at least twice as profitable as maize, the main consumption crop. Usually maize is intercropped with beans (*frijol* and *haba*), so is written maize (+ beans) in the model. For brevity, "maize (+ beans)" will be referred to hereafter simply as maize. A system of crops is defined as a set of crops that is harvested on the same field in one year (a first harvest of wheat and a second harvest of peas, 2 harvests of potatoes, or 3 harvests of vegetables). Second in the farmers' priorities is the planting of as much maize as is necessary to meet the family's consumption requirements between harvests. Third, if farmers still have more land, they plant a crop or system of crops that is not twice as profitable as maize. It may be as profitable as, a little more profitable, or less profitable than maize.

Figure 3 represents the choice process of stage 1, in which a farmer unconsciously eliminates (H. Gladwin and Murtaugh 1980) some of the possible crops in the set at the top of the tree. To shorten interviewing time, only crops that have some possibility of passing the stage 1 constraints are included in the system of crops. Each possible crop of the farmer is then put down the decision tree — the farmer is asked a series of six questions about each crop possible in the set. For a stand of tree crops such as fruit, coffee, or avocado, there is a seventh investment constraint. If a crop passes all six or seven constraints, then the model in stage 1 sends the farmer to stage 2 with that crop.

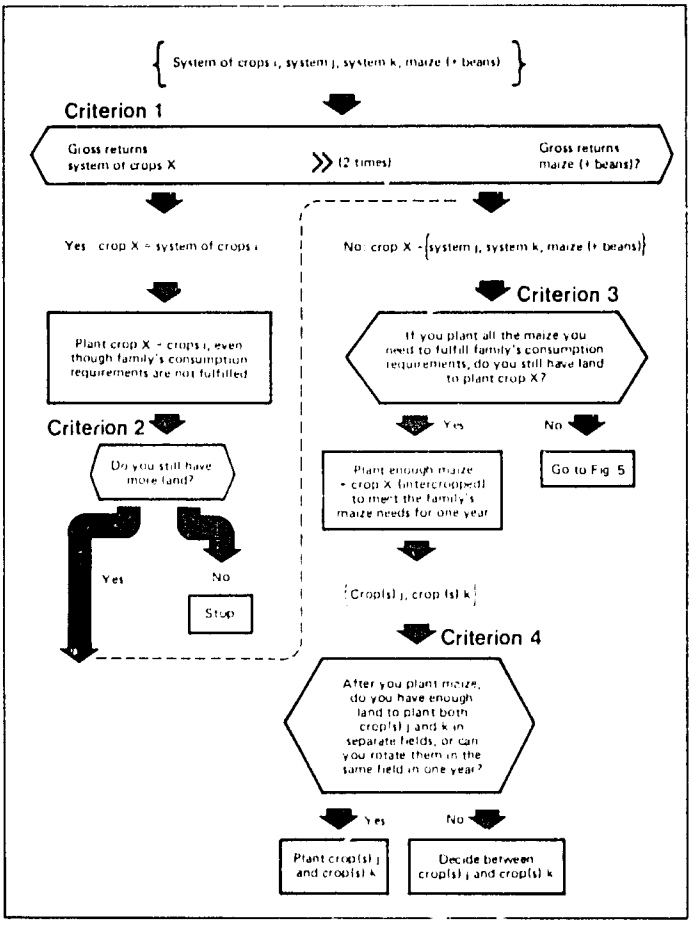
For generality, it is assumed here that three systems of crops and maize have made it to the feasible subset at the top of Figure 4. The first criterion in the flow chart then considers each crop system independently of the others and looks for a very profitable crop, i.e. one that is at least twice as profitable as the consumption crop maize. Each alternative cropping system is compared with maize because — as the farmers testify — "maize is first." Because all the feasible crops are not rank-ordered on profitability, the order in criterion 1 is a partial not a full order. The profitability of wheat is compared to that of maize and the profitability of potatoes is compared to that of maize, but wheat and potatoes are not compared or ordered on profitability.

The very profitable crops, which may be up to five times as profitable as maize, are then sent down the left-hand branch of the tree. In this flow chart (Fig. 4) the farmer considers only crop *i* to be twice as profitable and it is sent down the left-hand path. Crops *j* and *k*, and of course maize, are not considered very profitable with respect to maize. They are sent down the right-hand path to criterion 3. On the left-hand path, however, the model predicts that the farmer will plant the very profitable crop first, even though he has to take some land out of maize production. The result is that the farm may not be able to produce the family's yearly consumption requirements for maize.

If the farmer still operates more land after planting the very profitable crop *i*, criterion 2 in the model sends him to the consumption criterion 3 on the right-hand branch of the tree. Here the farmer is asked if he has enough land to plant the not-so-profitable cash crop(s) after he has planted enough maize to fulfill the family's



3. Choice process in stage 1 of decision making – elimination by aspects.

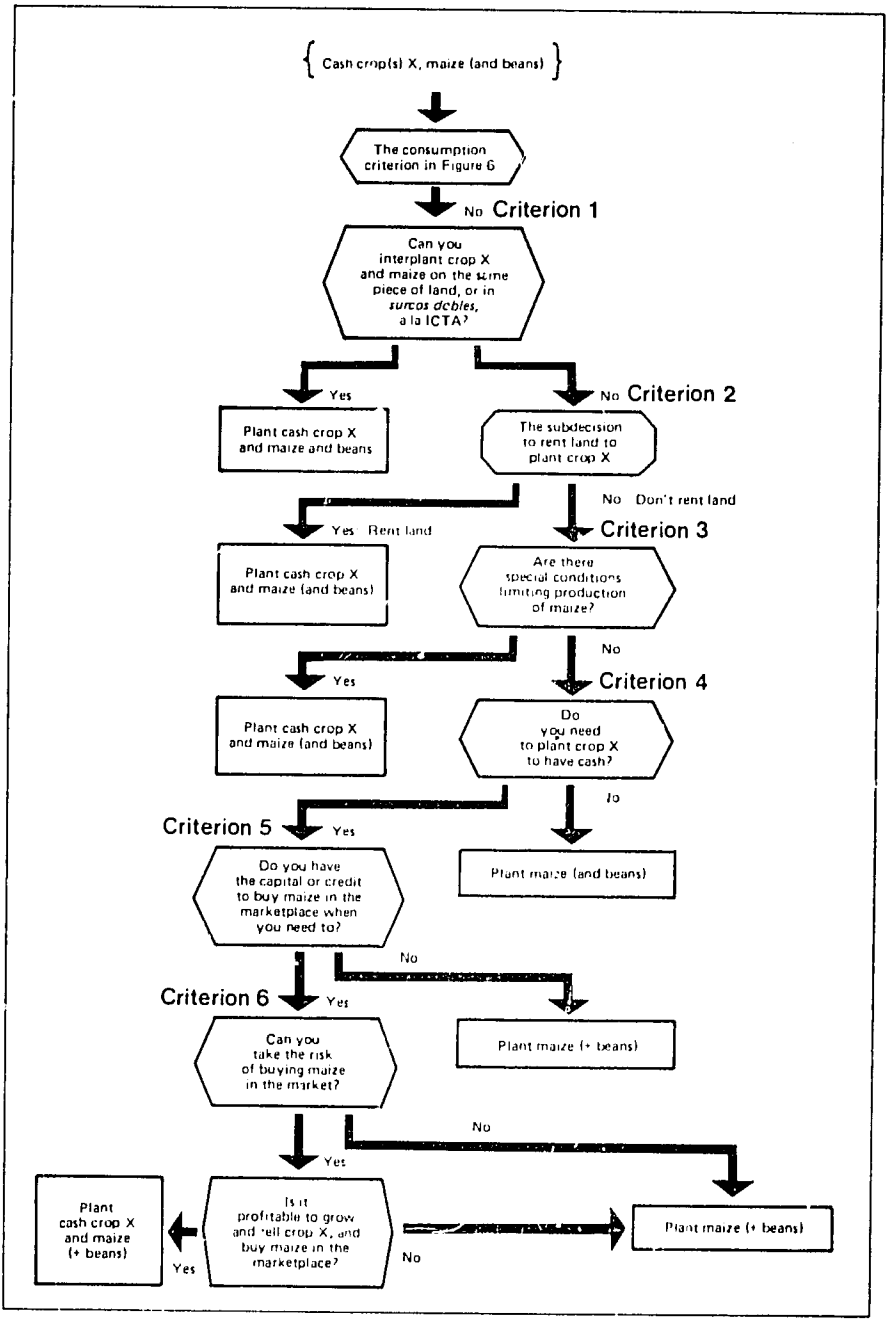


4. Stage 2 of the cropping decision in the Altiplano.

consumption requirements. If there is enough land, the subset below criterion 3 predicts that maize will be planted first.

The decision between two or more cash crops is simple if the farmer has enough land to plant both crops. If there is not enough land and the farmer cannot rotate the crops within the year, then he must decide between them by trading off the profitability and risk of the cash crops. Because results show that most farmers manage to squeeze in both cash crops on their land, the model of this subdecision is presented elsewhere (Gladwin 1980).

If farmers do not have enough land to be self-sufficient in maize and plant a cash crop as well, they are asked the questions in the decision model in Figure 5. These questions identify extenuating circumstances that would lead the farmers to take some land out of maize to put into a cash crop, even though they would then have to buy some maize for home consumption. The decision for farmers now is between a crop mix of cash crop(s) and maize vs a crop mix of just maize.



5. The decision to plant a cash crop and maize or just maize.

Four criteria lead farmers to grow a cash crop and maize.

- First, they can multicrop or interplant cash crop *x* and maize so that their production of maize does not diminish substantially.
- Second, they can rent land for the cash crop and devote their own land to maize. This is really a subdecision: farmers will rent land if rental land is available, they find the owner before planting time, they have the capital to pay the rent, and they think that renting land is profitable.
- Third, they may think there are special conditions that limit the production of maize to only a portion of their land. For example, farmers may plant maize only on the fields around the house to discourage the theft of green maize in the field by people and birds.
- Fourth, farmers need cash and don't have another source of cash such as full-time, off-farm employment.

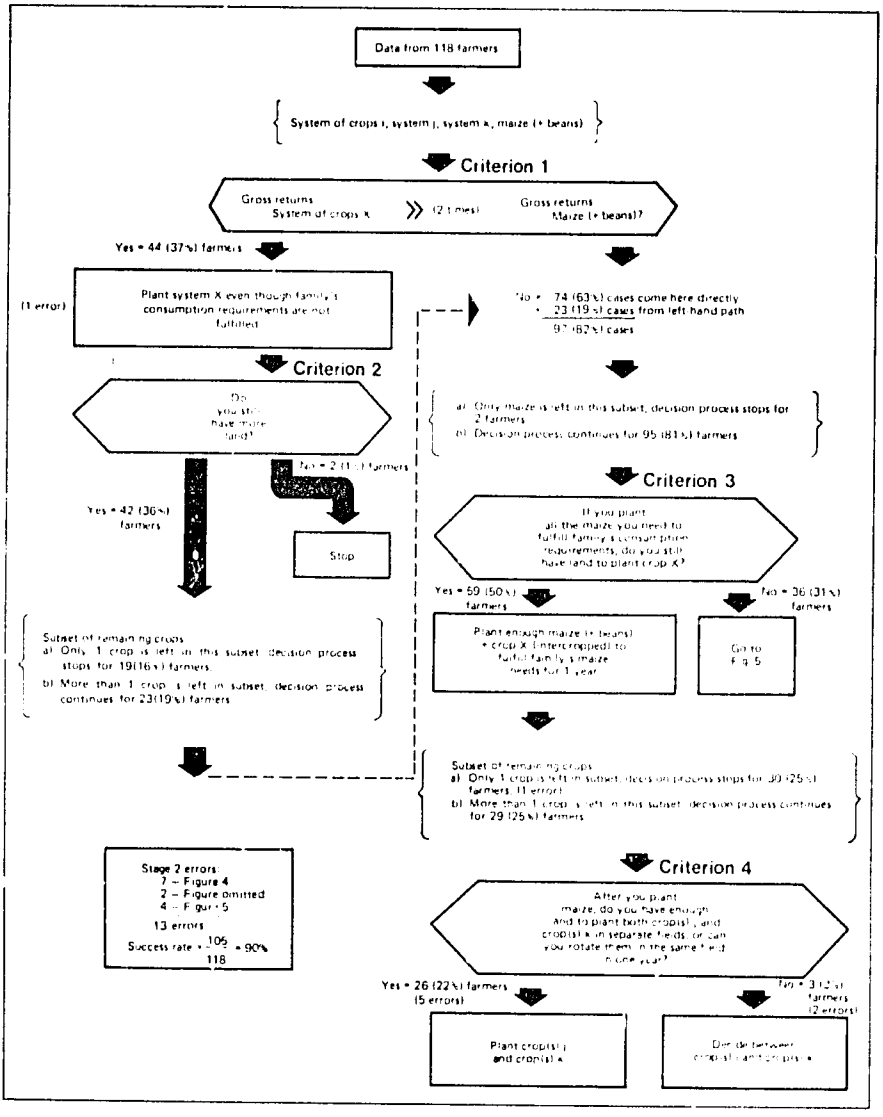
Besides passing these criteria, which act to encourage them to grow a cash crop, Altiplano farmers who need cash must also pass three constraints that discourage cash crop production.

- First, they must anticipate that they will have enough cash to buy maize in the market. For farmers with severe capital constraints, planting and then storing a year's supply of maize is insurance against later shortage of capital.
- Second, they must be willing to take the risk that there will be maize available when they go to buy it.
- Finally, they must think it is profitable to grow and sell a cash crop before they will plant some maize land to a cash crop. In summary, the first four criteria in Figure 5 encourage farmers to switch some needed maize land to a cash crop while the last three act as a brake on this switch.

RESULTS

The model in Figures 3 to 5 was tested against actual cropping-choice data gathered from farmers in six subregions of the Altiplano. The regions differ in altitude, the predominant crop mix, the extent and type of off-farm labor opportunities, language, and the percent of the population that is rural, indigenous, and in agriculture (Gladwin 1979c). There is considerable individual variation in crops grown by farmers within the same subregion, so the model tests or processes data from each farmer independently. Indeed, there can be a separate decision tree for each farmer with different subsets of crops proceeding from stage 1 to stage 2, and to different branches in stage 2.

The results of testing stage 2 of the cropping decision model (Fig. 4) are summarized for 118 farmers in Figure 6, again assuming that a subset of crops *i*, *j*, *k*, and maize has passed stage 1 constraints. Of the 118 farmers, only 44 have a crop or system of crops that passes stage 1 and is twice as profitable as maize. Data from these farmers pass to the left-hand branch of the tree to the outcome "Plant system *x* even though the family's consumption requirements for maize are not fulfilled." Farmers consider only a handful of cash crops profitable enough to plant before maize. Those cash crops require irrigation or sandy soils and an afternoon cloud cover. Results show that one crop per year of rainfed vegetables, potatoes, or wheat



6. Stage 2 results in six zones of the Altiplano.

is not profitable enough to plant before maize.

After planting the twice-as-profitable crop, the farmers on the left-hand path then pass on to criterion 2, to see if they have more land left to plant another crop. Only 2 of the 44 farmers do not have land left to plant another crop.

Farmers without very profitable cropping systems

Ninety-seven farmers proceed to the decision process on the right-hand path of the tree (Fig. 6). Seventy-four of them go directly to the right-hand path of the tree because they do not have a crop that passes stage 1 and is twice as profitable as

maize. Therefore they consider their family's consumption requirements for maize before their need to plant a cash crop. Twenty-three come from the left-hand path because they have more land left after planting the twice-as-profitable cash crop, and have two or more crops left in their feasible subset. At this point, the decision process stops for two farmers, because maize is the only crop left in the feasible subset.

Of the 95 remaining farmers, 59 pass the consumption constraint — they have the land to plant enough maize to fill their family's consumption requirement and one or more cash crops. They proceed to the outcome "Plant maize plus a cash crop that can be interplanted with maize in the same field." After planting enough maize to satisfy their consumption needs between harvests, these farmers allocate their remaining fields to the cash crops that remain in their feasible subsets. For 30 of the 59 farmers, only one cash crop is left in the feasible subset. The remaining farmers have two or more cash crops still in the feasible subset so their decision process continues on to the diversification criterion 4. Here, 26 of them manage to squeeze out the land required to grow both crops or the climate is such that the farmers rotate the two crops on the same field within the year.

The cash crop and maize compete for land

Thirty-six of the 95 farmers on the right-hand branch of the tree fail the consumption criterion. Data from these farmers are sent through the decision process in Figure 5. There were 48 cash crop options for the 36 farmers. This model predicts a cash crop will be planted, even though consumption requirements of maize are not met in these cases:

- 7 in which crops are interplanted or multicropped with maize,
- 5 in which land can be rented for the cash crop,
- 15 in which special conditions limit the production of maize, and
- 9 in which the farmer needs cash and passes the profitability, capital, and risk constraints associated with buying maize in the marketplace.

The model predicts that the farmer will plant only maize in these cases:

- 8 in which he doesn't need a cash crop,
- 2 in which he cannot risk buying maize in the marketplace, and
- 2 in which he considers it unprofitable to grow the cash crop to buy maize.

Twenty-four of the 36 farmers will plant cash crops, even though they failed the consumption criteria for maize; 12 will plant just maize.

IMPLICATIONS OF THE RESULTS FOR ICTA

The results of testing the model have two main policy implications for ICTA. The first concerns institutional allocation of resources to specific commodity programs. The second regards policy recommendations to the technical teams designing farm trials.

Support for ICTA's maize program in the Altiplano

Constant debates in Guatemala over the value of maize production in the Altiplano are expressed in statements such as:

"Maize is not the right crop for the Altiplano."

"The growing season in the Altiplano is too long for maize."
"There is too little rain for maize."
"Maize is not a profitable crop that will help conditions change."

If one were to suggest, "But the people eat maize three times a day," the typical reply would be, "But farmers should grow and sell higher-valued cash crops and buy maize."

Because one of ICTA's original aims was to increase food grain production and maize is ICTA's main commodity program, debates over the value of maize production in the Altiplano hit home.

The counterargument is, of course, that farmers do not always do what they should. Sixty percent of the farmers sampled plant a cash crop only if they can first meet their consumption needs for maize. Fifty percent plant the family's consumption requirements for maize first, and a cash crop second. Another 10% plant only maize because they do not have enough land to be self-sufficient in maize and plant a cash crop.

These results suggest that any attempt to diversify farmers' cropping patterns in the Altiplano must try to improve maize yields. When maize yields are improved, farmers can then divert some land from maize production to a cash crop. Improving maize yields seems to be the diversification strategy most capable of reaching the majority of farmers in the Altiplano, whether or not they should plant maize.

Other diversification strategies are also implied. Because a sizable minority of the farmers sampled (37%) now plant a very profitable cash crop first, and maize second, ICTA might try to introduce a profitable cash crop into more subregions of the Altiplano. The results show, however, that only a handful of cropping systems are twice as profitable as maize. They include: two crops of potato, two or three crops of vegetables plus one crop of potato, a rotation of wheat and vegetables (or potato), coffee, and a monocrop of fruit trees. Few farmers perceive one crop of rainfed vegetables, potato, or wheat to be twice as profitable as maize and capable of replacing maize as the number one crop. Furthermore, only a few subregions of the Altiplano have the climate or irrigation or both necessary for these multiple-crop systems. Finally, the lack of a strong market for some of the crops (vegetables and potato) may limit their profitability (Smith, pers. comm.). Therefore introducing a very profitable cash crop into an area will not be an effective diversification strategy capable of reaching the majority of farmers in the Altiplano.

Data summarized in Figure 5 show other ways to diversify a farmer's crop mix. Multiple cropping or intercropping with maize, without significantly decreasing maize production, should prove the most effective diversification strategy for small farmers with one-quarter of a hectare or less who have family labor available (Hildebrand 1976). Unfortunately, knowledge of ICTA's relay crops or double rows has not yet diffused widely in the subregions of the Altiplano sampled. Another problem with this diversification strategy is the shortage of family labor in some parts of the Altiplano (Totonicapán) due to competition from the indigenous weaving industry (Smith 1978). Farmers do plant a cash crop when they can rent land, but the scarcity of rentable land limits this diversification strategy.

The special conditions criterion accounts for more cases of cash crops planted than any other criterion in Figure 5. It is clear that many farmers feel maize is not

suitable on some of their fields and plant a cash crop on them. This criterion, however, is not easily amenable to policy intervention. (The exceptional policy recommendation would be to encourage extension agents to suggest that farmers rotate their crops.) Because farmers plant cash crops to have cash, one way to push them into diversifying their crop mix is to increase their need for cash by intensifying their involvement in a cash economy and decreasing their self-sufficiency. The Conquistadors did that in Totonicapán by introducing wheat. They levied on the indigenous population taxes that could only be paid in cash or wheat. This diversification strategy has adverse secondary effects such as an overall decrease in real rural family income; its social costs are greater than the benefits.

Design of farm trials

Because the decision model was developed after sampling 10 subregions of the Altiplano, and was tested in another 6 subregions, the results could be generalized to predict farmers' cropping patterns in a new subregion with different cash crops. To test this, I participated in two other sondeos initiating technology generation in the Altiplano — the potato zone of Quezaltenango and an apple producing area in El Quiché.

Using the decision tree model, I contributed to those parts of the sondeo report that discuss:

- the constraints that limit potato production in the peripheral subregion of the potato zone and lead farmers to plant maize or rotate wheat with potato, rather than plant two potato crops as do farmers in the center of the zone (Hildebrand et al 1979); and
- the factors that lead some Chichicastenango farmers to plant a fruit tree stand or orchard while the majority interplant one or two rows of fruit trees in their maize field, and the constraints that prevent the majority from switching to a monocrop of fruit trees (Socioeconomia Rural ICTA y DIGESA 1979).

The results of the sondeo led to recommendations that:

- ICTA should place most of its potato trials in the center of the potato zone, but include in the peripheral areas trials in which an early-maturing wheat variety followed a first crop of potato; and
- DIGESA technicians in Chichicastenango should give technical assistance to farmers growing fruit trees interplanted with maize as well as to those with large orchards or credit with DIGESA.

Sources of conflict

In accordance with sondeo rules that all interviews are informal and no notes are taken in the farmer's presence (Hildebrand 1979), the test of the decision model was also informal. I had to remember all stage 1 and stage 2 questions and work them in between questions posed by the other members of the group. I had to internalize the model to mentally put each farmer interviewed down the tree. This testing method caused some professional conflict for me. Although I benefited greatly from participating in these sondeos I became increasingly wary and critical of the use of the sondeo method.

The length of time sounding out farmers in the field is too short; the sondeo is

unavoidably superficial. Even though the team may interview a total of 60 farmers in different areas of the region of interest, each team member interviews only 10 to 15 farmers in 3 or 4 days. Each team member then is generalizing from too small a sample by any statistical standard. Usually, observations of the more articulate or assertive team member are written up as the findings of the whole team. Disagreements between team members are not treated fully because there is not enough time to investigate the problem further.

The sondeo method ignores individual variation in farmers' decision rules, plans, and farming practices. The heterogeneous nature of farmer behavior is swept aside in the effort to generalize from the too-small sample of the population. Team members forget that there are differences in farmer behavior and decision rules even in a region with homogeneous agroclimatic conditions.

Although Hildebrand claims that the sondeo is used only to point the technical team in the right direction and that detailed socioeconomic data are gathered later, there is no procedure to test the importance or universality of the constraints identified in the sondeo. Unlike the test of the decision model in which the constraints identified by a first set of farmers are compared with choice data from a second sample, the hypotheses and generalizations in the sondeo report remain untested.

The anthropologists in the socioeconomic team waste their uniquely anthropological training. While they contribute to ICTA's program by surveying farmers, analyzing regional budget data, and evaluating last year's farmers tests, they do nothing that cannot be done by a sensitive agronomist with two or three courses in social science. They could be collecting ethnolinguistic or ethnoecological data on the ways farmers process information about their environment and categorize their traditional varieties of seed (Brush 1980, Brush et al 1981); their lands, soils, and crops (Johnson 1980), and the pests and diseases that attack their crops and livestock (Araujo 1977). Ethnoecological analyses of native terms and expressions and ethnographic decision modeling of the kind presented here are tools that would make an anthropologist's contribution to a farming systems program unique and invaluable.

This paper would end neatly if I could say that all anthropologists on ICTA's socioeconomic team learned to use decision trees, or that the sondeo's procedure of identifying farmer constraints is now accompanied by a more rigorous testing procedure. But the conflict was not resolved before the Rockefeller field staff (myself among them) terminated their work in August 1979 at ICTA's request. Consequently, most of the original socioeconomic team left ICTA to be replaced by agronomists with some social science training. Although many of the technicians I worked with in Quezaltenango became proficient in the use of decision-tree methodology, the model was never fully nor formally integrated in ICTA's farming systems program. Its potential in a farming systems program, as a tool to be used along with the sondeo in the design stage, or complemented by an adoption measure such as the acceptability index in the evaluation stage, still remains to be explored.

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