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Impact of CTTA Interventions on Farmers in Comayagua, Honduras

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EXECUTIVE SUMMARY

This report presents the conclusions of the farmer impact evaluation of activities completed by the Communication for Technology Transfer in Agriculture Project (CTTA) in Comayagua, Honduras. It is intended primarily for agricultural communicators. Neither structural nor socio-demographic variables were investigated during the analysis. Instead, three dimensions of the technology transfer process were evaluated, farmer exposure to information about new or improved agricultural technologies and farming practices, knowledge acquired by farmers about those technologies, and the resulting behavior change among farmers.

CTTA used multi-channel communication strategies based on social marketing principles to support the extension activities of the Honduran Ministry of Natural Resources (MNR). Communication strategies were designed to transfer agricultural technologies to farmers producing basic grains (corn, beans, and rice) and, to a lesser extent, vegetables (tomatoes, cabbage, and onions). This report quantifies the effectiveness of the CTTA process for transferring agricultural and soil conservation technologies to basic grain producers.

The following hypotheses shaped the study:

1. CTTA would increase coverage of the extension system in the pilot area.

2. Increased coverage would be a result of increased exposure to technical information via print materials, radio broadcasts, interpersonal contact with extensionists, or a combination thereof.

3. Farmers who were exposed to extension information would show increased knowledge of recommended practices.

4. The greater the degree of exposure, the greater the changes in knowledge and practices would be.

5. Changes in farmer knowledge and behavior in agreement with MNR recommendations would persist even after removing the effects of prior knowledge and practices.

A longitudinal investigation was carried out in four of the ten extension districts in Comayagua. Districts were selected to represent the different production systems throughout the region. Basic grain growers within the districts were randomly selected. Two measurements were conducted, one in 1987 that coincided with CTTA Project start-up, and another in 1989 before project close-out. In 1987, researchers interviewed 755 farmers; in 1989, 610. There were four reasons for farmer attrition, farmers were absent when the data were gathered in 1989, some farmers abandoned basic grain cultivation, some farmers moved from the area, and some refused to be interviewed a second time.

Results supported the hypotheses.

- There were statistically significant increases in exposure. Pre-post comparisons indicated that aggregate exposure to technological information through CTTA interventions doubled for corn, beans, and rice producers, and tripled for soil conservation. Much of the increase among corn and bean producers was attributed to the role played by radio. Among rice producers, interpersonal contact with extension workers was most effective. These results reflect programmatic emphasis. Rice producers were affiliated to cooperatives and, therefore, most appropriately reached by interpersonal communication.

- There were statistically significant increases in knowledge. Aggregate knowledge of MNR recommendations promoted by the CTTA Project increased four-fold among corn and bean producers, and two-fold for rice growers. In addition, there was a 60 percent increase in knowledge about soil conservation practices.

- Behavior change attributed to recommendations made by the extension system increased with CTTA support. Pre-post comparisons indicated that there was a 6 percent increase in mean aggregate behavior change among corn producers, a 23 percent increase among bean producers, and an 8 percent increase among rice producers. In addition, there was a 55 percent increase in mean aggregate behavior change with soil conservation recommendations for sloping land, and a 13 percent increase with those that can be applied on any farm, independent of topography.

- Aggregate measures provide a general picture of CTTA impact. A breakdown of results by type of practice shows that the greatest increase in compliance among corn producers was observed for fertilization practices (30 percent). For bean growers, the greatest single increase was observed for plant protection practices (80 percent). And for rice producers, the greatest change occurred in planting distances (290 percent). Recommendations for minimum tillage, for any type of soil, demonstrated the largest gain in compliance (50 percent).

- Aggregate exposure is related to aggregate knowledge, and aggregate knowledge is related to aggregate behavior change.

- The relationship between aggregate knowledge and behavior change remains constant when the influence of pre-CTTA knowledge and experience is removed.

The results of employing the CTTA process are impressive. Increases in exposure appear to have been generated without significantly expanding recurrent costs in MNR extension activities. CTTA implementation did not require augmenting the number of extension staff working in the project region. Instead, the project required only additional costs for the expatriate communication personnel (provided by CTTA) who introduced the process and supported all extension activities. The findings of this evaluation suggest that farmers are more likely to adopt those practices that make the most economic sense, and are relatively low risk and low cost. Moreover, they demonstrate that using social marketing principles can successfully enhance the effectiveness of national agricultural extension programs.

ABOUT THIS REPORT

This report summarizes results of longitudinal surveys in Comayagua, Honduras, to evaluate the impact on farmers of the Communication for Technology Transfer in Agriculture (CTTA) Project. It integrates findings from studies focusing on technology adoption relative to soil conservation and corn, bean, and rice cultivation. The first section describes the project objectives worldwide and characteristics of the Honduras intervention. The following sections present the model that guided the evaluation, the methodology used, major findings, and conclusions.

An assumption that guided this study from the outset was that the technologies identified and selected by the MNR and subsequently disseminated to farmers by the CTTA Project would either directly or indirectly contribute to:

- increasing crop yields;
- reducing the time, energy, and financial inputs spent by farmers to cultivate their crops; and
- increasing farmer incomes and their quality of life.

Therefore, because of the short duration of project implementation and the complexity of natural and human components that have an impact upon agricultural production, this evaluation focused upon behavior change, not upon yields.

CTTA PROJECT DESCRIPTION

Objectives

The CTTA Project represents a systematic approach to encourage adoption of production technologies by small farmers. The approach is based on applying principles and methods derived from behavior analysis, development anthropology, non-formal education, social marketing, and communication. CTTA seeks to achieve its goal by

- using innovative communication approaches to support agricultural development and
- developing, testing, and demonstrating multichannel communication strategies for increasing technology transfer at affordable costs. In addition, CTTA works to strengthen linkages among extension, research, the agro-support sector, and farmers. Participating countries and institutions were expected to institutionalize the CTTA approaches on a sustainable basis.

The CTTA approach uses a five step process:

- field identification of the technology constraints farmers face based on information from farmers;
- developing a technology transfer strategy based on audience segmentation, message segmentation, and media mix;
- testing and producing materials needed for implementing the transfer strategy;
- implementing the strategy; and
- evaluating effectiveness through monitoring, mid-course corrections, and impact assessment.

CTTA programs were implemented at pilot sites in Honduras, Indonesia, Jordan, and Peru. CTTA-related activities were also completed in Niger, Bolivia, Nicaragua, and Portugal. This report describes results of the CTTA evaluation in Honduras. Honduras was the chief site where quantitative and qualitative impact data were systematically collected over time. Honduras also was the longest running site and the site where the volatility of the political situation did not interfere with project implementation and evaluation.

The Honduran Intervention

Traditional agricultural extension in Honduras

To meet the demand of its growing population, Honduras must increase staple food production. The Ministry of Natural Resources (MNR) is responsible for designing and implementing programs and projects to help achieve national food security and allow Honduras to sustain, and increase, its agriculture base. Most MNR clients are small farmers who grow food for national consumption.

The MNR divides Honduras into 11 administrative regions. Each region is sub-divided into districts, each served by an extension agency. There are 154 extension agencies throughout the nation. Each extension agency is staffed by 4 to 6 extensionists, researchers, and social promoters. Because the area to be covered is generally large given resources available, extension staff must decide how best to allocate their time to reach the most farmers, most effectively. Before CTTA, planning tended to favor the most accessible communities and the most responsive independent farmers. Before CTTA, most extension agents served farmers along one route, which they retraced each week.

Most extension-disseminated technology was developed by regional research centers. Many of the needs that triggered the research were identified by technicians and researchers, with no involvement by farmers. The centers sometimes collaborated with agency researchers to conduct trials to adapt technology to local conditions.

Before CTTA, almost all extension activities relied on personal contact, usually with groups rather than individuals. Extension activities may have involved para-technicians and volunteer community-based leaders working as liaisons between the extension service per se and producers.

The extension system was having problems with both the quality of services provided and coverage. Results of studies in different regions of Honduras before CTTA showed that traditional MNR extension activities reached only about four percent of small farmers. The lack of farmer involvement in planning and the usefulness of technical recommendations given farmers' socio-economic constraints had been questioned (Puerta, 1989:22-25).[1] Moreover, there was no strict follow-up of changes in farmer behavior and the resulting effect on yields. Evaluation of extension worker performance, managed by the Department of Sectoral Planning within MNR, was based on physical outputs (e.g., number of hectares supervised, number of farmers attending collective training sessions, etc.) rather than on changes in farmer behavior or increases in productivity. Other evaluations indicated the need to strengthen linkages between the farm-based agricultural research program, extension, and peasant family consumption improvement activities.

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[1] Ricardo Puerta. *El Pequeño Agricultor en Honduras. Situación y Perspectivas de Desarrollo.* IFC. Tegucigalpa, 1989.

Extension under CTTA

CTTA attempted to overcome the limitations of the traditional extension system. The pilot project was implemented in Comayagua, an area covering 483,000 hectares in central Honduras. The Comayagua Region is divided into ten extension agencies that are expected to serve 40,000 land holdings and about 32,000 rural families.

In Comayagua, there are two distinct agro-ecological zones: highlands and lowlands. Ninety-one percent of the area is highland and 9 percent lowland. Land use in the highlands includes pine and hardwood forests, open pasture, and crop land for coffee, basic grains, and vegetables. Lowlands include three valleys, only one third of which are arable. Three public irrigation systems serve the lowland, making it possible to irrigate about one percent of total land areas. Most irrigated fields are used to grow vegetables. The remaining tillable area is cultivated with basic grains and fruit trees. Livestock production is important throughout the region, especially in the valleys.

CTTA, in both highland and lowland areas, concentrated upon supporting extension activities related to food production, mainly basic grains. The CTTA intervention in Honduras embraced the entire process of technology transfer. It expanded communication capacity, but was not limited to communication activities. The project

- sought to place farmers at the center of research and extension activities;
- sponsored the use of multi-channel communication strategies to improve agricultural outreach;
- conducted audience analysis and periodic evaluations to determine the extent to which the information needs of target audiences were being satisfied;
- helped agencies redefine their geographical priorities, thus increasing the ability of extension to have a greater impact by concentrating interventions in areas with the most basic grain producers; and.
- contributed to the adoption of a management-by-objectives approach that required extension activities to be built around technology transfer projects. These projects clearly defined the learning objectives to be achieved and the activities to be carried out to meet those objectives.

Extensionists who worked in Comayagua both before and after CTTA have said that before the project, the focus of extension activities was on the farm and the crops under cultivation. With CTTA, the focus shifted to the farmer, and particularly, training the farmer to become independent, capable of understanding the foundations for new practices, and capable of new initiatives.

CTTA permitted extensionists working in the pilot area to arrive at a consensus regarding the technologies that could be transferred to farmers within different agro-ecological sub-systems. This helped highlight the similarity of available technology for equivalent agro-ecological subsystems across agencies, thus showing that message content was not bound to individual agencies. This, in turn, encouraged and helped extensionists to update the technical guides used to direct their field work.

CTTA also influenced research activities, including the development of research agendas for some agencies. It helped research and extension programs in the pilot region to identify and disseminate technology options that would result in cost-savings for producers.

A major project activity was to develop stronger links between research and extension. This allowed extension to help guide the MNR regional research agenda and to make research more responsive to farmers' needs.

CTTA worked to institutionalize its approach in MNR. Courses were conducted to train extensionists in the CTTA process. In-service training benefitted the communication specialists who supported the extensionists. CTTA played a leading role in defining an extension approach that was subsequently adopted as the public sector extension methodology.

CONCEPTUAL FRAMEWORK FOR THE IMPACT EVALUATION

The goal of the summative evaluation in Honduras was to learn if, to what extent, and how CTTA interventions influenced farmer practices. The goal was supported by several assumptions about the intervention. The fundamental assumption held that the package of improved communication and extension methodologies introduced by CTTA would build upon and improve existing systems, not replace them. Thus, the evaluation question of greatest interest was: "What is the marginal contribution to the impact of extension services that adding CTTA methodologies provides?"

Another central premise of the CTTA Project was that at least some useful practices were under-used by farmers, and that farmers could be induced to adopt them. This premise is also central to extension in general. The difference is that the CTTA Project relied upon disseminating more relevant information to producers via more intensive and persuasive promotions. As a result, it had a strong focus on (or expectation of success with) behavioral change where knowledge constitutes the main determinant to farmer adoption.

Therefore, the purpose of the evaluation was to assess the impact of the CTTA methodology on technology transfer. The evaluation centered around outcomes related to specific practices. But, the focus was not technology assessment (e.g., increases in yields per se), and the evaluation did not aim to verify the effectiveness of specific agricultural technologies in increasing yield or profit.

The Honduras impact evaluation adopted an integrated, multi-method plan. It consisted of multiple studies using different data collection and analysis methods. The evaluation activities included a major longitudinal study of a cohort of farm families and four ad hoc studies that focused on process issues and outcomes not well accominodated by the survey format.

This document focuses exclusively on the research questions addressed by the longitudinal investigation, a description of the longitudinal study, and the major findings. Comparisons are made between data collected at two points in time, 1987 and 1989. Data collections were at project outset and when the project was ending, about 28 months after the intervention began.

Evaluation Model for the Longitudinal Investigation

CTTA applies communication-oriented techniques to help improve social and economic conditions. The techniques, drawn from many disciplines, are often referred to as social marketing techniques.

McGuire (1989) outlined a principal paradigm that has guided social marketing programs. It is based on common-sense premises of persuasion theory that are generally defined as a persuasion/communication model presented through an input/output matrix. Inputs are considered

to be independent communication variables and constitute the causes of change. Outputs are response steps that mediate persuasion and are considered to be the end-results of an intervention.

Input variables include:

- attributes of the source presenting the information,
- content and appeal of the message delivered,
- channel(s) used to transmit the information,
- concerns and interests of the receiver of the information, and
- intent of the messages communicated.

Output variables that can be measured through an impact evaluation include:

- exposure to information;
- attention to and comprehension, reaction, and acceptance of information;
- retention (or knowledge) of information;
- retrieval of information when needed;
- decision to use information;
- behavior according to decision;
- reinforcement of that behavior; and
- consolidation of skills and behavior.

This theory holds that a source communicates a message through a given channel to a specific audience with a specific intent. For communication to be effective, the audience must be exposed to the message, must attend to it, understand it, like it and decide about its usefulness, store it for future use, retrieve and use it when appropriate, and obtain reinforcement for having used it before it is consolidated.

Based on McGuire's method, the linear relationship to evaluate this project is simple, even though it takes into account the importance of certain external factors. The evaluation presumes

that exposure (E) leads to knowledge (K), and knowledge leads to skills development and behavior change (P). This line of causality is expressed as:

$$E \rightarrow K \rightarrow P$$

When using this line of causality as an analytical tool for evaluating the impact of CTTA, certain definitions and considerations are in order.

- **Exposure** refers to level of contact with technological information about farming practices that was disseminated through different media by the MNR as part of the CTTA intervention. The media considered in this analysis were interpersonal extension activities, print materials, and radio.

- **Knowledge** refers to the technological information about farming practices generated and disseminated by MNR. The intent was not to determine if farmers knew more about farming practices after the intervention. Rather, the intent was to determine if they knew more about the practices that MNR was recommending through CTTA. In this evaluation, knowledge was defined as correct recall of these recommendations.

- **Skills development and practices** were defined as behaviors that complied with the recommendations about certain farming practices made by MNR. All behavioral indices used in the analysis were indices of compliance with those recommendations. This was an important distinction. The behaviors being recorded were specific to the recommendations, not simply a measure of whether farmers were following reasonable procedures.

This paradigm still had to account for several intervening variables that could influence outcomes.

First, the MNR extension service has been in place for a number of years. Basic grain growers at the project pilot site had been directly and indirectly exposed to technological information generated and disseminated by MNR. From the evaluation perspective, it was important to determine the incremental contribution CTTA made in increasing exposure, knowledge, and practices. It was also important to consider that contributions by CTTA did not exist in a vacuum, but would be observed against the backdrop of many other interventions and a history of prior extension efforts.

Second, recommendations (i.e., messages) changed over the years, even during, and partially as a result of, project implementation. The 1989 recommendations were the most updated and elaborate available, and therefore were used as the benchmark against which to measure change which had occurred during the preceding 28 months. They included, but were not limited to, farming practices that had been developed by some of the most advanced and successful farmers and sometimes improved by MNR researchers. Using the 1989 data assumed the need to assess how the less successful farmers emulated those who had experienced greatest success. The sample was drawn to include "successful" and "unsuccessful." The greatest change in behavior

was expected to have occurred for "unsuccessful" farmers. The more successful a farmer was in 1987, the smaller was the gap to overcome, both in terms of knowledge and behavior change relative to advocated practices.

Third, farmers' socio-economic characteristics and status have an impact on knowledge, practices, and, as a result, on yields. Due to the longitudinal design adopted for this study, farmer age, educational level, gender, marital status, family size, and socio-economic status were kept constant while studying the relationships of the exposure-behavior causality line.

Fourth, farm features such as size, extent of irrigation, degree of slope of terrain, and soil quality may have influenced both practices and yields. These factors were kept constant in the statistical analysis.

Hypotheses tested

The evaluation explored five hypotheses.

1. CTTA would increase coverage of the extension system in the pilot area.

2. Increased coverage would be a result of increased exposure to technical information via print materials, radio broadcasts, interpersonal contact with extensionists, or a combination thereof.

3. Farmers who were exposed to extension information would show increased knowledge of recommended practices.

4. The greater the degree of exposure, the greater the changes in knowledge and practices would be.

5. Changes in farmer knowledge and behavior in agreement with MNR recommendations would persist even after removing the effects of prior knowledge and practices.

Because of the short duration of project implementation and the complexity of natural and human components that have impact on agricultural production, this evaluation focused on behavior change, not upon yield.

METHODOLOGY

Sample

The longitudinal investigation to record CTTA impact on farmers spanned three years, from 1987 to 1989. The sample was constructed using a multiple-stage sampling technique. Extension districts were selected first, followed by selecting farmers within the districts.

Extension districts were selected to represent the full range of production systems in the pilot area. All the production systems include corn and bean cultivation, but vary with respect to commercial crops, which may be rice, coffee, or lowland or highland vegetables. The extension districts of Ajuterique, El Rosario, San Jeronimo, and San Luis were chosen because they best represented the range of production systems in the region. San Luis offered the advantage of being a district where no extension activities had taken place over many years. Thus, it was an area where the influence of on-going extension programs would be minimal. In addition, the government intended to promote rice cultivation, particularly in San Luis, allowing the project to study the impact of a newly promoted crop.

Respondent farmers within the selected districts were chosen randomly by using a master file constructed from enumeration lists for both independent farmers and land reform beneficiaries who practiced independent farming. Enumeration lists for independent farmers were obtained from a cadastre survey concluded two years before the first wave of data collection. Independent farmer lists were corrected to account for multiple plot use by a single farmer.

San Luis had the most land reform beneficiaries. To have a more accurate count of the universe from which to select the sample, the enumeration lists for land reform group members for this area were generated by the evaluation team. The lists included farmers who individually farmed part or all of the adjudicated parcels. Farmers who cultivated adjudicated parcels collectively were excluded from the process of deciding what agricultural practices to perform. To avoid repetition, names and addresses of the farmers on the survey list were checked against those listed in the master file of independent farmers. All unrepeated names were added to the master file.

At the beginning of the evaluation, the study sample included 755 farmers; 89 percent were independent farmers and 11 percent were land reform beneficiaries. There were 210 respondents from El Rosario, 200 from Ajuterique, 190 from San Jeronimo, and 155 from San Luis.

There was 18.5 percent attrition between 1987 and 1989, reducing the sample size to 615. Most attrition could be attributed to factors such as farmers could not be interviewed because they were absent during the data collection period, had abandoned basic grain cultivation, refused to give information, or no longer lived where the research was conducted.

Design

The design was a panel design in which the same farmers were assessed in 1987, at project outset, and again in 1989 when the CTTA program had been implemented during 34 months. The evaluators chose a panel design[2] for several reasons. First, it was originally expected that the entire population of basic grain growers in Comayagua would be exposed to extension activities via one or a combination of the different media to be employed during project implementation.

Second, because all of Comayagua was a target for project activities and because CTTA would have to become a full-coverage program in the pilot area[3] different degrees of exposure to technological information diffused with project support could be expected over time. The impact of different degrees of program exposure could then be compared.

Third, panel studies permit the use of reflexive controls where interviewed farmers act as their own controls. This is an appropriate mechanism for reducing the error variance generated by variables defined as crucial, examples of which may be farmers' socio-economic characteristics and land features.

Fourth, for financial reasons, a constructed control group of farmers outside the pilot area was not possible. As already indicated, CTTA was designed as a full-coverage program for Comayagua. To avoid contamination effects, full coverage programs require constructed control groups that are not contiguous to the region where the intervention is implemented.

Instrument

The evaluation used a typical knowledge-attitude-practice study. The taxonomy suggested by Bloom in 1956[4] was used to determine that knowledge would be defined as recall of messages diffused. The study variables were measured by self-report, using a pre-coded questionnaire. The questionnaire included four modules. The first module was used to collect general information about:

- farmer demographics,
- farm characteristics and land use,

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2 A panel study is a longitudinal investigation carried out with a randomly selected sample during x number of years. Periodic measurements of the sample are conducted throughout the intervention.

3 Full-coverage programs are those that intend to reach all potential beneficiaries.

4 Bloom, B.S. et.al. (1956). *The Taxonomy of Educational Objectives: The Classification of Educational Goals*, New York, McKay.

- farmer linkages to a service structure,
- production level,
- produce destination,
- farmer understanding of certain terms and concepts, and
- knowledge and practices related to soil conservation.

Each of the three remaining modules focused on a particular target crop -- corn, beans, and rice. Each module had two sections: information about farmer practices related to the target crop, and data about farmer awareness of MNR recommendations for the crop. Farmers were asked what and how useful the recommendations were. Each section of the module addressed all stages of production, from land preparation through storage and, sometimes, post-harvest handling.

Questions regarding practices were asked for up to a maximum of three plots per respondent in the first wave of measurement, but thereafter were limited to the main plot cultivated. (An analysis of the data collected during the first wave indicated that there was little variation in practices across plots when multi-plot farming was practiced.)

Analytical Approach and Index Construction

Data were analyzed using multiple-regression analysis. Whenever possible, instrument design was guided by the need for continuous variables. Using continuous variables permits employing parametric statistics to test for hypotheses.

The continuous variables used in the analysis were built by condensing information.[5] Basic data refers to raw data or meaningful elementary transformations thereof. Raw data were condensed into sub-aggregate indices, and sub-aggregate indices were collapsed into aggregate indices.

Three dimensions were selected for analysis: exposure, knowledge, and behavior change. Thus, there are basic, sub-aggregate, and aggregate indices for exposure, knowledge, and compliant practices (behavior change). The values of the aggregate and sub-aggregate indices range from 0 to 1. The different indices were constructed by aggregating information that would logically reflect different degrees of intensity of a given dimension, or represent discrete elements of that dimension.

[5] Continuous variables may be represented as scales that have degrees. The higher the degree, the more intense the presence of the attribute that the variable is measuring.

Exposure indices were constructed following the first procedure. Behavior change indices were constructed following the second procedure. Whether to use a procedure was determined by the nature of the information collected. The exposure index to interpersonal extension activities, for example, was constructed by aggregating information about the following topics.

- Had a farmer ever received technical assistance from an MNR source in the past?
- Was the farmer involved in technical assistance activities in the agricultural cycle about which information was being collected (e.g., 1987, 1988 or 1989)?
- Did the farmer claim to know the extensionist assigned to work in his or her area of residence?
- Did the farmer correctly identify the name of the extensionist?
- Was the farmer a member of the agricultural committee normally set up by extensionists to conduct extension activities?
- Was the farmer an active member of that committee?
- Did the farmer play or had he or she played a directive role in that committee at the time of the interview?

The logic of the index would suggest that a farmer who met all the criteria would have had more exposure to technological information via interpersonal contact than a farmer who met only some of the criteria. The index was constructed by assigning a value of 1 when a criterion was met and a value of 0 when it was not. Aggregated values were then weighted by dividing them by the number of variables used in the computation.

Similarly, indices of compliant practices were constructed by aggregating different components into a single indicator. That process would generally include the following steps:

- breaking down technological recommendations into their different behavioral components,
- determining what farmers did with respect to those recommendation components,
- assigning values to the level of compliance manifested by farmers, and
- adding up the values and dividing them by the number of elements considered.

For example, the land preparation recommendation for rice cultivation included several behaviors:

- Turn over the soil to be planted.

- Turn the soil one month before planting.
- Till the soil with a disk harrow to allow a 25 cm penetration.
- Till the soil when it is neither too dry nor too wet.
- Pulverize the soil three days before planting.
- Do the pulverization with two crossings of machinery or an open-plow.

Each one of these behaviors was recorded separately and the performance of each one of them would be considered in determining whether adoption of the recommended practice took place. A value was assigned to performing each behavior. The values assigned for compliant behavior were either 0 or 1. For dichotomous variables, 0's were assigned for non-compliance and 1's were assigned for compliance. For continuous variables, credit was given for both partial and complete behavior change. Partial behavior change was defined as both under- and over-compliance. A limit to over-compliance was established, however, as it was assumed that practicing a recommended behavior in excess of what is suggested may either damage crops or imply a waste of resources. Limits for acceptable over-compliance were determined by agricultural researchers in Comayagua. The logic used to grade behavior change for continuous variables is illustrated in Figure 1.

Fertilization behaviors can be used to illustrate how compliance scoring was done for continuous variables. Fertilization recommendations suggested do two fertilizations. The first required using between 150 and 200 pounds of a given formula by "margins" (e.g., 0.7/hr). Staying within the 150-200 pound range was considered as full compliance. Based on agricultural research, using less than 150 pounds/margin would be insufficient, and using more than 200 pounds/margin would be wasteful. Practices below or above those limits were considered non-compliance.

By the same token, fertilization recommendations also suggested that the second fertilization be done 60 days after planting. Agricultural researchers suggested that a 60-to-75 day period was tolerable. Any behaviors below or above those limits were considered unacceptable and consequently, non-compliant. The different recommendations for corn, beans, and rice cultivation respectively are in Annexes 1, 2, and 3. A description of soil conservation technologies can be found in Annex 4.

RESULTS

Results are discussed in stages, beginning with changes in exposure. A breakdown of the impact of the different channels (E), presented by type of producer, is then discussed, followed by a report of changes in knowledge (K) by crop. Changes in practices (P) are then described, followed by a description of the relationships between exposure (E), knowledge (K), and practices (P). Results are first presented for technologies related to soil conservation and corn and bean cultivation.

Data related to rice cultivation are presented separately. This decision was made because rice growers produce primarily for the market, which creates different result patterns. Also, the sample of rice producers did not include the same farmers for both studies. Rice cultivation is not as stable as either corn or bean cultivation. There were rice farmers in 1987 who had abandoned the practice by 1989. There were also farmers who began cultivating rice in 1989. Where results are presented by crop, farmers involved in multi-cropping may be included in more than one comparison.

Changes in Exposure

Changes in exposure between the two measurements (1987 and 1989) are presented in Figure 2. These results refer to the percentage of farmers that reported hearing or seeing technical information promoted by the CTTA Project. The percentages reflect aggregate exposure, independently of the channel through information was received. The percentage of farmers who had heard or seen project information at least doubled for corn and bean growers, and almost tripled for the soil conservation technologies. The different increments in access to crops versus soil technologies may be a result of the specific nature of the crop related recommendations and the universal nature of those related to soil conservation. Farmers may tune in to the information depending on need and problems at hand. Someone cultivating corn may be concerned about specific recommendations dealing with that crop. Soil conservation recommendations may interest everyone, regardless of crops under cultivation or to be cultivated in upcoming cropping seasons. Furthermore, soil conservation technologies were constant messages and were delivered, primarily via radio, throughout the duration of the project. Crop related technologies varied over time depending on the cropping season.

Figure 3 presents the same results by the channel through which the information was transmitted. Data presented in Figures 3A and 3B indicate that exposure via radio, print materials, and interpersonal contacts increased significantly from 1987 to 1989 for all the producers considered. Radio, which is available to most households in Honduras, increased exposure most. Print materials, which require complex distribution and literacy, were least effective.

The percentage of people who heard or saw some CTTA-promoted recommendation, regardless of the medium by which it was disseminated, was always higher than the percentage that heard or saw a specific CTTA promotion. Comparisons of the data in Figures 2 and 3 show that aggregate exposure was always greater than exposure to a single channel (Figure 3). This finding underscores the necessity for developing multi-media communication strategies. First, they

Figure 1. Assigning a compliance score within an acceptable range of behavior, Comayagua, Honduras

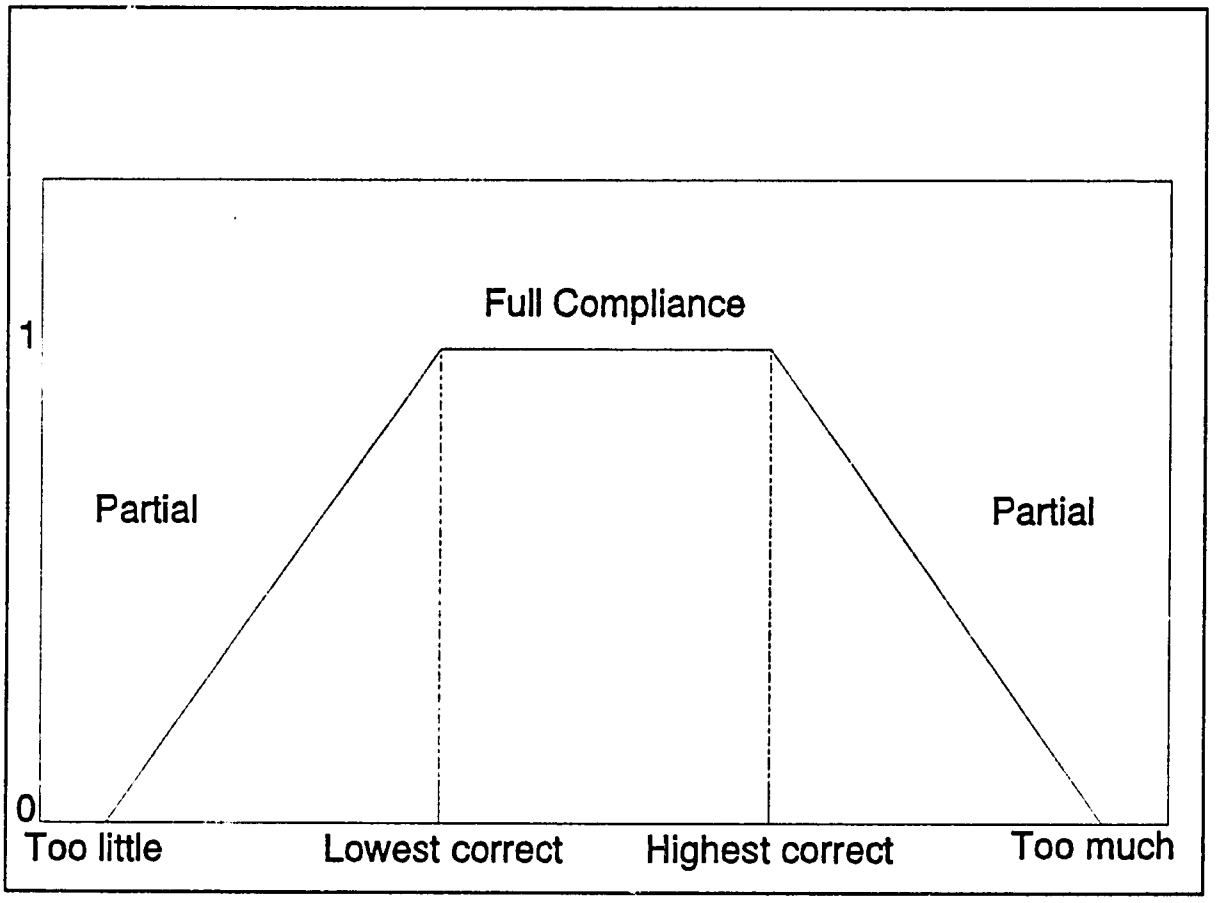


Figure 2. Farmers exposed to technological information by crop, Comayagua, Honduras, 1987-1989. *

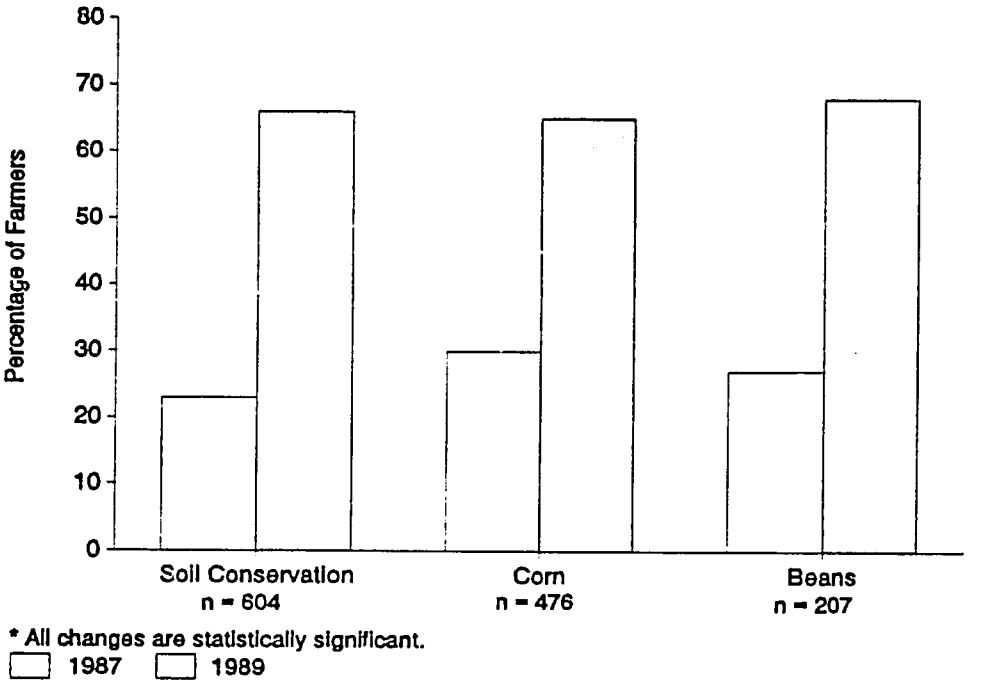


Figure 3A. Role of different media in increasing exposure among farmers, Comayagua, Honduras, 1987-1989, as assessed by farmers reporting acces to information by medium.*

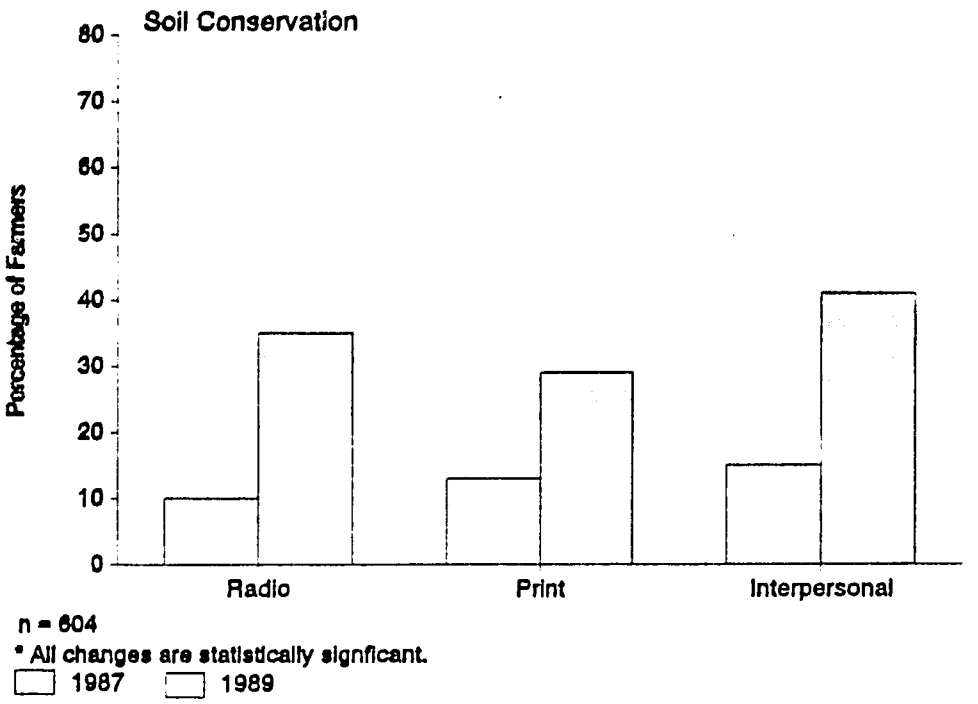
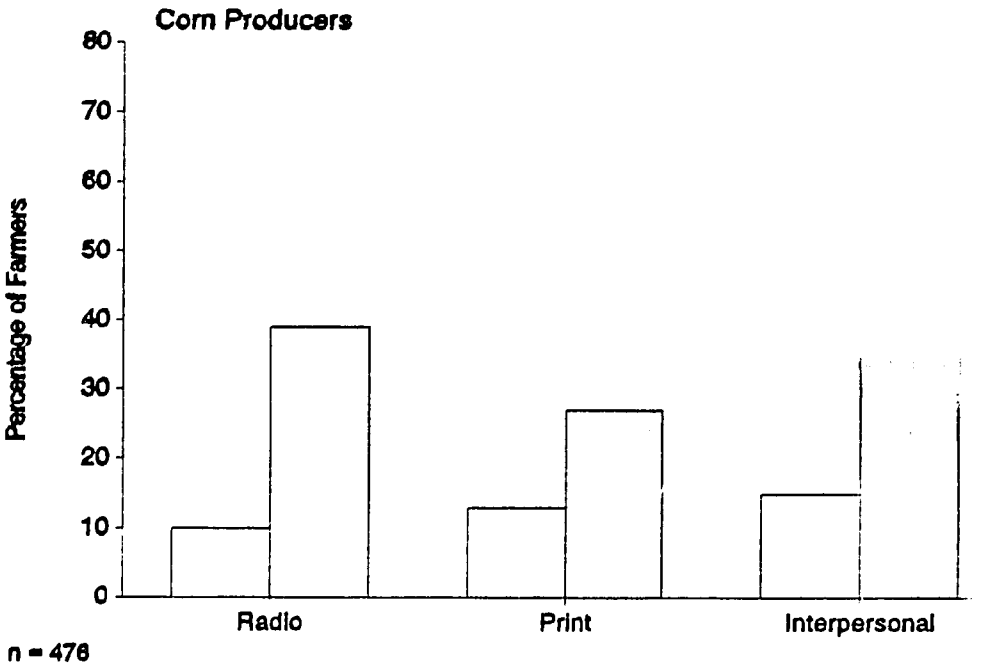


Figure 3B. Role of different media in increasing exposure among farmers, Comayagua, Honduras, 1987-1989, as assessed by farmers reporting access to information by medium*



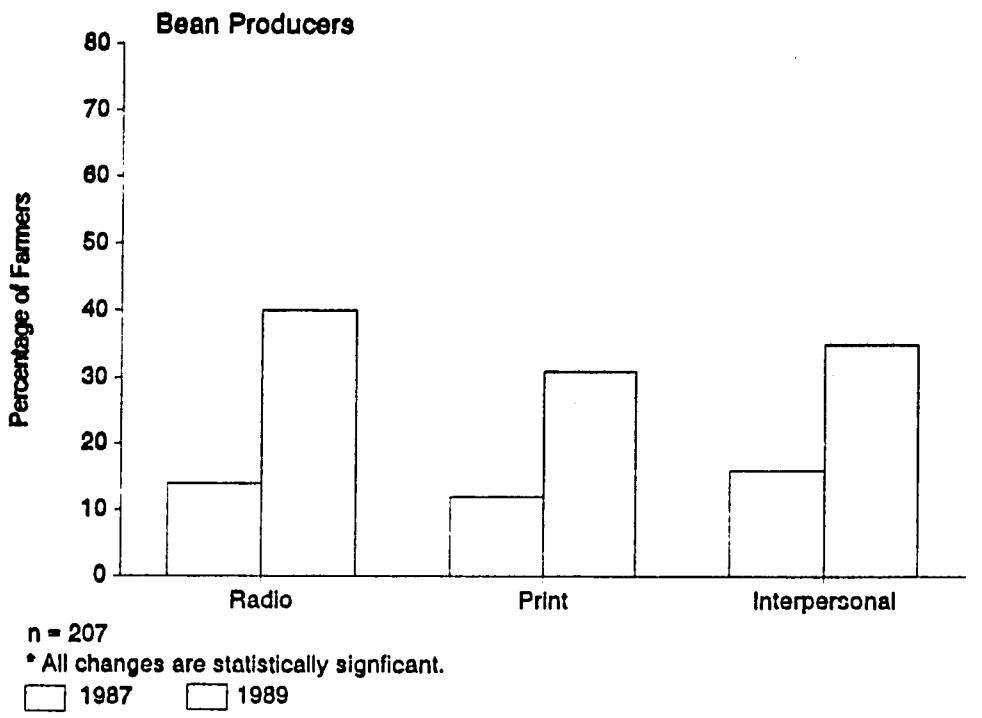
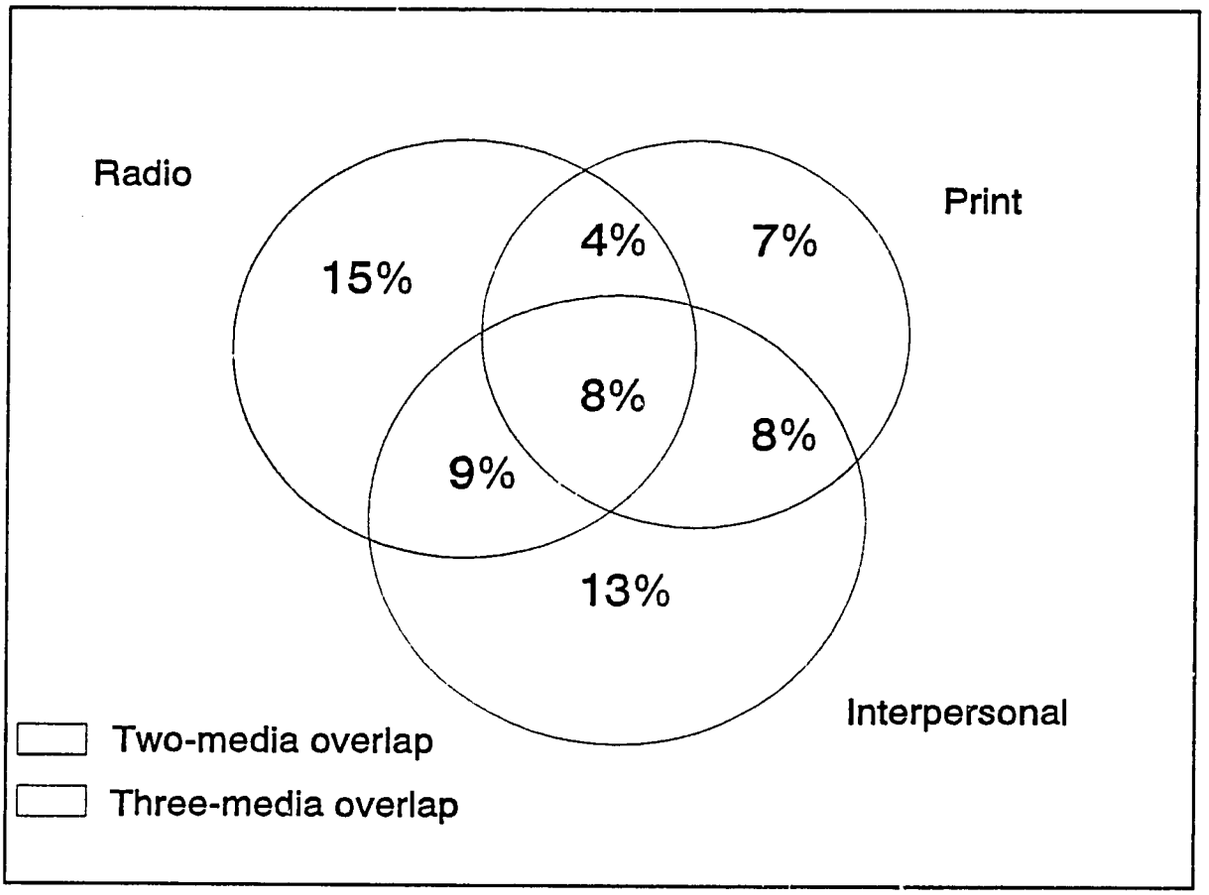


Figure 4. Interaction of different media to facilitate exposure of corn producers to information about new technology, Comayagua, Honduras, 1989.



increase the level of coverage by providing access to information to those people who only attend to one channel. Second, some people are reached by all the media, thus permitting an intervention to take an integrated, complementary approach to information delivery. Figure 4 represents the interaction of different media to facilitate exposure to a message.

Changes in Knowledge

For this study, it was important to record increases in knowledge among the target audience that occurred during the intervention, not how many people knew the recommendations. That is, after the intervention, did farmers know more about the soil conservation technologies recommended by the extension service? Did corn and bean producers know more in 1989 than in 1987 about extension recommendations for those two crops? Increases in knowledge are best measured through knowledge indices. Such measures are scales that help detect even small gains.

Figure 5 illustrates changes in the average knowledge levels for recommended practices for soil conservation and corn and bean production between 1987 and 1989. The aggregate measure of knowledge, calculated by adding the individual knowledge values per topic and dividing that total amount by the number of topics considered, aggregated differently for soil conservation than for crop production. These data indicate that statistically significant gains in knowledge were obtained at the aggregate level for all three content areas. From 1987 to 1989, mean average aggregate knowledge increased from 0.20 to 0.32 for soil conservation recommendations, from 0.04 to 0.16 for corn recommendations, and from 0.03 to 0.12 for beans. In relative terms, the data indicate that aggregate knowledge increased 60 percent for soil conservation recommendations and 400 percent for corn and bean recommendations.

A close look at the data in Figures 5A and 5B suggests that, in 1987, farmers were better informed of the soil conservation recommendations than they were of those pertaining to either corn or bean cultivation. This greater base of knowledge may have occurred for two reasons.

- Soil conservation recommendations were the same for all farmers, independent of the extension district where they farmed. For both corn and bean cultivation, however, recommendations varied by extension district. It may have been easier for pre-CTTA extension to disseminate information useful to all farmers than to disseminate content-specific information that was useful in some geographical areas and not in others.

- Before CTTA, soil conservation practices were being disseminated by other, public sector agencies, particularly the Honduran Coffee Institute. These recommendations were similar, if not identical to, those of the MNR extension service. Thus, 1987 knowledge about soil conservation may reflect the cumulative effect of both agencies.

Figure 5A. Changes in knowledge about recommeded practices for soil conservation, Comayagua, Honduras, 1987-1989*

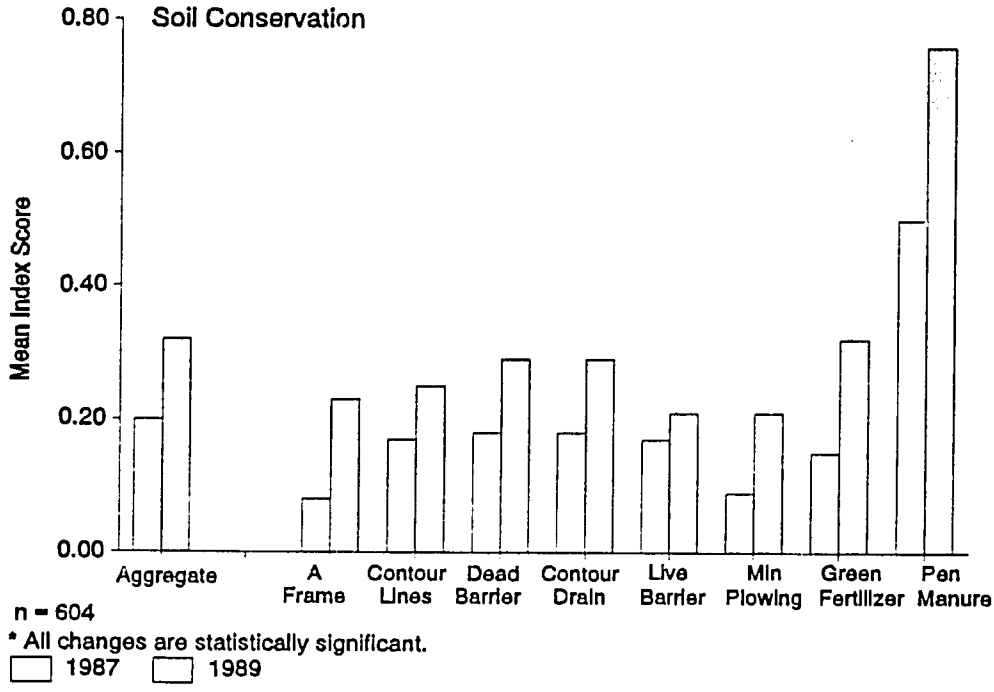
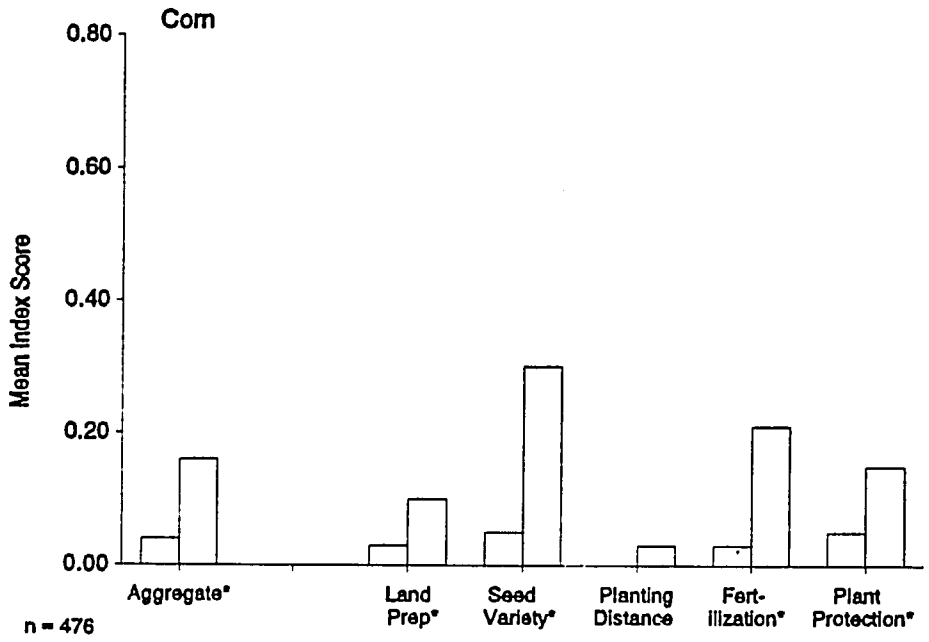
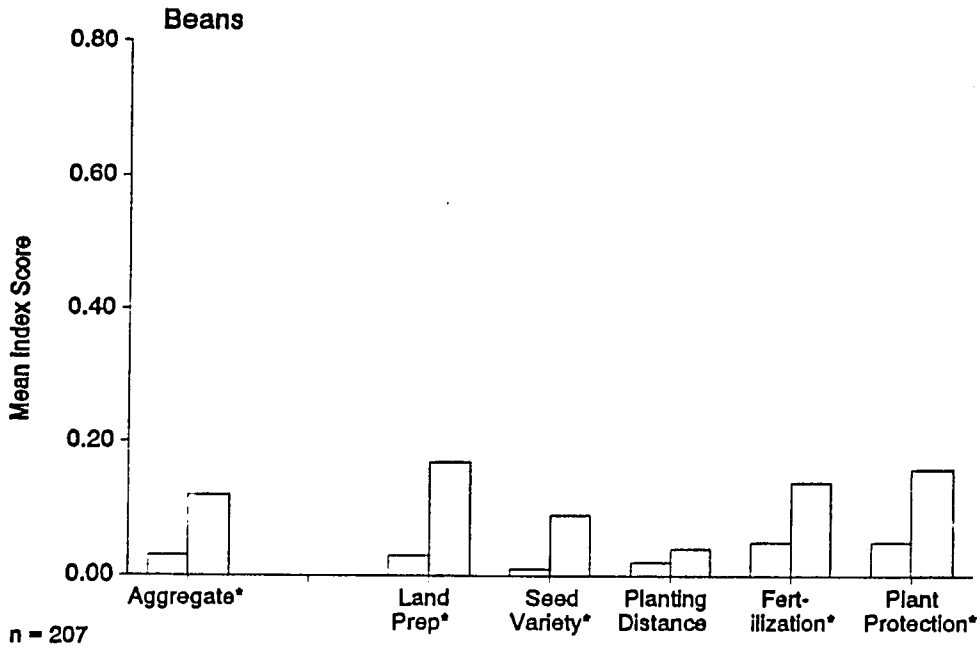


Figure 5B. Changes in knowledge about recommeded practices for corn and bean production, Comayagua, Honduras, 1987-1989.





An analysis of the data presented in Figure 5 by content area indicates that from 1987 to 1989 there were statistically significant gains in knowledge in all the different soil conservation technologies disseminated. For corn and bean cultivation recommendations, except for those pertaining to planting distances, all knowledge gains observed are statistically significant.

Changes in Practices

Farmers do not necessarily adopt all elements of a recommended technology. For example, fertilizer recommendations may include type of fertilizer to be used, amount to be applied by unit area, number of applications, time of application, and place of application with respect to the plant. Farmers might adopt only parts of those suggestions. A farmer might choose to use the suggested fertilizer, but apply it only once instead of twice as recommended, and use half the amount that extension has indicated as appropriate. Therefore, the indices that have been constructed to measure behavior change make it possible to detect changes in partial change. They capture any change in the direction of the recommendation, regardless of the size of the change.

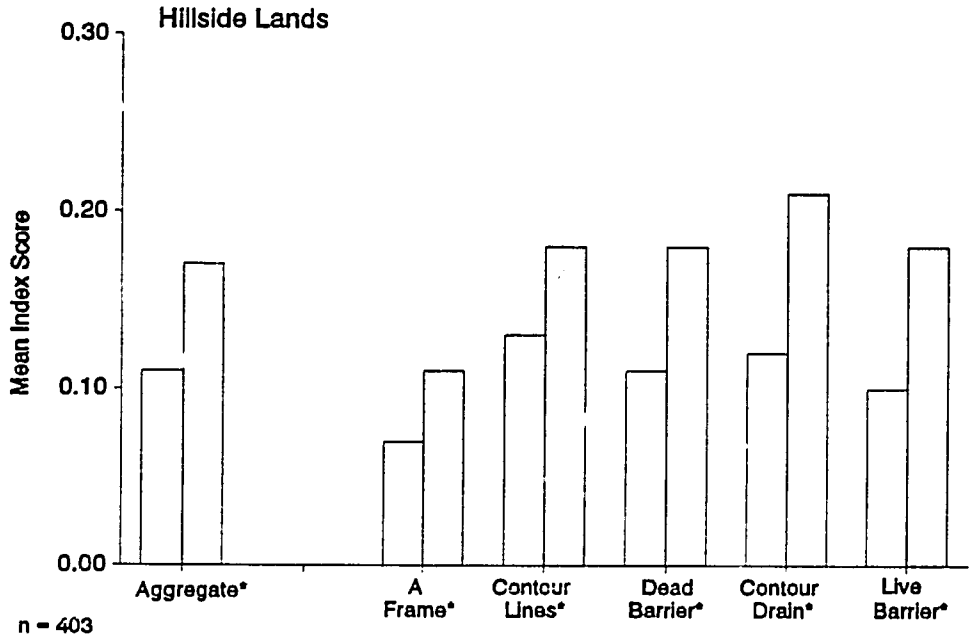
To study changes in behavior between years, it was most appropriate to compare average behavior change in 1987 to average behavior change levels in 1989. Figures 6 and 7 present the results of the evaluation.

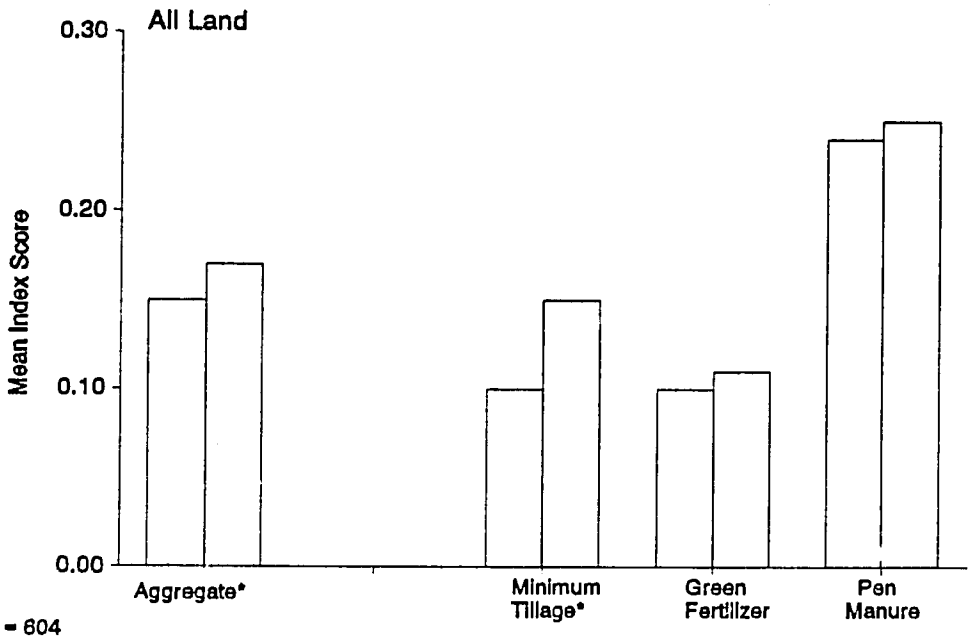
Figure 6 presents results for soil conservation technologies. It distinguishes between technologies that are useful only to farmers who cultivate on sloping land, and technologies that could be used on any plot of land. On average, behavior change related to soil conservation recommendations for slopes increased by 55 percent between 1987 and 1989. The greatest changes in behavior change were observed for constructing contour drains and planting live barriers.

For universally applicable soil conservation technologies, behavior change increased an average 13 percent between 1987 and 1989. Most change centered around increased adoption of minimum tillage (Figure 6). Change for other recommended behavior was not statistically significant. These data seem to indicate that there was a stronger interest in adopting practices that affected the physical characteristic of farms, thus those that would more likely have a longer lifespan and possibly have a more permanent impact on the soil. Such a tendency may reflect both the condition of deterioration of the soil as well as a concern on the part of farmers for more stable solutions despite the labor required to put them in place.

Figure 7 reports behavior changes for technologies recommended for corn and bean cultivation. Although the changes were small, they are statistically significant. Average aggregate behavior change increased from .32 to .34 for corn producers, and from .17 to .21 bean producers. Interestingly, the data show significant decreases in compliance with recommendations for weeding and plant protection. Such decreases may be related to the cost of inputs suggested by the extension service. By 1989, Honduran exporters of agricultural commodities began to buy hard currency to purchase imported products, resulting in a rise in the price of imported currencies. The extension service was starting to adopt, whenever possible, a strategy based on

Figure 6. Changes in soil conservation practices, Comayagua, Honduras, 1987-1989.



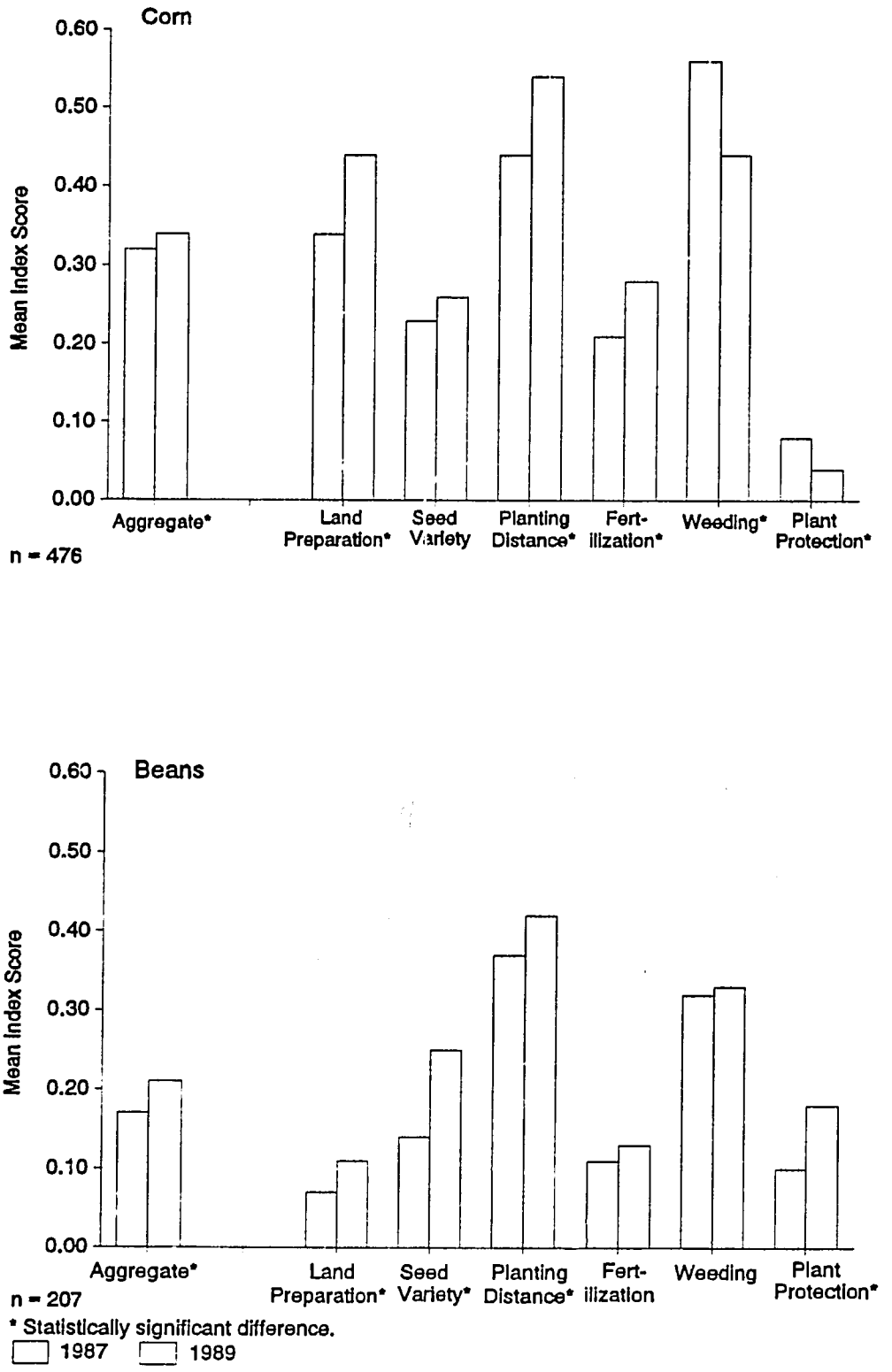


n = 604

* Statistically significant difference.

1987 1989

Figure 7. Changes in practice among corn and bean producers, Comayagua, Honduras, 1987-1989.



technological options that would have less costly implications, but it was beginning only as CTTA was ending.

Rice Growers

The impact of CTTA Project recommendations on rice growers merits separate attention because rice production is a largely commercial operation. Figure 8 summarizes the increases in exposure of rice farmers to CTTA information. The percentage of rice farmers reporting exposure to technological information more than doubled, increasing from 30 percent to 75 percent between 1987 and 1989.

Increases in radio and interpersonal extension activities were much larger than those observed for print materials. During CTTA, the role played by print materials decreased as radio and interpersonal contact became more important. One reason that interpersonal extension become so important was that the rice farmers belonged to land reform cooperatives, which are an MNR extension priority.

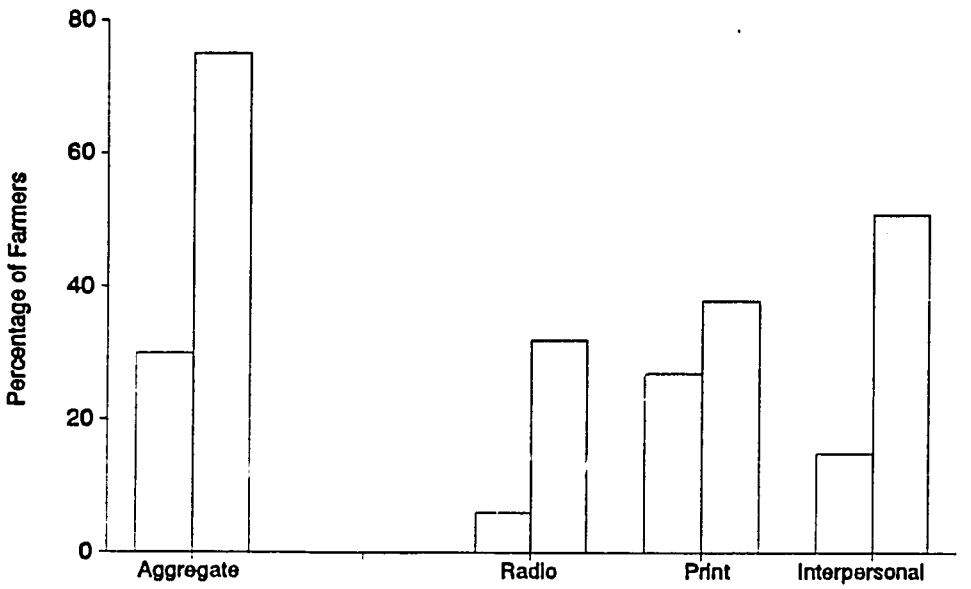
Figure 9 shows increases in knowledge related to the recommendations. From 1987 to 1989, average aggregate knowledge, of MNR recommendations doubled.

The gains in knowledge among rice producers were larger than those observed for any other crop which was a reflection of the effort made by the extension service to introduce rice cultivation, particularly in San Luis. Although farmers did not need to become acquainted with appropriate seed varieties to plant, they had to learn what practices were being suggested for land preparation, weeding, and fertilization.

Figure 10 reports behavior change for rice growers. These data were calculated using a reduced sample of only farmers who reported cultivating rice in 1987 and 1989. This decision was based on the need to control error that might result from the determinants of behavior other than knowledge. By limiting the analysis to only these farmers, the influence of such variables was reduced to the minimum and the value of the longitudinal design of this study was retained.

At the aggregate level, the data show a small yet significant increase in adoption from 1987 to 1989. Average behavior change related to recommendations increased by eight percent. In general, adoption remained constant from one year to the next for land preparation, fertilization, weeding, and plant protection. On the other hand, a significant decrease in behavior was observed regarding seed varieties, most likely reflecting difficulty of access to the recommended variety due to important fluctuations in the availability of agricultural imports during the life of the project. Significant increases occurred only for planting distance. This was the major focus of the extension activities during the project. Both experimental and anecdotal evidence had shown that, by this change alone, important increases in production might be achieved. The data show that rice producers changed their behavior precisely regarding a topic highly promoted by the extension service. Modifying planting distance was a simple behavior that required no capital expenditure and had a clear payback.

Figure 8. Changes in exposure to MNR recommendations among rice growers, Comayagua, Honduras, 1987-1989*



n 1987 = 76, n 1989 = 96

* All changes are statistically significant.

1987 1989

Figure 9. Changes in knowledge of MNR recommendations among rice growers, Comayagua, Honduras, 1987-1979.

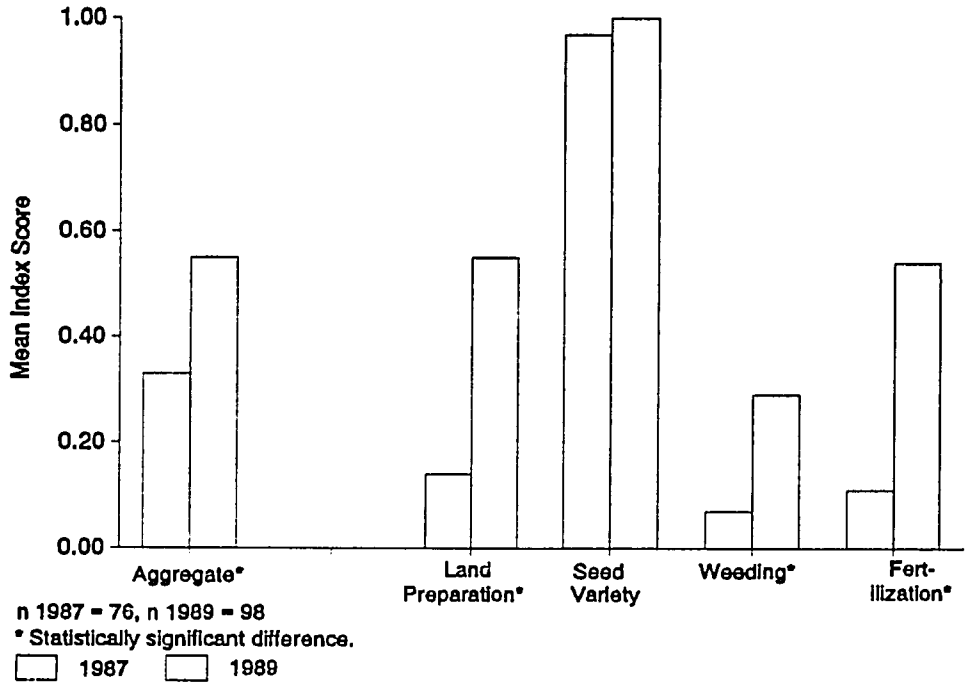
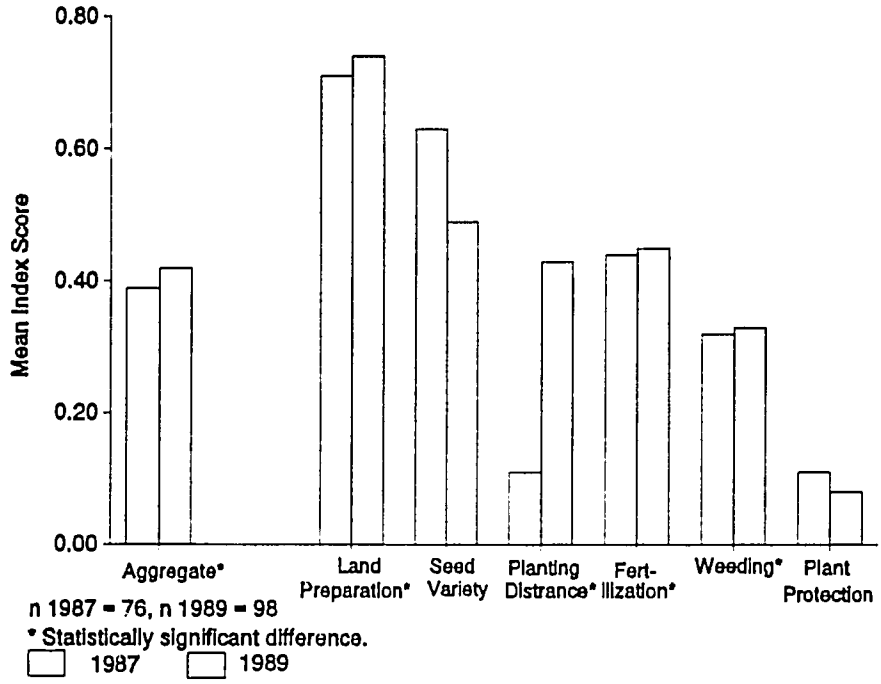


Figure 10. Changes in practices among rice growers, Comayagua, Honduras, 1987-1989



Relationships between Exposure, Knowledge, and Practices

Results described in the previous sections have dealt individually with the three dimensions of this analysis, exposure, knowledge, and practices. Increases in all of those dimensions were observed between 1987 and 1989. From here, it is important to ask a further question: to what extent are those increases related? That is, does knowledge increase with exposure, and do practices increase with knowledge?

The principle of attenuated effects of communication theory suggests that in the line of causality (Exposure → Knowledge → Practices), stronger relationships are to be expected between contiguous dimensions than among distant dimensions. That is, a stronger relationship should be expected between exposure and knowledge than between exposure and practices. Relationships between non-contiguous dimensions are attenuated by the fact that in any given population, not all of those who are exposed to information will learn it. By the same token, not all of those who learned it will put it into practice. Structural, sociological, socio-psychological, and circumstantial variables will interact to attenuate the relationships between non-contiguous variables. Therefore, a direct relationship between exposure and practice is not likely to be found, and the intermediate dimension of knowledge must be considered.

Exposure and knowledge

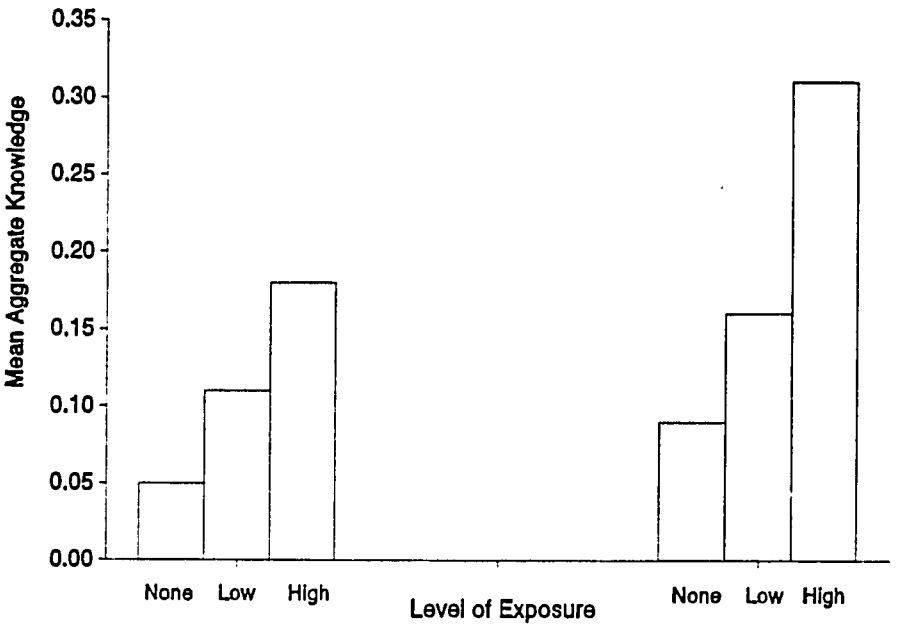
Figures 11A, 11B, and 12 present the relationships between exposure and knowledge when the level of exposure has been categorized as none, low, and high. Figure 11 gives results for soil conservation, corn, and beans. Figure 12 gives results for rice growers.

It might be expected that levels of exposure and knowledge would be related in 1987 and in 1989, but that the relationship would be stronger in 1989, given the multiple media communication strategy implemented and that technological messages improved as CTTA interventions matured. It might also be expected that if there was a relationship between exposure and knowledge, knowledge would increase as exposure increased.

Results presented in Figures 11 and 12 confirm both these expectations. Results associated with soil conservation best exemplify the expected pattern. Exposure and knowledge were associated in 1987, and the relationship strengthened by 1989.

That for any content area (soil conservation, corn, beans, and rice) there was some knowledge associated with no exposure is explained by the fact that in this study, the measurement of exposure refers to direct exposure to information via the channels used in the CTTA-supported multi-media strategy. Both before and during the intervention, farmers may have been indirectly exposed to information disseminated by the MNR. Indirect exposure may have occurred as MNR reached other sources of information that farmers use such as private sector extension agencies, input retailers and distributors, and other farmers. That the relationship between no exposure and knowledge was strengthened in 1989 in all content areas, as expressed by the height of the 1985 bars compared to those from 1987, indicates that there was a project multiplication effect that

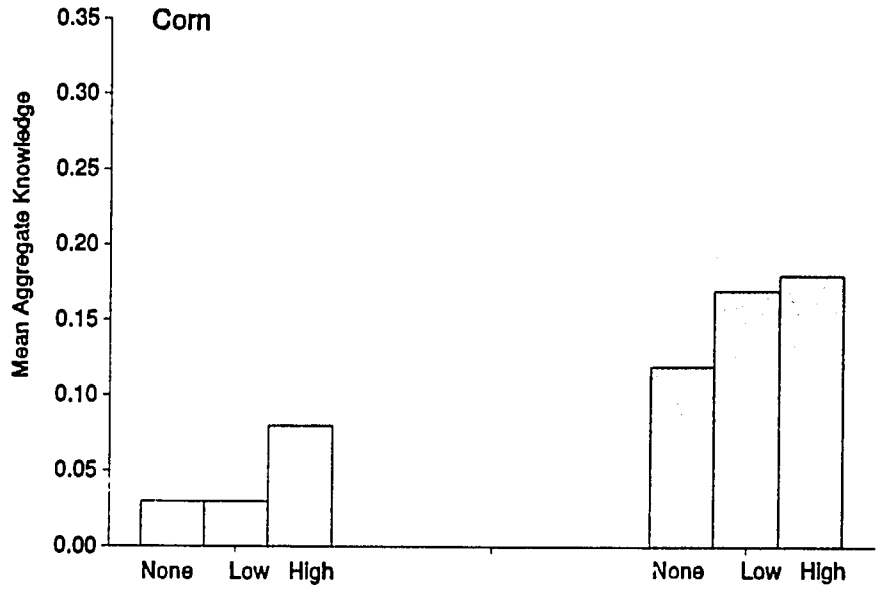
Figure 11A. Relationship between exposure and knowledge related to soil conservation, Comayagua, Honduras, 1987-1989*



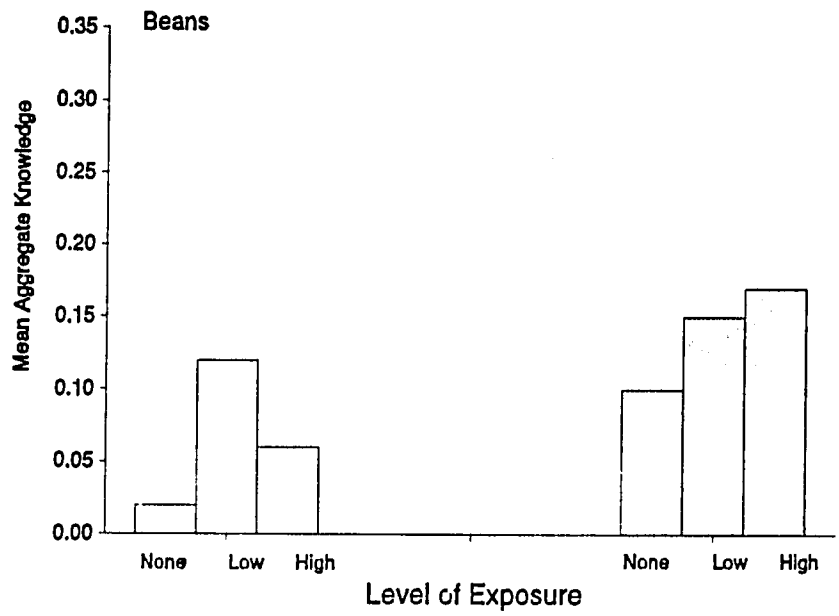
* All relationships are statistically significant.

1987 1989

Figure 11B. Relationship between exposure and knowledge related to corn and bean production, Comayagua, Honduras, 1987-1989*



n = 476

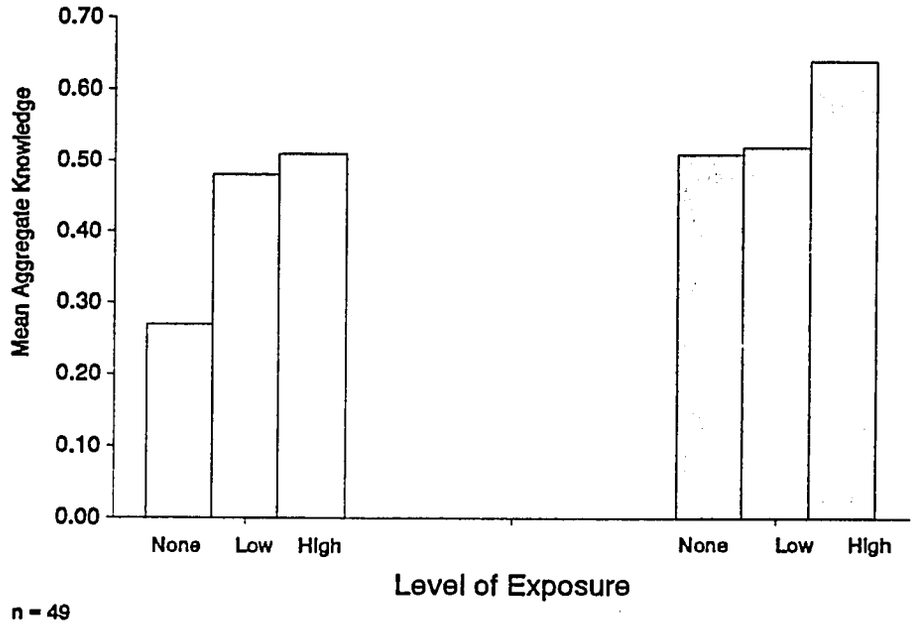


n = 207

* All relationships are statistically significant.

1987 1989

Figure 12. Relationship between exposure and knowledge among rice producers in Comayagua, Honduras, 1987-1989*



n = 49

* All relationships are statistically significant.

1987 1989

allowed for farmers who were not directly exposed to the messages disseminated to have indirect access to them.

Knowledge and practices

Figures 13 through 15 present results of the analysis conducted to examine the relationships between knowledge and practices. The same analysis techniques were used as were employed to study the relationships between exposure and knowledge. The variable "aggregate knowledge" was seen as a categorical variable with three levels and the variable "aggregate practices" was kept continuous.

The data indicate that there were significant relationships between knowledge and practices, as follows:

- for soil conservation technologies and corn cultivation in 1987 and 1989, and
- for bean cultivation for the data corresponding to 1989.

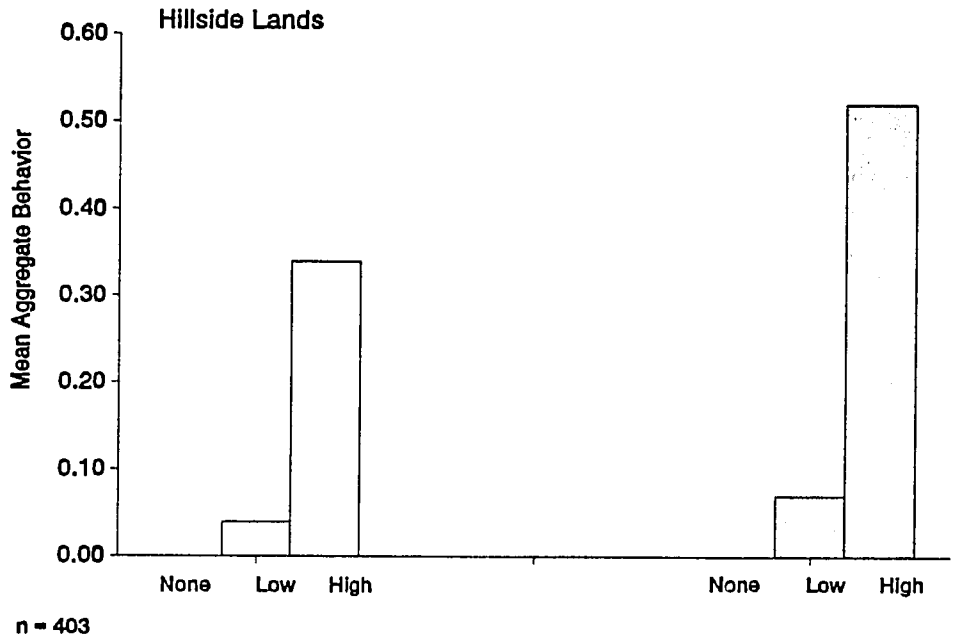
The strongest relationships were for soil conservation, particularly in 1989. Figure 13 describes the relationships by topology and practice. The data are from a smaller number of technologies than were recommended, but represent all farmers in the sample, independently of the type of land that they farm. Figure 13 indicates that no knowledge implied no compliance with the recommendations. This was true for both years, and it constitutes striking evidence in favor of the need to make soil conservation information accessible to farmers.

The largest mean compliance scores were associated with a high level of knowledge. The difference in mean aggregate compliance between low and high knowledge was impressive. And, it appeared that the relationship between knowledge and practices was stronger in 1989 than in 1987.

Data presented in Figures 14 and 15 indicate that adoption is associated with zero knowledge. This contradictory observation appeared to hold for corn, bean, and rice producers. Evaluators and program implementers agreed on the following explanation for this phenomenon. Recommendations disseminated by the extension service included some practices that were already being carried out by some farmers before CTTA. In fact, CTTA helped identify those farmers as the most successful farmers. CTTA also helped incorporate their practices and concerns into the extension agenda, with the goal of including the practices as part of the recommendations to be disseminated in areas with comparable agronomic characteristics.

Figure 14 indicates that in 1987 farmers who reported no knowledge had slightly higher adoption rates than those who reported low knowledge. These results may have been a consequence of disseminating technologies used by more successful farmers in some areas to less successful farmers elsewhere, and may partially explain why the 1987 relationship between knowledge and practices for bean growers was not significant. The 1989 relationships in Figure 14 are significant. The expected progression of greater compliance with increased knowledge was clear for both corn and bean producers.

Figure 13. Relationships between knowledge and practices for soil conservation technologies, Comayagua, Honduras, 1987-1989*



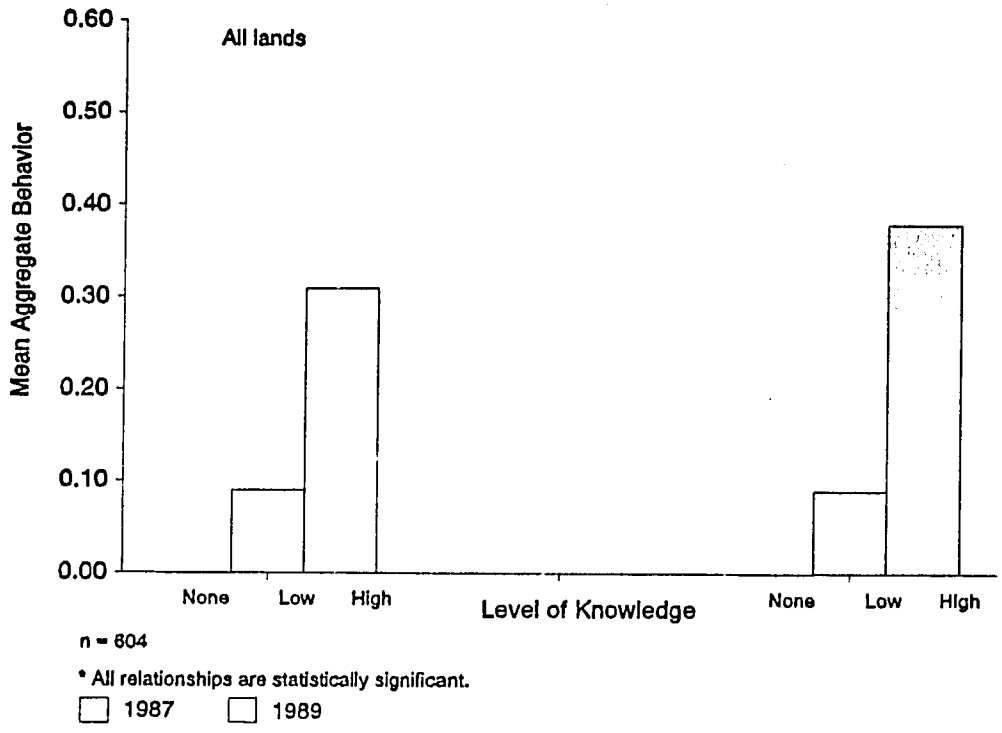
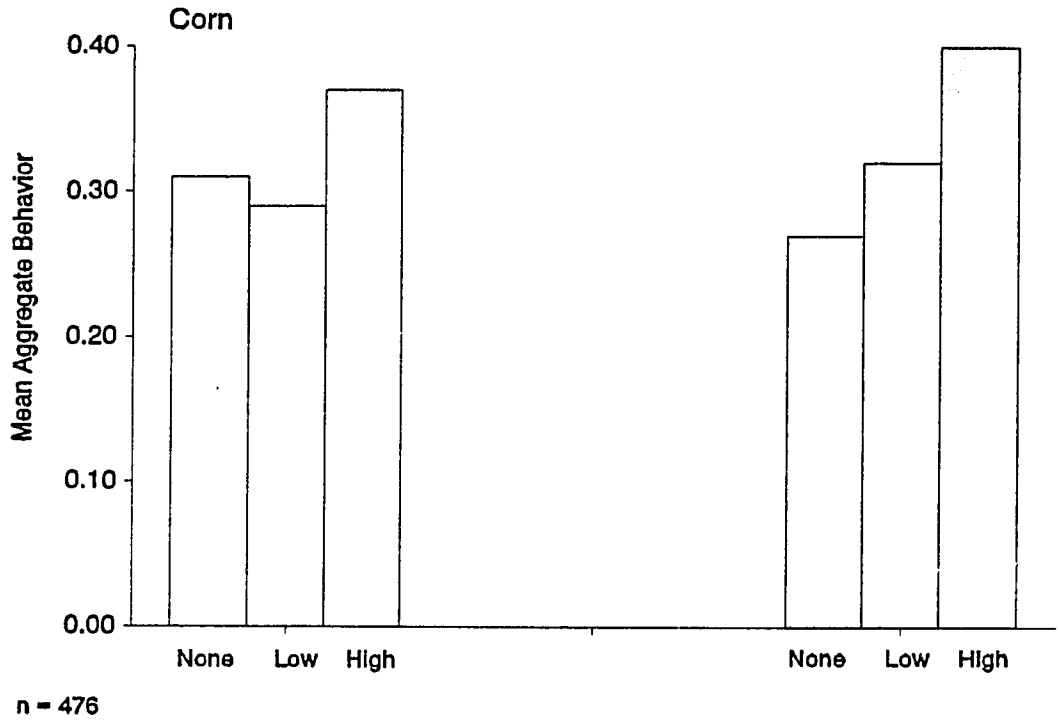


Figure 14. Relationships between knowledge and practices for corn and bean producer Comayagua, Honduras, 1987-1989*



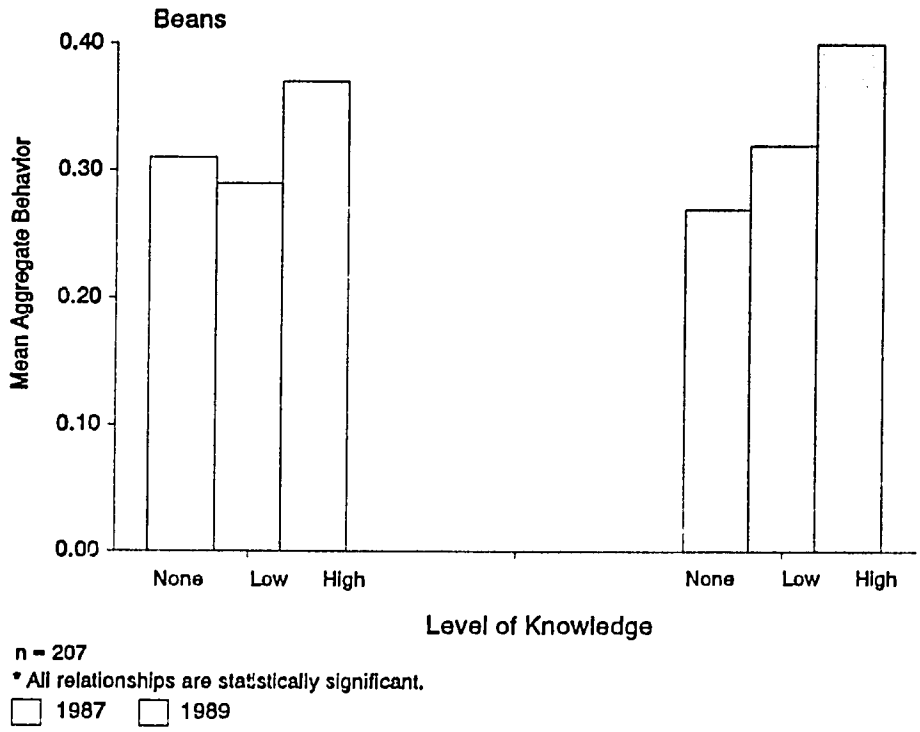
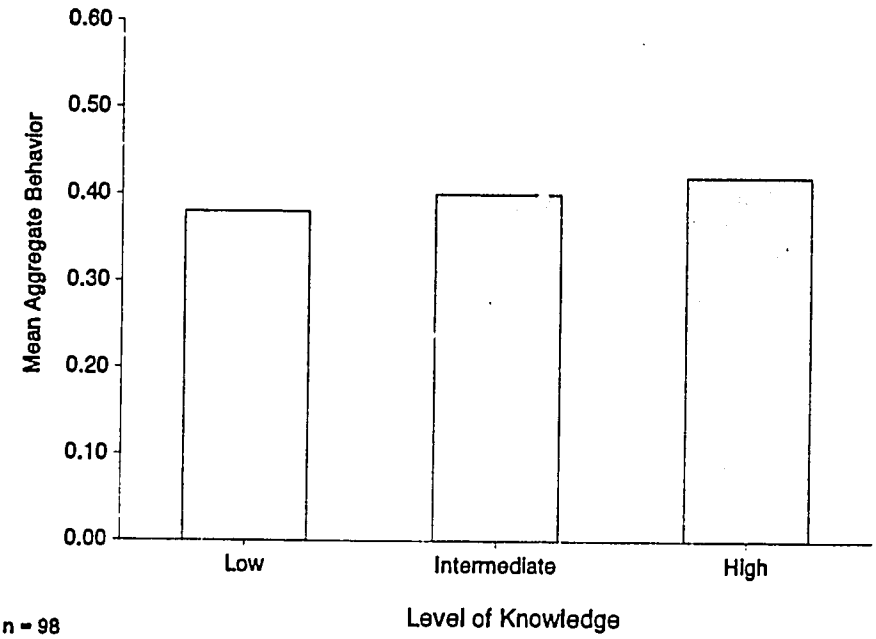


Figure 15. Relationship between knowledge and practice of rice producers, Comayagua, Honduras, 1989



n = 98
Relationship is not statistically significant.

Figure 16.
Regression analysis results of residuals of 1989 practices, Comayagua, Honduras.

Relationship Tested	Adjusted R Square	BETA
Knowledge in 1989 predicts practices in 1989, when effects of exposure, knowledge and practices in 1987 have been removed from practices in 1989	.255	.506

It was to be expected that the relationship between knowledge and practices in 1989 for rice producers would not be significant. From the beginning, rice farmers showed a high level of compliance with the recommendations. Little aggregate level behavior change was observed in practices from 1987 to 1989 and that only for planting distances. In addition, the decrease in compliance with the recommendation regarding seed varieties due to the contextual reasons explained earlier, reduced the behavior change increase at the aggregate level.

Removing the influence of prior exposure knowledge and behavior

CTTA/Honduras sought to determine if it was possible to predict the change in behavior from the changes in knowledge that took place between 1987 and 1989. The analysis assumed that what a farmer does in any given year is, in part, influenced by what he or she was exposed to, learned, and practiced in previous years. Therefore, for an extension program to be successful, practices should be predicted based on recent exposure and recently acquired knowledge rather than from prior exposure, knowledge, and practices.

This analysis was conducted using multiple regression. It assumed that 1987 data would be used as proxies for prior exposure, knowledge, and behavior. Behavior in 1989 was then predicted from 1987 data. Results of this analysis indicated that the 1989 behavior variance could be broken down into explained and unexplained variance. Unexplained variance is normally referred to as residual variance. Residual variance was predicted from 1989 knowledge. The researchers assumed that if 1989 knowledge predicted the 1989 residual behavior variance, the extension program had made a contribution above and beyond what farmers knew and did before the project.

This analysis only considered soil conservation technologies (Figure 16). Results indicated that there was a significant relationship between knowledge and practices in 1989, when the effect of prior exposure, knowledge, and practices was removed from 1987 practices. 1989 knowledge explained 25 percent of the variance observed in the residual 1989 practices. Therefore, a considerable amount of new behaviors was explained by knowledge acquired in 1989.

SUMMARY

CTTA was instrumental in helping the Honduran Ministry of Natural Resources in Comayagua meet its objectives of expanding extension coverage during a time when the Honduran Government needed to reduce its budget deficit by making sizeable cutbacks in public sector services. Pre-post measurements of a randomly selected sample indicated that exposure to technological information doubled for corn, bean, and rice producers, and tripled for soil conservation technologies during the period when CTTA was implemented. These results support the first and second hypotheses that guided the impact evaluation of the project.

Among independent farmers investigated, radio was by far the most common medium for receiving information. Interpersonal channels played the most significant role among land reform beneficiaries who were organized into production groups. During CTTA, the cost of extension coverage may have marginally increased due principally to the addition of external

communication staff (long-term CTTA technical assistance) who supported regional extension activities. One of the successes of CTTA was that it required no additional MNR extension staff.

Information disseminated by the MNR with CTTA technical assistance not only reached farmers, but also attracted their attention and made them more knowledgeable of what the Ministry's extension services recommended for the priority food crops. Significant increases in aggregate knowledge were observed for all of the subject crops and for soil conservation technologies.

Although knowledge gains in absolute terms for corn and bean cultivation recommendations were small, they imply a four-fold increase in relative terms. A two-fold increase in knowledge was observed among rice producers. Such an increase may have been due in part to their high knowledge levels at project outset and to the fact that the sample of rice growers does not include the same producers for 1987 and 1989.

Knowledge gains related to soil conservation practices represented a relative increase of 60 percent. This increase may represent the cumulative impact of different public sector institutions implementing extension activities in the Comayagua region, including the Honduran Coffee Institute, which delivered similar messages to those disseminated by the MNR with CTTA support.

Farmers do not necessarily adopt all practices for a crop that are recommended by an extension service, and they may not fully adopt a particular practice. There may be partial adoption of packages, and individual recommendations. The procedure used in this study to measure compliance proved fruitful because it detected the smallest acceptable change in the direction of the messages disseminated.

At the aggregate level, the observed increases in compliance from 1987 to 1989 were statistically significant. Mean aggregate compliance increased as follows:

- 6 percent among corn producers,
- 23 percent among bean producers,
- 8 percent among rice producers,
- 55 percent for technologies to be used on slopes, and
- 13 percent for technologies that can be used in any farm, independent of topography.

There were important variations in terms of the adopted technologies. Corn producers were most likely to adopt recommendations related to fertilization. Bean producers favored technologies related to plant protection. Rice producers were most likely to adopt technologies related to planting distances.

These adoption patterns may reflect a tendency to adopt technologies that make the most economic sense to farmers. That is, technologies are only adopted if they yield potentially high payback at relatively low cost and risk. Moreover, they also may be technologies that were

strongly supported by the communication strategy for precisely those same reasons. For example, the technology with greatest compliance among rice producers was planting distances. MNR research and extension services had predicted that this single technological adoption would have the greatest impact on production. As a result, it became the focus of extension activities. Farmers were interested in following that advice.

The larger behavior change in soil conservation practices observed in hillside technologies when compared to technologies suggested for any topography may reflect a preference for making semi-permanent or permanent changes in the physical characteristics of farms. It may also be related to the level of erosion in hillside farming in Comayagua.

Results support the third and fourth hypotheses of this study. Generally speaking, gains in knowledge were statistically associated with gains in exposure. In addition, gains in compliance were statistically associated with gains in knowledge. Rice producers were the exception, but this may have been due to both the size of the sample and the fact that aggregate compliance gains were small.

The results presented regarding the impact of knowledge of improved practices in 1989 regarding soil conservation technologies clearly illustrate that CTTA had a significant, positive impact on adoption. They support the fifth hypothesis of this study.

CONCLUSIONS

Multimedia communication strategies that employ social marketing principles can be effective in improving access to technological information by both subsistence and commercial farmers who have been traditionally ignored by extension activities. Using both radio and print media, in particular, can complement and enhance extension efforts based on interpersonal channels.

Future evaluations of agricultural extension projects should pay closer attention to proper approaches to measure the productivity gains resulting from the adoption of recommended practices. Accurate production information may not always be obtained through structured questionnaires given the different units of measurement used to report crop yields. In addition, when reporting on production, farmers may ignore production that was consumed before crops become fully mature.

In addition, future evaluation activities of agricultural extension projects should use an analysis approach that will guarantee the detection of partial adoption. Such evaluations also should use research designs that include a control group. Such a design would help rule out the possibility that observed variations are not due to historical trends occurring in a given context.

ANNEX 1

BEAN RECOMMENDATIONS 1989

ANNEX No. 1

RECOMMENDED TECHNOLOGIES FOR BEAN CULTIVATION
SECOND CROPPING SEASON OF AGRICULTURAL CYCLE
1989

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
1. Land Preparation	Hillsides	No recommendation listed in the materials.	Continuous minimum tillage, 30 cms. wide and 20 cms. deep.	Continuous minimum tillage, 30 cms. wide and 20 cms. deep.	Continuous minimum tillage 20 cms. wide and 20 cms. deep.
	Valley Land	■Rainfed: Begin planting 8/15 to 9/15 ■Irrigated: Begin planting 12/15 to 1/15	No recommendation listed in the materials.	*Use machinery to prepare soil. Three crossings are suggested. One to break through to soil; the two others to pulverize it.	Farmer's most commonly used practice is recommended.
2. Seed Varieties	Hillsides	No recommendation listed in the materials.	■Farmer's most commonly used variety is recommended. ■Charrano ■*Catrachita	Farmer's most commonly used variety is recommended.	■Dessarural. ■Porillo negro. ■Charrano.
	Valley Land	■Rainfed: No recommendation listed in the materials. ■Irrigated: Catrachita	No recommendation listed in the materials.	Desarrural.	Farmer's most commonly used variety is recommended.
3. Planting	Hillsides	No recommendation listed in the materials.	Two grains per pocket. Distances of 50 cms. between furrows and 20 cms. between pockets.	One grain per pocket. Distances of 50 cms between furrows and 10 cms. between pockets.	One grain per pocket. Distances of 60 cms. between furrows and 10 cms. between pockets.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
Planting (Continued)	Valley Land	Distance between furrows 0.40-0.45 cms. If one seed per pocket, distance between pockets: 0.10 cms. However, if 2-3 seeds per pocket, distance between pockets 0.20 cm.	No recommendation listed in the materials.	*Plant in a straight line, no pockets. Keep a 0.45 cm distance between furrows. Use 80lbs. of seed per manzana.	Farmer's most commonly used practice is recommended.
4. Fertilization	Hillsides		150lbs. of 18-46-0 or 17-50-0 placed in either lines at the bottom of the furrow or per hole mixed with the seed.	100lbs. of 18-46-0 or 17-50-0 utilized when sowing, placed in lines at the bottom of the furrow.	200 lbs. of 18-46-0 or 17-50-0 when minimum tillage is practiced. 100lbs. of 18-46-0 when there is no soil conservation practice.
	Valley Land	150lbs./ manzana of 18-46-0 or 17-50-0. Application at planting or 4-8 days after germination.	No recommendation listed in the materials.	100lbs. of 18-46-0 or 17-50-0 utilized when sowing, placed in lines at the bottom of the furrow.	Farmer's most commonly used practice is recommended.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
5. Soil Pests	Hillsides	Pest controlled: white grubs. Use 20lbs. of Counter 10G per manzana mixed with seed and fertilizer. Another option is to use 15-20lbs. of Volaton 5% per manzana.	*Pest controlled: white grubs. Use 20lbs. of Counter 10G per manzana mixed with seed and fertilizer. Another option is to use 25-30lbs. of Volaton 5% per manzana.	*Pest controlled: white grubs. Use 20lbs. of Counter 10G per manzana mixed with seed and fertilizer. Another option is to use 15-20lbs. of Volaton 5% per manzana.	*Pest controlled: white grubs. Use 20lbs. of Counter 10G per manzana mixed with seed and fertilizer. Another option is to use 15-20lbs. of Volaton 5% per manzana.
	Valley Land	Farmer's most commonly used practice is recommended.	No recommendation listed in the materials.	Farmer's most commonly used practice is recommended.	Farmer's most commonly used practice is recommended.
6.Weed Control	Hillsides		Farmer's most commonly used practice is recommended. *When using chemicals, use 1.5 ltrs./manzana of Gramoxone. This is equivalent to using 4 cups/4 gallon sprayer.	Clean the weed with a hoe 8-12 days after planting.	Clean the weed with a hoe 10 days after planting.
	Valley Land		No recommendation listed in the materials.	Farmer's most commonly used practice is recommended.	Farmer's most commonly used practice is recommended.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
7.Foliage Pests	Hillsides and Valley Land	*After prior sampling to detect presence of pests such as green aphids and white flies, and if Counter 10G or Citrolane not applied to soil, apply one cup (30 cc) of Perfekthion/4 gallon (18 ltr.) sprayer. Apply this 6-8 days after planting. An alternative would be Arrivo, using 1/3 of a cup (10 cc)/4 gallon sprayer.	*After prior sampling to detect presence of pests such as green aphids and white flies, and if Counter 10G or Citrolane not applied to soil, apply one cup (30 cc) of Perfekthion/4 gallon (18 ltr.) sprayer. Apply this 6-8 days after planting. An alternative would be Arrivo, using 1/3 of a cup (10 cc)/4 gallon sprayer.	*After prior sampling to detect presence of pests such as green aphids and white flies, and if Counter 10G or Citrolane not applied to soil, apply one cup (30 cc) of Perfekthion/4 gallon (18 ltr.) sprayer. Apply this 6-8 days after planting. An alternative would be Arrivo, using 1/3 of a cup (10 cc)/4 gallon sprayer.	*After prior sampling to detect presence of pests such as green aphids and white flies, and if Counter 10G or Citrolane not applied to soil, apply one cup (30 cc) of Perfekthion/4 gallon (18 ltr.) sprayer. Apply this 6-8 days after planting. An alternative would be Arrivo, using 1/3 of a cup (10 cc)/4 gallon sprayer.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
8.Other Pests	Hillsides and Valley Land	■Bean Bug (Picudo): 2.5 cups of Folidol M480/4 gallon sprayer. An option would be 1/3 of a cup (10cc)/ 4 gallon sprayer of Arrivo. Depending on intensity of attack, two applications are suggested. The first application should be done at blooming. The second one eight days after blooming.	■Bean Bug (Picudo): 2.5 cups of Folidol M480/4 gallon sprayer. An option would be 1/3 of a cup (10cc)/ 4 gallon sprayer of Arrivo. Depending on intensity of attack, two applications are suggested. The first application should be done at blooming. The second one eight days after blooming.	■Bean Bug (Picudo): 2.5 cups of Folidol M480/4 gallon sprayer. An option would be 1/3 of a cup (10cc)/ 4 gallon sprayer of Arrivo. Depending on intensity of attack, two applications are suggested. The first application should be done at blooming. The second one eight days after blooming.	■Bean Bug (Picudo): 2.5 cups of Folidol M480/4 gallon sprayer. An option would be 1/3 of a cup (10cc)/ 4 gallon sprayer of Arrivo. Depending on intensity of attack, two applications are suggested. The first application should be done at blooming. The second one eight days after blooming.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
8. Other Pests (continued)	Hillsides and Valley Land	■Slugs: MNR's bait used from germination to blooming. Use 60-80lbs./manzana, applying it in squares of 1 mtr./side. Use handfuls/application.	■Slugs: MNR's bait used from germination to blooming. Use 60-80lbs./manzana, applying it in squares of 1 mtr./side. Use handfuls/application.		

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
9. Prevention and Control of Diseases (Anthracnosis; Fusarium; Rust; Angular Stains)	Hillsides and Valley Land	■Use disease resistant varieties. ■*Preventive fungicides: Antracol, Dithane M45, or Cupravit at the rate of 4 cups/4 gallon sprayer. ■Curative fungicides: Benlate or Ridomil, 2 cups/4 gallon sprayer. Two applications of Ridomil, maximum. Applications should be 15 days apart.	Disease is nonexistent.	■Use disease resistant varieties. ■*Preventive fungicides: Antracol, Dithane M45, or Cupravit at the rate of 4 cups/4 gallon sprayer.	■Use disease resistant varieties. ■*Preventive fungicides: Antracol, Dithane M45, or Cupravit at the rate of 4 cups/4 gallon sprayer. ■Curative fungicides: Benlate or Ridomil, 2-3 cups/4 gallon sprayer.
10.Harvest	Hillsides and Valley Land	*Harvest when grain has matured. Do not wait for 80% defoliation.	No recommendation listed in the materials.	No recommendation listed in the materials.	No recommendation listed in the materials.
11.Storage	Hillsides and Valley Land		1 pill of Phostoxim/-500lb. drum.	Farmer's most commonly used practice is recommended.	Farmer's most commonly used practice is recommended.

ANNEX 2

CORN RECOMMENDATIONS 1989

ANNEX No. 2

RECOMMENDED TECHNOLOGIES FOR CORN CULTIVATION
SECOND CROPPING SEASON OF AGRICULTURAL CYCLE
1989

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
1. Land Preparation	Hillsides	*Make temporary dead barriers using residues from the previous harvest, hay or garbage. Utilize these materials by placing them against the slope.	*In the higher parts, clean the land where the planting will take place. Use a hoe or a machete. Use the residues to create temporary dead barriers. Place the residues in lines against the slope. After that, practice minimum tillage following the contour of the plot being planted. Break the soil with a pick as deep as you can. Leave 1 mt. between furrows.	*In the more sloping hillsides, clean the land where the planting will take place. Use a hoe or a machete. Use the residues to make dead barriers. Place the residues in lines against the slope. *In less sloping areas, prepare the land by using an oxen plow. Do two crossings after the first two rains of the rainy season. The furrows must be done against the slope.	*In the more sloping hillsides, clean the land where the planting will take place. Use the residues to make dead barriers. Place the residues in lines against the slope.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
	Valley Land	Prepare the land between 5/15 and 6/15. One month before planting: ■use tractor to turn over the soil; ■do one crossing; ■use a plow that is 25 cms deep.	In the lower parts, prepare the land by using a plow. Do three crossings. The furrows must be done against the slope.	*In the totally flat areas, use a tractor to plow the land. Use a row plow in April or May. Do two crossings.	In the flat areas, use a tractor to turn the soil upside down. For this activity, use a plow that would go 25 cms. deep into the ground, and do one crossing. Three days before planting, do two crossings to pulverize the soil.
2. Seed Varieties	Higher Latitudes	No recommendation specified in the materials.	No recommendation specified in the materials.	*Plant local varieties such as Pablo or Purple Husk.	No recommendation specified in the materials.
	Hillsides	No recommendation specified in the materials.	*Plant the local variety names Pacaya. Make sure to use seeds from the previous harvest. Select the seed to be planted so that the crop will be healthy and will get to be of normal height.	*Plant the Short Honduran Stalk variety. It is a white corn variety, has a three-month growth period and can produce yields from 70 to 80 100-lb. weights / manzana.	*Local varieties and hybrids can be planted. If local varieties are used, make sure that the seed is from the last harvest. The hybrids recommended are the following: Sintetico Tuxpeno, the Short Honduran Stalk, Guayape B-102 and HB-104. HB-104 is drought resistent. Thus, it is recommended for areas where there is no irrigation. The other three hybrid varieties produce a good sized ear with good husk coverage.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
Seed Varieties (continued)	Valley Land	•For rainfed plots, use HB-104 and Short Honduran Stalk for white corn. For irrigated plots, use Guayape B-102 for white corn.	Same recommendation as Hillsides.	•Plant Sintetico Tuxpeno. It is white corn, having a good sized ear and a husk with good coverage. It is a tall plant measuring 2 meters when fully grown.	Same recommendation as Hillsides.
3. Planting	Higher Latitudes			•Keep a distance of 90 cms. between furrows and 50 cms. between pockets. Put two to three seeds per pocket. Plant Pacaya keeping one meter of distance between plows and 50 cms., that is one step, between pockets. Place alternately two and three seeds per pocket.	

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
Planting (Continued)	Hillsides	No recommendation specified in the materials.	*Keep one meter of distance between furrows and 50 cms., (one step) between pockets. Place alternately two and three seeds per pocket.	No recommendation specified in the materials.	(Drawings show flat lands. It is difficult to say if these recommendations apply also to highlands.)
	Valley Land	Plant the seed from 6/15 on. When HB-104 and the Short Honduran Stalk varieties are planted, leave 80-100 cms. between furrows and 50 cms. between pockets. Place 2 and 3 grains alternately per pocket.	No recommendation specified in the materials.	*Plant at the end of May, beginning of June. Keep a distance of 90 cms. between furrows and 50 cms. between pockets. Place alternately two and three seeds per pocket.	If Guayape B-102, Sintetico Tuxpeno and local varieties are planted, keep a distance of 90 cms. between furrows and 50 cms. between pockets. If Short Honduran Plant and HB-104 are planted, keep a distance of 80 cms. between furrows and 50 cms. between pockets. In any case, alternately place two and three seeds per pocket.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
4. Fertilization	Hillsides	No recommendation specified in the materials.	At planting or 12 days after that, apply 100lbs. of 18-46-0 or 17-50-0 per manzana. Place the fertilizer in specific areas or close to the pockets. *A second fertilization is recommended. The fertilization to be used is urea.	*At planting or 12 days after that, apply 100lbs. / manzana of 18-46-0 or 17-50-0. Place the fertilizer in specific areas or close to the pockets. Do a second fertilization using 200lbs. / manzana of urea.	*Fertilize twice. For the first fertilization, apply 150lbs. of 18-46-0 / manzana either when planting or 12 days after having done so. Place the fertilizer in specific areas or in lines in the furrows. If placed in specific areas, put the fertilizer 20 cms. away from the seedlings. *For the second fertilization, use 150lbs. of urea / manzana. Place the fertilizer in specific areas and do it five weeks after the corn was planted.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
Fertilization (continued)	Valley Land	*For rainfed agriculture, fertilize twice. For the first fertilization, mix 70lbs. of 18-46-0 with 60lbs. of urea / manzana. Apply the fertilizer in lines at the bottom of the furrow when planting. The second fertilization should be done 35 days after planting the seed. For the second fertilization, use 85lbs. or urea / manzana. Place the fertilizer in strips or in special areas where needed. *For irrigated plots, do two fertilizations. For the first fertilization, mix 70lbs. 18-46-0 with 60lbs. of urea, and place the mix in lines at the bottom of the furrow when cultivating. Do the second fertilization, 35 days after planting. For this fertilization, use 100lbs. of urea / manzana.	*At planting or 12 days after that, apply 100lbs. of 18-46-0 or 17-50-0 / manzana. Place the fertilizer in lines at the end of the furrow. A second fertilization is recommended. The fertilizer to be used is urea.	*At planting or 12 days after that, apply 100lbs. of 18-46-0 or 17-50-0 / manzana. Place the fertilizer in lines at the end of the furrow.	Same recommendation as Hillsides.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
5. Soil Pests	Hillsides and Valley Land	*Pests to be controlled: "carapacho", "gusano nochero", "gusano soldado", "gusano alambre". Use 25-30lbs. of Volaton 5% / manzana or 20lbs. of Counter 10-G / manzana. Apply the pesticide when planting, next to the fertilizer.	*Control pests such as the white grubs, "gusano nochero", "gusano soldado" and "gusano alambre". Control these pests when sowing the land. Use Granulated Volaton 5% or Counter 10-G. If you use a plow, place the pesticide when planting the seed. Place the pesticide in lines at the end of the furrow. If you use a stick to sow, place the pesticide in the same pocket where you place the seeds. Use 25-30lbs. of Granulated Volaton 5% / manzana.	*Control pests such as "carapacho", "gusano nochero", "gusano alambre" and others that damage the roots of a newly born plant. Control these pests when sowing the land. Use Granulated Volaton 5% or Counter 10-G. If you use a plow, place the pesticide when planting the seed. Place the pesticide in lines at the end of the furrow. If you use a stick to sow, place the pesticide in the same pocket where you place the seeds. In the case of Granulated Volaton 5% use 25lbs. / manzana. In the case of Counter 10G, use 15lbs. / manzana.	*Control pests such as white grubs, "gusano nochero", "gusano alambre" and "gusano soldado" that damage the roots and leaves of a corn plant. Use Granulated Volaton 5% or Counter 10-G. Place the pesticides next to the fertilizer, at the bottom of the furrow, planting the seed. Place the pesticide in lines at the end of the furrow. In the case of Granulated Volaton 5% use 25-30lbs. / manzana. In the case of Counter 10G, use 15lbs. / manzana.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
6. Weed Control	Hillsides and Valley Land	*Control weeds twice. The first control should take place 10-15 days after germination. The second control should take place 25-30 days after germination.	*Do it manually using a hoe or a machete. Control the weed twice. Do the first control 8-12 days after germination. Do the second control two weeks after the first control. Try to keep your corn field clean of weeds. *If a chemical control is done, apply 2-4D.	*Do it manually using a hoe or a machete. Control the weed twice. Do the first control 10-15 days after germina-tion. Do the second control do it 25-30 days after germination. Try to keep your corn field clean of weeds. *If a chemical control is practiced use Gesaprin 80WP. Use 3.5 lbs. / manzana or 80 gms. / 4 gallon sprayer. This chemical should be used only if a wide leaf crop (e.g., corn) is not planted in the second cropping season of the agricultural cycle.	*Do a minimum of two weed controls. The corn field should be kept clean of weeds during the first five weeks. The first control should be done from 8 to 12 days after germination. The second weed control should be done two weeks after the first one. If your corn field has weeds such as "coyolillo" and "caminadora", do a third weed control.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
7. Foliage Pests	Hillsides	*Examples of pests to be controlled: "cogollero", "falso medidor". If the attack takes place when the corn is less than 20 days old, use either Dipel 16000 or Folidol M-480. The amount to be used of any of these products is 1 cup / 4-gallon sprayer. If the attack takes place when the corn is more than 20 days old, use Granulated Volaton 2.5%. Use 14lbs. / manzana. Apply directly to the bud of the plant.	Control "cogollero", "falso medidor", "gusano soldado" and others. The control of these pests will depend on whether the attack is when the plants have less or more than twenty days of germination. If plants are less than twenty days old, use 1 cup / 4-gallon sprayer of Dipel 16000 or Tamaron L-200. Another option is to use 2 cups / 4-gallon sprayer of Dipterex SP-95. If the plants are more than twenty days old, use 25-30lbs. / manzana of Granulated Volaton 2.5%. Apply Granulated Volaton 2.5% directly on the plants' buds.	*Control "cogollero", "falso medidor", and "gusano soldado". The control of these pests will depend on how bad the attack is and on whether the attack takes place when the plants have less or more than twenty days of germination. If plants are less than twenty days old, 4 cups / 4-gallon sprayer of Dipel 16000 or 2-2.5 cups / 4-gallon sprayer of Folidol M-480. Another opinion is to use 2 cups / 4-gallon sprayer of Dipterex SP-95. If the attack continues after 20 days of germination, use 15lbs. / manzana of Granulated Volaton 2.5%. Apply Granulated Volaton 2.5% directly on the plants' buds.	Control "cogollero", "falso medidor", and other worms. If plants are less than twenty days old, use 1 cup / 4-gallon sprayer of Dipel 16000 or 2 cups/4-gallon sprayer of Dipterex SP-95. If the attack takes place after 20 days of germination, use 25-30lbs. / manzana of Granulated Volaton 2.5%. Apply Granulated Volaton 2.5% directly on the plants' buds.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
8. Prevention and Control of Diseases ("Cenicilla": "Cabeza Loca", etc.)	Hillsides and Valley Land	*Prevent these diseases by disinfecting the seed to be planted. Disinfect the seed with Ridomil. Wet the seed and add one tablespoon of Ridomil per pound of seed (or 2 gms. / kg.). Do this procedure the same day that the seed will be planted.	*Prevent these diseases by disinfecting the seed to be planted. Disinfect the seed with Ridomil. Wet the seed and add one tablespoon of Ridomil per pound of seed. Do this procedure the same day that the seed will be planted.	*Prevent these diseases by disinfecting the seed to be planted. Disinfect the seed with Ridomil. Wet the seed and add one gram of Ridomil per pound of seed. Do this procedure the same day that the seed will be planted.	*Prevent these diseases by disinfecting the seed to be planted. Disinfect the seed with Ridomil. Wet the seed and add one tablespoon of Ridomil per pound of seed. Do this procedure the same day that the seed will be planted.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
9. Drying the Ear Cobs on the Plant.	Hillsides and Valley Land	Turn the cobs upside down in August and September.	Turn the cobs upside down when cultivating beans.	Turn the cobs upside down in September or October in highlands, and in October or November in valleys.	*Turn the cobs upside down when they are very dry.
10.Harvesting	Hillsides and Valley Land	*Harvest the cobs when the grain is totally dry. Thresh the cobs on the farm or at home. Do this manually or mechanically. *When harvesting green cobs do it 85 days after germination.	*In the highlands, harvest your corn 30 days maximum after turning the cobs upside down. Make sure that the corn is totally dry before harvesting it. In the lowlands, harvest the corn in January and February. Make sure that the corn is totally dry before harvesting it.	*Make sure that the corn is totally dry before harvesting it. The separation of the kernels from the cobs can be done in the field or at home. This can be done by hand or mechanically.	*Harvest when corn is dry. Threshing can be done in the field or at home, manually or mechanically.

Production Stage	Location	Ajuterique	El Rosario	San Luis	San Jeronimo
11.Storage	Hillsides and Valley Land	*Make sure that corn is very dry in order to store it. Use drums or metallic silos for storage.	Corn must be totally dry before storing. Corn should be stored in metallic silos or in drums. Consult the extensionists in the agency for more details.	*Corn must be totally dry before storing and free of insects. Corn should be stored in metallic silos or in drums. If this is done, expose the corn to the sun during these days. The silos and drums must be kept tightly closed. To avoid damages to stored corn, add one pill of Photoxin or Gastion/drum. If silos are used, use 1 pill per every 500 lbs. of the silos' storage capacity.	*Corn must be totally dry before storing it. Corn should be stored in metallic silos or in drums.

ANNEX 3

RICE RECOMMENDATIONS 1989

ANNEX No. 3
RICE RECOMMENDATIONS
for
SAN LUIS AND SAN JERONIMO
1989

*1. Land Preparation

Turn over the land 1 month before planting. Use a disk harrow allowing a penetration of 25 cms. which is equivalent to the span of a hand (width between thumb and little finger). Plow the land when the soil is neither too dry nor too wet. Three days before planting, pulverize the soil by doing two crossings.

*2. Seed Selection

Use improved seed varieties: Cica-8 or Yojoa-44. They are resistant to pests and some diseases, and can be sold easily in the market.

*3. Planting Distances

If broadcast planting is done, use 200 pounds of seed per manzana. Try to do an even distribution of your seed in your plot. However, this type of planting makes weed, pest and disease control harder to do.

If plowing, use 130-150 pounds of seed per manzana. Leave 30 to 40 cms. between furrows. Place the seed in a straight line. Do not place the seeds in bunches because you will waste space and obtain lower yields.

If planting with machinery, use 150 pounds of seed per manzana. Keep a distance of 12 to 1[illegible] cms. between furrows.

4. Fertilization

Two fertilizations are needed.

The first fertilization should take place when sowing. Use 150-200 pounds/manzana of 18-46-0 or of 17-50-0. These fertilizers contain a high proportion of Nitrogen and Phosphorus, required soil nutrients. Place the fertilizer in lines at the bottom of the furrow where the seed will be planted.

*The second fertilization should take place between 55 and 60 days after planting. Use 100-150 pounds/manzana of urea. Urea has Nitrogen needed to help rice grow. Place in lines.

*5. Soil Pests

Control the following pests: carapacho and gallina ciega. The control has to be done at the outset of the planting cycle. If in the plots where rice will be cultivated there have been serious attacks of these pests, when applying the fertilizer at the time of planting use one of two products: Granulated Volaton 5% or Counter 10G. You need to use 25-30 lbs./manzana of Granulated Volaton 5% or 11 lbs./manzana of Counter 10G.

*6. Weed Control

Rice must be kept clean of weeds, particularly during the first two months. Weeds compete with rice for water, light, nutrients and space to grow.

Weeds may be controlled in three ways: culturally, manually or chemically. Culturally it would require appropriate land preparation and planting distances. Manually, it would require using a hoe and a machete. Chemically, it would require using mixes of herbicides. The recommended mix is composed of 1 1/2 juice-sized cans of either Herbax or Stam LV-10 and 1 cup of 2-4D. This mix should be diluted in a 4-gallon sprayer full of water. This dosage is equivalent to using per manzana 2 1/2 gallons of Herbax or Stam LV-10 mixed with half a liter of 2-4D.

If chemicals are used, the following instructions must be followed.

Apply the urea five days after using the herbicide; do not apply the herbicide during rainy days as the herbicide will be washed down; apply the mix the same day that was prepared; do not throw left over of the mix in irrigation canals, sources of water or ravines as it contaminates them; wash the pump very well to avoid damaging the crops when using it again.

*7. Foliage Pests

Pests that need to be controlled include: gusano cogollero and falso medidor. However, the intensity of the attack may not require the use of pesticides. To determine whether pesticide use is required, consult the extensionist from MNR.

*8. Disease Control

The most common disease is piricularia. The use of varieties such as Cica-8 and Yojoa-44 will help prevent piricularia. If there is an attack, nevertheless, use Hinosan. You may apply 1 liter of Hinosan per manzana when the plants are between 20 to 60 days old. The frequency with which Hinosan is used will depend on the intensity of the attack. Consult the MNR extensionists for more details.

*9. Harvesting

Rice harvest can be done manually or mechanically. If it is done mechanically, suspend irrigation twenty days before the harvest. Harvest the rice when it is neither too dry not too humid. The best results will be obtained when it has 25% humidity.

ANNEX 4

SOIL CONSERVATION 1989

ANNEX No. 4
SOIL CONSERVATION MEASURES
1989

The "A" frame is a structure in the shape of an A used as an instrument for determining the contour lines on a plot of land along which a farmer is practicing soil conservation, would practice strip cropping or build barriers to erosion.

Minimum plowing is a method of land preparation that emphasizes minimum tillage of the soil. This is especially recommended for sandy soil where even a little tillage of the surface can excessively loosen the soil and render it prone to water erosion.

Green fertilizer is the term used for improving soil fertility by cultivating leguminous crops. These plants extract nitrogen from the air for the manufacture of nitrogenous compounds in their roots. When the legumes are harvested, the roots remain in the soil and the nitrogen becomes available for other crops. In addition, the roots tend to hold the soil together and thereby contribute the reduction of erosion. Further, the entire leguminous crop may be plowed into the soil, thereby providing organic material and help improve soil structure.

Contour drains are trenches along contour on sloping land constructed to interrupt the downhill flow of water and to redirect it to especially constructed downhill drains. The trenches also allow the water to accumulate for some time thereby allowing soil being washed away to gravitate to the bottom where it can be recovered by the farmers.

Live barriers are strips of grass or other types of plants that form a thick vegetative cover of the soil. The strips are planted along contour lines on a plot of land and may be used together with dead barriers (stonewalls, sticks, etc.) or alone to interrupt the downhill flow of water and to trap any soil being carried away by the water.

Dead barriers are narrow strips formed by accumulating stones or wood or both along contour lines on a plot of land to interrupt the downhill flow of water on sloping land.

Contour lines are lines laid out on a plot of land by using usually a Frame A. These lines identify areas that are on the same level and along which barriers can be built to prevent the steep flow of water on slopes thereby reducing the amount of soil that can be washed away or eroded by otherwise uninterrupted flow of water.

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