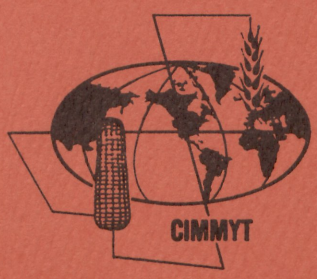
Issues in Organization and Management of Research with a Farming Systems Perspective Aimed at Technology Generation

Proceedings of a Workshop



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Centro Internacional de Mejoramiento de Maíz y Trigo

International Service for National Agricultural Research

The International Maize and Wheat Improvement Center (CIMMYT) is an internationally funded, nonprofit scientific research and training organization. Headquartered in Mexico, CIMMYT is engaged in a worldwide research program for maize, wheat, triticale and barley, with emphasis on food production in developing countries. CIMMYT is one of 13 nonprofit international agricultural research and training centers supported by the Consultative Group for International Agricultural Research (CGIAR).

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing, and operations.

ISNAR is the only center within the CGIAR network which focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on organization, planning, manpower development, staff requirements, financial and infrastructure requirements, and related matters, complementing the activities of other assistance agencies. In addition, ISNAR has active training and information programs which cooperate with national agricultural research programs in developing countries.

ISNAR also plays an active role in assisting these national programs to establish links with both the international agricultural research centers and donors.

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3.3 Concepts and Implementation of Farming Systems Research at CATIE

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Introduction

This paper is intended as a modest contribution by CATIE to the workshop on Issues in Organization and Management Research with a Farming Systems Perspective Aimed at Technology Generation. It describes the experiences of CATIE in production systems research with emphasis on cropping prototypes design, implementation, validation, extrapolation, and strategy for technology transfer. The evolution and development of methodology, and the implications for readjustment of personnel and financing at CATIE are presented.

Methodology development is discussed, with reference to implementation and development of the organization and research management of the Crop Production Department at CATIE.

From 1942 until 1969, research at CATIE was fundamentally oriented by commodity or by discipline, alternating or superimposing the two forms on many occasions. Beginning in 1970, documentation from the Center began to appear. These publications contained information and concepts directed towards multidisciplinary investigation (2,16).

During 1970 and 1971, the Center suffered from severe budgetary restrictions, with its future not clearly defined. This undoubtedly obligated the administration and its scientists at the Center to visualize new directions for future work, even to the extent of considering combining the three departments of Crop Production, Animal Husbandry, and Natural Renewable Resources, in order to develop programs sufficiently capable of attracting external support.

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The focus on systems evolved in a gradual form in the different technical fields. It was initiated in the Department of Tropical Crops and Soils, then, after four years, it was applied in the areas of animal husbandry and natural resources.

Conceptualization and implementation of production systems-oriented research, particularly aimed at resolution of small farmer problems, was a continued process based on experiences as they were acquired. These experiences influenced the management of resources and organization. It is difficult to differentiate phases during the process. However, for this presentation three closely related phases are considered in sequential order.

The first phase in the development of CATIE's systems approach began in 1971 and involved only the Crop Production Department because the conditions did not yet exist for implementing this approach in the areas of animal husbandry and natural renewable resources. In 1973 the Department of Crops and Soils designed and implemented the largest field experiments that had ever been attempted by the Center at Turrialba, or elsewhere: The central experiment and its satellite experiments covered several hectares and combined hundreds of crop and treatment combinations. Simultaneously, the strategy of the Department of Crops and Soils required that all of its scientists and students work and do their research in these giant systems experiments.

The second phase was initiated in 1976 with consolidation and expansion of the concepts and operation in systems and models for small farm production. A number of improved systems were implemented, resident scientists were installed in the different Central American countries, farming systems training was increased, and CATIE's physical presence at the country level was secured. The operation of this phase brought important changes to the Center.
The third phase, initiated in 1981, emphasized

validation and extrapolation of improved production prototypes. The production prototypes were conceived as instruments not only to improve production, but also as units for training, technology transfer, and research.

The evolution of the systems approach of CATIE produced changes, adjustments, and reallocations of finances, human and physical resources, and operational-organizational aspects.

Without doubt, the process of putting into operation the systems approach produced reactions of varying magnitudes among scientists in the Center. Some scientists wanted to maintain the status quo in a way that allowed them to conserve their identity as specialists; other scientists considered it convenient to leave the Center; and yet others promoted the change because they believed the new approach would produce more stability in training and research programs at CATIE.

Technical and Institutional Dynamic: Transition from Disciplinary Research to Complex Systems Research

In 1970, CATIE's staff members initiated discussions about the idea of a research approach which could directly benefit the small farmer. In 1973, the Center at Turrialba designed and implemented a five-hectare central experiment comprising various alternative production systems (11,20). This complex experiment was designed on the basis of soil-use gradients dictated partially by the type of crops, permanency of the cropping systems (alone, associated, or in rotation) and technological gradients of cultural practices. Of the 216 cropping configurations, arranged in 54 cropping patterns, some produced interesting alternatives.

During subsequent years until 1977, the central experiment was maintained with several readjustments (13).

The central experiment generated various satellite experiments that were developed to enhance understanding of certain production factors or to increase coverage of inferences derived from the main experiment in which some factors were confounded. Most of the experiments were conducted as thesis studies by postgraduate students in the UCR/CATIE Graduate School. Important characteristics of this stage follow:

Focus change

It appears absolutely necessary, in this initial phase of systems research, to establish the relation between the concepts of systems, partially represented in the central experiment, and the classical concepts of agronomic experiments (at that time practiced by all of the CATIE investigators). Many interesting changes were originated by the central experiment, for example, the large plots constituted production complexes where innumerable interactions occurred and consequently required the combined attention of multidisciplinary research staff (13).

This mixture, where general principles of classic experimentation are partially maintained and at the same time several new elements are incorporated, produced a positive general balance. This strategy partially facilitated the acceptance of the concept by a respectable number of investigators who were usually accustomed to conducting specific experiments related to their field of specialty.

Human resource adjustment

Complex experiments of great coverage demanded the joint attention of interdisciplinary specialists. The Department of Tropical Crops and Soils implemented, as an operative strategy, the participation of all staff, students, and collaborators in the central experiment. The fundamental decision was made that disciplinary efforts would not be developed independently of the complex experiment. As expected, varying reactions were soon manifested to the multidisciplinary and complementary efforts that the department demanded for adequately conducting the complex central experiment. Some investigators preferred to resign because they believed that their specialty contribution would be lost in the complex of activities, negating the possibility that they as individuals would receive recognition from the common effort leading to a mutual final product. In contrast, other scientists rapidly assimilated the concepts of the systems approach, evaluated its implications and decided to continue participating in the operation of the central experiment; they accepted the risk that their identities as specialists would be diluted within the complexity of the multidisciplinary team action. A third group of colleagues left CATIE for reasons entirely unrelated to the new circumstances and focus on systems research. In any event, there was a notable turnover of personnel. Those who formed part of the systems team developed a zealous, quasi-mystic conception of their work and a firm conviction that the systems focus for agricultural research unites the researchers as professionals with the producers, who are the users of agricultural technology.

Physical and financial resources change

From the beginning it was evident that the resources

demanded by an experiment of this nature were considerable. However, comparing the cost in physical resources necessary to realize independent experiments with those utilized in the central experiment demonstrated that a substantial economy exists in the central complex experiment and its satellites. The experimental complex requires less space, less investment, less cost, and can be managed more directly and efficiently.

Organizational implications

It is obvious that a research and training institution in the process of transition from one mode of organization to another suffers from reverses of opinions and interpretations of various kinds. Some classified the new focus and strategy of systems research (3) as the end of serious research in CATIE and considered it as the beginning of a new stage in extension work, one of luxury, but one less related to the generation of new knowledge of the technical problems and scientific problems that affect agricultural production and productivity. On the other hand, the change attracted the blessings of many who considered that this type of research would put appropriate technology in the hands of producers with greater rapidity and efficiency.

Systems and prototype building

The second phase was characterized by the development of production systems designs based on surveys conducted at the producer level (12,15). Systems considered more typical and more frequent were improved in various technical aspects and offered as alternatives to the farmers who put to trial the performance and adaptability of the system. The most important characteristics of this stage were

Focus adjustment. It was relatively easier for the professional team of CATIE to pass from the central complex experiment conducted at the experiment station in the Turrialba Center to a larger scale and new mode of experimentation, developed on producers' farms. The evolution in the crop production systems research concept at CATIE coincided partially with the designing and implementation of dairy production systems for small farmers and the agroforestry systems that were consolidated, and these encountered greater unity of criteria for their application among CATIE researchers.

Human resources change. The evolution of complex experimental concepts to more specific or typical production systems designed in producers' farms did not encounter major difficulties, and moreover, attracted the attention and interest of the scientists towards the new type of investigation. On the other hand, new high-level professionals hired by CATIE found themselves forced to work specifically with this new line of activities of the Center, facilitating the "internationalization" of the approach.

The great quantity of personnel working within this focus dominated, in number and volume of operation, all other actions that have not yet been incorporated into the new concepts and systems technologies developed by the Center and applied throughout the Central American region.

Physical and financial resource implications. Due to geographic expansion of activities carried out in various locations of the six countries of the Isthmus, physical and financial resources have increased substantially. This type of activity requires significant physical, human, and operative resources. However, for the coverage and inferences that can be derived from this investigative model, it is very probable that its cost is lower than that of classical research conducted at experiment stations.

Organizational implications. By nature, this research activity has generated close associations between CATIE and national research organizations, even though initially it was difficult to consolidate institutional criteria and the research focus. However, this was accomplished because CATIE's concern for developing technology that brought researchers, extension workers, and producers close together was well received.

On-farm production prototype validation and extrapolation

The third phase of the systems research approach in CATIE is still being carried out, with emphasis on validation of systems investigated in the second phase and incorporation of adjustments to make the production prototypes more efficient (10). At the same time, activities were initiated in production systems extrapolation based on analysis of determinant and conditional factors that affect the productivity of the systems (among others, physical factors, management factors and socioeconomic aspects related to the system).

Model farms or improved prototype production farms also served as instruments for training and technology transfer. The main characteristics of this phase follow:

Focus refinement. There has not been a change in focus per se, rather, there has been a continuing process where emphasis has been placed on validation of the prototypes already tested at some level and scale (10).

Human resources change. This aspect merits more detailed analysis because during this phase some key elements were incorporated into the crop production team. Their specialties are more closely identified with technology transfer and with research. However, the systems researchers remained in the department and complemented the labor of the economists, extension workers, and biophysical researchers.

This phenomenon was also observed with validation of the dairy production prototypes throughout the Central American countries. The agroforestry systems followed a slightly different path but used similar concepts and implementation at the country level (4,5,6).

Physical and financial resource change. There were no important physical and financial resource changes required for this type of investigation. Concepts mentioned in the previous phase were still valid at this level (20).

Organizational implications. One of the most interesting aspects derived from the prototype validation and extrapolation activities was the decision by CATIE to implement a program of training in development and transfer of agricultural technology (7).

The plan does not intend to create a department of strategy for technology transfer per se, but a program solidly articulated with the departments of Animal Husbandry, Crop Production, and Natural Renewable Resources. This implies that the reseachers of the program (specialists in farm management, sociology, and economics) will conduct their functions while assigned to the technical departments. The idea of placing these professors-researchers in these departments facilitated association with and training of students in systems-oriented work, including research, validation and technology transfer.

This type of program tends to produce a prototype professional with knowledge and expertise in the elaboration of technologies and strategies for rural community development. These researchers are knowledgeable about the farmers, their traditions, needs, attitudes, and aptitude for changing.

Graduate students conduct thesis research in their disciplines, within their technical department, but on themes that give continuity to the process of generation, transfer, and adoption of the technologies.

General Remarks on Development and Implementation of the Systems Technology

Pressure and demand generated by systems research implementation

At the beginning, research and training activities were carried out primarily at CATIE's base in Turrialba. The new orientation of the crop production research forces changes in research strategies, training, and technical cooperation. These changes occurred slowly during the process of methodological development and were in response to continual and cumulative experiences.

Research. Research orientation became clearer during the process. Initially, a separation between disciplinary research and the recently integrated orientation was created; however, little by little the necessity of complementary scientific research support on specific subjects was understood. This understanding helped improve harmony within the disciplinary groups. The existence of professionals in charge of specific research and support permits a research group in a specific area to remain small and flexible.

With the extension of the work area to the countries of the region, research at Turrialba, basically on physical and biological aspects of cropping systems, was enlarged to incorporate socioeconomic aspects. This extended the external projection, particularly of the Crop Production Department, to other countries, primarily in technological development work, and thus resulted in on-farm research with the participation of the farmers. The integration and use of national investigative resources through the use of concentrated action modules was sought.

In response to the complexity of validating experimental results, researchers oriented their activities in investigation by ecological areas, aiming to improve the transfer-adoption possibilities of those results. This has permitted progress in research to develop a methodology for extrapolation of the cropping systems alternatives.

The methodological development shifted its emphasis at different stages, depending on logical learning processes and the experience of the technical group. During the first years, much emphasis was placed on area characterization, diagnosis, field trials, and evaluation. Later, criteria for work area selections were developed and attempts were made to improve design capability. In the last years, the design stage was clarified, with the connection between diagnosis and field trials being firmed up. Finally, the stage of validation and technology transfer was developed.

This has permitted a demonstration of the advantages of the methodology, including the advantages of a close relation between farmers, extension workers, and researchers.

The methodological development tends to find adequate mechanisms to increase the validity of the research results in specific sites through extrapolation. Moreover, it seeks to arrive at the transfer of the validation and transfer stage results.

Training. Postgraduate and short courses training programs at CATIE were varied in content in accordance with the experience and results that were obtained in the development of the research methodology.

When CATIE was founded, the graduate school continued its activities through an agreement with the University of Costa Rica. Although the academic responsibility is the University's, production systems-oriented courses have been incorporated into the curriculum, that is, Agroecosystems, Cropping Systems, etc. In these courses, information obtained by the department is used in discussion topics. Most postgraduate student theses are conducted within the guidelines of the departmental research program, thus familiarizing the student with department orientation.

Short-course training was conducted at Turrialba and was primarily characterized by the teaching of courses focusing on concepts. As the department developed a research methodology, the content of the course on conceptual ideas was varied to include demonstrations and case studies. Later the short courses were taken to the countries of the region, thus expanding coverage. Short courses cycles have been organized to follow the phases of research methodology and technology development. They cover the principal concepts discussed in an intensive short course of 14 weeks taught in Turrialba. The same course is offered in the other countries by methodological stages following the training approach of learning by doing. In these countries, the phases of the course are separated by periods in which the trainees realize and develop the corresponding work. In the following stage, progress made in the application of the methodological concepts is evaluated and discussed prior to continuing with the next phase. The total training time requires approximately one and one-half year.

Technical cooperation. The technical assistance by discipline and by commodity previously used by CATIE has been changed completely to cover the new demand generated by systems technology implanted at country level. The technical cooperation offered by the Center, in general, responds to the need generated by the systems research implantation at the country level. The areas of cooperation in systems technology go from concept, design, and layout, to implementation, testing, training, etc. On the other hand, the mode of cooperation goes from the indirect and weak contact to direct participation and sharing of responsibility.

Institutional aspects

Operational structure. Initially, CATIE maintained its departmental organization. Later it created programs and finally returned to the departmental structure. During the first years when the department of crops and soil extended its work to the countries, resident scientists for each country and a technical coordinator were appointed. This team of resident scientists was mainly in charge of the execution of the work plans and was directly responsible to the department head of CATIE. In the following years, with the creation of programs (previously departments), three subdivisions were formed: research, training, and administration. The program was known as the Annual Crops Program. Each project has a technical coordinator and the residents were maintained in the countries. Finally, with the return to departments (Crop Production Department), country residents and project coordinators were maintained.

During the last period, good logistic support was sought from the IICA offices in the countries. The Crop Production Department is being subdivided into programs and projects due to budgeting reasons. The structure is now in its last phase of evolution and indications are that it will be appropriate for the departmental research focus.

Interorganizational cooperation. Financial and technical cooperation agreements to strengthen crop production systems research include universities of countries outside of the area, principally the United States, and technical international financing organizations. CATIE was able to continue with the conceptualization and experience obtained through signing of an agreement with the Regional Office for Central America and Panama of USAID (ROCAP). Later agreements, oriented towards cropping systems research were signed with IDRC of Canada; later and with similar orientation, agreements were signed with the European Economic Community (EEC), the International Fund for Agricultural Development (IFAD), the German Agency for Cooperation (GTZ), and others on specific aspects. All of these agreements have considerably strengthened the systems research at CATIE.

Financial resources. Financial resources during the first years were from regular sources. Resources

from external agreements and contracts were rather limited. Thus, until 1977 funds of regular resources of the Center were very important, while those funds from external agreements were not important. In 1978, funds from regular resources of the Center increased about 3.7 times those of 1977 while the project increased 5.3 times. In 1980 funds from regular resources passed 6.8 times those of 1970 and those of projects were 15.7 times more. This accelerated growth in funding precipitated difficulties in management, resulting in financial disequilibrium and an elevated deficit. Since 1981 financial resource management was reorganized and regulated, leading to normalization and stabilization of Center activities.

Human resources. For various reasons, professional personnel paid with regular funds increased at different rates at Turrialba in comparison to in-country staff. This created some disproportion with regular personnel at some points during the methodology development.

In Crop Production Systems, CATIE maintains some multidisciplinary teams in selective areas of Central America. These basic teams are composed of professionals in production, plan protection and agricultural economics. They are responsible for the implementation of cropping systems prototypes and for production of technologies in their respective areas. They are trained and supervised in the use of methodology, as well as motivated to channel the support available in CATIE and other institutions that attend the area to benefit agriculture. In particular, they are encouraged to seek the support of the agricultural extensionists, demonstrating use of developed innovations to increase their area coverage, particularly in the validation and transfer phase. This implies that the team can increase temporarily the personnel in particular disciplines as needed and practicable. The basic group is responsible for work continuity but must maintain a minimum size, three in the case of cropping systems work with a farm perspective.

Since 1982, these teams have been used to study training needs, support, and supervision; also for demonstrating and training other scientists at the national institution level, including university students. Various additional multidisciplinary teams have been established in the different countries of the Isthmus.

Maintenance of effective working teams in the areas requires not only adequate logistical support, but also permanent motivation. Strict supervision appears to be necessary in the first stage, primarily to detect training needs until the teams can discover their own needs and request support. Supervision after this initial stage takes on more of a character of bridging connections with other groups and institutions, contributing to the team motivation.

To maintain connections between these multidisciplinary teams that receive support from CATIE in the different countries, the institutions dispose of the following elements of structure and organization: (a) resident agronomists in the country; generally interacting with some national institution in fieldwork involving the multidisciplinary teams stationed in the different parts of the country; (b) external project coordinator: a scientist who travels continually between the Turrialba base and each country, and between countries. Both elements permit the maintenance of adequate contact and communication between the Crop Production of CATIE, the residents, national institutions, and the multidisciplinary teams that need to be supported. The same elements permit a synchronization of requests and answers for support between the teams, the national institutions and CATIE. This support can be in terms of methods or it may involve support of research, training, or technical scientific services based on available resources or those which can channel the national institutions and CATIE.

To maintain motivation and work between multidisciplinary teams at the area level, CATIE is promoting the formation of a network for scientists interested in practicing the methodology of research and technology development oriented towards systems. This network will permit another type of connection between teams, permitting an exchange of experience and results as well as a professional projection of the members. Part of the members of this network will constitute a work group selected by CATIE for consulting related to the institutionalization and development of methodology at the country level; and also for specialized work that may be necessary in the countries.

Final Remarks

In the first stage, as a consequence of the process, a series of restrictions due to necessary institutional changes has emerged. Solutions were elaborated as the restrictions became perceptible. The principal restrictions were at the beginning necessary logistic changes that accompanied the new organization made it necessary to restructure installations and improve fund management mechanisms. It became necessary to produce a methodological process that helps researchers in application of conceptual criteria developed in this stage.

In this phase, serious difficulties were encountered with the acceptance of the new focus by research

institutions in the countries. There was a marked lack of interest for the acceptance of the new approach, and a strong tendency toward the classic orientation of research by discipline or commodity.

In the middle of the second phase, the marked increase in external resources, with a consequent personnel increase at the Turrialba base and in the countries, created a marked disequilibrium between the large number of special project personnel in comparison with permanent base personnel, a situation that could jeopardize CATIE's identity if it complied with all of the acquired obligations. Fund management procedures were severely complicated to the point of creating a situation of great tension due to the administrative infrastructure not being adequately prepared to manage the accelerated growth of resources coming from external financing.

At the beginning of the third stage, the marked austerity was a restrictive aspect, principally in basic resources due to the difficult financial situation of the Center. The mobility of experienced technical personnel with the multidisciplinary research focus is also noted. However, at the end of 1982 this situation came back to normality. The present technical, financial, and operational situation of CATIE is very healthy and is approaching great stability and normality.

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Brief Description of CATIE

The Tropical Agricultural Research and Training Center, CATIE, was founded June 1, 1973, by the terms of a contract signed between the Inter-American Institute for Cooperation on Agriculture, IICA and the Government of Costa Rica. It is a nonprofit civil association, scientific and educational in nature, established to promote and stimulate research and technical cooperation in animal, crop, and forestry production, to provide alternatives to meet the needs of the American tropics, especially in the countries of the Central American Isthmus and the Antilles.

CATIE's origin, however, goes back to the creation of IICA itself, when the Training and Research Center was established at Turrialba in 1942. Since its constitution, the Center has been strengthened by the following member countries: Panama, Nicaragua, Honduras, Guatemala, and the Dominican Republic.

The Center is located in the Turrialba valley, in the Atlantic watershed of Costa Rica at an elevation of 625 m above sea level, in a tropical area classified as moist premontane. The average annual rainfall is 2,600 mm, with February through April being the months having less rain generally. The average annual temperature is 22.5°C (72.0°F). The Center has 950 ha of land, and is located at a distance of 5 km from the city of Turrialba. It also has a 100 ha cocoa farm, known as La Lola, near Port Limon.

The main objectives of the Center are (1) to conduct research for generating technology that will solve the agricultural problems of the tropical areas of Central America and the Caribbean, to benefit mainly small-scale farmers; (2) to train professionals from Latin America and the Caribbean at different academic levels, in order to provide specialists required by the countries to strengthen their national institutions and their agricultural development programs; and (3) to provide technical cooperation services to the countries, especially those of Central America and the Caribbean, working with them to strengthen their national institutions and to assist them in executing their agricultural research, training, and development programs.

Three research departments (Crop Production, Animal Husbandry, and Natural Renewable Resources) and one support department (Development of Resources for Research and Training) allow the present outreach work of CATIE.

The priority for CATIE's orientation and focus on the small farm sector of the region was identified by the member countries in 1973 (3).

CATIE operates with a staff of professionals in different fields of agriculture (half of them expatriates). A good proportion of the budget is accounted for by specific agreements and projects financed by USAID, DDA, EEC, IBM, IDB, IDRC, IFAD, GTZ, ODA, UNU, Kellogg Foundation, and the Government of The Netherlands. IICA and the member governments provide the core budget.

At its headquarters in Turrialba, CATIE houses the oldest graduate school and one of the principal libraries in agriculture for Latin America.

CATIE develops most of its activities out of Turrialba at the country level and in strict interaction with the different national institutes.