AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

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BATCH 47

1. SUBJECT CLASSIFICATION

A. PRIMARY
Food production and nutrition — AC00-0000-0000

B. SECONDARY
Education,extension,and advisory work

2. TITLE AND SUBTITLE
Regional agricultural production programs,training and design strategies

3. AUTHOR(S)
Swanson,B.E.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1976	30p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
MUCIA

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(In Program of advanced studies in institution building and technical assistance methodology. Publication)

9. ABSTRACT

A description of certain real-world problems of institution building as an instrument of social and economic development, and of some practical responses to them. Case material is presented concerning the training of research and extension workers in an internationa agricultural research center. The relations between training and results are then examined. The two successful pilot projects analyzed in this paper provide certain lessons regarding how to design and implement regional production programs. First, both cases demonstrate that well-designed pilot projects can be used as an important tool in pressing for institutional change within established research and extension agencies. Second, technology development and dissemination functions in project design must be closely integrated. Third, pilot projects must go beyond the traditional roles of research and extension organizations; regional production teams must become active advocates and proponents for small farmers and peasants. Fourth, interdisciplinary teams of research and technical assistance specialists must be trained so that they can move into new regions and establish new production programs. National programs attempting to adopt this approach must recognize that the technical, as well as social, economic, and political factors in each country are different, and that regional agricultural production programs must be carefully designed to accommodate these differences. After a workable strategy has been developed on a pilot scale, the project can then be used as a training mechanism to prepare regional agricultural production teams and village-level extension agents for programs in other parts of the country.

10. CONTROL NUMBER
PN-AAC-934

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Application	Personnel development
CIMMYT	Project planning
IRRI	Regional planning
National level	Research
	Technology transfer

13. PROJECT NUMBER

14. CONTRACT NUMBER
CSD-2958 211(d)

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

Burton E. Swanson

REGIONAL AGRICULTURAL PRODUCTION PROGRAMS

Training and Design Strategies

PASITAM
PROGRAM OF ADVANCED STUDIES IN INSTITUTION BUILDING AND TECHNICAL ASSISTANCE METHODOLOGY

Regional Agricultural Production Programs

Training and Design Strategies

A PASITAM Design Study

By Burton E. Swanson

International Development Research Center
William J. Siffin, Director
1005 East 10th Street
Indiana University
Bloomington, Indiana

This publication was financed by a grant from MUCIA's Program for Advanced Study in Institution Building and Technical Assistance Methodology, which is funded by a 211(d) grant from USAID. Contractors undertaking projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official AID position or policy.

ISBN 0-89249-014-4
Printed in the United States of America
1976

Swanson, Burton E
Regional agricultural production programs.

(A Pasitam design study)
Bibliography: p.
1. Agricultural extension work—Study and teaching. 2. Agricultural research —Study and teaching. 3. Agriculture and state. I. Title. II. Title: Agricultural production programs. III. Series: Pasitam. A Pasitam design study.
S544.S9 630'.7'1 76-13188
ISBN 0-89249-014-4

Preface

The merit of this study is not indicated by its length. In an age where paragraphs of knowledge are packaged into articles, and articles blown into books, short informative statements have a special merit. This is such a statement.

It is a palpable portrait of certain real-world problems of institution building as an instrument of social and economic development, and of some practical responses to them. Swanson presents case material about the training of research and extension workers in an international agricultural research center. He then examines key relationships between training and results—between the preparation of persons for developmental roles and eventual action in the field. His findings offer lessons for the design of certain kinds of agricultural production programs, and for using training as one tool in such design.

The study is informed by the author's own experience as a training officer, and by his extensive analysis of the program strategies of such organizations as the International Maize and Wheat Improvement Center and the International Rice Research Institute.

William J. Siffin
Director
PASITAM

INTRODUCTION

International agricultural research centers, such as the International Rice Research Institute (IRRI) in the Philippines and the International Maize and Wheat Improvement Center (CIMMYT) in Mexico, have made important contributions to increased food production in the tropics and subtropics by assisting national programs to develop and utilize new, improved agricultural technology.[1] An essential aspect of this technology transfer process is building national research capacity.[2] To help national programs build this research capacity, both IRRI and CIMMYT developed research training programs which have had a significant influence on the behavior of returning research workers and national research capacity.[3]

This paper will focus on the problem of training research and extension workers who are responsible for developing and extending to farmers locally adapted, improved crop production technology. International centers can play an important role in helping to carry out this training function. However, in order to prepare the large numbers of research and extension personnel needed at the local level, training programs and strategies must be devised to achieve a multiplier effect within each national program.

Another aspect of the training problem, which must be given fuller consideration by international centers, is the need to move beyond the obvious objective of imparting new technical and communication skills to trainees and begin to concentrate on institutional change. Research and extension workers may receive well-organized and appropriate skill training; but unless they are then assigned to a work situation where they can effectively utilize their new skills, international training programs can result in minimal impact on the productivity of national agricultural programs and personnel. To examine how international centers might accomplish these institution-building objectives, the experiences of the IRRI rice production training program and the Puebla Project (initiated as a joint project

of the Graduate College of Agriculture, Chapingo, Mexico and CIMMYT) will be described and analyzed.

THE IRRI RICE PRODUCTION TRAINING PROGRAM

Background

The IRRI rice production training program was established in 1964 as a response to the growing need for competent rice extension specialists who could (1) diagnose serious rice problems; (2) grow a rice crop using the high yielding rice technology being developed by IRRI; and (3) communicate these skills, methods, and techniques to rice producers through efficient extension methods. Demand for the well-trained rice extension workers who graduated from this program soon outstripped IRRI's training capacity and resources. Therefore, in 1966 IRRI shifted the focus of their training program to one of "training trainers." The program continued to emphasize practical training in rice production skills, but was designed to train selected extension personnel who could return home and establish practical training programs for their own rice extension specialists.[4] The aim was to create a multiplier effect within each national program whereby large numbers of field level extension personnel could be trained to use and demonstrate the new, improved rice technology.

The Training Approach

The rice production training program is a six-month course conducted yearly during the wet rice-growing season which begins in early June. The behavioral objectives of the present program, in addition to the three original objectives mentioned above, are that trainees will be able to conduct applied research trials to modify the modern rice technology (package of practices) to fit local growing conditions in their home countries and/or regions; and that they will be able to organize and teach in-service rice production training programs for extension personnel in their home country programs.

To achieve these objectives, trainees spend about one-half of their time in the classroom gaining up-to-date knowledge about modern rice production in the tropics. The other half is spent in the field applying this knowledge, acquiring new skills in rice production, and communicating this technical information. One outstanding feature of the training methodology is the careful integration of classroom instruction and field practice. Classroom instruction is directly relevant to the problems faced in the field.

Another feature is the overall efficiency of the program. The entire course is completely organized before the trainees arrive (i.e., lectures, field practice, field trips, etc. are scheduled); each hour is accounted for in terms of the person(s) responsible and the behavioral objectives to be achieved. In addition, most technical lectures, field practice exercises, etc. are reproduced and made available so each trainee has a rice production training manual and a complete set of technical lecture notes to refer to both during the training program and after returning home.

Participants also receive instruction in planning, organizing, and conducting short-term rice production training programs. Again, classroom instruction is closely integrated with practical experience so that trainees are responsible for actually planning and conducting a two-week short course for Filipino extension agents.

A Tentative Analysis of the "Train the Trainer" Approach

In a recent follow-up study of former IRRI rice production trainees,[5] the "train the trainer" objective was evaluated. A survey conducted in 1973 indicated that only 19 respondents (12.8%) were assigned and working as rice production trainers in their home countries. On the other hand, two thirds of the respondents indicated that they had participated in one or more organized rice production training programs since returning home. In most cases, however, these training activities were in addition to their regular job assignments.

One of the key training techniques emphasized by IRRI is the use of growth-stage plots (staggered plantings) for short-term training courses. This approach allows each trainee to become experienced with all field practices associated with growing a rice crop. The success of this approach requires careful organization, adequate land and training materials, and the continuing, full-time involvement of competent rice production trainers. Based on my observations in the field (1972) and Donald Green's study of Indian returnees (1970), it appears that many of these ad hoc rice production short courses are not being organized around this key "learn by doing" approach. Where training courses are only an adjunct part of an extension worker's overall program, it is less likely that such a technique can be successfully implemented. The tendency is to rely heavily on lectures, information giving, and a few practical demonstrations. In these cases, second generation trainees are leaving the training pro-

gram without the full experience of carrying out the practices necessary to grow a rice crop with improved rice technology.

IRRI's training officer has appraised the "train the trainer" concept and its success in creating a multiplier effect within national programs:

> . . . we are not getting the multiplier effect from our trainees that we desire or hoped for. . . . It is hard to get a country involved in development activities without a strong leadership that is desirous of making change. . . . A number of our graduates (production) are promoted and fill important positions, but we wonder sometimes why we call our training a "train the trainer" program. This is no fault of the graduates, but is another indication of the low esteem in which training is held by agricultural leadership in developing countries.[6]

The Transition to the "Masagana 99" Rice Production Program

The IRRI rice production training program had a major impact on the technical skills of individual extension workers, but it had less impact on influencing extension organizations to fully utilize these trained specialists. In the Philippines, for example, Castro reported that administrative factors such as limited program funds, the indifference of superiors and co-workers, the poor climate for professional development, and low salaries were some of the main reasons why trained rice production specialists were not utilized more effectively after returning home. His recommendation was clear: "All indications of this study point to one thing—the need for a strong, well organized plan or program to utilize effectively people trained to carry out new roles within the home organization."[7] "Masagana 99"[8] was such a program.

Beginning in 1971, the Rice Production Training Office at IRRI, in cooperation with the National Food and Agriculture Council of the Philippines, conducted extensive applied research trials in two provinces in Central Luzon (Bulacan and Nueva Ecija) as part of a project in Rainfed and Upland Rice Production (RURP). These trials were part of a three-year pilot project aimed at developing improved technology for small farmers who were growing rice under rainfed and upland conditions. Until 1971 the high yielding dwarf rice varieties had been bred for use under irrigated conditions and had never been systematically tested in rainfed and upland areas.

During the first growing season, 150 applied research trials were established in the project area. Results were so promising that the pilot extension phase of the project was started the second year—two years earlier than originally planned. In spite of a devastating flood

in 1972 which was followed by an extended drought and a heavy infestation of the virus disease "tungro," participating farmers recorded impressive yields.[9]

The next step was to bring these production successes to the attention of policymakers in the Department of Agriculture. After a persuasive campaign to obtain the support of government leaders, in 1973 the Department of Agriculture decided to take on Masagana 99 as a national production campaign. Based on the earlier experiences of former rice production trainees[10] and observations made during the pilot extension phase of the RURP project, key administrative and institutional constraints were identified: (1) inadequate rice production competence of the (extension) technicians; (2) incommensurate salaries in relation to the professional training and responsibilities of the technicians; (3) inadequate transport facilities to keep technicians mobile on the project site; (4) rigid and stringent lending requirements of credit institutions leading to the failure of most producers to apply the right kind and quantity of production inputs; and (5) lack of a locally tested package of technology applicable for rainfed growing conditions.[11]

The IRRI Rice Production Team, having identified the major bottlenecks to the successful implementation of a rice production campaign, worked closely with government officials and university research workers in overcoming these obstacles. In 1973 IRRI trained 680 extension workers in ten two-week short courses. The University of the Philippines trained another 214 extension workers in similar two-week short courses. In addition, approximately 1,200 additional extension workers received a three-day "crash course" from extension specialists who had worked in the pilot project.[12]

To alleviate the transportation problem faced by extension agents, the government bought over 1,000 motorcycles which extension workers were able to buy at cost on easy credit terms. The field extension workers were now both trained and mobile, two of the most critical limiting factors to the dissemination of improved rice technology.

The improved production technology or "package of practices" for the national Masagana 99 Program was worked out jointly by research scientists and technicians from the University of the Philippines, the Department of Agriculture, and IRRI. The resulting technological package included recommendations on the best available varieties, as well as the appropriate use of fertilizers, insecticides, and herbicides.

Capital inputs had generally been out of reach for most small farmers because of their inability to obtain credit. Given the production potentials offered by the improved production recommendations and the political support of the government, resulting in government-guaranteed production loans, banks were persuaded to streamline procedures to make credit available to as many small farmers as possible. Peter Kann of the *Wall Street Journal* reported that during the 1974 growing season, more than 650,000 small farmers signed up for the program and that the Philippines' national and rural banks loaned them about 600 million pesos.[13]

Results of this massive government campaign were impressive. "In 1973-74, the Philippines achieved the highest annual rice production in their history—a 28 percent increase over 1972."[14] In addition, prospects for the future appear bright. IRRI's rice production team has already tested and is in the process of implementing a new technological innovation for rainfed areas called the "sabog-tanim" or direct seeding scheme.

Traditionally, farmers in rainfed areas of Central Luzon waited until there was sufficient rainfall to puddle their fields before transplanting rice seedlings. This procedure frequently resulted in the crop being grown under conditions of decreasing rainfall and to some extent accounted for the low yields in these areas—particularly in years when the rainy season was of short duration. The direct seeding innovation involves the planting of rice seed into dry or moist soil in mid-April to take advantage of the main rainy season which begins in May and peaks in July. Thus, a farmer using the new short season varieties is able to harvest his main rice crop in early August before the flood and typhoon season. In addition, he can plant and harvest a second crop per year—either a second crop of rice (on heavy soils) or a short-season and more drought resistant crop such as sorghum (on lighter soils)—depending on soil conditions and early rainfall patterns.

PUEBLA PROJECT TRAINING PROGRAM

Background

The Puebla Project in Mexico was initially established as a regional pilot project experiment to test an alternative strategy of obtaining rapid increases in the yield of a basic food crop—in this case maize—among small farmers producing at subsistence levels with traditional methods.[15] The state of Puebla, the project area selected for the experiment, covers about 116,800 hectares (ha) of cultivated land with

about 80,000 ha used for maize production.[16] The average farm size in the project area is about 2.7 ha with approximately 90% of the farms having less than 5 ha.[17]

The project team, which was established to develop and disseminate improved maize production technology in the Puebla Project, consisted of five main functional components: (1) agronomic research, (2) varietal improvement of maize, (3) technical assistance to farmers, (4) socio-economic evaluation, and (5) coordination.

Agronomic research serves the regional program by testing the performance of different crop varieties in the area and by developing an appropriate package of production practices given economic considerations for the major ecological zones in the region. "In general, the amount of research required is proportional to the ecological variability in the area."[18]

The major steps in conducting agronomic research are: (1) evaluating the existing technology being used by farmers in the area; (2) generating possible modifications of that technology which might yield substantial production increases; (3) planning and carrying out applied research trials to test these modifications; (4) analyzing data from field trials and expressing the results as response curves; (5) estimating the risk farmers take at different levels of capital investment vis-à-vis climatic variation and price fluctuations; and (6) developing production recommendations for the different ecological zones, at different levels of investment, given production and marketing risks.[19]

Varietal improvement, or the development of high yielding varieties, has been a key component of the Green Revolution technologies in wheat and rice. This research function was included in the original project design because, although two "improved" hybrids were available and being recommended in the Puebla area, only about one percent of the farmers were actually using these materials in 1967.[20] In addition to evaluating the traditional varieties that were available in the project area, two strategies of maize improvement were pursued: (1) the development of cryptic double-cross (S_1 X S_1) hybrids and S_1X double-cross hybrids, and (2) the development of open-pollinated varieties through mass selection.

After seven years of work in maize improvement in the project area, the ". . . program did not meet its goal of developing higher-yielding materials and putting them into commercial production. . . ."[21] The reason for this disappointing result is two-fold. First, the traditional varieties that were available in the project area

had a relatively high yield potential, but this potential had never been exploited because an improved package of practices had never been worked out for these local varieties. Second, the development of improved genetic technology in an open-pollinated crop, such as maize, is more difficult to achieve than in self-pollinated crops like wheat and rice.[22]

Technical assistance to farmers in the Puebla Project went beyond the traditional communication and education functions of the regular extension service. In addition, farmers were directly assisted in obtaining capital inputs and, when necessary, the credit to finance them. One major aspect involved organizing farmers into small groups which became the key institutional mechanism to help small farmers obtain credit from banks and inputs from supply dealers. Leaders who emerged within these groups became the primary communication link to technical assistance agents and serve as the chief representatives of the group when dealing with the credit bank or supply dealer.

The *evaluation* component within the project performed two basic functions. First, the evaluator was responsible for measuring the progress of the project over time in achieving the stated objectives. An initial benchmark survey of the project area was made in 1967 to determine what production practices were being used by farmers and to ascertain average yield levels immediately prior to the start of the project. In 1970 a second survey measured the progress of the project in increasing yield levels and helped identify reasons why farmers were or were not participating in the project.[23]

The evaluator's second major function was to serve as a project troubleshooter by identifying and studying obstacles limiting the success of the project and then collecting necessary information to possibly modify the team's strategy.[24] Because research and technical assistance personnel were usually busy carrying out their day-to-day work activities, they would frequently identify potential problem areas; but they did not have sufficient time to investigate further and to think through possible solutions. The evaluator was responsible for following through on these suppositions; and, after discussions with the project staff, operational strategies were altered accordingly.

The *coordinator* of the project had the most complex and difficult position within the project team and was responsible for several different functions. First, as project director and administrator, he was responsible for decision making on program plans and for the direc-

tion of staff activities. In addition, he was in charge of hiring project staff, setting general policies, and administering project funds.

Second, since the project team consisted of technical research workers, technical assistance (extension) personnel, and the evaluator —a social scientist—the coordinator had to perform the necessary leadership function of integrating team activities and helping to build esprit de corps. In any interdisciplinary team effort, each team member must fully understand the division of labor and how each member contributes to and is responsible for the success of the overall team.

Finally, the coordinator served as the main communication link between the project (both team members and participating farmers) and the political and economic institutions in the community. For example, when the evaluator identified a serious institutional obstacle that was limiting the increased use of the improved technology or participation by farmers, proposed solutions were first discussed by the team and the coordinator would then meet with policy level officials in the appropriate organization(s) to work out an acceptable solution. Furthermore, at the end of each project year, project successes were clearly articulated and demonstrated to key leaders in the political and economic community to insure their continuing and increased support during the next year.

Types of Training

Two different training approaches are being utilized in connection with the Puebla Project: (1) an in-service, on-the-job type of training which involves six to eight months of practical experience in the project area, and (2) a two-year educational degree training program (generally at the Masters degree level). In the latter program, the first year is devoted entirely to course work at the Graduate College of Agriculture at Chapingo, and the second year is spent in the project area where the student researches a specific problem within the ongoing production program and writes his M.S. thesis.

Although the concern in this paper is primarily with the in-service training program, the relationship between these two types of training should be noted. The Puebla Project team believes that professionals who receive both in-service and degree training should begin with in-service training and then work for one or two years in a regional production program before continuing with their academic degree training.[25] There are four reasons for this strategy: (1) after on-the-job training, they can return home to work in an accelerated production program and make an immediate contribution to their

home country program; (2) at the same time, they will be able to practice their newly acquired skills and gain additional confidence in their ability to function effectively in this type of production program; (3) after former trainees gain a few years' work experience in an accelerated production program, they will be able to define their career goals and interests more clearly and will be able to identify relevant, practical problems that can be emphasized during their academic program and thesis research; and (4) perhaps most important, a group of highly trained and committed professionals who can plan and implement similar on-the-job training programs *within their own country* can be systematically built. These individuals would be expected to give competent leadership to well-organized regional production programs. At the same time, this program would serve as a training mechanism within the national program for teams of national research and extension workers from other parts of the country. These second-generation trainees would be expected to plan and implement similar regional production programs in their own areas.

In-Service Training of the Production Team

As mentioned earlier, there are five main functional components within the production program.[26] The number of staff members required for a regional production team is largely dependent on the size of the region being served.[27] Here we are interested only in the training strategy and methodology employed, so each functional area will be considered without reference to the actual number of people that may be required vis-à-vis the production team.

The unique nature of this in-service training program is the simultaneous training of both research and technical assistance specialists as a functional, interdisciplinary production team. The objective of such an approach is not only to accomplish the relevant and necessary practical skill training for each member of the team, but at the same time to train each specialist to work in an interdisciplinary team effort. Part of this training involves learning the different roles and responsibilities of each team member, the relationship between these roles, and how each team member contributes to the project's overall success. Another important aspect involves the building of close informal or personal relationships among team members—relationships that should continue to grow once the team is operating its own regional production program.

The idea of simultaneously training the different members of a production team is essentially to create the necessary critical mass

of trained personnel (who are in agreement on project goals and approach) to actually operate a regional accelerated production program. Programs of this type are often seriously limited or stifled by the lack of key technical specialists or a lack of cooperation between specialists working in different organizations (e.g., between research and extension). Simultaneous training of the various technical manpower components of a production team should eliminate this problem.

The Training Approach

Participants selected for training in the Puebla Project generally have completed at least a B.S. or Ing. Agronomo degree and are expected to be reasonably well trained in the basic aspects of their field of study.[28] The training program builds on this basic theoretical foundation and concentrates on specific skills and knowledge required to function effectively in a regional production program.

In terms of technical skill training, the methodology used is an "on-the-job" training approach. Each trainee works with an experienced specialist from planning in the spring (before the growing season begins) and through the entire crop season until project activities diminish after harvest. At each step, trainees learn how to perform each task until they actually take responsibility for helping carry out each task in the project.[29]

In an aggressive production program like the Puebla Project, trainees must learn how to organize their work in order to most efficiently utilize their time. Working with experienced professionals in an efficient and effective production campaign gives trainees first-hand experience in the skills of program organization and implementation —skills seldom effectively taught in an off-job training program.

One problem exists concerning the essentially negative or paternalistic attitudes that research and extension workers have toward the farmers they are supposed to serve.[30] According to Diaz, most university graduates in Mexico have essentially urban values and go into extension programs only as a last resort. With generally negative values toward rural life, few of these graduates are seriously committed to helping small farmers and continue to look for better jobs in urban areas. For those who do stay in extension work, most concentrate on helping larger, commercial farmers.[31] Therefore, the Puebla Project's training program spends considerable time, in both seminars and informal discussion sessions, attempting to alter the

trainees' attitudes, emphasizing the importance and potential of helping small subsistence farmers in the development process.[32]

Finally, trainees are expected to learn first hand how to work together as members of an interdisciplinary production team. The final report of the Puebla Project stated emphatically: "The primary objective of this training is to prepare technicians to work together as a team in all activities."[33] Interpersonal skills and attitudes are difficult to develop, particularly in formal or off-job training programs. Fostering these skills and attitudes can probably be best achieved by giving trainees the opportunity to observe an experienced production team working in the field and by giving them actual on-the-job experience working as a member of the team.

PROJECT DESIGN AND TRAINING STRATEGIES: AN ANALYSIS

Project Design

Both the rice production team that initiated the Masagana 99 program and the Puebla Project team initiated their programs with extensive on-farm applied research trials which clearly demonstrated the production potentials that could be achieved through an accelerated production campaign. Both programs enlisted the support of political leaders, economic institutions, and government officials to mobilize resources and remove serious obstacles that could retard the spread of improved technology to small farmers. It is important to examine the project teams in both of these successful production programs to better understand the similarities and differences between these two approaches.

The structure and function of the Puebla Project team was carefully and explicitly organized from the outset. There was, however, considerable staff turnover during the seven years of the project. Staff instability in an accelerated production campaign generally would be expected to be dysfunctional. In this case, the organization of the team (division of labor and job responsibilities) had been carefully worked out, project goals were clearly established, and the program strategy of achieving these goals was the product of considerable deliberation, contributing greatly to the project's continuity and effectiveness.

The function of the Rainfed Upland Rice Production (RURP) team was similar to the Puebla Project team, but the organization of the RURP team was less structured. The team leader played a more instrumental role in directing (rather than coordinating) team activ-

ities. Most of the core technical staff of the rice production team had worked together for several years at IRRI in both applied research and training roles. Team members were relatively competent in all areas of rice production; therefore, there was less specialization in the RURP than in the Puebla Project. This characteristic of the RURP team members made possible more flexibility, in terms of moving staff members to different job assignments on a day-to-day or week-to-week basis as the need arose. The RURP functioned well as a project team with no serious role conflicts among team members because (1) the technical team was experienced and competent; (2) there was continuity of leadership through the project; (3) there was considerable staff loyalty to the project director; and (4) the staff had worked together closely in the past (strong informal relationships).

Both projects, however, did have role conflicts with other agencies or institutions. Although the nature of these conflicts differed, one common to both projects concerned the conduct of on-farm applied research trials. In the case of the IRRI rice production program, the conflict was to a large extent over the fact that the team members who conducted the trials were all trained as extension workers. Since this group had never received much support from research scientists in conducting on-farm research trials aimed at developing and testing improved production recommendations, they developed the necessary competence to carry out this task themselves. However, once they started to make production recommendations to farmers based on over 100 replicated research trials per year, and after they began attracting public attention due to their production successes, research organizations and scientists became very concerned. As Cuyno points out, ". . . two research agencies claimed that it should have been they who should have been involved in the applied research activities . . ." rather than the extension service.[34]

In many developing countries, research personnel tend to conduct most of their research in experiment stations and seldom take their research to farmers' fields where recommendations can be fully tested and modified under actual farmer growing conditions. Although research organizations claim that on-farm applied research trials are part of their organizational responsibility, few scientists are interested or trained to do this work; and too few resources are committed to this essential testing activity. However, when extension personnel start conducting applied research trials, they are quickly told that they are completely out-of-bounds in doing "research" work.

Where the research and extension functions of the technology development and dissemination continuum should be integrated is an extremely important policy question. Sterling Wortman touched on this issue at the first Bellagio Conference on Agricultural Research and Development in 1969:

> The major difficulty encountered in the organization of effective research, training and production programs in developing nations is the general lack of appreciation of the scope and depth needed in the research system. That agricultural research must be undertaken at central experiment stations or in the laboratories of national research organizations or colleges of agriculture is well understood; frequently, however, the further steps of identifying and testing packages of technology in each distinct farming region of a nation and finally at the ultimate experimental site—the individual farm—are erroneously excluded. Too often, scientists as well as extension leaders consider that activities leading to adoption by farmers are not the responsibility of the research establishment. Until this erroneous idea is overcome, progress will be slow indeed.[35]

Because trained research workers were an integral part of the project team, this type of organizational role conflict (between research and extension) did not occur in Puebla. However, because the research workers concentrated on applied trials in farmers' fields, they were criticized by their colleagues in the national research organization. In this case, the role conflict revolved around what is expected behavior for a well-trained research scientist. It is hard physical work to conduct a large number of on-farm applied research trials. In addition, the research scientist doing this work has to be knowledgeable about the farmer's traditional technology, capable of growing a good crop under the farmer's conditions, and, perhaps most important, be interested in working with poorly educated peasant farmers. These are skills and attitudes that many research (and extension) workers do not have and instead prefer to stay in their "safe" experiment stations, laboratories, and offices. Practical, "farmer-oriented" research and extension workers can be a direct threat to the credibility of professional agriculturalists who do not have practical skills and/or who are not interested in working to help farmers increase production. Role conflicts of this type may create problems for a regional agricultural production team, but these social/professional barriers must be overcome if research workers and institutions are to develop and test improved production technology that will enable small farmers to increase their productivity and income. Although there may be some question as to where the research and extension functions should be integrated, there is agreement that technology develop-

ment and dissemination functions must be closely linked. In the case of the RURP, extension workers carried out both functions in the initial stages of the pilot project. In the Puebla Project, there was a division of labor; but both research and extension (technical assistance) personnel shared the same offices and communicated on a day-to-day basis. The lack of communication between research and extension organizations and personnel has been a serious obstacle in many agricultural development programs. In both of these successful cases, the closely integrated research and extension functions are important elements in explaining their success.[36] The final report of the Puebla Project emphasized the importance of this integration:

> A key concept within the philosophy of the Project has been that the production and dissemination of information are parts of a development continuum that should not be compartmentalized in program operations. Constant interaction among staff members and feedback of information have been viewed as integral functions of the Project—from planning of research through delivery of findings to farmers and evaluation of results.[37]

One important difference between the two projects concerns the level of success of their pilot regional production programs and the impact on expansion of these programs into other areas. Clearly the Masagana 99 program had a larger, more rapid impact on national production than did the Puebla Project, probably because of the difference in the increased production potentials of the two technologies. In the case of rice, high yielding varieties were available and were well suited to the local rainfed growing conditions in the project area. Extensive, on-farm applied research trials clearly established that a twofold increase in production (over traditional varieties) was a realistic target for upland farmers. With the newly introduced direct seeding innovation and the possibility of two crops per year, the production potential of these rainfed areas was increased even more.

In the case of the Masagana 99 program, the regional pilot project became a national production campaign within two years. This resulted in more generalized production recommendations for large regions, rather than tailoring recommendations more closely to local growing conditions (as was the case in the Puebla Project). Some observers indicate that many of the new resources that became available as part of the Masagana 99 program went to larger farmers who grow rice in the irrigated areas. This outcome, while detracting from the original intent of the program, probably reflects the fact that the Philippines was in a deficit rice production situation after two years

of bad weather and poor harvests, and the government was anxious to rapidly increase total production. Furthermore, the government, acting as the guarantor of bank loans, was concerned with minimizing its own risk. If a substantial share of the new resources went into irrigated areas where annual production was more stable, political decisions were involved; and the outcome should not detract from the usefulness of the RURP project as a model for understanding how to organize regional production programs.

In Puebla, because the "improved" hybrid varieties were no more productive than the traditional varieties, progress was steady but not as dramatic. There was less pressure from the government to rapidly launch a national accelerated maize production program such as Masagana 99; however, there was and continues to be considerable government interest in the Puebla approach. During 1974-75, the Mexican government committed approximately three million dollars to establish a National Center for Research and Training in Rural Development (Centro Nacional de Capacitación) based on the Puebla Project approach. As an outreach program of the Graduate College of Agriculture, the center is using the Puebla Project as a field laboratory where teams of research and extension workers are being trained to initiate new regional production programs elsewhere in Mexico. In addition, at the international level, regional production program teams have already been trained for Colombia, Peru, and Honduras.

Training

The IRRI Rice Production Training Program is a carefully organized, off-job training program designed to train and prepare extension workers for active roles in both developing (modifying) and disseminating improved rice technology. It also prepares extension workers for possible involvement as trainers in national rice production training programs. The experience of the RURP project, which was spearheaded by the IRRI rice production team, demonstrates that properly trained and supported extension workers can successfully implement a regional production program.

Although IRRI has an effective off-job training program to prepare extension specialists to work in these programs, a counterpart training program for agronomic research workers appears to be missing. IRRI has discipline-oriented, research training programs available for agronomists; but an earlier research study[38] suggests that this training approach may be inappropriate for preparing agronomic

research workers for regional production programs. It is better suited for research scientists working in universities or at central research stations and laboratories.

The Puebla Project, on the other hand, provides simultaneous on-the-job training for both research and extension workers within the context of a regional production program. In addition, it prepares other individuals to take on leadership (coordination) and evaluation roles within regional production programs.

Another important training function in production campaigns is the task of quickly upgrading the production skills of village level extension workers. The Puebla Project used para-professionals as an important link between technical assistance (extension) agents and farmers for communication purposes, but no formal training programs were organized for these village level extension personnel to learn maize production skills. Para-professionals did learn these skills through on-the-job training.

The Masagana 99 program, on the other hand, made a significant effort to upgrade the rice production skills of *large numbers* of field level extension workers. But this training was done only after a package of practices had been developed and tested locally, and in the context of regional production programs. It is at this stage that IRRI's "train the trainer" concept appears both logical and necessary. It is well documented that the short-term training program worked out by the IRRI Rice Production Training Office is an efficient approach to imparting basic rice production and diagnostic skills, as well as giving information about the proper use of improved rice technology to large numbers of extension workers.[39] However, attempting such training programs without first having a regional production team in place seems premature. Once such a team has developed an improved production technology for the region, and institutional obstacles (such as the availability of capital inputs and procedures for obtaining credit) have been identified and at least partially resolved, then such short-term training courses fill a specific need in preparing field level extension workers for production campaigns.

CONCLUSION

The two succesful pilot projects described and analyzed in this paper provide certain lessons regarding how to design and implement regional production programs.

First, both cases demonstrate that well-designed pilot projects can be used as an important tool in pressing for institutional change

within established research and extension agencies. The experience of both projects suggests that this process may not be smooth or well received by established agencies. However, if national programs are to be responsive and effective in meeting the technological needs of farmers, such institutional change will probably be necessary.

Second, in terms of project design, both cases suggest that technology development and dissemination functions must be closely integrated. The components and structure of the Puebla Project team appear to be a more useful model to draw from in terms of initiating a pilot project in another country where socio-economic and technological factors are different.

Third, both cases suggest that pilot projects must go beyond the traditional roles of research and extension organizations; regional production teams must become active advocates and proponents for small farmers and peasants. In particular, they must seek out resources from political-economic institutions in the country and then work with them to effectively make these resources available to a relatively unorganized and inarticulate small farmer community. To accomplish this, the project team must be seriously committed to working with small farmers and be confident that they can rapidly increase their agricultural production. In addition, the team must be able to articulate and demonstrate clearly to political and economic leaders that a substantially improved technology of production is available and rapid production increases can be achieved if new resources (capital inputs and credit) are directed to small producers.

Fourth, both cases offer important lessons in the training of research and extension personnel for regional production programs. At the project team level, the Puebla Project offers an apparently effective approach to training an interdisciplinary team of research and technical assistance specialists who can move into new regions and establish new production programs. The IRRI rice production approach appears to be an effective and efficient approach to training large numbers of extension workers who can link the more highly trained project team to large numbers of small farmers.

National programs attempting to adopt this approach must recognize that the technical, as well as social, economic, and political factors in each country are different, and that regional agricultural production programs must be carefully designed to accommodate these differences. These two pilot projects, which developed into successful national crop production programs, offer important lessons which other countries can follow as they design and test an

appropriate regional agricultural production strategy. After a workable strategy has been developed on a pilot scale, the project can then be utilized as a training mechanism to prepare regional agricultural production teams and village level extension agents for programs in other parts of the country.

Notes

1. Dana G. Dalrymple, "Measuring the Green Revolution: The Impact of Research on Wheat ana Rice Production," Foreign Agricultural Economic Report No. 106, Economic Research Service, United States Department of Agriculture in Cooperation with U.S. Agency for International Development (Washington, D.C., July 1975).

2. Vernon W. Ruttan and Yujiro Hayami, "Technology Transfer and Agricultural Development," *Technology and Culture* 14 (April 1973).

3. Burton E. Swanson, "Evaluation of the CIMMYT Wheat Training Program," *Journal of Agronomic Education* 4 (1975): 85-89; idem, "Evaluation of Research Training at IRRI," *Journal of Agronomic Education* 4 (1975): 89-93; idem, *Organizing Agricultural Technology Transfer: The Effects of Alternative Arrangements* (Bloomington, Ind.: International Development Research Center, 1975).

4. Vernon E. Ross, "The Evolution of the IRRI Rice Production Training Program" (Paper presented at the Annual Rice Research Conference, Los Banos, Philippines, April 19-23, 1971).

5. Burton E. Swanson, "Training Agricultural Research and Extension Workers from Less Developed Countries" (Ph.D. diss., University of Wisconsin, 1974).

6. Francis C. Byrnes, "Agricultural Production Training in Developing Countries," in *Strategies for Agricultural Education in Developing Countries* (New York: The Rockefeller Foundation, 1974), p. 7.

7. Diosdado V. Castro, "The Filipino Graduates of the Rice Production Training Program: A Follow-up Study" (M.S. diss., University of the Philippines at Los Banos, 1972), p. 136.

8. "Masagana" means "bountiful harvest," and 99 cavans is the yield target—an equivalent of 4.3 tons per hectare. See Irene Uribe, "Rice: Larger Yields for Smaller Farmers," *R.F. Illustrated* 2 (March 1975): 9.

9. Rogelio V. Cuyno, "A Conceptual Model for Assessing Program Performance," mimeographed (University of the Philippines at Los Banos: Department of Development Communication, 1974), pp. 12-13.

10. Castro, "The Filipino Graduates."

11. Rogelio V. Cuyno, "Organizing for Change: A Temporary Cooperative Systems Strategy for Generating and Diffusing Agricultural Knowledge" (Paper presented at the International Rice Research Institute, January 16, 1975), pp. 12-13.

12. Uribe, "Rice," p. 9.

13. Ibid., p. 9.

14. Ibid., p. 1.

15. Centro International de Mejoramiento de Maiz y Trigo, *The Puebla Project: Seven Years of Experience: 1967-1973* (El Batan, Mexico, 1974), p. viii.

16. Ibid., p. 1.

17. Ibid., p. 5.

18. Ibid., p. 107.

19. Ibid.

20. Ibid., p. 39.

21. Ibid., p. 42.

22. There is also a serious question as to whether a varietal improvement research function should even be included as a component of a regional production program. The conclusion reached in the final report of the Puebla Project speaks to this issue. "Maize improvement experience in the Puebla Project indicates that the development of improved varieties for a regional program can perhaps best be achieved in a cooperative effort with a nearby research center. The crop improvement component of the regional program would have the responsibility of collecting the information that is necessary to clearly define the characteristics of the improved varieties needed by farmers. . . . The crop improvement program at a neighboring research center would have the responsibility for selecting the materials and methods for producing improved varieties." See ibid., p. 43.

23. It should be noted that the RURP project also had an evaluation component included in its project design. The Agricultural Economics Department at IRRI conducted a benchmark and follow-up survey to measure the progress of the project. Vernon E. Ross, October 28, 1975: personal communication.

24. Centro International, *The Puebla Project*, p. 75.

25. Ibid., p. 102.

26. In most cases, varietal improvement would probably not be included as a component within a production team; therefore there would only be four functional components within most teams. See note 22.

27. See Centro International, *The Puebla Project*, p. 112 for estimates of the number of staff members required in each functional area by size of region.

28. Other selection criteria used are outlined in Reggie J. Laird, "Selection and Training of Technical Personnel for Rural Development Programs in Areas of Small Holders" (Paper presented at the Latin American Association for Rural Development meeting, Chapingo, Mexico, September 1973), pp. 5-7.

29. A general course outline for the specific technical training of agronomic research and evaluation trainees is included in Heliodoro Diaz, "An Institutional Analysis of a Rural Development Project: The Case of the Puebla Project in Mexico" (Ph.D. Diss., University of Wisconsin, 1974), pp. 26-39, appendix.

30. See, for example, Paulo Freire, *Pedagogy of the Oppressed* (New York: Herder and Herder, 1970); and Armando Samper, "A New Look Is Needed for Extension," *Training for Agriculture* (Rome: Food and Agriculture Organization, 1973).

31. Diaz, "An Institutional Analysis," pp. 2-4, appendix.

32. For an outline of the material covered in this section of the training, see ibid., pp. 10-[illegible] appendix.

33. Centro International, *The Puebla Project*, p. 101.

34. Cuyno, "A Conceptual Model," p. 20.

35. Sterling Wortman, "The Technological Basis for Intensified Agriculture," in *Agricultural Development: Proceedings of a Conference Sponsored by the Rockefeller Foundation* (New York: The Rockefeller Foundation, 1969), p. 31.

36. Ross points out that applied research trials can be used for both research and extension functions. These plots show farmers how different levels of one or more inputs affect yield. Ross believes ". . . applied research plots are a better teaching instrument than the so called demonstration plots which illustrate the effect of the best combination of inputs." Ross, personal communication.

37. Centro International, *The Puebla Project*, p. ix.

38. Swanson, "Evaluation of Research Training at IRRI."

39. Francis C. Byrnes and William G. Golden, *Changing the Change Agent: A Step Toward Increased Rice Yields*, (Los Banos, Philippines: International Rice Research Institute, 1967).

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This paper was written as part of a research project on international technology transfer systems supported by the Program of Advanced Studies in Institution Building and Technical Assistance Methodology (PASITAM) of the Midwest Universities Consortium for International Activities (MUCIA) through a 211(d) grant from the U.S. Agency for International Development.

Burton E. Swanson is assistant professor in the Department of Vocational and Technical Education, College of Education, University of Illinois, Champaign-Urbana.