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AGRICULTURAL EXTENSION AND EDUCATION IN DEVELOPING COUNTRIES

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AGRICULTURAL EXTENSION AND EDUCATION IN DEVELOPING COUNTRIES*

Wherever one goes in the developing world he is likely to find growing restlessness about and mounting criticism of the ability of local agricultural educational systems to cope effectively with development problems

While agreeing that development depends upon education most development specialists find themselves attacking existing educational systems as being dysfunctional Typically, rather than attempting to correct the problems, they launch ambitious programs to train already educated people, either at home or abroad, in what they need to know or be able to do if they are to help achieve particular development goals

Several factors confound the issue (23) First, there is the development specialist's concepts of development and what is necessary to bring it about, as well as his tendency to reflect his experience-and culture-bound criteria when he evaluates the operations and products of a given educational system

Second, representatives of different socio-economic sectors of the developing country frequently identify with diverse expectations of and commitments to development Their concepts of development vary as widely

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as do those of foreign development advisers

Third, national leaders may differ radically in educational background, ranging from that which is strictly indigenous to holding one or more advanced degrees from abroad This significantly influences the heterogeneity of their concepts of development and what they see as priorities

National leaders in the developing countries frequently request and support training efforts in specific areas as development stimulants Less frequently do they recognize the felt need for such activities as a symptom of inherent shortcomings in their national educational systems As a result, the existing educational systems continue, changing slowly if at all, producing "educated" persons who subsequently must be trained if their "education" is to become viable

At the same time, while some may benefit from their training, many encounter great difficulty in finding opportunities to use their new knowledge and skills fully, or in gaining the administrative and technical support necessary for their training to become functional Moreover, their training becomes dysfunctional to the extent that their acquired knowledge, skills, and even orientations (values, beliefs, attitudes, opinions, etc) are foreign to those of their educated, elder superiors who tend to perceive them as threats rather than as valuable resources

Correction of this situation is vital to the efficiency with which development progresses in the developing countries The dissipation of energy and time in criticism and defense of national educational systems and their products cannot be constructive It is time to think positively, to focus attention on some emerging concepts of development and their implications for agricultural extension and education

Included among these concepts are the following propositions

1 The essential variable and target of development is people

2 The development of and by people requires new approaches to the organization and management of people and resources--in short, social innovation, the creation of new ways to facilitate and direct change

3 Social innovation depends upon a willingness to approach problems with an open mind, and upon a recognition of the need to acquire the data necessary for planning and decision-making

4 This recognition and willingness is conceptualized as the total systems approach and includes continuing appraisal of what education must contribute to changing people, institutions, and processes

5 The objectives of education must stress changes in the behavior of the student and define clearly the level of performance expectations These objectives and performance expectations must be derived from the basic manpower requirements of the developing country and specify how the learner's changed behavior will help fulfill these needs

6 Indigenous models of education and extension are required to produce the kinds of persons the developing countries need, now and in the future For too long we have wrestled with the conceptual, methodological, administrative, and even diplomatic problems that

result from trying to transplant and adapt models from the developed countries (16) Whatever the model, the relevant functions to be performed include " (a) the development of new materials and knowledge, (b) the transfer of innovations into use on the land, and (c) the building of human resources to perpetuate the evaluation, transmission, and use of new technology " (34)

Implicit in much of the above is the need for objective application of research to the development of viable educational systems Unfortunately, relevant research is limited, and much of this reflects the assumptions associated with the study of educational processes and establishments indigenous to the developed world Nevertheless, we shall present some empirical data related to agricultural educational efforts in the developing countries We focus on the preparation and performance of the change agent, the extension worker whose response to the farmer's requirements puts to a test the relevance of the knowledge, skills, and orientations which agricultural educators assume are necessary and are acquired in the educational process

The relevance of the extension worker's response depends upon his competence the quality of being adequate or sufficient for the purpose We hypothesize that the more underdeveloped a country's agriculture, the more competent must the extension worker be--and in more areas of competency The illiterate farmer in the developing country depends almost solely on the extension worker He does not have the diversity of communications media (telephone, radio, television, newspapers, farm magazines, etc) nor ready access to other information sources (experiment stations, local commercial input distributors, supervised credit advisers, etc) that are available, for example, to the farmer in Iowa If the extension worker cannot competently respond to the farmer's questions or if he gives wrong advice, the farmer and many others suffer

Agricultural education and extension also involves the organizational dimension of the agricultural college and the extension service This dimension is treated briefly under communication competency later in this chapter Though we are primarily concerned with appropriate behavioral objectives and performance expectations for extension workers in developing countries, the discussion carries implications for the development of effective "indigenous' models of agricultural education-extension organization

Innovation Validation and Change Agent Competency

Those who study the diffusion of agricultural innovations (i e , purportedly "improved" varieties, practices, and/or packages of these) usually focus on the farmer and his social and physical environment in seeking explanatory variables for the acceptance or rejection of recommended innovations They rarely, if ever, consider the role of change agent competency as a possible explanation of why farmers accept or reject new technology They do not ask

- How does the change agent (e g , extension worker, village level worker, agrónomo, etc) objectively ascertain that a particular innovation has a significant advantage for farmers in microenvironments other than the area or areas where the innovation was developed?

- Where the farmer fails to adopt or tries and later abandons an innovation, had the change agent failed because of his inability to teach the farmer how to use it?

These questions emphasize the problems of validating both the innovation's minimax advantage and the worker's change agent competency

By minimax advantage, we mean an innovation's significant advantage for the particular environment of a given farmer This depends on, but is not limited to, whether adoption of the innovation is a sufficient condition for

- minimization of costs in the production of crop and/or livestock yields that are significantly greater than those obtained by the farmer using his present technology, and
- maximization of profits sufficiently large that net returns (balance to the farmer after repayment of input costs) are significantly greater than those obtained by the farmer using his present technology and its associated input costs

Additionally, as the farmer's "test of relevance is whether a practice proves superior on his farm or on his neighbor's farm, and not on the experiment station farm," (8) the extension worker must be able to demonstrate in the farmer's environment that adoption of the recommended agricultural innovation achieves the minimax advantage One way to determine that adoption of the innovation is a sufficient condition for the minimax advantage and to minimize risk of failure in the demonstration of the innovation to the farmer is to test the innovation in an environment similar, if not identical, to that of the farmer

This requires of the extension worker competency in at least four areas

1 technical competency, or the level of knowledge (the ability to recall specific bits of information and facts and a familiarity with terminologies) and understanding (the ability to apply principles and generalizations in a given specific problem-situation) which the extension worker possesses relevant to the crops or livestock the farmer produces, the production practices involved, and the physical environment in which the production takes place This includes, but is not limited to, the ability to diagnose typical problems and abnormalities correctly, plus knowledge and understanding in the application of proper treatments

2 economics competency, or the ability to weigh (e g , calculate cost-benefit ratios, interests, etc) alternative production input and product commercialization strategies to determine whether adoption of the innovation is sufficient for the minimax advantage An effective strategy must be based on, and can go no further than, the availability of the necessary production input and product commercialization factors Included among possible production input factors are guaranteed product demand and market price, certified seeds, fertilizers, insecticides and herbicides, credit, irrigation, crop and/or livestock insurance, technical competency, etc) Included among possible product commercialization factors are accurate and timely information on product demand and market prices, farm-to-market roads, transportation, storage, packaging, wholesale and retail outlets and functionaries, etc)

3 science competency, or a basic understanding of the philosophy of science and the ability to conduct a simple replicable field experiment which objectively tests whether adoption of the innovation is a sufficient condition for the minimax advantage

4 farming competency, or the willingness and skills to perform the range of physical tasks involved in producing a specific crop or animal This includes, but is not limited to, the extension worker's ability to perform at least the range of physical tasks within the existing competency of the farmer Also, as mechanization advances, the extension worker must acquire the relevant knowledge, understanding, and skill in the operation and maintenance of various energy-driven machines and processes

After the extension worker has employed these four competencies to validate an innovation's minimax advantage, then he is ready to demonstrate it to farmers and to seek its adoption At this time, a fifth change agent competency becomes vital

5 communication competency, or the ability to specify and coordinate specific behavioral objectives for relevant audiences whose changed behavior is necessary for the minimax advantage This includes, but is not limited to, the ability to plan, prepare, and present appropriate messages for and to obtain feedback from the relevant audiences which may include for the farmer's environment the landlord, the credit agency, the input distributor, the wholesaler, retailer, or even the consumer The most appropriate message for the farmer audience, of course, is an innovation whose minimax advantage has been validated in an environment similar, if not identical, to the farmer's

Support for the hypothesis that agricultural development requires competence on the part of the extension worker usually emerges as fortuitous or qualitative data in case studies of development projects (2, 17, 39, 40) However, case studies usually lack control over numerous intervening factors In each of the sections that follow, we discuss one change agent competency, reporting available data and related problems

Technical Competency

The notion that effective extension work involves more than one dimension of change agent competency is not new Lacking in most attempts to demonstrate the tenability of the hypothesis, however, has been independent measures of the change agent's competency and the "success" of the extension effort studied These studies have assumed, instead, that the perceptions of extension supervisors, administrators, and even extension workers alone validly measure

a) which of a group of extension workers are more "knowledgeable" and 'successful" and which are not, and

b) the area(s) in which a given number of extension workers need training if they are to become "knowledgeable" and "successful "

Warren (52) used the subjective judgments of the supervisors and administrators of a population of Oklahoma extension workers to measure whether a particular extension worker had been successful or unsuccessful He reports that

> the more successful employees of the Cooperative Extension Service had taken a significantly greater amount of course work in the areas of education, sociology, mathematics, science, communication, and economics

Though Warren's findings suggest that the "successful" agricultural extension worker is at least familiar with, if not competent in, more than one area, measurement of who is a "successful" extension worker by reference to the perceptions of such by extension supervisors and administrators leaves unanswered the question of whether <u>any</u> of the extension workers studied had been recommending to farmers innovations having the <u>minimax advantage</u>

Judy (30) empirically questioned the assumption that extension supervisors or extension workers can accurately estimate the extension worker's knowledge By correlating (a) scores of a test designed to measure the extension worker's knowledge of soil science, and (b) the quantified estimates by extension supervisors and extension workers of the latter's knowledge of soil science, he found the

> correlation of the agent's estimate with his own test score was in the range of about 1 to 2 The soils specialists' estimate of the agent's knowledge with the agent's score was in the range of around 15 to 2 The district director's estimate of the agent's knowledge when correlated with the agent's test score was around 3 to 4 Slightly less than one-half of the agents were accurate concerning the estimate of their knowledge, and approximately one-fourth over-estimated their knowledge and one-fourth under-estimated their knowledge

While Judy indirectly measured one dimension of change agent competency (i e , the extension worker's technical competency in soil science), his study neither included adoption as a variable nor considered whether the extension workers, even the more knowledgeable ones, had been recommending innovations having validated minimax advantage

Contado's recent study of communication fidelity between farm management technicians (FMTs) and rice farmers in Leyte, Philippines (13), included approximate measures of both adoption and technical competency In order to include (a) the communication purpose or objective of the extension worker's communication behavior, and (b) other farmer responses in addition to adoption, he developed a measure of communication fidelity the extension worker's effectiveness based on farmer response (awareness, conviction, trial, and adoption) to practices recommended by FMTs This measure, the quotient of the farmer's response index and the FMT's communication input index, represents the degree of accuracy with which messages encoded by FMTs are decoded by farmers Contado's motivation for construction of this measure was based in his observation that

> (a) in adoption studies the communication behavior of the communicator is unknown, (b) the purpose of communication is presumed to be always adoption of the practices, and (c) the responses of the farmers other than adoption are not included in the assessment, i, e , reports carry only the percent of farmers who have adopted at the time of the survey

As his measure of technical competency, Contado used a test developed by Cuyno (14) at the International Rice Research Institute (IRRI) in the Philippines

Contado's analyses revealed a non-statistically significant tendency for highly competent FMTs to obtain high communication fidelity However-ever, Contado also found statistically-significant inverse relationships (i e , negative correlations) between technical competency and the number of years the FMT had been on his present station, the number of years he had been a FMT, and authoritarian personality Contado concludes "that the longer the change agent is in the service and in his present station,- and the more autocratic he is, the less likely he will be to make a high score in a test on knowledge in rice production "

Contado infers that a "rusting" effect possibly operates from being in a station and on the same job for a long time or "that those who had remained for a long time in a particular station and in the same position were those who had failed to demonstrate superior ability that would merit consideration for transfer or promotion " It is also possible that the FMTs had never been competent in rice production This possibility is considered in the following

In addition to the kind of knowledge and understanding which can be measured by written tests, a vitally important aspect of <u>technical competency</u> is the extension worker's ability to identify and to diagnose correctly the typical problems and abnormalities which the farmer may have If the extension worker does not recognize the problem, he can be of little help to the farmer Further, if he does not know but is unwilling to say "I don't know," he will guess at either the diagnosis or the treatment, or both At this stage, the farmer becomes the victim of the extension worker's imagination

Data (6, 29) from the International Rice Research Institute's rice production training programs, to be described later in this chapter, illustrate the point at issue The Institute tests an incoming trainee's ability to identify such symptoms as grassy stunt virus, tungo virus, bacterial leaf streak, bacterial leaf blight, dead heart, rice blast disease, white head, and such specimens as brown planthopper, striped stem borer, pink stem borer, green leaf-hopper, lindane granules, and rice bug A similar exercise is repeated at the end of training

During seven programs, each of a week's duration, 95 North Americans averaged 12 5% correct answers on the first day and 81 1% on the sixth, while 73 Filipinos averaged 34 9% correct answers on the first day and 85 2% on the sixth These data illustrate three significant points

1) Many rice workers lack the technical competency necessary to teach farmers how to increase their rice yields
2) Where outside agencies try to help national workers, the specialists provided may be less competent than the personnel they are to assist
3) When instructional objectives are crystal clear and appropriate methods used, significant behavioral changes can be achieved in a relatively short period

Economics Competency

Economics competency involves the ability to calculate whether adoption of an innovation is a sufficient condition for the minimax advantage The literature provides numerous examples of the necessity to recommend innovations having the minimax advantage, otherwise, they were not adopted beyond a possible trial stage

Contado asked each of the local FMTs whether the practices he recommended to farmers in his area were perceived by farmers to be as costly as commercial fertilizer On the other hand, farmers were asked if they perceived the practices recommended by their local FMT to be as costly as commercial fertilizer The FMTs reported that most of the practices they recommended to the farmers were not as costly as the use of fertilizers The mean of the FMTs' responses fell in the range of "no, not really" and "maybe yes, maybe no " On the other hand, farmers reported that the practices recommended by their local FMT were generally somewhat more costly than the use of fertilizer, the mean of their responses falling in the range of "maybe yes, maybe no" and "most of the time " The differences in perceptions of cost of recommended practices were statistically significant

Contado's data are insufficient for determining whether the FMTs had recommended innovations having minimax advantage He reports, however, that "the FMTs and the farmers differed significantly in their appraisal of the compatibility of the practices the FMTs introduced to the farmers with the farmers giving the lower rating " Similarly, Contado reports statistically significant differences between the farmers' and the FMTs' perceptions of whether the latter were meeting the present needs of the farmer Thus, misperceptions by the change agent of the minimax advantage of the innovation he recommends to the farmer can be a significant factor in explaining the farmer's acceptance or rejection of it

Studies of the Farm and Home Development Program at the University of the Philippines College of Agriculture further illustrate the influence of economic factors in extension projects Of 25 farm practices introduced to 380 farmers, Feliciano (18) reports that 8 were adopted by about 40 to 50 percent The principal reasons farmers gave for adoption were (a) the compatibility of the practice with the farmer's needs and goals, (b) the seen and proved effectiveness of the practice, (c) use of effective extension techniques, such as the result of demonstration,

(d) ease of doing the practice, and (e) availability of necessary resources These reasons suggest that the farmer's management decision-making is economic-oriented

Lacking, however, are data on the change agent variables which contribute to a farmer's valid perception that adoption of a particular innovation has a significant economic advantage over the farmer's present technology

Some authors suggest that the extension worker as an information-source, just as the farmer's information-seeking behavior, is a critical intervening variable Myren (36) reports that Latin American farmers search for information "Even those on small peasant holdings appear to have a considerable desire to produce more efficiently and are interested in information on how this can be done " On the other hand, Myren (37) considers, in another article, the credibility of the information-source

> What, then, would adequate information for a farmer about a new practice consist of? First of all, the idea must appear to be credible--it must make sense when considered in the light of his past experience That is, it must not sound illogical or impossible But much more than this, the source of the new information must be considered trustworthy by the farmer, and this judgement will be based again largely on his past experience and the observations of people whom he trusts --these may be neighbors, extension agents or even farm magazines which have developed a reputation for honesty and trustworthiness

Evidence from persuasion research (25) indicates that responses to a message are significantly affected by cues to the communicator's credibility (i e , his expertness and trustworthiness) Preliminary analysis of more than 900 documents in the Diffusion Documents Center, Michigan State University, however, indicates that few of these report use of expertness or trustworthiness as variables in agricultural diffusion studies Similarly, few studies have considered the relative advantage of the innovation to the farmer as a factor influencing adoption

In contrast to the inductive approach, implicit in Myren's orientation, to the communication of information, Campbell (7) proposes that extension services take a deductive approach which would include (a) the interpretation of market outlook and changing price relationships, (b) the provision of more specific information about the relation between inputs of various resources and likely output, and (c) the interpretation of major changes in agricultural policy Campbell's rationale is this

> Many extension programmes have been based on the assumption that farmers use inductive thought processes almost exclusively Demonstration plots and experiment farms have been used to provide factual information about production practices If the conditions prevailing on a specific farm are similar to those obtaining on the experiment farm, the operator of that farm might appropriately apply the practice demonstrated on his own farm The weaknesses of this approach stem from the fact that no two farms have identical physical, economic, and managerial resources and on no privately owned farm can conditions on the experiment farm be duplicated
>
> If one accepts the fact that farmers can and do reason deductively, the problem of the extension service becomes infinitely easier The task then is to provide the farmer not with isolated approved farm practices or bundles of practices which he can adopt by emulation, however ill-suited they may be to this immediate situation, but rather to provide him with the information he needs to work out the best plan for his own farm taking into account his personal goals and the resources at his disposal

In a similar vein, Dandekar (15) proposes that the extension services take a more deductive approach in communicating information to the farmer

> As it is generally understood, the function of extension seems to be to communicate to the farmer techniques and technology which either are supposed to be known, or are imported fresh from abroad or at best are produced in highly exclusive labo-

> ratories and experimental stations The farmer hardly, if ever, participates in the evolution of these techniques and technology, and therefore seldom understands their experimental character What is required is some arrangement by means of which at least a small number of progressive and intelligent farmers in each district or smaller area may participate actively in the research experimentation and a forum where they may regularly report the findings of their experimentation in a scientific manner

These proposals for a deductive approach to communicating information to the farmer indicate a possibly needed emphasis in extension services But the effectiveness of a deductive approach to communicating information on economic conditions would depend on two factors (1) the economics competency of the extension worker, and (2) those factors affecting the farmer's response to "economic incentives " Let us consider the latter point

A growing body of evidence supports the proposition that farmers respond to "economic incentives" (53) but it is not clear (a) whether the farmer has the same meaning as the extension worker for such economics terms or concepts (e g , "economic incentive") as the latter may use to communicate to the farmer, nor (b) how much "incentive" constitutes an "economic incentive" for the farmer Some data from the developed world indicate that farmers vary in the degree to which they comprehend economics terminology

Felstenhausen (19) measured the degree to which farmers and high school students in a Netherlands farming community comprehended economics terms and concepts The comprehension was higher for economics concepts which represent events or relationships that are a part of personal experience than for theoretical concepts Farmers tended to score higher than students on those concepts observable within a limited space in time from market place activities or in the course of making individual farm management decisions guaranteed subsidy, over capacity in agriculture, free market, guaranteed price, insurance premium, financing with outside capital, mortgage, costs of production, and inflation These concepts were more frequently meaningful to farmers than to students, reflecting the former's greater involvement in government programs and farm financing Farmers tended to score lower than students on concepts relating to the organization and operation of the economic system price index, elastic demand, capital goods, and economic goods, reflecting the students' greater exposure to macroeconomics in the high school curriculum

The following variables contributed significantly toward explaining variation in comprehension of economics concepts education, organization membership, mass media usage, tractor ownership, and production units per farm Felstenhausen concludes

> Agricultural information people should not expect to reach all farmers in a community like Bennekom with the same degree of effectiveness by presenting all material at one level of difficulty or via one medium Information generally understood may still not reach some farmers if transmitted only through mass media and groups This implies, for example, that programs such as agricultural extension which are committed to helping all farmers, should use several levels of approach and not just one In some cases, separate programs may be needed for farmers who are non-readers and non-joiners

What do we know about farmers' comprehension of economics concepts in developing countries where the differences between subsistence and commercial farmers are even greater than among the commercial farmers of Bennekom? Though lacking such information, extension workers have tried to "convince" or "persuade" the peasant farmer and villager to adopt innovations *assumed* to be "improved " In the face of perceived resistance by farmers to adoption of the recommended innovations, not only extension workers but also those charged with allocation of resources for agricultural development, the administrators of extension services, "have eagerly adopted the idea that peasant farmers are not rational economic men " (53)

Some agricultural economists are now seeking answers to the question How much "incentive" constitutes an "economic incentive" for the peasant farmer?

Hill (24) proposes that farmer response to extension efforts in developing countries "is going to be slow at the outset unless relatively simple combinations of improved practices are available, capable of increasing yields by at least 25 to 50 per cent on good soils with good water supplies Increases of 50 to 100 per cent would be still better " Hill suggests "that in most circumstances, research workers set as their initial target the development of combinations of improved practices that will at least double yields on the better land "

Hill's hypothesis deserves empirical test Wharton (55) outlines a conceptual framework for handling the problem and reports data to support Hill's hypothesis While space limitations do not permit redevelopment of the complexity of Wharton's thesis, the relevance of his argument for extension worker performance is summarized in the following paragraphs

Wharton observes that while agricultural innovations are a potencial force for change in subsistence agriculture, peasant farmers resist adopting varieties, practices, and/or combinations of these which they perceive as not maximizing survival. The risks and uncertainties associated with yield, cost, and market price variabilities combined with low levels of income (output) and subsistence levels of living produce a strong "survival" element in decision-making. What is important for the farmer under these conditions is his expectation of output variance if the innovation is adopted compared with the current output variance obtained under conditions of the farmer's present technology.

> The subsistence farmer has learned that any recommended technological introduction has associated with it a different expected variance on his fields--a variance which may be wider than that on the fields of the research station. Under these circumstances the determining factor is the comparison between the expected variance of the new technology and the known variance of the traditional technology.

If the farmer sees or expects the negative variance in yield per acre (i. e., the worse that the innovation would yield) to be below what he perceives as a necessary yield to provide for the minimum subsistence needs of his family, the farmer will resist adoption. Thus,

> even though the average expected yield may be considerably higher than his average yields with current varieties and practices, the variance in expected yields with the alternative technologies as viewed subjectively by the individual farmer are far more important in determining the adoption of the new seed, practice or factor input.

These considerations lead Wharton to hypothesize that adoption is more likely to occur when the negative standard deviation of yield distributions is above the traditional average output, i. e., that the worst the innovation could do is still better than what the farmer now gets on the average.

Recent experience (29, 55) with innovations (high yielding rice varieties IR8, IR5, and attendant rice production practices) developed at

IRRI supports the hypothesis A sample of rice farms in Rizal province, Philippines, was drawn and farmers were asked to recall their yields for the 1966 and 1967 dry seasons Not only was the IR8 average yield higher than the local variety average yield (5 86 as compared to 3 17 metric tons per hectare), but also, the local variety yield of 3 17 was still lower than the IR8 yield at one negative standard deviation (3 24) of its yield distribution Put somewhat more simply, a sizable number of farmers whose IR8 yields were less than the IR8 average yield for Rizal province still had higher yields than obtained on the average by farmers using the local variety

In addition to the increased yield, the innovations provided considerably larger net returns than obtained by using the local variety (See Table 1)

TABLE 1

	Net Return (in Pesos)		No Farms Growing	
Dry Growing Seasons	IR8	Local Variety	IR8	Local Variety
1966	1829	904	4	143
1967	1615	921	200	127

Data from Table 1 also illustrate the rapidity with which IR8 and related innovations were adopted by Rizal farmers Similar rapid adoption rates have since been reported (1, 3) for other countries throughout Southeast Asia, demonstrating that change (10), many development specialists to the contrary (26), can come rapidly and peacefully

These data are reported not only as possible answers to the question "How much 'incentive' constitutes an 'economic incentive'?" but also to bring into relief the observation that the validation of the minimax advantage of the innovations (IR8, etc) depended upon an applied research program conducted in microenvironments throughout Asia The success of this program partially depended upon the economics competency of the extension workers who were responsible for field trials at the farm level This program of applied research or field trials[1] described later in this chapter

Science Competency

Adequately preparing an agricultural graduate in the developing countries is in many ways the task of equipping him with the necessary concepts, skills, and motivations to engage effectively with the physical reality of the immediate environment in which he works He must not only be taught to look, but where, when, how, why, what to look for and how to recognize it when he sees it

While he learns much of this in training aimed at increasing his technical knowledge, economics sophistication, and farming skills, he also needs some grounding in the methods and philosophy of science to make these competencies more fully operational

The frequent lack of preparation of agricultural graduates (12, 31, 46) coming to the United States for graduate work prompted the Agricultural Development Council (48) to remind prospective guarantees that they will be expected to increase their mastery of the three rudimentary skills--perception, analysis, and synthesis

> Perception is the ability to receive and assimilate facts and information from the outside Analysis is the process of examining and sorting out from among a mass of information the most significant parts Synthesis is the process of generalizing It involves the ability to discern significant relationships and is the basis of theorizing It is a process whereby the student constructs, whether from facts or conceptions or propositions, a connected whole Synthesis ultimately permits the relating of learning to life

The A/D/C also cautions them about the temptation of

> rote learning, mere memorizing as though there were a collection of facts that a student has only to absorb, retain, and reproduce at appropriate times Memorizing in this sense, that is, receiving, unexamined whatever is spoken or read, is not the purpose of U S graduate training

Whatever the methods employed to enable an agricultural student to acquire some science competency, the minimum goal should be to help him develop an intelligent skepticism about situations, observations, statements, and data He needs to know what kinds of questions to ask of the data he will be expected to communicate as a teacher or an extension worker

This skepticism is based on acquaintance with assumptions about and an understanding of variability, probability, and process (as opposed to viewing all relationships in terms of cause and effect) With these basic concepts of science, he is more apt to seek empirically-supportable explanations for relationships among phenomena, to communicate these explanations to others, and to develop confidence in his ability to make predictions and check data

If the extension worker desires to maximize his effectiveness in the field and to protect his credibility as an information source, he needs more than these basic concepts of science He needs to be able to conduct simple, replicable field trials While it is possible for the extension worker to employ economics competency to work out, prior to recommending an innovation to the farmer, the strategy which combines production input and product commercialization factors to minimax advantage, only after testing the innovation locally can the extension worker ascertain whether a promised minimax advantage empirically obtains

> Experienced agricultural scientists know that small, subtle differences in environments can have very great effects on crop yields These differences must be recognized and cultural practices adjusted accordingly Because unreliable advice is worse than none, the scientist needs to be reasonably sure he is right before he gives advice, and the best way for him to acquire this confidence and trustworthiness is to test his ideas in well designed experiments carried out in the particular area (47)

Extension services generally recognize the extension worker as a liaison between research worker and farmer, although less frequently have these services realized that innovations developed by research must be tested for their relevance in the farmer's environment To the extent that the extension worker is to fulfill this function, not only must his science competency be adequate for the level at which he is expected to perform, but also he must see his job as that of communicating back to the research worker information on the innovation's performance in the farmer's environment While much is said in extension literature about the importance of the extension worker as a two-way communication link between the research worker and the farmer, Brown and Deekens (4) found little evidence that extension subject-matter specialists in Pennsylvania defined their job as communicators of problems from the farmer to the research worker

We do not know whether extension workers in the developing countries see their job in these terms--communicating to the research worker information about the farmer's problems and data on the performance of innovations in the farmer's environment The problem, however, is not only that of role perception but of administration, coordination and support

> A serious missing link in most research and development schemes in the hot-humid tropics of Latin America is the production or subject-matter specialist Even though field-extension organizations exist, the depth of training of most extension agents is insufficient for the problems they face Research personnel are often severely limited in their understanding of extension needs and practices The feedback of farm-production problems to the researcher is usually inadequate (42)

The extension worker may aspire to higher levels of science competency although this may not be necessary in his work But higher levels are required of those who carry on research, and they frequently do not have the motivations, skills, and/or concepts which situations demand The research worker too often lacks the ability to generate hypotheses grounded in theory, to plan statistically sound experiments, or to analyze effectively the resulting data Unfortunately, data may be of little value because the experimental plots were poorly supervised and farmed The resultant data are confounded by the uncontrolled influence of such variables as weeds, insects, diseases, lack of water, or other random misfortunes (some of which the scientist may be totally unaware because of the infrequency with which he visits his field plots)

Somewhere, somehow, the agricultural research worker must become committed to engaging with the physical reality of his research in the field rather than at his desk Simultaneously, he must approach agricultural problems from a scientific viewpoint In these two respects, at least, his needs and those of the extension worker are nearly identical The implications for agricultural education are obvious

Farming Competency

One of the development problems which national agencies face is recruiting, training, and managing a field staff of extension workers Not only are there frequently not enough well-trained persons to fill all of the jobs (27, 28 51, 56), even those available usually lack the rural background which would make them most immediately useful

> A dean of a prominent agricultural college in Colombia lamented the fact that there were only 900 "agrónomos" in his country, where 2,000 were needed He was disturbed that farm boys were not coming to the university generally the only farm boys to matriculate were those from the rich, landed families educational opportunity for the sons of the average farmers, who were poor, was quite meager (41)

The case of Colombia reflects the rondex paradox of Latin American agriculture Felstehausen (20) reports that most farms in Colombia are of the peasant type, or _minifundio_ some 1 2 million farms in 1960 of which more than 60 percent were less than five hectares (1[illegible] acres) in size Richardson (42) points out that Colombia's agricultural colleges graduate each year about 90 students with the degree of "ingeniero agronomo" to help serve a rural-farm sector population about equal in size to that of the United States' farm population of 7,500 000

> The number of Latin American students graduated each year in the agricultural sciences is approximately 1,000 These individuals are to assist in serving a population of approximately 115 million whose livelihood is derived from, or is immediately related to, agricultural production

For purposes of comparison, in 1963-64 alone, the United States graduated 7,050 students with B S degrees in agriculture and closely related disciplines, 1,759 with M A or M S degrees, and 569 with the doctorate The tally includes agriculture, agricultural economics, agricultural education, agricultural engineering, forestry, and veterinary medicine

Chaparro and Allen (11) point out that even in countries with large rural populations and a public policy encouraging their education, fewer than 25 percent of the agricultural graduates come from rural areas

Thus the new extension worker must not only acquire farming competency but also learn about rural customs, values, and ways of thinking (35) Where the graduate lacks preparation in these areas, he feels insecure and inadequate in his role of extension worker This problem is brought out in Cotterill's study* of persons who had completed their courses in two Colombian agricultural colleges and were involved in information-dissemination activities (mainly extension and technical assistance) within 12-18 months after leaving the classrooms

He asked each person to rank, in order of importance, a set of personal characteristics related to performance of his current work role of "agronomo," and this same set of characteristics in order of the suitability of his university preparation Appropriate statistical analyses revealed that the personal characteristics for which the respondent perceived an unsuitability of university preparation were those he now saw as important to performing the "agrónomo" role In other words, the more important he perceived a characteristic for performance of the "agronomo" role, the less he perceived his university to have prepared him in that characteristic

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* Data gathered by Ralph Cotterill in Colombia during 1967-68 dissertation research At the time this chapter was written, Mr Cotterill was completing his doctoral program in the Department of Agricultural Economics Michigan State University, East Lansing, Michigan

This inverse relationship is found for such characteristics related to farming competency as ability to analyze problems in the real world, ability to communicate with uneducated persons, understanding the relation between the "agrónomo" career and reality, ability to work without much supervision, practical farming skill in the field, and knowledge of rural sociology

While the respondents' generally felt their university had suitably prepared them in such areas as mathematics, soils, control of insects and diseases, statistics, biology, chemistry, zoology, agricultural economics, irrigation and drainage, their technical competency in any of these areas falls short of that required by the development needs of Colombian agriculture As in other Latin American universities, in Colombian agricultural colleges

> The undergraduate is often equally trained in nearly every phase of agriculture from agricultural engineering through agronomy and animal science to food technology and rural economics This system combined with insufficient training in critical analysis, tends to produce a generalist inadequately prepared to direct critical thought to the solving of the problems which will confront him (41)

Wharton (54) notes that in developing countries where there is a pressure for expansion of entering classes in higher education, these pressures combined with other factors ---such as those discussed above-- have lowered standards to the point that the quality of the final product tends to deteriorate Also, many disciplines most important for the developing countries, particularly the agricultural sciences, have the lowest prestige and attract the poorer students

> The students who entered these courses are often the rejects from other disciplines and have made agriculture a last desperate choice They are consequently, in many cases, least suited to the needs of their nation and poorest in providing the answers needed for the problems of their countries The result is the poorest talent devoted to the most critical problem, affecting 75 to 80 percent of the population

Of 1,919 alumni of the University of the Philippines College of Agriculture reporting in an alumni study (33) 28 55 percent were employed in agricultural extension work Of these 548, the majority had been "general curriculum" graduates, and they report that the "curriculum" they took failed to provide the necessary concentration on specific subject fields and skills needed in their jobs The majority of those who took the "general curriculum" were almost always the lower scholastic achievers

The consequence of inadequate preparation and feelings of insecurity is reflected in the infrequency of extension workers' visits to the field and the difficulties extension agencies have in getting field workers who are willing to live in the field and develop effective rapport with farmers These points are illustrated in a study (50) in the Land Reform Area, Bulacan, Philippines Of the farmers who responded, 60 percent recalled that the extension worker had made one to three visits to the barrio, 38 5 percent that he had made more than three visits, while only 1 5 percent indicated the worker lived in the barrio

Some perspective on the extension workers' influence and leadership in the barrios is found in the opinions of the farmers as to who among the barrio people should take the leadership in an agricultural improvement project Only 21 percent said the extension worker, while 36 percent named the barrio captain and 22 percent a barrio council member. Those choosing the extension worker said they would do so far for (a) his knowledge of farming methods, and (b) his personal traits of helpfulness, kindness, and leadership.

The importance of these qualities in an extension worker is reflected in other studies by Castillo (8, 9). When extension workers demonstrated a readiness to carry on above and beyond the call of duty, the farmers' skepticism was substantially reduced. Actions that were perceived favorably included getting into the paddy to plant rice, remaining in the barrio to work on Sundays and holidays, and arriving for evening classes despite heavy rains and bad roads. Not surprisingly, Contado found that FMTs in the high communication fidelity category were significantly more likely to consider the value "enjoy working with farmers" as of high importance in their job than did FMTs in the low communication fidelity category.

But to "enjoy working with farmers" is not enough. The extension worker must have the <u>farming competency</u> necessary to cultivate an innovation the way it should be cultivated, even if the practices required appear strange to the farmers. This is illustrated by the personal experiences of an extension worker involved in <u>a field trial</u> of innovations to be described later in this chapter.

> I became the laughing stuff of all the farmers who passed by the seedbed because I had to stay there watering the seedlings all day. Though I was only an alternate choice for the job, I endured all kinds of humiliation by the farmers because of my desire to learn some more about rice culture. As for the farmer cooperators some of their paddies were not really

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> ideal for planting the miracle rice but just the same, the yields were satisfactory enough on the part of the farmers -- more than enough to convince everybody that the output gives a profitable margin over the input The successful outcome of the project as could be gauged by the favorable acceptance of the farmers of the outstanding characteristics of the crop is a complete rebuff to their jeers, sneers and all sorts of humiliating criticisms from the start Furthermore, I am now equipped with more self-confidence and vigor in dealing with the farmers and their problems Of course, the farmers are not just lavishing praises and eloquent comments They are now willing to use certified seeds, insecticides and fertilizers and are eager to follow the scientific methods of farming As further proof of this, many farmers sowed the IR-8 selection for this cropping season It is anticipated that next dry season, most if not all the farmers shall be planting the miracle rice There is now widespread talk among the farmers that the miracle rice will eventually replace the varieties they have been using *

Contrary to the frequently expressed criticism that agricultural graduates perceive themselves as being too important to engage in such undignified work as farming, we believe that much of this avoidance behavior results from feelings of inadequacy and insecurity --they simply never had opportunity to learn farming skills

Communication Competency

For the past 15 years, we have been involved in planning and conducting communication workshops, seminars, and training programs for diverse groups of persons interested in the problem of how to use communication to direct change in the developing countries Among these persons were thousands of U S Agency for International Development sponsored participants for some 70 countries, dozens of U S technical assistants about

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* Battad, Isidro A , field trial report of provincial agriculturalist to Office of Communication, International Rice Research Institute, Manila Hotel, Manila, Philippines, July 6, 1967, (personal communication)

to go abroad for the government, foundations, or industry, and, more recently, several hundred foreign nationals, principally Southeast Asians, in training at the International Rice Research Institute (IRRI)

Whatever the audience, we structure a communication training program so that the trainee learns

1 To state his communication objectives in terms of specific behavioral changes in the audiences relevant to the problem at hand

2 To observe, listen, and question for insight on the decision making criteria of relevant audiences and the rationales supporting these criteria and consequent behavior

3 To be a communication strategist, i e , to recognize individuals and situations available for, ready for, and receptive of communication as potential facilitators of achievement of the behavioral objectives and to specify how psychological, sociological, and cultural dynamics which affect attention, interest, understanding, acceptance, behavioral change, and selected social action may be employed to activate and coordinate the behavior of facilitators

4 To be a communication technician, i e , to develop, evaluate, and adapt as necessary decision-making criteria for selecting appropriate means (content, treatment, code, channel) for communication of messages to activate the facilitators

5 To assess and coordinate the behavior of communication efficiency through monitoring the social and physical environment for response and reaction (feedback) to communicated messages

6 To understand and control one's own behavior and mental orientations as significant communication variables

7 To have a sense of urgency for development and to assume personal responsibility within the realm of one's sphere of daily influence

These communication training objectives constitute a detailed statement of the dimensions of communication competency, the appropriate role of which has not always been recognized by those in extension Prior to 1952, U S extension workers generally assumed, and the methodology specialists under whom they trained advocated, that the more methods or channels employed in extension work, the greater the likelihood of success In short the more message production the better The pervasiveness of this assumption was reflected each year in the hundreds of hours which extension workers in most states spent learning the mechanics of specific methods and arguing, without much evidence or theoretical base, the superiority of one method over another

In 1952, administrators and editors of the United States extension services, supported by a grant from the W K Kellogg Foundation, established a national project (38) with the objective of increasing the effectiveness of extension programs in the U S through identification, integration, and translation of the findings of human behavior research into approaches and materials which the extension worker might use to improve the quality of his skills in communication decision-making

As a major dimension of this new project, a series of intensive two and three-week training programs was undertaken for carefully selected members of state extension staffs Their behavior during training documented repeatedly the great extent to which the United States extension worker advocates adoption of innovations rather than teaches the farmer "how" Many extension workers evidenced considerable distress about and resistance to the notion that communication competency or effectiveness depends in part in defining clearly behavioral change objectives for specific audiences relevant to the problem at hand Illustrative of not uncommon violent reactions to this idea was one home demonstration specialist who declared loudly "But I don't want to change any-body, I just want to help people help themselves "

Unfortunately, this philosophy is part of the package of assumptions, organizational structures, and operational procedures which the U S has exported as an extension model In a study of the impact of foreign programs on the organization of Chile's extension effort, Brown (5) states that there has been

> A wholesale transfer of extension philosophy and methodology from the United States, especially regarding administrative and institutional arrangements for carrying out extension functions From its inception as a ministerial bureau the Departamento de Extensión Agrícola has borne many similarities to its counterpart in the United States In the early years this similarity was more in philosophy and method (i e , demonstrations, farm visits, meetings) than in structure, and was largely a result of the fact that some of the department's people had been to school in the United States Over the years the similarity has increased The division of the country into pseudo regions and zones approximating U S counties, the introduction of subject matter specialists, supervisors, and home agents, the initiation of 4-C clubs for rural youth and the organization of work along project and campaign lines were all instigated largely by U S advisers

Rather than stressing acquisition of <u>communication competency</u> among workers, the specialists advocated extension methodology as the royal route to maximizing the likelihood of the farmer accepting a recommended innovation Brown states that underlying this emphasis on methodology is a notion

> that the basic communications task (i e , extension) is one of persuasion and attitude change This may be appropriate to a modern agriculture in an industrial nation, but it ignores the economic, institutional and other situational constraints that greatly limit the utility of a strictly informational or educational program for the vast majority of Chilean farmers Besides advocating, a wholesale transfer of modern U S institutional forms, this kind of advice denies the history of these institutions in our own country by implicitly ignoring the fact that early extension workers in the United States

were very much involved in controversial and political activities It is for example, quite impractical for Chile to maintain a purely informational extension program that stays away from "political" issues./ The surest way to make extension irrelevant and ineffectual in Chile is to isolate it from land reform, credit, and other development programs that are and will be underway in the countryside

Other writings (21, 22) suggest that Chile is not alone among the developing countries as recipients of ineffectual, and irrelevant transplants However, organizing extension efforts around "political" issues neither makes them relevant or effectual Instead we believe that extension efforts organized around competency are relevant and potentially effective But if competency is not to be misdirected, a mechanism is required to assure that it is well utilized This role we conceive for a sub-dimension of communication competency, communication strategy, or consideration of behavioral changes required in other audiences if the farmer is to be facilitated in adoption of innovations

In fact, thinking in terms of communication strategy, the extension worker is more likely to see that in some cases the appropriate audiences for message are not the farmer but rather landlords, input distributors, bankers, friends and neighbors, etc who may play a significant role in response to the farmer's information-seeking behavior or who can facilitate or frustrate the action he wishes to take

In a study of information sources for 2, 4-D weed spray in Colombian peasant neighborhoods, Rogers (43) found that farm store personnel were more often information sources than extension agents at all stages of the classical model of the adoption process (see Table 2)

TABLE 2

	Information Sources	
Adoption Stage	Extension Agents %	Farm Store Personnel %
Awareness	7.4	36.6
Interest	6.9	27.29
Evaluation	3.1	11.6
Trial	8.3	41.2

Activities of a private individual to multiply the IR-8 seed and his efforts to sell a farm management plan to 65 rice farmers in a Philippine barrio further illustrate the role of audiences other than the farmer in the diffusion of innovations. Of particular note (see Table 3) is how the farmers learned about IR-8 and the farm management plan as compared to other farm matters (29)

TABLE 3

	Learned Information About		
Sources	IR8 %	Plan %	Other Farm Matters %
expert agents	10	1	44
self, own experience	--	--	32
other farmers	35	17	19
landlords	12	3	4
[illegible]	4	--	--
management plan promoter	39	72	--

Conclusions Into Practice

What conclusions may we draw from these data and experiences? In the absence of the change agent competencies necessary to validate an hypothesized minimax advantage following adoption of a recommended innovation, we most probably find

1 Extension educators who stress, in pre-and in-service training programs, extension methods rather than acquisition of the competencies described,

2 extension administrators who consequently send inadequately trained extension workers to "teach" farmers rather than to obtain behavioral changes among other relevant audiences,

3 extension workers who

   a) tell farmers and villagers what to do rather than asking them what they do and why they do what they do,

   b) talk about and advocate practices assumed to be "improved" rather than (i) demonstrate innovations for which the minimax advantage has previously been validated, and (ii) teach the farmer the "how" and "why" of the recommended variety or practice, and

4 Farmers who increasingly learn to resist extension workers

In short, extension efforts tend to be promotional rather than educational, persuasive rather than informative or instructional, the farmer is told he ought to increase production but the extension worker lacks the competencies necessary to instruct the farmer in the "how" and "why" of the innovations he recommends As a result, "resistance to change can be "resistance to extension workers "

Interviews (50) with 45 farm household heads chosen at random in five Philippine barrios produced the following comments (at the frequencies noted) about the extension worker assigned to each barrio

- He is young compared to the majority of the farmers and so is not too experienced in matters of farming (27)
- He uses (technical) language we cannot understand very well (33)
- He goes by the book and not on what is really happening in the field (17)
- He is not very sure sometimes of what he is advising us to do (35)
- He cannot answer many of our questions (16)

Farmers reported their perceptions of incompetency in some workers in such terms as "Aba, eh, mas marunong pa kami diyan, ah," which can be translated as "Why, we know more than he does He's young, what does he know?"

Except in a few instances, structures (e g , ministries, agencies, institutes, organizations, bureaus, etc) in the developing countries concerned with agricultural problems lack the communication and administrative links to coordinate effectively research, education, and extension

Considering the problems of the education-research link, Peterson and Frazier (41) observe that

> Educational institutions and experiment stations are usually separate organizations with little cooperation between the two The extension programs introduced in several countries are also too frequently carried as separate programs, not embodied in a

> unified effort of research and education Consequently the extension personnel lose the stimulus of contact with a large body of scientific fellows and must expend much energy in locating sources of new information Also, research and teaching programs suffer from lack of contact with professional colleagues working daily with real agricultural problems

Similarly, with reference to research and extension activities, Hill (24) points out that

> One of the important missing links in the extension service of many developing countries is the person we call the subject-matter specialist He is the man with an advanced degree who makes it his business to know both the scientific and the applied side of his particular field He shuttles back and forth between research workers and extension workers In too many developing countries there is not a sufficiently close working relation between research and extension When the research worker holds an advanced degree, not to mention a white-collar job, and the extension worker has a high school education or less plus a thin veneer of special training, the gap between the two services is often hopelessly wide The subject matter specialist as we know him can help bridge this gap

Lionberger and Chang (32), analyzing the modern-day agricultural success story of Taiwan, point out that the high levels of productivity have been achieved "by the use of systems (agencies) for developing and disseminating scientific farm information very different from those used in the United States This success of a different system is a fact that U S technicians generally dedicated to the land grant college system sometimes find difficult to recognize "

They describe the system most developed and most extensively used in Taiwan as "composed of a series of more or less crop-specialized, publicly-supported research organizations for developing scientific farm information These systems, in turn, are connected in a variety of ways to a more or less dual extension system designed to carry new scientific knowledge about all crops and livestock of concern to farmers "

One extension operation is publicly supported, the other is financed by local farmers' associations

Where one's assumptions no longer hold and the "state-side' model of extension does not fit, as is usually the case in the developing countries, it is time to develop indigenous models of agricultural research, extension and education

The IRRI approach to the training of extension rice specialists (6, 29) institutionalizes exchange of information among those involved in agricultural research, education, and extension This "changing the change agent" technique is based on the notion that the purpose of training is to change human behavior --what people know and are capable of doing, how they think, and their orientations This point of view holds that the extension worker, who deals with the farmer, must be able to grow rice at least as well as the farmer, to have grown the new variety before recommending it to the farmer, or to have applied the treatment before advising the farmer to do so

Field experience with different varieties and practices give the worker conviction and credibility when he talks to farmers If he cannot grow rice, he finds it difficult to win and maintain the farmer's confidence It is difficult to teach what one does not know As expressed so well by Sophocles in 400 B C "One must learn by doing the thing, for though you think you know it --you have no certainty until you try "

Those responsible for the training continually ask "What competencies do we wish these trainees to acquire as a result of this training?" They assess, at the start of each program, a trainee's existing levels of technical competency by diagnostic exercises and written tests, including one which asks him to respond to some 100 statements about rice production He checks whether he considers each to be "true, "false," "it depends," or "I don't know " On checking any of the first three, he must write his reasons for answering as he did The trainee retains a carbon copy of the test throughout the program and reviews his responses and reasons frequently, correcting and revising the original answers as he acquires new information The original sheets are organized by subject areas for review by the training staff and are referred to the scientists who will serve as instructors This assessment establishes a starting point for lectures, seminars, individual consultations, field trips, and other learning experiences

Approximately one-half of all instructional time is spent working in the paddies Trainees, individually or in small task forces, grow one or more plots of rice, performing every operation Rice-growing experiences for trainees in 1 and 2-week courses are arranged by planning a series of plots, each with rice at a different growth stage In this way, the trainee obtains in a week experience with working with rice at all stages, and thus acquires some knowledge of farming practices and skills

Trainees who are to be production or extension specialists spend from 6 to 12 months in similar programs, spending the latter months in teams of two on actual rice farms There they are responsible for managing from 5 to 50 hectares depending upon the willingness of the owner As a result, they become competent farmers, but also extremely aware of the many economic factors involved

While at the Institute, the trainees meet regularly with the staff and senior scientists to discuss the problems they encounter in the field Examinations and diagnostic exercises are given periodically (1) to measure the learner's progress and to provide him with feedback on which areas of subject matter and which diagnostic problems are giving him difficulty and (2) to help the instructors to focus on the areas in which the bulk of the class has major problems

Trainees prepare and present papers on rice production In so doing, they learn how to use the library, how to organize and present materials, and how to defend a point of view before their peers Trainee verbal responses change over time from the sharing of speculations and personal experiences to precise reporting of research data The kinds of questions they ask also change, and with increasing frequency one hears "How do you know?" "Show me the data," and "If we don't know, how might we find out?'

Through interaction with scientists and small group projects, they acquire a basic understanding of the philosophy and methods of science. They become familiar with such concepts as assumption, process, probability, observation, prediction, explanation, theory, law, validity, reliability, and variability What emerges from these training experiences is a basis on which the trainees can improve their science competency They put this into practice by designing and carrying out simple replicated trials

The trainees develop communication competency throughout their training First, instructors in the technical areas base their instructional approach on communication principles They practice what the communication specialist might preach, hoping that the trainees --who later will teach others-- intuitively pick up the ability to teach others as they had been taught

Second, communication instructors, by provoking analysis of learning situations which the trainees have experienced, help them to identify and learn how to apply communication concepts and principles This built-in feedback mechanism also affords the instructors insight into trainee reaction to instruction in technology

Third, throughout the program, trainees, individually and in small groups, plan, prepare, and present --and later evaluate-- a wide range of communication exercises These assignments include demonstration plots, field days, briefing sessions for high officials, leaflets, posters, seminars, diagnostic tests, and lesson plans (including instructional aids) for a range of specific instructional situations and audiences In short, they learn communication by doing it Trainees return home not only with confidence in their ability to communicate but also with tangible materials ready to adapt to communication and instructional tasks they are quite likely to encounter

The opportunity to sharpen and put to a test all of their skills comes during the last six months of the year-long program Trainees, in teams of two, are assigned to rice production farms Each team makes the management decisions, supervises the work, trains the laborers, and keeps detailed records Emphasis is upon the use of new technology so as to make a profit During the first season of 1967, all the 12 teams produced high yields with production investments that returned net profits of from \$150 to \$200 (U S) per hectare (29, 45)

After returning to their employing organizations at the completion of training, the trainees continue to work with IRRI by establishing field trials to obtain quantitative performance data on new research developments Under some conditions, a research finding may not respond in the farmer's environment and to have determined this in field trials before recommending it to farmers has obvious benefits, including that it minimizes the possibility of demonstrating innovations that turn out to be failures in certain situations

All field trials are conducted in cooperation with national agricultural agencies involved in extension or research and provide a basis for continuing IRRI interaction with the supervisory and field staffs of these agencies

When field trial results are positive, the innovation is ready to be extended to farmers through demonstrations and other means If results are negative, the innovation is not demonstrated Instead, the worker sends his results to his agency and to IRRI for review Where possible, the causes of the negative response are determined If the rice plant or the practice is at fault, the scientists study ways to adapt the variety or practice

Results of field trials and Institute research are discussed currently in production training programs, and previous trainees return to the Institute at least once a year to report to scientists on their experiences, to learn about emerging new technology, and to plan the new series of field trials for the coming year

Over the past five years, IRRI has demonstrated the workability of this training approach as a way of linking research, education, extension and the various governmental and private agencies involved in rice production Participants in the program have been employees of official research and extension agencies, agricultural colleges, religious mission groups, fertilizer manufacturers and distributors, insecticide salesmen, landowners, politicians, and foreign technical assistance personnel By emphasizing the functions to be served, and the competencies required to fulfill them, the Institute helped these groups and agencies to make existing models of education and extension organization viable Efforts and time were not dissipated trying to transplant an imported model or reorganizing existing agencies

The cooperative efforts of many interests, public and private, helped the Philippines to mount and carry forward its first successful rice production program, the country becoming rice sufficient for the first time in 50 years The credit must go to the organized total systems approach, an approach triggered by the development of a new, high-yielding rice variety but strongly reinforced by an aggressive training program coupled with national field trials

Spread of the new rice varieties and practices throughout Southeast Asia has been facilitated by training of research and extension workers, cooperative research programs, and active exchange of information and materials (44) Encouraged by the success of the Philippines, most countries of Southeast Asia have enrolled teams of rice specialists in the production training programs to learn how to grow rice and how to organize similar programs at home (6, 29) Most have successfully adapted the training approach to the needs of their areas (1, 49)

In West Pakistan, for instance, informal data indicate that rice yields of farmers in areas served by extension workers trained via the IRRI pattern are nearly twice those in the areas with conventionally trained workers Where trained wrokers are encouraged and facilitated to use their training, they demonstrate that competence or performance-oriented training DOES make a difference

In retrospect

What, then, can we conclude about the role which agricultural education can play in facilitating acquisition and maintenance of the competencies required in agricultural development, particularly for those who work with farmers?

Development requires knowledge and persons competent to produce needed knowledge if it does not exist This requires research, if competent research workers are not available, they must be produced This may require establishing new institutions or orienting old ones to prepare people who can study the farrer's production input and product commercialization problems

If this research is to be relevant to the problems of agricultural development, we need mechanisms that increase the likelihood that the resulting innovations are capable of solving the farmer's problems regardless of his environment This is one of the roles we see for the extension worker Performance here assumes, however, that the extension worker has the necessary competencies, such as already described Without these, he cannot objectively test an innovation for its local advantages

Where such tests produce positive results, the extension worker, given adequate communication competency, can develop appropriate communication strategies and messages for the farmer and various supporting audiences Where negative, the relevance of future research may depend upon how well he can report this to the research institution

Thus, the relevance of research, the justification of education, and the effectiveness of extension depend upon the extension worker having, at least to some degree, the technical, economics, science, farming, and communication competencies described

Unfortunately, the majority of agricultural educational institutions in the developing countries probably are not so oriented to these goals, or do not have the human resources to pursue them They may feel they also lack the physical resources, but this, too, is part of the problem Chances are that the most readily available, low-cost, efficient classroom --the farmer's field-- is rarely used

Universal agreement with the point of view about agricultural education or extension described here is not expected Our experiences at home and abroad have documented time and again that the heterogeneity among institutional settings is much too diverse and complex for any particular model of extension

We have presented, instead, a set of characteristics which we believe to be minimal for the success of any agricultural education or extension model While we do not expect anyone to disagree about the importance of competency, some may disagree about which competencies and how much of each are important

Others may argue that we have neglected the most important virtues or characteristics of agricultural workers ---a dedication to service, an interest in agriculture, and a desire to help one's fellow men Such characteristics are desirable, but we cannot accept them as substitutes for competency

Finally, we recognize that it may be difficult to find all of the five competencies --technical, economics, science, farming, and communication-- combined in a single agricultural graduate, or to marshal the resources necessary to provide the learning opportunities so that he may acquire those missing or inadequate To the extent that it is not possible, and this certainly may be the case in many developing countries where workers in agriculture have minimal education, then the agricultural development organization must provide the missing competencies through domestic or imported specialists, teams of specialists, and/or cooperative arrangements with other entities

Although we all probably know better, there is a pervasive tendency, at home and abroad, to try to solve all developmental problems through a single disciplinary approach What is needed is an approach that mobilizes, energizes, and qualifies the range of persons and institutions in the total system, or all of the relevant, interacting systems This means attention to research, education and extension, yes, but also to multitudinous production input and product commercialization factors We need a broader viewpoint, and we need better information about the competencies required to make the total system effective

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