INTERDISCIPLINARY WORK: PATTERNS AND PRACTICALITIES

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This paper presents patterns and practicalities associated with an interdisciplinary mode of doing agricultural research. Interdisciplinary work requires that more than one component, one factor, one dimension, one aspect, and therefore more than one discipline is involved in carrying out research programs or projects. Approaches to interdisciplinary agricultural research can be categorized into eight typologies: conceptual; multicomponent; systems-oriented; consultative; hypothesis-testing; interactive, focused, problem-solving; action-research-in-action, and "hybridized". While there are clear gains from its pursuit, interdisciplinary work poses clear challenges: it entails relatively higher costs in terms of time, research staff, and skills requirements. It particularly relies on research leadership, support from funding agencies, and the ability of members of the research team to avoid professional enthnocentrism in their work.

This is not an essay expounding on the beauty and rightness of interdisciplinary research. Because the rhetoric on the subject is robust; the demands are great; and practical tips on how to do it in real-life situations are rare, concepts on what constitutes interdisciplinary research are as varied as the researchers engaged in it. Interdisciplinary research projects differ in nature, intensity, scale, complexity, level, and aspired for outcomes. This paper is an attempt to portray patterns of interdisciplinary work and practicalities associated with this mode of doing agricultural research.

PATTERNS OF INTERDISCIPLINARY WORK

Interdisciplinary (based on Webster's definition) means involving or joining two or more disciplines or branches of learning. But the prefix inter conveys a nuance not evident in the above definition. Inter means between or among, with or on each other (or one another), together, mutual, reciprocal. Multidisciplinary, on the other hand, means combining the disciplines of many different branches of learning or of research. This nuance is provided by the prefix *inter* and *multi* simply means many. Such subtleties when applied to the conduct of research may not be very subtle, operationally speaking.

Interdisciplinary work (accent on work) is probably both a product and a stimulus or even a simultaneous companion of concepts like: integration, holism, coherence, comprehensive, synergism, multisectoral, sustainable, environment, farming system, ecosystem, land-use patterns, participatory, quality of life, poverty, women-in-development, user's perspective, etc. The substance behind each of these is more than one component, one factor, one dimension, one aspect, and therefore more than one discipline is often called upon to carry out research programs or projects which emerge from any of these concepts.

Publications with titles like: "Trees, Food, and People: Land Management in the Tropics" (Bene, Beall, and Cote 1977); "The Technology Triangle: Linking Farmers, Technology Transfer Agents and Agricultural Researchers" (Merill-Sands and Kaimowitz 1989); "Management of the Potato Tuber Moth by Tunisian Farmers" (von Arx et al. 1988); "Integration of New Rice Technology in a Mindanao Village" (Mallonga 1988); "Seed Potato Systems in the Philippines" (Crissman 1989); "Consequences of Deforestation for Women's Time Allocation, Agricultural Production and Nutrition in Hill Areas of Nepal" (Kumar and Hotchkiss 1988); among many, imply some kind of interdisciplinarity in the underlying research. Without claiming an exhaustive survey of relevant materials, a typology of interdisciplinary agricultural research projects is attempted here in order to provide us a variety of scenarios involving social scientists. The categories in this typology are not mutually exclusive. They are meant to illustrate the predominant operational mode manifested in each type.

Conceptual Interdisciplinarity

The approach involves two or more disciplines examining the dimensions of a complex problem through dialogues at a much more abstract level.

Example:

The United Nations University which had a five-year effort on an inter-disciplinary dialogue on world hunger bringing together social scientists (Human and Social Development Programme) and nutritional scientists (World Hunger Programme) reports the following:

1. "Real interdisciplinarity is difficult to achieve" – all the more so when the effort involves scholars from many cultures and schools of thought.
2. In general terms, the social scientists argued, on the one hand, that "hunger and malnutrition are merely the most obvious symptoms of a much more complex set of societal issues which must be resolved before world hunger can be eliminated." On the other hand, the nutritional scientists expressed a concern for what could or should be done in the meantime, while such fundamental societal changes were coming about, for the millions of people who are hungry now.
3. The general thrust of the social scientists is to emphasize the holistic approach - a process by which a large number of variables are considered simultaneously... Whereas the World Hunger Programme is oriented toward the identification and melioration of specific needs (e.g., nutritional deficiencies, postharvest food losses), the Human and Social Development Programme proposes that few, if any, effective long-term developmental consequences can be obtained for viewing and acting upon such needs apart from the broader context of social, cultural, economic and political issues with which they are inextricably bound.

4. The critical question left unanswered is: "How does one enter into the reality?" Holism is a concept with an infinite capacity of extension and meanings but it needs to be operationalized. Real problems are "the expression of actual processes in given conditions and have to be tackled with action rather than words..." This "reality check" is a constant requirement which assesses the translation of theory into practice.

Multicomponent interdisciplinarity

This type of interdisciplinarity refers to research programs characterized by multiple components and several disciplines within a program which have little or no interaction between and among them except the recognition that these components are logically related to each other.

To illustrate, a research program can cover several aspects of the sweet potato from production, distribution, utilization, and impact involving relevant disciplines including socio-economics but each component has a separate identity with minimal input from each other and no common goal which every component must contribute to. For example, is the goal to transform sweet potato subsistence production into commercial production? As one plant breeder argues: "We should not glorify traditional and subsistence production." Do relevant users want sweet potato to continue performing different functions such as subsistence, soil erosion control, cash income, security, etc? Can socio-economics and anthropology contribute to plant breeding objectives? For example, what role does indigenous knowledge play in the agricultural scientists' research agenda?

In the past, so-called multi-disciplinary research programs meant several independent and separate projects in one program. The only times they come together are in the project proposal and in the pages of the project report. This state of affairs is changing, albeit slowly.

Systems-oriented interdisciplinarity

This approach attempts to arrive at an analytical description and diagnosis of the system showing the inter-connectedness between different parts of the system. It helps locate diagnosed problems in their relevant physical, biological, and social context. Participation in and/or exposure to the analysis and its outputs enable researchers in narrowly-defined specializations to acquire a farming system or agro-ecosystem perspective, including sensitivity to gender issues.

Gordon Conway (1985), a prominent advocate of agroecosystem analysis, argues that "farmers out of necessity adopt a multidisciplinary, holistic approach to their work and it would be logical that this should also apply to the design and implementation of agricultural research and development programmes." He reasons further that "many, if not all of the problems are essentially systemic in nature. They are linked to each other and to the performance of the system as a whole." The agroecosystem analysis begins by

> "defining the objectives of the analysis and the relevant systems, their boundaries and hierarchic arrangement. This is followed by pattern analysis, the system being analyzed by all the participating disciplines in terms of space, time flows and decisions. Those patterns are

> important in determining the important system properties of agroecosystems, namely: productivity, stability, sustainability, and equitablity. The outcome of the analyses is a set of agreed key questions for future research or alternately a set of tentative guidelines for development."

Another systems-oriented type of interdisciplinarity is farming systems research (FSR). Schubert et al., for example, focuses on the household rather than the farmer in his definition:

> "A farming system is a set of interrelated farm enterprises and household activities managed by members of a farm household in order to achieve their goals within the restrictions of their resource endowment and within the limits of the physical, ecological, and socio-economic environment of the farm."

There are three main subsystems: the farm system, the household system, and off-farm enterprises and activities. These systems are very closely connected so that a change in one subsystem has consequences for the whole farming system. Associated with these subsystems are particular cropping calendars, cultivation practices, labor requirements, food availability, and cash-flow pictures. The analytical description of the system shows the production-consumption linkages, understanding of which is essential, if the objective is to change the production system (Schubert et al. 1986). Using the farming systems approach, gender issues have been considered by Thelma Paris (1988) at the various stages of the technology development process specifically in the design, dissemination, and extension phases. The basic elements for achieving this are:

- analysis of women's productive activities within the farming systems including their roles in the household and agricultural production;
- identification of existing, emerging, and future technology options conducive to the expansion of women's productive capacity;
- greater understanding of the factors constraining or supportive of women's more productive participation in farming system such as access to information, organization, and productive resources, access to, and control of one's resources; and
- application of this understanding throughout the farming systems research process; and pilot testing of promising technologies.

A research team is almost always a feature of the systems-approach. As a matter of fact, Conway (1985), assumes the existence of a team in his agro-ecological analysis:

> "The goal of multidisciplinary analysis is to achieve an interaction between the disciplines that produces insights which significantly transcend those of the individual disciplines. Arranging the working environment so as to promote ease of communication among the disciplines is important. Experience suggests that the generation of good interdisciplinary insights also requires organizing concepts and frameworks and a relatively formal working procedure which encourages cross-disciplinary exchange."

Consultative interdisciplinarity

Some research projects are predominantly social science (e.g., economic anthropology, sociology) but consult with agricultural experts for specific aspects of the research problem.

For example, Gascon's (1989) study of women's technical knowledge and participation in rice farming used rice scientists in developing the technical knowledge test which consists of a series of questions on basic management practices judged to be critical in achieving maximum input efficiency. It included the following categories of technological practices in rice farming: varieties and seed management, fertilizer use, insect and weed control, and other pre- and post-harvest management practices.

Among the findings of this study are: the main factor that influenced the participation of women in farm tasks was their expectation for higher income; estimates of women's technical knowledge showed that through husbands' technical knowledge, women improved their skills and technical know-how in farming; a reduction in women's home production time gave them more chances to develop interest in new rice technology; and participation in economic activities proved to be a determinant of wife's technical knowledge. The study also found out that participation knowledge in the rice production system proved to be a significant determinant of wife's technical knowledge. However, its impact is not sufficient to guarantee the improvement of wife's knowledge in rice technology without the proper program designed to assist them in acquiring technical skills in rice farming.

What is worth noting is that an average of 65 and 52 percent of the questions were answered correctly by husband and wife, respectively. In general, this performance is not encouraging when one considers the great exposure the community has had to rice production information but women performed well considering that they are never deliberate targets of agricultural information. Because of the rice scientists' contribution to the content of the technical knowledge test, the social science study acquired greater significance not only for women-in-development but also for technology for development and extension.

Hypothesis-testing interdisciplinarity

When well-defined research problems of an interdisciplinary character emerge from a system-like perspective when the variables are clearly identified, when the expected relationship between them are articulated, and when the indicators are operationalized, a hypothesis testing stage has been reached with more than one discipline participating. Although each discipline is assigned a very specific task in its area of expertise, all their contributions are essential to the substance of the hypothesis to be tested.

One example of this type of interdisciplinarity is Abansi et al.'s (1990) study using the hedonic pricing model to evaluate consumer preference for rice quality. Consumers were categorized by rural-urban and by income class. Physical and chemical considered important determinants of rice price were whiteness, transluscency, grain length, foreign matter content, head rice recovery, apparent amylose content, and alkali spreading value. Both urban and rural consumers were price responsive to changes in quality characteristics. Cooking and eating qualities like texture and softness of cooked rice were found to exert the biggest influence on the price paid by both groups. However, higher income urban consumers attached higher implicit values to quality characteristics than rural consumers. Low-income groups prefer high amylose content rice which "guarantees" greater volume expansion; thus allowing them to feed more people with relatively less rice. High-income consumers expressed preferences for higher head rice recovery but lower amylose content. For this group, there was an inverse relationship between price and amylose due to the presence of high-priced traditional varieties with intermediate amylose content.

While this study was basically an economics research project, the physical and chemical characteristics of the rice samples were analyzed at the cereal chemistry laboratory of the International Rice Research Institute. Without this analysis of the preferred rice qualities, the results would have been socially interesting but would not be of much specific use to other agricultural scientists. Because of the physical and chemical results which are associated with socio-economic characteristics of consumers, the project investigators could draw implications: for rice research on breeding, cultivation, and postharvest systems to produce qualities which better satisfy consumer needs (Abansi et al. 1990).

Another example of hypothesis-testing interdisciplinarity is Pingali et al.'s (1990) study on pesticide use, safety practices, and health costs, which is led by an agricultural economist with collaboration from a medical doctor and some inputs from entomologists. The results indicate that farmers and agricultural workers face chronic health effects due to prolonged exposure to pesticides. Pesticide-related health costs and associated productivity losses are already significant and can be expected to increase with increasing pesticide use. Unsafe pesticide handling practices are as important a determinant of adverse health effects as the total quantity of pesticides handled. The returns to generating awareness among farmers and pesticide applicators and the importance of safe pesticide use can be quite significant, especially in reducing over-all health costs for the farm household. Research results also indicate the role of integrated pest management strategies that minimize pesticide use in reducing health costs.

Interactive, focused, problem-solving interdisciplinarity

Agricultural research projects which ultimately aim to develop relevant and effective technology for users have begun to consider the involvement of social scientists in the technology generation process. Their role is not only to help assess potential acceptability of the technology or to evaluate its success or failure after it has been introduced but as a working partner in the technology development process. Unlike other types of interdisciplinarity, this one is not only interactive between agricultural and social scientists but also continuous and focused on solving a particular agricultural problem. It seeks not just to understand, identify and define the problem but to solve it.

An excellent example of this is the work of an interdisciplinary team (anthropologists and postharvest technologists) in developing postharvest technology at the International Potato Center (CIP) [Rhoades 1984]. The project came about after potato stores in Peru which were technically sound and extremely well-designed according to storage specialists were hardly ever used.

The research team approached the problem of storage from the farmers' point of view. Farmers claimed that the difficulty was not with their storage technology but with new "varieties" that produced long sprouts when stored under traditional methods. The long sprouts had to be pulled off before planting and this was considered by farmers to be labor costly. As a result of this anthropology-technical science dialogue, the team concentrated on a new method of storing improved seed potatoes in the farm by applying a technique which CIP has been experimenting with for some time. Under experiment station conditions, naturally diffused technique aids in the control of sprout growth and lessens pest and diseases damage. The question was whether this design was relevant to farm conditions and acceptable to farmers was examined through continued ethnographic research and on-farm trials with farmers acting as advisers. After considerable modification based on farmers' advice, the team developed rustic seed store model. Upon seeing that diffused light storage reduces sprout elongation, farmers expressed interest but were then concerned about the cost of seed trays. In response, the team built simple collapsible shelves from local timber and used them in a second series of on-farm trials. The results were again positive but this time farmers were able to relate more closely to the rustic design of the stores.

The prototype rustic seed store was promoted in 25 countries by national programs but virtually every farmer developed his or her own unique design based on the diffused light principle. Anthropological follow-up in adoption areas demonstrated clearly that "technology" as a unique physical "package" was not being accepted. The diffused light principle was being translated into an amazing array of farmer experimental and adapted versions of potato stores with their own cultural flavor.

In this particular case, the anthropologist and the postharvest technologist applied their respective technical and sociocultural knowledge, skills and methods in an interactive manner to find a solution to some of the potato seed storage problem. In the process, they learned a great deal from each other and about the technology itself.

Another example of interactive, focused, problem-solving inter-disciplinarity is the potato tuber moth research program in Tunisia which involved the following:

1. Determining seasonal population patterns,
2. Assessing economic damage to stored potatoes,
3. Experimental research to identify promising control components, and
4. On-farm research to:
    - document levels of pest damage and control practices farmers' fields and stores, and
    - test the effect of new or improved production components on yields

and net returns in comparison with the farmers' current practices.

The research team composed of entomologists and economists did their research in the experiment station, in the laboratory, in farmers' fields, and in wholesale and retail markets in a joint effort to understand the problem and find solutions. The researchers conclude that:

> "the development of decision rules, based on entomological research results and the farmers' socio-economic constraints, can help the extension service to disseminate an improved integrated pest management program. This will require information on the pest, crop and market situation, based on routine observations by entomologists and economists" (von Arx et al. 1988).

Action-Research-in-Action Interdisciplinarity

The process of working out implementation strategies in agricultural development programs which have both technical and social components require research not only before and after the action is taking place. As a matter of fact, research guides the action. The action-research-in-action type of interdisciplinarity involves technical experts, farmers, social scientists, and policymakers.

An example of this is provided by the Philippine National Irrigation Administration's (NIA) experiment on participatory communal irrigation as reported by de los Reyes and Jopillo (1986):

> "The usual irrigation development strategy focuses on the construction of the physical irrigation system and becomes concerned with the development of the social organization of the system only upon completion of construction. NIA's approach in contrast, addresses the development of the irrigation organization before the start of construction. For this purpose, NIA fields full-time organizers to a project area months before the agency expects to begin construction of the irrigation system. These organizers, called irrigation community organizers or ICOs, work with farmers to develop and strengthen their association. They prepare farmers for working with engineers in planning the layout and design and construction plans of the irrigation system. Thus a key characteristic of NIA's approach is the participation of farmers in the development of their irrigation system from the design phase up to the actual construction. Once the construction assistance is completed, NIA turns over the improved irrigation system to the irrigators' association. This turnover bestows formal recognition on the association as the system owner which from then on becomes responsible for system operation and maintenance."

The research part of this approach includes community and social profiling, continuing process documentation of what is going on which feeds into the actions taken, and evaluation studies to assess the effects of the intervention on the irrigator's associations. The entire approach involves farmers, irrigation engineers, policymakers, community organizers, and social scientists.

The empirical findings of the evaluation study showed that compared to the non-participatory projects, those which were participatory achieved more of the intended results such as: larger irrigated areas, greater productivity, stronger associations, improved water distribution, better compliance with government policy and improved relationship between farmers and the government (de los Reyes and Jopillo 1986).

"Hybridized" Interdisciplinarity

Through training, personal inclination and interest, exposure to, and experience in more than one type of subject matter and more than one discipline, some professionals acquire hybridized interdisciplinarity. This means that they are able to function with a systems – or at least a broader perspective than social science alone or agriculture alone.

Examples of this hybridization are agricultural anthropologists, ecological anthropologists, agricultural economists, agricultural sociologists, etc. One requirement of social scientists who will be engaged in agriculturally-related research is to understand enough about agriculture so that there will be a common basis for interaction.

Raintree's (1989) study on the socio-economic attributes of trees illustrates this kind of hybridization. His paper posits a set of relationships between the biophysical attributes of trees, on the one hand, and the socio-economic attributes of trees, on the other. Socio-economic attributes of particular trees refer to "those biophysical attributes which make them useful or useless, adoptable or non-adaptable, beneficial or harmful, relevant or irrelevant, etc., to different users in different socio-economic settings."

It is probably fair to say that Raintree would not have thought about this concept if he did not have the professional background as an ecological anthropologist and the exposure to and understanding about different functions of trees in different contexts and for different groups of people.

As a second example, after his experiences working with experiment station scientists at the International Potato Center, and farmers at the field level, Rhoades (1982) arrived at seven basic questions to be asked in connection with farm trials:

- In the problem to be solved important to farmers?
- Do farmers understand the trials?
- Do farmers have time, inputs, and labor required by the improved technology?
- Does the proposed technology make sense within the present farming system?
- Is the mood favorable for investing in certain crops in a region?
- Is the proposed change compatible with local preferences, beliefs, or community sanctions?
- Do farmers believe the technology will hold up over the long term?

A third example of hybridized interdisciplinarity is Michael J. Pott's (1983) paper which documents the:

> "historical development of the potato crop as an example of a typical vegetable crop in Southeast Asia and shows how this development has affected the cropping practices used today before many practices are superseded and totally forgotten as the older generation of settlers die out. It also serves to illustrate the importance of this information in formulating development projects and should serve

as a basis for the development of other crops, both in the Philippines and elsewhere in Southeast Asia, where similar circumstances arise."

The paper includes the historical development of Benguet Province, agricultural patterns, farm units, labor-cultural practices, marketing, financing, economics, and consumption. Potts is an agricultural scientist who is sensitive to social issues and has worked in Benguet for several years.

PRACTICALITIES IN INTERDISCIPLINARY WORK

Despite its current "glamour," interdisciplinary work has its cost. It is not cheap in terms of research staff, time for meetings, dialogues, arguments, and skills required in pulling it off. This cost must be offset by the gains. In assessing the potential benefits and costs, the following issues might be worth looking at:

Leadership. Who writes the proposal and provides the guiding hand? Who writes the report and how are others credited especially when the process is so interactive that the output is above and beyond the sum total of the identifiable individual contributions from each discipline? As Rhoades points out:

> "Each discipline interprets the problem in its own way and perhaps overstates or misstates the position of the other discipline. Professional ethnocentrism in agricultural development is still more powerful than we like to admit."

The research team and its dynamics. What is the composition and size of the research team? Where would the members be recruited from? Some elements which could contribute to the realizability of an interdisciplinary undertaking include:

- Crossdisciplinary learning
- Common definition of the problem
- Mutual professional respect (Social scientists tend to be self-righteous in thinking that concern about the human factor and human welfare is their own special turf.)
- Catalytic rather than "explosive" chemistry of personalities or at least an ability to return to relative harmony after each major or minor "explosion." Some call this "creative tension." Identifiable outputs from the interdisciplinary exercise which are beyond what each discipline would have produced by itself.

Interdisciplinary sponsor. An interdisciplinary project will find support only if the sponsors are also interdisciplinary in orientation. Otherwise, a research project has to be broken down into different components to obtain funding from different divisions or sections of the same funding agency.

Possible outcomes from inter-disciplinary work. What have we gotten, so far, from interdisciplinary work in agricultural research:

- Consciousness-raising with respect to the role of other factors in order to provide specialized disciplines a broader, perspective, if not a holistic one;
- Descriptive-analytical diagnosis of existing systems;
- Identification and specification of problems within the agricultural system which lend themselves to more specialized disciplinary research;

- Hypothesis-testing in an interdisciplinary fashion;
- Development of technologies which have a better fit to user's needs;
- Increased skill in applying the system-diagnostic procedures to variable scales such as:
  a) micro (household management unit),
  b) meso (local community or ecosystem, neighborhood, small watershed, village),
  c) macro (region, country, eco-zones), and
  d) judicious "borrowing" of research methods (e.g., qualitative, quantitative).

It has been said that while an economist can teach the anthropologist how to count, the latter can show the former what to count. At the start of any research project (whether biological science or social science), an introduction to anthropological field research methods is useful because they offer a systematic way of getting acquainted with field realities. But perhaps there is a great deal of wisdom in the admonition that: "the best type of interdisciplinary thinking is one that takes place within the same skull."

NOTES

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