Anthropologists and Effective Resource Management

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Abstract:

Effective management of subsistence agriculture is based on indigenous technical knowledge (ITK) of local ecosystems. Included in this knowledge are management techniques which produce effective adaptations to micro-environmental niches. New management techniques such as organic soil enhancement must be viewed in the context of relevant land-use practices and local environmental constraints. The Tropical Soil and Biological Fertility (TSBF) research program attempted to look at the management of tropical soils and place it in a socioeconomic context. Anthropologists can take a leading role in evaluating the effectiveness of resource management techniques, such as soil management techniques, by using or modifying such models as Robert E. Rhodes' Farmer-Back-to-Farmer model to ensure global sustainability.

Introduction

Most of human history has been involved in various forms of food production. The origins of food production and its development from horticulture to agriculture have been studied by anthropologists for many years. Food production is a human activity that manages its resources according to a wide range of cultural concepts, beliefs, and attitudes regarding nature. Culture, with its use of technology, has been the intermediary between human activities and the environment, which has translated into management practices that have made agriculture the chief agent of the transformation of land (Hillel 1991; Dahlberg 1986; Bohren 1995). Effective management of resources that can ensure sustainability thus depends on the combination of new management techniques within the cultural context of local ecosystems.

Anthropologists have studied the origins and development of agriculture but have rarely participated in agricultural research. However, in the 1970s the Rockefeller Foundation's "Social Science Research Fellowships in Agriculture and Rural Development" (1974) included the non-economic social science perspective in their mission. Many anthropologists received these fellowships. Consequently, the International Potato Center (CIP) was formed in Peru.

The CIP defined agro-ecosytem zones and land-use patterns and introduced the rapid appraisal approach for studying cultural systems in developing countries. It was learned that potatoes are essential to subsistence and cash-crop economies and that similar ecological conditions give rise to similar potato production patterns and farmer strategies. The native/indigenous taxonomies used in these production patterns were complex, thus demonstrating the need to pay attention to indigenous preferences – in this case, the color, size, and shape of potatoes. By using the anthropological comparative approach parallels, principals, and cultural laws were found that would allow for the transfer of new agricultural techniques for potato production in a more successful manner. Culture proved to be the framework used to adapt to living in the local environment.

Ecologists, as a result of the Sustainable Biosphere Initiative proposed in 1991, recognized that human dimensions were a key element in ecosystem sustainability and that effective resource management is based in the local value system. This was demonstrated in developing countries and was particularly evident in areas where ecological issues are related to poverty and population pressures. Thus, sustainability is closely linked to human cultures and resource management and requires the expertise of interdisciplinary teams, including anthropologists and ecologists, to resolve complex ecological issues.

Background of Agriculture Research

Traditional agricultural research has focused on commodity research with the goal of increasing crop yields and farm income. The farm has been looked at as a business enterprise, not as a household in an ecological and socio-cultural context. The Green Revolution, a result of commodity research, increased total production and provided much needed food for many parts of the world (van Willigen 1986; TSBF

1990; Chambers and Ghildyal 1984; Greenland 1990). In northwest India, for example, irrigated wheat helped to alleviate food shortages. Resource-rich farmers whose land had good supplies of groundwater, canal water, infrastructure, etc., became very successful (Chambers and Ghildyal 1984). However, the technologies developed for resource-rich farmers did not work for resource-poor, subsistence farmers due to their complexity, expense, and the fact that the resource-poor farmers often farmed marginal lands. In fact, the Green Revolution made many resource-poor farmers worse off due to little change in production combined with low prices (Greenland 1990).

Population pressures and the reduced availability of land are forcing traditional subsistence farmers (often resource-poor) to consider new ways to make their farming practices more productive and keep their farms sustainable. Traditional farmers will actively seek and adopt new technologies (tools or management practices) that will increase production, such as crop rotation, soil management practices, and the use of machinery, if they fit into the natural and socioeconomic circumstances that dominate a farmer's decision-making process. These circumstances are holistic and define the ecological and socio-cultural context in which sustainability can occur.

Farmers' Decision-Making Process

Farmers' decisions are based on the situation in which they find themselves; i.e., the farmers' circumstances (CIMMYT 1985). According to *Centro Internacional de Mejoramiento de Maize y Trigo* International Maize and Wheat Improvement Centre's (CIMMYT) *Planning Technologies Appropriate to Farmers* (1980), the circumstances that most affect farming decisions with respect to crop technology are the natural environment, the economic environment, and their own goals, motivations, and preferences (culture) (Figure 1). The natural environmental circumstances include climate, soils, topography (such as soil slope and depth), and resource constraints (such as the weeds, pests, and disease complex of the crop). The economic circumstances include the input and output markets in which the farmer operates, such as price variability for inputs and outputs and access to input and output markets, credit facilities, land tenure systems, capital (in terms of equipment and animals), management practices, and the physical infrastructure. The socio-cultural environment is made up of beliefs and attitudes, including goals and motivations, food preferences, and social obligations such as household and kin exchanges. These circumstances are based on relatively fixed resources in terms of land, farm labor (generally kin), and capital (equipment and money) (Behnke and Kervin 1983; CIMMYT 1985).

Decisions to accept new technology are made on the basis of how well the new technology fits within the farmer's circumstances. These circumstances are dominated by the primary goal of increasing income through productivity of resources, land, labor and capital as modified by food preference, and risk-aversion. Risks of circumstances, for example, rainfall and prices, are assessed in terms of their effect on the whole farming system, including production and consumption decisions such as the choice of crops, crop location, crop storage, livestock, off-farm income, food preferences of the household, and family labor exchanges. Management strategies include risk-aversion techniques such as staggered planting and crop diversification, which ensure that the farmers' own food supply needs are met first and that cash-crop needs come second (Chambers and Ghildyal 1984). For example, a risk-aversion strategy is to plant subsistence crops on the best soils or to plant them several times to cover the risk of drought and unreliable market prices. New technologies, such as fertilizers which may maximize yields, will only be accepted if they are consistent with the local income-increasing and risk-avoidance objectives.

The cultural acceptance of new technology continues to be an issue within agro-climate areas (areas where crops roughly have the same biological expression and would respond similarly to similar fertilizers) due to differing socioeconomic circumstances. Different recommendations would have to be made in similar areas due to differing community organizations and infrastructures such as roads, markets and access to inputs such as fertilizer or pesticides and seasonal or local price variations, and labor markets. Different land tenure systems and settlement patterns, different credit structures, different trends such as changes in resource use, and different policy environments such as how local prices and input distributions are influenced by government policies must also be taken into consideration (PTAF 1980).

In spite of all these differences, target areas or domains can be chosen according to similar production practices, opportunities for development, and resources. The criteria for grouping should be based on the similarities of farmers and also take into consideration similarities of land type. Both agro-climate and socioeconomic variables are important in identifying target groups. These target areas are dynamic and should be redefined as technology or understanding of the system changes. Most importantly, farmers must make decisions based on local circumstances (CIMMYT 1985).

Natural Environment

- climate
- soils
- topography
  - N slope
  - N depth
- resource constraints
  - N weeds
  - N pests
  - N disease

Socio-cultural Environment

- goals
- beliefs
- attitudes
  - N motivations
  - N preferences
    - -food
- social obligations
  - N household
  - N kin exchange
  - N community

Economic Environment

- input/output markets
  - N prices
  - N access
- price variation
  - N local
  - N seasonal
- credit facilities
- labor requirements
- land tenure system
- capital
  - N equipment
  - N animals
  - N cash
- management practices
  - N seeding
  - N harvest
  - N risk-aversion strategies
- physical infrastructure
  - N roads

Figure 1. Farmer's Circumstances Involved in Decision-making (Modified from CIMMYT 1985).

New Directions in Agricultural Research

Farming Systems Research

Traditional agricultural development projects which gave us the Green Revolution were based on a top-down approach where technology is developed on an experiment station or laboratory and then introduced to farmers. It benefitted resource-rich farmers. Small, or resource-poor farmers have become the new target of agricultural development projects. A new bottom-up approach which looks at the priorities and economic circumstances of farmers in terms of their scarce resources and risk-aversion management practices is needed (Chambers and Jiggins 1987; Rhodes 1984). Farming Systems Research (FSR) was developed as a holistic approach to small farming in developing countries. According to Shaner et al. (1982) and Beebe (1985), FSR is a holistic approach to farming which focuses on the interdependencies between the components controlled by the household members and the physical, biological, and socioeconomic components not under the control of the household members. It includes economic, social, and cultural issues, the world beyond, and the crop and biological potential. The FSR approach emphasizes the essential nature of socio-cultural factors in the process of accepting new technology. It is an interdisciplinary problem-solving process where the farmer and the scientist work together. The process includes diagnosis, on-farm trials, and continuous modifications to adapt to farmer responses and local conditions. It emphasizes research, farmer participation, and continuous adaptation of appropriate technology for the farmer's changing circumstances.

FSR uses an interdisciplinary team approach. The team is made up of social scientists, agronomists or biologists, and farmers (Figure 2). The social scientists formulate the cultural logic of cultivation perceptions, the logic on risk-perception and risk-taking among farmers, transform local knowledge of crop production into more general statements that can be understood by biological scientists, and place farm decisions on technology in a social context. Agronomists or biologists translate the cultivator's experience into scientific designs and adapt trials to local conditions. Farmers do the experimentation from the logic of having to live by the consequences of their decisions (Chambers and Jiggins 1987; Box n.d.; Grandstaff et al. 1985; Rhodes 1984).

FSR is an adaptive process where scientists learn about the technology and its socioeconomic aspects. The success of the adaptive process depends on the willingness of the farmer to adopt new technology. Included in the socioeconomic components of acceptability is the fact that in order for the equipment or techniques to be acceptable, they must be culturally acceptable and capable of being built and maintained by local craftsmen with local materials. The cultural acceptability is based on social conditions which are, in turn, based in a belief system that surrounds a technology's use (Rhodes 1984).

FSR was designed to look at the priorities and economic circumstances of farmers; however, according to Behnke and Kervin (1983), it is deficient in getting to values, rationales, objectives, goals, and motivations beyond economics. FSR concentrates on the agro-economic analysis of farming systems and tends to ignore non-agricultural activities and the fact that agriculture may be secondary in terms of the household economy. FSR often fails to recognize the overlapping nature of household and kin exchanges and, thus, misses the fact that change in one area of a community may change the nature of community-wide relationships, issues which may be primary in accepting or rejecting new technology. In Baluchistan, for example, economists and scientists interested in raising the standard of living and avoiding environmental degradation could miss the essential link between the pastoralists and the Baluch economy. The pastoralists are the essential link to the outside world in terms of trade and seasonal labor. If they were to be "settled down," the local populations would be too numerous, causing more environmental degradation, and the link to the outside world would be severed. Their nomadic nature is an essential part of the ecological adaptation in Buchistan (Spooner 1987).

Other studies have shown how local participation throughout the process can greatly increase the success of the project. In the Philippines and Thailand, for example, the participation of the local community allowed for the identification and analysis of a variety of natural, economic, social, and operational factors that influenced the maintenance and utilization of a small-scale irrigation system. The participatory nature of the project increased the likelihood of success. It has now become routine for the National Irrigation Administration of the Philippines to incorporate a socio-technical profile of the community into irrigation development activities (Grandstaff et al. 1985).

Rapid Appraisal

The process of collecting the socioeconomic data for FSR can be cumbersome. Traditional questionnaires are structured to quantify large amounts of data on generally large populations. Attempts to use structured questionnaires in development work have been largely unsuccessful due to the time needed to collect the data and the large volumes of data produced. As a solution, very efficient in-depth interview techniques have been developed such as Rapid Appraisal (RA). In-depth interviews can be adjusted to local conditions, available resources, and specific research objectives.

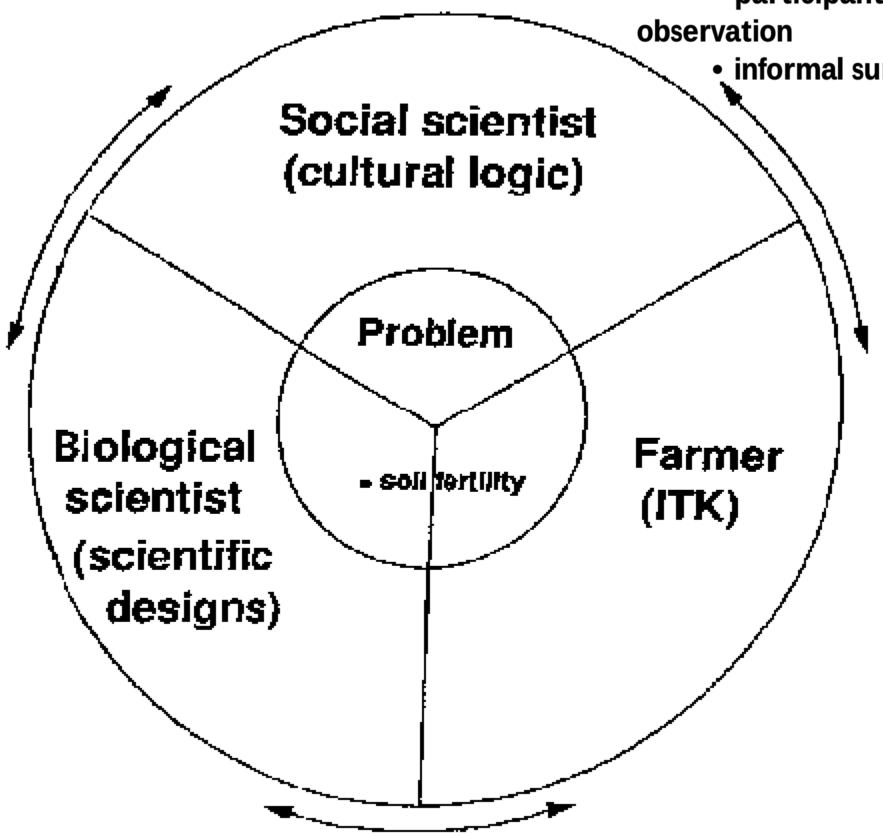
RA is an interdisciplinary approach using small teams of researchers, such as social scientists and biological scientists, to understand a farmer's situation and to try to help design appropriate technology. This is done first by acquiring information from the farmer in order to understand his or her knowledge of the local environment and the problems faced, and by

Information Exchange

- cultural logic for farming practices
- biological information which could enhance farming
  - experiment station
  - laboratory results
- ITK – indigenous technical knowledge

Diagnosis

- participant observation
- informal survey



On-farm research

- modifications
- acceptance

Figure 2. Interdisciplinary Team.

defining the problem by the scientists and the farmers and identifying possible solutions. Second, testing and adapting possible solutions to local conditions is followed by experimentation on experiment stations and on-farm trials with constant interaction between farmers and scientists. Third, independent use of the new technology by the farmer is studied to determine the suitability to his own conditions, resources, and management (a process which may be repeated several times until the technology is acceptable). Because production is embedded in the socioeconomic structure, the social scientist learns the farmer's perspective on production decisions and biological resources and feeds this information back to the biological scientist so that management can be linked to the biological potential of the area. This process is often followed by more specialized research in order to determine the possibility of transferring the technology to other areas (Grandstaff et al. 1987; Chambers and Jiggins 1987; Beebe in press; Bohren 1993; TSBF 1989, 1988).

The real value of techniques such as RA is the emphasis on indigenous technical knowledge (ITK). ITK is the farmers' holistic view of the local ecosystem, including knowledge of a wide range of plants, soils, and their interactions. Those who have examined ITK have been impressed by the depth of local knowledge but have cautioned that local knowledge can easily be destroyed by development. The introduction of monocroping, for example, could increase economic production but decrease crops needed for household nutrition. Indigenous mixed crop systems are the basis of risk-aversion for resource-poor farmers; i.e., it meets nutritional needs and preferences as well as providing cash crops. Monocropping often results in the loss of biological diversity, while indigenous systems model natural diversity. Decisions should not be made that decrease diversity and discourage self-sufficiency; the results would not serve the goal of promoting sustainable agriculture (Howes 1980; Howes and Chambers 1980; TSBF 1988; Scones and Cousins n.d.).

Farmer-Back-to-Farmer Model

Since small and resource-poor farmers have become the new target for agricultural research projects several researchers have come up with models for understanding the general acceptance of agricultural technology. In 1982 Robert Chambers (Chambers and Ghildyal 1984) came up with a Farmer-First-and-Last Model. Also in 1982, Robert E. Rhodes (1984) came up with a Farmer-Back-to-Farmer model. The theme behind these models was that successful adaptation of technology must begin and end with the farmer, farm household, and local community. They attempted to encourage the effective design and the spread of appropriate technology that builds on, rather than replaces, traditional practices. The models are based on an ongoing process of interdisciplinary teams of farmers, social scientists, and biological scientists.

The Farmer-Back-to-Farmer model was developed by Rhodes while working at CIP (Figure 3). It consists of four activities: diagnosis, identification of solutions, testing and adaptation, and farmer evaluation.

Diagnosis is based on understanding and learning (similar to farming systems research, but from the farmer's point of view) and problem identification. This is done by surveys, on-farm experimentation, and participant observation of farmers' and community activities. Identification of solutions is a constant process of communication of possible solutions until potential solutions are identified. Testing and adapting potential solutions is a process of testing and adapting the potential solutions/technology to the local circumstances. This is done first in experiment stations and then in on-farm trials. The solutions/technology must fit the technical, economic, and socio-cultural circumstances of the farmer. Farmer evaluation is the critical activity. The solutions/technology is evaluated by the farmers under their circumstances, including resources and management. The scientists must understand the farmers' adaptation and modifications and note the impact of the solutions/technology on the farmer and the society at large.

The essence of these models is the emphasis on the farmer's point of view, informal survey techniques, continuous adaptation, and farmer experimentation. The goal is the successful adoption of a technology that will increase productivity and income without interfering with the risk-aversion activities of the farmer. These models foster sustainability by allowing the farmer to adapt within his circumstances rather than to become dependent on outside agencies.

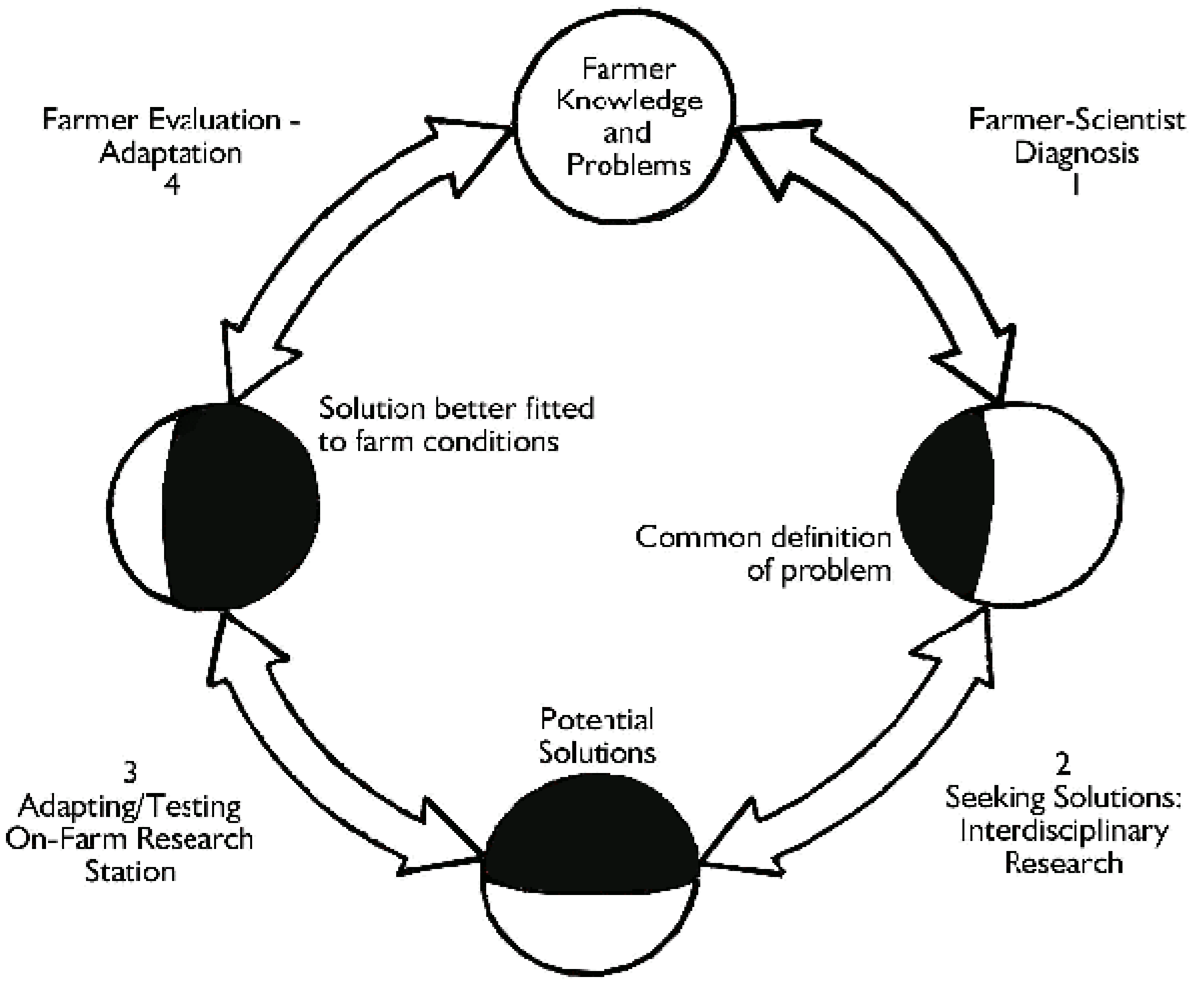


Figure 3. Farmer-Back-to-Farmer Model (Rhodes 1986).

Modification of the Farmer-Back-to-Farmer Model

The Tropical Soils and Biologic Fertility (TSBF) Project was initiated in 1984 by the International Union of Biological Sciences and the UNESCO "Man in the Biosphere" Program. The goal was to stimulate research in the role of biological processes in the maintenance of soil fertility. TSBF used an integrated approach to the development and application of sustainable management techniques for tropical soils that was consistent with economically sound conservation policies.

The primary objective of TSBF was "to develop and evaluate management options for improving or maintaining soil fertility through the manipulation of soil biological processes" (TSBF 1990, 30). This objective was approached from two research perspectives: "strategic" research concerned with a better understanding of the soil biological processes; and "target" research concerned with the soil biological aspects of specific management problems (TSBF 1989). Extensive research had been done on the role of biological processes in the maintenance of soil fertility. Research on the importance of understanding the socioeconomic context of organic matter management on tropical soils and the resulting application of new management techniques has been less well-studied. Both were addressed in this project.

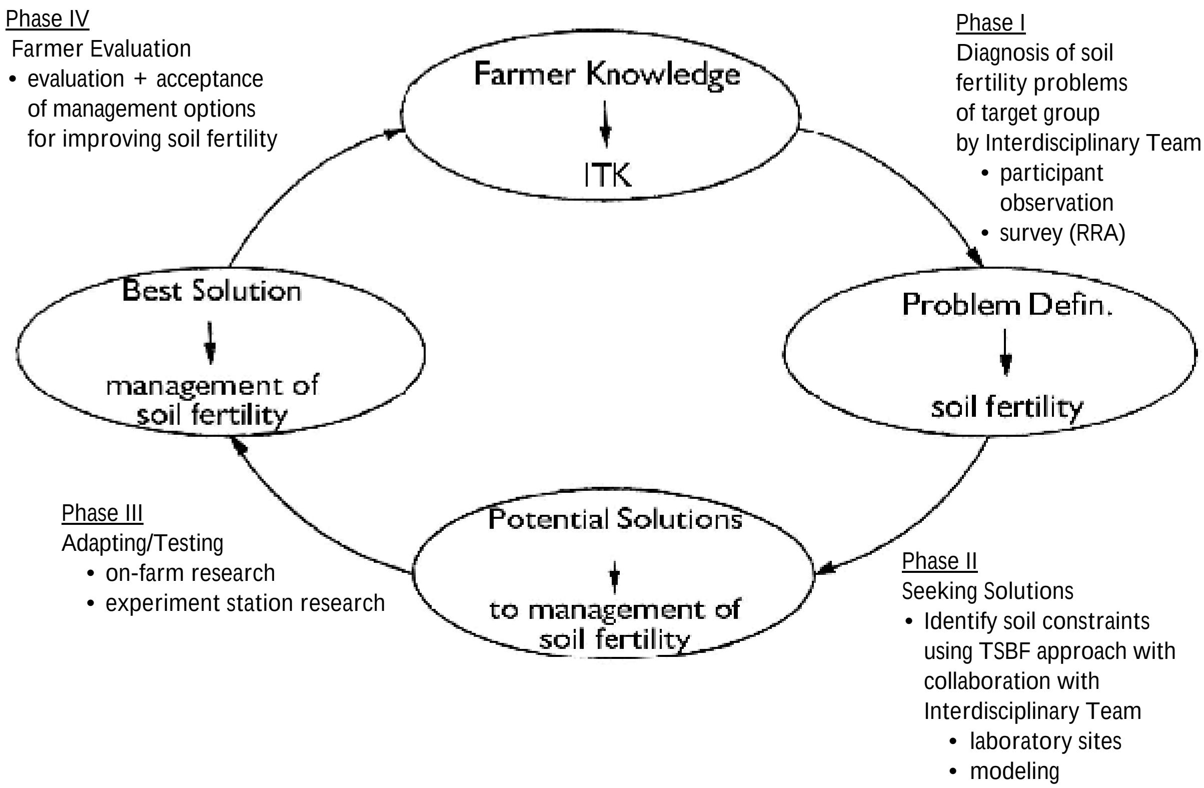


Figure 4a. Farmer-Back-to-Farmer Model with the TSBF approach (Modified from Rhodes 1984).

The Farmer-Back-to-Farmer model was used in this project to introduce scientific findings into a community. In the context of TSBF, it was necessary to modify the model in order to introduce findings learned from the strategic research into the community. Figure 4a shows that the problem of soil fertility had been defined before the participatory process begins; however, the iterative, interdisciplinary team approach (including the farmers) begins with the understanding of the problem in the local context and follows the model as described above. Figure 4b is a more detailed description of the process including utilized by the TSBF project.

The introduction of methods utilizing biological rather than chemical methods to increase fertility would allow the traditional farming system to increase fertility without depleting the long-term fertility of the soils. Tropical soils are inherently infertile; chemical fertilizers can increase production in the short-term while decreasing fertility in the long-term. This is particularly important for resource-poor farmers who are already farming on marginal soils. By using the Farmer-Back to-Farmer model with the modifications shown in Figures 4a and 4b, it is possible to introduce appropriate scientific findings into a farming community in a participatory manner. This project was able to implement its primary objective of developing and evaluating management options for improving or maintaining soil fertility through the manipulation of soil biological processes.

Conclusion

Sustainability is both biological and cultural. To ensure global sustainability it is necessary to encourage effective agricultural management practices, especially in areas with marginal resources. A team approach that is interdisciplinary and participatory can use appropriate science to solve environmental problems in micro-environmental niches. This can be done by utilizing and perhaps modifying appropriate models such as the Farmer-Back-to-Farmer model.

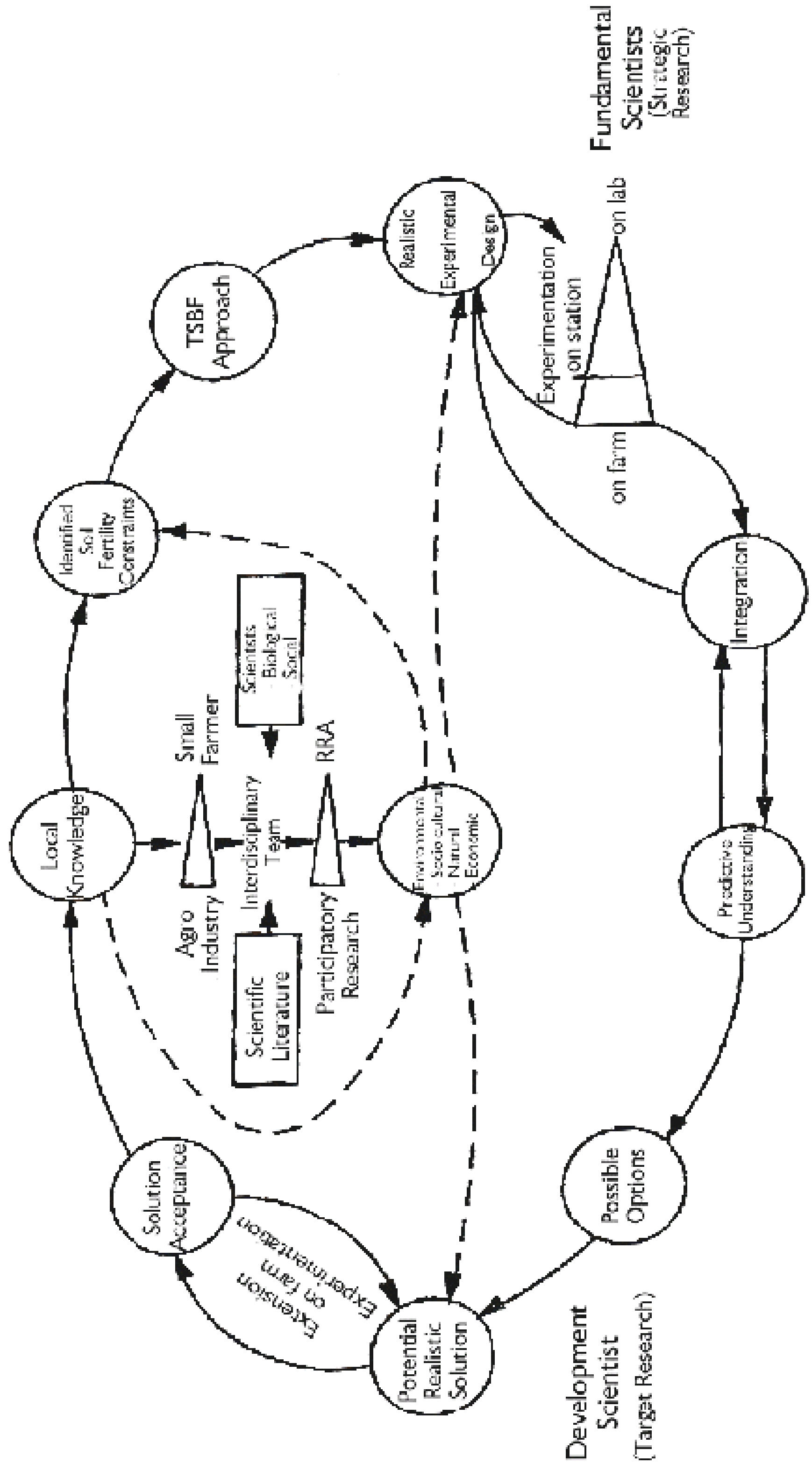


Figure 4b. TSBF Conceptual Information Transfer Model.

Research demonstrates the importance of understanding the whole system, including the socio-cultural system, when looking at sustainability. At Yurimaguas, Peru, for example, increasing population pressure has resulted in unproductive shifting agriculture. Fertilizer use is not economically feasible. Sustainable agriculture depends on efficiently managing organic inputs and soil organic matter (TSBF 1990). Using knowledge gained from TSBF research in a modified technology transfer model could promote sustainable agriculture in areas experiencing environmental degradation due to population pressures. The model can be used by interdisciplinary research teams to evaluate effective resource management practices to promote global sustainability. Anthropologists can play an important role!

Notes

1. Lenora Bohren is a Research Scientist and Director at the NCVECS, Colorado State University, Fort Collins, Colorado. She has managed research projects focusing on environmental issues and helped develop methodologies for organizations such as the USEPA and the USDA. She has addressed environmental issues at both the national and international level for many years. Lenora also serves on a local Land Trust Board and the National Climate Change Assessment Steering Committee.

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