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Farming Systems Research Group
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ISSUES IN FARMING SYSTEMS RESEARCH-
a multidisciplinary behavioral science perspective

by George H. Axinn

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Issues in Farming Systems Research -- A Multidisciplinary Behavioral Science Perspective

by George H. Axinn*

1. What is Farming Systems Research?

A farming system has been defined by the MSU Farming Systems Research Group as a unit consisting of a human group and the resources it manages in its environment, involving direct production of plant and/or animal products, and possibly other products, as well as consumption of those products.

From this perspective, a farming system is a result of interactions among several interdependent components. Although no two farms are identical, each farming system may include such components as land, people, crops, and animals. Like other systems, such a system may be considered, at another level of analysis, to be merely one component of a larger system. Similarly, each of the components in such a system may also be considered as systems themselves, with smaller components within each of them.

Farming systems research can be defined as the application of the systematic approach to the study of whatever is defined as a farm. The purposes of such research may vary from the attempt to understand such a system to a programmatic attempt to make changes within certain aspects of such a system.

The original or traditional type of farming systems research, is that which is done by farm families themselves. Those who actually tend the livestock and till the soil of this world also practice a continuous process of learning from their environment, solving the problems which face them, and making appropriate adjustments from what they learn. This type of farming

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systems research is not confined to the narrow parameters of any of the academic disciplines of professional scholars. Instead, it applies the "science of the farming family" to the "real world problems" of that family, in a continuous series of interactions. It may be labelled "non-formal research."

Without this non-formal type of farming systems research, humanity would not have survived over the centuries. On the other hand, since the researchers themselves must be highly generalized in such an effort, it does not take advantage of the fruits of application of the highly specialized "science of the academic" which could be applied to the problems of the farming system.

The "non-formal type" farming systems research carried on by each individual farming family also lacks the ability to access the world's accumulated knowledge which the highly specialized system of "formal" agricultural research has evolved over the last dozen or so decades.

Both the "non-formal type" and the "formal type," while necessary and functional for their own purposes, have serious problems if they operate independently of each other.

From time to time the international professional agricultural research community has been the resource from which others have attempted to deliver inappropriate technologies to farming systems in several parts of the world. This tends to happen when the formal system lacks sufficient information about the nature of particular farming systems, or when formal agricultural research system purposes are different from those of the farming families. At the same time, small farming systems, trying to adjust to a rapidly changing economic, social, political, and technological outside environment have been placed under increasing stress conditions -- particularly during the last three decades.

Growing populations in some areas have pressed the ecosystem to its productive capacity, becoming a force toward technological change. Increased speed and capacity of the world's communication and transportation systems have influenced national policy affecting agricultural prices, for example, altering relationships between farming systems and marketing systems And the strategies which many national governments have employed, with help from the international development assistance community, have been designed to convert subsistence farming systems into market-oriented surplus producing farming systems. This pressure to change from relatively self-contained, small, unspecialized, independent, low-energy farming systems which consume most of what they produce and produce only what they consume to relatively market-oriented, larger, specialized, dependent, higher-energy farming systems which purchase inputs from outside with cash or credit, and sell outputs to others for cash ... this pressure is perhaps the greatest stress encountered by millions of small farming systems in today's world.

An opportunity, then, for the MSU farming systems research group, is to evolve innovative approaches to bridging the gap between the farm-family-conducted "non-formal" farming systems research and the academic-community-conducted "formal" agricultural research. If this succeeds, it will weaken neither and strengthen both. Its goal is to combine the wisdom of the farming and herding families with the wisdom of the academic scientists, and address both knowledge building and problem solving activities.

The strategies for accomplishing this goal are evolving among many professional agriculturalists who are devising innovative approaches to "farmer's field" application trials, multidisciplinary research teams, involvement of farmers themselves in evaluation of new technologies, and participation with farmers in establishing research goals. (Collisen, 1979; Harwood, 1979;

Hildebrand, 1977; McDowell and Hildebrand, 1980; Norman, 1978; Zandstra, 1979). A major objective is to improve the information flow from what has been labelled as "indigenous knowledge systems" to those who have been trained by and are in communication with the international scientific knowledge systems. (Brokensha, Warren, and Oswald, 1980)

In places where farmers themselves have banded together and pooled their resources to establish agricultural experiment stations, those employed as scientists at the experiment stations (or research farms, as they were often called) had to listen to their farmer clientele. Farmers paid their salaries, supported their research, and identified the most pressing problems of local farming systems for research attention. The early experiment stations in Scotland, Germany, and the Northeast part of the U.S.A. were of this type. (Knoblauch, et. al., 1962; Kuhn, 1955; Rasmussen, 1975; Griswold, 1963)

As the numbers and sizes of agricultural research organizations grew, they were "forced" to decentralize to stay in tune with the different types of farming systems which supported their work. Thus "branch stations" characterize the organizational structure of several national agricultural research systems.

However, where agricultural research organizations are parts of large national government ministries, where the main source of financial support is in the urban centers of political strength, and where the scientific staff tends to be persons with urban academic backgrounds, rather than any on-the-farm work experience, problems of communication with those who till the soil and tend the livestock have arisen. This is particularly significant in those systems which have grown out of "colonial" agriculture research organization focused on export crops.

One approach to overcoming this problem, and increasing the ability and willingness of those conducting "formal" agricultural research to learn from farmers, is the organizational approach described in the next section of this paper.

2. Organization and Administration for Farming Systems Research

From the mixed perspective of a multidisciplinary behavioral science approach, governments and educational institutions of various types have attempted to supplement the kind of farming systems research which is conducted within the farming system itself in various ways over the years. To do this they have set up formal agriculture research systems. There seem to be two polar "ideal-type" approaches to formal agricultural research systems.

The term "polar ideal type" is taken from sociology. There it refers to a category of human organization which is quite different from an alternative category of human organization. Thus, "polar ideal types" of schools might be the "teacher-centered-school" and the "student-centered-school." The polar ideal type teacher-centered school is absolutely dominated by the teacher. The polar ideal-type student centered school is absolutely dominated by the student. These are merely categories which can be used for comparison. In the "real world," there may not be any schools which actually fit the polar ideal-type. However, all schools may have some characteristics of one polar type, and some characteristics of the other polar type. Using such a typology, any two schools can be compared with each other. (Weber, 1947; Parsons, 1949)

With this approach to the study of agricultural research systems, it is possible to create and define polar types, and then compare "real" cases with these "polar ideal types," and with each other.

One type might be labelled the decentralized system, while the other could be called the centralized system. There is a tendency for the first to serve the needs of rural people, and to enhance rural life. There is a tendency for the second to serve the needs of urban people, and to industrialize, commercialize, and depopulate the countryside. Several aspects of these two "ideal types" are characterized below.

The decentralized agricultural research system tends to be "owned and operated" by local rural organizations, and control is in the hands of farmers. It is an extension of what farm families can do within their own family farm ecosystems; an effort to bring together their knowledge and resources, and to focus somewhat more specialized effort on problem solving for and on behalf of their day-to-day interests. The centralized agricultural research systems, on the other hand, tend to be "owned and operated" by national governments, with control in the hands of scientists and administrators in the central capitol cities.

In the decentralized systems, information exchange tends to be part of the broad function and responsibility of the staff of scientists. Their task is to learn from farmers, do research appropriate for farmers, and inform farmers of what they find. In the centralized systems, scientists can specialize in the discovery of new knowledge, with little responsibility for communication with family farm ecosystems.

In the decentralized agricultural research systems, the staff tends to be recruited from among the local people. In the centralized systems, the staff tends to be recruited from outside the local situation, because the base of selection is specialized skills.

Funding for research activity in decentralized systems tend to come from local sources. In the centralized systems, funding tends to come from central government sources.

In the decentralized systems, there is a tendency for research and extension functions to be merged. In the centralized systems, there tends to be a specialization of research and extension functions, with centralized agricultural research systems focusing on their knowledge discovery functions.

There are also differences in methodologies between the two kinds of systems. A basic research methodology in the decentralized systems tends to be continuous interaction with rural people in an effort to learn from them. In the centralized system, methodology tends to be based on replicated field experiments, with interaction wherever possible with the international agricultural research community (through publications, meetings, correspondence, etc.).

The decentralized systems tend to emphasize local applications, and encourage communication with farmers. The centralized systems tend to emphasize basic scientific research, and encourage communication with the international scientific community.

In the "real world" there are not many cases of a "polar ideal-type" of either the decentralized or the centralized kind. However, there are many more agricultural research systems which are closer to the centralized -- looking at the various nation states and international agencies in the world in 1981 -- than there are decentralized systems. One reason for the renewed interest in the so-called "farming systems research" in the last few years is an effort to achieve some of the benefits to farming families of the decentralized system while also maintaining the strength of the centralized system.

3. Research in the social and behavioral sciences relating to farming systems.

There has been a great deal of anthropological, sociological, psychological, economic, and political research which is tangential. What follows is an attempt

to reflect on multidisciplinary social science scholarship on this subject.

A first observation is that there has not been much serious scholarship relating to the phenomenon discussed above. Neither political scientists nor anthropologists nor sociologists nor economists have successfully related the types of agricultural research systems found around the world with patterns of political power and control and patterns of farming systems themselves. This seems to be an area of opportunity for future research.

The climate for such research has improved, both within the disciplines involved and among those agencies and organizations which support agricultural research. Further, the conceptual and methodological issues can now be worked out because international collaboration makes comparative approaches feasible.

There is a growing body of study relating to the appropriateness or inappropriateness of technologies; the attempts to transfer technologies from one social system or culture to another; and some back-tracking relating to the rationale for the development of particular types of technology. (Dunn, 1978; Eckaus, 1977; Goldschmidt, 1978; Long and Oleson, 1980; Lovins,1977, 1978; Morrison, 1980a, 1980b; Schumacher, 1973).

All of this can contribute to scholarship addressed to comparative effectiveness of different approaches to the organization, the planning, the staffing, and the directing of agricultural research organizations.

Second, with respect to the farming systems themselves, it seems that the social sciences, again, have failed to study them from a systems perspective. Rural sociologists have been more concerned with urbanization, the rural community, and the diffusion of innovations from a central research source to rural people, than they have with the nature of the farming systems,

perhaps seen as farming family ecosystems. There is a great opportunity for research in which the conceptual tools of the various social sciences can be applied to the farming system qua system.

One approach to the "whole systems" study of farms has been demonstrated by several social scientists who have traced interactions among the various components of farming systems. Among them, Odum, 1971, 1976; Thomas, 1974; Rambo, 1979; Axinns, 1978, 1979, 1980; and Cox and Adkins (1979) have used energy as a proxy for materials flow. They can clearly demonstrate the effects of the size of the farming system, the extent of specialization of the farming system, and the eco-system relationships of the farming system to its relationships with other farming systems, marketing systems, and the larger political-economic-social-cultural systems of which they are a part.

Another approach, in which money values serve as a proxy for all types of flows, has been developed by those who simulate the farming system and its larger economic system with computer simulations. See, for example, Rossmiller, 1978; Heady, 1949; Johnson and Rossmiller, 1978; Abkin et. al 1980; Manetsch, 1971; Crawford, 1980; McRea, 1930; and FAO, 1980.

4. Basic Principles, Concepts, and Generalizations

From the above, it seems apparent that there are some generalizations about the way in which agricultural research systems are organized and controlled which relate to the type of research they are likely to do, and the extent to which it will be appropriate for various types of farming systems.

Within the family farm ecosystems themselves, there are social phenomena which have not been sufficiently studied, and which offer great opportunity. One of these is differentiaion. Farming systems range from the

least differentiated to the most differentiated, with many gradations. The least differentiated family farm ecosystems are quite unspecialized. They feature a mixture of many different crops and different classes of livestock with some "other" production, some work off the farm by family members, plus a kitchen garden. Women and children do a major portion of the work on such systems, and in many portions of the world the adult men of the system exchange labor outside for some of the internal requirements of the system.

The most differentiated are highly specialized farming systems, which produce only one crop or type of livestock, and the farm is the major source of the family income. They tend to be capital intensive, labor efficient, and highly specialized. (See Axinn & Axinn, 1980).

The least differentiated types of farming systems are also the least dependent on the outside world. The most differentiated farming systems are also the most dependent upon the outside world. Thus the variable of dependence/independence tends to vary directly with the variable differentiated/undifferentiated.

Dependency upon the physical world is a characteristic of almost all types of farming systems, with weather, soil characteristics, and other geological features, along with the risks and the uncertainties of the biological processes which farming systems manipulate as constant concerns. Therefore, there are some trade-offs between the dependence of specialization and the independence of unspecialization. It is an area which has promising opportunities for research.

Also, there is a relationship between the quantities of energy transformed and both the differentiation variable and the dependency variable. The least differentiated and the most independent farming systems also tend to

transform smaller quantities of energy, vis-a-vis what their ecosystems can sustain over time, than do the most differentiated and most dependen types of farming systems.

Farming systems also range from almost 100 percent subsistence farming systems to almost zero percent subsistence farming systems. The latter type are highly market oriented. Subsistence agriculture can be understood in terms of the three variables mentioned above: differentiation, dependency, and energy transformation. Understanding of farming systems from this perspective can lead to applied and problem solving research which will be more appropriate to the interests of members of such family farm ecosystems than the types of farming systems research which ignores these phenomena. (Axinn & Axinn, 1980).

To generalize again, highly subsistence farming systems tend to consume most of what is produced; tend to supply whatever inputs are needed for production; have fewer linkages with outside systems; and fewer transactions on whatever linkages there may be; and thus are relatively independent. Innovative technology which requires credit, (or which assumes production for sale on a market) is not likely to be readily adopted by such family farming systems.

On the other hand, highly market - oriented farming systems tend to sell most of what is produced to others; tend to purchase inputs needed for production; tend to have more linkages with outside systems and carry on more transactions on those linkages; and are thus relatively dependent upon those outside systems. Because of that dependence upon the market, and susceptibility to changes in price and price policy, such highly market-oriented farming systems are also dependent upon innovative agricultural technology -- particularly technology which will allow them to produce more for the outside market at lower cost of the inputs they must purchase from the outside supply system.

This contra t between subsistence farming systems and market farming systems is not made to suggest that one is, normatively, "better" than the other, or "worse" than the other. Clearly, as the populations of the world's urban centers continue to increase, there is need for increasing the surplus (above farming family needs) of food production from some market farming systems. Also, clearly, there are in today's world hundreds of thousands of small farming and pastoralist systems which are primarily subsistence farming systems. As with other aspects of life, that which is desirable from the perspective of some individual farm families may not be in the best interest of the larger society. The issues are political, economic, social, and cultural. How the formal agricultural research systems approach the application of science to the problems of different types of farming systems is a sensitive matter. The goals and objectives of agricultural research organizations are likely to be determined by those who have the political and economic power to influence them. Perhaps innovative and sensitive farming systems research can lead to what will be most appropriate.

5. <u>What is needed from other disciplines?</u>

A great deal is needed by a multidisciplinary social science perspective on farming systems from the other disciplines.

In the beginning, it is necessary to approximate and understand the plant component and the animal component in order to know the extent of differentiation in either of those, as well as the extent of energy transformation through them. Thus, if one wished to study relationships among the variables listed above, and to use those to assess the appropriateness of particular biological, mechanical, or economic changes for particular farming

systems, it would be desirable to have collaboration among social and behavioral scientists with economists, animal scientists, agricultural engineers, agronomists, horticulturists, human nutritionists, and others.

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