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LACK OF INTEGRATED STUDIES OF FARMING SYSTEMS
HAMPERS TRANSFER OF RESEARCH TO ORGANIC FARMS

by

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INTRODUCTION

As a young college graduate just beginning farming, I had an intuitive understanding that farmer's faith in unlimited agricultural technology was at best naive and near-sighted. In the longer term the production practices encouraged by that faith could potentially threaten rather than insure continued agricultural productivity. I was introduced to the concept of organic farming,¹ an alternative philosophy that emphasized the cyclic aspects of plant and animal nutrition and generally sought to minimize off-farm resources.

¹For purposes of this paper, I will assume the following definition: "Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests." (USDA, 1980)

As I sought to learn more, I found that information about organic farming theories and methods was scarce, largely anecdotal, and stored primarily in the minds of practicing farmers. None of the traditional sources of technical information for farmers -- the farm press, commercial farm-supply companies, and the land grant universities represented by the cooperative extension service -- had helpful information. Clearly neither companies whose business is selling inputs to farmers nor the farm press, whose bills are paid by advertising for those same farm inputs, would receive much direct benefit from supporting investigation of reduced-input farming methods. Lack of attention to limited-input or organic agriculture by the land grant universities could not be so lightly dismissed.

The organic farms that I visited appeared to be successful. The crops and livestock looked good and the farmsteads and machinery suggested economic viability as well. The farmers claimed their farming methods were, for them, superior to conventional methods. Eventually more objective studies appeared that suggested that organic farming can produce good crop yields, lower production costs, sustain an economically viable business unit, reduce soil erosion, and increase livestock feed efficiency (Lockeretz, 1981; USDA, 1980; Balfour, 1975; Hodges, 1981). Why, then, was so little recent information available from the land grant universities concerning growing crops by organic methods, especially in light of strong expressed interest on the part of farmer constituents (Dahlgren, 1983; I.G. Youngberg, personal communication; W.W. Sahr, personal communication).

Current research of particular interest to organic farmers includes studies on nutrient cycling, biological nitrogen fixation, crop and weed interactions, disease- and insect-resistant or tolerant crop varieties, and biological pest control. Information on these various topics is not easily packaged for application to organic farming systems. Very little research examines these components as they interact with other elements of an organic farm-management system.

I have found that this lack of integrated study is not unique to organic farming systems. I contend that, with the exception of farm-management business analysis, study of farming systems is systematically discouraged. I further contend that absence of integrated study of farming systems is especially detrimental to organic farming. This paper contains evidence in support of these two contentions.

DEPARTMENTALIZED AGRICULTURAL SCIENCES

Adoption of advanced and scientifically sound farming practices has long been appreciated in this country. Three major pieces of legislation, the Morrill Act in 1862, the Hatch Act in 1887, and the Smith-Lever Act in 1914, established the public commitment to formal training in practical agriculture, scientific agricultural research, and rapid popularization of new techniques on farms. From the outset, the mission of the land grant schools has been "to democratize knowledge," by serving the common man (Breimyer, 1987). Commitment to applied rather than basic research was also expressed early and was insured by establishing dependence on state legislatures for research funding (J.L. Flora &

C.B. Flora. An historical perspective on institutional transfer. In progress).

Agricultural science was originally developed by researchers and instructors with broad understanding of all components of the subject. The early land grant schools, frequently, little more than glorified high schools, often had only a handful of professors, each of whom taught many widely varied subjects. But the schools grew in number of students, number of faculty, and number of departments (Geiger, 1987). Scientific research began to compound, and understanding of agricultural principles blossomed.

As knowledge grew, so did the degree of specialization by the scientists, the number of specialties within the scientific community, and the restrictive focus of research. Meanwhile, farming remained a complex endeavor, requiring the management of a great many different kinds of resources and, in most cases, a large variety of different products. Consequently, within the land grant universities, multidisciplinary farm-management teams pulled together scientists from diverse areas such as crop production, poultry and livestock production, and farm mechanics (Johnson, 1982). These teams allowed detailed information from a variety of disciplines to be applied to the broad range of problems encountered in managing a farm.

Production economics was introduced into the farm-management group in the 1920's, and by the late 1950's it dominated farm-management thought (Johnson, 1982). Today at Kansas State University, as at most universities, farm management is within the Department of Economics and focuses on the management of the farm

resources as an economic unit rather than as a biological production unit. This is appropriate as long as we can assume the goal of the farm to be maximum profit (Flora, 1983) and that the various farm components do not interact at a biological level. In our economy we use money to create a common denominator for unlike items. We can compare apples and oranges if we first express both in terms of dollars. When we consider costs and benefits of resources in agriculture, it is natural to evaluate them in financial terms. Money is a language understood by scientists of all disciplines.

The organizational structure of the cooperative experiment station should allow if not encourage inter-disciplinary research. Very little is done. The cooperative extension service in Kansas, with county-based agricultural extension agents and regional and statewide specialists, would seem to provide an excellent opportunity for whole-farm management assistance. In practice the agents are ultimately limited by research results available to them, since extrapolation to new situations is often dangerous.

The field of agronomy has certainly shared in the explosion of scientific knowledge and resultant narrowing of research focus by individual scientists. The subjects and processes involved are so complex that at some point investigation and analysis must be limited to a small component for overall understanding to be enhanced. Proliferation of specialized scientific journals and the need of the scientists to be frequently published have also encouraged narrowly focused research.

While specialization allows for detailed study, it can prevent the specialist's seeing clearly how his/her area of study interacts with other disciplines. Three types of inefficiencies can result. 1) If his/her focus is too narrow, even the best of scientists can easily overlook what would seem to be obvious problem areas. Examples are cases of plant breeders who developed unpalatable new fescue varieties and new sorghum varieties with low digestibility (Carmen, 1970). 2) The real goals of the applied-research constituency may be different than those ascribed to it by the researcher. This has become especially obvious in international agricultural-development programs where the research/extension personnel usually have different value backgrounds than do their clients (Flora, 1983). As detailed below, this also becomes a problem when the constituency is organic farmers in this country. Researchers may mistakenly assume organic farmers share the values of conventional farmers. 3) The whole is frequently greater than the sum of its parts. Interaction of two or more variables can often cause results that would not be predicted from study of only the individual components. A simple example is the compounding effects of moisture stress, disease, and late-season storms on crop lodging. Complementary and antagonistic interactions among components of an organic farm can similarly confuse predictions. In more complex situations, understanding interactions may be more difficult than understanding the parts of the system.

Administrative segregation within the universities has both followed and encouraged separation into specialized fields.

Departmentalization frequently separates scientists of differing disciplines both physically and socially as well as in administrative concerns such as budget and tenure. It is difficult for agronomy faculty and graduate students to attend seminars in departments across campus, and it is often impossible for them to share coffee breaks with colleagues from other departments.

Those scientists inclined toward interdisciplinary work must, to survive, become established in one discipline before becoming involved in others (Innis 1975). Team approaches to broad-range projects are difficult for both administrative and personal reasons. Increased specialization has decreased the ease of communication between and within the traditional disciplines (Charlton & Street, 1975).

ORGANIC FARMING: PRINCIPLES AND GOALS

To presume that "organic farming" and "conventional farming" are distinctly separable is to ignore the realities of the situation. "In crop and livestock production practices, conventional and organic farming have more in common than not" (CAST, 1980). Differences in motivations and practices among all farmers are so great that the concept of a continuum from "extreme chemical" to "extreme organic" can be advanced. It seems to be largely accepted, however, that a distinction between "organic" and "conventional" can be drawn advantageously. The USDA Report and Recommendations on Organic Farming (1980) stresses that organic farming encompasses a spectrum of beliefs and practices, and suggests that, in fact, adherence to the "organic ethic" may be a more realistic differentiating quality than use or avoidance

of particular techniques or materials. The report summarized the ethic in this way: "...organic farmers seek to establish ecologically harmonious, resource-efficient, and nutritionally sound agricultural methods."

Foster (1981) made this comment: "The organic emphasis is upon a minimum disruption of ecological processes and a maximum conservation of resources and energy, and within the organic gestalt, one emphasis facilitates and complements the other. That is, the direct agricultural resources (e.g., soil, water, plant variability) experience maximum ecological protection through an absence of input products (e.g., chemical fertilizers, pesticides, herbicides)."

Although organic farmers share with conventional farmers the goals of economic viability for the farm business and a satisfactory standard of living, the stress organic farmers place on the above-mentioned values necessitates a whole-farm analysis approach different from that employed by those in farm-management research. The individual farm components such as soil fertility, soil conservation, and crop- and livestock-production components cannot be simply translated into the common language of economics for integration into an analysis model.

Many technologies introduced into farming in recent years have simplified management decisions for conventional farmers. Chemical fertilizers, pre-emergence herbicides, and stress-tolerant crops allow simplified crop rotations and fewer farm enterprises. These simplifications decrease the total number of decisions which must be made. Herbicides and insecticides

that can be applied after a pest problem is apparent have greatly decreased the lead-time required to deal with these problems. To a great extent the conventional farmer can make short-term decisions based upon the situation that exists in a particular growing season.

Because of the long-term nature of the organic farm's fertility program and the problem-preventing approach to weed and insect control, repercussions of management decisions are felt throughout the farm system and throughout future years. To illustrate the integrated nature of the organic farm, I will discuss factors considered in making one of many management decisions: What crop, if any, should be planted in a given farm field? To emphasize that no one academic discipline could adequately examine the different aspects of this one decision, I will suggest the specialists required to study each factor.

CHOICE OF CROP

The choice of a crop to plant in a particular field is influenced by many factors. Some factors are primarily agronomic in nature, some are primarily economic, but most are multifaceted.

Climate places severe limitations on the type of crop that can be grown. As a result of more favorable precipitation, a farmer in the eastern part of Kansas has more crop choices than does a farmer practicing rain-fed agriculture in western Kansas. A wide choice of crops is especially important on the organically managed farm where a diverse crop rotation is considered vital. A climatologist's understanding of climate and an agronomist's

knowledge concerning climatic requirements of crops would be necessary to study this aspect of the crop-choice decision.

A farmer is limited in crop choices by the crop varieties available. The plant characteristics considered important by organic farmers may be different than those valued by conventional farmers. For example, a soybean variety that quickly establishes a weed-shading canopy or has improved nitrogen-fixing qualities may be used for a particular situation where traditional varieties are deemed unsuitable. A plant breeder familiar with crop traits could best evaluate this part of the decision.

Previous cropping history must be considered when choosing which crop to plant. The organic farmer strives to improve system stability through greater diversity. In order to help reduce insect and disease problems, the preference in cropping of annuals will be to plant a crop different from the crop grown on that field the previous year. In addition, cropping history has an effect on the soil's ability to provide plant nutrients. Alternating leguminous and non-leguminous crops is preferred. An entomologist, a plant pathologist, and a soil-fertility analyst could best evaluate this aspect.

The fertility level of the soil will affect the crop chosen, especially since a minimum of fertilizer is to be added. A chemical soil analysis indicates the presence and availability of essential nutrient elements and the soil pH. The cropping history of the field is particularly important since much of the emphasis of the fertility program on the organic farm is on providing plant nutrients through decay of old plant residues.

Nutritive elements that are in organic form at the time a soil sample is taken will not appear on the analysis, although a portion of them will become available during the growing season. Previous applications of fertilizing materials will affect crop nutrition in much the same way. Release of nutrients from organic materials such as livestock manure, sewage or manufacturing wastes, or composted wastes of animal or vegetable origin can take place over a number of years.

Crops such as corn that demand high levels of nitrogen would be preferred for those field where nitrogen is abundant. Leguminous crops such as soybeans or alfalfa would be indicated for fields where nitrogen is lacking. Other nutrient elements would be similarly considered. In addition, soil pH may be too high or too low for some crops, as illustrated by alfalfa's intolerance of acid soils. The skills of a soil-fertility specialist with expertise in evaluating release of nutrients from organic matter and of a crop specialist familiar with crop-nutrient demands would be required for a study of this aspect.

The soil-moisture reserve and the potential for additional moisture during the year are important when choosing a crop. Deep-rooted crops such as alfalfa or clover, which are widely employed on organic farms, may deplete soil moisture more completely than do other crops. Crops vary both in amount and timing of consumptive water use. Winter wheat, for example, grows most during late spring when evapo-transpiration rates are lower. Grain sorghum has a lower total water requirement than does corn. If potential water supply appears to be small, a

crop should be chosen that can best use available water. In some cases, a fallow period to allow recharge of the soil-moisture reserve may be advisable. A plentiful water supply or irrigation potential allows other options. Agronomic skills in soil-water relations and crop response to water are needed to study this relationship on the farm.

Given the high priority that organic farmers place on resource conservation, the potential for soil erosion is an important consideration in choosing a crop. Plants that cover the soil completely will help prevent erosion more effectively than will widely spaced plants with more vertical growth habits. A perennial crop that produces a sod will likewise aid in erosion control. The time of the year that the crop is planted also will affect the potential for erosion since the soil is most vulnerable prior to planting if conventional-tillage practices are used. The erosion factor is more important on fields with steeper slopes. An agronomist with expertise in soil conservation could best evaluate this aspect of the decision.

Potential for profit from growing different crops will affect crop choice. Calculation of potential profit requires that agronomists determine resource inputs and crop yields. In addition, consideration of this aspect demands economists with skills in production-cost analysis and market-price forecasting. Calculating the cost side of the profit-projection equation may be complicated by extensive use of on-farm resources that are difficult to price. Income potential also may be hard to determine. Crops may be used in a livestock enterprise, making pricing difficult.

In addition, they may be grown partly for side benefits that are difficult to price, such as fertility enhancement for future crops. If a specialty-organic market is available, appropriate market prices may be difficult to ascertain.

The financial situation of the entire farm operation must influence the relative weight given to the potential profit discussed above. A farmer may opt for greater profit at the expense of some other objective if the situation demands that choice. Conversely, if the overall financial situation is good, potential profit may be sacrificed for another goal such as fertility enhancement. This factor would also influence a decision on whether to harvest a crop such as clover or alfalfa for forage or turn it under as green manure. As mentioned, skills from both agronomy and economics are needed to investigate these influences.

Livestock-feed requirements and farm cash-flow demand both are major factors in choosing the crop to plant. Since high-value crops grown for direct sale bring more immediate cash inflow than do feeds marketed through livestock, these two needs often compete with each other. The emphasis that organic farmers place on minimizing off-farm purchases demands that most livestock feeds be grown. A balance must be struck among the number of livestock, the acreage available for feed crops, and the expected yield. The farmer who wants to minimize purchased feed will usually build a safety margin into this equation. Livestock-feed requirements are seldom absolute, as alternative combinations of feedstuffs are usually possible. Alternatives are available in arranging farm cash-flow as well. The understanding of a live-

stock nutritionist and an economist in farm management are needed to evaluate this part of the decision.

Personal preferences and skills have considerable effect on the success of farm enterprises. Organic farmers must prevent rather than cure most problems such as damaging weed or insect populations, and attention to management details is often the key to success. Time must always be shared among many tasks, and preferred projects tend to receive more attention and a higher level of management from the farmer. These favorite enterprises may very well develop into the most successful ventures. A psychologist could best evaluate this relationship. In addition, the management skills and physical skills required may vary considerably among different crop options. A researcher familiar with the day-to-day management demands is needed to consider this topic.

The type and level of weed infestation have major impacts on crop choice for a field. Usually fields with summer-annual or winter-annual weed problems will benefit from crops that grow in the off-season. For example, summer-annual pigweed can be controlled by tillage in mid-summer if the field is planted to winter wheat, with seeding in fall and harvest in early summer. Frequently fields with serious perennial-weed problems can be planted to highly competitive green-manure crops or perennial hay crops, and competition and/or frequent mowing will reduce the weed vigor. In some cases a fallow period with timely cultivations would be beneficial. The organic farmer relies on cultural practices such as these, rather than herbicides, to control problem

weeds. The skills of agronomists, knowledgeable in growth habits and interactions of weeds and crops as well as the implications of soil-fertility levels and physical condition on weed growth, are required to evaluate this decision.

Similarly, real or potential insect problems must be considered when choosing the crop to plant. If a particular insect-pest species has increased its population, perhaps non-host crops can be chosen. Another option might be a host plant which allows timing of cultivation or other field operations that would interfere with the insect's life-cycle. The crop's potential for encouraging insect predators or insect-disease outbreaks should also be considered. Sometimes insect pests can move from one host-plant species to another as occurs when chinch bugs move from wheat into grain sorghum. In those cases, the type of crops growing in or planned for adjacent fields should be taken into consideration when choosing a crop. Since the organic farmer tries to eliminate or minimize use of insecticides, these management factors are particularly vital. Entomologists with expertise in insect ecology and pathology should evaluate the crop choice from these perspectives.

Potential for plant-disease problems must be considered in a manner similar to the insect-pest evaluation. A plant pathologist could best consider the implications of crop choice on disease.

Whether or not to participate in government acreage-reduction programs is usually treated as purely an economic decision. On the organic farm, agronomic factors also deserve consideration. With the crop rotation on the organic farm, fewer acres are normally

planted to cash "program" crops, and more land is devoted to non-surplus crops such as hay or green-manure crops. A crop rotation over a number of years may increase fertility and reduce weed, insect, and disease potentials. The farmer who has thus prepared a field for a particular crop such as corn, benefits less from corn-acreage reduction than does a farmer whose primary fertility and pest-control measures are applied on an annual basis. Conversely, if the organic farm has fertility or pest-control problems that would be remedied by greater acreage of non-program or conserving-use crops, the organic farm may find the program more attractive than does a conventionally managed farm.

As illustrated by the above discussion of factors affecting an organic farmer's choice of which crop to plant, the various components of the farm system are highly interdependent. I will now discuss the integrated nature of the organic system from another direction. I will explore the impact of one of the most visible differences between conventionally and organically managed farms -- the selection of a nitrogen source.

NITROGEN SOURCE

A change from using biologically fixed nitrogen to using industrially fixed nitrogen in a farming system always brings more than a change in nitrogen source. While the direct effects on the soil from applications of inorganic or organic forms of nitrogen are of interest, the indirect effects may have greater overall impact.

When the nitrogen needs of a farm are met with industrially

fixed nitrogen, the farmer is allowed to eliminate legumes from the crop rotation. In practice, the crop rotation is usually greatly simplified or even eliminated.

The addition of legumes to a crop rotation is in keeping with the idea of increased ecological stability from increased plant diversity. With increase in the complexity of the system comes improved control of insect and disease pests that prefer specific hosts.

When sod-forming legumes or grasses are used in the rotation, reduced soil erosion occurs because of greater ground cover. Organic farming practices also decrease soil-erosion potential by increasing soil organic-matter level and/or stabilizing the soil structure (USDA, 1980). Potential for improved infiltration and water-holding capacity also exist with increased organic matter.

Often livestock manures are viewed as a waste-disposal problem rather than as a resource to be used. Consequently, they frequently are not used effectively. In recent years, increases in the cost of nitrogenous fertilizer have encouraged better manure management, but the transportation and labor demands of manure handling are expensive. The distance the manure has to be transported is a major consideration when determining economic feasibility. On the organic farm, where minimum use of manufactured fertilizers is a stated goal, perceived benefits other than the nitrogen supplied, help offset costs involved. In any case, feasibility is affected by the time of the year the field is free of crops and dry enough to accept application of manure. Composting of the manure could

relieve some of the coordination problems, allow use of seasonally available labor, and lessen weed problems normally associated with use of manure.

The organic farmer will also be more receptive than the conventional farmer to use of organic materials from off-farm locations. Sources of these materials include city sewage plants, meat-packing plants, food-processing plants, cattle feedlots, or large poultry operations. Transporting these wastes to the farm is seen as completing a cycle, helping to close the system and conserve resources.

The use of legumes and manure instead of industrially fixed nitrogen also increases the number and diversity of soil organisms (Madge, 1981). This increased biological activity can contribute to improved soil structure. In addition, the organic farmer hopes that the increased activity and diversity will help control crop damage from soil insects and disease.

Mineralization of nitrogen in organic matter to forms available for use by plants occurs through temperature-sensitive decomposition by soil microorganisms. When soil temperatures are warmer, nitrogen is released more rapidly. Warm temperatures also cause plants to take up nitrogen more rapidly. Nitrogen supplied to the soil in organic form is thus less subject to leaching than is that supplied in inorganic form (USDA, 1980).

When nitrogen is fixed by legumes rather than by industrial processes, solar energy rather than fossil fuel powers the process. Organic farms studied by Lockeretz (1981) used only two-fifths the energy required by paired conventional farms to produce the

same value of crop. Most of the energy savings occurred because of the difference in nitrogen source. The rest of the energy savings stemmed from crop rotations on the organic farms. The legume rotations resulted in smaller fractions of total acreage being devoted to corn, an energy-intensive crop.

Reducing or eliminating purchase of industrially fixed nitrogen appreciably reduces cash-flow requirements. Lockeretz (1981) reported variable costs/ha on organic farms averaged two-thirds that on similar conventional farms, while net incomes/ha were essentially equal. Contributing greatly to the lower cash-flow needs were the differences in nitrogen source and the accompanying differences in crop mix.

Replacing industrially fixed nitrogen with biologically fixed nitrogen has repercussions throughout the farming system. Changes are required in both the cropping system and the livestock system. Changes are affected in terms of soil condition, erosion, water use, energy use, and variable costs. It is not a simple change but a complex one.

Actually, an organic farmer usually does not refrain from use of industrially fixed nitrogen because of the cost, or because of handling hazards, or because someone said it makes the ground hard. Rather, the organic farmer refrains from using the farming system that has come with the introduction of industrially fixed nitrogen and other agricultural chemicals. He views this system as basically manipulative of nature rather than cooperative with nature. He sees it as being geared toward problem solving rather than problem preventing. He regards

it as being in conflict with the principles of minimum interference in the ecosystem and maximum conservation of resources. The organic farmer does not replace one nitrogen source with another, but replaces one farming system with another.

CONCLUSION

Land grant universities have a long and strong tradition of service to farmers. Through the extension service, research results are rapidly transferred to farms. In addition, through extension personnel, researchers at experiment stations are kept in close contact with conventional farms, gaining better understanding of their needs and learning from innovations developed by farmers. The differences between conventional and organic farms are such that the needs of organic farmers are not being met by the land grant universities, nor are the organic farmers contributing to the body of knowledge at the universities.

The value system of organic farmers is the basis for their choices of technologies. While their value system has much in common with that of conventional farmers, it is sufficiently different to invalidate many assumptions by researchers.

The narrowly focused and detailed nature of most agricultural research, coupled with professional and administrative practices, has encouraged proliferation and narrowing of scientific specialties. Whole-farm study of farm systems has been restricted to analysis of the financial aspects of the farm business. Reduced biological interdependence among farm components, made possible by introduction of new technologies, has made this trend appear appropriate for conventionally managed farms.

Organically managed farms are highly integrated, with complex management decisions. Applying detailed research results to an organic farming system is difficult and requires holistic understanding of that system. The techniques that research and extension personnel currently use to service conventional farmers cannot provide that kind of understanding.

The Farming Systems Research approach (Norman, 1980), generated for use in developing countries, would be helpful for producing the needed understanding. Two elements of this approach are particularly important: 1) Identification of farmers' values and goals is considered essential for development of appropriate research objectives. 2) A team of scientists from many different disciplines is utilized.

The emergence of system analysis as a field in its own right would provide another means by which organic farming systems could be studied within the land grant universities. A trend in that direction can be seen in the development of computer simulations of a wide variety of physical and biological processes. Systems-analysts, working with specialists in various components of the system, can integrate research into a more general model. The approach taken by these systems-analysts could be applied to farm-management systems.

Pilot projects in systems-research are now appearing at some land grant universities including Pennsylvanie State University, Michigan State University, and the University of Florida. The institutional structure and tradition of the land grant system would seem to allow, if not encourage, such studies. Nevertheless,

given the many scientific and administrative roadblocks in the way of research on organic farming systems, I anticipate that development of integrated studies will be slow.

LITERATURE

- Balfour, E.B. 1975. The living soil and the Haughly Experiment. Latimer Trend & Co., Plymouth, England.
- Breimyer, Harold F. 1978. Outreach programs of the land grant universities: Which publics should they serve? p. 5-17. In Outreach programs of the land grant universities: Which publics should they serve: Proceedings of a conference on the campus of Kansas State University.
- Carment, G.M. 1970. Agronomy and animal nutrition. p. 21-36. In Agronomy and health. ASA Special Publ. No. 16. ASA. Madison, WI.
- CAST. 1980. Organic and conventional farming compared. Report No. 84. Council for Agricultural Science and Technology, Ames, IA.
- Charlton, P.J. and P.R. Street. 1975. The practical application of bio-cynamic models. p. 235-265. In G.E. Dalton (ed.) Study of agricultural systems. Applied Science Publishers, London, England.
- Dahlgren, Robert B. 1983. Foreword in R.B. Dahlgren (compiler) Proceedings of the management alternatives for biological farming workshop. Iowa State University, Ames, IA.
- Flora, Cornelia B. 1983. Farming-systems research and farm-management research: What's the difference? The Rural Sociologist. 3:292-297
- Foster, Gary S. 1981. The Kansas Organic Producers: alternative agriculture as a social movement. Ph.D. Thesis. Department of Sociology. Kansas State University, Manhattan, KS.
- Geiger, Louis M. 1978. The Morrill Act and its interpretation through practice. p. 21-36. In Outreach programs of the land grant universities: Which publics should they serve? Proceedings of a conference on the campus of Kansas State University, Manhattan, KS.
- Hodges, R.D. 1981. An agriculture for the future. p. 287-300. In B. Stonehouse (ed.) Biological husbandry: A scientific approach to organic farming. Butterworths, London, England.
- Innis, G.S. 1975. The use of a systems approach in biological research. p. 369-391. In G.E. Dalton (ed.) The study of agricultural systems. Applied Science Publishers, London, England.

- Johnson, G.L. 1982. Small farms in a changing world. p. 7-28.
In Wendy Sheppard (ed.) Proceedings of Kansas State
University's farming systems research symposium -- Small
farms in a changing world: Prospects for the eighties.
Kansas State University, Manhattan, KS.
- Locheretz, W. 1981. Organic field crop production in midwestern
United States. p. 265-278. In B. Stonehouse (ed.) Biological
husbandry: A scientific approach to organic farming.
Butterworths, London, England.
- Madge, D.S. 1980. Influence of agricultural practice on soil
invertebrate animals. p. 79-98. In B. Stonehouse (ed.)
Biological husbandry: A scientific approach to organic
farming. Butterworths, London, England.
- Norman, D.W. 1980. The farming systems approach: Relevancy
for the small farmer. MSU Rural Development Paper No. 5.
Department of Agricultural Economics, Michigan State
University, East Lansing, MI.
- U.S. Department of Agriculture. 1980. Report and recommendations
on organic farming. U.S. Govt. Printing Office,
Washington, D.C.

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ABSTRACT

Differences between organic and conventional farms are such that transfer between land grant universities and organic farms is stymied. The value system of organic farmers is sufficiently different to invalidate many assumptions by researchers.

Specialities in agricultural science have grown in number and narrowed in scope. Whole-farm study of farm systems has been restricted to analysis of financial aspects of the farm business.

Organically managed farms are highly integrated. Applying detailed research results to an organic farming system is difficult and requires holistic understanding of that system. The research and extension techniques currently used cannot provide that kind of understanding.

The Farming Systems Research approach would be helpful in producing the needed understanding. Development of systems analysis as a field in its own right would also provide a means for study of organic farms.

The institutional structure and tradition of the land grant system would seem to allow, if not encourage, integrated studies. Nevertheless, given the many road-blocks to research on organic farming systems, I anticipate that development of such studies will be slow.