



# **Sustainable Agriculture and Sustainable Development: At the Crossroads**

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## **First Travis P. Hignett Memorial Lecture**

The Travis P. Hignett Memorial Lecture Series was initiated during 1994 by the International Fertilizer Development Center to honor a distinguished chemist, chemical technologist and developer, author, and administrator. Mr. Hignett (1907-89) received global recognition for his many accomplishments in the fertilizer world over a period of some 50 years. After a 35-year career with the Tennessee Valley Authority, Hignett served as a special consultant at IFDC for more than a decade. Often referred to as the “Father of Fertilizer Technology,” Hignett held 15 patents and was the author of approximately 150 publications. He received a number of awards, including the Francis New Memorial Medal from the Fertiliser Society of London in 1969. This lecture series is being sponsored by the Hignett Memorial Fund, which was established in 1987 to honor Mr. Hignett.



# **Sustainable Agriculture and Sustainable Development: At the Crossroads**

by

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## **Introduction**

I am greatly honored to initiate the Travis P. Hignett Memorial Lecture Series. I have long admired Mr. Hignett. I first visited the Tennessee Valley Authority in 1962 and until the early 80's was a frequent attendee of TVA conferences and symposia. On several occasions Mr. Hignett and I had the opportunity to share Iowa stories and discuss research issues. He had a profound positive influence on our society and food and fiber production.

I would like to present to you my view of how sustainable agriculture and sustainable development intermesh and present, from the U.S. perspective largely, what I feel is involved in agricultural sustainability. Sustainable development can be defined as providing for a continuing improvement of the quality of life while maintaining our natural resources for future generations. Agriculture is the key to sustainable development because ultimately quality of life must hinge on a well-fed healthy population and high-quality natural resources including water, soil, and air.

The objective of my presentation is to link sustainable development and sustainable agriculture. We will first struggle through the development of the terminology and concepts and then discuss how our natural and cultural resources are

linked to sustainability. No solutions are offered, but perhaps this discussion will help all of us approach sustainability in a way that will place it in context with our personal and professional goals. The issue is of primary, some say overriding, importance to the well-being and perhaps the survival of the human race.

In the United States, “sustainable agriculture” has become more accepted as a term, but it remains a complicated and controversial concept, particularly in its definition and in the application of practices and policies to achieve sustainability. It is a critical issue fueled by concerns about our food supply and the exhaustion of natural resources, but the term is vague and thus easily adopted by special interest groups. In the developed world, current agricultural practices are sustainable in the near term (5 to 10 years) with regard to the dependable and affordable supply of food and fiber. However, it is worth questioning if today’s agriculture is unsustainable in terms of environmental quality, social costs, and energy availability. In many developing countries, population pressures and lack of quality soils, water, and infrastructure are threatening agricultural sustainability even today.

### **Constraints to Global Sustainable Agriculture**

There are several agricultural production and natural resource factors that will limit sustainable growth worldwide. They include shortages of fossil fuel energy; global climate change; water for irrigation and deterioration of water quality; losses of land because of deterioration in soils through erosion, salinity, and quality; and loss of biodiversity to produce germplasm for biocontrols, new crops, and alternative uses of current crops. These are serious problems indeed, but food availability and affordability must be regarded as the ultimate limitations. An old Byzantine proverb states that “Those

who have no bread have only one problem. Those who have bread have many problems.” Ultimately, the loss of our food production capacity results in starvation and the collapse of the world’s social order. Yet this is not a good time to mention the specter of food shortages, at least in the developed world. We have surpluses of meat, milk, cereal grains, and coarse grains; in fact, because of the magnitude of these surpluses, profits to agriculture have reached low levels. It is important to remember that agriculture is part of the global food system. Producing more food in food-rich areas will not prevent problems in other areas that cannot afford the food.

It is widely recognized that the real costs of growing food are not reflected in food costs. The myriad of subsidies in the food system camouflage the costs of production, off-site pollution, and social problems. Polluting a water supply so that a drinking water treatment plant is required or displacing people from the land to the cities with social and welfare costs are examples of our poor cost accounting. We have not yet developed ways to determine the costs to natural resources such as landscapes, wildlife, and rare plants.

### **Possible Pitfalls of Production Agriculture**

Production agriculture has been linked with numerous environmental problems, especially soil erosion and water pollution, and the emphasis on production efficiency has accelerated the loss of farms and led to the instability of many rural communities. Many of agriculture’s and rural America’s dilemmas can be linked with agricultural policies of the past 50 years.

Many macroeconomic forces seem to be moving farming to larger and more specialized operations. Some of the land uses associated with this agriculture, often termed “industrialized agriculture,” may not be sustainable because they rely on

depletion of soils and other natural resources. They also require high inputs of energy-intensive chemicals and the use of monoculture approaches with the resultant lowering of biological diversity.

There are many indications that the rate of transformation to a more industrialized agriculture is accelerating in the United States and possibly globally. However, because of their complexity the reasons for these trends are difficult to address and modify so that rural revitalization can also be a part of the new agriculture. Solving problems of improper use of natural resources, especially the land, must be a primary objective of the policies of the future. To provide the information needed for these policies requires that agricultural science orient a major portion of its research and educational capacity to sustainability and land use.

### **Appropriate Policies for Sustainable Agricultural Development**

Appropriate land management policies are critical to preserving natural resources for future generations while using these resources to support the needs of today's people (Cairns and Pratt, 1992; Grove and Edwards, 1993; Schaller, 1993; Hatfield, 1993; Keeney, 1993a, 1993b). Sustainable land management follows the holistic concepts of Leopold (1949) who, in his epic *The Land Ethic*, stated, "In short, a land ethic changes the role of Homo sapiens from a conqueror of the land-community to a plain member and citizen of it." He further stated that "We abuse the land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may treat it with love and respect."

Yet often society ignores the land ethic as we attempt to conquer nature with policies and technologies that in the long run cannot be sustained. The results in the agricultural



landscape are apparent. They include the erosion of soils, with loss in soil quality and filling of rivers and lakes with sediment, declining yields that must be offset by greater inputs of fertilizers and pesticides, and pollution of ground and surface waters with soil, pesticides, and nutrients (Hatfield, 1993). Rural economies suffer. Ultimately the global food situation may be so sharply curtailed by current treatment of the land that future food demands will not be met (Cairns and Pratt, 1993).

If sustainable development policies are adopted throughout the world, major changes in our food production system will evolve (Allen, 1993). However, sustainable development remains a controversial and poorly understood concept (Crosson, 1993; Ruttan, 1991; Ryan, 1992). A major hurdle is the acceptance that growth as defined in today's corporate world cannot continue indefinitely, i.e., the term "sustainable growth" is indeed an oxymoron (Daly, 1990).

Sustainable agriculture suffers also from the problem of vague definitions (Keeney, 1990, 1993a, 1993b; Schaller, 1993). It generally means "an agriculture that will continue to conserve natural resources and protect the environment indefinitely, enhance health and safety of the public, and produce adequate quantities of food at a profit for the farmers" (Schaller, 1993). Social welfare, quality of life, farming in harmony with the landscape, and proper accountability of offsite costs are also factors of sustainability (Crosson, 1991; Allen, 1993). As Crosson (1993) points out, the working definition of sustainable agriculture must have temporal, quantitative and normative dimensions. Perhaps a better question to ask of elusive definitions is whether today's agriculture can sustain us into the future. The answer to that question points to future directions for agricultural research, education, and policies at the national and global level.

In many nations, agriculture is on its way or has already arrived at a structure that can be loosely termed "industrial."

High-energy inputs are required for traction power, irrigation, agricultural chemicals, and food and feed handling and processing. Other external inputs include seed, capital, and unskilled labor. Industrialized farms must be managed to maximize economic returns, which often lessens the opportunity to conserve nonproductive natural resources (those that do not produce a tangible income) and to treat the landscape in ways that conserve and improve on soil and water quality. These farms are in part the outgrowth of government policies that provide financial support (through subsidies, tariffs and export enhancements) but also are the logical outcome of a global highly competitive food system driven to maximize efficiency. However, corporate farms also have good and poor managers of the land. Good managers often have the resources to do things right environmentally and may be better at landscape preservation than small family farms.

Today the world enjoys an excess of food but with widespread problems of distribution due to inequity in sharing of the world's wealth. However, reasonable projections are that by 2050 food demand will have risen by 2.5 to 3.0 times the present level (Crosson, 1993; Grove and Edwards, 1993). This critical 50 to 60 years must be the period when the technology of agricultural production and knowledge of ways to ameliorate its environmental consequences must be greatly expanded (Ruttan, 1991). Yet at the same time many of the publicly supported agricultural education and research establishments in developed countries are being downgraded or dismantled. Presumably this is because society has decided that the information these institutions are developing is not critical to the production of food. It is partly the result of short-sighted policies of budget reductions but also the outcome of an agricultural research and education system that many feel has become irrelevant, particularly in its lack of treatment of people and environmental issues.

## **A New Paradigm for Sustainable Agriculture**

“Industrial agriculture” also implies that fewer people are associated with agriculture and therefore fewer farm voters are able to influence national policy. While all agree that the science of agriculture should be recognized in terms of its critical need in a world of expanding population and food needs, it appears that a redefinition of agricultural research and education is needed. Sustainable agricultural development to protect natural resources, meet food needs, and address rural infrastructure problems must switch to a new paradigm. This new paradigm will use systems-based research and education and will involve rural and urban people concerned with preservation of their resources (Francis and Madden, 1993).

The concern of many is that we cannot expect improved technologies, particularly the use of fertilizers, pesticides, new varieties, and irrigation, to increase the world’s food supply at a rate similar to that achieved during the 1965-85 period (Ruttan, 1991). For example, during this period grain production has more than doubled in Asia, and several formerly food-importing nations now export coarse grains and value-added agricultural products.

The “feed the world” philosophy for development of agricultural policy is often at direct odds with sustainable agricultural policies (Allen, 1993). Yet this should not be so. Degradation of natural resources to produce grains at low prices for nonexistent markets seems inherently counterproductive. Distortions in market signals sent because of tariffs, subsidies and special interest protection are recognized culprits.

The net result has been an agriculture that is efficient in terms of production per land area or person-hour. However,

this efficiency is obtained by consuming high inputs of fossil fuel and providing low returns to labor and management, and questionable ethics is involved. This agriculture also leaves farmers vulnerable to price swings for one or two commodities, highly dependent on government programs, and unable to capture more of the consumer's dollar by adding value to raw commodities. An increasing number of U.S. citizens feel this agriculture is environmentally, socially, and economically bankrupt, that is, not sustainable, while others argue that high productivity is essential to feed the world's population, that high efficiency is the only way to stay competitive, and/or that current agricultural systems are not harmful to the environment. This debate, like others on the issue of regional and global sustainability, offers little hope of being resolved in the near future but must be addressed as agricultural policies for the next decade are formulated (Faeth, 1993).

### **Conclusion**

Proponents of sustainable agriculture often state that the social and economic advantages of the family farm to the rural community are the primary goals of sustainable agriculture (Browne et al., 1992). A logical question in the United States is whether the owner/operator "family farm" can be preserved by reversing the current industrialization trend through policy changes, enhancing the use of on-farm resources, providing diversity in crops and markets, substituting management for purchased inputs, and enhancing rural communities.

For some, the crux of the debate on the issue of agricultural sustainability is often simplified even beyond the summary provided in the previous paragraph; for them, the dilemma rests almost entirely with the issue of short-term profitability. The argument that agriculture must be profitable to

be sustainable, that is, that profitability is an essential component of sustainability, is used by those who regard sustainability to be largely a matter of short-term economics. Markets, however, cannot be relied on to place a value on irreversible land use problems that may occur beyond one or two generations. New industrial technologies and methods of farming consistently promise more profits, but these benefits accrue only to the early adopters. Usually new technologies increase reliance on outside inputs and borrowed capital. Over time the industrialization process lowers overall profits and causes a decline in the quality of life for farmers and rural communities.

The alternate view supports a major paradigm shift with emphasis on the environment, community, resource conservation, social justice, equity, and ethics in addition to sustained profitable production. The farm is regarded as the biological entity, and the farmer is an integral part of the landscape. Most sustainable agriculture advocates prescribe to many of the issues in this view but are not yet able to offer specific steps that need to be taken to reach this nirvana. Component production and environmental protection research, policy shifts that include “green” incentives, and likely changes precipitated by people to improve the landscape and their quality of life will prevail over more revolutionary changes.

Obviously there are no simple solutions regarding how to reach agricultural sustainability from the land use perspective. In reality it is a question of developing multiple objectives and pursuing these objectives with multiple strategies - a very difficult operation for governmental policies to effect. For example, soil conservation techniques such as no-till often emphasize greater herbicide use. Removing erosive soils from production through government set-aside programs such as the Conservation Reserve Program in the United States has been shown to result in population and income loss in rural regions.

Ultimately our quest for agricultural sustainability must stem from the desire, or perhaps the need, for a sustainable earth. Population control, wise resource use (declining rate of consumption of nonrenewable resources), and careful use of the earth's resources will be key. Research to develop new technologies will be part of the approach. In the future, our research and education programs must involve much more the caretakers of the land, the farmers, and also the users of the products, the citizens. Together they will have to reach agreement on how the land will be managed, the level in the food chain that the products of the land will be consumable, the cost of the food relative to nonmarket costs of social and environmental damage, and the energy devoted to foods. The result will likely be an agriculture far different from that of today.

Leopold stated in 1948 "We shall never achieve harmony with the land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve but to strive." Let us strive together.

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Dr. Keeney has enjoyed a very distinguished career and is recognized as a foremost authority on the sustainable agriculture issue. He received a B.S. degree in agronomy from Iowa State University, an M.S. degree in soils from the University of Wisconsin, and a Ph.D. degree in agronomy (soil chemistry) from Iowa State University. In 1966 Keeney joined the faculty of the University of Wisconsin in the Department of Soil Science. Keeney spent a year's study leave in New Zealand in 1976/77. At the University of Wisconsin, he was Chair of Soil Science from 1979 to 1984 and Chair of the Land Resources Graduate Program in the Institute for Environmental Studies from 1985 to 1988. In 1988 he became Director of the Leopold Center for Sustainable Agriculture at Iowa State and in 1991 he was named Director of the Iowa State Water Resources Research Institute.

Keeney has conducted research on nitrogen methodology and transformations in soils, waters, and lake sediments; efficiency of nitrogen used by plants; nitrate movement in soils; environmental effects of the application of urban and industrial wastes to agricultural land; and assessment of nonpoint nutrient sources to waters. He has also conducted research in nitrification inhibitors, denitrification, measurement of nitrate leaching in soils, and modeling of the agricultural nitrogen cycle. Professor Keeney has authored or coauthored more than 180 technical and semitechnical publications.

He is a member of the American Association for the Advancement of Science, American Society of Agronomy, Soil Science Society of America, and the Soil and Water Conservation Society. He received the Soil Science Research Award in 1981 and the Environmental Quality Research Award in 1985. He was President of the American Society of Agronomy during 1992/93 and was President of the Soil Science Society of America in 1987/88.





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