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# The Agricultural Agenda for the Twenty-First Century

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## Introduction

Regarding responsible agricultural technology, I was asked (1) to give an overview of where current technologies have taken us, and in the light of this analysis, (2) to describe new responsibilities in agricultural research and technological development, and (3) to describe the role of the Mid-west in the development of a world without hunger. This is a difficult assignment but critically important, and like a fool, I shall rush in where angels fear to tread, for I deeply appreciate the contribution that Dordt College is making in the area of agriculture and rural society.

The title of this paper suggests that something needs to be done, that perhaps today's agriculture is not good enough for the next century. Or one might ask: Is today's agriculture appropriate for a radically changed

world? Are there specific problems within agriculture that need to be addressed? Or, is our whole understanding of agriculture to be scrutinized? The least that can be assumed from the title is that we must articulate what ought to be on the agricultural agenda as we approach the next century.

## The Fundamental But Forgotten Goal of Agricultural Research

In the first decade of this century, agriculture unfolded within a world which was providing sustenance for about two billion people. It was a world dominated by Western colonial possessions. The colonies, organized by mother countries, were producing primarily to export agricultural commodity: rubber, palm oil, spices, sugar, tea, coffee, timber, groundnuts, maize, cotton, and some cattle hides. By the

end of two world wars with accompanying horror and destruction, the focus shifted to food production. The war-torn nations were hungry and had to be fed. By this time, (the mid-decades of this century) with the global advances in health care, the world's human population began to double about every thirty years. It grew from a little more than two billion to what will probably be a population numbering a little more than six billion by the end of this century. This is historically unprecedented.

The breeding grounds of this kind of runaway growth is poverty. Until it and the injustices that cause poverty are overcome, it is difficult to predict when human population growth will level off. In the late 1940s, prospects of global famine were on the horizon. During this period the Green Revolution was born. Massive efforts were undertaken, with the combined development of nitrogen fertilizers (derivatives of oil and natural gas), and the genetic development of the three major food grains (maize, wheat, and rice), in order that these grains would respond to heavy inputs of soluble nitrogen. Although the goal was to increase yields as efficiently as possible, this method to reach it was considered an emergency, short range strategy, but the effort was quite successful. Yields have skyrocketed. But, in this process, increased production has blinded us to the original purpose of the Green Revolution—to buy time while simultaneously working on the first agenda of developing reliable domestic food systems to replace the old colonial export cropping structures which now have resulted in massive food deficits across the old colonial world. Also, the idea was to come up with less exhaustive (soil, water, vegetative and animal species loss) and therefore more promising agricultural technologies. This fundamental but forgotten goal is the agenda of agriculture for the twenty-first century.

### **The Geo-Physical Context of the Research and Development Agenda**

This agenda sits within its historical context

of the twentieth century and much before. Since the permanent settlement of the human species into villages, towns, city-states, cities, and now the megalopolis, fifty percent of the original soil deposits of the earth have been eroded into the sea and air. Today, the phenomenon of desertification continues to take its terrible toll. By the beginning of the next century, about five percent of the earth's surface will be arable for the sustenance of six to seven billion people. We must realize that of the entire earth's surface, seven-tenths is covered with water, one-tenth is too cold for agriculture, one-tenth is too hot, and about one-tenth of this remaining fraction is presently being transformed to desert. This is the physical context of the agricultural agenda for the twenty-first century. The world has been radically changed since former times. We must remember this as we shape agricultural research and development for the future.

### **Basic Problems: Where Our Current Technologies Have Taken Us**

It is not necessary to describe at length the basic problems we need to address. The United Nations Environmental Program, FAO, WHO, WMO, The World-Watch Institute, and the International Union for the Conservation of Nature and Natural Resources, to name but a few, have articulated the issues well. But, for the purpose of this brief article, I list the major issues.

(1) In addition to unprecedented *world-wide losses of arable soil*, our global food system is most (2) *dependent upon the artificial nitrogen technology* developed during this century. We now have a global food system almost totally dependent on a non-renewable resource that will near exhaustion by the middle (at the latest) of the twenty-first century. This is an agenda item! Generally speaking, (3) *irrigation systems* (because they are located in semi-arid and arid places) are *discharging aquifers* at rates far beyond natural recharge from rainfall and snow-melt. Along with this process, greater salinization, alkalization and, as in my home state of California, waterlogging

takes place. Not many places in the irrigated world have adequate drainage. This is an agenda item!

(4) Of worldwide concern is the problem of toxicity in our food, along with toxic residue accumulation—a phenomenon of the twentieth century. (5) Given the continual emphasis of monocropping systems (85% of all food consumed by the human species comes from fourteen plants: wheat, rice, maize, sorghum, millet, barley, bananas, coconuts, cassava, yams, potatoes, soybean, peas, and table beans) the health of species diversity of our biosphere is threatened. This is an agenda item!

(6) Within the industrial nations, vast areas

unaddressed. Although we hardly see answers to these problems of today's agriculture, and as unpopular as they are to discuss, they must be addressed.

(9) Furthermore, the fundamental assumption of twentieth century agriculture needs to be questioned. For example: Does agriculture (the land and rural people) exist to serve the economy of nations, or ought it be the other way around? Is humanity really free to manipulate, dominate, and use the natural system found within the biogeographical provinces of the earth, or must it respect the basic responsibilities of trusteeship? Is the twentieth century industrial paradigm relevant to

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of prime agricultural land are being converted to urban and industrial use. Grasslands and forests are now placed under new pressures. (7) We are all aware of the growing threat to atmospheric stability: carbon dioxide build-up, the new problem of nitrogen oxidation, high altitude particulate concentrations and the growing probability (if not fact) of climatic shifts. All of these issues are agenda items for agriculture for the next century. They ought to be front and center concerns for all the nations.

(8) Finally, and of equal importance with the others, is the issue of the tragic neglect of the welfare of farming populations and their supporting rural communities. People and rural community welfare have been left out of the agricultural equation during the decades of this century due to its preoccupation (research and development) with producing commodity efficiently. Rural populations have been neglected and exploited. The issue of rural infrastructural support which is socially just and meaningful for the development of the quality of human life in the rural sector continues to go

agriculture or must we substitute a more ecological worldview?

So much for this brief identification of contemporary problems and issues. Obviously, it is within this awesome context that we are challenged to identify the needs to be addressed in the next century. We need to get beyond addressing the issues of a long record of destruction, waste, and loss in agricultural history. There is little long-range hope in continuing efforts to repair historic agriculture so that it might work a little longer in the radically changed world of the twenty-first century.

### **The Twenty-First Century Agenda: The Quest for Just and Regenerative Food Systems**

The first item on the new agenda is to ask: How do we conceptualize the goals of a twenty-first century agriculture? This question frees us from the limited agenda of present agricultural research established during the Green Revolution. By asking an entirely different question we address different challenges which, for

agriculture in the next century, may also result in very practical approaches to meeting new needs.

The overarching goal of twenty-first century agriculture, like the goal of today, is a world without hunger, without environmental stress, and without resource loss. In view of many centuries of exhaustive agricultural history, the specific goal ought to be that of achieving a global regenerative and nationally self-reliant food system.

The word *regenerative* refers to the idea that in the twenty-first century, agriculture (for the first time in agricultural history except for traditional paddy rice production found in the tropical world) will regenerate its resource base of soil, water, and bio-diversity. Agriculture, of all the sciences, technologies and industries, has this unique potential. The word "sustainable," which frequently refers to new agricultural futures, too often is interpreted to mean that, given necessary resources, even a poorly designed system can be sustained over an extensive period of time so long as a community can obtain the needed resources. To move beyond this ambiguity, the word *regenerative* is used. The idea of regenerativeness goes beyond conservation, for regenerativeness usually implies being careful about using a resource in order to make it last as long as possible. Regeneration, particularly in the case of agriculture, refers not only to replacing the essential resource, but also to enhance it.

We have observed in many instances that if agriculture is carefully developed, it enriches soil resources, rehabilitates, and even improves the landscape as it restores stability and integrity to the rich diversity of the biotic community. Good agriculture and good rural community are inseparable parts of the equation of agricultural development.

A regenerative agriculture (the agenda for the twenty-first century) involves finding ways in which biological reproduction can be managed to benefit the immediate society as well as the future. Regenerative agriculture produces in a way that enhances the physical and biological environment, which, at the same time, brings

greater dignity and welfare to the producing community. A regenerative agriculture restores the land to a semblance of its original form. It mimics the complexity and diversity of a given natural ecosystem. It becomes an analogy of the more original biotic community. Regenerative agriculture visualizes the total components of an immediate environment or recognizable habitat or self-contained ecosystem which is composed on the one hand of the inorganic and organic realm, and on the other, of the various organisms which live together in community, comprising the biota.

### Requirements for Survival

There are three requirements for the survival of any organism, be it a salamander or a human being. They are simple to remember but awesome to practice in our modern and hoped-for post-modern world. For an agricultural system to be considered regenerative, it must operate on three principles:

- Renewable resources of the given biota are not drained.
- All essential non-renewables are recycled.
- Wastes produced in the life-cycle can be absorbed by the biota.

These facts of life are simple to remember. However, to develop a food system capable of supporting the human population within these essential constraints is a very different matter. This is where challenges as well as normative guidelines are to be found. This set of principles is the warp and woof of the tapestry of regenerative agriculture. But, there is an additional principle which forms the design and holds it together. It is this: Since all ecosystems are complex, agriculture must be coherent and consistent with this reality. Agriculture must attempt to diversify a given biotic community (just the opposite of our present system of biological simplicity and the vertical integration of agricultural technology and economy).

## Approach to Regenerative Agriculture

Regenerative agriculture must consider six questions:

1. What did the original ecosystem look like before extensive human intervention?
2. How did humanity relate to those earlier environments?
3. What are they like today?
4. What caused the transformation?
5. What might be analogous to those earlier communities?
6. What strategies will move us from where we are to post-modern approximations?

## Clues for Meeting the Challenge

Although the challenge of developing a regenerative agriculture is awesome, there are a few clues. Regenerative agriculture will be solar and biologically intensive instead of petrochemically and capital intensive. Farmers will be understood as managers of micro-biotic communities of which there are millions. We call this kind of agriculture "agro-ecology." This activity is biologically very complex. It is not truncated as are today's monocropping systems. Farms and farming systems will be designed to be analogous to earlier ecosystems. Agricultural colleges will be called "Schools of Agro-ecology," or "Colleges of Biotic Community Management." Farming will be site-specific. It will attempt to harmonize and enhance the massive diversity of ecological niches. Zero tillage, or perma-culture, will be the rule, not the exception. Such an agriculture will integrate perennial grasses, trees and indigenous animal species into the system. It will involve the unlocking of the genetic potential of more than twenty thousand identified edible

plants. An agro-ecology will involve the development of the food potential of more plant species as well as the ranching of indigenous animals such as the antelope, bison, elk, and deer. We will talk in terms of prairie farming, woodland farming, desert farming, tropical forest farming, sahelian farming, and aquaculture.

In livestock production, we will work symbiotically with creatures that have evolved within their ecosystems during tens of thousands of years and have contributed to the health and balance of the plant communities of their natural habitats. New agricultural infrastructures for research, food production, and processing will unfold. Agriculture will be regionalized. An agro-ecology will engineer itself in ways that maintain and enhance the health of the land and those who farm it. Agribusiness as we define it today will fade just as soon as oil, gasoline, and nitrogen fertilizers skyrocket in price by the mid-1990s. Undoubtedly, large scale capital-intensive agriculture assets will shift to other more profitable places once artificial tax structures that now favor corporate investments in agriculture are modified to reflect a wider justice for folks still on the land. When this happens, the search will begin once again for the nearly lost wisdom of former folk who understand the land—its limits as well as its potential.

## The Implication is Radical Change

The development of a regenerative and socially enhancing agriculture implies radical change in how we think about agriculture, how we design the research agenda, and how we evaluate agriculture.

The concept of a regenerative and self-reliant domestic food system suggests that "efficiency" in agriculture be evaluated according to how well it contributes to the health of the land (the ecosystem) and the health of the human society, maintaining a carefully balanced priority for both the urban as well as the rural sector. Efficiency will be measured along the lines of productivity within the regenerative capacity of a given biogeographical province or biotic com-

munity over a long time-horizon of several hundred years. Efficiency will be measured with the criteria of biospheric enhancement now that we are numerous riders upon a very small spacecraft.

Implied in the goal of a self-reliant agriculture is the ending of the emphasis on international agricultural commodity trade. Agriculture will, of course, be committed to maintaining an international emergency grain reserve, but not on seeing agriculture primarily as an activity for contributing to a nation's ability for international trade to generate wealth or balance trade budgets. Domestic and self-reliant agriculture is coherent with the concept of a world (a nation) free of hunger. Self-reliance is a contradiction to food deficits and the need for agricultural commodity trade. The agenda for the agricultural economists of the twenty-first century is enormous. We need to work for smooth economic transitions. We cannot continue with the idea that there will always be food-deficit and food-exporting nations. Regenerative and self-reliant domestic food systems in the twenty-first century replace centuries of colonial export cropping. Prior to colonialism was slavery and the consequent disappearance of ecologically sensitive and regenerative food systems that indigenous populations understood and practiced.

A regenerative system is based on optimizing the bio-diversity (stability) of the original biota. This assumes that we substitute complexity for simplicity. The emphasis on monocropping gives way to an entirely new approach. The possibility is real in view of what is at least a 20,000 edible plant species resource pool and our growing knowledge and skill in biology and genetics.

Regenerative and self-reliant agriculture also substitutes for a petro-chemically and capital intensive agriculture, a solar, biological, and labor intensive agriculture. By labor intensive I mean, not a laborious, exhausting and monotonous technology, but ecologically sophisticated management. The emphasis on annual cropping systems will likely shift to integrated (livestock and crops and fisheries) perennial systems, eliminating annual

ploughing in most places. The concept of regenerative agriculture assumes eliminating toxicity throughout the entire food system and the ending of aquifer pollution and exhaustion.

Not only must we strive for a regenerative agriculture in the technical sense, but socially, we must recognize that the idea is dependent upon a secure, prosperous, numerous, and highly skilled national community of farmers who are well supported by a sound social, technical, and economic infrastructure within a secure rural society. The social implications of a regenerative agriculture for human renewal and a rehabilitated and enhanced landscape poses an awesome challenge. The search for a regenerative agriculture enables the national society, as well as the international community of nations, to discover new insights about our common security and to prioritize concerns accordingly. More and more it appears to be evident that the concept (and discipline) of regenerative agriculture holds great promise for enabling society to relate to the land as trustees of a common heritage. Within this we are able to define once again what it means to be human.

### The Role of the Mid-West

I cannot suggest what the role of the Mid-west might be. I am not a citizen of this part of our nation. But, I will suggest what might be the role of Dordt College. These suggestions reflect the role that I play in the work that I do at one of the California state universities near my home. What I am doing in association with my colleagues simply represents a tentative start in what we estimate to be a process extending beyond our lifetime. To be patient about my work, I continually remind myself that goals which we can achieve in our lifetime are really not deserving of our life, but goals for beyond our time make our efforts worthwhile.

The role of this college in this state involves a profound analysis of the problems of contemporary agriculture. For the analysis I would start with the question: "Why has Iowa lost half of its topsoil during the past two hundred years and why are there farm bankruptcies?" I would

follow the leads as far as they go.

Dordt College needs to work toward a broad, inclusive definition of agriculture. Is agriculture limited to producing food and fiber or is there more? It seems to me that agriculture involves the design and engineering of agriculture so that, as humanity interacts with the earth in its attempt to adequately feed, clothe, and shelter itself, the interaction enhances the landscape in integrity, beauty, and justice.

The role of Dordt College and its supporting constituency is to analyze the violence of farm foreclosures, and the exhaustion of human, physical, and biological resources. As it analyzes and judges from the normative perspective of social justice and environmental righteousness, it must envision new sciences and technologies which promise to maintain and even improve the welfare of the future of all life of our bio-sphere. As indicated above, perhaps the way to begin is to get beyond the paralysis of the status quo, and to remember what the landscape of Iowa looked like before the human invasion and to begin the long and arduous task of testing for a relevant analogue.

A most difficult role to play involves the recruitment of talented people in the field of agricultural economics and social policy so that work can begin on charting a smooth transition, perhaps over the course of a half-century, from an agricultural system dominated by exporting commodities to one that achieves a healthy regenerative and self-reliant domestic food system within each and every nation which can still rehabilitate its stressed environments, find the essential resources, and develop a post-colonial agriculture. Within the context of this role, or task, Dordt College may see export trading in food grain and livestock feed commodities as the antithesis of a world free from hunger. Just as we search for an ecologically sound substitute for "efficient production," we must search for a socially and ecologically responsible substitute for comparative trade advantage in agricultural commodities.

Finally, the task of the Dordt College community (present and future), is to offer to the

whole American society an agricultural ethic. We must clarify what responsible agriculture consists of or demands. Presently, our normative concepts are very narrow and ill-informed. Borrowing ideas from Aldo Leopold as a starter, I suggest that responsible agriculture enhances the natural system with which it interacts. This process preserves species and increases the health and fertility of the land from generation to generation. Beauty and justice in personal and community relationships is experienced, and agricultural technologies for the production of food and fiber are self-reliant on a sustained regenerative basis. Perhaps the strategy for all this is to develop an agro-ecology, where the ultimate measure of responsibility is the health of the land and those who nourish it—the farming community. If we value the health and the life of the land and quality in all our relationships, and if we value justice and meaningfulness in work and relationships, then what has been said makes at least a little sense.

We must all express gratitude for the opportunity to experience life and community. But we are also trustees, responsible and accountable to the Creator and his creation.

These things are on the agricultural agenda for the twenty-first century. For the sake of the survival of this planet, and all that this implies, we must work for just and regenerative food systems. It is good to be reminded that faith laughs at impossibilities and cries out, "It shall be done!"

#### Suggestions for Further Reading

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