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## New-Crop<sup>1</sup> Development as Part of Sustainable Agriculture<sup>2</sup>

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“Of the 10,000 grasses only seven—wheat, rice maize, barley, sorghum, rye, and oats—are employed globally, even though [we] consider grains from grasses to be “staffs of life,” and “foundations of civilization.” Of the 18,000 legumes, only six—peas, beans, soybeans, peanuts, alfalfa, and clover—are used intensively, despite the fact that legumes tend to be remarkably rugged and nutritious plants: ... Nature offers thousands of potential resources, yet we cling desperately to a handful of plants and animals...”

—Noel Vietmeyer, 1988

“Today even the most potent innovators are unlikely to be effective unless their work coincides with a crisis or series of crises that put people in a mood to accept innovation.”

—John W. Gardner, 1981

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1. New nonfood/nonfeed crops, including high-value and bio- raw materials for value-added products to replace imports and increase exports. New-crop development is not an end in itself, and they should not be seen simply as one more avenue for low-margin resource extraction. New-crops development is not a panacea. Free markets will help enfold consumer interests in promoting the well-being of farmers if public funding is used to increase the profit potential of undeveloped crops within sustainable systems. The objective is to develop new markets for new renewable resources. Food and feed crops are avoided because of the potential for generating political and economic turmoil among existing food and feed-producing commodity-specific organizations through the threat of simply shifting products within the same markets if new food or new feed crops were developed. Nonfood/nonfeed terminology is intended to minimize internal competition with existing domestic agricultural commodity organizations. However, categorizing a crop as “industrial” is difficult because all potential future uses of the crop are unknown.

2. Prepared as an invited paper for the workshop “Enviro/Economic Sustainability”—A Policy Discussion Including Agricultural, Environmental & Industry Interests. Co-sponsored by the Iowa State University Leopold Center for Sustainable Agriculture and the USDA Alternative Agricultural Research and Commercialization (AARC) Center. December 8-9, 1993, Indian Lake Resort Conference Center. Bloomingdale, Illinois.

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**ABSTRACT**

The purpose of the paper is to generate new thinking and dialogue for 1995 Farm Bill policy discussions. Attention is drawn to the call for changing paradigms<sup>4</sup> in U.S. agriculture policy, and the ways some authors suggest facilitating the process of change. Arguments are presented to support the notion that U.S. farm policy should include language mandating minimum levels of funding earmarked for new-crop research and development. New-crop development is not a panacea. Contributions of various new crops to sustainability will differ in nature and timing, and predicting or proving the future of a new crop is not possible. Therefore, visionaries are needed to lead an effort for investing public resources in new-crop development for the benefit of the environment and society-at-large. The “sustainability movement” is suggested as a logical arena for identifying leaders and coalitions to formulate and promote appropriate language for the 1995 Farm Bill and other relevant policy.

**INTRODUCTION**

*Objective of this Paper*

My objective is to provoke discussion and, perhaps, stimulate new ideas to gain support for a national policy to develop new nonfood/nonfeed crops in an environmentally and economically sustainable agriculture. But equally important is the process of finding common ground among the diverse interests represented at this workshop. And to this end I have provided a wide variety of literature references. The quotations included in the references should challenge all of us. The workshop plan is to promote political discussions, and therefore this

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4. The term “paradigm” is in vogue, but it is also useful to help describe part of what we need to discuss in this workshop. Joel Barker (1992a) has defined paradigm as “a set of rules and regulations (written or unwritten) that does two things: (1) it establishes or defines boundaries; and (2) it tells you how to behave inside the boundaries in order to be successful.” Each of us potentially has a different paradigm related to agriculture. In other words, each of us potentially would see a different set of rules for governing the way agriculture should be practiced, how priorities are set, and the relative importance of various consequences of agricultural research or production practices. Paradigm pioneers get the advantages of new ideas. Barker builds the case for being tolerant (pliant) of new ideas; be tolerant of people who are suggesting those new ideas and have tolerance toward people who see the world differently. The moral in Barker’s book: “During the next decade many people will be coming around blind curves yelling things at you. They will be too busy to stop and explain, so it will be up to you to figure it out. If you have paradigm paralysis [unable to think in new ways], you will be hearing nothing but threats. If you have paradigm pliancy, you will be hearing nothing but opportunity. I (Barker) would submit, in the context of all that I have said, that the choice of which you hear is entirely up to you.” (See also Covey, 1989).

paper is substantially about learning, communication, philosophy, open-mindedness, anticipation, innovation, leadership, action, politics, and the future.

### *Past Efforts Found Wanting*

The United States has not engaged in adequate efforts to domesticate, improve, and commercialize potentially profitable new crops. New-crop development is not a high priority in the sustainable agriculture literature I reviewed while preparing this manuscript.

### *Stresses in Rural America*

Both of the organizations sponsoring this workshop exist because of concerns about the stresses in rural America. Much has been written about the deterioration of rural environments, economies, and communities—all of which have some potential for being eased by a shift in farm policy. Many challenges face U.S. agriculture.<sup>5</sup> Indeed, the costly agricultural crop commodity surplus problem<sup>6</sup> was a prime motivation for Congress to enact Subtitle G of the 1990 Farm Bill that resulted in the formation of the Alternative Agricultural Research and Commercialization (AARC) Center, a co-sponsor of this workshop. However, if we are to gain adequate Congressional funding of AARC Center programs, support must be enlisted from outside traditional agricultural circles. Therefore, it is important for the AARC Center to move beyond conventional agriculture and traditional business-as-usual philosophies in seeking support for the development of new crops for U.S. agriculture. This workshop is an important step in that process.

### *New Players in Farm Policy Formulation*

The United States and other developed countries are shifting emphasis away from production, consumption, and growth toward quality of life, the environment and sustainability. Society at large is shifting the paradigm for domestic agriculture. Not-for-profit and volunteer organizations have voiced concerns about these issues for many years, but only in the past decade have they gained sufficient voice to significantly increase their influence on formulation of national farm policy. There seems to be an increasing rate of broad public concerns about farm policies and their consequences. The call is for conversion to a system where the economics of family farming favor production practices associated with sustainability—for environmental, health, social, economic, and aesthetic reasons. It appears that agriculture will be facing the kinds of policy debates experienced in recent years surrounding forestry and logging issues in the Pacific Northwest, and grazing on public lands.

### *Policy-Precipitated Stress*

It is widely agreed among non-vested interest groups outside the profit-driven conventional production agriculture industry that government subsidies of surplus production of major agricultural commodities promote, directly and indirectly, the economic, environmental, and social deterioration of many parts of rural America. Senator Tom Harkin from Iowa has stated, “As long as farm policy is decided in Washington, the agribusiness interests that benefit

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5. I encourage you to now read the quotes from Dr. Sandra Batie, 1992, in the reference section of this paper. Many additional quotes with references are listed which echo the concerns about farm policy and its ramifications. I encourage you to review those materials as well.

6. Jolliff, 1993.

from overproduction will control the agenda.”<sup>7</sup> I have focused my remarks on new-crop development rather than on new uses of existing surplus commodities.<sup>8</sup>

### *Call for Research Relevance in Addition to Competence*

Competent scientific research without clear social relevance is being rejected via budget reductions and organizational restructuring in the public sector.<sup>9</sup> The definition of sustainability continues to evolve,<sup>10</sup> and although this has caused some confusion it appears that the sustainable agriculture movement has become a social revolution that is strongly influencing U.S. farm policy.

### *The Challenge of Finding Common Ground*

Views and values differ significantly on what is termed “Conventional Agriculture” compared to “Sustainable Agriculture.”<sup>11 12</sup> Perspectives differ because of personal values or belief systems.<sup>13</sup> However, we can find positive ways to contribute to the workshop dialogue despite these potential differences.<sup>14</sup> Even participants with similar values or belief systems may be operating with different sets of rules. As we entertain new thoughts at this workshop, we can identify new options for mutual gain. With the help of a facilitator, we should be able to learn much from each other, and identify information needed for the next steps. As a group of individuals we must learn together in order to move forward effectively.<sup>15</sup>

## **WHAT IS THE PROBLEM?**

### *Lack of Crop Options and Management Tools*

As I see it, a significant part of the problem is associated with, or rooted in, a lack of options for profitable crops<sup>16</sup> and production practices<sup>17</sup> that would allow farmers to maintain a good standard of living<sup>18</sup> while using environmentally sustainable production practices.<sup>19</sup>

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7. Harkin, 1987; NRC, 1989; Pimentel, 1990; Krome, 1991; Orr, 1991; Batie, 1992; Flora, 1992; Pimentel, et al., 1992; and Smith, 1992.

8. There is evidence that focusing attention on developing new uses for surpluses of existing commodities historically: 1) diverts attention from addressing the root problem of over-concentration of agriculture in too few commodities, 2) diverts resources, through the political process, from the development of profitable new crops, and 3) continues the conventional agricultural policies and production practices blamed for rural stresses.

9. For example, reorganizations within USDA and within land-grant universities.

10. Young and Burton, 1992; and Gale and Cordray, 1994.

11. I assume a continuum exists for pros and cons of developing profitable new crops.

12. Beus and Dunlap, 1990, 1991, 1992; Beus, et al., 1991; Dunlap et al., 1992; Pimentel, 1990, Pimentel, et al., 1992; and Swanson, 1993.

13. Brunson, 1992; Krueger, 1992; Vietor and Cralle, 1992; and William and Lev, 1993.

14. Ury and Fisher, 1983; and William and Lev, 1993.

15. Senge, 1990; William et al., 1994; and Daniels and Walker, 1993.

16. Such as new nonfood/nonfeed crops. See also Smith, 1992.

17. Or “tools”. For example, farmers need practical tools to allow them to make wise decisions about nitrogen fertilizer management. Farmers need these tools to provide management guidance for environmental and economic sustainability. Legitimate profit motives of the fertilizer industry have promoted the use of nitrogen fertilizer application technology to enhance crop yields for farmers. Land-grant university scientists legitimately use the industry funding or industry-promoted, or leveraged, public funding to research the use of nitrogen fertilizer management technology. However, apparently, because of the lack of profitable business incentives, inadequate attention has been given to securing funding to develop the tools farmers need, as described above. Scientists need to speak up for getting these tools developed. In the meantime farmers, the environment, and society-at-large are the

*Survival Mindset by Default*

Given the lack of options, farmers often do “the best they can to survive”, given the available land, labor, capital, technological tools, crop options, markets, government programs, etc., even if the environmental, social, and economic consequences pose risks to their own long-term well-being as family farmers. Further, farmers may unknowingly damage the environment because of lack of monitoring tools or scientific information revealing damage done by a particular practice. Surplus production of a few crops, with low crop prices, has generated consequences that will not be overcome easily or quickly.

*The Thesis of this Paper*

One useful way to help relieve stress in rural America is through 1995 Farm Bill policy to develop profitable new crop options for America’s family farms.<sup>20</sup> Farmers will grow and appreciate new crops if they are sufficiently profitable. Potential new-crop plants can be made profitable by applying new and existing technologies and by developing marketing structures that add and retain value to sustainable systems.

**WHERE U.S. AGRICULTURE IS NOW?***Operating on Myth-Based Policies?*

Browne et al. (1992) describe the role of agrarian myths in perpetuating the mission of yield-per-acre and surplus production in this culture.<sup>21</sup> Compared to the cost of surplus commodity programs plus the costs of the research invested to support them, historically, little investment has been made in alternative crops, practices, or missions. Reasons for this apparent paradigm paralysis in agriculture may be in part the result of a feeling of entitlement<sup>22</sup> in some sectors of the agricultural industry that benefits from overproduction.

*Chickens Coming Home To Roost ?*

The United States has developed an industry-based, limited-diversity system that has led to ecological, economic, and social problems as well as paradigm paralysis. Failure to acknowledge these negative “externalities,” as well as the failure to recognize the positive

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losers. Also, the farmer may lose more freedoms if environmental regulations end up as the only way to make the needed progress in sustainability.

18. In a free market.

19. The problem appears to be substantially the result of U.S. farm policies.

20. Many other things are also needed, such as tools, as mentioned below. Short-term solutions to certain aspects of the problems related to agriculture are needed, but are generally outside the scope of this paper. Nevertheless, those ‘other things’ are not viewed as prerequisites to initiating meaningful efforts to develop profitable new nonfood/nonfeed crops.

21. In March 1993, a major grain handler/exporter published the statement: “The first challenge for agribusiness is to produce a larger, more secure food supply”. From: A speech by Cargill Public Affairs Vice President Robbin Johnson to the USDA Agriculture Outlook ‘93 Conference. *The Cargill Bulletin*, March, 1993, page 5. In April, 1993, *The Cargill Bulletin* published the following statement of Cargill Chairman and CEO, Whitney MacMillan: “The real problem isn’t merely a shortage of food supplies. The real problems occur when people don’t have money or access”. See also Harkin, 1987, and Smith, 1992.

22. Bardwick (1991) describes how attitudes of entitlement and fear influence productivity in businesses. Those principles may be useful in diagnosing some of the root issues in agricultural policy. Policies which promote surplus commodities and low prices (at taxpayer expense) might be viewed as sustaining the entitlement of the buyers who benefit from low prices; while the farmer remains trapped because of a lack of profitable alternative crops to produce.

opportunities for new-crop development, has allowed the system to become vulnerable, both directly and indirectly, through costly government programs and lost opportunities to generate new wealth.

### *Cost is Enormous*

Excess production capacity in U.S. agriculture, which is policy-driven, has cost society hundreds of billions of dollars between 1978 and 1992.<sup>23</sup> This problem has many causes,<sup>24</sup> but one of them surely is the lack of profitable new crops that might have helped prevent the decline of farming profitability.<sup>25</sup> Farm policy has encouraged excess production capacity development, which is a national liability.<sup>26</sup> Because of the lack of profitable crop alternatives, farmers have been trapped by costly production inputs and low commodity prices.

### *Dependency Forced on Farmers*

Without alternatives, farmers may be locked into or become dependent upon current commodities until provided with economic or other incentives. Development of profitable new crops for use by farmers, while simultaneously fashioning new sustainable agricultural systems, may help reduce the stress caused by this “forced” dependence. Other alternatives for agriculture are outside the scope of this paper.

### *New-Crop Development Voice is Faint—if Existent*

While technological resources are available, vision and voice for new-crop development have heretofore been muffled or faint, not only from the U.S. Department of Agriculture, but also from the land-grant universities, the agribusiness-industrial complex, the farming community, and the sustainable agriculture movement. For several decades the shared mission in at least the first four of these sectors of agriculture has focused on high yield-per-acre to maximize economic profit.

### *The AARC Center, Sustainability, and New-Crops Development*

The establishment of the Alternative Agricultural Research and Commercialization Center offers promise for providing the needed vision and voice for the future, although its initial focus has been more on development of alternate uses for existing commodities, particularly corn. This may signal the need to focus on alternative objectives by the commodity-specific agricultural organizations. It is important to note that the sustainable agriculture movement has shown little vision for the potential role of new-crop development in the future of U.S. agriculture. The reasons for this lack of vision are important points to assess when planning strategies for national farm policy development.

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23. Jolliff, 1993.

24. Browne, et al., (1992) describe the roles of agrarian myths in agricultural policy. It is widely recognized that policies that set the research agenda for technology development in agriculture are important for directing the nature of agricultural production.

25. Jolliff, 1993.

26. NRC, 1989; Harkin, 1987; and Smith, 1992.

## WHERE U.S. AGRICULTURE NEEDS TO BE?

### *What Justification is Needed to Support New-Crop Development?*

A determination needs to be made as to whether additional justification for development of new crops is necessary to mobilize needed political support. Should the multiplicity of benefits from crop diversity be reviewed, studied, quantified, and appropriately credited for past and potential economic, environmental, and social contributions to society at large? This would require increased support of, and rewards to, multidisciplinary teams substantially beyond the traditional biological scientists doing technology-driven reductionist research on large-acreage crops. A well-conceived effort could benefit everyone.

### *Is There Not Enough Evidence ?*

It is suggested that ample evidence exists to justify an aggressive national policy for the development of profitable new crops for U.S. agriculture. References with many cross-references<sup>27</sup> as well as statements and reports<sup>28</sup> are provided in this paper.

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27. Janick and Simon, 1990, 1993; Jolliff, 1989, 1990, 1993; USDA, 1992; Kelley, 1993; and Jolliff and Snapp, 1988.

### 28. **Statements and Reports in Support of Alternative Crop Development in the U.S.**

“...neither my overseers nor manager will attend properly to anything but the crops they have usually cultivated; and, in spite of all I can say, if there is the smallest discretionary power allowed them, they will fill the land with corn, although even to themselves there are the most obvious traces of its baneful effects. I am resolved, however, as soon as it shall be in my power to attend a little more closely to my own concerns, to make this crop yield in a degree to other grains, to pulses, and to grasses.” (In other words, Washington plans to diversify into other crops rather than growing just corn. The letter proceeds to discuss many of the alternative crops he has tested.) *Letter from George Washington to Thomas Jefferson (October 4, 1775)*. Source: Rasmussen, W. D. 1975. *Agriculture in the United States: A Documentary History*. Vol. 1. Random House, New York.

“It may be asked, what is meant by agricultural science?... I answer, would it be difficult for the agriculturalist, or horticulturalist, to determine what his lands were best calculated to produce, who should sow three kinds of grain in the same field, the ground of which are equally well fitted...? These experiments made, and entered into a journal, which should be kept by every farmer...thus enabling him to fit and prepare his land for that kind of crop which pays the best, and with the least labor and expense. And is this knowledge not worth acquiring?” *Ezra Graves in “Agricultural Science” and article which appeared in the New York State Agricultural Society Transactions (1850)*. Source: Rasmussen, W. D. 1975. *Agriculture in the United States: A Documentary History*. Vol. 1. Random House, New York.

“The duties to be performed by this agency of government are (7 are listed)... (3) The study of unknown indigenous plants for familiar cultivation in our country, many of which may doubtless prove an addition of the greatest importance to our wealth.” *Thomas Clemson, Superintendent of Agricultural Affairs of the United States, American Agriculturalist (1859)*. Source: Rasmussen, W. D. 1975. *Agriculture in the United States: A Documentary History*. Vol. 1. Random House, New York.

“Be it enacted by the Senate and the House of Representatives of the United States of America in Congress assembled, that there is hereby established at the seat of the Government of the United States a Department of Agriculture, the general designs and duties of which shall be to acquire and to diffuse among the people of the united States useful information on subjects connected with agriculture in the most general and comprehensive sense of the word, and to procure, propagate, and distribute among the people new and valuable seeds and plants.” *The opening section of the legislation establishing the new U.S. Department of Agriculture (May 15, 1862)*. Source: Rasmussen, W. D. 1975. *Agriculture in the United States: A Documentary History*. Vol. 1. Random House, New York.

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Numerous studies have identified the needs for, and potentials of, new crops research and development. Expanded research and development of new crops would provide a basis enhancing economic development in terms of new products, such as industrial oils, medicines, pesticides, and fibers, as well as alternative sources for established crop products, and diversified agricultural production, thus reducing surpluses of established crops and decreasing the vulnerability of U.S. agriculture to adverse or changing environments. (several more points listed). *Source: Council for Agricultural Science and Technology. 1984. Development of New Crops: Needs, Procedures, Strategies, and Options. Report No. 102. Ames, IA.*

“Based on its findings, the Task Force concluded that diversification of agriculture and forestry must become national priority. Indeed, the group concluded that diversification, via both new crops and new uses for existing ones, appears to offer the only alternative which promises to enable both (1) revitalization of ailing segments of the industries; and (2) revitalization of the full economic potential which agriculture and forestry hold for the nation.” *Opening statement in “A Report from the New Farm and Forest Products Task Force to The Secretary of the U.S. Department of Agriculture” (June 25, 1987). Source: New Farm and Forest Products Task Force. 1987. New Farm and Forest Products: Responses to the Challenges and Opportunities Facing American Agriculture. U.S. Department of Agriculture. Washington, D. C.*

“Developing new crops or products could raise farm income and reduce government subsidies, the trade deficit, and potentially adverse environmental effects of farm production.” *Opening statement in “Alternative Opportunities in Agriculture: Expanding Output Through Diversification. Economic Research Service, USDA (May, 1990). Source: Economic Research Service. 1990. Alternative Opportunities in Agriculture: Expanding Output Through Diversification. Agricultural Economic Report No. 633. U.S. Department of Agriculture. Washington, D. C.*

“I begin from a conviction about the importance of diversification in U.S. agriculture, including the economic impact it will have.... There is now a widespread interest in diversifying to new crops.” *Hon. Cooper Evans, Special Advisor for Agriculture. Source: Evans, C. 1990. New Crops/Products from Agriculture: Setting the Stage. Presentation at the 18th Annual Breimeyer Seminar. November 15, 1990. University of Missouri, Columbia, MO.*

“In passing the 1990 Farm Bill, the set of agricultural statutes by which USDA currently operates, Congress identified six priority areas for agricultural research. The law states “Federally funded agricultural research and extension programs shall be designed to, among other things, accomplish the following:... (4) improve the production of American agricultural system and develop new agricultural crops and new uses for agricultural commodities.” *Public Law 101-624 (1990).*

“Development of new industrial crops and new uses of traditional crops offers future flexibility to respond to changing political, economic, and environmental conditions in supplying industrial materials.” *Source: U.S. Congress, Office of Technology Assessment. 1991. Agricultural Commodities as Industrial Raw Materials. May 1991. OTA-F-476. U.S. Government Printing Office. Washington, D. C.*

“At the 68th Annual Agricultural Outlook Conference on December 3, 1991, I announced plans for the Department of Agriculture to accelerate the development of new crops and uses of farm commodities. Clearly the time has come to intensify our efforts in expanding markets at home and abroad. New crops and new uses offer that potential.” *Honorable Edward Madigan, U.S. Secretary of Agriculture, in New Industrial Uses, New Markets for U.S. Crops (October, 1992). Source: U.S. Department of Agriculture, Cooperative States Research Service. 1992. New Industrial Uses, New Markets for U.S. Crops: Status of Technology and Commercial Adoption. (Advance Issue). U.S. Department of Agriculture, Washington, D. C.*

“Of the 10,000 grasses only seven - wheat, rice maize, barley, sorghum, rye, and oats - are employed globally, even though [we] consider grains from grasses to be “staffs of life,” and “foundations of civilization.” Of the 18,000 legumes, only six - peas, beans, soybeans, peanuts, alfalfa, and clover - are used intensively, despite the fact that legumes tend to be remarkably rugged and nutritious plants: ... Nature offers thousands of potential resources, yet we cling desperately to a handful of plants and animals...” *Source: Vietmeyer, N. 1990. The New Crops Era. Forward, In J. Janick and J.E. Simon (eds.) Advances in New Crops. Proceedings of the First National Symposium—New Crops: Research, Development, Economics. October 23-26, 1988. Indianapolis, Indiana. 560 pages. Timber Press. Portland, Oregon.*

*Agriculture Needs to be Environmentally Benign*

Agriculture needs to be more in harmony with nature. This requires that we learn more about agricultural practices as they relate to nature. The development process for setting the national research agenda should include more diverse participants, and added attention should be paid to ecology and cropping systems research. Reward systems in public research institutions need to be adjusted to accommodate these changing priorities.

*Farmers Need Viable Profit Margins*

We need economic sustainability for rural communities as well as the national treasury. Profitable new-crop options have the potential to become an integral part of new sustainable agricultural systems. Moreover, farmers need these new crops and other options to enhance their profitability and improve their chances for economic survival. New crops represent a complement to the continued, government controlled, low-margin production of traditional crops.

*New-Crops Can Provide Options*

Where do new crops fit in the current picture?<sup>29</sup> In my opinion, new crop development *per se* will not cure the ills caused by conventional agricultural practices, research priorities, and commodity markets as promoted by traditional national agriculture policies. However, as part of a developing sustainable agriculture system, new crop development can provide numerous benefits. These include plant diversity and accompanying benefits of crop rotations, pest control, adaptation to intercropping, work distribution efficiencies, soil erosion control, new markets, and reduced producer exposure to risks from fluctuating commodity prices and weather. For example, in 1993 in Missouri, canola harvest beat the floods while wheat that was ready for harvest one or two weeks later did not. Also, summer annual crops like corn and soybean could not be planted after fields became plantable in August, but buckwheat could (R. Myers, personal communication).

*Increased Potential for Farmer Rewards*

Increased options with new crops can shift control and economic rewards in agriculture to the farming sector and over the long run might help reverse current trends. Adding value to a new crop on the farm or in a nearby small town can contribute to the sustainability of rural America. Selection criteria for the public funding of new crops or value-added products there from might emphasize the prospect of each to directly create new farm/rural community-based wealth.

*Increased Technology Development for Rural-based Value-Addition*

Technology development to facilitate farm-scale efficiencies in value-adding activities might be critical co-development considerations for rural development projects including new crops.

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29. I should emphasize at the outset that I have no silver bullets, no magic wands, and no snake oil. Note that none of the literature citations are from *Crop Science* or *Agronomy Journal*. I have not tried to present a short-course on new crops or a comprehensive list of merits of new crops. Based on the literature, it appears to me to be primarily a political problem.

*Research Agenda Policy and Assessment Need Broad-based Inputs*

Research priorities must be based on more than just short-term economic profit. Accounting procedures need to be developed to credit and debit farming policies/practices for enhancements to, and detractions (“externalities”) from, sustainability. For example, a crop that enhances soil tilth should be given credit (contingent valuation) for the benefit. Similarly, determination of the true value of a crop commodity, or its economic impact, needs to include the costs of externalities such as environmental damage, loss of family farms from low crop prices, and costs of government subsidies in all forms—including research funding. This type of new paradigm should begin to level the playing field for development of profitable new crops for use in sustainable systems.

*The AARC Center / Earmarked Funding*

It is critical that AARC Center Board members and staff be effective national advocates for new crop development in the United States. Congress could, and probably should, earmark funds for the support of new crop development. That approach might limit the ability of existing agricultural commodity-specific interest groups to control project funding. The AARC Center would do a service by promoting long-term research funding of development projects on at least the 10 best new-crop candidates—to accompany their respective commercialization efforts.

*1995 Farm Bill Language*

Specific language is needed in the 1995 Farm Bill to assure national commitment to, and specific earmarked funding of, new-crop development.<sup>30</sup> Simultaneously, new-crop development strategies need to be woven into the legislative fabric of the sustainable agriculture development effort. The national economy needs more market freedom in agriculture combined with profitable options for farmers so that everyone benefits from fair competition. A combination of available resources and incentives is needed to link market opportunities with entrepreneurs, scientists, farmers, and other appropriate audiences.

**HOW TO GET U.S. AGRICULTURE TO WHERE IT NEEDS TO BE?**

We must learn how to identify and overcome resistance to change,<sup>31</sup> if possible, and identify reasons for low support of new-crop development. These then must be addressed, possibly via workshops, research, etc. There must be leadership that provides vision and voice for new-crop development as part of sustainable agriculture. Finally, we must develop essential specific legislative language for the 1995 Farm Bill and mobilize leaders to work on Capitol Hill.

*Identify Leaders in the Sustainable Agriculture Movement*

If the sustainable agriculture movement promotes the economic advantages (to society in general and to farmers in particular) of its philosophy, along with the environmental benefits, it suddenly acquires the potential to represent the broad interests of farmers, the environment, and

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30. Jolliff, 1990.

31. Employ a process where people (including farmers) can explore their values, beliefs, views, and concerns; where participants (including farmers) begin to develop trust and, therefore, can respectfully challenge each other’s assumptions and facts; and where inquiry is focused toward action based on consensus and visions of the future (Barker, 1990, 1992a, 1992b, 1993) that represent overarching goals such as unleashing the creativity of farmers. Important criteria for participation are people with an open mind for learning (R. William, 1993, personal communication).

society. Supporters of the movement should be able to avoid the hindrances of profit-driven and narrowly focused commodity-specific organizations, and therefore could become a significant “lobby” to articulate language for the 1995 Farm Bill which mandates the support of new-crop development.

*Invite, Include, and Encourage Participation From Many Entities*

Additional organizations representing individual farmers and rural community development might provide valuable support in helping USDA and established agricultural commodity-specific organizations to share in this vision. This coalition is needed because we cannot expect farmers to take the lead on financing or lobbying for long-term, high-risk, projects such as new-crop development.

*Establish Realistic Expectations From Private Industry*

Agribusinesses and commodity-specific organizations should be provided with information to stimulate their imagination and persuade them to join the effort—although it must be recognized that initial risk-benefit ratios with new-crop development likely will not be very attractive to those operating on a short-term economic profit mandate.<sup>32</sup>

## WHAT NEXT?

*Expected Outcomes*

The new paradigm for sustainable agriculture, which should include new crops, will likely threaten practitioners of the old paradigm.<sup>33</sup> Therefore, support from new constituencies is needed.<sup>34</sup> “Tilted playing-fields”, often supported by taxpayer dollars,<sup>35</sup>—are major obstacles to developing, and capitalizing on, new-crop potentials—and will require legislated action for change. Given sufficient profitable new-crop options and appropriate tools, farmers can become leaders<sup>36</sup> as well as managers<sup>37</sup> in developing dynamic and sustainable agricultural systems.<sup>38 39</sup>

*Crop Improvement or Marketing? The Chicken-Egg Syndrome and Stalemate*

I assume that it would be politically unacceptable simply to remove subsidies on all crops that are produced in surplus. Yet, ironically, critics of new-crop development cite lack of markets as a prime reason for not investing in their development, while wincing only slightly as large redistributions of wealth to certain sectors continue. Market development for new crops may be one of many topics that need attention. It is probable that development of profitability in producing new crops at competitive prices will play a major role in market development.

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32. Duvick, 1988.

33. Because: “a new paradigm puts everyone back to zero, so practitioners of the old paradigm, who may have had great advantage, lose much or all of their leverage” (Barker, 1992). The intent is not to threaten; it is simply an inevitable part of the process.

34. It can be especially important for the new paradigm for new-crop development to come from, and be supported by, new constituencies, as was the case for the sustainable agriculture movement. The sustainable agriculture community is a logical leader of a new movement to develop profitable new crops for family farms in America. Recruitment efforts for a new coalition should include public-interest groups not hindered by old paradigms.

35. Pasour, 1988.

36. And thus “doing the right things”, such as developing sustainable systems.

37. And “doing things right”, technologically.

38. Other needed policy changes are beyond the scope of this paper and my expertise.

39. Flora, 1992.

However, the lack of immediate profit typically stifles recruitment of political support for new-crop development.

*Profit is Related to Yield, and Requires Investments*

Yield-improvement research is a key first step in making a new crop profitable for farmers, while simultaneously retaining competitive pricing to generate market demand. The principle is much the same as in the familiar story about humanitarian aid. Give a person a fish, and soon the fish will be gone and the person will again be hungry. Teach the person to fish and daily needs, human dignity, and society-at-large are better served. Continued reliance on farm subsidies and surplus crops is analogous to giving the person a fish, simply perpetuating the problem rather than seeking a solution. For some reason U.S. agriculture has clung to the paradigm of farm subsidies instead of making appropriate investment in “learning how to fish”. Perhaps the answer is related to what was quoted earlier from Senator Tom Harkin, “As long as farm policy is decided in Washington, the agribusiness interests that benefit from overproduction will control the agenda.”

*What Will it Take to Cause Change?*

One has to wonder how much data or rationale would be needed to encourage change. Is agriculture going to wait for a taxpayer revolt before taking action to reduce costly commodity surpluses? The GATT negotiations indicate the high level of difficulty involved in agriculture-related negotiations. The influence of Japanese farmers in agricultural trade is another indicator of how difficult change can be. Senator Tom Harkin believes that farmers must be given more voice in national farm policy. Smith (1992) builds a case that the land grant university research agenda must direct public funds toward technologies that support farming activities rather than nonfarm activities. It appears that the external force of the sustainable agriculture movement will be necessary to get needed national policy change. In short, there is a call for reducing the political influence of those who benefit, at public expense, from continued overproduction. Revolutions have been the hallmark of change throughout human history, and that may be what is now taking place in the sustainable agriculture movement.

## A WINDOW OF OPPORTUNITY

*The 1995 Farm Bill*

We have an important window of opportunity in the 1995 Farm Bill. Today’s urban dwellers have changed the rules about how agriculture fits into the broader scheme of society.<sup>40</sup> This includes emphasis on “reduction, reusing, and recycling”. We can expect more of these kinds of changes in the 1995 Farm Bill and subsequent Farm Bills.

*Time is of Essence for Coalition-Building*

In my opinion, it is time for the USDA, the land-grant university system, and the agricultural-industrial complex to develop more collaboration, and to demonstrate willingness to accept new thinking and recognize these emerging new rules. It is not too late to listen, to learn, and to act.<sup>41</sup>

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40. Batie, 1992; Beus and Dunlap, 1991; Brunson, 1992; Flora, 1992; Krueger, 1992; Smith, 1992; Stauber, 1992; Vandermeer, 1992; Vietor and Cralle, 1992; Vaux, 1993.

41. Some of these established institutions slowly have begun to warm up to the concept of sustainable agriculture. It has taken 10-15 years. A vital motivation for the gradual shift has been the allocation of federal resources to

*Consider Special Communication Skills*

Our workshop deliberations need the benefit of special communication skills. We can learn new approaches to listening,<sup>42</sup> dialogue, and principled negotiation<sup>43</sup> that will help us move forward. Conventional and sustainable agriculture interests need to find common ground to minimize the kinds of intractable circumstances experienced recently in the forest products industry in the Pacific Northwest, and the Uruguay Round of the GATT<sup>44</sup> negotiations. Steven Daniels (personal communication) suggests that the major attributes of collaboration (coalition-building) are: process oriented, information sharing, mutual learning, accepting of newcomers, acknowledging values, sharing implementation responsibilities, and commitment to place (i.e. shared sense of community). He lists the drawbacks of collaboration as: slow, expensive, time consuming, requires a minimum level of goodwill, and must operate in the face of competitive options. Clearly, working through coalition-building is not for the faint-hearted.<sup>45</sup>

*Professional Facilitators Might Help*

I am pleased that one facilitator will be participating in our current workshop. Ideally, the workshop would involve participatory learning<sup>46</sup> by all. It may be a disadvantage that none of the individual discussion groups will be led by subject-neutral professional facilitators. Nevertheless, it may be possible to formulate a new composite vision for how a sustainable agriculture policy, with a new-crop development component, needs to be written into the 1995 Farm Bill.

*Leaders are Different from Managers*

Warren Bennis, past president of the University of Cincinnati, published a book entitled *Why Leaders Can't Lead*. He made a clear and simple distinction between leaders and managers. "Leaders are people who do the right thing; managers are people who do things right. Both are crucial, but they differ profoundly." He often observed people in top positions doing the wrong thing well. Does this latter scenario describe U.S. agriculture of the past few decades? "If the LGU [land grant university system] got it wrong—that is, it intended its research to assist farmers and farming activity when in fact it has done the opposite—then no one can get it right within the neoclassical paradigm" (Smith, 1992). The need for new paradigms seems apparent.

*Mobilize Farmers as Leaders, as Well as Managers*

Are farmers primarily managers of technology for producing large volumes of low-value products? Are technologies developed with primary focus on economic profit to designated players? Can leadership dedicated to the interests of society at large come from sectors driven by the profit motive? Do family farmers need more direct input into national farm policy?

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support research in sustainable agriculture. Resources devoted to development of profitable new crops will attract scientific expertise. The nature, stability and duration of the funding mechanisms can dramatically influence the qualities, and types of outcomes.

42. Barker, 1992a; Covey, 1989; Gardner, 1981; William, et al., 1994; William and Lev, 1993.

43. Fisher and Ury, 1983.

44. GATT = General Agreements on Tariff and Trade.

45. Daniels, S.E., and G.B. Walker, 1993.

46. William, R. L. Lev, and F. Smith, 1994.

### *Source of Leadership for Policy Development*

Do nonprofit and volunteer organizations provide a more trustworthy source of leadership (to do the right thing)? Who decides? Who sets the farm policies, which give preferences to development of one kind of technology over another?<sup>47</sup> In recent decades U.S. agriculture policymakers, profit-driven technology developers, and farmers have done well at producing surpluses of low-value bulk commodities. The problems are in the negative consequences of their production strategies.<sup>48</sup> For example, hundreds of thousands of farmers have gone bankrupt.<sup>49</sup> Universities may inadvertently contribute to the problem by pursuing a narrow technological agenda.<sup>50</sup> One would expect that Universities could contribute to the solution, if given a more explicit mandate, opportunity, and support. This workshop might facilitate the articulation of a national policy that would result in a mandate for supporting the development of sustainable agriculture.

### *The Decision-making Process, Self-examination, and Self-criticism*

Participants in this workshop, and the people we represent, need to determine how to make responsible decisions about new-crop development as a part of developing a sustainable agriculture. I offer the following quote as an articulation of what we should try to do: “The ability of (Oregon) citizens and policymakers to make informed and responsible decisions can be enhanced by the methods of self-examination and self-criticism....The complexity of decision-making at the intersection of ethics, science and the environment requires scholarly breadth and depth. Multidisciplinary perspectives enhance problem-seeing and thereby facilitate responsible problem-solving. Scientific progress is both supported by and affects the broader society. Responsibility requires researchers and policymakers to be accountable for the actions they undertake on behalf of society. The application of scientific research requires knowledge that transcends the factual and technical.”<sup>51</sup>

### *Vision-Development Opportunity*

The elements in the above quote are outside the immediate scope of this paper, yet the principles involved should be useful in developing new strategies for farm profitability within the scope of the sustainable agriculture movement. A need exists to form coalitions to support the development of profitable new crops for American family farms.<sup>52</sup> The history of soybean and canola<sup>53</sup> development suggest it is the right thing to do. It should be done, even though it is not the kind of program that will quickly return huge profits and thereby justify paying large sums to lobbyists to help get the program through Congress. It is the right thing to do, but it is not the kind of thing that attracts profit-driven industry. Therefore, persons in the sustainable movement appear to be the logical leaders.

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47. Smith, 1992.

48. NAS, 1974; Hassebrook, 1990; Congress of the United States - OTA, 1992; and Smith, 1992.

49. NRC, 1989.

50. Bella, 1987b; and Smith, 1992.

51. Campbell, 1993.

52. History suggests it will be challenging, at best, to convince existing U.S. agricultural commodity-specific organization administrators to support new, long-term, high-risk concepts outside their short-term, profit-driven, specialty-focused agendas. That political arena seems to have a whole set of challenges of its own.

53. Canola (Canadian, oilseed rape, low in erucic acid) is an edible vegetable oil developed in Canada.

### *A Call to Leadership*

As participants in this workshop, we have an open door to contribute to leadership—doing the right things in U.S. agriculture. Clearly, the sustainable agriculture literature is calling for improved leadership, i.e. “to do the right things” first, followed by “doing things right”. It appears that a process of self-examination and self-criticism during the workshop is in order. This will enhance our ability to make informed and responsible decisions. We can examine the premise that the 1995 Farm Bill should include provisions for significant development of profitable new-crop options for farmers to use in developing sustainable agricultural systems. Farmers need farm policy that provides crop options, appropriate tools for sustainable production practices, and stable and predictable incentives to develop and use sustainable systems.

### *Bring Nagging Questions to the Table*

Some workshop participants may have reasons for not viewing the development of new crops as a viable opportunity. Such reasons could be expressed and discussed to determine what information is needed to satisfy questions and concerns. This could be a key aspect of the workshop dialogue regarding new crops.

### *Excess Capacity Problems—Learn From Analogies*

The excess production capacity problem is the result of decades of policies. One aspect of those policies was to neglect development of profitable new crops. There is no quick way to fix this problem. But it is urgent that we start reversing trends of recent decades. General Motors, IBM, and Sears have shown us that poor management of excess production capacity is not easily fixed, regardless of the reason for the excess capacity. Poor management of excess capacity typically impacts most severely those persons positioned lowest on the socio-economic ladder. For example, tens of thousands of workers lost their jobs at General Motors. The sudden nature of this event draws attention to the resulting social stress. Although changes in rural America have not occurred as abruptly, their impact has contributed to the lack of social sustainability and social justice. The U.S. agriculture industry is larger than the previously mentioned businesses, and the excess capacity management issue is a political hot potato. Action by the group at this workshop is needed.

### *Unity From Workshop Participant Diversity*

Although the participants in this workshop are a diverse group, there are examples of recent successes in learning how to find common ground.<sup>54</sup> Recognizing the need for learning how to constructively deal with these differences for the good of society is our challenge and opportunity at this workshop.<sup>55 56</sup> Seeking first to understand, then to be understood,<sup>57</sup> will help us develop a spirit of harmony to displace habits of defensiveness and contention. It could be one of the greater challenges for any of us!

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54. Brunson, 1992; and Krueger, 1992.

55. Brunson, 1992; William, et al, 1994; and Vietor and Cralle, 1992.

56. Ever present is the hazard of the systematic distortion of information by organizations to meet the needs of the organization (Bella, 1987a).

57. Covey, 1989.

## A CASE FOR NEW CROPS

New crops can be profitable alternatives to government program crops in some areas.<sup>58</sup> New crops, by definition, have no voice in the agriculture policy arena.<sup>59</sup> Historically in the U.S. political system, sufficient resources have not been allocated for developing the profit potential of new crops.<sup>60</sup> Development of new crops has received only intermittent, token support at federal and state levels.<sup>61</sup> I am not aware of a single example of a futuristic or visionary approach taken in the United States that called for a comprehensive program to develop a profitable new crop. The stimulus for most past efforts can be traced to crisis-based decisions—even for soybean.

### *The Case of Soybean*

Examine the history of the development of soybean as a useful U.S. crop.<sup>62</sup> Soybean provided farmers an alternative crop on 40 to 60 million acres of corn, wheat, and cotton land in the U.S. in recent decades. Net national economic wealth benefit—including savings from reducing surpluses of replaced crops, and stimulus of protein meal-driven animal industries—might exceed a trillion dollars between 1925 and 1993.<sup>63</sup> Should some investment be made to quantify these benefits if this could aid in justifying the development of policies to support the development of additional new crops? (Obviously, each new crop potential will not be another soybean).

The history of soybean reveals much about development of new crops. The process is complex and long-term. It is unpredictable. There are visionaries. And there are naysayers. Timing can be important. It took the crisis of a vegetable oil embargo to get things moving—after public agency support for soybean development languished for more than a century. Several factors played key roles in the development of the U.S. soybean industry, for example: 1) successful utilization of the soybean in Europe during 1900-1910, 2) beginning in 1911, imports of soybeans from Manchuria for processing in Seattle, 3) processing of American-grown soybeans in cottonseed-oil mills in North Carolina in 1915—a welcome second oilseed crop because the cotton boll weevil was spreading eastward from Texas, 4) the general shortage of fats and oils during World War I,<sup>64</sup> 5) increased yield as a result of soybean improvement for seed rather than forage, and 6) development of the combine, which facilitated mechanical harvest.

The benefits from soybean<sup>65</sup> as a crop far exceeded the expectations of even the most visionary of the early observers. But as early as 1910 (and probably earlier), some paradigm pioneers<sup>66</sup> saw great potential in soybean as a new crop.<sup>67 68</sup>

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58. Jolliff, 1989.

59. Jolliff, 1993.

60. Jolliff and Snapp, 1988.

61. Jolliff, 1989.

62. Piper and Morse, 1923; Forrestal, 1982; Probst and Judd, 1973; Robinson, 1987; Jolliff and Snapp, 1988; and Jolliff, 1989.

63. “In 60 years since 1925, soybean had a total, inflation-adjusted, farm-gate cash value of \$188 billion (2, 50). The larger benefit to the nation’s economy, assuming a multiplier of 2.75 to project economic activity (10), is estimated at \$518 billion” (Jolliff, 1989).

64. Probst and Judd, 1973.

65. Industrial uses, animal industries, exports, etc.

66. Paradigm pioneers intuitively choose to follow new paradigms early—their anticipation allows them to be in the right place at the right time with innovative products or service. “Settlers”, on the other hand, follow the pioneers.

*The Case of Canola*

A similar story can be told about the development of canola<sup>69</sup> in Canada,<sup>70</sup> with at least one distinction. An established crop-marketing cooperative, the Saskatchewan Wheat Pool, was a partner in its development.<sup>71</sup>

*Investing in the Future—Toward a Legislated Commitment*

New-crop development, as a long-range activity, needs to be supported by public funds. The need for new-crop development will be with us forever and, the odds for success in any one program are very low. This means that many programs and many leads must be tried simultaneously, and lack of success in most programs should be seen as normal, even for well-conducted programs. A proportion of gross national product or gross agricultural product must be invested in new-crops research. Finally, the public must understand and support the fact that this effort must go on forever. The need for new-crop research can be compared to the need for plant genetic diversity and conservation. We must try to save part of everything, for genetic diversity of source breeding materials is essential. Diversity is essential because most of what we save will not be useful, but we cannot predict what will be useful.<sup>72</sup>

*Recruit the Commodity-Specific Agricultural Organizations*

I propose investigating what might be done to persuade established U.S. crop-specific commodity organizations to use their political influence and check-off funds to encourage the development of profitable new crops. Partnerships are very important for the development of new crops.

Settlers must wait until all the objective evidence is collected. Settlers miss the benefits of anticipation, which are gained by the pioneers. Settlers protect themselves from the risk of making a wrong decision, but pay a price of missed opportunities (Barker, 1992a, 1993).

67. Piper and Morse, 1923.

68. It has taken approximately a century for the development of a political voice for soybean, which approaches the strength of influence held so long for commodities such as tobacco, cotton, dairy, wheat, and corn. Presently, it appears that the American Soybean Association, like other commodity-specific organizations, is substantially narrowly focused inward. This should serve as a signal for national leaders and policymakers, that legislation is essential to give the needed focus on development of new crops for the national good.

69. Canola is a specialty oilseed rape. Rapeseed research interests in the U.S. were “outcompeted” by soybean interests for many years—and possibly even still are. This is somewhat like the dairy industry request to Congress in 1929 for tariff increases up to 100 percent on vegetable oils (Journal of the American Oil Chemists Society 6(1): 13). I have heard it said that the dairy industry fought the development of soybean as a new oilseed crop. The root of the problem in American agriculture might be clarified through some careful study of history. In the spring of 1933 the corn growers lobbied Congress for legislative support to use corn for alcohol motor fuels (Wright, 1993), similar to present efforts. Soybean, as a new crop was clearly of more benefit to society during the ensuing 60 years than an alcohol motor fuel entitlement program. However the Agriculture Adjustment Act of 1933 was transferred in subsequent farm bills into a more permanent farm protection entitlement program (Batie, 1990). The liabilities to businesses attendant with employee attitudes of entitlement are clearly presented by Bardwick (1991). History shows entitlements in agriculture have created dependencies and stifled motivation, innovation, and independence. There is no business reason to take a chance developing a new crop if Uncle Sam is the caretaker, banker, and security for handsome profits through cheap existing commodities for which the infrastructure is well established. It appears that significant entitlement may rest with agribusiness industries rather than with farmers who are trapped without alternative crops to produce.

70. White, et al, 1974; and Busch, et al., 1993.

71. Can we find ways to demonstrate to American agriculture that new crops can help even farmers who do not grow them, because of indirect effects on acreages and markets? Might agribusinesses (e.g. input suppliers and output buyers) see worthwhile opportunities for themselves, while simultaneously better serving society-at-large?

72. D. Duvick, personal communication.

### *A Call to Develop a Vision*

Thomas Jefferson said, “The greatest service which can be rendered any country, is to add a useful plant to its culture”.<sup>73</sup> What perspective did Jefferson have that is lacking in the United States today? Would the answer to that question help guide our dialogue at this workshop? Might the soybean be an example of what Thomas Jefferson had in mind? So, at this workshop might we build new coalitions, and recapture an old idea? Even long journeys begin with a single step once the destination has been envisioned. It is time to take that step.

## **DISCUSSION QUESTIONS**

The following discussion questions are posed to stimulate your thinking in preparation for dialogue at the workshop.

Discussion question # 1

**Why is there not a voice within the USDA (other than the AARC Center) for the development of more new crops?**

The USDA is the agency where the historical mission/charge has included development of new crops (Carabelli, 1972). Abraham Lincoln signed the bill giving USDA the mandate to work on new crops. Producers of the large acreage commodity crops such as corn, cotton, and wheat have benefited from having the new crop soybean as a profitable alternative for making wise use of otherwise excess production capacity<sup>74</sup>. The USDA has made giant contributions to increased production of major crops. It may be the inertial nature of such a large governmental research organization to promote the status quo with regard to the particular plant species developed as crops. It is easy to imagine that a mindset could develop that was reluctant to “fix” something that is viewed as not broken. It has been my experience that few of my colleagues and other biological scientists have a clear view of the magnitude of costs to society associated with excess production capacity in U.S. agriculture. They spend their time and use their innovativeness to work on crops for which funding and political support is available. These kinds of problems also exist in the European Economic Community (EEC). Taxpayer costs of surplus agricultural commodities in the EEC seem to be just as bad, or worse than in the U.S. However, the EEC has taken steps to initiate development of new crops (Rexen, 1992).

In the early history (1890-1930) of soybean development, the USDA commitment of resources was less than stunning (Cunningham, 1984, Jolliff and Snapp, 1988). It appears that USDA research funding levels on particular crops have historically been almost proportional to the economic and political influence of the commodity-specific organizations (Jolliff, 1989). It is well known that, in the political arena, the focused concerns of a minority will always prevail over the unfocused concerns of the majority. Commodity groups bring focus to their specialized interests. Unlike the existing commodity organizations, the broad beneficiaries of new crops—society-at-large, including farmers—do not have similar lines of political connection through organizations tied to their means of livelihood. Therefore, interests are too diverse to focus for political influence—without someone making a special effort. That is the reason for the need of a new coalition. This new coalition could develop methods of gaining environmental, social, and

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73. Cunningham, 1984.

74. Even soybean surplus production is now becoming a frequent problem.

economic benefits from developing profitable new crops for use in new sustainable agricultural systems.

Today, as in the early 1900's, USDA is an organization substantially serving existing interest groups. That situation may virtually preclude the USDA (other than the AARC Center) from being a voice or leader for the development of new crops. We have hope that the AARC Center will improve the situation, but it appears that other influential forces will be needed to mobilize resources to support development of profitable new crops. New-crop interests seem to get overlooked or outmaneuvered when public resources are allocated (Jolliff, 1989; Jolliff, 1993).

The historic approach of USDA seems to have resulted in a vicious circle, because of the lack of new crops, farmers do not plant new crops, and there is a lack of self-generating interests demanding research on new crops. Yet thousands of farmers who primarily produce crops controlled by government programs have few or no profitable alternative crops to grow. Progression toward monocultures and chemical-based management has tended to give farmers fewer and fewer management choices, and thus less opportunity to be innovative in developing sustainable systems. This progression has, in effect, been imposed on farmers who wish to survive economically. The virtual assurance of commodity surpluses, and thus low prices for farmers, further limits the opportunities of farmers to realize financial rewards when good management is practiced. The AARC Center, as an institutional innovation, is an important first step in an effort to help USDA break out of this vicious circle.

Discussion question # 2

**What is the cost of this vicious circle?**

It would be nice to be able to predict the future benefits of developing profitable new crops. That type of speculation, as done 10-15 years ago by proponents of biotechnology, can lead to serious anticipoimentment. Therefore, it seems essential to use historic information in making some judgments. In the spirit of making informed and responsible decisions, some self-examination and self-criticism may be in order.

The negative consequences of the excess production capacity are enormous. The national losses of economic wealth related to the problem of excess production capacity during the 15-year period 1978-1992 have been estimated to total at least \$500 to \$691 billion (Jolliff, 1993). This 15-year estimate may climb to approximately \$2.25 trillion when including unpriced environmental and social costs of the U.S. food system (Pimentel, 1990). Clearly, these cost estimates need to be evaluated, and improved upon by unbiased experts. Nevertheless, the costs seem to be much higher than the average citizen, including agricultural scientists, would have imagined. Pimentel (1992) has estimated annual costs to U.S. society for health and environmental effects of pesticide use at \$8 billion. New crops used in sustainable agriculture systems can help reduce pesticide use. If one applies the concept of true-cost pricing, the cost of food in the U.S. would be much higher than advertised. Who can guess what consequences of present or past practices will be discovered next, or at what cost? One can envision applying band-aid upon band-aid and attempts to deflect public concerns through lobbyists, peer pressure, lack of alternatives, advertising, and free samples touting the merits of the newest band-aid to try to cover the others. Costs are so high that the problem begs for action, and it appears that public patience is wearing thin.

Agriculture is a huge industry. It might learn from some of the recent experiences of large U.S. businesses. We can locate an example of both the source of the force to revitalize an industry and the consequences of a slow response. We have seen General Motors, IBM, and Sears respond

extremely slowly to changes that were needed in the best interest of their survival. These large U.S. businesses have demonstrated what is the virtual antithesis of what Joel Barker (1992) describes as the essential skill to be successful—that of anticipation of the future.

Japanese automakers were the outsiders who operated as paradigm pioneers<sup>75</sup>. It took the U.S. auto industry approximately a quarter of a century to pull through their paradigm paralysis and its consequences. United States agriculture is in a position to minimize creating more of this kind of problem. We can lead. The automakers' problems occurred despite marketplace signals much clearer, and more threatening, than those signals that traditionally come to agriculture through the non-regulatory and bureaucratic parts of Farm Bills. Realistically, future signals to agriculture promise to be clearer, at least in the environmental and food safety areas. New crops could provide new options for cropping systems that give alternatives to conventional agriculture.

I concede that new crops are likely to be subject to the same kinds of undesirable conventional agriculture production practices as existing crops. Furthermore, there will always be a few people who will abuse any system. Whether or not the abuse is premeditated, some farmers will pollute the environment. Therefore, laws to enforce some aspects of environmental stewardship for sustainability of agriculture seem inevitable. But let's not allow this fact of life to deflect our attention from the central issue. And an economically prosperous farmer, having profitable new-crop alternatives—with technological tools and incentives to develop sustainable agricultural systems—will be in a better position financially (and probably emotionally) to comply with any necessary environmental regulations, than will a bankrupt farmer. So, the time is right for development of leadership and vision in the arena of new-crop development policy for the 1995 Farm Bill. It seems that more than ample justification exists. The next step may be to identify leaders.

Discussion question # 3

**How do individual farmers view the need for, and the potential benefits of, developing profitable new crops as alternatives to surpluses?**

It could be that many farmers feel trapped by the big commodity industrial input-supplier/output-buyer-processor complexes. Thus farmers may be locked in or dependent on current commodities and cannot move until there are economic or other incentives. Thus they end up in a real bind, being both the friend and implementer of new crop development, and at the same time the enemy or protector of government-secured existing programs. Another coalition that can bridge or intervene to resolve the issue may be the best alternative. I believe farmers would respond favorably to leaders who had good information and a vision for development of new crops. Persons at this workshop might develop those leaders. The leaders might be industrial managers or engineers who have vision and needs that may be met by new crops. They would need information about how crops are developed. The leaders would need to learn of potentials that exist. They could help identify particular barriers to propagating the vision, such as myths, politics, ignorance, tilted playing fields, and lack of information. Maybe another objective of this current workshop should be to determine if there is a consensus as to why there is such a lack of vision for the development of profitable new nonfood/nonfeed crops. We might begin to change the stereotype of agricultural production from: "Food, Feed, and Fiber" to "Food, Feed, and Renewable Resources". The U.S. farmland would remain available for producing primarily just food in case of a worldwide food shortage. In the meantime, we need to develop the sustainable

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75. Which threaten the establishment.

environmental, social, economic and aesthetic wealth potential to help improve our nation's human, environmental, and economic situation, rather than putting us deeper in debt.

Discussion question # 4

**What incentive is needed to attract agriculture commodity organizations to support development of profitable alternative crops in addition to their respective commodity?**

Understanding why commodity-specific organizations in U.S. agriculture remain commodity-specific might provide much of the grist needed to move this workshop toward a useful outcome. If past behavior has been based on myth, or some other false hope, maybe exposure of that reasoning could be constructive in the search for solutions. Consider the benefits the soybean has provided for corn growers during the past 60 years—a profitable alternative to such crops as pasture, hay, rye, oats, barley, alfalfa, wheat and corn, as well as a valuable rotation crop. History shows that a rising tide lifts all ships. Yet today it appears that the National Corn Growers are more focused on ethanol production<sup>76</sup> than on developing new crops. Perhaps someone at this workshop knows how many acres were planted to corn and soybeans in Iowa in 1910 versus today. Those kinds of numbers might help convince more people of the need to develop a vision for the potential benefits of new crops. In spite of the huge growth in soybean acreage during the past 60 years, surplus corn has been produced in the majority of those years. It would be useful to know how many acres were in excess. The amount of national wealth lost from those acres of surplus corn would have made a healthy start at developing at least two or three profitable new crops. Wright (1993) listed leaders of the Chemurgic movement in the 1930s: William J. “Billy” Hale, Charles Holmes Herty, Francis Gaven, Wheeler McMillen, Clifford Gregory, and Les Christensen. The vision of these people, for industrial use of agricultural output, needs to be rekindled today for the benefit of the U.S. and the global community. Sustainable agriculture must allow for, and indeed promote, the development of new crops as industrial raw materials and as other renewable resources such as cover crops, trap crops, and intercrops as alternative methods of pest control and soil protection and conditioning.

Discussion question # 5

**How can we meet the need for leadership and vision development in educational institutions?**

Or should that be left to come along after-the-fact? My personal perception is that few people have a vision for the development of a new crop. The topic gets very little attention in national policy. Therefore, it gets very little funding. Therefore, very little work is done. Therefore, other than history, there is relatively little to teach, even if anyone is interested and funded to teach the subject. By default, rather than decree, this result somewhat resembles, in effect, how “party-line” topics are taught, or not taught, in countries with centrally planned

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76. See Wright, 1993 citation with quotation, and footnotes elsewhere describing the efforts of corn growers in 1933 to get legislation to subsidize power alcohol production from corn. While these ideas are not necessarily bad in and of themselves, entitlement attitudes and long-term subsidies stifle innovation, productivity, competitiveness and generation of renewable wealth at expense to society-at-large. The former Soviet Union is a prime example of this concept in an extreme case. Recovery from such dependence is not easy or necessarily rapid. Does continued dependence of corn growers on ethanol fuel markets jeopardize their future when nuclear fusion technology reduces the value of liquid fuels? New-crop options are critical to the future of American agriculture.

economies. Teaching the systems approach to sustainable agriculture, which I suggest, should include a place for new crops, would probably be even more difficult.

Apparently little is taught, at any level of education, about the history of crop development in the context of new-crop development potentials. In today's world it is easy to get caught up in the "gee whiz" mentality<sup>77</sup> of new technology and lose sight of the need for careful choices about the applications of those technologies (Bella, 1987b). For example, in the midst of the biotechnology euphoria, the mindset has been promoted that technology is available to do virtually anything we want with biological systems. But those technologies continue to be applied to produce costly surpluses while national policy lacks teeth to assure that the technologies are applied also in ways more useful to family farms, society-at-large, the environment, and the national budget.

The visions and foresight of scientists, administrators, politicians, business leaders, and farmers seem to be dreadfully lacking in connecting available technologies and plant genetic resources with the excess production capacity liability problem in the U.S. and the world. The situation is astounding. We need to better understand the reason for this (see quote with Wright, 1993) and act accordingly. It is so far out of balance that one might be tempted to consider the current situation the result of a scheme (Wright, 1993). It appears that too often the focus is on technology (Bella, 1987b) and competence in using that technology, rather than on the question of the relevance of technology application for the greater good of society (Batie, 1992)<sup>78</sup>.

Let's use the experiences of the past to give us the resolve to take the high road and identify win-win opportunities. We need to assure allocation in the 1995 Farm Bill of sufficient earmarked funds for the development of new-crops research to contribute to the development of sustainable agricultural systems. History shows that budgets dictate where people invest their energies. Budget allocations will attract the needed attention. Resources could be sharply targeted even on a particular crop—for example, in the USDA National Research Initiative competitive grants program. A rationale for recommended budget levels for development of new crops has been published (Jolliff, 1990).

Finally—Some CAUTIONS !!!

- 1) New-crop development takes time (It is not a quick-fix!).
- 2) New-crop development takes resources (Don't expect "something for nothing")
- 3) Be vigilant for opportunists (Of every sort, and from every quarter!!)
- 4) New-crop development might be viewed by some as prospecting for gold. They expect to find the "mother lode". The same kinds of characters—good and bad—come with the territory. Therefore, plan accordingly.
- 5) Gain a well-grounded historical knowledge base of crop development to aid in developing realistic expectations.

#### Annotated Bibliography and Selected References

Allen, C. Eugene. Vice-President, Institute of Agriculture, Forestry and Home Economics, University of Minnesota, St. Paul. Addressing Change in Land-Grant University Programs.

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77. Especially when huge amounts of public and private funds are being channeled into a particular politically popular area of research and development.

78. This is especially important since so much of agricultural research and extension is funded by the public sector.

- Presented April 3, 1992, at a meeting of the Board on Agriculture with representatives of the professional scientific societies. National Academy of Sciences, Beckman Center, Irvine, CA. “It seems that many of the criticisms of public higher education in the U.S. can be boiled down to real or perceived issues that involve accountability... we need to ask the question, ‘When is it appropriate for us to help shape change vs. just accepting that change will shape our programs and institutions?’”
- American Society of Agronomy. ASA, CSSA offering ethics statements. *Agronomy News*, January 1993, p. 8. “...Statement of Ethics, American Society of Agronomy...Demonstrate social responsibility in scientific and professional practice, by considering whom their scientific and professional activities benefit, and whom they neglect...”
- Bardwick, Judith M. 1991. *Danger in the Comfort Zone: From Boardroom to Mailroom—How to Break the Entitlement Habit That’s Killing American Business*. American Management Association. New York. “When Security is Institutionalized: Over time, the organization’s culture becomes an accumulation of hundreds of ways to achieve security and avoid mistakes. These means are informal at first, then formal, until eventually, Entitlement is fully institutionalized. This is the truly insidious danger with Entitlement: It settles in everywhere, and becomes part of the mortar that holds the organization together.”
- Barker, Joel. 1990. *The Business of Paradigms*. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Video Cassette. Concept: Too strong a belief in a paradigm can create paradigm paralysis, a terminal disease of certainty, which blocks progress.
- Barker, Joel. 1992a. *Future Edge—Discovering the New Paradigms of Success*. William Morrow and Company, Inc. New York. “For the past four years I have been describing three keys to the future for any organization, profit or nonprofit, that wants to participate fully in the twenty-first century. They are: anticipation, innovation, and excellence. Excellence...is the base of the twenty-first century...Innovation...is the way you gain competitive edge...However, excellence and innovation are not enough. Anticipation provides you with the information that allows you to be in the right place at the right time.”
- Barker, Joel. 1992b. *The Power of Vision*. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Video Cassette. Concept: Effective leaders empower people to real goals by the manner in which they develop a “vision community”.
- Barker, Joel. 1993. *Paradigm Pioneers*. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Video Cassette. Concept: A special kind of leader is needed to facilitate paradigm shifts...this [paradigm] concept reinforces the power and need for “cross-over” discussions between different fields—especially between the technical and nontechnical.
- Batie, S.S. 1990. Agricultural policy and environmental goals: Conflict of compatibility. *Journal of Economic Issues*. 24(2):565-573. “The farm bills originated in the 1930’s as a response to the Great Depression...that original emergency Agricultural Adjustment Act of 1933 (AAA) was transferred in subsequent farm bills into a more permanent set of ‘quasi-contractual farm protection entitlement’ (Lowi 1969; Paarlberg 1989)...Members of the agricultural sector...organized in such a way that they basically regulated themselves (Lowi 1969)...farmers’ groups may be better off realigning themselves with environmental interests,

as opposed to their historic alignment with agribusiness representatives. Subsidies for adoption of environment-protecting practices would enable the American public to maintain its historic social contract with farmers, that is, of protection of farm income without compromising on the strong desire for improved environmental protection.

Batie, Sandra S. 1992. Changing demands on agriculture in today's society and the role of the land grant university. Paper prepared for presentation at the University of Minnesota, Program on the Forum of Agriculture's Future, March 21, 1992; and for Virginia Polytechnic Institute and State University, College of Agriculture and Life Sciences Faculty Meeting, April 24, 1992. "It is now widely recognized that different disciplines have embedded values that affect the choice and investigation of problems to be studied....Once the values embedded in science are exposed, it is a small step for some in society to perceive scientists as identified with and supporting various power relationships or sectors of the economy. We see this in agriculture, for example, with the accusation that agricultural scientists are 'handmaidens of' or 'held hostage' to agricultural industry interests. Such accusations have been pivotal in the recent BST (Bovine Somatotropin) controversy. This perception also underlies much of the criticism of reductionist, traditional agricultural research in addressing sustainable agricultural problems [Batie and Taylor 1992]. Even without the accusation of scientists serving special interests, scientists are increasingly seen as fallible....This lack of faith in experts is the natural accompaniment to the public ambivalence about the social value of undirected scientific research [Hiskes and Hiskes 1986]....In addition, ethical issues are increasingly framing the debate with respect to the value of agricultural science and its products....For agricultural science products, this sort of question [Can we manage it? Can we afford it?] can translate into questions of 'why is this product desirable?' and 'To whom and for whom is it desirable?'. For science and technology in general, such inquiry is the key societal issue of 'What comprises a good society?'. Thus, science and technology are a means to a good society and not an end in themselves. Fundamentally, we need to recognize that the quality of science is not the debated issue. The debate about science and technology is a debate about values and ethics... Because debates are over ethics and values, there is a need for considerable more analysis of the potential impacts of technologies and scientific products on human health, on safety, on rural and urban communities, on the environment, on species diversity, and on the quality of life. There is a need to involve the broader public in science 'agenda-setting'...Thus, land grant universities in addition to nurturing traditional agricultural constituents, should be assisting these same constituents to embrace new clients—just as the land grant universities should be embracing new clients themselves."

Bella, D.A. 1987a. Organizations and systematic distortion of information. *Journal of Professional Issues in Engineering*. 113:360-370. "... modern organizational systems, by their very nature, distort information to meet organizational needs...[distortions] do not [necessarily; or by nature] require unethical behavior on the part of individual persons...[and, distortions are] often... sustained by basically good people."

Bella, D. A. 1987b. *The University: What Does It Do?* Oregon State University Faculty Forum Paper. October, 1987. 6 pages. "This has been a bad year for universities. We've been criticized at the national and state levels and our responses to such criticisms have not been convincing. It is time for reflection. What qualifies us to be called a University? What is essential?...to explain; to be held accountable for their [our] claims through exposure and inquiry...Expectations are tested through such questions as: What do you mean? Does this

make sense? Does the evidence support this? Is this reasonable? Just? Trustworthy? Is this supported by our most trusted knowledge and experience?...Strong arguments can be made in support of other activities such as job training, obtaining grants, enhancing economic development, and developing a competitive athletic program. However, when such activities limit or undermine these essential expectations [accountability, exposure, and inquiry] when such activities are employed to justify a university and sustain its identity, then, they are in conflict with the real University.”

Bennis, W. 1991. Learning some basic truisms about leadership. *Phi Kappa Phi Journal*. Winter Issue. pp. 12-15.

Beus, C.E., and R.E. Dunlap. 1990. Conventional versus alternative agriculture: The paradigmatic roots of the debate. *Rural Sociology*. 55(4):590-616. “Increasingly, however, the U.S. agricultural system is being criticized for its deleterious environmental impacts and to a lesser extent, because of the economic and social problems that highly industrialized agriculture is believed to be creating in rural America.”

Beus, C.E., and R.E. Dunlap. 1991. Measuring adherence to alternative vs. conventional agricultural paradigms: A proposed scale. *Rural Sociology*. 56(3):432-460. “The results indicate that the wide range of issues being raised by the alternative agriculture movement, going well beyond the ecological aspects of agriculture, are coming to be viewed as part of an interrelated whole. This suggests that issues such as pesticide use or soil erosion (which have often been debated and dealt with in a somewhat isolated manner) may become increasingly tied to other issues in future agricultural debates. Debates over the structure of agriculture or the viability of rural communities, for instance, may increasingly merge with debates over pesticide use and other ecological issues in agriculture.”

Beus, C.E., R.E. Dunlap, R.M. Jimmerson, and W.L. Holmes. 1991. *Competing Paradigms: The Debate Between Alternative and Conventional Agriculture*. Washington State University, Pullman, WA. 80 pp.

Beus, C.E., and R.E. Dunlap. 1992. The alternative-conventional agriculture debate: Where do agricultural faculty stand? *Rural Sociology*. 57(9):363-380. “Results reveal that the faculty are slightly more conventional than are farmers statewide [in Washington], slightly less conventional than proponents of conventional agriculture, and far more conventional than known alternative agriculturalists. When looking at particular elements of the agricultural debate, however, the faculty tend to be more conventional than farmers on the socioeconomic elements of the competing paradigms but considerably less conventional on elements dealing with ecological and conservation issues.”

Browne, W. P., et al. 1992. *Sacred Cows and Hot Potatoes: Agrarian Myths in Agricultural Policy*. Westview Press. “The strength of this book is that it defines American agriculture as it really is, not as it exists in popular mythology, then proceeds to show the incongruity between government programs and those realities”—Rudy Boschwitz, Former U.S. Senator. “First, policymakers and the public are held captives of the agrarian past through myths [Myth: a notion based more on tradition or convenience than on fact.] that have evolved over time...These myths rest on a nearly blind faith that agricultural interests will both want and do the right things... We ask only that agricultural interests pick up the mantle of proof. If they want programs to continue, they should demonstrate beyond some reasonable doubt that the public well-being is served.”

- Brunson, Mark. 1992. Professional bias, public perspective, and communication pitfalls for natural resource managers. *Rangelands* 14(5):292-295. “We in natural resources have our own characteristic biases...This paper will examine causes, consequences, and antidotes for bias among resource professionals...we do have to admit to the reality of other value systems, and acknowledge that they’re part of the managerial landscape. And we must broaden the realm of debate...Four things are needed if we are to provide effective natural resource management in a multi-value-system world: a search for common ground; an ecosystem perspective; an integrated approach to management, research, and education; and a more equitable and comprehensive level of attention to social values...But constructive dialogue must begin quickly, before the shouting match begins in earnest.”
- Busch, Lawrence. 1984. Science, technology, agriculture, and everyday life. *IN: Research in Rural Sociology and Development*, vol. 1, pages 289-314. Includes 66 references. JAI Press. “In this paper this implicit idealism and special status for scientific knowledge are challenged. It is argued instead that scientific knowledge and technical problems are founded in everyday life experiences, experiences which are themselves conditioned by class, status, wealth, and power....The concluding section argues for the democratization of science....Put simply, there are points at which one can intervene in the process of science and technology. These are the points at which the decision to embody certain intentions and not others in particular techniques are made. As such, the process of research problem formulation is far less constrained than the process of adoption. Democratization of the problem formation process through a broadening of the range of interests that have access to it would go a long way toward ensuring that science and technology contribute to further democratization rather than control.”
- Busch, L., V. Gunter, T. Mentele, M Tachikawa, and K. Tanaka. 1993. Socializing nature: Technoscience and the transformation of rapeseed into Canola. Manuscript as exhibit. Pages 44-67. *In: Jolliff, 1993, Op cite.* “Of particular note is the role of the Canadian State in providing large-scale financing necessary for the research to transform the commodity from a specialty crop into a bulk commodity.” [Accepted for publication in *Crop Science*].
- Campbell, C. (ed). 1993. Program for Ethics, Science, and the Environment. Brochure. Department of Philosophy. Oregon State University. Corvallis, OR. “The ability of Oregon citizens and policymakers to make informed and responsible decisions can be enhanced by the methods of self-examination and self-criticism...The complexity of decision-making at the intersection of ethics, science and the environment requires scholarly breadth and depth. Multidisciplinary perspectives enhance problem-seeing and thereby facilitate responsible problem-solving. Scientific progress is both supported by and affects the broader society. Responsibility requires researchers and policymakers to be accountable for the actions they undertake on behalf of society. The application of scientific research requires knowledge that transcends the factual and technical.”
- Carabelli, A. J. (ed.) 1972. Abraham Lincoln: His legacy to American agriculture.. Assoc. Nat. Agric. Library. Beltsville, MD.
- Council for Agricultural Science and Technology (CAST). Ecological Impacts—of Federal Conservation and Cropland Reduction Programs. CAST Report No. 117. September 1990. 28 Pages. “Overproduction in agriculture first became a major problem in the United States in the years following World War I. ...The primary purposes of these programs [Acreage

Reduction] have been to reduce the overproduction of agricultural commodities and to elevate the depressed prices of agricultural products and declining farm income... Farmers are being asked to diversify their ecosystems without an adequate research base to provide an understanding of the potential beneficial or detrimental consequences... The year 1985 was important in agricultural policy, because a new coalition of agriculturalists and environmentalists fashioned a farm bill that continued the recent pattern of large economic transfers to farmers, but imposed unprecedented requirements and incentives for conservation.”

Congress of the United States; Office of Technology Assessment. Page 1. *In* Agricultural Research and Technology Transfer Policies for the 1990's; OTA-F-448, March 1990; A Special Report of OTA's Assessment on Emerging Agricultural Technology: Issues for the 1990's. 50 Pages. “A new agenda is emerging for American agriculture in the 1990's, and there are serious questions as to whether the current agricultural research and extension system can respond effectively”.

Congress of the United States; Office of Technology Assessment. Pages 410-411. *In*: A New Technological Era for American Agriculture Research and Technology Transfer Policies for the 1990's. OAT-F-474. August 1992. 452 Pages . “Over time, the sense of institutional mission [of the land-grant universities] has declined as research has become more basic and more focused on increasing disciplinary knowledge than on solving the problems of society .... External critics focus primarily on the heavy research emphasis on agricultural productivity and the lack of research devoted to nutrition, rural problems, and environmental concerns... ...the public sector agricultural research system is being challenged from many directions. Whether the system can be revitalized and renew its historic commitment to solve the problems of society, or whether it becomes isolated and loses its credibility with the public remains to be seen. The decade of the 1990's will be a period of significant change within the agricultural research system...increased activism of a wider range of constituents is indeed changing the climate in which the land-grant system conducts research.”

Covey, Stephen R. 1989. *The 7 Habits of Highly Effective People*. Fireside. Simon and Schuster. New York. “Kuhn shows how almost every significant breakthrough in the field of scientific endeavor is first to break with tradition, with the old way of thinking, with old paradigms...Paradigms are powerful because they create the lens through which we see the world...You don't have much confidence in someone who doesn't diagnose before he or she prescribes...It is extremely valuable to train the mind to stand apart and examine its own program. That, to me, is the definition of a liberal education—the ability to examine the programs of life against larger questions and purposes and other paradigms. Training, without such education, narrows and closes the mind so that the assumptions underlying the training are never examined. That's why it is so valuable to read broadly and to expose yourself to great minds...The person who doesn't read is no better off than the person who can't read....My contemplation of life and human nature in that secluded place had taught me that he who cannot change the very fabric of his thought will never be able to change reality, and will never, therefore, make any progress....Change—real change—comes from the inside out.... It comes from striking at the root—the fabric of our thought, the fundamental, essential paradigms, which give definition to our character and create the lens through which we see the world.”

- Crookston, R. K. 1993. Calling for better appreciation of the rotation effect. *Agronomy Abstracts*. page 133. “We have repeatedly confirmed the rotation effect and its benefits, but have not identified its cause. We conclude that the rotation effect is based on a natural principle. If we violate the principle (i.e., monoculture) we get in trouble with nature and have to spend money and resources trying to “fix” things. It’s like spending money on medication to sustain a lifestyle that is not in harmony with the rules of good health.”
- Cunningham, I. S. 1984. Frank N. Meyer: Plant hunter in Asia. Iowa State Univ. Press. Ames. “Meyer concentrated on fruits, nuts, grains, and fodder crops. Entering China in 1905...he searched primarily for economically useful plants rather than ornamental—the first plant hunter to do so...His 2500 plant introductions have changed the landscape and improved the economy of the United States...Friends on three continents mourned this complex and charismatic man whose character and vision were as unique as his contributions to American agriculture.”
- Danbom, David. 1991. Challenges to the agricultural research system from a historical perspective. *IN: Proceedings of Conference on Innovative Policies for Agricultural Research*. November 21-22, 1991, Tufts University School of Nutrition. The Lenox Hotel, Boston, Massachusetts. “While it [the American agricultural research system] has been compelled to hold public support, the system has also striven to achieve scientific respectability. Gaining acceptance from more established disciplines has forced the system to place a premium on long-term, basic research as opposed to the immediately practical work to which clients have usually been attracted. It has also compelled the agricultural sciences to duplicate the academic reward system existing among the more established scientists in university settings. By so doing, the agricultural disciplines have gained a degree of scientific acceptance, but have perhaps sacrificed some flexibility and imagination in the process. Today the tension inherent in the system has become the basis of a crisis of purpose and direction. The client group on which the system has depended historically is shrinking and has virtually disappeared in a number of states, and its surviving members demonstrate increasing discontent with the system and demand change. At the same time, a galaxy of new public interest groups focusing on such issues as the environment, nutrition, animal rights, food safety, and rural poverty have challenged traditional research directions and have demanded attention. Contemporaneously, the rise of modern biotechnology in the life sciences menaces traditional agricultural scientists, strains budget, raises questions about the quality of the system’s science, and threatens to alienate the system from many components of the interested public.”
- Daniels, S.E., and G.B. Walker. 1993. Forest health in the Blue Mountains Region: The case for a collaborative approach. Draft version of a technical bulletin prepared for the Blue Mountains Natural Resources Institute. Department of Forest Resources and Department of Speech Communication, Oregon State Univ., Corvallis, OR. It is suggested that the following quote can be applied to the contrasting views held concerning conventional agriculture and sustainable agriculture. "Much of the current political situation in federal forest management can be understood as a profound dynamic between two competing tenets of faith that are fundamental to the American psyche: 1) belief that citizens should have a voice in the public decisions that affect them and 2) a desire to find answers to problems. These notions conflict because participatory democracy grants standing to the broadest segments of society, but technical solutions to complex problems grants standing to those groups who are able to spend

the time and money needed to become technically proficient, thus creating a much more narrow politics of expertise. Moreover, a participatory democratic approach to land management would include stakeholders whose interests are largely framed in terms of social values, but these values have been notoriously difficult to include in rational/technical decision processes...Both the recent motivation and direction for ecosystem management have been shaped by social forces...Thus the concept of 'desired' is central to the direction established by this definition, and desired by whom and for what must be addressed...Any given dispute may involve multiple issues...Natural resource professionals need to have a tool kit of techniques that they can select from, modify, or hybridize among as needed...such as transactive planning (Friedman, 1973) soft systems methods (Checkland, 1980; Wilson and Morren, 1990), and alternative dispute resolution (Raiffa, 1982; Bacow and Wheeler, 1984; Susskind and Cruikshank, 1987)...Collaboration is going to require innovative kinds of decision building structures, and they have to be designed with considerable attention to the incentives they create. If they do not create rewards for collaboration and disincentives for competition, there is no reason to expect much change... Collaboration, the sharing of responsibility in both planning and implementation, is a potential supplement to the current set of competitive mechanisms for decision-making. It is by no means a panacea that will work in all cases, nor can it replace the mechanisms currently in place. In addition, any early attempts at collaboration will occur in a context of strained relationships, memories of past confrontations, and a presumption among stakeholders that competitive strategies are either expected or required. One should therefore not expect miracles from early attempts at collaboration. A more likely outcome is that they will fail to create much substantive progress, and many critics might label them as failures. If they are sincerely undertaken, however, progress will have occurred in terms of developing collaborative processes and increasing mutual respect among stakeholders. It might be realistic to expect the first generation of collaborations to be both tortuous in process and modest in substantive results, but that they are penance for the damage that decades of competition have done to the social processes around public land management." [Bosnia is a reminder that wounds of the past may not be healed easily or quickly].

Doering, O. 1992. Federal policies and incentives or disincentives to ecologically sustainable agricultural systems. *Journal of Sustainable Agriculture*. pp.21-35. "Our task is to invent new policy mechanisms to deal specifically and equitably with the new environmental concerns. The 50-year-old hammer should be discarded as a relatively ineffective tool, and a new one taken up that reflects society's changing values while also recognizing the actual production decisions farmers face every day."

Dunlap, R.E., C.E. Beus, R.E. Howell, and J. Waud. 1992. What is Sustainable agriculture? An empirical examination of faculty and farmer definitions. *Journal of Sustainable Agriculture*. 3(1):5-39. "While both farmers and agricultural faculty will be involved in the development of a more sustainable agriculture, our study indicates that the two groups have rather different conceptualizations of sustainability. Whereas the faculty tend to emphasize the environmental protection and resource conservation aspects of sustainability, the farmers are more likely to put emphasis on the importance of the survival and well-being of rural residents and farm communities. Allen et al. (1991) argue that we must not be too hasty in narrowly defining sustainable agriculture in agronomic terms in order to facilitate the search for quick 'technical fixes' (solutions which obviously have appeal to agricultural scientists). These authors contend that the structural dimensions of agriculture and the social justice implications of

sustainability must be addressed if we are to make a successful transition to sustainable agriculture.”

- Duvick, D.N. 1988. Responsible agricultural technology: Private industry's part. *Pro Rege* 16(4):2-14. Dordt College, Sioux Center, IA. "...society as a whole determines the direction its science, economy and agriculture will take; agribusiness (and farmers) will work in those areas indicated to them as useful by society. That is, the nature of agriculture and agribusiness is dictated by the nature of the public's real demand for goods and services, for protecting health, and for securing social justice. Nevertheless, industry (and agribusiness in particular) as a responsible part of society can and should take an active partnership in helping define new and ecologically sounder societal goals, and in developing the kinds of needed technological supports it uniquely can provide for assistance in reaching those goals. But the public must realize that industry can serve agriculture only with products or systems that can be made and sold for a profit. There are practical limitations to what agribusiness can do on its own."
- Elias, M.J. 1993. Why common sense isn't common. *Creative Living*. 22(3):2-7. "Common sense is surprisingly complicated...Looking beyond the surface, it is clear that common sense refers to some of our most basic and deeply held beliefs about the world and how we think it should work. Put another way, common sense is based on faith that one's ideas about the world are correct and correct for all. Rigid bureaucracies and other organizational "pronouncements" reflect a striking paradox: they do not "trust" people's common sense. Therefore they legislate and prescribe the "sensible" things to do in innumerable situations. Some bureaucracies and groups are so worried about violations of their view of common sense that they "cloister" themselves to limit exposure to alternative points of view...Twenty-first century common sense requires cross-cultural knowledge and an understanding of others."
- Flora, C.B. 1990. Policy issues and agricultural sustainability. *In: Sustainable Agriculture in Temperate Zones*. C.A. Francis, C.B. Flora, and L.D. King (eds.). John Wiley & Sons. pp. 361-379. "Sustainable agriculture is based on decisions made by individual farmers. Yet those decisions are a function of a wide variety of other decisions made at other system levels...There are at least five conflicting goals that agricultural policy has attempted to achieve... For sustainable agriculture to become a part of the research dialogue and agenda, we need criteria that do not simply measure agricultural productivity and progress by yield per acre...Subsidies can be seen as leading to high chemical-input agriculture and distorting the balance of the larger economic and social system in which agriculture is embedded...It will be difficult to break the Gordian knot of policies that indirectly favor high-input agriculture unilaterally, because the policy bias toward such techniques is worldwide in the temperate zones. Collective action, probably through existing mechanisms such as the GATT, will be necessary for the "mutual agricultural disarmament" that is necessary for public sustainability of agriculture in the temperate zones."
- Flora, C.B. 1990. Presidential address: Rural peoples in a global economy. *Rural Sociology*. 55(2):157-177. "Rural social economic structures are increasingly dependent on capital. As a result, concern in the international community is increasingly focused on the well-being of capital rather than the well-being of people...While the problems facing rural areas are international and macroeconomic in their origin, solutions to these problems are not as easy to identify and implement...Viable solutions will be based on a good analysis of the macroeconomic and political context. They will develop the particular assets of a specific

area by analyzing carefully the addressable constraints. We must address policy as well as organization. We have become adept at implementing policies worldwide that favor capital—for example, we are able to guarantee markets through our export enhancement programs. We have not been able to guarantee jobs or distribution of income. We need now to turn our attention to policies that favor people over capital, particularly rural peoples in an increasingly global economy.”

Flora, C.B. 1992. Building sustainable agriculture: A new application of farming systems research and Extension. *Journal of Sustainable Agriculture*. pp. 37-49. “Sustainable agriculture requires balancing a variety of goals...transdisciplinary teams...provide an important input...farmer membership...is particularly crucial, because a sustainable agriculture means that the farmer shifts from a user of technology to a producer of technology and a monitor of its impact...Universities must reevaluate how they set their research agendas and their methods of measuring research and extension productivity.”

Flora, Cornelia B. 1992. The institutional challenge of linking environment and society. *In: Proceeding of the Spring Symposium of the Board on Agriculture and the Professional Scientific Societies: “Enhancing the Future of the Land Grant System—A Dialogue on Environment and Society”*. April 3-4, 1992. National Academy of Sciences Beckman Center, Irvine, California. “Scapegoating and underbidding our neighbors by ...giving interest free loans and tax breaks while our water and air are polluted, are not sustainable solutions... We must address policy...the role of government is to make it profitable to do what is moral...Taxes and regulations are tools to this end. We fine polluters so it will cost them less to confine pollution than to pollute. We now seem to be [at] a juncture, where if something is profitable, it must therefore be moral. Our national hero is T. Boone Pickens, upholder of stockholder rights.”

Forrestal, D. J. 1982. *The kernel & the bean: The 75-year story of the Staley Company*. Simon and Schuster. New York, New York.

Fuglie, K., and V. W. Ruttan. 1989. Value of external reviews of research at the International Agricultural Research Centers. *Agricultural Economics*, 3:365-380. “Disciplinary and project activity should be reviewed by individuals who are at the leading edges of their field of science or technology development. They usually will not be the same individuals who are best able to evaluate long-range strategies and priorities, i.e., to evaluate relevance rather than competence”.

Gale, R. P., and S. M. Cordray. 1994. Making sense of sustainability: Nine answers to ‘What should resources sustain?’. Depts. of Sociology. U. of OR, Eugene, and OR State U., Corvallis. Manuscript submitted to *Rural Sociology* for publication.

Gardner, J.W. 1981. *Self-Renewal: The Individual and the Innovative Society*. W.W. Norton & Co. “...The book deals with the institutional arrangements and processes that affect renewal...there cannot be long-continued renewal without liberty...liberty requires limiting and disciplining power...two strategies [for limiting power] have emerged as superior to all others. One is the creation of institutional arrangements and laws designed to place constraints on power. The other strategy is to disperse power;...Dispersing power is an endless task; it never stays dispersed for long.... the abuse of power remains an ever-present possibility.” “...There is today a new awareness of the nonprofit segment of the private sector...” “An idea that is controversial, unpopular or strange has little chance in either the commercial or the political

marketplace. But in the nonprofit sector it may very well find the few followers necessary to nurse it to maturity..... And it is from just such individuals and groups that one may expect emergence of the ideas that will dominate our society and our world a century hence. Generally speaking, great social changes begin with few supporters.”

Harkin, Tom. 1987. The Save The Family Farm Act. pp. 388-397. *IN*: G. Comstock (ed). Is there a moral obligation to save the family farm? Iowa State University Press. Ames. “Chronic overproduction doesn’t reward efficiency. But it does affect large and small farms differently...When prices plummet...they have only two choices...Get big or get out. Under this kind of free-market approach, the freest are the richest. That will continue to be the case as long as we have chronic overproduction. The large agribusiness concerns, the fertilizer and chemical companies, the food processors, have a vested interest in keeping it that way. Since I’ve been in Congress, I have seen the influence of the agribusiness interests grow by leaps and bounds, while the farmers’ influence has decreased...The fact is that unfettered production is a surefire formula for only one thing: the concentration of landownership and agricultural wealth. And that in turn threatens the very basis of our democracy [p.391]...Over the next four years, four out of every five dollars in net farm income will come from the government treasury. We’re faced with either bankrupting the farmer or bankrupting the treasury—or both...Clearly, we need a new direction in farm policy. And first on the agenda is ending the chronic overproduction that is keeping farm prices low. But to do that, we’ve got to give farmers a voice in their own destiny. As long as farm policy is decided in Washington, the agribusiness interests that benefit from overproduction will control the agenda.”

Hassebrook, Chuck. 1990. Economic and policy implications of sustainable agriculture. *IN*: Francis, C.A., J. L. Bushnell, and R. Fleming (editors). 1990. Proceedings of the National Sustainable Resources Conference, Lincoln, Nebraska, August 15-18. 163 pp. “If sustainable agriculture is to be truly sustainable we must broaden its scope to include social considerations. We must develop farming systems which enhance economic opportunity in agriculture, are socially just and enhance rural community viability, as well as protect the environment. To achieve a sustainable agriculture in this broad sense, we must develop a set of coherent public policies supportive of it. With respect to publicly funded research and extension programs, Congress should define the purposes to be served by these programs - incorporating sustainability, and establish procedures to ensure that those purposes guide the priority setting process for the entire agricultural research and extension program. In short, sustainability must become the guiding purpose of the public research and extension system and not be relegated to a marginal program. We must also change “demand side” policy. Sustainable systems can be quite productive, but they produce a more diverse set of commodities than conventional systems. Existing policies designed to absorb surpluses of corn, wheat, rice and cotton should be altered to steer demand toward a mix of crops which can be produced sustainably. This may involve greater emphasis on improving existing uses of forages, tree crops and rotation crops and creating new uses for them. Finally, commodity programs must be fundamentally reformed. Current programs penalize crop diversification and encourage intensification of crop production on a limited number of acres. They reward chemical dependent monoculture production of a few commodities. Farm programs should be reformed instead toward stewardship and enhance economic opportunity in agriculture.”

Hatfield, J. L. 1991. Problem-oriented vs. scientist-oriented research structures. *IN*: Proceedings of Conference on Innovative Policies for Agricultural Research. November 21-22, 1991,

Tufts University School of Nutrition. The Lenox Hotel, Boston, Massachusetts. “Research problems are becoming increasingly complex and agencies are being asked to provide complete answers in minimum time. To accomplish this goal requires innovative research structures and use of personnel. Historical scientific problems have been addressed through a scientist-based organizational structure. In this case, individuals are asked to contribute their disciplinary expertise to the problem, and the results often do not provide a good solution because of unanswered questions. Interactions among individuals in this structure are often less than effective because there is no clear definition of the problem or restatement of the problem into researchable questions. The contrasting organizational structure is the problem-oriented approach. In this organization, the problem and development of the research questions drive the process, and scientists then contribute their expertise toward answering these questions. The products and the timeliness of the problem are more clearly defined. This approach allows for a more complete understanding of the knowledge gaps and areas of critical research needed to arrive at an answer for the problem. In the balance between the two research structures, there is a need to ensure that the research question is properly framed. The problem-oriented approach may have a tendency to address broader-scale problems without developing a thorough process-oriented project. On the other hand, scientist-based structures tend to address the basic process-oriented approach and are hard to integrate into larger problem issues. A careful blend of scientists’ freedom to interact with the problem matrix is necessary to realize the potential of this type of approach. Of critical concern to individuals in both organizational structures is the recognition of their efforts. Both cases allow for the individual to be an effective scientist, with the problem-oriented approach providing a greater opportunity for interaction among scientists and interdisciplinary research. The scientist-oriented approach has more individual freedom in problem choice but more difficulty in integrating the information into an overall solution. The problem-oriented approach is being followed in the development of the research program of the National Soil Tilth Laboratory. This organizational structure has proven to be effective for the rapid identification of critical knowledge gaps and integration of additional scientists into the laboratory staff. Problem-oriented research structures provide an alternative to our current organizations that can foster more effective research programs.

Heichel, G. H. [Past-President of the Crop Science Society of America]. A Farewell to “Reluctant Revolutionaries”. *Agronomy News*. April, 1993. page 9. “An ‘ethic’ is a principle or standard of what is good, right, or moral conduct, behavior intention, or social action in relation to others...In my opinion, the wall of silence on ethical matters behind which crop scientists and agronomists had hunkered for so many years crumbled to ruin on 1 and 2 Nov. 1992.... The responsibility [to demonstrate social responsibility] is not more obvious than in the imperative to consider the external costs flowing from the pursuit of the productive agriculture that society does not view or value as benefits: environmental problems, social inequities, geopolitical inequities, fraud and misrepresentation, conspicuous mistakes. Why have external costs been omitted from the calculation of the benefits of “production” and “productivity”?...I urge you to affirm this [Crop Science Society of America] statement of ethics and to implement it... and exemplify its principles in mentoring... students... citizens and public policymakers.”

Herbel, K.L., and J.R. Williams. 1992. Profitability of a resource-conserving crop rotation: An analysis for a central Kansas farm. *Journal of Sustainable Agriculture*. 2(4):31-45. “Quantitative methods such as budgeting are meant to aid decision making, but cannot

account for all values and factors which enter the decision making process. Some benefits and costs cannot be expressed well in quantitative terms. Individual and experienced judgement must be used to interpret the results in the total context of the farm and the manager's goals. These goals can vary substantially from one operation to the next."

- Hinkle, Maureen K. 1990. Visions of the future. *IN*: Francis, C.A., J. L. Bushnell, and R. Fleming (editors). 1990. Proceedings of the National Sustainable Resources Conference, Lincoln, Nebraska, August 15-18. 163 pp. "The one clear lesson that I have learned from these battles is that a careful, practical strategy is the most important key to influencing policy. Developing a coherent agenda early on in negotiations; cultivating powerful allies and party leaders, both on and (perhaps especially) off the Agriculture Committee; corralling lots of footpower at crucial times; providing timely, factual, focused, and rigorous arguments to support our proposals; flexibility in details but firmness in resource protection goals—these are all part of a practical strategy for change. We must remain 'ahead of the curve', but not so far ahead that we're out of the scene of action and incapable of influencing the key actors, including Congress, the Administration, and vested agricultural interests alike. And we must balance our desire for progress with the recognition that we can't demand change that is more rapid than an entrenched institution's ability to respond. Change is difficult at best, and must balance many diverse needs. In order to bring about our vision of the future we need to participate in the arena of today, do our home work, and be there all the way to the finish line."
- Hullar, Theodore L. 1992. Enhancing the future of the land grant university: A dialogue on the environment and society. *In*: Proceeding of the Spring Symposium of the Board on Agriculture and the Professional Scientific Societies: "Enhancing the Future of the Land Grant System—A Dialogue on Environment and Society". April 3-4, 1992. National Academy of Sciences Beckman Center, Irvine, California. "The big picture for the land grants holds out little hope of increases in overall funding, if the future is not different from the past...As reflected in the current-day reality of the land grants, there is clearly a tension between the trend toward consolidation (competitive grants tend to go to larger, comprehensive universities) and dispersion (earmarks tend to go to smaller, more specialized institutions). The tension seems to have produced a stalemate, the status quo. Will the status quo persist? If it does, it seems clear that high priority environmental research may not be done; unless of course, a way is found to do more without additional resources. The challenge to the land grant system today, then, is to initiate a serious, constructive dialogue about the way the system conducts research, its size, and its scope. Professional societies can participate in this process by examining new ways of organizing land grant universities and their colleges of agriculture. How appropriate is the traditional disciplinary orientation? How does the current professional reward structure promote or hinder movement toward multidisciplinary research? And, professional societies should consider how the land grant system continues to justify its existence to society. Is the mission orientation still appropriate, more than 100 years after its initiation? How do individual disciplinary scientists contribute to fulfillment of the mission? In conclusion, it is not hard to see an era of transition ahead for agriculture and its dedicated research institutions."
- Janick, J., and J.E. Simon (eds.) 1990. Advances in New Crops. Proceedings of the First National Symposium—New Crops: Research, Development, Economics. October 23-26, 1988. Indianapolis, Indiana. 560 pages. Timber Press. Portland, Oregon.

- Janick, J., and J.E. Simon (eds.) 1993. *New Crops. Proceedings of the Second National Symposium—New Crops: Exploration, Research, and Commercialization.* October 6-9, 1991. Indianapolis, Indiana. 710 pages. John Wiley and Sons. New York.
- Jolliff, G. D. 1989. Strategic planning for new-crop development. *J. Prod. Agric.* 2:6-13. “Technology exists to exploit the economic potential of new crops as annually renewable alternatives to chronic expenditures on surpluses. The national challenge is to focus sufficient public resources on a prudent number of new crops to make them profitable, without subsidies, for production on U.S. farms. An orderly development of botanical resources is needed to overcome entry barriers and to maximize successes of efforts to develop new farm and forest products. To achieve this goal, an organized national commitment is essential, with responsible institutional structure, resources, accountability, and continuity over several decades. As Bloch has observed, ‘New roles for institutions, and more cooperative and innovative relationships among them, will require alteration of some deeply ingrained political attitudes’.”
- Jolliff, G. D. 1990. Testimony on HR 47, HR 1505, and HR 2691 regarding new-crop development. pp. 521-523 and 557-576. *In: Formulation of the 1990 Farm Bill (Research, Teaching, and Extension Programs). Research, Development, and Commercialization of New Products and Crops.* U.S. House of Representatives Hearings. Serial No. 101-30; Part 11. July 19, 1989; Feb. 6, Mar. 7 and 13, 1990. 682 pp. (Sudoc: Y4. Ag8/1:101-30/pt.11). “The bills HR 47, 1505, and 2691 do not contain language needed to assure the development of new-crops. There is no assurance that even the single most promising new crop for America’s farmers would get the needed funding for research, development, and commercialization. Supporting documentation has been summarized in the prepared written statement provided to the Subcommittee. With your permission, Mr. Chairman, I offer this set of 20 exhibits as further documentation to support my recommendation to this Subcommittee...Development of the mind-set that agriculture includes the production of industrial raw materials in addition to food, feed, and fiber is, in my opinion, long over-due...The nature of the entity described in these bills, whether a corporation or an institute, probably could theoretically function for the commercialization of new crops as well as new products from existing crops. However, I see a major problem with the language in these three bills, HR 47, 1505, and 2691. I speak now from the perspective of development of new-crops for America’s farmers. This means the development of choices for farmers. It means providing farmers with profitable options, so they are not trapped in the circumstances of having to grow federal government program crops. This means development of new crop plants which can generate annually renewable wealth, as an alternative to costly surpluses or costly idle land. This means investing in the development of plants which are unfamiliar to most people—plants which have no commodity organizations, or other political voice to speak at times like the present. Mr. Chairman, the record shows that new-crops will not be a part of a strategic plan for U.S. agriculture unless Congress makes them such. This is documented in the materials I have presented to the Subcommittee...However, none of the bills contain language to assure the strategic investment in the development of new-crops. There is no assurance that even the single most promising new crop in the nation, or the world, would be developed for U.S. farmers...These bills do not preclude the use of resources for new-crop development. But the record shows that U.S. agriculture politics are dominated by vested interest groups. The consequences of this are described by Ruttan and Hayami in my written testimony and other documentation. It is important for me to clarify that vested interest groups in U.S. agriculture

have little, if any, legitimate economic reason to take the kinds of risks associated with new-crop development. Thus, the need for federal leadership becomes obvious. Also, federal funds for agricultural research are very limited. Thus, the vested interest groups in agriculture can be expected to be very aggressive in competing for the scarce resource endowments allocated by Congress. This concept is also described by Ruttan and Hayami. It is very important to recognize that new-crops do not have an adequate voice to obtain resources in the political marketplace, or through bureaucratic mechanisms...Therefore, Mr. Chairman, in my judgement, new-crop development in the U.S. should include earmarked funds which cannot be diverted to other areas. Congress will have to decide the level of investment. In my opinion, U.S. agriculture deserves a national investment in the most promising new crops. The language should allow for investments at a minimum level of 15 scientist years per year with a 20 year commitment if justified. But, with these bills in their current form, I see our nation simply repeating a rather dim history, from the strategic development standpoint.”

Jolliff, G. D. 1993. Testimony (Invited, Written) on Oversight of the Alternative Agricultural Research and Commercialization (AARC) Act of 1990 (Public Law 101-624): A Review of the First Year of Activities of the AARC Center Board of Directors. Subcommittee on Agricultural Research, Conservation, Forestry, and General Legislation; United States Senate Committee on Agriculture, Nutrition, & Forestry. April 29, 1993. pp. 17-31, plus 3 exhibits, pp. 32-68. ISBN 0-16-041261-7. “The AARC Center is an institutional innovation. Rightly, the objective of the AARC Center design is to facilitate doing business differently from existing organizations. Similarly, it seems there is now a critical need for innovation in developing an accountability system to be constructive and to assure that the AARC Center Board of Director activities also meet the letter (Section 1659.c.) and spirit of the AARC Act of 1990 over the long term. It is recommended that a system of accountability for the AARC Center Board of Directors be developed as soon as possible to avoid giving the impression that something is being done wrong within the AARC Center system which needs correction. Careful selection of professional counsel is recommended to bring an appropriate balance of expertise in guiding the development of an accountability mechanism. It is recommended that the decision making process used by the AARC Center Board of Directors, including deliberations on policy, should include at least one rural sociologist and one ethicist having expertise relative to the family farm and rural America. A highly effective and helpful accountability system should aid in attracting the best talent to the AARC Center Board and staff in the future.”

Jolliff, G. D., and S. Snapp. 1988. New crop development: Opportunities and challenges. *J. Prod. Agric.* 1:83-89. “A future U.S. agricultural scenario, involving full use of our nation’s capacity to produce an excess of annually renewable farm products, can be envisioned... American agriculture, safeguarded by the expansion of cropping options, would utilize soil and water resources more efficiently...Improved productivity and increased stabilization of farm income and farm soil might be expected from widespread availability of profitable, locally adapted cultivars...Methods of accelerating development of profitable new crops for U.S. agriculture need to be explored...Members of industry, government, academia, and production agriculture, working together in a collaborative, multidisciplinary approach have an opportunity to foster accelerated new crop development. The benefits for consumers and producers alike from the improvement of cropping alternatives cannot be ignored.”

- Keeney, Dennis. Changing Paradigms and the American Society of Agronomy. *Agronomy News*, Feb. 1992, p. 3. "...What is agronomy's role in society?... Much of the discussion is based on the role of disciplines in science and education... Complaints of reductionism abound. The public feels science has turned inward, being mostly concerned about continued propagation of the species and less on returning value to the public that supports its activities... ASA must launch a new strategic planning exercise to chart its future..."
- Kelley, H. W. 1993. *Always Something New: A Cavalcade of Scientific Discovery. Highlights of 50 years of crop utilization research conducted at four regional laboratories of the United States Department of Agriculture.* U.S.D.A., Agricultural Research Service Misc. Pub. No. 1507. 150 pages.
- Klopatek, C. C., E. G. O'Neill, D. W. Freckman, C. S. Bledsoe, D. C. Coleman, D. A. Crossley, Jr., E. R. Ingham, D. Parkinson, and J. M. Klopatek. 1992. The sustainable biosphere initiative: A commentary from the U.S. Soil Ecology Society. *Bulletin of the Ecological Society of America* 73:223-228. "Although soil systems are implicitly included in the SBI [Sustainable Biosphere Initiative], we propose that any initiative undertaken to explore and achieve sustainability must include a significant and explicit belowground component. Soil systems are not necessarily equivalent to aboveground systems, they are much more complex...soil organisms exist and operate in three dimensions—numbers and processes are usually expressed as a function of volume rather than area...Disruption of the belowground component may have immediate and long-lasting consequences to the whole ecosystem (Perry et al. 1989). Yet little research money has been directed toward soil system studies...At present it is difficult to assess the biological diversity of soil organisms...Research Recommendation: Substantial effort should be devoted to research directed towards a greater understanding of the ecology of soil, particularly research to determine diversity of soil organisms, responses to belowground systems perturbation, and the contribution soil systems can make towards achieving global sustainability."
- Kloppenber, J., Jr. 1991. Social theory and the de/reconstruction of agricultural science: Local knowledge for an alternative agriculture. *Rural Sociology* 56(4):519-548. "The deconstructive project—actually, it is more a diffuse historical tendency than a coherent project—has been gathering momentum for nearly three decades now. Rachel Carson (1962) was midwife to the birthing of a wide variety of initiatives directed to forestalling the kind of ecological apocalypse described in *Silent Spring*. Subsequent critiques have focused not only on the social and environmental externalities associated with modern agricultural technologies (Berry 1977; Commoner 1972; Strange 1988), but also on the manner in which particular social interests gain differential influence over the institutional structure of knowledge production. There is concern that corporations and agribusinesses have managed to shape to their own advantage the choice of the problems that public agricultural science has undertaken and the way solutions to those problems are expressed in technologies (Busch and Lacy 1983; Buttel 1986; Friedland 1978; Hightower 1973; Kenney 1986; Kloppenburg 1988)."
- Krueger, William C. 1992. Building consensus for rangeland uses. *Rangelands* 14(1):38-41. "Each group analyzes different, sometimes selected, information in a different logical framework and naturally, then, defines the truth differently."
- Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions.* The University of Chicago Press. "Even more important, spending the year in a community composed predominantly of

social scientists confronted me with unanticipated problems about the differences between such communities and those of the natural scientists among whom I had been trained. Particularly, I was struck by the number and extent of the overt disagreements between social scientists about the nature of legitimate scientific problems and methods. Both history and acquaintance made me doubt that practitioners of the natural sciences possess firmer or more permanent answers to such questions than their colleagues in social science...Attempting to discover the source of that difference led me to recognize the role in scientific research of what I have since called ‘paradigms’...The study of paradigms...is what mainly prepares the student for membership in the particular scientific community with which he will later practice. Because he there joins men who learned the bases of their field from the same concrete models, his subsequent practice will seldom evoke overt disagreement over fundamentals. Men whose research is based on shared paradigms are committed to the same rules and standards for scientific practice. That commitment and the apparent consensus it produces are prerequisite for...continuation of a particular research tradition.”

Lal, R. 1991. Soil structure and sustainability. *Journal of Sustainable Agriculture*. 1(4):67-92. “Decline in soil structure can set in motion the onset of degradative processes e.g. compaction, accelerated erosion, water and salt imbalance, and soil fertility depletion. Through these processes, deterioration in soil structure has local regional and global effects on economic, environmental quality and resource sustainability. However, both soil structure and sustainability are often treated as qualitative and subjective concepts. There is a need to develop quantitative measure of these concepts, and establish empirical and conceptual relationships among them. Practical-oriented, and problem-solving research undertaken in diverse benchmark soils and ecological environment can help address the problem of resource management and sustainability.”

National Academy of Science (NAS). 1974. *Productive Agriculture and a Quality Environment*. Washington, D.C.

National Academy of Sciences. *Enhancing the Future of the Land Grant System. A Dialogue on Environment and Society*. Spring Symposium, Board on Agriculture and the Professional Scientific Societies, National Academy of Sciences Beckman Center, Irvine, California, April 3-4, 1992. “Many observers have noted that the land grant system must renew its social contract. The system must respond to a changing student body, a changing set of critical problems and opportunities, a changing clientele, and changing technology for information delivery. Old structures and cultural norms no longer fully meet the demands of these new realities”

National Research Council (NRC)—Committee on the Role of Alternative Farming Methods in Modern Production Agriculture. 1989. *Alternative Agriculture*. Board on Agriculture. National Research Council. Washington, D. C. “The 1980s have been a time of change in U.S. agriculture...More than 200,000 farms went bankrupt. Since 1986, increasing market prices and exports of major farm commodities have improved the farm economy, but this recovery would not have been possible without record levels of government support...The Environmental Protection Agency has identified agriculture as the largest nonpoint source of water pollution...Crops eligible for income support are planted on more than 70 percent of the cropland in the United States... Government price and income support can have significant unintended effects...Over the years, the programs also have contributed to soil erosion and surface water pollution by encouraging the cultivation of marginal lands and subsidizing

excessive and inefficient use of inputs. Further, producers pay no price for offsite environmental consequences of production. In many parts of the United States, producers now routinely strive for higher yields than those profitable in the absence of government programs designed to reduce risk. In other areas farmers grow crops with a high risk of failure from weather or pest conditions because government programs absorb all of the risk...Deficiency payments are often a substantial share of gross farm income...Commodity programs also influence which crops are planted and the economic and environmental impacts associated with land-use decisions.

- Ogg, C.L. 1992. Addressing information needs to support sustainable agriculture policies. *Journal of Sustainable Agriculture*. pp. 113-119. “Policy innovation requires providing information to policy makers that anticipates the major consequences of implementing policy changes...We can increase our effectiveness in providing this information by increasing communication and joint research across disciplines, conducting cooperative research efforts, and being alert to institutional changes that occur at all levels of government.”
- Olson, R.K. 1992. The future context of sustainable agriculture: Planning for uncertainty. *Journal of Sustainable Agriculture*. pp. 9-20 “Unless ecological knowledge is used, directly or indirectly, in the formulation and testing of management practices, it will not contribute to meeting the goal of sustainable agriculture.”
- Olson, R.K. 1992. Integrating sustainable agriculture, ecology, and environmental policy. *Journal of Sustainable Agriculture*. pp. 1-7 “Successful translation of ecological research results into agricultural management decisions will require a multidisciplinary approach. Ecologists may be the most effective in influencing agricultural practices by working as members of multidisciplinary research teams that include farmers and on-farm research.”
- Orr, David W. 1991. Prices and the life exchanged: Costs of the U.S. food system. Pages 1-13. *IN: Proceedings of Symposium on Understanding the true cost of food: Considerations for a sustainable food system.* Institute for Alternative Agriculture. March, 1991. Washington, D.C. “The practice of ignoring the difference between price and true cost is the stuff out of which historians write epitaphs for whole civilizations. The difference between price and cost is also a matter of honesty and fairness between those who benefit and those who, sooner or later, are required to pay. One effect of not paying full costs is that we fool ourselves into thinking that we are much richer than we really are. Prices that do not ‘tell the truth,’ in Amory Lovins’ words, eventually lure us (or our children) toward bankruptcy. But the truth that needs to be told cannot be spoken only or even primarily in the language and with the numbers of economics alone. It must be told in the language of ecology, culture, and politics. I would like to suggest six kinds of costs that are not reflected in prices...[1] costs resulting from damage to natural systems that accompany conventional food production...David Pimentel estimates that the total unpriced costs of the U.S. food system at [approximately \$150 billion] dollars per year...[2] the loss of farms and rural communities...[3] the loss of the sort of intelligence about the land that once resulted from the close contact with soils, animals, wildlife, forests, and the seasons fostered by farming and rural living...[4] the increasing concentration of wealth and power as agriculture and food processing and distribution have become big business...[5] the costs of future investment and capital depreciation which well-run businesses include in current prices...[6] damage it does to our health.”

- Pasour, Jr., E.C. 1988. The farm problem, government farm programs, and commercial agriculture. *J. Prod. Agric.* 1:64-70. "It is shown that farm programs, rationalized as measures to assist low income family farmers, benefit mostly farm operators who have higher incomes, on average, than the taxpayers financing the programs."
- Pimentel, D. 1990. Environmental and social implications of waste in U.S. agriculture and food sectors. *Journal of Agricultural Ethics* 3:5-20. "Because the agriculture/food sectors appear to be driven by short-term economic and political forces, cheap energy, and agricultural-chemical technologies, waste and environmental/social problems in the agricultural/food sectors are estimated to cost the nation at least \$150 billion per year. Most of the waste and environmental/social problems can be eliminated through better resource management policies and the adoption of sustainable agricultural practices."
- Pimentel, D., H. Acquay, M. Biltonen, P. Rice, M. Silva, J. Nelson, V. Lipner, S. Giordano, A. Horowitz, and M. D'Amore. 1992. Environmental and economic costs of Pesticide Use. *BioScience.* 42(10):750-760. "... environmental and social costs [in the U.S.] of pesticide use total approximately \$8 billion each year."
- Piper, C. V., and W. J. Morse. 1923. *The soybean.* McGraw-Hill. New York. 329 p.
- Probst, A. H., and R. W. Judd. 1973. Origin, U.S. history and development, and world distribution. Pages 1-15. *In: Caldwell, B. E. (ed.). Soybeans: improvement, production, and uses.* American Society of Agronomy Monograph 16. Madison, WI.
- Rexen, Finn. 1992. The non-food dimension in the EEC research programmes. *Industrial Crops and Products* 1:1-3. "The main aim of EC research in this [non-food] field is to secure a better match between production of land- and water-based biological resources and their use by consumers and industry...Research on industrial crops and non-food production from agricultural raw materials was included in both the second and the third Framework programme. There are at least two main justifications for this. (1) The EC is faced with costly imbalance problems in the primary production sector, especially in agriculture, with surpluses of some products like sugar, cereals, animal products, etc., and deficits of others, such as cellulosic fibres and proteins....(2) The consumer preferences are changing toward more 'natural' and environmentally friendly products...An encompassing research and development strategy is needed....A strategic multidisciplinary, transnational approach should be taken with both public and private sectors involved. The strategy should be market oriented and not just focused on crop development, and it should include all links in the innovation chain from basic research over applied research to pilot scale experiments and industrial scale demonstration. This strategic approach is to some extent reflected in the EC research programmes such as ECLAIR which includes projects spanning over a wide range of disciplines and countries...For example 45 MECU is devoted to demonstration activities in the non-food area."
- Robinson, R. G. 1987. *New Crops: Successes, Failures, and Why?.* pp. 13-18. *In: Grain Legumes as Alternative Crops. Symposium Proceedings.* The Center for Alternative Crops and Products, Univ. of Minnesota, St. Paul.
- Ruttan, V. W. 1990. *Challenges to Agricultural Research in the 21st Century.* Paper given at Symposium on Technology and Economics, National Academy of Engineering, Washington, D. C. April 4, 1990. "Thus, in the populist view, agricultural research was [is]

regarded as a powerful instrument of technical and social change that has been captured by organized agribusiness and has misdirected its energies against the people and the institutions that it was designed to serve”.

Ruttan, V. W. 1992. Sustainable growth in agricultural production: Into the 21st Century. *Choices* Third Quarter:32-37. “Develop incentives for behavior compatible with social objectives for management of resources. Initiate...research on the design of institutions capable of carrying out incentive compatible resource management policies and programs... The challenge is to design institutions whereby people and organizations find it advantageous to act in ways that help achieve overall goals of society...”.

Seitz, Wesley D. 1991. Changing professional reward structures in higher education. *IN: Proceedings of Conference on Innovative Policies for Agricultural Research*. November 21-22, 1991, Tufts University School of Nutrition. The Lenox Hotel, Boston, Massachusetts. “I discuss some of the recent literature indicating dissatisfaction with current higher education reward structures, summarize the outcomes of a midwestern regional conference on this issue, and report an ongoing effort to modify the promotion and tenure process and criteria at the University of Illinois at Urbana-Champaign. I also note several implications for agricultural faculty. Recent literature criticizing higher education institutions has called for a rebalancing of the research, teaching, and service missions to place more emphasis on teaching, and especially on public service. Some argue that if higher education is to be successful in attracting public support, it must be more “relevant” to social problems. One means of accomplishing this change noted in the literature is to modify the criteria in evaluating faculty for rewards. A recent workshop to discuss these issues, organized by the Committee on Institutional Cooperation, was attended by administrators and faculty leaders representing approximately 15 major universities. The representatives from each university were given the task of developing a tentative plan that would respond to these issues in a manner appropriate for their campus. There were several common themes among the plans developed for the several institutions. They included: the development of a clearer statement of mission; tighter linkage between mission and faculty rewards; more systematic evaluations of teaching and service activities; more recognition of teaching and service excellence; increased flexibility in faculty assignments and promotion and tenure criteria; and improvements in the mentoring of young faculty and the socialization of Ph.D. candidates. An effort is underway to change significantly the promotion and tenure process and practices at the University of Illinois.

Senge, Peter. 1990. *The Fifth Discipline*. Doubleday. “From a very early age we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable, but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole. When we then try to ‘see the big picture’, we try to reassemble the fragments in our minds, to list and organize all the pieces. But as physicist David Bohm says, the task is futile—similar to trying to reassemble the fragments of a broken mirror to see the true reflection. Thus, after a while we give up trying to see the whole altogether. The tools and ideas presented in this book are for destroying the illusion that the world is created of separate, unrelated forces. When we give up this illusion—we can build ‘learning organizations’, organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspirations is set free, and where people are continually learning how to learn together....we tend to focus on snapshots of

isolated parts of the system, and wonder why our deepest problems never seem to get solved...Though the tools are new, the underlying worldview is extremely intuitive; experiments with young children show that they learn systems thinking very quickly.”

Smith, Stewart. 1992. Farming activities and family farm: Getting the concepts right. Paper presented October 21, 1992 at the Joint Economic Committee of the U.S. Congress Symposium: “Agricultural Industrialization and Family Farms: The Role of Federal Policy”. Washington, D.C. Publication Forthcoming. “The development of U.S. agriculture into an increasingly industrialized system has resulted in a substantial shrinkage of the role of farming in that system. Indeed the loss of farming drives the reduction in farm number, not vice versa. The distinction is important because the policy responses to loss of farming seems to be more definable, and maybe more achievable...Technology is the linchpin to the process of farming activity loss. Most technologies adopted by farmers result in a shift of activity from the farm to the nonfarm sectors. That shift of activity results in a loss of returns per unit of production and leaves the farmer with excess management capacity if production is not increased...The loss of farming activity process also provides insights into the size bias charge often leveled at land grant university (LGU) research...Most agricultural research results in more nonfarm activity at the expense of farm activity...Because technology is the primary cause of farming activity loss, farming loss policies must be directed to the two forces which drive technology adoption, first the availability of technologies, and second, the incentives to adopt....Technology availability depends on technology development which is determined by both the public research system, especially the land grant universities, and the private research system, which is located in nonfarm agricultural firms...With only a few exceptions, technologies developed by both the public and private systems have shifted activities away from farms...driven...by two other forces: first, the source of public research funding and second, the phenomenon of the revolving door of research scientists. Despite the preponderance of public funding, public research is strongly influenced by private funding...Biotechnology, with its ability to engineer materials that can be protected as private property, will likely increase the amount of research that is privatized and its corresponding influence on the LGU research agenda. The phenomenon of the revolving door of research scientists is imbedded in the stronger professional relationship that LGU faculty have with private sector scientists than with farmers...researchers determine which technologies become available, the private sector does the adoption. Farmers adopt technologies to increase their net returns...It is quickly seen that these influences are affected by public policies...Redirecting technology development towards increasing farming activities involves a social equation...Those interested in maintaining farming activity must ask: What would have been the outcome if the money spent on bST research had been spent on rotational grazing research, for example finding legumes and handling systems to make that technology even more efficient. My guess is that it would be a very competitive system with more farming and more farms. It is no mystery why that alternative research was not conducted. There was no private sector to contribute funds to public research or to conduct its own research [or to lobby to secure public funding for use in public institutions for serving the public—as is the case for new-crops research and development]. None of these alternatives will develop without a change in the LGU research agenda and in other public policies towards agriculture. Support of a farming based agenda is a research imperative for the LGUs, which must find ways to assess their research projects with respect to sector bias. They should direct public funds away from technologies that shift activity from farmers to nonfarm firms, unless there is not

alternative technology that might be developed which would be generally of equal efficiency. LGU administrators may find it advantageous to demonstrate how research funds can be directed to support farming, rather than nonfarming activities...it has been raised indirectly during the past two farm bill debates regarding funding sustainable agriculture research. In all likelihood, the issue will be raised again in 1995, possibly more directly than in the past.”

Soth, Lauren. 1992. Time for agricultural reform. *Choices*. Third Quarter. pp. 50-51. “The time has come for drastic reform of agricultural policy in the United States—not just periodic updating of price and income support levels and crop-acreage set-asides. The time has come to abandon the acreage-control method of supply control after a 59-year tryout. The time has come to recognize the conflict between national goals of short-run and long-run farm productivity, taking maintenance of natural resources into the equation. The time has come to face the costs of rural community deterioration caused by stress on economies of scale in farm food and fiber output...We have placed a higher value on the amount produced than on equality in sharing the benefits of economic growth. In short, you can say that economic growth is the cause of continued disparity between rural (raw-material producing) areas and urban (added-value processing and distributing) areas...The cost of less emphasis on economies of scale would not be heavy, according to studies of efficiency by USDA and agricultural colleges. The growth of large-scale farming has been in part the consequence of commodity price-support guarantees, not just production efficiency.”

Stauber, Karl N. 1992. Enhancing the land-grant system. *In: Proceeding of the Spring Symposium of the Board on Agriculture and the Professional Scientific Societies: “Enhancing the Future of the Land Grant System—A Dialogue on Environment and Society”*. April 3-4, 1992. National Academy of Sciences Beckman Center, Irvine, California. “...three trends that I think represent major challenges to the land-grant system. These trends are: demographic change, the decline of the social contract with science, and industrial agriculture compared to ecological agriculture as competitive conceptual models...when the land-grant universities were created, approximately 75% of the adult American population was involved in agriculture as a primary source of income. Today that number is 2%...The United States land-grant universities were created to aid and assist [that which] no longer exists...[society’s] uncritical belief in science has been eroding at an increasing rate, particularly since the 1960’s...At some level, Rachel Carson and a concern for the environment won and USDA and belief in production science lost...I would suggest to you that industrial agriculture, which focuses on norms of profit maximization, is closely associated with the land-grant university. Ecological agriculture, which holds up nature as the norm, is an alternative view of the future, one that is seen as being opposed by many of the institutions you represent, just as Rachel Carson was ridiculed at USDA...The association of your institutions with industrial agriculture may further alienate the public, particularly in a time when governments are looking for ways to reduce their budgets...In the beginning, the land-grant university was clearly seen as a proponent of positive social change in America. How is it seen today? Is seen as a benefactor of the poor, the disadvantaged, undeveloped rural America? Or is it seen as the publicly supported R&D facility for a polluting, elite, economically advantaged class of private interests? Baby Boomers, living in the suburbs, are and will be setting much of the political agenda for the next two decades. They are interested in more than cheap food and profit maximization for fewer and fewer farmers.”

Swanson, Lou. 1993. Agro-environmentalism: The political economy of soil erosion in the USA. Pages 99-118. *IN*: S. Harper (ed.), *The Greening of Rural Policy—International perspectives*. Belhaven Press. New York. “The mid-1980’s was a period of qualitative changes in US public policy toward *agro-environmental* issues.... Historically, US commercial farming practices have produced wastes...in creating agricultural commodities. But, for a complex array of reasons associated with agrarian myths and misperceptions of US farm structure, public opinion has been opposed to the regulation of what was perceived as a family farm sector (Buttel and Swanson, 1986)...The compelling question, though, is *not* why did such qualitative changes in agroenvironmental policy occur so quickly and decisively, but *why was the farm sector exempt from such State intervention on behalf of the environment for so long*. The explanation developed here relies on a constellation of social, political, and economic forces. Socially, American agrarian myths assumed both a unity between sustainable agricultural practices and family farming and the dominance of family farming in the US farm structure. The public and farmers alike internalized this myth. This configuration of values and presumptions about the character of U.S. farm structure contributed to a generalized belief that farmers could be trusted to do the right thing by the environment because it was in their best interest to do so. In terms of national politics, the structure of the US federal government assured the compartmentalization of commercial farm interests, and therefore their impressive hegemony over agricultural policy, within Congressional agricultural committees and the Department of Agriculture (USDA) (Browne, 1988). Culturally protected by the agrarian myth, politically protected by the rules of Congressional law making, and programatically protected by the bureaucratic self-interest and inertia of the USDA, commercial farm interests had little incentive to impose on themselves public policy which would push them to conserve the agricultural environment, and more incentive to ensure capital accumulation within the sphere of agricultural production (including agribusiness supplying and purchasing from farmers). As a consequence, conservation policy was more often associated with farm income maintenance than with conserving soil (Reichelderfer, 1992; Browne, 1988).”

United State Department of Agriculture. 1992. *New Crops, New Uses, New Markets*. Yearbook of Agriculture. Washington, D. C. 302 pages.

Vandermeer, John. 1992. Thoughts on agriculture and the environment in a postmodern world. *In*: *Proceeding of the Spring Symposium of the Board on Agriculture and the Professional Scientific Societies: “Enhancing the Future of the Land Grant System—A Dialogue on Environment and Society”*. April 3-4, 1992. National Academy of Sciences Beckman Center, Irvine, California. “I view such problems [contamination of water ways with agricultural chemicals, topsoil loss, pesticide resistant pests, loss of genetic diversity, farm foreclosures, the crisis of rural life, loss of national competitiveness, deforestation] as symptoms of something rather more profound, something structurally amiss in the present socioeconomic and political/ecological relations of agriculture as a world ecological system...We metaphorically characterize agriculture as production in factories whose machinery is incompletely understood at best...in many ways our understanding lags far behind what it should be, which is what leads to many of the problems cited by those who criticize the modern agricultural system...The false extrapolation occurs when we cease our search for understanding each component of the system and presume that knowledge of components implies knowledge of the whole...understanding of a component of a system is not necessarily related, even approximately, to an understanding of the system as a whole...and ...it is not correct to extrapolate from a knowledge of the parts to presume to know the whole, no matter

how well we understand the parts...The second major problem is ideological inertia...Ideologies contribute strongly to one's willingness to undertake particular tasks, not surprisingly, and ideologies tend to have a staying power beyond rational discourse...The world has changed and continues with very rapid changes in all spheres. Having the wrong models in an era of global and intricately interconnected economic and ecological systems could be devastating for the future on a world scale."

- Vaux, Henry. 1993. Public land management: New mandate for the land grant university? *California Agriculture* 47(5):2. "Today's urban society no longer views natural resources primarily as commodities for extraction. There is growing concern for developing sustainable, healthy life styles from the land base; there is increasing controversy about the effects of agriculture on the management of natural resources, and public lands in particular."
- Vietor, D. M. and H.T. Cralle. 1992. Value-laden knowledge and holistic thinking in agricultural research. *Agriculture and Human Values* 9(3):44-57. "Critics have challenged agricultural scientists to address concerns for environmental quality, farm size and structure, international justice, and the health and welfare of consumers and farm labor in research planning. The goal of this research was to determine what is and what could be done to consider value-laden knowledge relevant to these concerns in research planning. Value-laden and value-free knowledge of agricultural scientists were heavily represented in broad research goals such as increased productivity and efficiency. In addition, these goals were not evaluated at the levels of inquiry typically practiced by the agricultural scientists. A soft systems methodology provided a more holistic level of inquiry that could facilitate consideration of value-laden and value-free knowledge of world views more diverse than those of agricultural scientists and administrators."
- Vietmeyer, N. 1990. The New Crops Era. Forward, In J. Janick and J.E. Simon (eds.) *Advances in New Crops. Proceedings of the First National Symposium -- New Crops: Research, Development, Economics*. October 23-26, 1988. Indianapolis, Indiana. 560 pages. Timber Press. Portland, Oregon.
- Warden, C. 1993. Why you pay more for less food. *Consumers' Research*. April 1993. pp. 15-18. "As agricultural researchers rush to develop the world's most advanced technologies for more efficient, productive farming, farmers are required to idle their land and workers so they can collect payments for food they aren't allowed to grow...for a total of more than \$45 billion in outlays [in 1991] for food—all of which eventually comes out of consumer pockets...federal farm programs frequently come under attack in Washington, but rarely in terms of the effect they have on consumers...price supports subsidize the production of 23 different commodities...Put another way, almost half of what consumers pay for milk at the grocery store is due to federal farm policy...The federal sugar program is responsible for 49% of what consumers pay for sugar, and wheat subsidies account for 23% of consumer's costs for wheat products."
- Water Quality, Agriculture's Role. Council for Agricultural Science and Technology. Report 120, Dec. 1992. "...The time is right for everyone to work toward a new agricultural ethic that will achieve both agricultural and environmental quality goals of a safe affordable food supply, a prosperous farm sector, and a stable, productive ecosystem."

- White, W. J., C. G. Youngs, J. M. Bell, B. R. Stefansson, R. K. Dryden, and B. M. Craig. 1974. The story of rapeseed in Western Canada. Saskatchewan Wheat Pool, Regina, Saskatchewan, Canada.
- William, R., and L.S. Lev. 1993. Actions and words define systems approaches in Oregon. Paper presented at the Association for Farming Systems Research-Extension - North American Assoc. symposium, Oct. 12-16. Univ. of Florida, Gainesville. "While working with diverse groups on a variety of contentious natural resource issues, we have reached two fundamental conclusions. First, words that individuals select are related to their actions. Therefore, listening to word choice will help you predict the actions of others. Second, many individuals and groups restrict themselves to specific word/action sets. They view words and actions that represent alternative approaches as both wrong and threatening. In contrast to this black and white world, we have explored the power of blending apparently opposite word/action sets. We choose our words or word/action sets depending on the situation, need, and desired consequences."
- William, R., L. Lev, and F. Smith. 1994. Learning and consensus-building: Ways to improve complex natural resource issues. Draft manuscript. Departments of Horticulture and Agricultural Resource Economics. Oregon State University. Corvallis, OR. "Various approaches exist for dealing with complex human and natural resource systems. The following approach describes a learning process that moves people toward consensus and action. The process facilitates participatory learning among people holding diverse views and values. The sole criterion for participation is an open mind and a willingness to learn. The approach requires delaying judgement until many alternatives are explored. Consensus develops as alternatives are considered and sometimes combined. Keys to success include developing respect for diverse viewpoints, exploring each other's assumptions and worldviews, building trust, inventing alternatives, and sharing ownership of the learning and action process."
- Wright, David E. 1993. Alcohol Wrecks a Marriage: The Farm Chemurgic Movement and the USDA in the Alcohol Fuels Campaign in the Spring of 1933. *Agricultural History* 67(1):36-66. "It might be fair to say, then, that while the marriage between Wallace's USDA and the Chemurgists failed, the divorce was never made final. The Chemurgic program's value of self-reliance, technical ingenuity and the importance of revitalized rural life ran deep in the American grain. Its promise of self-help for agriculture through scientific innovation was, in principle, as attractive to many inside the USDA as it was to corn-belt farmers and businessmen. But it emerged in the spring of 1933 that Wallace meant something by science (the union of centralized economic planning and traditional research) that the Chemurgists found unpalatable. Further, the marginal economics of most Chemurgic industries—the fact that they required at least initial subsidies—and their comparatively long development time made them vulnerable to attacks by powerful economic competitors such as the oil industry and by politicians in search of a quicker fix. On the other hand, with its promised union of technically viable products and hard-to-quantify social benefits, the Farm Chemurgic Movement persisted as a force into the mid-1950's, and as a slowly declining entity into the 1970's. Moreover, the essential features of the Chemurgic program—whether marching under the banner of Chemurgy or that of 'sustainable agriculture' or 'biotechnology'—are as scientifically and politically resilient today as they were in the 1930's."

Young, T., and M.P. Burton. 1992. Agricultural sustainability: Definition and implications for agricultural and trade policy. FAO Economic and Social Development Paper 110. Rome. “The main obstacle to sustainable agricultural development is the failure of economic policy to address adequately the problems of natural resource management. Where there are external, social costs associated with production, agricultural policy, including trade policy cannot be formulated in isolation. If excessive environmental and resource degradation is to be avoided, there must be explicit integration of agricultural and resource management concerns in economic policy design and implementation.