Rajotte, J. Rytter, and J. Travis. 1991. Small fruit production and pest management guide, 1991-92. Pennsylvania State Univ., University Park.

Goulart, B.L. (coordinator), R.B. Crassweller, B.L. Goulart, C. Haeseler, E. Rajotte, L. Hull, M. Saunders, J. Travis, J. Rytter, J. Halbrendt, W. Hock, and A. Muza. 1991. Small scale fruit production: A comprehensive guide for the backyard and amateur grower. Pennsylvania State Univ., University Park.

Goulart, B.L., M. Brittingham, P. Harper, J. Heinemann, and W. Hock. 1994. Small fruit production and pest management guide, 1994–95. Pennsylvania State Univ., University Park.

Handley, D.T. 1992. Sustainable small fruit production. Univ. of Maine Coop. Ext. Sustainable Agr. Ser.

Kovach, J., W. Wilcox, A. Agnello, and M. Pritts. 1990. Strawberry scouting procedures. New York State College of Agr. and Life Sciences, Cornell Univ., Ithaca.

Pritts, M.P., W.F. Wilcox, A. Agnello, and G. Schaefers. 1990 Cornell recommendations for small fruit production, New York State College of Agr. and Life Sciences, Cornell Univ., Ithaca.

Pritts, M.P., W.F. Wilcox, A. Agnello, and G. Schaefers. 1994. Pest management recommendations for small fruit crops. New York State College of Agr. and Life Sciences, Cornell Univ., Ithaca.

Pritts, M.P., W. F. Wilcox, A. Agnello, and G. Schaelfers. 1991. Cornell recommendations for small fruit production. New York State College of Agr. and Life Sciences, Cornell Univ., Ithaca.

Schloemann, S.G. and D.R. Cooley (eds.). 1990. 1990 New England small fruit recommendations. Massachusetts Coop. Ext. Publ.

Schloemann, S.G and D.R. Cooley (eds.). 1993–94. New England small fruit recommendations: Managing diseases and insects on small fruit. 1993–94. Coop. Ext. System, Univ. of Massachusetts.

Schloemann, S.G. (ed.). 1992–93. New England small fruit recommendations: Managing diseases and insects on small fruit. 1992-1993. Coop. Ext. System, Univ. of Massachusetts.

Schloemann, S.G. and D.R. Cooley (eds.). 1993. Integrated pest management for strawberries in the northeastern United States: A manual for growers and scouts. Univ. of Massachusetts Coop. Ext. Publ.

PUBLISHED ABSTRACTS

Demchak, K., G.M. Heisler, B.L. Goulart and S.B. Gleason. 1993. An aspirated radiation shield for use with thermocouples in agricultural applications. Hortscience 28:536.

Goulart, B.L., K.B. Evensen, P.E. Hammer, W. Janisiewicz, and F. Takeda. 1991. Effect of temperature, modified atmosphere and pyrrolnitrin on black and red raspberry shelflife. HortScience 26:702.

Goulart, B.L. 1993. Welcome to reality: An overview of a LISA project in small fruit. Hortscience 28:443-444.

Handley, D.T. and J.E. Polalrd. 1993. Effect of cultivar and insecticide sprays on tarnished plant bug injury to strawberries. HortScience 28:118.

Handley, D.T. and J.E. Pollard. 1993. An examination of tarnished plant bug feeding injury on strawberry. HortScience 28:259.

Trinka, D. and M. Pritts. 1990. Tissue-cultured raspberry plant establishment. HortScience 25:1162.

Wing, K. and M. Pritts. 1994. Etiology of strawberry black root rot. HortScience 29:458.

TRADE JOURNALS

Goulart, B.L. 1992. Pruning basics. Amer. Agriculturist 3:18, 20, 40.

Goulart, B.L. 1992. Pruning for fruit quality. American Agriculturist 2:48-49.

Handley, D.T. 1992. Tarnished plant bugs. Natl.Gardening 15(4):18-19.

Pritts, M.P. 1993. Careful evaluation is critical. Amer. Fruit Grower. May.

Pritts, M.P. 1993. See no weevil. Amer. Agriculturist. September.

Pritts, M.P. 1990. Strawberry diseases. Amer. Agriculturist. October.

Pritts, M.P. 1990. Strawberry insects. Amer. Agriculturist. December.

Sustainable Agriculture Research and Education (SARE) Program

G.W. Bird[1]

United States agriculture has been highly productive during the past 50 years. The benefits of this increased productivity, however, have been reaped by the off-farm sectors of the agricultural system (Table 1) at the expense of the farmer (Smith, 1992).

There have been many other unexpected changes associated with United States agriculture during this period. These include a decreased number of farms, increased farm size, increased dependency on off-farm purchased inputs, decreased system diversity, decreased biodiversity, increased risk associated with environmental quality and human health, decreased reliance on rural communities, and decreased direct contact with suburban and urban communities. This has resulted in the evolution of a single dominant system of agriculture—the industrial agribusiness farm model.

About 85% of the food and fiber produced in the United States comes from about 15% (300,000) of two million farms. Most of these enterprises are operated under the structural components of the following model (Bird and Ikerd, 1993; Strange, 1988):

- Centralized management.
- Emphasis on specialization.
- Hired worker days exceed owner on-farm work days.
- Separation of management and labor.
- Technology used to minimize labor inputs. Limited education requirement for labor component.
- Heavy reliance on purchased inputs.
- Technology designed to minimize real-time in-field decisionmaking.
- Emphasis on standardized farming practice.

The industrial agribusiness model farms have type of enterprise, economic, environmental, and conservation goals. They have remained viable by increasing their size. During the pro-

[1]*Former director, USDA–CSREES–SARE. Current address: Department of Entomology, Michigan State University, East Lansing, MI 48824*

Table 1. Sectors of the U.S. Agriculture system and respective benefits (Smith, 1992).

System sector (1910–90)	Absolute $
Market	627%
Input	460%
Farm	–8%

cess, most of the value-added portion of the food system has been separated from the farm and local rural community. Relatively few components of the industrial agribusiness farm model appear to be sustainable. Many enterprises are indicating that they can not continue to operate under the current system. As these operations search for alternatives, it is truly a teachable moment.

The second major component of the United States farm sector is the part-time farm. There are currently about 1.2 million part-time farms representing 60% of the total number of farm enterprises. The off-farm income of part-time farms exceeds the net farm income. They have an average annual net farm income of about (–$3,500). The farming practices of part-time farms usually consist of a small-scale version of the industrial agribusiness model. Practices, however, may consist of those of a certified organic farm or various options between organic agriculture and the industrial agribusiness farm model. Many part-time farms are not part-time farms by choice. They have adopted this type of farming as a default function designed to protect the desire for an agrarian style of life. The viability of the part-time farm depends on factors outside the farm sector and, in many cases, factors outside of agriculture.

During the past 50 years, the research, education, and extension activities of our land-grant institutions have changed dramatically. There has been a major increase in emphasis on fundamental research. There has not been a comparable increase in mission-linked research designed to interface directly with farming practices and their interactions at the enterprise system level. In addition, there has been decreased emphasis on agricultural education and a restructuring of extension initiatives.

SARE program overview

In response to the current state of United States agriculture, Congress appropriated $3.9 million in fiscal year 1988 for a new research and education initiative in alternative agricultural systems. The program became known as the Low Input Sustainable Agriculture (LISA) program and was renamed in the Food, Agriculture, Conservation and Trade (FACT) Act of 1990. In fiscal year 1993, the SARE program was funded at $6.725 million. These resources are mandated for Chapter 1 of Subtitle B of Title XVI of the FACT Act. In response to a joint request from Congressmen Mike Synar of Oklahoma and Fred Grandy of Iowa, the General Accounting Office (GAO) released a report, "Sustainable Agriculture: Program Management, Accomplishments and Opportunities" on 17 Sept. 1992 (GAO, 1992). The GAO report describes the SARE program in relation to the overall programs and organization of the USDA.

The SARE program is managed by the Cooperative State Research, Extension and Education Service, in cooperation with the Natural Resource Conservation Service and the Agricultural Research Service. The program is implemented through four statutorily mandated regional administrative councils. Council membership consists of farmers and ranchers and representatives of nonprofit private organizations, agribusiness, government, and academia. The congressional instruction to build new coalitions among these groups of constituents is the grassroots foundation of the SARE program. As full partners with government, the regional councils are responsible for forming recommendations in relation to policy, spending federal resources, and designing oversight protocols. This unique way of doing business transfers responsibility and empowers citizens at the regional and local levels. Each council appoints a host institution for daily management of the regional programs. Current host institutions include the Univ. of Vermont, Univ. of Nebraska, Univ. of California, and a new host consortium between the Univ. of Georgia and Fort Valley State College.

The SARE program is designed to provide a research and education base for the sustainability of United States agriculture as described in Section 1603 of the FACT Act. Emphasis is given to whole-farm systems and on-farm research, with special reference to shared decisionmaking and meaningful involvement of farmers and ranchers in the design and implementation of SARE program projects. The program also has a major commitment to farmer-to-farmer education. This role of farmers as educators could be enhanced significantly through implementation of Chapter 3 (Subtitle B, Title XVI, FACT Act).

When I became the SARE program director, I knew I would be involved in an innovative program dealing with research and education related to environmentally sound farming practices. To my surprise, however, many of the activities during the past 2 years have been in the area of quality of life: quality of life for farmers and ranchers, members of rural communities, and society as a whole. The SARE program has a national task force on quality of life, and an economic impact assessment initiative in cooperation with the Economic Research Service. These activities are directly related to rural economy and family farming.

The SARE program regional administrative councils prepare annual requests for research and education proposals. The requests are based on specific needs of the regions in relation to the mandates of the FACT Act. Proposals or preproposals, depending on the region, are screened for relevancy to sustainable agriculture. This is done by the regional administrative council or a special task force. Each full proposal is then evaluated comprehensively for scientific merit. This is done by a technical committee. Proposals of high technical merit are returned to the council to develop an appropriate portfolio of projects for funding. This unique review protocol is a very important attribute of the SARE program. It provides a balanced integration of the sustainable agriculture priorities of the regions and the expertise of the scientific community.

In addition to Chapter 1 resources, the U.S. Environmental Protection Agency (EPA) provides $1.0 million per year for a joint initiative with the SARE program known as the Agriculture in Concert with the Environment (ACE) program. Also, the SARE program currently is investigating ways to increase interactions with existing integrated pest management (IPM) and water quality initiatives. The National Sustainable Agriculture Advisory Council (NSAAC) was mandated by Section 1622 (FACT Act) and held its first meeting 9–11 June 1993. It was, however, discontinued through the USDA board structure reorganization statutes of the 1996 Farm Bill.

Since making this presentation at the 1993 ASHS annual meeting and returning to Michigan State Univ. as a professor of nematology, there have been several important changes in the SARE program. In fiscal year 1993, Congress funded Chapter 3 of the SARE program.. This program provides for training in sustainable agriculture for Extension and Natural Resource Conservation Service employees. Implementation of this program should be facilitated by the merger of the Cooperative State Research Service and Extension Service into a single Cooperative State Research, Extension and Education Service. Federal resources for the SARE program increased in fiscal years 1994 and 1995. USDA initiated the first department-wide task force on sustainable agriculture during Summer 1995, and the National Sustainable Agriculture Advisory Council (advisory to the secretary of agriculture) held its most recent meeting on 26 Sept. 1995.

The SARE program is having an important impact on the United States agricultural and scientific communities (SARE, 1993):

- Building soil fertility.
- Reducing water pollution.
- Controlling weeds with fewer herbicides.
- Improving dryland farming systems.
- Boosting livestock profits.
- Using legumes to replace fallow.
- Improving the quality of life for United States farm families.

The procedures associated with sustainable agriculture are designed to enhance America's economic strength and create meaningful employment opportunities at the farm and local community levels. In many cases, local value-added technologies are an essential attribute of sustainable agriculture.

The definition of sustainable agriculture in Section 1603 (Food, Agriculture, Conservation and Trade Act of 1990) has been very useful. It has become widely accepted by the agricultural community as a goal for United States food production systems. The definition states that farming practices must "enhance environmental quality and the natural resource base upon which the agricultural economy depends" and "make the most efficient use of non-renewable resources and integrate, where appropriate, natural biological cycles and controls." This is also very compatible with President Clinton's 21 Apr. 1993 Earth Day commitment to biological diversity. The emerging concept of sustainable agriculture, however, mandates alternative agricultural systems that are structurally different from the industrial agribusiness farm model. In a keynote address to The Commission on Sustainable Development of the United Nations on 14 June 1993, Vice-President Gore announced the establishment of the President's Council on Sustainable Development (PCSD), which completed its charge in Spring 1996.

The SARE program is designed to provide a research and an education base for the future economic viability of United States agriculture. Special emphasis is placed on whole-farm systems research and economic impact assessment. Additional projects are funded in the areas of experimental component research and exploratory research. An economic assessment project led by the USDA–Economic Research Service consists of six regional microeconomic initiatives and one national macroeconomic effort. An integrated decision-support system (PLANETOR) was developed as a national initiative for assessment of on-farm economics.

Human resource development is approached by the SARE program through national and regional initiatives on the quality of life for farmers and ranchers, members of rural communities, and society as a whole. A national task force has developed a program for increasing interaction among the biophysical and social scientists. The program was offered for the first time during winter 1993. NSAAC membership includes farm family, human nutrition, and food safety representatives.

The most difficult scientific issues facing the SARE program include whole-farm systems analysis, environmental assessments, regional and national economic impacts, and quality of life programs. A whole-farm systems task force completed a protocol for use by the sustainable agriculture community. Economic impact and quality of life issues are under the leadership of national task forces. Disciplines such as weed science, nematology, and soil microbiology do not have adequate baseline resources to provide necessary contributions; whereas, economics, entomology, and plant pathology have enough critical mass to readjust to new priorities. The SARE program has identified several unique emerging issues that need evaluation. These include local value-added processes, on-farm participation, and encouraging a grassroots understanding of sustainable development.

Vision of sustainable development

Sustainable development is a rapidly emerging concept. It is based on the fundamental difference between growth and development (Meadows et al., 1992). Growth is a quantitative phenomenon characterized by increase in size through assimilation of materials. Growth has limits. Development, however, is a qualitative phenomenon in which an entity realizes potential or is brought to a fuller or better state. There are no known limits to development. The following is an emerging concept of equitable and sustainable development (Meadows et al.,1992):

Rate of use of renewable resources in a system should not exceed the regenerative capacity of the system.

- Rate of use of nonrenewable resources in a system should not exceed the rate of development of substitutes.
- System residuals should not exceed the assimilation capacity of the system.
- The system must provide an appropriate quality of life for members of rural, suburban, and urban communities.
- The system must be designed to result in intergenerational equity.

It is possible that sustainable development is incompatible with neoclassical economics (Daly and Cobb, 1989) and the positivistic heritage of western science (Batie, 1992).

Sustainable agriculture is not only a component of sustainable development, but it is serving as a significant catalyst for the evolution of the overall philosophy of sustainable development. The sustainable agriculture activities during 1988–93 have resulted in development of a twenty-first century diversified farm model (Bird and Ikerd, 1993; Strange, 1988):

- Owner-operated farm.
- Hired worker days usually do not exceed farm family worker days.
- Usually a maximum of a three-family partnership.
- Joint management–labor relationship.
- Farm families usually live on the farm.
- Diversified farm: with special reference to biodiversity.
- Emphasis on use of on-farm resources: a knowledge-intensive process.
- Common use of site-specific and real-time decisionmaking, requiring extensive education and experience.
- Diverse set of enterprise statements; including type of enterprise, economic goals, environmental goals, natural resource conservation goals, and quality of life goals.

A system objective of this model may be to catalyze and support local value-added enterprises and on-farm value added initiatives. This could have the potential for about 1.3 million environmentally sound and economically viable new farms if 10% of the market sector and 10% of the input sector could be returned to the farm and local value-added activities.

The nature of sustainable development as outlined here is vastly different than that of the industrial growth era. Although it may be possible for the industrial model to evolve to a state where most food is produced in factory-like environment, existing evidence indicates that this system is even less sustainable than the current industrial agribusiness farm model. The foundations of sustainable development must be built on an appropriate optimization of our natural resource base, a twenty-first-century agrarian base, an industrial base, and the desired value-added quality-of-life mandates of society. For the immediate future, the best strategy appears to be a system designed to develop local, regional, national, and global support for the concept of alternative agricultural systems: industrial agribusiness farm model, holistic resource management, twenty-first century, diversified farm model, permaculture, part-time farm model, biodynamics, organic agriculture farm model, and kyusei nature farming.

The alternative agricultural systems listed above require separate and targeted polices, separate and objective-dependent research programs, and separate and targeted communications of innovations initiatives if they are to evolve as long-term viable alternatives for United States and global agriculture. It cannot be over-emphasized that the policies, research, and outreach programs of

Table 2. Transitioning to an age of sustained and equitable development.

Major societal event	Time
Tool Revolution	2.4 million–100,000 years ago
Agricultural Revolution	10,000 years ago
Industrial Revolution	250 years ago
Chemotechnology Era	50 years ago
Electronic Era	10 years ago
Biotechnology Era	5 years ago
Sustainable Development Revolution	---
Industrial Growth Age	1750–
Age of Sustained and Equitable Development	---

the past 50 years have supported a single type of agriculture.

For the twenty-first century, diversified farm model to become a reality, the role of the farmer must to be expanded beyond that of producer of food and fiber (Thompson, 1991):

- Producer of food and fiber.
- Primary steward of the land.
- Major citizen leader.

It is possible that sustainable agriculture is an initial catalyst in a greater societal transition to an age of sustainable development. This even could be of the magnitude of the fourth major societal transformation in the history of humankind (Table 2).

If we are in the early stages of transitioning to an age of sustainable development, then the overall strategies related to the industrial growth age of the past 250 years are inappropriate. This must be recognized or our agricultural institutions will be frustrated as they misread, confuse, or ignore the signals from most aspects of the world aroundus.

Literature Cited

Bird, G.W. and J. Ikerd. 1993. Sustainable agriculture: A twenty-first century system. Ann. Amer. Acad. Political Social Sci. 529:92–102.

Batie, S.S. 1992. Biotechnology and science: The imperatives of choice. The 18th James C. Synder Memorial Lecture in Agricultural Economics, Purdue Univ.

Daly, H.E. and J.B. Cobb, Jr. 1989. For the common good: Redirecting the economy toward community, the environment, and a sustainable future. Beacon Press, Boston.

Food, Agriculture, Conservation and Trade Act. 1990. Public Law 101-624, 101st U.S. Congress, Washington, D.C.

General Accounting Office. 1992. Sustainable agriculture: Program management, accomplishments, and opportunities. GAO/RCED-92-233, Washington, D.C.

Meadows D.H., D.L. Meadows, and J. Randers. 1992. Beyond the limits. Chelsea Green Publishing Co., Post Mills, Vt.

Sustainable Agriculture Research and Education Program. 1993. National overview: SARE. USDA–CSRS–SARE, Washington, D.C.

Smith, S. 1992. Farming activities and family farms: Getting the concepts right. Testimony, Joint Economic Committee, U.S. Congress. 21 Oct. 1992. Washington, D.C.

Strange, M. 1988. Family farming: A new economic vision. Univ. of Nebraska Press, Lincoln.

Thompson, P.B. 1991. Constitutional values and the costs of American food. Proc. Inst. Alternative Agr. 8th Annu. Sci. Symp., Washington, D.C. p. 64-74.

Landscape Sustainability: Environmental, Human, and Financial Factors

Lynn Ellen Doxon[1]

ADDITIONAL INDEX WORDS. environmental damage, cultural pratices, costs, human activity

SUMMARY. When determining whether landscaping is sustainable, we should consider environmental, financial, and human factors. Environmental factors include the capacity of the landscape to damage or heal the system in which it is placed, the environmental effects of the cultural techniques and products used to install and maintain the landscape, and the ability of that landscape to endure without environmentally damaging inputs. Financial factors include the cost of the landscape compared to the economic return in terms of increased property values, the ability to attract and hold industry in the neighborhood, and user fees paid by people attracted to an area by the landscaping. Human factors include the effects on the landscape on mood, employee retention, and health and activity of the individuals who interact with the environment. The ideal landscape would be sustainable in all three of these areas, meaning there is more benefit than cost environmentally, financially, and humanly.

Sustainability started out as an environmental issue in production agriculture and perhaps even as a compromise between "we are destroying the earth" alarmists and "production at all costs" extremists. It has been carried into a number of other fields, like industrial development, but has not yet made the full step from production agriculture to landscaping. Sustainability looks at a system, rather than being

[1]*Formerly with the New Mexico Cooperative Extension Service. Current address: 1002 Montclaire, N.E., Albuquerque, NM 87110.*