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## Sustainable Horticulture

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Many people define sustainability in agriculture only in terms of local environmental effects. The definition of sustainability in a landscape or crop production system must be much broader than that. Sustainability involves the effects of the system on people, the economy, and the environment. The effects are felt well beyond the current time and location. The ultimate definition of a sustainable system is one that serves people, sustains or improves the environment, and enhances the economy on the scale of the entire planet and over the next hundred or several hundred years. Because we are unable to predict all of the consequences of our actions, we can only approach true sustainability; we cannot achieve it with certainty. Still, we can think in broader terms than we currently do about the consequences of our actions.

Most people who are working toward sustainability in horticulture appear to think first in environmental terms. They consider water and nutrient use and pest control measures. Some landscapers consider the ability of plants to cool living spaces, filter air (Lohr, 1991) and water pollution, and control erosion and wind. With the recognition of the greenhouse effect, some foresters, landscapers, and nursery managers have gone beyond thinking only of local effects. People across the nation have been discussing the use of landscaping and other managed plantings to try to restore the atmosphere. Increased CO<sub>2</sub> levels are not being caused by landscaping or its lack, but by the entire system of food production, development, transportation, and population concentration that makes up our modern world. We have had a part in creating this situation, and those who work in horticulture are in a good position to ameliorate it.

To move toward a sustainable production system, landscapers and horticulturists must look for ways to re-create the CO<sub>2</sub>-fixing effect of natural systems. We must look to plant physiology as well as systems ecology to guide us in this effort.

The amount of CO<sub>2</sub> an individual plant will fix depends on the type of plant, its condition and size, and the environment in which it lives. Under bright, warm conditions, a C-4 plant will photosynthesize at a higher rate, sometimes fixing more than twice as much CO<sub>2</sub> as other plants (Salisbury and Ross, 1985). C-4 plants include several flowers and tropical grasses but no trees and very few shrubs. Students of landscape design and horticulture should be taught practical applications for the interactions of factors that affect CO<sub>2</sub> fixation. A list of C-4 plants suitable for landscape use also would be helpful.

Selection of plants should be based on these ecological considerations as well as on traditional considerations like form, color, and texture. We can then make more informed and ecologically appropriate choices and move toward sustainability.

The environment is not the only consideration in moving toward sustainability; economics play a major role. A sustainable landscape has been defined as providing more benefit than the cost of maintaining it (Perry, 1990). That definition involves economics but only on a small-scale, local level. We must examine our horticultural systems within the broader context of macro-economies. Our overuse of fossil fuels for transportation, manufacturing, and crop production is maintaining the current economic inequities between ourselves and other people around the world.

Again, horticulturists did not cause the problem, but we can provide the means to at least a partial solution. We should do everything we can to move toward local production, composting and recycling nutrients, and integrated pest management as economic measures as well as environmental ones. We should use cultural methods that limit the need for pesticide and fertilizer inputs and be aware of the broad consequences of our actions. When we do these things, we will be moving toward economic sustainability.

What are the human benefits of horticulture? These are easily measured for food crops in terms of nutrition and health benefits. It is more difficult for ornamental horticulture crops. Human benefits of ornamental plants are sometimes measured in economic terms. For example, Evans (1991) studied Opreyland Hotel in Nashville. The hotel installed \$1 million worth of plants in indoor garden

areas and spends \$1.2 million annually to maintain those areas. The rooms adjacent to the garden areas are always occupied and the hotel can charge an average of \$30 more a night for those rooms. This increases income by \$7 million a year. People obviously find some benefit to those plants or they would rent identical rooms in another part of the hotel.

Property values increase after landscaping. Where inner-city gardens have been started, vandalism and graffiti drawing have decreased and neighborhood improvements have been undertaken, which has led to the revitalization of some of these areas (Bonham, 1991). Corporate gardens reduce absenteeism and, perhaps, encourage people to remain in some positions for longer periods, reducing training costs (Parker, 1991). These plantings have value to people or they would not be willing to pay for them.

Ulrich (1991) and Parsons (1991) have studied the influence of passive experiences with plants on individual well-being and health. They discovered many effects of viewing plants on emotional states, cognitive functioning, physiological activity, and health-related indicators. Ulrich reported shorter hospitalization is required after surgery if patients can see a natural view from their hospital windows. There are other human benefits-pride in accomplishment (Patel, 1991), restorative experiences, stress relief, increased work satisfaction, feeling at home (Lewis, 1991) or feelings of sacredness, and the psychological effects of plant odors. These benefits are difficult to quantify but are very important in justifying landscaping. Thus, landscaping is very important to the psychological health and emotional well being of people. We must be as careful not to deny our descendants these benefits as we are to provide them for ourselves and those around us. If we can maximize the environmental, economic, and human benefits of landscaping, we will be moving toward sustainability.

Part of the difficulty in defining sustainability is that we intuitively understand that the consequences of our actions are felt around the world and through many generations, but it is beyond the capacity of one person to analyze all of these consequences. We must cooperate with people in all disciplines to begin to understand sustainability. We must cooperate with economists to determine the

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economic consequences, with sociologists and psychologists to determine the human consequences, and with ecologists and natural resource managers to determine the environmental consequences. We must be the ones to form the interdisciplinary teams that will be investigating these factors (Relf, 1990).

We must borrow from other disciplines to get the tools that will enable us to gather this information. If the tools and methods are not available, we must develop them. In this way, we can develop clear and accurate data on the costs and benefits of plants and landscape types. We also must recognize the legitimacy of these new efforts and the complexity of the research.

Until we consider all of these factors, we may have environmentally responsible landscapes or cropping methods that are nurturing to people, or economically viable research programs, but we cannot have truly sustainable systems.

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