

Sustaining Ecosystem Services on Farms: The Healthy Farm Index

By John Quinn and James Brandle, School of Natural Resources, UNL
Ron Johnson, Department of Forestry & Natural Resources, Clemson University

Introduction

The concept of healthy farms brings to mind fertile soils, clean water, and abundant wildlife. These amenities or ecosystem services were at one time taken for granted, but are now increasingly in the news and scientific literature, as we recognize that many are degraded. Ecosystem services are the benefits that people receive from nature. Global agricultural intensification, with a focus on maximum production, has resulted in decline of many ecosystem services. Our research program is designing a Healthy Farm Index that seeks to measure and optimize multiple ecosystem services, communicate their value, and ensure that ecosystem services remain in the decision-making process of farmers, agency personnel, and other stakeholders.

Services from nature's ecosystems, including from well-managed working landscapes, benefit society and each of us. Although we are well aware that food production costs dollars, time and labor, we often do not consider the fact that agriculture depends on natural processes to assemble sunlight, water and soil nutrients into an ear of corn, to pollinate a fruit crop, or to provide benefits of pest suppression. These services, and the management practices that support them, are difficult to value in a traditional sense. Consequently, conventional economic means of valuing agricultural landscapes do not typically recognize these essential services or include them in economic decisions. Furthermore, despite their value and importance, many individuals remain unaware of ecosystem services. Recognizing and communicating the value of ecosystem services is essential to ensure their protection in the future.

Services provided by healthy agricultural systems include the production of food, fiber and fuel, biological control, pollination,

biodiversity conservation, aesthetic landscapes, carbon sequestration, climate control, purification of air and water, production of high quality soil, flood control, and breakdown of waste into nutrients. Though ecosystem services are provided free of charge, their estimated global value exceeds \$33 trillion dollars per year.

Beneficial species such as insects and birds provide an estimated \$4.5 billion in biological pest control and \$3.1 billion in pollination services annually (Isaacs et al.).

As an agricultural state, much of Nebraska's landscape is devoted to working farms and ranches. To improve the sustainability of this land and associated rural communities, it has become increasingly necessary to view agricultural land as an agricultural ecosystem, or agroecosystem, which is part of nature and a source of a variety of ecosystem services. Agricultural practices such as conservation buffers, agroforestry, mixed-farm systems, and organic management can improve the quality of these and other services. These practices improve habitat for pollinators, natural enemies of crop pests, and wildlife. They also provide food and fiber, sequester carbon, moderate crop microclimate, and reduce soil loss.



Figure 1. Windbreak, flowers, crop production (credit E. Sarno)

Current Projects

Our current research efforts are focused on ecosystem services provided by wild biodiversity in organic farm systems. The response of birds to organic farm management is being monitored on 27 organic farms in Nebraska and Kansas (Figure 2). We recently completed our third season of breeding bird surveys. We also collected measurements on relevant insects and vegetation

(continued on page 5)

Sustaining Ecosystem Services on Farms: The Healthy Farm Index (continued from page 1)

that function as food and habitat for birds and support many of the services mentioned previously. More than 100 migratory and breeding species are found on these farms. Surveys tallied a mix of rare and threatened species across grassland, edge and woodland guilds. A few highlights include loggerhead shrike, long-billed curlew, bell's vireo, grasshopper sparrow, horned lark, sedge wren, burrowing owl and lark bunting.

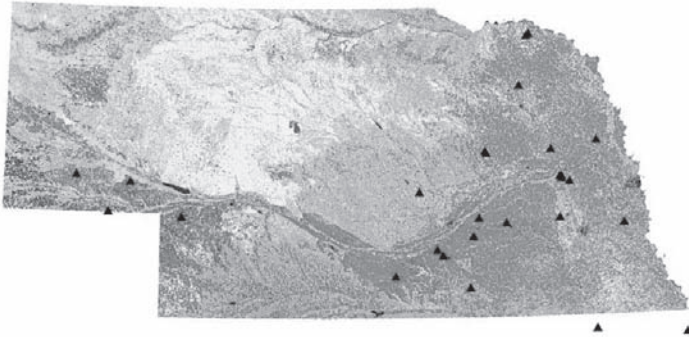


Figure 2. Organic Farm Research Sites

By enhancing native and planned biodiversity in the fields, farms and surrounding landscapes, farmers will be better able to benefit from the ecosystem services that sustainable farm management practices support through bird conservation efforts. As an additional output of our project, the bird community at each farm will be modeled as one measure of biodiversity along with other measures of farm success, including profit, yield, land protection and grower satisfaction, as components of the Healthy Farm Index.

The Healthy Farm Index — Momentum to include ecosystem services in management and economic decisions is growing. Governmental agencies and non-governmental agricultural, economic, and conservation organizations are working together to include ecosystem services in the decision-making process. To meet the needs of these agencies and to engage individual landowners in the process, new assessment and decision-making tools are required. Building on past and current research efforts, an interdisciplinary organic working group at the University of Nebraska-Lincoln, in cooperation with organic producers in Nebraska and Kansas, has designed a new assessment and decision support tool, the Healthy Farm Index, which encompasses the multi-functional nature of sustainable farm systems and reflects a vision of sustainable farming.

Agricultural systems are typically managed to maximize the provision of food and fiber. The multiple goals of farmers and society, however, include food production, ecological and environmental health, and a high quality of life now and in the future. To diversify management goals, the Healthy Farm Index incorporates multiple outputs from a farm system. The values of these outputs are reflected in a group of indicators within ecological, environmental, and socio-economic categories using measures of farm profitability, biological diversity, and ecosystem services to and from agroecosystems. Research, feedback from farmer advisory groups, and evidence of the benefits of a practice are being used to set target values for each indicator. The structure of the index allows for the integration of future components as research and shared goals evolve. Listed below are 11 selected indicators and future indicators under consideration (Table 1).

Table 1. Current and Potential Indicators for the Healthy Farm Index

Current Indicators	Indicators in Development
Production: 1) yield, 2) diversification, 3) acres	Functional species (biological control, pollination)
Biodiversity: 4) habitat, 5) birds, 6) crops & livestock	Energy balance, carbon sequestration
Conservation practices: 7) soil, 8) water 9) landscape	Land tenure (duration) and farm succession (is there a plan in place)
Satisfaction with: 10) profit, 11) farm management	Civic engagement (involvement in farming, civic and other organizations); Rural amenities or landscape elements related to rural community satisfaction

We have designed the Healthy Farm Index to address management decisions on fields and farm — the area over which the farmer or landowner has the greatest level of control. Understanding the driving forces, tradeoffs, and relationships at field and farm scales will improve the effectiveness of whole farm management. The index does have the potential to be scaled up. For example, collective use of the index by many stakeholders in a region could shape decisions made at the watershed or larger scales, resulting in measurable benefits to all.

Conclusion

Recognizing the importance of ecosystem services to human well-being is an essential first step to sustaining healthy ecosystems now and for the future. Although research will continue to assess both the economic and non-economic values of ecosystem services to and from agricultural lands, it is essential to ensure that the broad array of services is part of the decision-making process. The Healthy Farm Index seeks to improve how decisions are made by providing a full range of outcomes from farm decisions, not just how yield or profit will change.

This first iteration of the Healthy Farm Index is based on data from the Great Plains. It brings a tool that farmers and others can use to visualize outcomes when managing to optimize multiple ecosystem services from land in row-crop production. Although there are tradeoffs, preliminary assessment indicates that managing land cover and land use to sustain soil and water will sustain multiple ecosystem services without significant losses in total production. Ultimately, we foresee the Healthy Farm Index as a potential means to bring about payments for ecosystem services. Direct payments or subsidies would be a way for society, which benefits from these services, to compensate the landowners who provide the services. The concept of payments for services will be discussed further in the next issue of this newsletter.

For more information on the integration of farming and bird conservation, the Healthy Farm Index, and to suggest further indicators, please visit our websites at <http://hfi.unl.edu> and <http://organic.unl.edu>.

References:

Isaacs, R., J. Tuell, A. Fiedler, M. Gardiner and D. Landis. 2009. Maximizing arthropod-mediated ecosystem services in agricultural landscapes: the role of native plants. *Frontiers in Ecology and the Environment* 7:196-203.