KBS LTAR Executive Summary

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KBS LTAR research is focused on row-crop agriculture and is located at Michigan State University's W.K. Kellogg Biological Station (www.kbs.msu.edu) in southwest Michigan. Building on its history of Long-term Ecological Research (http://lter.kbs.msu.edu), KBS LTAR seeks to better understand the ecology of intensive row-crop agriculture, with an emphasis on the corn, soybean, wheat, and alfalfa crops that dominate the upper Midwest. In anticipation of the eventual importance of cellulosic bioenergy crops KBS LTAR also studies cellulosic biofuel crops: switchgrass, miscanthus, poplar, and mixed-species grassland communities including restored prairie. These diverse crop ecosystems are compared to unmanaged forest and successional communities.

The KBS global hypothesis is that ecological knowledge of intensive cropping systems can reduce their reliance on synthetic chemical inputs and enhance the delivery of a number of ecosystem services in addition to yield. This hypothesis is addressed by observations and experiments at different geographic scales ranging from large plots to watersheds and landscapes to regional.

Research at KBS is guided by a conceptual model that integrates both ecological and social perspectives and explicitly addresses questions about the ecosystem services delivered by agriculture. The model represents coupled natural and human systems, highlighting relationships between human socioeconomic systems and the cropping systems and landscapes in which they reside. This approach reflects the need to balance attention between both human and natural elements and to understand their interacting linkages.

At the plot scale is the KBS Main Cropping System Experiment (MCSE) established in 1988 to reflect the range of ecosystem types typical of row-crop landscapes in the upper Midwest. Replicated ecosystems along a management intensity gradient include four annual cropping systems, two perennial crops, and both early- and late-successional unmanaged ecosystems. The annual cropping systems are corn–soybean–wheat rotations ranging in management intensity from conventional to biologically based (certified organic). Perennial crops include alfalfa and poplar trees. Successional treatments range in age from recently abandoned farmland to never-cleared deciduous forest. A Biofuel Cropping System Experiment (BCSE) added in 2008 includes replicated plots of continuous corn, switchgrass, miscanthus, poplar, mixed native grasses, early succession, and restored prairie.

Measurements are both organism and process based. Key organisms include plants, microbes, insects / pathogens, and humans. Each group is a focal area of KBS research, and together with research on primary production, hydrology, and biogeochemistry, constitute the core research areas of KBS. Understanding the interactions and integration among these core areas is crucial for generating a comprehensive understanding of the drivers and dynamics of the coupled human-natural system.

Specific measurements in the MCSE and BCSE include (i) plant species composition, above-ground net primary productivity, litterfall, and crop yield; (ii) predaceous insects, in particular coccinellids; (iii) microbial activity and community composition; (iv) soil moisture, pH, bulk density, carbon, inorganic nitrogen, and nitrogen mineralization; (v) NO_3^- loss; vi) soil greenhouse gas fluxes (N_2O, CH_4, CO_2) and (vi) a number of physical environment attributes such as weather conditions. Precipitation chemistry is measured as an NADP activity. Soil carbon is measured at decadal intervals. The soil seed bank is sampled on a 6 to 10 year cycle. Measurements at the watershed and landscape scale include water quality, insect movement, and human decision making.

KBS research is extended to the region by crop, biogeochemical, and economic modeling to evaluate potentials for the delivery of ecosystem services not now provided.