

## SYMPOSIUM PAPERS

## Introduction to “Symposium: Integrated Crop–Livestock Systems for Profit and Sustainability”

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AGRICULTURE in the USA and other industrialized countries has become increasingly specialized in response to political, regulatory, and economic pressures to meet market demands of an ever-larger food and fiber-processing sector. However, there is a growing concern with specialized agricultural systems, because of increasingly negative responses from the environment that are manifested in (i) water contamination with excessive nutrients, pesticides, and pathogens; (ii) decreasing groundwater levels due to high demand and competition from a variety of stakeholders, including specialized crop production; (iii) rising greenhouse gas concentrations from soils depleted in organic matter; and (iv) dysfunctional soils that have become degraded from excessive tillage, salt accumulation, and pesticide inputs. Alternative agricultural systems that integrate crops and livestock could provide opportunities to capture ecological interactions to make agricultural ecosystems more efficient at cycling nutrients, relying more on renewable natural resources, and improving the comprehensive functioning of soils while achieving acceptable or improved economic returns for the farmer.

A symposium was convened at the 2005 ASA-CSSA-SSSA Annual Meeting in Salt Lake City, UT, to address the theme “Integrated Crop–Livestock Systems for Profit and Sustainability.” The goals of the symposium were to (i) highlight the benefits and costs of integrated agricultural systems in comparison with specialized systems, (ii) describe some climate- and scale-specific opportunities for successful integration of crop and livestock operations, and (iii) attract a diversity of agricultural scientists and other agricultural professionals who together could creatively and successfully bridge the gap between current and future agricultural systems. The design of future agricultural systems should rely on a healthy balance of historical, current, and idealistic perspectives.

The five papers published in this issue of *Agronomy Journal* as a result of the symposium held in Salt Lake City in 2005 describe potential opportunities and challenges to make agricultural systems more economically and environmentally sustainable. The focus of several of the papers has been intentionally specific to a particu-

lar climatic region, because of the unique opportunities dictated by weather conditions and regional socioeconomic dynamics. Examples from other regions of the world are included to highlight particular ideas.

Russelle et al. (2007) take a broad view, with emphasis on the cold and subhumid climatic region of the north-central USA and western Canada by describing (i) agronomic and environmental advantages of improved cropping systems that include perennial forages; (ii) economic and environmental advantages of integrating livestock with cropping; (iii) concerns with current manure use and possibilities for improved animal manure management; and (iv) the nature and scale of integrated crop–livestock systems, that is, whether integration is within- or among-farms. They also present the idea that successful development of modern integrated crop–livestock systems will require a bold, new research effort, the size of which demands broad participation by biophysical and socioeconomic scientists, land practitioners, and other concerned stakeholders.

Sulc and Tracy (2007) focus on the cool and humid climatic region of the midwestern USA by describing (i) the opportunities for and benefits of integrating cattle grazing strategies with traditional grain crops; and (ii) the early stages of a long-term, integrated, systems-level experiment being conducted in Illinois. They also describe the difficult steps necessary to advance the successful implementation of integrated crop–livestock systems in the region.

Allen et al. (2007) focus on the hot and dry climatic region of the southwestern USA by describing (i) challenges of agriculture in an environment limited by water; (ii) agronomic and economic results of current and alternative agricultural systems distinguished by their reliance on external inputs; and (iii) the social and educational challenges faced by stakeholders in irrigated, dry climates. They outline the short- and long-term issues that researchers and landowners will likely face in the near to intermediate future.

Franzluebbers (2007) focuses on the hot and wet climatic region of the southeastern USA by describing (i) agronomic and environmental attributes of crop rotation, cover cropping, sod-based intercropping, and conservation tillage; and (ii) some agronomic, economic, and environmental results from integrated crop–livestock production systems in the Southern Coastal Plain and Southern Piedmont Major Land Resource Areas. Additional examples of how integration of livestock with crop production could improve the sustainability of agriculture in the southeastern USA were described by Katsvairo et al. (2006).

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Kirschenmann (2007) challenges (i) the effectiveness of current industrial agricultural systems in meeting the demands of society, (ii) the ecological interactions that drive terrestrial ecosystems, and (iii) the emerging energy limitations that power current agricultural systems. He offers a list of principles that will, or at least should, form the basis for agricultural systems that will be more sustainable.

We hope that this set of symposium papers will provide a sound basis for development of future agricultural systems that (i) take advantage of unique environmental conditions within a region to make agriculture successful; (ii) balance the economic, environmental, and social outcomes of agricultural manipulation of the earth's surface; and (iii) create opportunities to recycle nutrients, more fully utilize the natural capital of ecosystems, and develop biological diversity to avoid reliance on costly, environmentally degrading external inputs.

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