Precision Conservation: Increase Farm Profitability While Conserving Soil, Water, and Wildlife

Abstract

Agriculture intensification in Nebraska has resulted in the simplification of agricultural systems (e.g., corn and soybean rotation compared to multi-crop diversity and/or integrated crop-livestock systems), increased field sizes, and removal of non-crop habitat to maximize production. Despite increased farm productivity, rural and urban residents are becoming increasingly affected by multiple emerging and continuing challenges including environmental concerns (e.g., climate variability, soil erosion, water pollution, etc.), economic uncertainties, and declines in rural community vitality. These challenges for increased food production, environmental protection, and economic uncertainties require innovative solutions to achieve resilient agricultural systems. To address these challenges, new local (or field) scale, precision technologies and strategic conservation planning frameworks have been developed to offer opportunities for agricultural producers to maximize whole-field profitability by strategically identifying marginal (or low yielding) acres for cropland diversification, while simultaneously reducing negative environmental impacts. These new precision technologies and strategic conservation planning frameworks also offer natural resource agencies and organizations innovative ways to prioritize enrollment of private lands in conservation programs (e.g., State Acres for Wildlife Enhancement, Conservation Program 33-Habitat Buffers for Upland Birds) with the goal of increasing available wildlife habitat. Implementing these innovative precision technologies and strategic conservation planning frameworks in Nebraska will require a collaborative effort among farmers, farmland owners, industry, and local/state/federal/NGO partners to achieve resilient agricultural systems in the 21st century.

Detailed Research and Implications

Loss of biodiversity and degradation of ecosystem services in intensively managed agricultural lands is an important challenge facing land managers throughout the Corn Belt. Simplification of cropping systems with the goal of increasing yield and associated farm revenue has been one of the leading contributors to the loss in biodiversity. In the coming decades, agricultural intensification is expected to increase with the increasing human population and nutritional demands (Tillman et al. 2011). Agricultural producers in the Midwest are facing increase climate variability, which affects nutrient cycling and water availability, as well as shifts in pest occurrences and plant diseases (Fuhrer 2003, Jones and Thornton 2003, Lin 2011). Concomitantly, Nebraska is experiencing high levels of nitrate-N concentrations and agrochemicals (e.g., atrazine) in groundwater (Ferguson 2014), which pose a significant threat to human health (Rhoades et al. 2013). U.S. net farm income, an indicator of farm well-being, is also down over $9 billion (or -12%) from 2017 (U.S. Farm Income Outlook 2018). These challenges for increased food production, environmental protection, climate variability, and economic uncertainties require innovative solutions to achieve resilient agricultural systems.

To slow the decline in biodiversity, agricultural landscapes must be managed effectively to maximize biodiversity retention, while providing sufficient agricultural outputs to meet current and future demands (Norris 2008). Recently, new precision technologies and strategic conservation planning frameworks have been developed to offer opportunities to optimize agricultural production by strategically identifying marginal (or low yielding) acres for cropland diversification, leading to increased profits while simultaneously reducing negative environmental impacts (McConnell and Burger 2011, Brandes et al. 2016). For example, switching less productive and profitable portions of a field to a lower input management option, such as perennial vegetation funded by a conservation program, could increase overall cropland profitability by 80% (Brandes et al. 2016; Fig. 1). This unique approach also improves landscape diversity, which can help build greater agroecosystem resilience (Roesch-McNally et al. 2018).

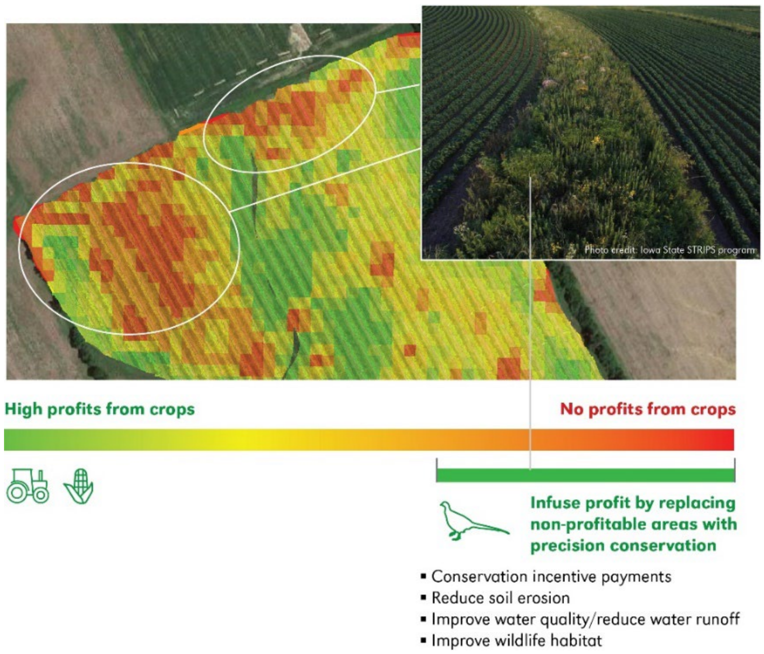

Fig. 1. Visual depiction of local (or field) scale Precision Conservation Delivery.

These new precision technologies and strategic conservation planning frameworks also offer state and federal natural resource agencies innovative ways to prioritize enrollment of private lands in conservation programs (e.g., State Acres for Wildlife Enhancement, Conservation Program 33-Habitat Buffers for Upland Birds) with the goal of increasing available wildlife habitat (e.g., regional scale; Fig. 2).

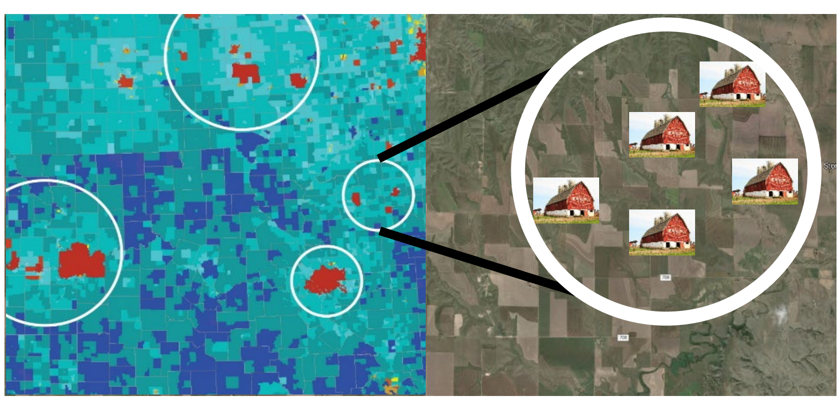

Fig. 2. Visual depiction of the regional scale Precision Conservation Delivery. Areas noted in red are high priority parcels for conservation, whereas blue parcels represent low priority parcels conservation.

Precision Conservation is a key tool to help reduce habitat loss, increase whole-field profitability, improve patch connectivity for wildlife, and help state/federal agencies target limited financial resources.

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