

Chapter 19

Understanding Land-Use Feedbacks and Ecosystem Service Trade-Offs in Agriculture

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OBJECTIVES

Globally, a burgeoning human population and rise of a middle class are placing greater demands on our planet to produce ecosystem services than ever before. This pressure is particularly acute for current and future demands placed on agricultural land use. Farmers and other land managers are expected to satisfy existing commodity markets (e.g., corn, soybean, forage, livestock), produce options for emerging agricultural markets (e.g., biomass for bioenergy), while protecting water quality, biodiversity, and recreational opportunities. Our global citizenry needs to understand how ecosystems function in relation to the services desired and how land-use choices impact this functionality. Challenges to developing this understanding are multifold, and include complexities in landscape ecological functionality; time lags and spatial mismatches in how land-use decisions manifest ecosystem services; and cumulative impacts of multiple decision makers acting independently. Furthermore, ecosystem services are not always needed or desired by the people who own the lands that produce ecosystem services. As such, the science associated with different ecosystem services, how they interact, and how people value them is not always well understood.

In this lab, you will work with an interactive online tool “People in Ecosystems Watershed Integration,” or PEWI, to evaluate feedbacks and trade-offs between agricultural land uses and environmental factors, including patterns in topography, soil, and rainfall in a realistic spatial simulation environment. Additional economic and social survey data will be used to determine how landowners and society value

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ecosystem services derived from different land-use configurations. This lab is designed to help students:

1. Understand the impacts of common agricultural land uses on the delivery of ecosystem services;
2. Explore how land use interacts with spatial and temporal factors to influence the level of ecosystem services produced;
3. Interpret, anticipate, and manage ecosystem and human system feedbacks;
4. Visualize and simulate coproduction and trade-offs among specific ecosystems services; and
5. Examine how individuals and societies value ecosystem services differently.

Working independently, students will design an agricultural watershed within PEWI to balance delivery of ecosystem services, including conventional crop and biomass production, clean water, soil carbon sequestration, and habitat for biodiversity. In Part 1, you will familiarize yourself with the levels of ecosystem services associated with different land uses and create your ideal watershed. Class discussion associated with this section will help you understand how different people value and trade off ecosystem services differently. In Part 2, you will design the watershed to produce specific, predetermined ecosystem service outcomes. Finally, in Part 3, you will use additional data to determine the economic value of the ecosystem services produced. You'll need a computer with either Google Chrome or Mozilla Firefox installed as a web browser and an internet connection to complete the lab. Because the PEWI model will be updated with new scientific findings and new modules will be developed over time, please continue with the lab online, starting here:

<https://www.nrem.iastate.edu/pewi/feedbacks-and-tradeoffs>