Valuation and Mapping of Environmental and Economic Factors to Support Climate-Friendly Land Use Decisions in the Massachusetts Cranberry Industry

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Abstract

Land-use decisions, particularly in an agricultural setting, lie at the nexus of the colliding challenges of climate change and food insecurity. Understanding and guiding these decisions at the regional scale is a key strategy in the development of natural climate solutions and sustainable food production systems. These issues come together in a particularly high-stakes context in the Massachusetts cranberry industry, which occupies a position of significant economic and sociocultural importance in the region, but faces a number of challenges in the form of heightened competition, unstable prices, an aging farmer population, and changing ecological conditions. Many farmers are looking either for ways to become profitable, or to exit the industry in a financially sustainable way. One option is to sell their land to developers; another option, which is exciting to scientists and environmental advocates, is undergoing an active habitat rehabilitation to restore the beneficial ecosystem services of a functioning wetland environment. Integrating satellite data and in-situ sensor data collected over the past decade, we aim to conduct a systems analysis that unites the viewpoints of cranberry industry stakeholders and clarifies the trade-offs between environmental, economic, and social factors in the region. We propose to address this aim via three core research efforts: a contextual analysis of the industry; a valuation and mapping of key ecological, economic, and social factors; and an integrated modeling approach that models interactions and trade-offs between these factors. In particular, this presentation will focus on the progress we have made valuing and mapping key environmental and economic factors using publicly available satellite imagery and census data. This work demonstrates how these factors align with existing features of the natural and built environment, supports conservation organizations and municipalities in their restoration and conservation advocacy, and provides a foundation for future scenario mapping that will analyze trade-offs in different land use cases.

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Background

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Methods

Integrating satellite data and in-situ sensor data collected over the past decade, we are conducting a systems analysis that unites the viewpoints of different cranberry industry stakeholders and clarifies the trade-offs between environmental, economic, and social factors in the region. We are working towards this aim via three core research efforts:

1. A contextual analysis of the industry using the **Systems Architecture framework**
2. A valuation and mapping of key ecological, economic, and social factors using **InVEST ecosystem service models** from the Natural Capital Project, and
3. An integrated modeling approach that models interactions and trade-offs between

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Contextual Analysis

I completely a preliminary contextual analysis of the MA Cranberry Industry using the *Systems Architecture* framework. Data for this analysis was collected via stakeholder interviews with ten members of the farming, restoration, and scientific communities, the 2016 report from the Massachusetts Cranberry Revitalization Task Force, and the 2020 Living Observatory Preliminary Benefits Assessment.

This analysis focused on understanding relevant system contextual factors, identifying primary, secondary, and tertiary stakeholders, and uncovering the needs and objectives of the primary stakeholders. A mapping of contextual factors and stakeholder relationships are presented in the figures below:

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Preliminary Modeling and Mapping Results

Here, we present our latest progress modeling, valuing, and mapping key environmental and economic factors using publicly available satellite imagery and census data. This work utilizes the InVEST ecosystem services modeling tool, and demonstrates how these key ecosystem services align with existing features of the natural and built environment.

The figures below display the results of implementing the INVEST Nutrient Delivery Ratio (NDR) model for Falmouth County in Massachusetts. The NDR model **quantifies** the ability of a given unit of landscape to **retain** nutrients (specifically nitrogen and phosphorus) and **keep** these nutrients out of the local watershed. The

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