Land Use Vulnerability:
Addressing New Themes with Extant Methods

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The problem: loss of farmland to urbanization & increased vulnerability of the coupled HE system

Without market intervention, urban uses tend to outbid agriculture for the use of land whenever urban suitability is high, thus resulting in the development of the land most of the cases.

This process has serious implications at a regional scale (fig.1). At a global scale, however, the cumulative effect of these land use changes may become an issue of global environmental change concern.

In many developed countries, an increased appreciation of the multifunctional character of agriculture along with the awareness of these issues, has prompted the support (and demand) for farmland preservation programs and policies.

We take this feedback as an opportunity to help reducing the hypothesized future exposure of the coupled human environmental (HE) system to potential perturbations derived from land use change, and respond by using a framework aimed at facilitating more strategic land use decisions in the area of farmland preservation.

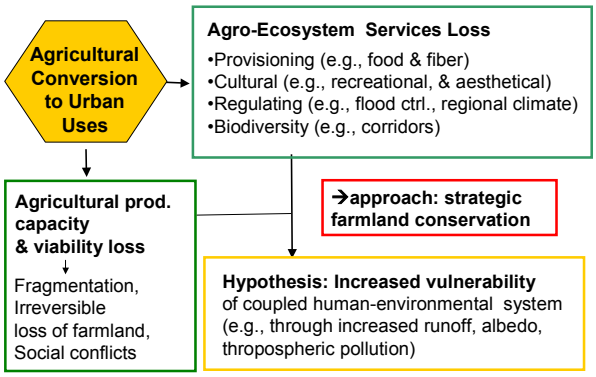


Fig. 1. Problem Setting

An application: the California Bay Area bioregion

California is one of the premier agricultural areas of the word, within it, the Bay Area bioregion contains some of the most valuable farmland in the sate and is experiencing the highest urban pressures of the state.

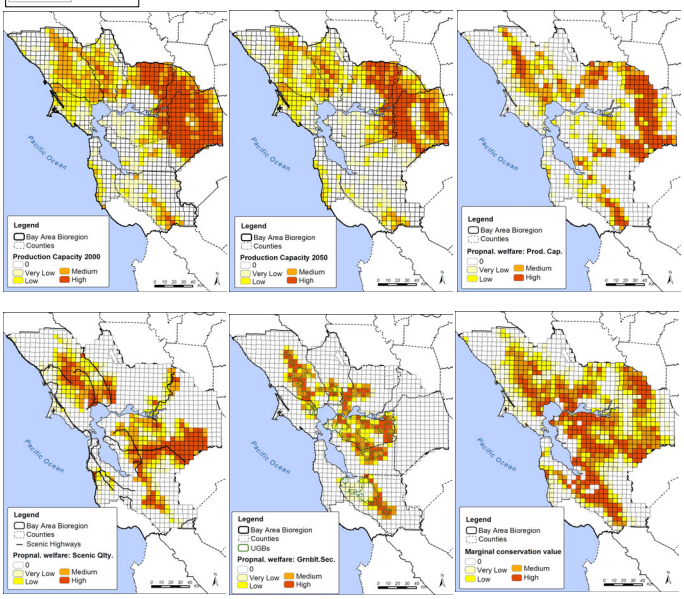


Fig. 2. Demonstration of the framework: application to the California Bay Area bioregion.

Our Approach: reducing vulnerability through conservation → framework steps and application:

Define planning GOAL

Maximize future farmland provision of environmental & social benefits and reduce future vulnerability of the coupled HE system

Define Conservation OBJECTIVES

Maintain agricultural. viability, locally important. agric. products & ecosystem production services	Preserve rural amenities	Urban Growth Management

Define spatial units: planning region, reference region, sites

CA Bay Area Bioregion; counties; ¼ townships

Define measurement CRITERIA, data & units

Production capacity = prod capability * condition	**Scenic Quality** = designated farmland scenic area's condition	**Greenbelt Sec. potential** = Proximity to UGB
Important farm. Categ. (FMMP) / Neighboring urban use (FMMP)	Viewsheds. (CA Scenic Hwys Prog.) / Degree urbanization (FMMP)	Distance decay function from UGB (city adopted UGBs)

Perform current criteria assessment

Current (2000) site & regional production cap.	Current site & regional scenic quality	Current site & reg. Greenbelt. sec.pot.

Identify future exposed sites & expected services loss without intervention => Scenarios

Land use change scenario: urban growth (CURBA, Landis et. al 1998)

Future (2050) production cap.~ secured prod.cap	Future scenic quality	Future greenbelt. securing potential.
Site production cap. loss.	Site scenic quality loss	Site grnblt.sec.p.loss

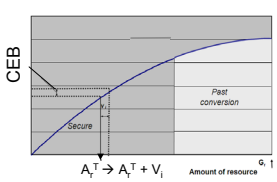
Define public benefits function & Convert criteria measurements to common scale of public benefits (fig.3)

Diminishing returns: Quadratic	Diminishing returns: Quadratic	Critical mass Stepwise linear

Determine the aggregate benefits & cost of preserving each site for all objectives

Equal weighted additive fc. & conservation easements estimates

Compute marginal conservation value: aggregate benefits/unit cost



A_r^T = Amount of resource secured at time 2 (2050) in the reference region
Vi = site expected resource loss
CEB =Cumulative Expected Benefits: social welfare

Fig. 3. A quadratic form or expected benefits

And the road ahead:

- Many methodological challenges
- Simplistic view of exposure
- Linking criteria and decision making
- Integration of vulnerability assessment into conservation approaches
- Broader applicability (e.g. Europe, CAP)?

Interested?
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