

UC

Modeling Farmland Conversion with New GIS Data

August 7, 2001

**Nicolai V. Kuminoff
and Daniel A. Sumner**

AIC

University of California Agricultural Issues Center

One Shields Avenue, Davis, CA 95616

TEL (530) 752-2320

FAX (530) 752-5451

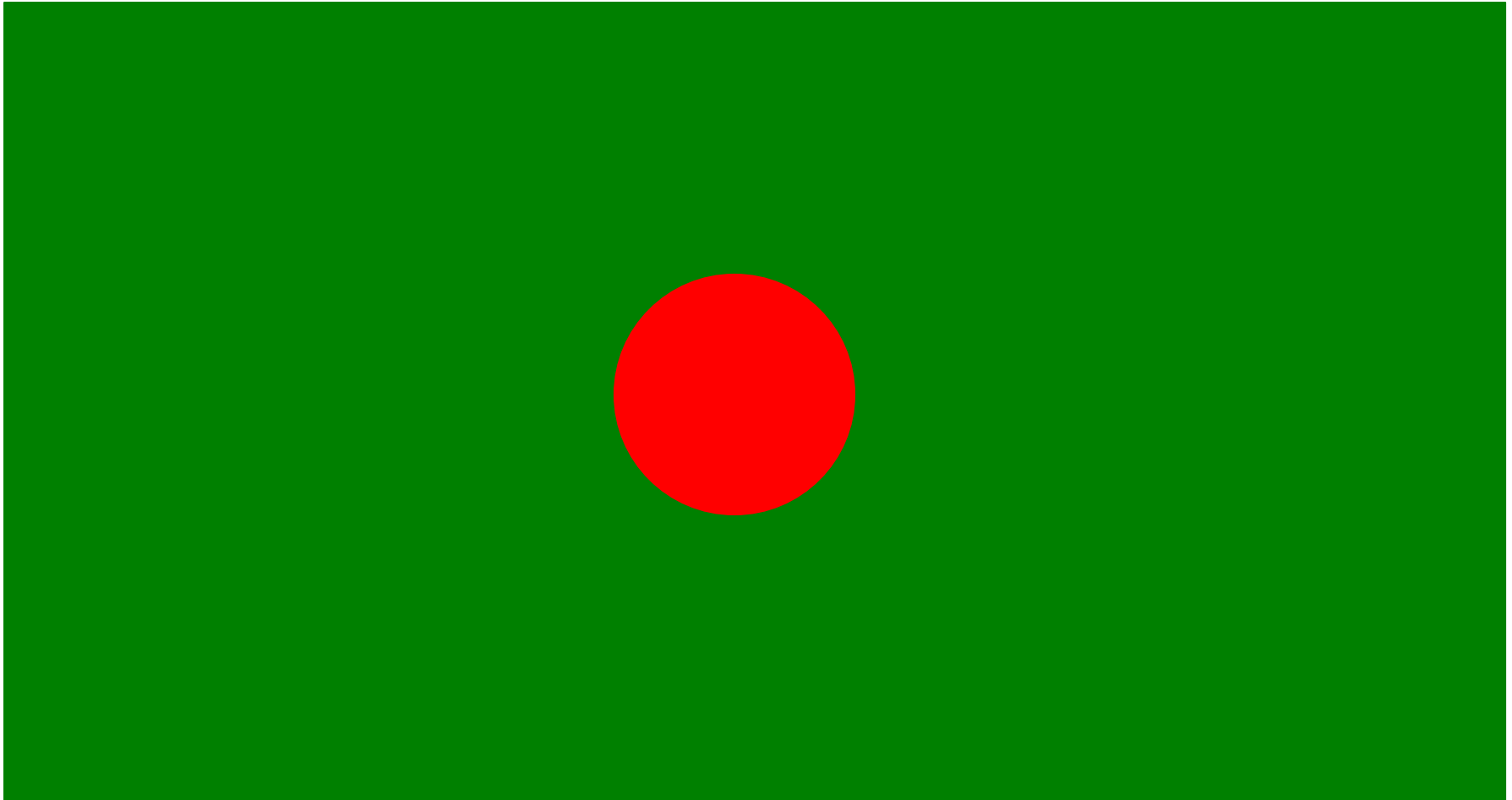
email: agissues@ucdavis.edu

webpage: <http://aic.ucdavis.edu>

Modeling Farmland Conversion

- Theoretical model developed by Richard Muth (Econometrica, 1961).
 - Agriculture and housing industries compete for land in a Von Thünen plain.
 - Direction of conversion depends on demand elasticities of housing and local agriculture.
 - Model is rigorous and provides insights, but lacks institutional richness necessary as a basis for empirical analysis.

Muth—Von Thünen Plain, 1961



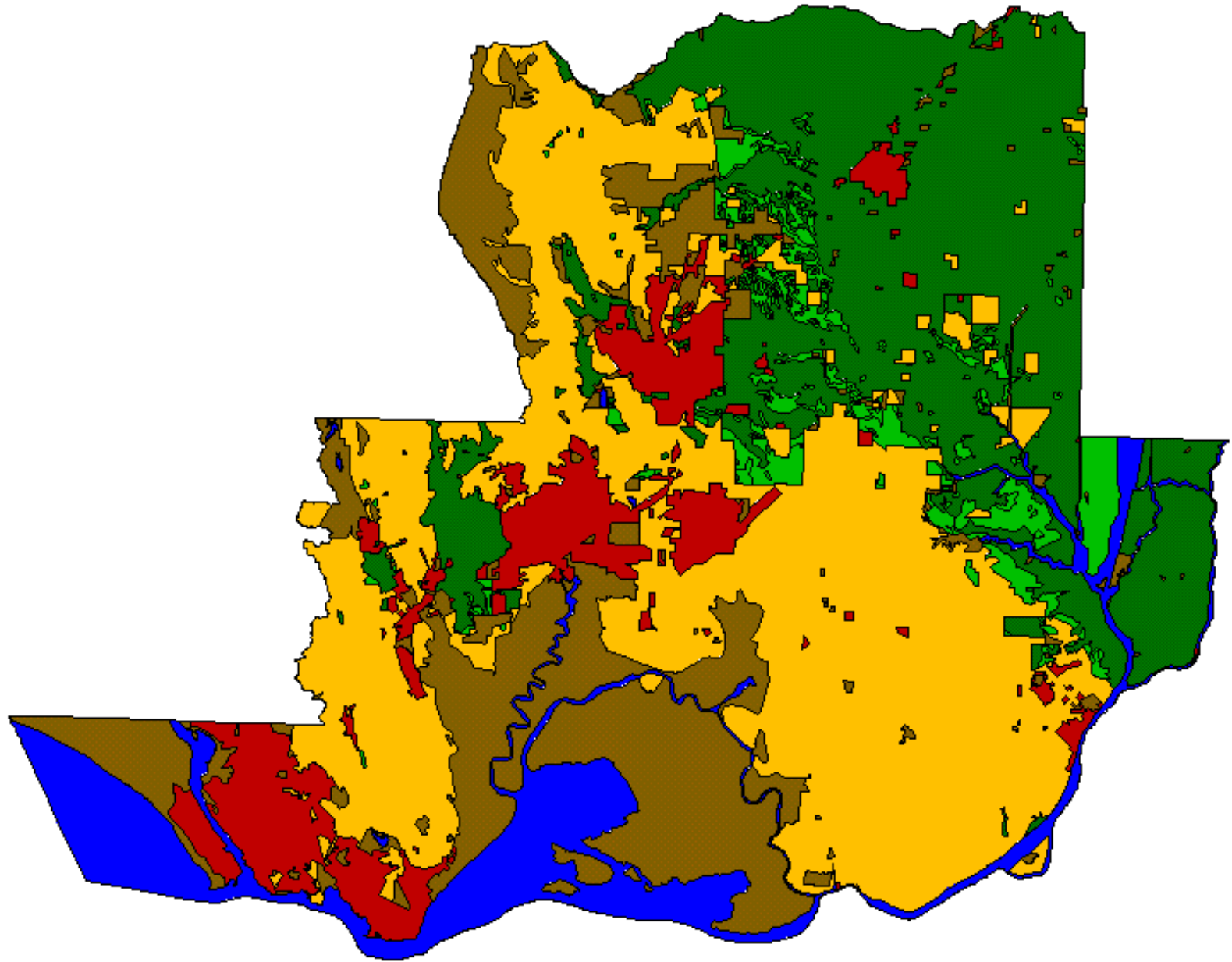
Objective of this Study

- Empirical analysis that examines the causes of farmland conversion using a unique dataset for California.

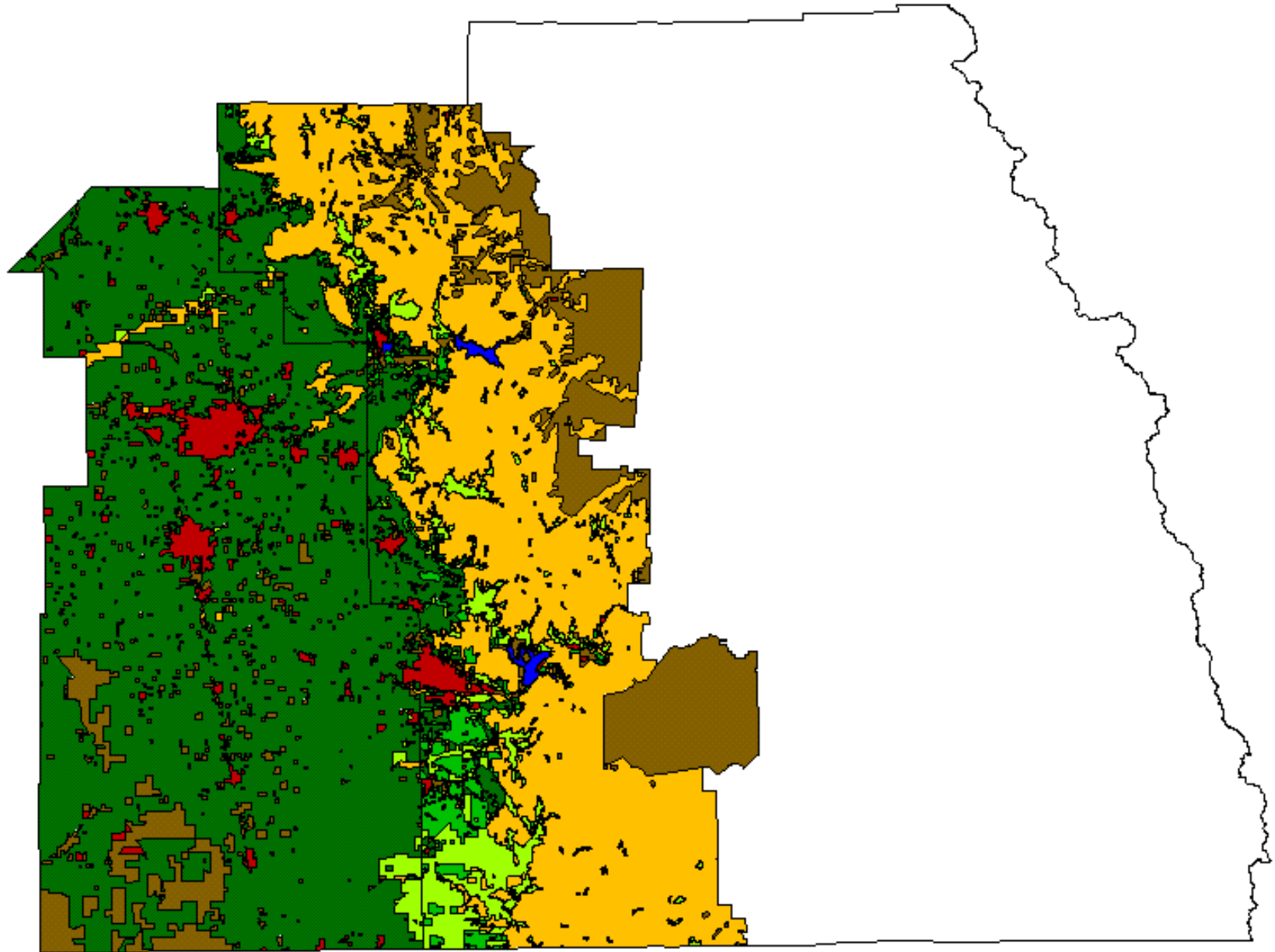
Farmland Mapping and Monitoring Program (FMMP)

- Since 1984 has used soil surveys, aerial photography, GIS mapping, and field checking to track conversion at the county level.
- Produces biennial summary reports of conversion between 6 types of agricultural land, urban land and “other” land.
- Recently made its GIS data available.
- Source for our dependent variables and independent variable for ag-urban edge.

Solano County CA, 1998



Tulare County CA, 1998



Urban Area Characteristics, 1998

	Acres	Population	Urban Perimeter (meters)	Ag-Urban Edge (meters)
Tulare	48,525	361,400	875,369	696,685
Solano	53,129	385,500	524,923	352,014

Theoretical Model

- Landowner maximizes net present value of land for farming and sale for conversion to urban and environmental use based on:
 - Current sale price of land for conversion.
 - Expected future farm income.
 - Option value for future conversion.
 - Relocation and transaction costs.
 - Personal factors.
- Regional level—zoning and development restrictions will also be a factor.

Dependent Variables

- For 1988-1992 and 1992-1998, average annual acres of land converted from:
 - **Agriculture to urban use.**
 - **Out of agriculture**
(ag-to-urban + ag-to-other).
 - **Into urban use**
(ag-to-urban + other-to-urban).
- 42 Counties, 2 time periods, $n = 84$

Independent Variables

- Urban edge (+).
- Change in farm income (-).
- Change in housing price (+).
- Change in population (+).
- Stock of land converted (+).
- Number of development restrictions (-).
- Dummy variable=1 for 1992-1998 (-).

Independent Variables

- Change in farm income:

$$\Delta \text{FARMINC}_{i,t} = \left[\left(\frac{\sum^n \text{FARMINC}}{m} \right) - \left(\frac{\sum^{m-4} \text{FARMINC}}{5} \right) \right]$$

- Same form for change in housing price.

Independent Variables

- Urban edge (+).
- Change in farm income (-).
- Change in housing price (+).
- Change in population (+).
- Stock of land converted (+).
- Number of development restrictions (-).
- Dummy variable=1 for 1992-1998 (-).

Independent Variables

- Zoning and Development Restrictions:
 - Ag element in general plan.
 - Growth management element in general plan.
 - Urban growth boundary.
 - Super Williamson Act.
 - Policy directing new growth toward cities.
 - LESA.
 - Ag Conservation Easements

Independent Variables

- Urban edge (+).
- Change in farm income (-).
- Change in housing price (+).
- Change in population (+).
- Stock of land converted (+).
- Number of development restrictions (-).
- Dummy variable=1 for 1992-1998 (-).

Econometric Specification

$$C_{i,t} = \beta_0 + \beta_1 \text{EDGE}_{i,t} + \beta_2 \Delta \text{FARMINC}_{i,t} + \beta_3 \Delta \text{HOUSEP}_{i,t} + \beta_4 \Delta \text{POP}_{i,t} + \beta_5 \text{STOCK}_{i,t} + \beta_6 \text{RESTRICT}_{i,t} + \beta_7 t + \mu_{i,t}$$

Where, $i = (\text{County}_1, \dots, \text{County}_{42})$, and

$$t = \text{dummy variable for second time period} = \begin{cases} 0 & \text{for } 1988-1992 \\ 1 & \text{for } 1992-1998 \end{cases}$$

Empirical Question

- Are urban factors or farm returns important enough as determinants of farmland conversion to appear statistically significant in our econometric estimation, given our proxy independent variables, omitted variables, and assumption of perfect expectations?

Results

- Edge length and population growth statistically significant and positively correlated with conversion in all three specifications.

Results

- Change in farm income positively correlated with ag-to-urban conversion.
- Change in housing price not statistically significant.
- Number of development restrictions not statistically significant.

Conclusions

- Urban factors, not low farm income have been the main cause of farmland conversion and new urban development in California.
- Spatial pattern of urban development affects farmland conversion.
- Results probably apply to other states with large urban and agricultural acreage.