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Modeling Development Threat to Farmland in Hadley & Northampton, MA

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Projection: Massachusetts State Plane: Mainland Zone
Sources:
Land Use: (1951-1999), UMass Resource Mapping Project, 2002.
Roads: MassDOT - Office of Trans. Planning, Road Inventory 2013.
Hydrography: MassGIS, March 2010.
Towns: MassGIS, February 2014.

Overview & Study Area Discussion

There are many rationales for farmland preservation, such as for the ecosystem services such land provides, or for historic or aesthetic purposes. In this project, I am concerned with loss of productive farmland, specifically cropland and pasture, to other uses.

The goal of this investigation was to develop a model that answers the question: how might a decision-making body prioritize farmland for preservation? While there are many ways to answer this question, I took as my starting point the following model: *Farmland conservation value = relative capability of land (primarily with reference to productivity / land quality) + level of threat to the land.* I did not attempt to address the model comprehensively. Rather, I focused on modeling one element of "level of threat"; in particular, I modeled the type of new land use that replaced farmland in Northampton and Hadley, Massachusetts, in order to hypothesize what type of development tends to threaten agricultural land.

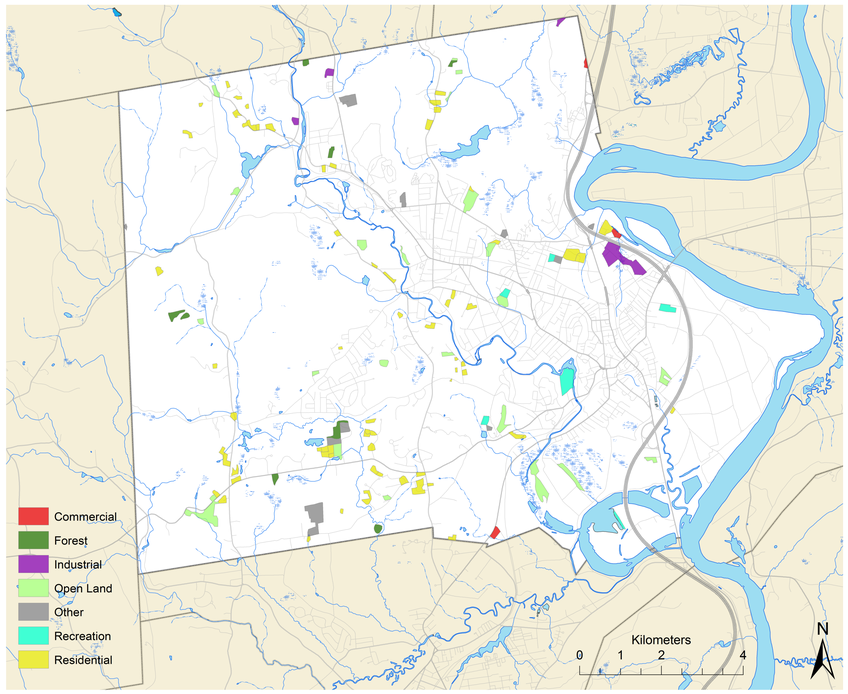
Hadley and Northampton are towns located in Hampshire County adjacent to each other, separated by the Connecticut River, with Northampton to the west and Hadley to the east. I chose this study area because both towns have high quality arable land, allowing me to (roughly) equalize one part of my model (relative capability of land), thus allowing me to focus on the concept of threat.

Hadley is a town with about 23 square miles of land, and a population around 5,000 as of the 2010 census. It was largely agricultural until the 1960s, and underwent a transformation over the next several decades, in part due to expansion of the University of Massachusetts Amherst east of Hadley (which stimulated residential development). Commercial development, such as the building of the Hampshire Mall, occurred primarily along Route 9, which connects Amherst and Northampton via Hadley.

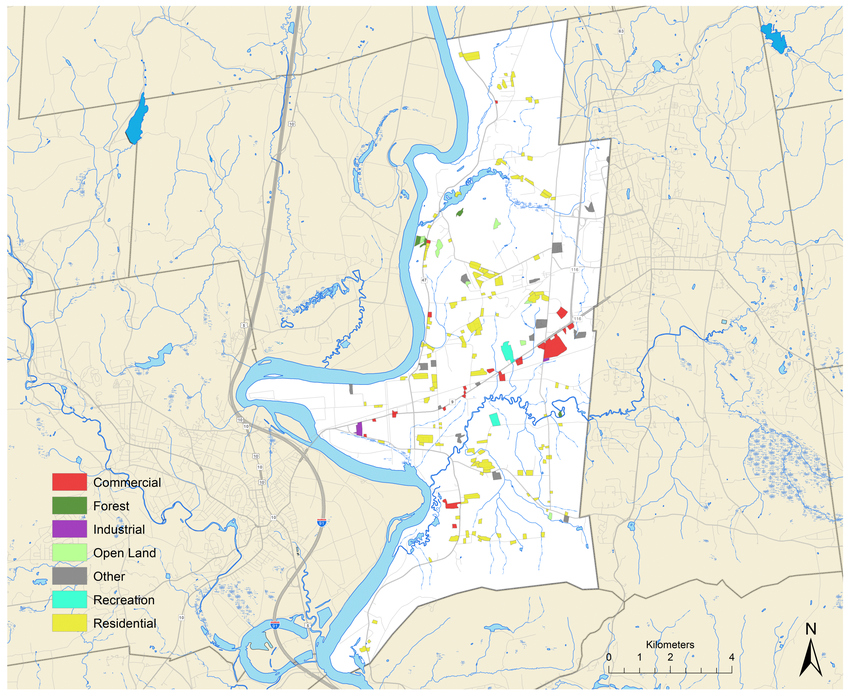
Northampton, the county seat of Hampshire County, is more populous than Hadley, at 29,000 residents as of the 2010 Census over its 34 mile land base (this population estimate includes the tows of Florence and Leeds, technically part of Northampton). It is connected to Hadley by a bridge (part of Route 9) which traverses the Connecticut River. Northampton is home to Smith College and a vibrant arts community and shopping district.

Topographic Reference Map of Hadley & Northampton, MA

Farmland Lost to Other Use in Northampton 1971-1999



Farmland Lost to Other Use in Hadley 1971-1999



Methodology

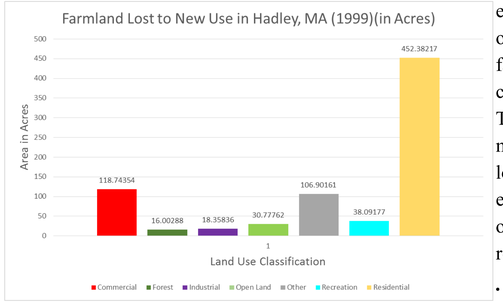
In this model I compare farmland at two points in time, 1971 and 1999, using the 1951-1999 Land Use dataset from MassGIS. By comparing farmland from these two points in time, I was able to see where farmland present in 1971 had been converted to some other use by 1999.

To carry out my pilot study, I selected Northampton and Hadley from the MassGIS towns datalayer, and applied the 1951-1999 MassGIS land use data to my town shapefiles using the "clip" feature in geoprocessing. Next, recategorized farmland as "cropland" and "pasture" to create a farmland-only shapefile. Subsequently, I created a "look-up table" in Excel to reclassify the land use\ categories relevant to Hadley and Northampton. I joined this "look-up table" to the land use datalayer and then applied the new land use categorization to each individual town land use layer for 1971 and 1999 both. Finally, I created a "new land use" layer for Hadley and Northampton both, which can be seen in _____. I used the field calculator to generate an SQL command that selected polygons that were agricultural in 1971, but that were not in 1999. Land use in 1999 is applied to these polygons to reflect the 1999 land use.

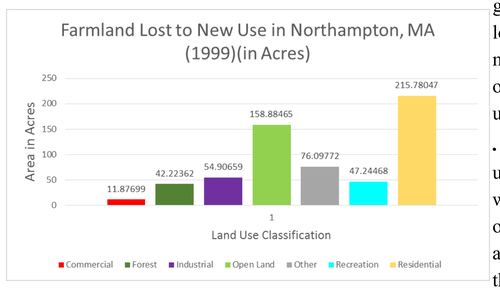
Results & Limitations

There were some key similarities and differences in land use change in Northampton and Hadley, which are summarized in the maps to the left, in the bar charts below.

The preponderance of farmland lost in both towns was classified as residential in 1999. But there was much more of this type of development in Hadley during the period in question: Other key differences include a greater share of commercial development in Hadley, and conversely, a greater loss to "open land" in Northampton (a broad category that may include abandoned agriculture, power lines, and/or areas of no vegetation).



How helpful is this analysis for determining threat to a given parcel of land? Ultimately, quite limited. The analysis above is heavily constrained by the data; what happened before 1971, and what happened after 1999? Moreover, what happened in between (what changes took place that we cannot see)?



Other limitations include:

- More specific soils data would be necessary to determine both the suitability of parcels of land for different crops and agronomic practices, as well as suitability for other land uses.
- There are many threats to farmland, and this project only attempted to model one possible threat.
- While I determined spatially where farmland was lost, and calculated the new land use, it might be useful to measure the lost land and new use relative to features such as major roads or population centers to provide other ways to analyze the relevance of this land use change to threat.
- There is a difference between "land in farms" and "farmland"; I looked at the latter, rather than the former, due to data constraints. That is, I felt confident classifying "cropland" and "pasture" as farmland, but I excluded forests. Forests are often part of "land in farms," but could not be accounted for in my analysis. Thus, I may have overestimated or underestimated loss, depending on how forested lands that were parts of farms were either lost or retained.
- While my analysis suggests farmland was largely lost, rather than "regained," my model exludes instances of land changing from some use back to farm use.
- The minimum mapping unit of my land use data was 1 acre, and not based on parcels of land, which are owned by real people in the real world. That is, in terms of measuring threat, ownership and value of a given piece of land likely has a lot of bearing on the likelihood that land will be lost to farming, but is ignored in this model.