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**LAND POLICY**  
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# Driving Factors in Fragmentation and Parcelization: A Michigan Case Study<sup>1</sup>

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**Abstract.** Forest and agricultural lands in Michigan are coming under increased pressure from development. Populations are increasing, and parcel sizes are diminishing. These trends may greatly influence our ability to sustainably support employment in extractive, forest products and agricultural industries and may adversely affect or fragment landscape-level biological diversity. We discuss the driving factors associated with land-use change and landscape fragmentation in Michigan from 1980 to 2000. We focus on a 3.3 million acre, nine-county, predominantly forested case study area in northwest Lower Michigan. This case study is part of a larger project to incorporate social, economic, institutional and ecological factors into a quantitative model to project land use change in Michigan with a focus on the built environment, especially. The overall project goal has been to determine the factors that have contributed to change from 1980 to 2000, statewide. In the case study area, we mapped selected attributes of classified land cover/use data and census data, including population, housing units, median house value, median household income, and seasonal homes; by minor civil division (MCD) for each of the nine counties. Similarly, institutional data, including zoning and master planning status, transportation networks, national and state forest lands, were mapped at the MCD level. Finally, with the cooperation of the Michigan State University County Extension Directors, we used a series of focus groups to assess stakeholders' perceptions of drivers of land use/cover change and parcelization. This allowed us to interact with stakeholders in each county to add an additional layer of information for the analysis and to directly provide products from the mapping and classification efforts to county and local decision makers and planning officials.

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## **Introduction**

In 1986, the U.S. Environmental Protection agency started a new program focused on environmental risks. In 1991, Michigan initiated a similar program, and three committees were formed representing citizens, scientists, and representatives of government agencies, respectively (Rustem et al. 1992). The committees were asked to identify and rank environmental problems facing Michigan's citizenry. The committees assigned a relative risk to problems posed to the environment and quality of life. Of 24 issues identified, the number one ranked issue was "Absence of Land Use Planning"; it received high-high ranks from all three committees. There have been a number of initiatives developed to address this issue since then.

One of the principal efforts at Michigan State University (MSU) was creation of the Land Policy Institute (LPI). LPI's focus is to develop strategies and policy tools to aid Michigan's policy makers in making land-use decisions based on the principles of strategic growth. LPI coordinates the Kellogg Foundation's People and Land Program and is home to the John A. Hannah Distinguished Professor in Land Policy, the Planning and Zoning Center, Citizen Planner, Picture Michigan Tomorrow and other land use initiatives.

The Picture Michigan Tomorrow Initiative (PMT) is an effort by Michigan State University to develop a set of modeling tools that will examine drivers of land-use change and make spatial projections of future land-use change in Michigan. Our project will provide feedback from local communities to improve development of the PMT model. Outreach and education components of the initiative are targeted to build relationships between university researchers and the state's planning community. Eventually, impact analysis tools will be added; they will examine fiscal and infrastructure impacts, ecosystems effects, and quality of life issues.

The purpose of this paper is to describe ongoing efforts to study drivers of land-use change from local stakeholders' perspectives. Researchers have identified drivers of change (variables for models), but this research engages local government officials and others in discussions of land-use change in various Michigan counties. Their ideas and discussions help us validate drivers of change and identify new drivers.

## **The Problem**

Landscape fragmentation (increased patchiness/edge and loss of forest and agricultural lands to development) and parcelization (reducing larger ownership parcels to smaller ones) are widely viewed as threats to functioning ecosystems and communities and industries that rely on agriculture and forest resources

Agriculture in Michigan, and throughout the Midwest, is at a critical juncture. Studies suggest that, in 20 years, urbanization trends will erase the state's most agriculturally diverse areas. Market forces, uncontrolled development, and the undervaluation of agriculture as a resource have deeply eroded its base. During the 1982 to 1997 period, farmland acreage in Michigan decreased approximately 1.5 million acres or 13.3% (Norris and Soule 2003). Agriculture along the urban fringe is especially vulnerable (Colunga-Garcia et al. 2004). Agriculture and associated food processing provide diversity to the state's economy and contribute to the aesthetics of open

spaces. Based on previous projections to 2040, Michigan will lose about 15% of its farmland, especially in metropolitan counties (Public Sector Consultants, Inc. 2001).

A recent study of Grand Traverse, Kalkaska, and Crawford counties illustrates the trend of average parcel or lot size decline across northern Michigan (Drzyzga 2000). The average lot was 24 acres in 1970, but the average was just over 10 acres by 1990. The effects of parcelization on forest cover and landscapes are less clear. During the same period, forest cover increased from 54 to 59 percent in the region. This was due to successional change (open to forest) on unmanaged farmlands. Effects on fragmentation need more study. For land-based industries such as forest products companies which extract timber, more parcels equates to the need to work with more people, more diverse interests and decreased economies of scale.

Many small-parcel forestland owners, however, are not concerned with growing timber, although some larger owners are. The timber supply situation is further complicated by rural development in areas near public lands, some of which produce commodities while others are protected. The likelihood of timber harvesting on private lands decreases as parcel size decreases. For example, only one owner out of 10 will likely harvest timber on parcels smaller than 10 acres in northern Michigan (Potter-Witter 2005). For larger landholdings this percentage may increase up to 70%.

One challenge we have had in Michigan is the lack of comparable land use/land cover data for multiple points in time. Hence, developing statewide landscape change analyses is not yet possible. Efforts are underway to develop new datasets to facilitate change analyses. Therefore, we can look at current land use/land cover and relate it various social, economic, institutional and natural resource attributes. Past efforts aimed at projecting future sprawl in Michigan have not relied on functional drivers of land cover/use change (e.g., population, income, education, infrastructure, etc.). To improve projections of future land cover/use, deriving the relationships between these drivers and land-use change is an important research step.

## **The Approach**

We are working on two interrelated projects on land-use change. The first, and the focus of this paper, involves using focus groups to discuss participants' views of drivers of land-use change at the county and minor civil division levels. The second is to develop statistical relationships between drivers of change and landscape fragmentation metrics. Results of the first project will help guide the second project and broader Picture Michigan Tomorrow efforts.

We conducted a case study to examine these drivers of change in a nine-county area in the western Lower Peninsula of Michigan (Figure 1). This area has experienced a range of population growth in recent decades. Significant growth has occurred particularly in the southern areas near the cities of Grand Rapids and Muskegon, whereas slower growth has occurred in the northern portion of the area (Figure 2). This range provides an opportunity to discuss sprawl and related parcelization along with habitat fragmentation under varying conditions. A unique feature of northern Michigan is the interspersed nature of public and private lands. This area is dominated by forest and agricultural lands. The forest lands include intermixed public and private forest land use (development and harvesting), which includes the Manistee National Forest and various state forest lands.

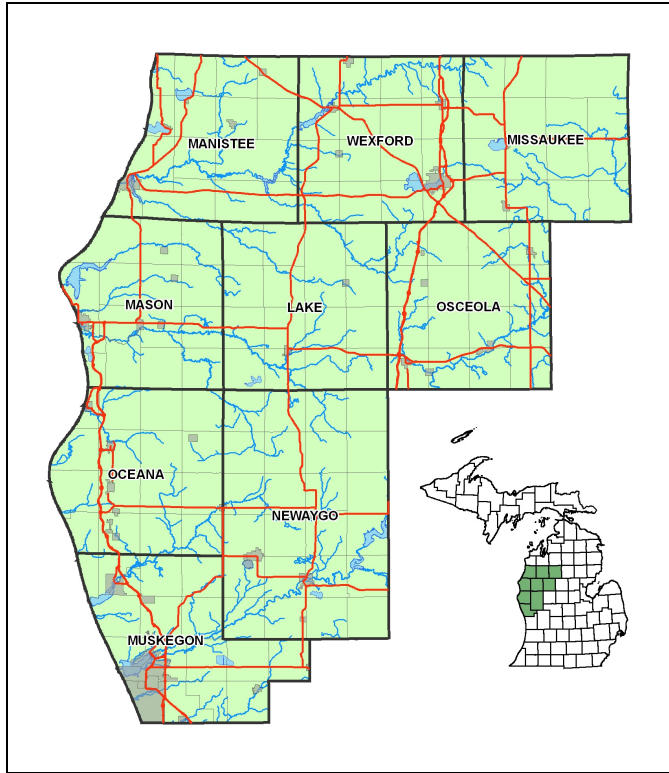


Figure 1. Nine-county study area in the western Lower Peninsula of Michigan.

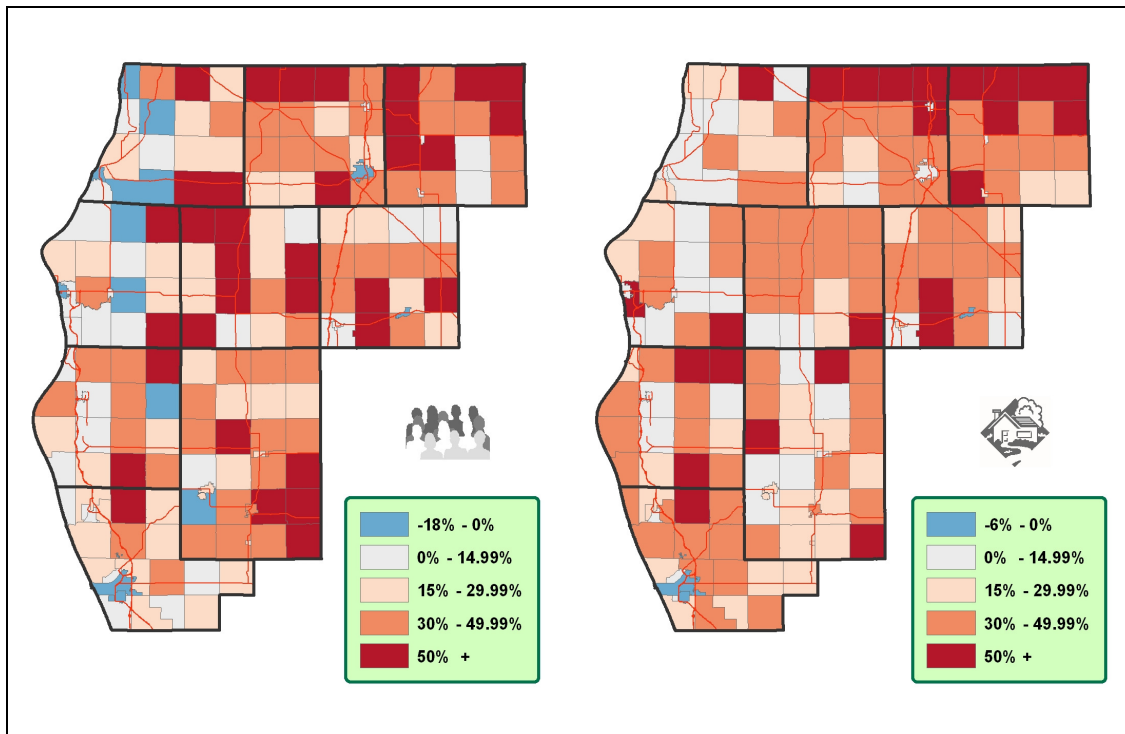


Figure 2. Percentage changes in population (left) and housing units (right) from 1980 to 2000 by minor civil division within the nine-county study area.

We contacted Michigan State University County Extension Directors (CEDs) in each of the nine counties to set a meeting date and recruit focus group participants. Generally, the participants were quite knowledgeable people with long experience in various planning and government roles (e.g., local planning commission members). Two researchers attended each meeting, with Dr. Georgia Peterson as the meeting facilitator. The CEDs were asked to give some introductory comments, but they were not allowed to participate in the focus groups. The researchers will conduct a focus group with CEDs to gain their perspectives on land-use change in a future meeting.

In preparation for the meetings, nine posters/maps were developed to provide a common factual setting for participants (similar to Figures 1 and 2). The large posters were displayed in the meeting room for easy viewing and reference. The maps covered

- Recent (circa 2001) land cover and land use,
- Locations of national and state forests,
- Housing units, median house value, and median household income (2000),
- Population (2000) and changes in population and housing (2000),
- Seasonal homes and changes in seasonal homes (2000),
- Percent of housing units classified as mobile homes (2000),
- Transportation and hydrography,
- Zoning and master planning data, and
- Names of cities, villages and minor civil divisions for all counties.

At the beginning of the focus group meetings, participants were told the purpose of the meeting: “To gain insights into factors driving land use and land cover change in your county. Part of statewide analysis by MSU’s Land policy Institute and the 9-county study area which includes your county.” Then, a synopsis of conditions in the county, based on the posters, was presented; a printed copy was distributed to each participant along with personal copies of the maps (8.5” x 11”). Questions regarding the project and the “facts” were answered, and participants reviewed and signed consent forms for the research project. Finally, the groups turned to a set of questions for a facilitated discussion.

The standard questions were:

- What land use changes have you noticed the most within \_\_\_\_\_ County in the past 20 years?
- What factors will influence land uses in the future? Within the county? In the region?
- How much influence will local decision makers have in these changes? Why?

The discussions were taped, and transcripts were prepared. We are currently conducting qualitative data analysis of the transcripts with Atlas.ti software ([www.atlasti.com](http://www.atlasti.com), Muhr 2004). The software allows us to locate, code, and interpret findings in the transcripts. Key words and concepts can be extracted and organized from the hours of transcribed meetings. Examples of text that will be analyzed are presented in the next section of this paper.

## Observations

Every meeting was different: different location, different participants, and different perspectives and ideas. After all of the transcripts are analyzed, we will share our findings with the CEDs to get their perspectives on land-use changes.

To highlight the types of topics covered in a local focus group, we summarize part of the discussion held in Newaygo County. In addition, we include several quotes to provide more depth to the summary points. Newaygo County is located just north of Grand Rapids; the combined statistical area population was 1.3 million people in 2000 (Figure 1). As a result, its size and economic activity affect Newaygo County. Some of the historic changes participants noted include:

- A shift from seasonal to full-time residences,
- Increasing population, especially in the southern part of the county,
- Population is aging and starting to sell their homes,
- Slow economic activity in Michigan is hurting the region,
- Expansion of subdivisions,
- Large parcel sizes have led to sales given high property taxes,
- Christmas tree farming has collapsed,
- Opening of the US 131 expressway
- Agriculture has declined, but ethanol plants may help, especially near route U.S. 131, and
- Re-zoning has helped agriculture survive in Barton Township.

The challenge of selling homes was expressed by one county resident who commented “Well this past fall, now I just moved up here two years ago this summer, but in Merrill Township I was amazed this past fall on how many for sale signs went up.” “You don’t see anybody taking them down, they are still for sale.”

Examples of factors influencing land uses in the future include:

- Road infrastructure from the south will influence future growth,
- Demand for orchard products leads to more migrant workers,
- River lots will attract buyers,
- Movement of people from the country back to the city (Grand Rapid),
- Decline of horse farms (perhaps the idyllic country lifestyle is not for everyone),
- Corporate farms are out-competing smaller local farms, and they are selling, and
- White River is a boundary to northward expansion due to limited access across the river.

The situation related to riverside properties was highlighted by one participant who said “...the riverfront property is still selling...we are talking hundred foot wide lots are selling for \$120,000...well then that \$120,000 piece of little lot that you are talking about takes to neighbor’s little place that he paid \$5,000 for back 20, 30 years and all of a sudden puts that into skyrocket tax bracket.” And when talking about agricultural shifts, one participant noted “...the mega cattle farms and turkeys and pigs and there are more and more coming into this area.”

The role or influence of local decision makers on these changes often leads to township-level (minor civil division) comments about local policies. In some counties, the level of planning and zoning is fairly meager, whereas more populous counties give it greater emphasis. In Newaygo County, there is a strong consensus that LPI's Citizen Planner program has "brought people together." Other comments include:

- A strong desire for residents to maintain the *status quo*, to keep their rural nature,
- Re-doing the township master plan,
- A desire by new residents for privacy by having large lots—this is contrary to planners' desires to concentrate housing, and
- More townships are working together on joint planning (a new tool in Michigan).

The desire for privacy was shared by one participant who said "...the people that are moving to Newaygo County, they don't seem to want to live in a subdivision. They don't want to look into their neighbor's window." And with respect to local planning, one person noted "...planning boards is probably one of the best things that's happened to our township. I think we have a better control of what is going on...we do have a few people that come up there from the city and sneak in and try to do things without permission...they get caught up with and you know, get things straightened around." And another person added "I would say the townships feel closer together and more cooperative for each other, because the county planning commission and other groups have kind of worked with the help of the Fremont Foundation to have a vision and to deal cooperatively in a lot more areas than when I started my involvement 13 years ago."

As analysis of the focus group transcripts proceeds, we will focus on similarities between counties regarding driving factors. To the extent that the factors can be quantified, we will do so for fragmentation and PMT modeling. Further, the qualitative results will be used to assess future land-use projections from PMT.

## **Discussion**

This project contributes to the expanding discussion of land use in Michigan. It provides information for our the next phase of a broad-scale analysis in Michigan examining drivers of land cover/use change—the PMT modeling effort and our examination of the relationship between drivers of change and landscape metrics. The primary goal of this future research is to determine which factors have contributed to land cover/use patterns across the state. Case studies provide good local information, and we will use the information to improve our broader modeling efforts.

Preliminary PMT modeling has led to a series of interrelated land demand equations (e.g., for residential, commercial, agricultural and industrial land) and equations for population, income and land values. Social, economic, and ecological drivers are included in the equations. Similarly, our fragmentation analyses are using drivers of change to estimate geographically weighted regression models for fragmentation metrics (e.g., number of patches, contagion, etc.). This current project provides a means to "ground truth" these models, and to identify other potential variables for the modeling work (e.g., percentage of housing units classified as mobile homes).

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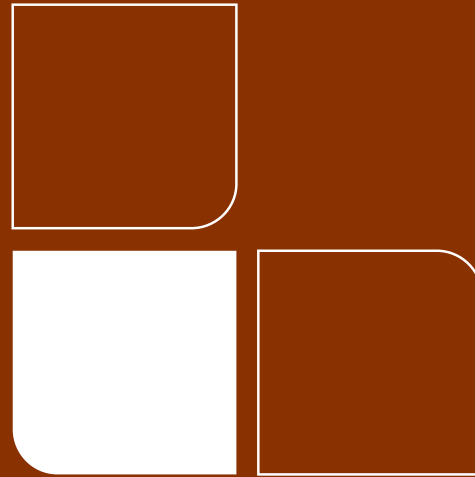




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