Changes in Land Use and Vegetative Cover Over Time in Detroit, MI

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Introduction

Detroit is comprised, in large part, of impervious surfaces from factories and residential land due to its industrial history, which leads to runoff and poor water quality. Increasing vegetative cover in the area can reduce the amount of runoff that reaches the water systems and food and jobs can be provided for an economically distressed community. This project aims to study the greening process in Detroit over time and analyze changes in NDVI (Normalized Difference Vegetation Index) as residents work towards a greener city by adding vegetation/farms/gardens. Changes that have taken place over the last two decades and the success of ongoing revitalization efforts will be determined by answering the questions "How has land use changed over time," "Where are urban farms/gardens located," and "How has NDVI changed from 2000 to 2014?"

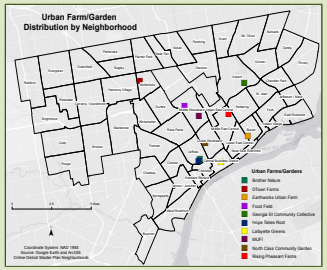

Figure 4. Map of 10 popular urban farms/gardens within the city of Detroit. Most of the sites are located centrally within Detroit, with DTown Farms reaching furthest into the North. The Northeast and the West Side weren't home to any of these gardens, but that does not mean that there aren't any located there. Aside from these farms/gardens, there are many other small scale operations scattered throughout Detroit.

Methods

"How has land use in Detroit changed over time?"

- Downloaded land cover data from USGS Earth Explorer for 1992, 2001, 2006, and 2011
- Created attribute tables (for land cover type) for each data set
- Raster clip used to get data for Detroit only
- Resulting attribute table gave data on change over time

"Where are urban farms/gardens located?"

- Addresses of 10 farms obtained via Google and pinpointed in Google Earth
- Places saved as .KML and converted to a layer in ArcGIS
- Neighborhood data added from ArcGIS online

"How has the NDVI changed between 2000 and 2014?"

- Landsat 7 data for 2000 (July) and Landsat 8 for 2014 (May) obtained from USGS Earth Explorer
- Raster calculator used to convert Landsat 8 data from 16-bit to 8-bit
-Image analysis tool used to create an NDVI for each year

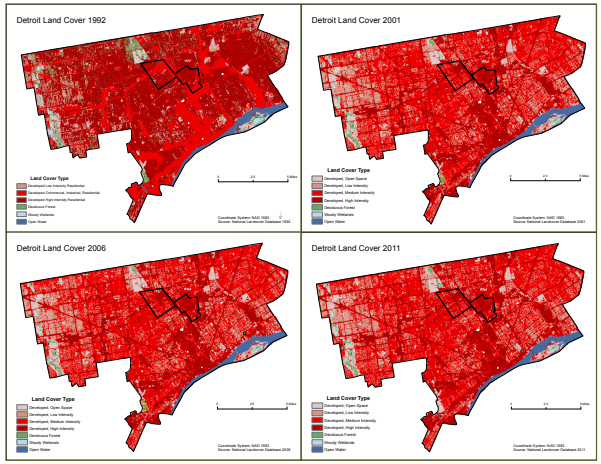

Figure 1. Land use changes in Detroit over time (including Hamtramck and Highland Park)

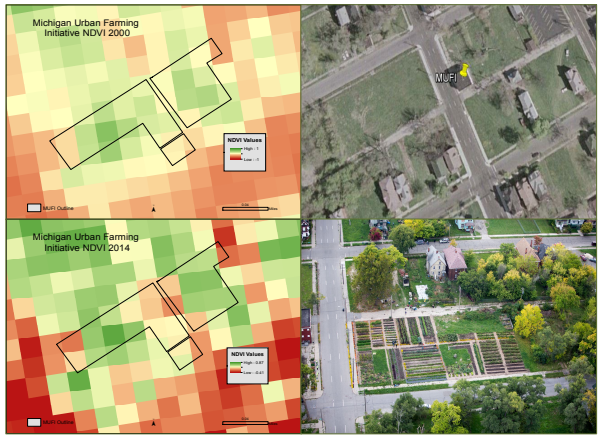

Figure 3. To determine density of green on a patch of land, distinct wavelengths of visible and near infrared sunlight reflected by plants must be observed (NDVI). The images on the left show the difference in NDVI over time for MUFI and the images on the right show MUFI in 2002 (top) and in 2014 (bottom).

Results

Land cover between 1992 and 2011 (Figures 2 and 3) showed visually and numerically that Detroit increased in impervious surfaces rather than vegetation. Deciduous forest cover decreased dramatically, but developed medium intensity (introduced in 2001) and developed low intensity became the dominant land covers from 2001 onward. In 1992 the dominant land covers were developed high intensity and commercial/industrial/residential (not represented in Figure 2). Between 2006 and 2011 there was actually an increase in developed high intensity and medium intensity, with a decrease in developed low intensity.

To determine whether there were any increases in vegetative cover, the NDVI of specific farms (Michigan Urban Farming Initiative (MUFI), Lafayette Greens, Georgia Street Community Collective, and North Cass Community Collective) were studied (Figure 3 and Table 1). An NDVI is the combination of visible and near infrared wavelengths to observe the density of green vegetation. The results showed that in all four cases there was an increase in NDVI (meaning an increase in vegetative cover) from 2000 to 2014. MUFI was the largest farm studied and was the best representation of an NDVI change over time.

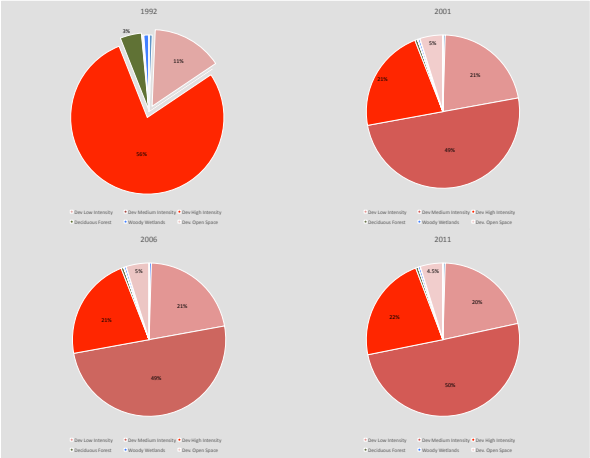

Figure 2. Numerical representation of Figure 1, highlighting the main land use types

In order to determine if this greening is spread out or condensed in a specific area, the aforementioned farms (and 6 others) were plotted within the boundaries of Detroit neighborhoods (Figure 4). The display showed that most of the farms/gardens are located centrally and in the southern parts of Detroit. The Northeast and West were not represented among the ten farms/gardens mapped.

Figure 5. Similar to the pictures in Figure 3, these images show the comparison of the location of Lafayette Greens in 2007 and 2014. A short seven years ago, Lafayette Greens was a tall building and completely impervious. Today, it is a beautiful downtown garden for residents to walk through and enjoy.

Conclusion

Land cover data shows that Detroit has seen a reduction in deciduous forest cover over time and an increase in developed low and medium intensity land. Upon exploration of the NDVI of known farms/gardens, however, there is a distinct greening that has taken place in the last fourteen years. This greening has been in the central portion of the city based on the ten gardens/farms used, but that is not necessarily the complete picture. In 2013 it was estimated that there are at least 1,400 community, school, and home gardens in Detroit (Ignaczak, 2013), spreading throughout the city.

The number of community gardens already present in Detroit, combined with the growing interest in neighborhood gardening, suggests that Detroit will continue to move out of the slump left by abandonment of the city and industry. There is still a ton of room for improvement (and ~40,000 vacant lots begging to be turned in to gardens) and Detroit has the potential to become a city known for its earth-friendly environment, not for its poverty and crime.

NDVI Change

Farms	Average Change
MUFI	.41
Lafayette Greens	.49
North Cass Community Garden	.40
Georgia St. Community Collective	.67

Table 1. Average changes in NDVI at four of the Detroit gardens/farms studied. Aside from MUFI, most gardens were too small for a proper analysis

References

- Helme-Day, Jody. "Lafayette Greens Urban Garden is Blooming in Downtown Detroit." Examiner.com August 29, 2011 (Lafayette Photo)
- Historic Photos: Google Earth
- Ignaczak, Nina. "No Stranger to Urban Agriculture, Detroit Makes it Official with New Zoning Ordinance." Seedstock. Reintegrating Agriculture. 9/4/13
- Maclean, Alex. "Detroit by Air." The New York Times. Sunday Review (MUFI photo)
- "Normalized Difference Vegetation Index (NDVI.)" NASA Earth Observatory