Land Suitable for Alternative Biofuel Farming Based on Temperature and Soil Quality

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Abstract

This study was done to find land suitable for growing biofuels as an alternative to having fields sit. Switchgrass was the biofuel chosen for this study due to its versatile and robust nature. By growing switchgrass, farmers allow the field to gain back the nutrients that are needed for growing cash crops, use previously un-farmable land and bring in a income while rotating crops. Looking at the final map it can be seen that suitable areas reside in the Lower Peninsula and in the southern regions of the peninsula.

Introduction

Popular biofuels used are corn, switchgrass, Pine trees and Poplar trees. Pine and poplar would be better in a situation where an area was trying to be reforested. The switch grass and the corn, however serves the purpose of recycling farmland quite well. (Davis, 2008).

Switch grass is also a grass farmers tend to turn to in order lower soil erosion due to runoff and wind, lending this crop to fitting the bill of the major problems looking to be solved by this study. (Robertson, 2011).

Switch grass is a hardy plant as it survives most harsh weathers better and can be grown in all soil types and on slopes large and small. This grass will grow in poorly drained areas which Michigan is prone to with the surrounding of its lakes.

Michigan consists of 38 different watersheds. Not all are the same but most contain all the same elements, just in different quantities.

When it comes to soil types switchgrass is versatile as it can grow in all the types of including the extremes which I use in my study. (Fletcher, 2011).

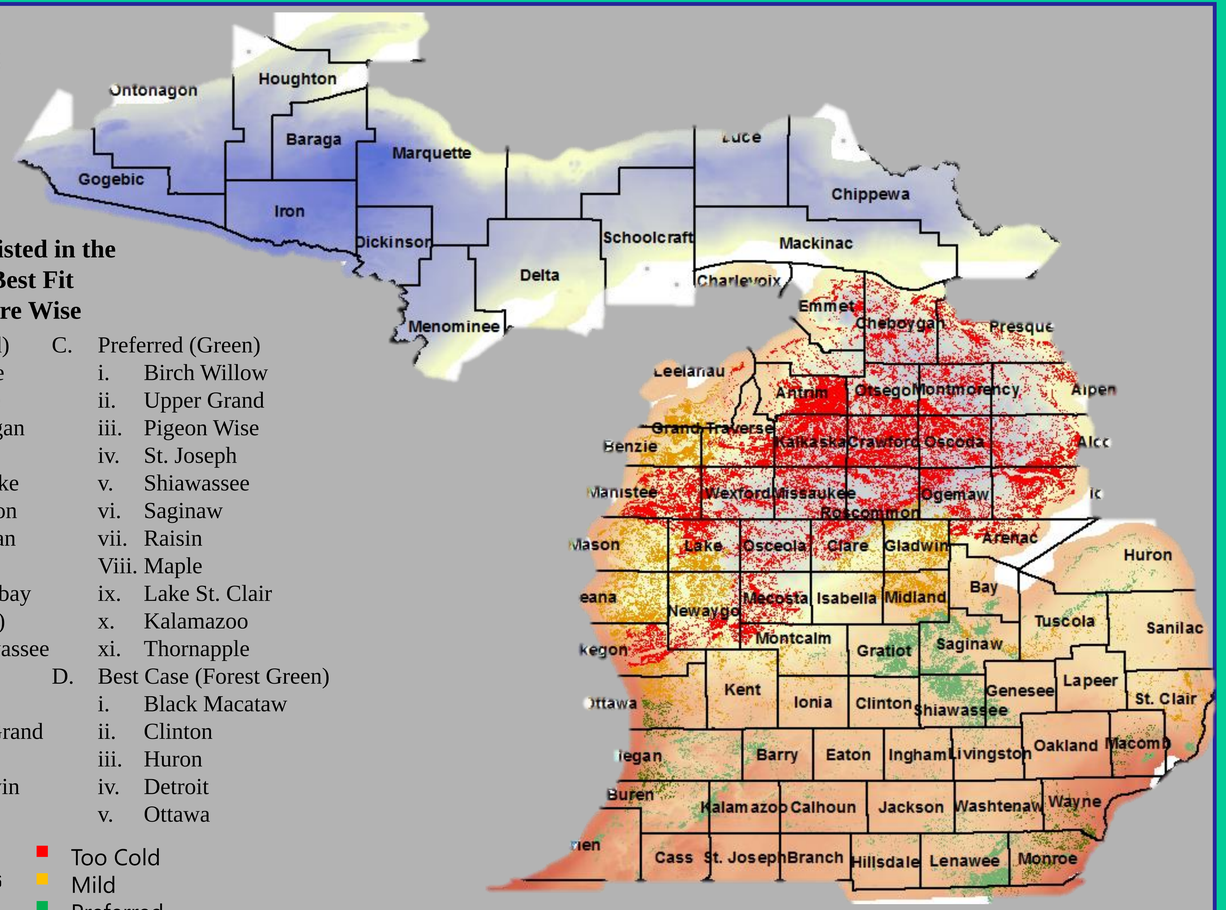
Some would suggest using corn instead but the point of the biofuel is to not pull from cash crops and sustenance's farming. Plus corn is one of the plants that is guilty of heavy nutrient stripping of the area. This is the opposite of what switch grass does.

Methods

The layers used were Farm Land Capabilities, Drainage Class, Non-Irrigated Capability, and Soil Type. All but land use were layers pulled from the SSURGO Soil Data derived from the United States Soil Survey.

I went to the SSURGO and began downloading each watershed in Michigan. After doing that I opened each Map Pack and created layers from the watershed boundary line and unit information. I then created a geodatabase to store it all in and created a map. From each unit I started by searching out farmland usage. Using select by attribute I found the categories I needed which were "Prime if Drained" and "Not Prime". From that layer I used select by attribute again and pulled the points that fell into the Non-Irrigated categories of 3,4,6 and 8. These categories describe rainfall and overall drainage of the point, 3 being the lowest amount of rainfall and greatest amount of drainage and 8 being highest rainfall and lowest drainage. Once that was done I then pulled out points that met the criteria of "Excessively drained", "Poorly drained", "Somewhat excessively drained" and "Somewhat poorly drained" with select by attributes. After all this was done for all 38 watersheds I added the Average Annual Minimum Temperature in Michigan layer from Arc GIS online. From that I derived what watersheds fell into temperatures to cold to grow grass and labeled the according to Too Cold to Base Case scenario.

Results



Watersheds Listed in the Order of Best Fit Temperature Wise

A. Too Cold (Red)
- i. Manistee
- ii. AuSable
- iii. Cheboygan
- iv. Black
- v. Lone Lake
- vi. Muskegon
- vii. Boardman
- viii. AuGres
- ix. Thunderbay

B. Mild (Yellow)
- i. Tittabawassee
- ii. Bestie
- iii. Pere
- iv. Lower Grand
- v. Cass
- vi. Kawkawin
- vii. St. Clair

C. Preferred (Green)
- i. Birch Willow
- ii. Upper Grand
- iii. Pigeon Wise
- iv. St. Joseph
- v. Shiawassee
- vi. Saginaw
- vii. Raisin
- Viii. Maple
- ix. Lake St. Clair
- x. Kalamazoo
- xi. Thornapple

D. Best Case (Forest Green)
- i. Black Macataw
- ii. Clinton
- iii. Huron
- iv. Detroit
- v. Ottawa

Legend

High : 43.376

Low : 26.636

- Too Cold
- Mild
- Preferred
- Best Case

Discussion and Conclusion

In this map I have displayed the Annual Minimum Temperatures in Michigan from 1991-2010. These temperatures range from 26 degrees to 43.4 degrees Fahrenheit. Baring these temperatures The Upper Peninsula met the requirements for all the other categories but temperature.

The Lower Peninsula however as can be seen is a different story. The northern area of the L.P. is in the same situation as the U.P. the annual winter temperatures and just yearly lows in general are too low to sustain a healthy switch grass population. These areas are displayed in red as they are able to carry switch grass in the summer they are not the ideal watersheds.

However the costal area strangely enough has temperatures that are more suitable to growing the crop. This would be because in the summer months the cost receives warm air and rain showers leading to rich and moist soils. But even with that being the case the cost still gets too cold for switch grass and doesn't contain prime farmland area due to drifting sands.

The key is to look inward where soils are away from flooding, harsh coastal winter and summer winds. The prime areas are in the interior and actually the farthest from incoming wind but still benefitting from one of Michigan's best resources: Lake Erie

Sources

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