Targeting Continuous Cropping
GIS Approaches to Identifying Lack of Crop Rotation by Soil Productivity

Introduction

Conservation of soil resources in agriculture is key to sustained production on any parcel of land. A well-established practice, which contributes to these aims, is crop rotation. Despite this, in 2012, the ARMS estimated 54 million acres of cropland in the U.S. are being continuously cropped (meaning there is a lack of crop rotation). The primary aim of this project is to identify fields in Ransom County, North Dakota that have been lacking in rotation cropping practices. Evidence of the positive effects of crop rotations have been well documented, from increasing yields to retaining soil moisture and nutrients. Therefore, it would be in the interest of agricultural producers and society at large to encourage the practice of crop rotation to sustain the highest possible productivity and resilience of our agricultural production lands.

County extension agents are well situated to provide incentives or intervention and the type of intervention that would be best suited to offer targeted incentives to non rotating producers if they could reliably identify fields that are being continuously cropped. The second aim of this project is to identify the inherent agricultural productivity of fields which are lacking crop rotation. In doing so, areas lacking rotation may be viewed as high or low productivity land. Understanding land productivity would improve extension agents value assessment of an intervention and the type of interventions that would be best suited.

Methodology

English et al.’s poster regarding cropping systems in Mississippi overlapped Cropland Data Layers (CDLs) from CropScape to determine areas of the Mississippi river basin (located within MS) that had been planted into specific cropping patterns such as soybeans following corn year over year. I will use a similar procedure to the one outlined by Stern et al. in their 2017 paper “Changes of Crop Rotation in Iowa.” In this paper they approached lack of crop rotation as a function of commodity price, namely corn. As one may suspect, there does appear to be a correlation between these two variables. They also noted NASS acres during the time of high corn prices and found that land was taken out of conservation when the commodity price was sufficient to offset the rental price of these programs and assist with the original purpose of providing crop insurance or commodity payments. A county extension agent could assist a producer by connecting them with these programs and assisting them with any questions they have.

Prior Work


Limitations of the CDL data set include clear areas of omission. This can be identified in fields of the pop-up map that are majority corn, but have pixels missing from them. It is very likely these blocks of land have been planted in 5 years of continuous corn like the pixels surrounding them. Fields with over 50% of the pixels missing would be identified as areas needing further investigation. Errors of omission can be seen where an individual pixel or a small cluster of pixels is present within a omission of a field, but the majority of this field has no pixels on it. It is very unlikely that such a small portion of a field would have been planted into soya or corn given that this five years would be the rest of the field was receiving some amount of rotation. Simply looking at map of Ransom County allows one could easily identify fields that are not being rotated, especially with the use of an aerial map as the base layer. Maps generated from this model could still be a useful piece of information in determining where investigations may be needed. Blocks of fields that are lacking in crop rotation could be identified as areas that need the most immediate attention and that warrant further investigation. Additional work on this map could be done to improve errors of omission and fill in areas of omission. In doing so, we could get a more accurate area measurement for the area of land that is not being rotated (such information is given in the chart). Overall errors for corn and soybean CDLs are notable, but still provide valuable information.

Next, the National Commodity Crop Productivity Index (NCCPI) was joined in the Gridded Soil Survey Geographic System (GSSG-TR6). An individual NCCPI for each of the crop soils was assigned to each representative 30x30 meter pixel. Index scores are based on soil taxonomy and includes variables, in a weighted manner, such as climate, slope, average precipitation, etc. from data available through the National Soil Information System. The result of which is a geographical data set for inherent productivity of any area to produce commodity crops (corn, soybeans, cotton, and wheat).

Discussion

5 Years Continuous Corn

Across by Category Ransom County, North Dakota

<table>
<thead>
<tr>
<th>Category</th>
<th>High Productivity</th>
<th>Low Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Years Continuous Corn</td>
<td>119</td>
<td>203</td>
</tr>
<tr>
<td>2. Years Continuous Soybeans</td>
<td>242</td>
<td>106</td>
</tr>
</tbody>
</table>

The soil productivity index may be useful in this context to give an overall view of high or lower quality soil. However, the practical significance of this data set in Ransom County may be called into question. A mix of fair and good quality land can be seen within many fields in Ransom County, essentially, the cut off for high and low productivity stands these values. Further research should attempt and improve the reclassification system for the NCCPI. In general, the majority of soils for Ransom County are in the mid range of the NCCPI index compared to all North Dakota soils. This index would provide more insight in areas on extreme ends of the spectrum. Fields with low productivity where producers are not rotating, such as in the eastern part of Ransom County, could use interventions such as the Conservation Reserve Program (CRP) or Conservation Stewardship Program (CSP). Fields with higher productivity soil, where producers are not rotating, could use interventions such as education on the benefits of crop rotation and potential incentives such as crop insurance or commodity payments. A county extension agent could assist a producer by connecting them with these programs and assisting them with any questions they have.

Sources

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NUTR 0231 Fundamentals of GIS, December 20th, 2017

Andrew Greenwell: "5 Years Continuous Corn"...