MISSISSIPPI DELTA COTTON, THE CROPLAND DATA LAYER, AND SOIL MAPS, 2006-2009

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Abstract

We studied cotton rotation and cropping intensity using three Cropland Data Layers (CDL) within two specific soils from the NRCS General Soil Map. The soil near the Tallahatchie and Sunflower Rivers and soil near Deer Creek of the Mississippi Delta are particularly well suited for cotton production. For the period 2006-2008, about 50 percent (50.8 and 49.2, respectively) of the land area of these soils has been used to grow cotton. But these soils exhibited a major difference in continuous cotton use of 10.6% vs. 2.7%, with the soil along the Tallahatchie and Sunflower Rivers maintaining higher rates of continuous cotton. A map of the cotton cropping intensity over the soil areas shows the result visually. The percent land use for the other two major crops grown in these soils, soybeans and corn, was also calculated. Crop rotations from the CDL show the change in land use from cotton in 2006. More acreage near the Tallahatchie and Sunflower Rivers continues to be used for cotton while acreage near Deer Creek has seen a more rapid change to other crops. GIS and multiple years of the CDL data provide maps and crop statistics for the study of cropping practices over time.

Introduction

Recently there has been a dramatic drop in cotton plantings in Mississippi corresponding to changes in the market place. These changes are revealed from an examination of USDA-NASS Quick Stats and the Cropland Data Layer (CDL) with a suggestion that the very best areas for cotton production are most likely to continue to be used for growing cotton (Gregory and Shore, 2009). The CDL with the USDA-NRCS General Soil Map allows us to compare crop plantings within specific soils using pixel changes to demonstrate cropping intensity and rotations. The purpose of this study is to quantify cotton planting patterns over time on two soils historically important for growing cotton.

The CDL was developed by NASS to document crop range and extent using classification of satellite imagery based on ground truth. In 2009, the CDL was produced for 47 states. Multiyear CDLs are available for many states. NASS has effectively used the CDL since the 1980's as an independent indicator for acreage estimate of crops (Allen and Hanuschak, 1988; Ozga and Craig 1995; Muller and Ozga, 2002) with results for the Mississippi CDL program in good agreement with the final NASS county estimates (Shore, Gregory, and Mueller, 2005, 2006). Multiyear comparisons of CDLs gives specific information on land use (Shore, Gregory, and Mueller, 2007a and b; Shore and Gregory, 2008).

Satellite images, obtained at important dates through the dormant and growing season of most crops (Allen, 1990; Shore, Gregory, and Mueller, 2005), were classified providing the range and extent of crops (Shore, Gregory, and Mueller, 2006). The CDLs used in this study were prepared using the See5® decision tree software. The current CDL includes the National Land Cover Database (NLCD) categories and replaces the NLCD cultivated crop category with specific crop categories.

Individual years of the CDL were summed by pixel to give multiyear data for either cropping intensity for a single crop or crop rotation patterns following the method of Boryan, Willis and Craig, 2008. The resulting GIS layers were used to obtain pixel based statistics for the full state and for selected soil polygons from the General Soil Map.

Materials and Methods

The Mississippi CDLs were prepared using satellite imagery (Landsat resampled to 56 meter and IRS Resourcesat-AWiFS), processed imagery (16-day composite MODIS NDVI), and ancillary layers (NLCD canopy, elevation, and impervious) using the See5 decision-tree classifier and ERDAS Imagine® by the NASS See5 Method (an adaptation of the NLCD method described at www.mrlc.gov (Homer, et. al., 2007). Training data for the non-crop training

areas from the NLCD were combined with crop categories from USDA-Farm Service Agency data replacing the NLCD cultivated crop category. The published Mississippi CDL products are available from http://www.mdac.state.ms.us/n_library/programs/gis/index_gis.html, http://datagateway.nrcs.usda.gov/, and http://www.nass.usda.gov/research/Cropland/SARS1a.htm.

Imagine was used to sum CDL crop results to give crop intensity or rotation patterns to allow compilation of multiyear CDL data following the method of Boryan, Willis and Craig, 2008. This method provides a pixel-by-pixel image and summary statistics from the CDLs.

Soil polygons were obtained from the NRCS General Soil Map and designated using their feature identification (FID) numbers (http://soildatamart.nrcs.usda.gov/USDGSM.aspx#DownloadedData, accessed February 11, 2009). Areas of interest were prepared from the soil polygons and used to subset the cropping intensity and crop rotation GIS layers with Imagine. The summary statistics for each of the subset layers were then obtained using Imagine.

Results and Discussion

Two soils from the NRCS General Soil Map were selected for study (Figure 1). These soils are bottomlands from ancient rivers, perhaps early courses of the Mississippi River. Figure 2 shows the location of these soils and the CDL results for 2006-2008. These two soils are historically important cotton planting areas with approximately 50 percent of the surface area of both soils used at least one year for cotton (Table 1) during the years of this study. Continuous cotton planting is more common for soil 1166 than soil 270 (10.6 vs. 2.7 percent during the three years). Cropping intensity for cotton, corn, and soybeans is shown in Figure 3. Note that no corn was grown on 70.3 percent of the surface area of soil 1166 for this 3 year period. This reflects more continuous plantings of cotton with soil 1166 vs. soil 270.

Figure 4 shows statistics of rotation from cotton in 2006 to 2008 for the state and each of the two selected soil areas. Note that there is a distinct difference in rotations with continuous cotton most important in soil 1166, as shown previously with the soil cropping intensity. These statistics also show that the most important rotation for the historic cotton land in soil 270 was to corn and other (primarily soybeans). In addition, the rotations for the Delta and the two specific soils are shown in Figure 4. The CDL from 2009 shows a similar pattern with only 1.4 percent of the surface area of soil 270 planted to cotton vs. 11.6 percent for soil 1166.

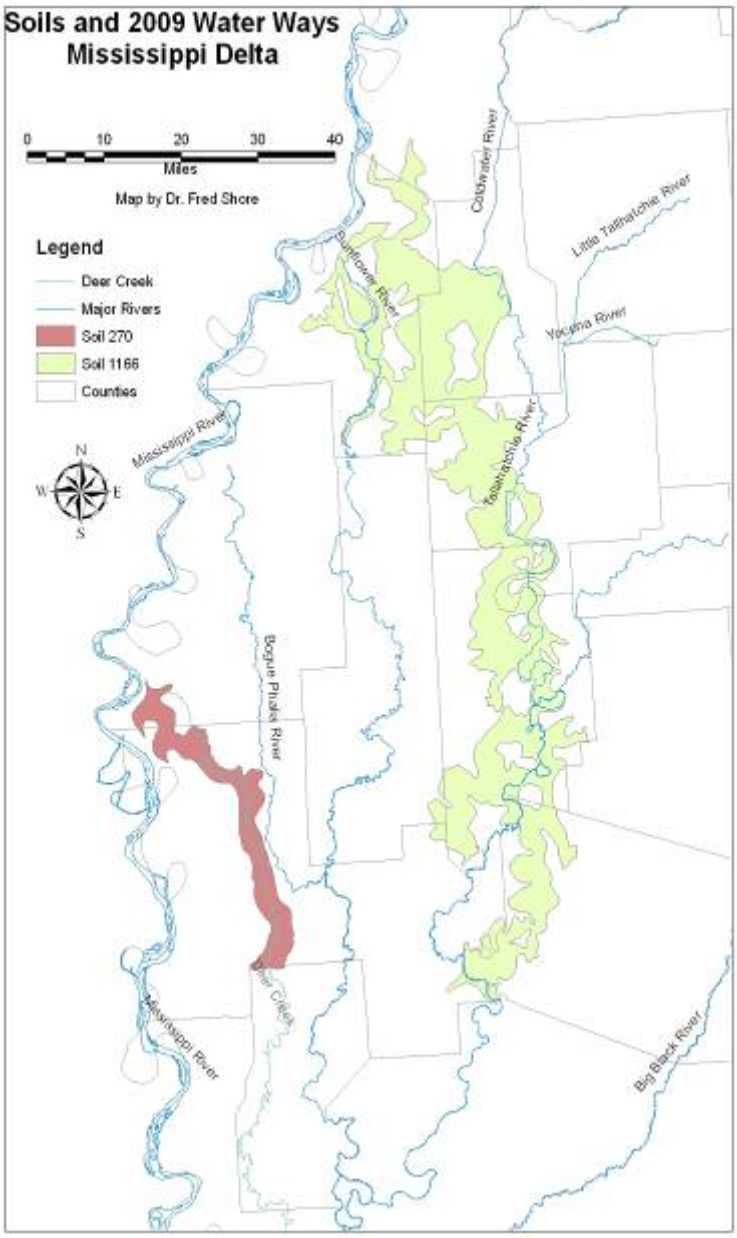

Figure 1. Two historically important soils for cotton from the NRCS General Soil Map.

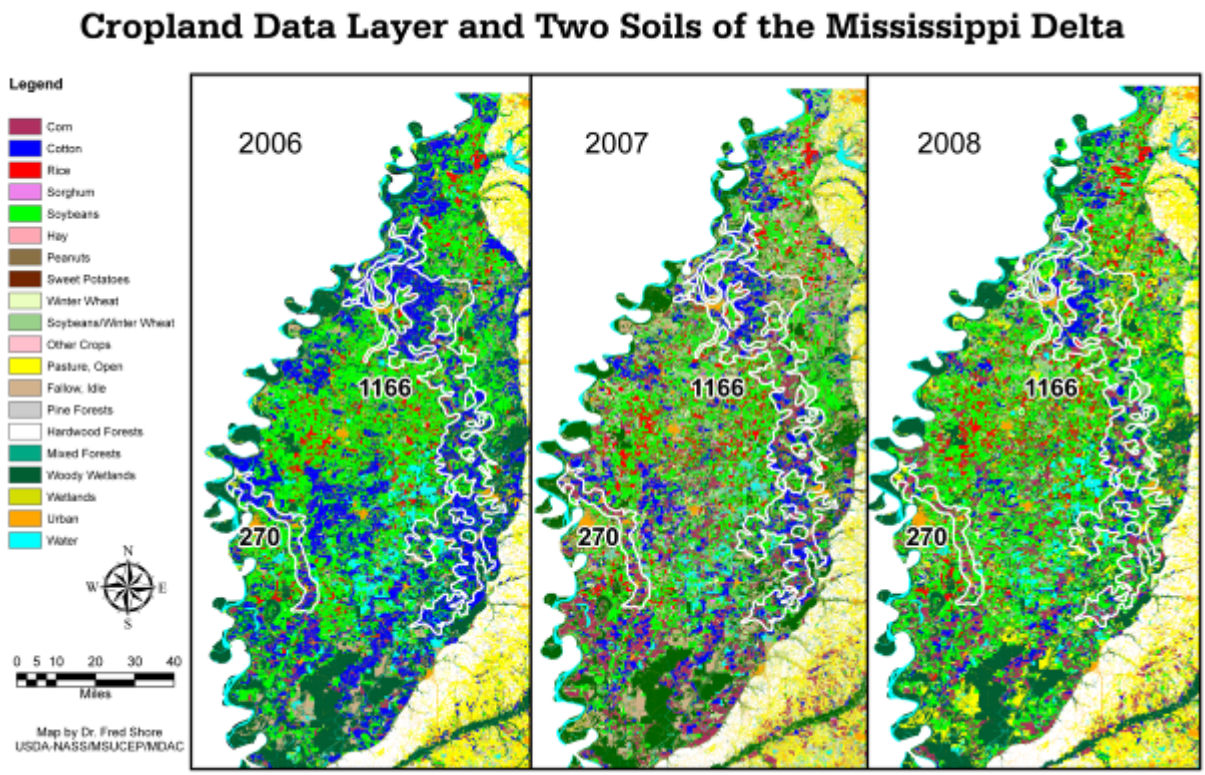

Figure 2. The CDLs of the Mississippi Delta with two soils indicated, 2006-2008.

Table 1. Cotton planted by soil and frequency, 2006-2008.

Years of Use	Soil 1166		Soil 270	
	Acres	Percent	Acres	Percent
0	287,982	49.2	41,538	50.8
1	131,137	22.4	28,110	34.4
2	103,823	17.7	9,890	12.1
3	62,330	10.6	2,170	2.7
Total	585,271	100.0	81,708	100.0

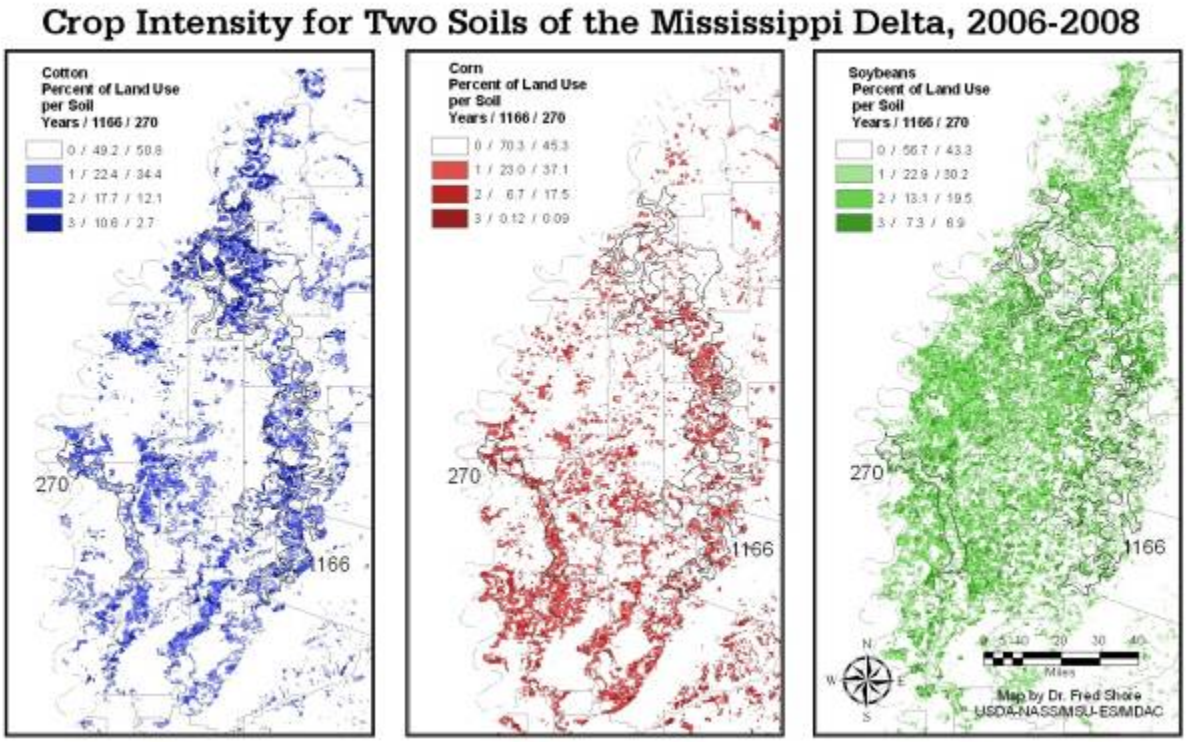

Figure 3. Crop intensities from the CDL for cotton, corn, and soybeans, 2006-2008.

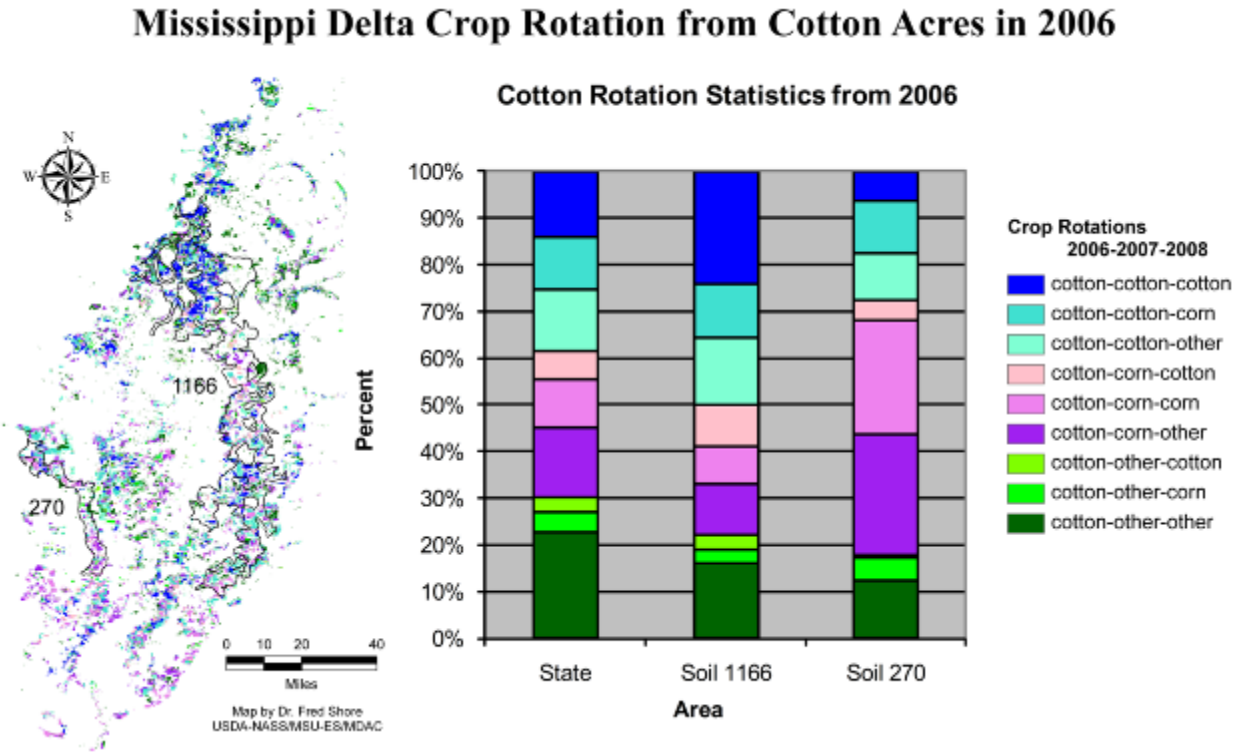

Figure 4. Crop rotations and soil statistics from areas planted to cotton in 2006.

Conclusions

Coupling the CDL cropping intensity and rotation with the NRCS General Soil Map gives statistics of crop use for specific soils.

Two soils traditionally planted to cotton are along the Tallahatchie and Sunflower Rivers (1166) and along Deer Creek (270). For these areas in 2006-2008:

- The percent land use for cotton at least one year is 50.8 and 49.2, respectively.
- The percent of continuous cotton use varies widely for the two soils: soil 1166 at 10.6 percent and soil 270 at 2.7 percent.
- In 2009, only 1.4% of the surface area of soil 270 was planted to cotton vs. 11.6 percent for soil 1166.

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