Estimation of Pecan Orchard Area in the Mesilla Valley, from 2008 to 2018, using Remote Sensing Classification Techniques

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Overview

Pecan cultivation in the Mesilla Valley of New Mexico has huge economic and cultural importance yet requires large quantities of water for irrigation (Sammis et al., 2013). Since the Mesilla Valley **(Figure 1.)** is a water-scarce region, methods for calculating and monitoring water usage in the area are crucial. Remote sensing presents novel, inexpensive, and easily accessible resources for classification of crop and land cover, and techniques utilizing such resources have been shown to provide accurate and useful results (Carfagna & Gallego, 2005). The main objectives for this project were to:

- Compare remote sensing approaches for classifying agricultural land cover in the Mesilla Valley
- Estimate and analyze crop area trends and changes from 2008 to 2018 for the study site **(Figure 1.)**

Methods

We used ArcGIS to test **three remote sensing approaches** for classifying crop cover:

- **Normalized Difference Vegetation Index (NDVI)**
  - Used Landsat Imagery
  - $NDVI = \frac{Near\ Infrared - Red}{Near\ Infrared + Red}$
- **Maximum Likelihood Classification (MLC)**
  - Used Landsat Imagery
  - "Supervised classification" technique; training data drawn from aerial images (NAIP & Google Earth)
- **Cropland Data Layer (CDL)**
  - Publicly available crop-classified layer

We estimated area for all approaches using a **direct pixel count approach.**

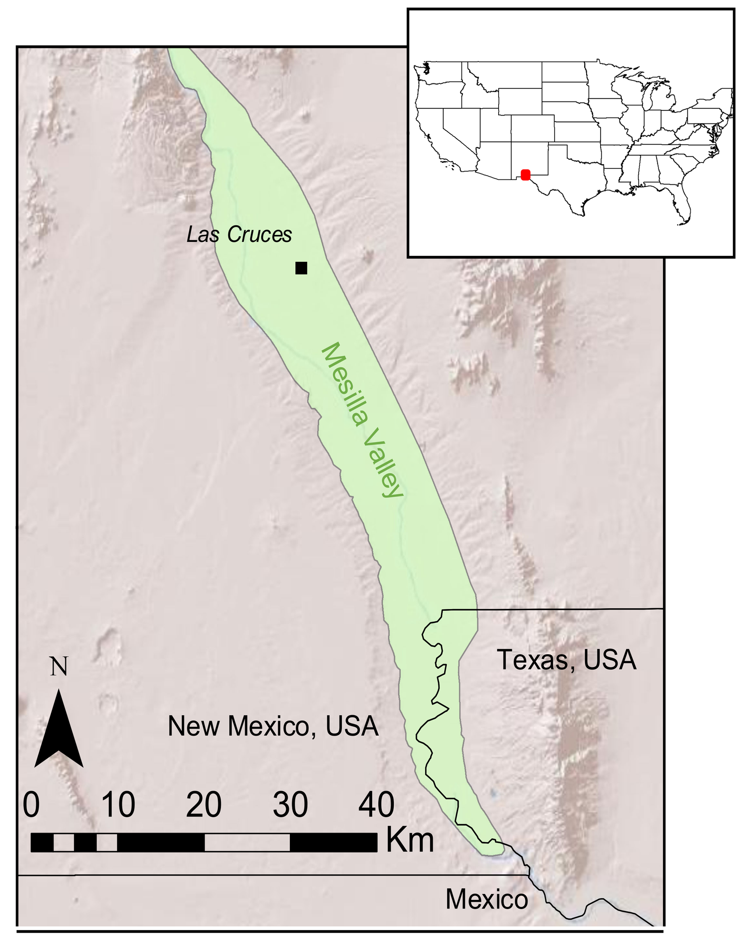

Figure 1. Study Site: The Mesilla Valley. Terrain base map from esri.com; state and country boundaries provided by U.S. Census Bureau.

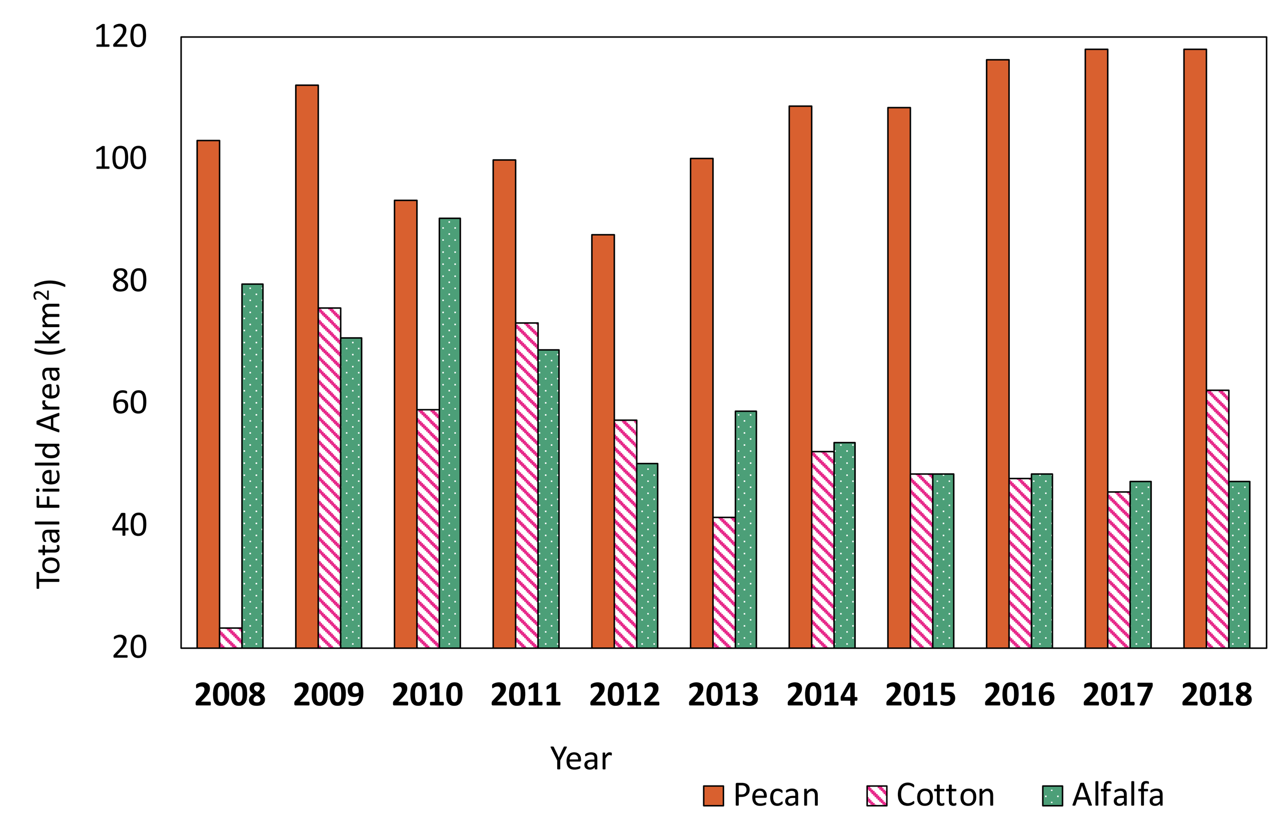

Figure 3. Crop area trends in the Mesilla Valley from 2008 to 2018. Field area is calculated using a direct pixel count approach with cropland data layer (CDL) classified maps. The CDL data is from USDA/NASS.

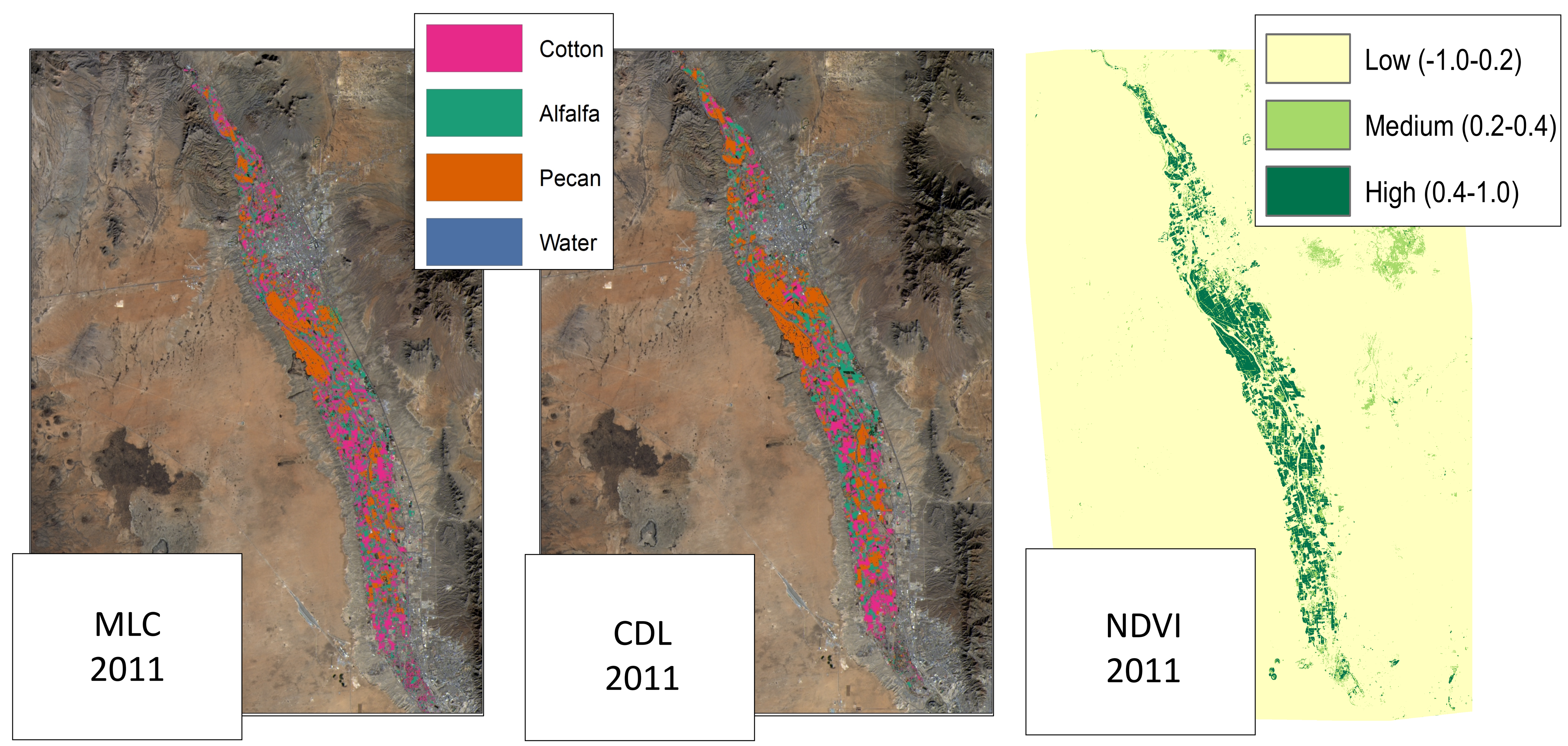

Figure 2. Example comparison of three classified maps for 2011. Landsat imagery composes the background of the MLC and CDL maps. Classified maps were constructed for years 2008 to 2018 for the CDL approach, 2011 and 2014 for the MLC approach, and 2005 to 2018 for the NDVI approach.

Approach Comparison

(Figure 2.)

- **NDVI:**
  - Provides valuable metric for "greenness" => possible proxy for water usage
  - Easily calculable
  - Doesn't classify for crop type
- **MLC:**
  - Process can be targeted towards specific local requirements
  - Time consuming
  - Confidence not as strong as CDL
- **CDL:**
  - Easily accessible
  - High accuracy
  - Constructed without strong consideration of local concerns

Crop Area Trends

(Figure 3.)

- Significant pecan area growth; loss of other crops
- Maximum pecan area at 2017
- Maximum growth from 2012 to 2014
- CDL trends are comparable to historical trends (Sammis et al., 2013) and agricultural census data from the USDA.

- **Is the region moving towards a pecan monoculture?**
- **What does increased pecan area mean for water usage?**
- **How can further research best utilize these methods to estimate water usage from remotely sensed measurements?**

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Key References

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