Spatially representing socio-cognitive and biophysical aspects of vulnerability to climate change: A study of Midwestern farmers

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Introduction

Upper Midwestern United States produces 70 percent of all U.S. corn and soybean:
• More than one-third of the global corn supply
• In 2015, an approximate value of $68 billion of corn and soybean was farmed in this region

Climate change will increase heavy precipitation events, causing:
• Reduced crop productivity
• On-farm soil erosion and runoff
• Off-farm leaching of chemicals into streams and lakes

Given these projected trends, this research aims to explain:
• How biophysical and socio-cognitive elements can influence farmers’ vulnerability to changes in the climate?
• How farm-level vulnerability can be aggregated to the county level? (useful for policy and planning purpose)

Materials and methods

Data:
• Survey: Stratified random sample mail survey of 4778 corn-soybean farmers from 11 Midwestern states.
• Soil: Soil Survey Geographic (SSURGO) database
• Climate Data: National Weather Service (NWS) Cooperative Observer (COOP)

From farm to county-level measures of vulnerability:
Problem:
• Geospatial coordinates not available (privacy reasons)
• Problem: Unequal sample size in county

Solution:
• Compute the county-level simple random sample variance
• Average, first quantile, and third quantile of vulnerability scores are calculated for each county, respectively
• Spatial smoothing using Conditional Autoregressive Modelling (CAR)

Results

Spatially Smoothed (a) Exposure, (b) Sensitivity, (c) Adaptive Capacity, and (d) Vulnerability

• Regional variations in landscape, with higher potential for soil erosion in some parts of the region.
• Fewer socio-cognitive differences between farmers within and between each county.

Conclusions

• Constructing reliable estimates of vulnerabilities for small areas can allow policy makers and planners to spatially locate areas with low/high climate change vulnerabilities.

• Socio-cognitive elements are consequential for adaptation, especially if farmers systematically under- or overestimate their own ability to adapt.

• Perceived climate risks should be understood in conjunction with objective risks.

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Literature cited