NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Modeling the dynamics of tillage choices

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Motivation

- Conservation tillage provides multiple environmental benefits, but only when used *continuously* over a number of years
- The *year-to-year dynamics of tillage (tillage rotations)* are largely unknown
- Panel tillage data are rarely available
  - » Only few field-scale, panel data sets
  - » The data most commonly used in large-region modeling of tillage come from CTIC
    - County-total acreage by crop and tillage category
    - Collected annually 1989-98, biannually 1998-04, selected counties 2005-08
    - Was never designed to track the same fields over time

Project goals

1) Develop methods for estimating tillage rotations with incomplete data
2) Estimate the costs of continuous conservation tillage (CCT)
3) Use the methods to evaluate the costs of CCT-based carbon offsets

Team

- Luba Kurkalova, NCA&T
- Tara Wade, NCA&T & ERS → University of Florida
- Silvia Secchi, Southern Illinois University Carbondale → University of Iowa
- Roger Claassen, ERS
- Dat Tran, NCA&T, Ph.D. student → Post-doc

Approach & progress to date

Markov chain models

1) Proof of concept, Iowa NT – Kurkalova & Tran (2017, JSWC)
2) CCT and ACT vary with (a) crop rotations and (b) soil erodibility in Iowa – Tran & Kurkalova (under review)
3) CCT and ACT in Iowa, 1992-2008, entropy methods – Tran & Kurkalova (drafted)

Done

ARMS data

1) Wade & Claassen (2017, JAAE)
   - National, 2010 corn & 2012 soybean ARMS surveys; NT, 4 yrs
   - The effect of HEL on CNT differs from that on ANT
2) Wade et al. (in progress)

50% done

Simulation modeling on GIS-based data

1) Secchi et al. (in progress) and
2) Tran et al. (in progress)
   - yearly costs of six-year CNT are ~ 3 times higher than those of one-year NT

30% done

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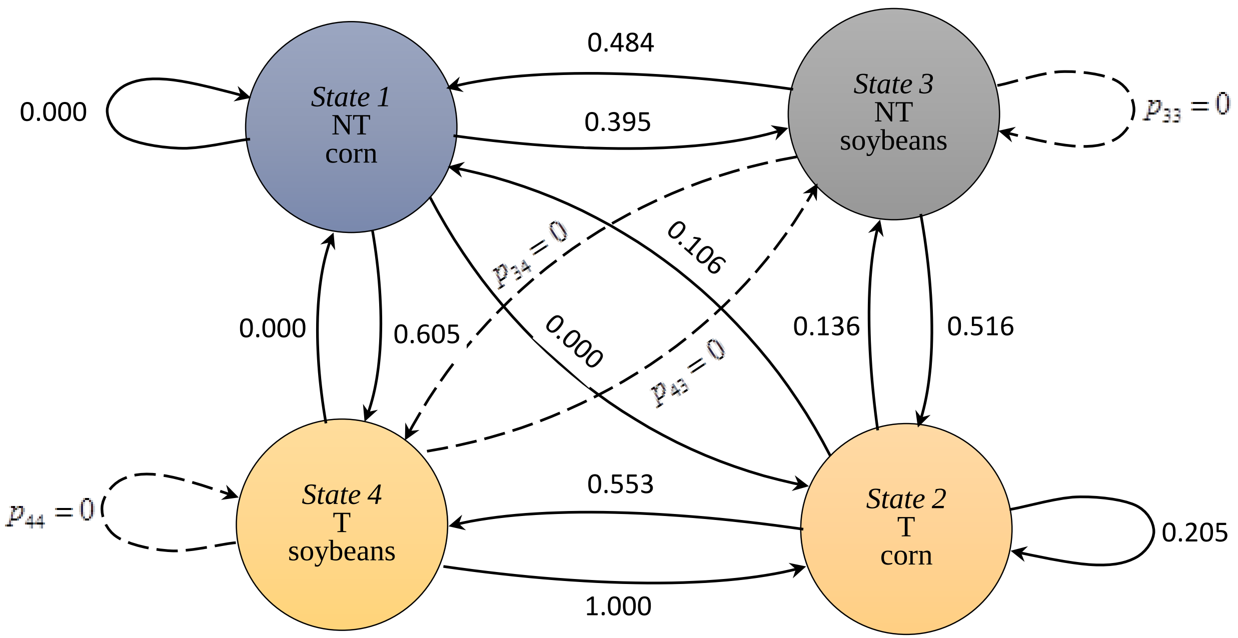
Markov chain model of tillage-crop dynamics



$$\begin{pmatrix} s_1^{t+1} \\ s_2^{t+1} \\ s_3^{t+1} \\ s_4^{t+1} \end{pmatrix} = \begin{pmatrix} p_{11} & p_{21} & p_{31} & p_{41} \\ p_{12} & p_{22} & p_{32} & p_{42} \\ p_{13} & p_{23} & 0 & 0 \\ p_{14} & p_{24} & 0 & 0 \end{pmatrix} \begin{pmatrix} s_1^{t} \\ s_2^{t} \\ s_3^{t} \\ s_4^{t} \end{pmatrix} + \begin{pmatrix} \varepsilon_1^{t+1} \\ \varepsilon_2^{t+1} \\ \varepsilon_3^{t+1} \\ \varepsilon_4^{t+1} \end{pmatrix}$$