David Leifer

11/01/2016

Notes

Reading 4

Feedback loops and types of adaptation in the modelling of land-use decisions

in an agent-based simulation

**Abstract**

-Use an agent-based land-use change model LUDAS to test inclusion of secondary feedback loop learning at different levels of aggregation

- [based on Vietnam Hong Ha watershed] – two models

-1) primary feedback loop learning- households directly adapt to annual change

-2) [method one] and a secondary feedback loop- households change behavioral model to respond to changes in conditions

-inclusion of method two depends on domain, time, and aggregation level

**1.) Introduction**

-Agent Based Models (ABMs)- number of human agents interacting with each other and environment

-environment is represented by autonomous land units AKA ‘landscape agents’

-problems in ABMs:

-1) systematic approach for classifying feedback mechanisms for human/envi coupling is lacking

-2) human adaptation in current ABMs is simplistic- fails to address assimilation and accommodation

-assumes human agents all behave the same

-3) Most ABMs don’t have feedback loops that incorporate assessed value-added changes

-produce potentially overly sophisticated models

**2.) Methodology**

*2.1 Concept of feedback loop learning in coupled human-environmental systems*

-human agents adaptive decision-making involves a primary (assimilation) and secondary feedback loop (human induced changes to the environment)

-secondary loops can trigger new classes of farming technologies

*2.2 The LUDAS model*

-includes secondary feedback loop to model land use and income patterns over the long term

*2.3 The Study Site*

-near Hue City whose demographic is representative of the three ethnic groups distributed throughout the region

-Agriculture supplemented by forestry products

-rice and fruit based agro-forestry- increased use of fertilizer

*2.4 Design of simulation experiments*

*2.4.1 Mechanism I: household’s behavior without any secondary feedback loop learning baseline*

*2.4.2 Mechanism II: Household’s behavior with secondary feedback loop learning*

*2.4.2.1 Imitation (learning by observing models) as a major cognitive process of social-ecological learning in rural land-use*

- “humans with enough need satisfaction tend to imitate others with similar characteristics”

-studying social learning theory goes back to farmer’s imitating agricultural innovations for hybrid corn varieties in the ‘40s

*2.4.2.2 Livelihood similarity*

*2.4.2.3 AgentCategorizer algorithm: imitative vs repeating strategy*

-evaluates temporal cumulative changes in variables of the five main household capitals:

-natural, physical, social, human, financial capitals

-based on K-mean clustering procedure-centroids were defined by descriptive stats of household groups outside the simulation

-categorical processing steps:

(i) household *h* measures comparison between self and defined household groups

(ii) household *h* assigns itself into the most similar livelihood group

(iii) if household *h* changes, then it will ask to delete the old model

else: *h* will repeat former LUDM

*2.5 Data inputs, pre-simulation data analysis, impact indicators, and uncertainty quantification*

*2.5.1 Data inputs for the LUDAS model*

-land use, terrain, accessibility and social holdings, territory, zoning

-household info was gathered through questionnaires

*2.5.2 pre simulation data analysis for specification of the Agent Categorizer algorithm*

-….wut

*2.5.3 Impact indicators*

-measure impact of secondary feedback loop by measuring divergence between two trajectories

-considered for different performance categories:

-*Landscape status of natural forests*

-coverage of forest cover type

-coverage of dense forest within buffer zone of the main road

-*Agricultural production patterns*

-total area of different farm types hahaha

-avg farm size (ha household)

-avg agronomic yield of different farm types

-*h* gross income, structure, equality

-avg see above

-Gini index of *h* income

*2.5.4 Quantification of uncertainty*

-1 output = 1 stochastic process, must run multiple times

-replicated values of the impact indicators have to follow normal distributions confirmed by Shaprio-Wilk tests

**3.) Results**

*3.1 land cover changes*

-forest cover types convert dense natural forest to open nature forest and grassland to cropland after 21-23 years (mainly within 2-4 km buffer from main road)

-population growth exceeds increasing cropland

*3.2 Income responses*

-inclusion of secondary feedback loop has no significant impact on income

-poor farmers imitate successful farmers- might not be aware of hidden constraints they face

*3.3 Global and local responses*

-farming follows concave upward pattern- heard that

-productivity of agro-farms is positively responsive to labor inputs and cropping time length (le 2005)

-secondary feedback learning triggers poor farmers to invest more time for agro-forestry farming, leading to increased yields

**4.) Discussions**

lawlz at Dung et al