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ABSTRACT

The sustainable use of land systems requires us to understand the complex drivers and mechanisms of agricultural land use. Many studies have concluded that the drivers for local land changes are from global pressures (e.g., the international food trade increases the deforestation in exporting countries). However, little is known about how these local land use changes affect distant locations, namely the feedback between them. Yet these impacts and feedbacks can be significant for governing local land systems.

In this study, we constructed a pioneering telecoupled agent-based model (TeleABM) to simulate land use changes in two distant places based on the integrated telecoupling framework (i.e., human and natural interactions between distant places). We used international soybean trade as a model example, and choose Brazil as the sending system and China as the receiving system because they are the world's largest soybean exporter and importer respectively. In the model, we selected one representative county in each country and simulated their agricultural land use changes. The model is informed by spatio-temporal analysis of historical land use changes and the empirical analyses on of household survey data. Using this model, we aim to advance the understanding of feedbacks in telecoupled land systems, and identify effective pathways to govern sustainable land transformations in local and distantly connected places.

Our simulation results suggest that farmers' cultivation activities in the receiving system (China) are largely influenced by the flow of soybean trade and information, which is the result of aggregated land use patterns from individual land use decisions in the sending system (Brazil). As for the current tariff dispute between China and US over soybean trade, we tested a "high tariff" scenario (i.e., China imposes a high tariff on the soybean imports from Brazil) to evaluate if this will reduce soybean cultivation in exporting countries and stimulate soybean production in the importing countries. Our results provide novel insights for land system science. They are also informative for policy makers when considering trade and food security issues.

COMMUNICATION OUTCOMES

Sustainable global land use is key for achieving the 2030 Agenda for Sustainable Development. The Global Land Program is the largest and most prestigious global research organization in land system science that aims to advance sustainable land use. This conference that happens in Bern, Switzerland next April will gather many world-leading scientists from all over the world and have global impact on sustainable science.

First of all, it is a great opportunity for me, a young scholar, to discuss my work and meet many of them in person. More importantly, most of my existing connections are from North America, China, and Brazil, and I'm lacking opportunities to meet land scientists from European countries, including Peter Verburgh from the Netherland and Patrick Meyfroidt from Belgium. The in-person meeting is not only important for my future career (my current contract with MSU ends next year), it also increases the probability for me to find a position in European institutes and re-locate to reunite with my husband who is working in France.

Secondly, my advisor Dr. Jianguo Liu, who is a fellow of the American Academy of Arts and Sciences and the American Philosophical Society, has been trying to promote the concept of "telecoupling". It is a framework that links distant coupled human-natural systems together. For instance, the soybean trade in my above abstract is a perfect example of telecoupled system. Brazilian deforestation is caused by Chinese consumers' preference for more meat in their diet, which drives the demand of soybeans and results in agricultural expansion in the Amazon forest; and vice versa. I have been constructing an agent-based model that can simulate the feedbacks between these distantly connected regions in the past two years while working with him. We believe it is a "first-of-a-kind" computer simulation model that will provide both scientists and policy-makers a tool to study the telecoupling causes and effects. The work has been presented at US-IALE (United States-International Association of Landscape Ecology) earlier this year in Chicago, however, we would like to reach a larger audience in OSM than US-IALS. This way we can have a more international audience and more researchers not only from landscape ecology but also from land science.

Lastly, we are on a "no-cost" extension on the NSF project and therefore I can't get reimbursed through the NSF fund. I believe that OSM is a great opportunity for me to present my work and connect with international leading scientists and audience. I would like to receive financial help from MSU-PDA to cover at least some of the cost.