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Exploring Regional and Telecoupled Land Use Change Impacts from Environmental Shocks

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ABSTRACT

Natural disasters or environmental shocks have the potential to disrupt local agricultural systems as well as distant agricultural systems through cascading effects. In this work we selected two distinct environmental shocks and traced their cascading effects on land use change. Quantifying cascading effects is a salient issue because climate change forecasts indicate an increase in frequency and intensity of global environmental shocks. This study incorporated the concept of telecoupled systems involving interrelating ecological, economic and political/social components. A telecoupled framework involving cascading effects was implemented using three approaches. The first approach involved using bilateral agricultural trade matrix data to analyze time-based production/consumption changes of agricultural systems directly and by using Input-Output. Next, we employed time-based network analysis to identify regions vulnerable to environmental shocks through globalization of agricultural trade. Land use changes associated with environmental shocks that occurred in telecoupled regions were delineated using image processing software to quantify the impacts of affected regions. Based on two selected environmental shocks, empirically-based case studies were developed that provided insight on cascading effects. Case study 1 linked a drought in the US to economic/trade changes that influenced land use changes in Paraguay releasing 128,950.4 Mg of stored Carbon. Case study 2 linked a typhoon in Malaysia to economic/trade changes that influenced land use changes in Colombia releasing 544,212 Mg of stored Carbon. These findings provide implications for future impact assessments of environmental shocks. The ongoing research should focus on quantifying and refining of global land use change impacts attributed to environmental shocks.

KEYWORDS

Input-Output, agricultural systems, network analysis, telecoupled, environmental shocks, cascading effects