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Eco-certification protocols as mechanisms to foster sustainable environmental practices in telecoupled systems

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Highlights

- The telecoupling framework is used to understand environmental outcomes of eco-certification.
- Remote sensing data is a reliable resource to assess environmental effects of certification before and after implementation.
- FSC certification may improve enforcement of preexisting state-based environmental policies.

Abstract

The international trade of forestry and agricultural commodities leads distant regions across the globe to become connected through flows of products, information and capital. To deal with the sustainability and socioeconomic challenges of these interconnections, the 'telecoupling' conceptual framework has emerged. The telecoupling framework takes a coupled human-natural system approach to understand connections between different systems, classifying them as 'sending', 'receiving' and 'spillover' systems. This paper uses the telecoupling framework to investigate how distant systems are connected through flows of eco-certified forestry products and demonstrates how these connections drive environmental law compliance at the rural property level. We identify rural properties with eucalyptus plantations in Paraíba Valley, São Paulo State, Brazil as a sending system, and trace the outgoing flows of cellulose pulp to receiving systems. China and the European Union are the receiving systems, having been the major importers over the last 10 years. Using a multitemporal and spatial approach, we found that between 1995 and 2005 rural properties containing eucalyptus plantations with FSC certification had higher rates of native forest cover regeneration than properties without FSC certification. Native forest conservation and regrowth in rural properties in Paraíba Valley is an effect of the telecoupled system based on the international demand of eco-certified cellulose pulp from elsewhere. Additionally, we find that the telecoupled system also results in impacts on surrounding areas in the Atlantic forest landscapes, which we identify as an adjacent spillover system.

Introduction

The effects of ecologically unsustainable supply chains on consumption behavior pose a risk to forestry and agri-food markets, leading industries to find ways of preventing unsustainability practices across the supply chain (Hamilton and Zilberman, 2006). For example, organizations have emerged to set protocols and standards for sustainable production chains that aim to connect consumers with producers through reliable mechanisms such as certification labels (e.g. the Forest Stewardship Council, FSC, 2018; Kill, 2016; Piketty and Drigo, 2018). To explain changes in production towards sustainable practices, eco-friendly products, and trusted brands, the scientific

literature in economics, ecology, and environmental sciences have developed studies in consumption behavior and markets (Waroux and Lambin, 2013; Ricci et al., 2018; Roheim et al., 2018; Weitzman and Bailey, 2018). These studies highlight the importance of individuals or groups in setting sustainable standards as a requirement to purchase goods and services. However, most recently Lambin et al. (2018) observed that demand for sustainable products is still tiny compared to overall demand.

In Brazil, certifications such as the Rainforest Alliance Certified™ (RAC) developed by Sustainable Agriculture Network (SAN) has proven effective for conserving forests and their biodiversity, as well as suppressing usage of pesticides and fertilizers in coffee plantations (Lima et al., 2009). In Colombia, coffee plantations certified by the RAC have fostered increases in native forest cover and landscape habitat connectivity significantly greater than in farms of non-certified coffee production in the same region (Rueda et al., 2015). The success of these initiatives is currently a subject of intense debate among researchers, stakeholders, governmental authorities and consumers, given that the recent literature shows examples of positive (Newsom and Hewitt, 2005; Dias et al., 2015), minor or neutral (Rametsteiner and Simula, 2003; Nebel et al., 2005; Lima et al., 2009; Blackman et al., 2015), and mixed (e.g., positive social and economic outcomes but not on-the-ground environmental outcomes – Blackman et al., 2017) results. In addition, previous studies have highlighted the lack of rigorous empirical evaluations of eco-certifications as the FSC (Blackman et al., 2017; Romero et al., 2017) and discussed the difficulty and costs associated with conventional monitoring systems (e.g., studies of species composition, forest and bird community structure) as a reason for scarce studies about the environmental impacts of certifications (Iongh and Persoon, 2010). More often, meta-analysis approaches relying on Public Summary Reports or corrective action requests issued by third-party certification bodies are used to evaluate environmental but also social and economic outcomes of FSC certification (Newsom and Hewitt, 2005; Blackman et al., 2017; Rafael et al., 2018). Fewer studies focus on empirical assessment, such as the study conducted by Dias et al. (2015) in which the authors used the Stream Visual Assessment Protocol method (screening-level assessment method based on visual inspection of the physical and biological characteristics of instream and riparian environments) to find that forest management units under FSC certification improved stream quality compared to non-certified areas.

Recently, the interdisciplinary ‘Telecoupling’ framework has been developed,

conceptualizing distant coupled human and natural systems (CHANS) as connected by flows (e.g., agricultural commodities, information) from sending to receiving systems and potentially triggering different expected and unexpected effects, including cascading effects in sending or receiving systems or the emergence of spillover systems (Friis et al., 2016; Silva et al., 2017a; Liu et al., 2018; Dou et al., 2018). In a telecoupled world, environmental products such as timber, food and cellulose pulp are supplied over great distances through long supply chains that facilitate flows of materials, capitals, and information (Liu et al., 2013; Silva et al., 2017a; Dou et al., 2018). In telecoupled systems, the demand of a given CHANS (e.g., a country) lacking capacity or ability to meet their own demands by internal production is externalized to export-oriented countries (Kastner et al., 2015). The dynamic markets of international agribusiness supply chains have also displaced the environmental externalities of receiving countries (i.e., importers) to producing nations (i.e. the sending systems or the export-oriented countries; Liu et al., 2013). For example, the oil palm plantations in Southeast Asia that dominate international palm oil supply chains, have been widely recognized as a major driver of tropical deforestation since the 1990s (Castiblanco et al., 2013; Koh et al., 2011). Consequently, many stakeholders in the palm oil supply-chain have pledged to eliminate deforestation from their palm oil sourcing, resulting in a zero-deforestation agreement in 2015 (Austin et al., 2017). Another example is in studies of forest transitions, where Lambin and Meyfroidt (2010) have argued that economic globalization displaced deforestation from countries under forest transition to forest-rich regions (e.g., tropical regions) at the cost of exploitation of forest products in those regions providing sources of timber to international supply chains.

The increasingly telecoupled world brings many challenges for sustainable development and highlights the need to broaden the perspective from local CHANS to understand the linkages of distant CHANS. Previous studies have emphasized that incentives for the adoption of forest certification are more related to external/international market forces (Tuppura et al., 2016). Additionally, limited governance capacity in the forestry sector at the national level, as in Ecuador, limits the potential environmental benefits of certification (Ebeling and Yasué, 2009). The telecoupling framework is a potentially useful tool to improve our understanding of international supply chains based on the exploitation of natural resources with potential environmental harm for sending systems (i.e., exporting countries) and the

related certification initiatives that according to Tikina and Innes (2008) must be analyzed as part of international environmental regimes.

Here we use the framework to investigate how certification protocols may promote sustainable land use practices with positive forest conservation outcomes in telecoupled systems of the forestry supply chain.

Section snippets

Eco-certifications

Eco-certification protocols are mechanisms to foster the adoption of sustainable environmental practices in production systems while also respecting social and economic dimensions intrinsically affected by the system through providing trusted evidence about the supply chain (Lima et al., 2009; Kraxner et al., 2017; Godfray et al., 2018; Lambin and Thorlakson, 2018). The insertion of the environmental dimension into trade relations has driven the emergence of new management approaches improving …

The telecoupling framework

The telecoupling framework integrates both human and environmental dimensions, taking advantage of previous social science studies on globalization (i.e., socioeconomic interactions between human systems across distances) and atmospheric science studies on teleconnections (i.e., environmental interactions between natural systems across long distances; Liu et al., 2013, 2018), advancing those approaches to develop an integrative science on coupled human and natural systems across distances. The …

The telecoupled system of eco-certified cellulose pulp trade

Applying the telecoupling framework, we defined the rural properties of eucalyptus production as the sending system, and countries that import cellulose pulp are receiving systems (Fig. 1). The cellulose pulp exported from São Paulo State flows to internationals markets and highlights the major trading regions for the State's production. The European Union is the major trade partner from 2000 to 2017, accounting for about 50% of the exported amount by the state. North America occupied the …

Public and private policies on the conservation pathway

According to the local cellulose pulp and paper company's 2016 report, 100% of its commercial forest plantations to supply the Valley's industry are certified by the FSC (Conde et al., 2016). In this case, being certified by FSC means that the rural properties of the company must follow the Brazilian environmental legislations, including the FC. When a company is not in full compliance with all legal requirements but wants to be certified, the company can submit a plan to meet them (IMAFLORA …

Conclusions

The non-growth of native forest cover within the rural properties with eucalyptus plantations between 2005 and 2015 (with a deficit of 40% of native forest cover within APP in 2015) contrasting with the 25% of native forest growth in the Valley's rural properties without eucalyptus in the same period, highlights the need for more studies to understand the decisions at the rural property level towards forest conservation.

The interaction of the Forest Code with the Forest Stewardship Council …

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> ...Nevertheless, the growing forestry industry in Brazil, which supplies human demand for

> many forest-based products (e.g., charcoal, wood, cellulose pulp), indirectly induced the observed increase in planted forests, mainly at the expense of natural vegetation areas in the case of the mountain regions of the BAF. Eucalyptus cellulose pulp production in the BAF has been shown to be an example of a forest-based telecoupled system with positive effects over natural vegetation, due to the adoption of international eco-certifications (e.g., Forest Stewardship Council) (Silva et al., 2019). However, little is known about forest plantations with products destined for local and regional uses (to supply charcoal, firewood, wood for tools and construction), overlooked by certification systems or robust public surveillance.…

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