



A systematic review of the socio-economic impacts of large-scale tree plantations, worldwide



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ARTICLE INFO

Keywords:

Socio-economic impacts
Land use change
Local communities
Plantation forestry
Planted forests
Land grabbing

ABSTRACT

Since their widespread introduction in the 1980s, large-scale tree plantations have seen contestations over their socio-economic impacts. With the establishment of new plantations on the rise, a review of the literature examining their impacts on local communities is needed to inform policies and practices. In this systematic review, we followed an *a priori* protocol to reduce the selection biases inherent to conventional literature reviews, and considered both grey and peer-reviewed literature. Of the 20,450 studies identified in our literature search, only 92 studies met our predefined inclusion criteria. However, only 22 studies presented a clear comparator and considered confounding factors in their analysis. Of the 251 impacts identified in this sample, most impacts across the nine categories were characterised as predominantly negative impacts attributed to large-scale tree plantations. Impacts on employment (22% of reported impacts/of which 41% predominantly negative), land (21%/81%), livelihoods (12%/48%) and the often intertwined social impacts (20%/69%) were the most commonly considered categories, within which a majority of studies agreed on the impact dynamics when in similar contexts, resembling the dynamics observed in other large-scale land-based investments. Most impacts were reported from Southeast Asia (34% of reported impacts), South America (29%), Africa (23%) and Australasia (12%). We corroborate that costs of large-scale tree plantations for residents tend to be front-loaded, especially when plantations have displaced customary land uses, and possible benefits to accrue over time, moderated by the emergence of local processing and complementary livelihood activities. However, given the methodological inconsistencies in our sample and the under-representation of areas known to have undergone plantation development, strong global evidence on the long-term socio-economic impacts of large-scale tree plantations remains limited.

1. Introduction

Although we can trace the origins of large-scale tree plantations to the colonial era, they have seen increasingly widespread adoption since the 1980s as an alternative source of raw material for tree-based commodities (Bull et al., 2006; Evans, 2009). Tree plantations are often characterised by high density monocultures of non-native species, established to meet increasing commercial demands and reduce the exploitation of natural forests (Chazdon et al., 2016; D'Amato et al., 2017a; Pirard et al., 2016a). Such plantations are also often posited as a

means of mitigating the effects of climate change through carbon sequestration in woody biomass (Ingram et al., 2016; Kröger, 2016). Recent estimates place the global extent of planted forests at 278 million ha in 2015 (Payn et al., 2015), with large-scale plantations of fast-growing tree species occupying 54 million ha in 2012 and predicted to double in extent by 2050 (Indufor, 2012).

The establishment of large-scale tree plantations remains a highly contentious issue among researchers, practitioners and stakeholders (Baral et al., 2016; Gerber, 2011; Kröger, 2011; Schirmer, 2013). Much of the criticism has been directed at their negative environmental

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<https://doi.org/10.1016/j.gloenvcha.2018.09.001>

Received 7 October 2017; Received in revised form 4 June 2018; Accepted 4 September 2018

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impacts, commonly caused by the clearing of natural forest prior to plantation establishment (Brockerhoff et al., 2008; Farley et al., 2005; Liao et al., 2012). However, residents exposed to the establishment of large-scale tree plantations also experience a range of impacts, both positive and negative. These impacts are likely to resemble those of other large-scale land-based investments, as they share key features in terms of their physical extent and social disruption in rural areas.

It has been shown that the land acquisition for large-scale agricultural plantations carries a risk of threatening or displacing customary land uses (Cotula et al., 2014; Hall et al., 2015); particularly in Africa and Southeast Asia, where most rural areas remain under land use without formal recognition by the state (Deininger, 2003; Inguanzo, 2014). Investors targeting such areas have tended to align with the interests of influential elites (e.g. politicians, privileged, chiefs, elders) de facto responsible for allocating resources and benefits, and capturing these unless held accountable for their proper distribution among customary land users (Cotula et al., 2014; McIntyre et al., 2015). Significant concentration of land can further threaten access to land by customary land users (Peters, 2009; Toulmin, 2009). Where in place, formal titles are portrayed as being effective safeguards against illegal seizures of land (World Bank, 2010); where not, the gradual processes of land formalisation could threaten communal arrangements and exacerbate inequalities in access to land (Alden Wily, 2011; Dwyer, 2015; Milne, 2013).

In terms of employment and livelihoods, Hunsberger et al. (2017) found that labour intensity in large-scale feedstock plantations is modified by mechanisation and investment phase, with land clearing and crop planting requiring much more labour per unit area than other phases. Labour intensity could also decrease due to efficiency gains achieved through land concentration (Wilkinson and Herrera, 2010). On average, rural residents in lower-income countries derive an estimated 28% of their total income from natural areas (Angelsen et al., 2014); and so the (lost) value of displaced livelihoods could possibly be higher than the (gained) value of labour per unit area (Schoneveld et al., 2011). Impacts are likely to depend on the trade-offs between the new and past employment and livelihoods in terms of labour intensity and value creation (Hunsberger et al., 2017). The type of business model – whether arranged such that the investor controls all means of production, or arranged, for example, so that residents are contracted with direct involvement in production through the large-scale plantation – could affect the trade-offs (Little and Watts, 1994; Vermeulen and Cotula, 2010a). In addition, plantation agriculture and biofuel production have often favoured migrant workers over residents for their greater acceptance of physically demanding labour and precarious contracts often described as exploitative (Deininger et al., 2011b; Lenard and Straehle, 2010). Outsourcing – with a significant role for contractors to undertake most of the tasks on the ground – has been pointed to as worsening working conditions with fewer guarantees for the sub-contracted workforce (ILO, 2016).

Additional impacts could follow the conversion and management of land for tree plantations that could modify the provision of pre-existing ecosystem services with links to human health and well-being (Howe et al., 2014; Scovronick and Wilkinson, 2014). Roads and other infrastructure, of which economies of scale are often beyond the reach of residents and governments in rural areas, in turn, could benefit from land-based investments by external investors (Byerlee et al., 2017). However, disparities in access to resources, utilities or opportunities could shape the perceptions of fairness among residents, between residents and migrants, or between residents and investors, increasing social tensions (Gerber, 2011; Hall et al., 2015; Norton and de Haan, 2012).

Such socio-economic impacts have never been subject to a global review in the context of large-scale tree plantations across different contexts of geographical location, commercial purpose and ownership structure. Our synthesis will also help to identify knowledge gaps and highlight patterns across the literature that promote best practice or changes to existing practices (Haddaway et al., 2016).

Our review thus aims to answer three main research questions: 1) What are the direct and indirect socio-economic impacts of large-scale tree plantations for local communities? 2) How do impacts differ across contexts? 3) What are the patterns, biases and gaps in the available evidence?

2. Methods

Systematic reviews aim to identify the most reliable research on a given question in a manner that minimises selection biases in the literature search and screening process. We used an *a priori* systematic review protocol published as Malkamäki et al. (2017), which was prepared based on the guidance for systematic reviews by the Collaboration for Environmental Evidence (CEE, 2013). This protocol defined the structuring components of the systematic review framework (population, intervention/exposure, comparator, impact and contextual factors) as applied to large-scale tree plantations, and their operationalisation in the literature search and screening process to identify relevant studies from bibliographic databases and organisational sources.

Definitions of these components are provided in detail in Malkamäki et al. (2017), and were developed through a participatory process and a stakeholder workshop in May 2016 involving seven experts from academic, civil society and private sector organisations. The following definitions and scopes were used to guide the identification of relevant studies:

Relevant populations: Local households and communities who reside inside or near to an area where at least one large-scale tree plantation is present. Here, the term *local* is not used to delineate populations within a particular distance from the plantation site as these may vary from area to area. However, non-local processors and consumers of plantation-sourced commodities further down the value chain – who are not impacted by the physical presence of the plantation site – are not considered.

Relevant intervention/exposure: Large-scale tree plantations established and managed for commercial purposes by private or public actors external to the local community. This definition excludes large-scale forest restoration programmes and outgrower partnerships as such. Tree species included are those falling under the FAO (2012) current definition of a *forest*; i.e. those able to reach a minimum height of five meters, hence rubber trees are included. Commercial purposes for which the plantations must be primarily designated are those derivable from the relevant tree species, including pulpwood (e.g. cellulose), sawnwood (e.g. construction), fuelwood (e.g. combustion), latex/rubberwood and carbon credits, or a combination of these.

Relevant impacts: Intentional and unintended changes to human well-being that are felt directly or indirectly due to the establishment or management of a large-scale tree plantation. These should fall under one of the nine impact categories: land, employment, livelihoods, cash income, infrastructure, health, regulating ecosystem services, cultural ecosystem services or social impacts (Table 1).

Apart from the initial list of potential impacts proposed in the stakeholder workshop, the design of impact categories drew from the literature on impacts of other land-based investments and links between ecosystem service provision and human well-being (Chapter 1; Fisher et al., 2014; Howe et al., 2014). To adapt these concepts into the context of tree plantations, we drew from the impact logic by Ingram et al. (2016).

The very final working definitions for the nine categories could only be assigned after we understood the range and types of all reported impacts. Taking into consideration the multi-dimensionality of some concepts also meant dealing with higher levels of complexity. For example, food security “exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2003, p. 29). Of the four dimensions of food security (Gross

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