



Effects of industrial plantations on ecosystem services and livelihoods: Perspectives of rural communities in China



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ABSTRACT

This paper addresses the current research void on local community views of changes in ecosystem services associated with rapid land use transformation in the context of plantation-based forestry. This interview-based study, conducted in southern China, aims at assessing the perspectives of local communities of: 1) the effects of *Eucalyptus* industrial plantations on selected ecosystem services and on local development; and 2) opportunities for future community livelihood development, based on the relations with the government and with forest industry operating locally. We analysed data from semi-structured interviews with 70 villagers for their views on changes in ecosystem services after the establishment of plantations, and their future expectations on the local livelihood development. Most interviewees mentioned some negative development on environmental quality after the establishment of the industrial plantations, especially on soil and water. Furthermore, the reduced productivity of cropland surrounding industrial plantations, coupled with other financial drivers, induced several villagers to switch from agricultural crops to household plantations. In the absence of destructive typhoons, household plantations can provide owners more free time, higher income, while industrial plantations provided some employment opportunities. Interviewees' expectations for the future included receiving financial support and capacity building for household plantations and crops, support to local roads and schools, and higher employment opportunities. Some interviewees suggested that solutions should be implemented for improving degraded water quality, while others suggested reducing forestry operations. Even though being highly context-specific, our findings open up the discussion about the further community development opportunities in the context of plantation forestry. In particular, the potential of value sharing mechanisms between the private sector and the local communities should be further studied.

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1. Introduction

The number of applications of the ecosystem services concept is growing in scientific research and policymaking. Existing research has hitherto greatly focused on assessing the state and value of ecosystem services (Abson et al., 2014), whereas 'less emphasis has been given to understanding the relative importance and interplay of biophysical, ecological and social components over time and space' (Bennett et al., 2015; p. 79). In particular, limited attention has been dedicated to assessing the demand for different ecosystem services combinations by different groups of beneficiaries¹

(Lamarque et al., 2011). In addition, most of the existing studies on the topic focus on the benefits obtained by people from natural or semi-natural ecosystems (e.g. Landreth and Saito, 2015; Rönnbäck et al., 2007; Simelton and VietDam, 2014).

There is, however, a paucity of research assessing local community views on ecosystem services changes associated with intense land use transformations (Suich et al., 2015). Exceptions include, for instance Vihervaara et al. (2012). Globalization and trade liberalization have influenced global environmental governance, and have often affected local ecosystems and the communities who depend on them (Aggarwal, 2006). Therefore, eliciting community perspectives on changes in land use and ecosystem services is of particular interest.

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¹ In ecosystem services literature people benefiting from ecosystem services are often referred to as 'stakeholders'. In this paper, we prefer to use the term 'beneficiaries' when referring to ES, to distinguish from the terminology used in business literature. The business literature in fact also employs the term 'stakeholders' to

identify groups who exchange relationship with or have an influence on the firm (Freeman, 1984), including employees, customers, suppliers, financiers, governmental bodies, media, civil society and local communities.

In this study we focus on the socio-economic impacts of forestry plantation, which is rapidly expanding worldwide, especially in the Global South (Bauhus et al., 2010). The expansion of tree plantations is often driven by public and private efforts rather than initiatives by smallholders (Kröger, 2014). The appropriate management of industrial plantations² and their future role in governing global forest resources is currently the object of heated debate (Bauhus et al., 2010; Gerber, 2011; Rudel, 2009; Schirmer et al., 2015).

Fast-growing plantations contribute greatly to increasing resource needs, while occupying limited amount of land and contributing to reduce pressure on natural forests. Expanding plantation forestry currently cover 7% of the world's forest area and provide one third of global industrial round wood (GFRA, 2015; Barua et al., 2014). Industrial-scale plantations often contribute to local and regional development by providing employment opportunities or by financially supporting local infrastructures (Pirard et al., 2017).

The environmental effects of plantations are very context-specific and depend on several variables, including previous and surrounding land uses, plantation purpose, land tenure and management, and plantation scale and configuration in landscape (Paquette and Messier, 2009; Batra and Pirard, 2015). Comprehensive and decisive analyses on the topic are thus difficult to obtain. However, intensive management of timber production may result in trade-offs especially with local ES, such as water purification and regulation, nutrient cycling, soil maintenance, genetic diversity maintenance, recreation and possibly cultural values (Baral et al., 2016). Therefore, sustainability concerns exist on whether environmental and social costs outweigh the benefits (Charnley, 2005).

A global survey of the perceptions of expert stakeholders perceptions (Kanowski and Drazen, 2015) about policies, governance of intensively managed plantations, as well as their implementation and practices suggest these have progressed since the mid-2000s. However, consistent variation exists across countries, businesses and key issues. Nonetheless, there is a need for 'different modes of plantation industry development and their impacts' (Landry and Chirwa, 2010; p. 543). Stakeholder concerns are of particular relevance to forest companies, for whom corporate sustainability and stakeholder engagement have become pivotal. Stakeholders' opinions are fundamental to legitimize companies' activities and maintain social licence to operate (Mikkilä and Toppinen, 2008).

Southern China is a research region of interest with regard to forest resources. Since the late 1990's the government has promoted a unique array of policies that targeted reforestation for environmental and economic purposes, in addition to rural development (Yin et al., 2014). These policies were also implemented to stop extensive deforestation and environmental degradation, while addressing the increasing demand for wood. There has simultaneously been a rapid development of industrial plantations led by consistent investments from domestic and international forest companies (Zhang et al., 2015). As a result of these phenomena, China has experienced rapid reforestation and development of intensive plantation-based forestry. About 38% of the national forest area in China consists of plantations, which represents the world's largest plantation area whereas the natural or semi-natural forests in China are newly regenerated and have low stocking levels (GFRA, 2015). Although increased tree cover may be a good achievement per se, forest quality is rarely assessed (Zhai et al., 2013). Intensively managed single-species plantations are not equiva-

lent to naturally regenerating forest, and the establishment of industrial-scale plantations has implications for ecosystem services provision and their beneficiaries, especially at the local level.

This study aims at deepening the understanding of the effects of industrial plantations on ecosystem services and livelihoods by investigating the perspectives of a key stakeholder group, local communities (Yu et al., 2016), about: 1) effects of the industrial plantations locally managed by a forest company, with a specific focus on the interactions between ecosystem services and local development; 2) needs for the future development of community livelihood, especially interactions among local communities, local government and the forest industry. Our study focused on the views of local villagers in Guangxi Province, China.

2. Theoretical background

The theoretical framework of this study (Fig. 1) merges the concept of ecosystem services (MA 2005) with that of sustainable livelihood approach (Scoones, 1998). Moreover, the framework introduces the concepts of ecosystem services valuation, corporate-sustainability and benefit-sharing.

The ecosystem services concept draws from a utilitarian framing of nature (Haines-Young and Potschin, 2010; MA, 2005). Provisioning, regulating and cultural services contribute to human well-being and fundamental livelihood assets (natural, financial, human, physical and social capital) by satisfying basic physiological needs and contributing to education, health, employment, security, social relations and the sense of belonging. In particular, ecosystem services from natural and semi-natural forest ecosystems are important to the livelihoods of local communities (Angelsen et al., 2014; Fisher et al., 2014; Yang et al., 2013) by contributing to food, income, shelter and spiritual values.

ES are determined by the geographical, natural, social, economic and cultural context of the beneficiary(ies) (Haines-Young and Potschin, 2010). The perception and value of ecosystem services also vary among and within different individuals (TEEB, 2010 pp. 3–29; Kumar and Kumar, 2008; Lewan and Söderqvist, 2002). Several assessment methods exist to assess or elicit the relevance of ES, including: qualitative evaluation, biophysical assessment, benefit-flow assessments, mapping and economic valuation (IPBES, 2014). Among these methods, there is the investigation of people's awareness of ecosystem services, and eventual inequalities in the distribution of benefits between actors. Different actors mediate ecosystem services access, status and flow for others. This is determined by the institutional setting (Sikor and Baggio, 2014), including the spatial (e.g. upstream-downstream) and power relations among different beneficiaries, such as access rights, governance, and land stewardship (Bennett et al., 2015; Felipe-Lucía et al., 2015; Pereira et al., 2005). The analysis of the views of a specific group of beneficiaries, such as local communities, can be of interest both as providing novel scientific data and applied knowledge for civil society, regulators, and the private sector (Campos et al., 2012; Sodhi et al., 2010).

Beneficiary management and community involvement have gained a pivotal role for companies by shaping sustainability goals, strategies and actions (Branco and Rodrigues, 2007; Freeman, 1984; Freeman et al., 2004; Jennings and Zandbergen, 1995). According to Bowen et al. (2010), different strategies of community involvement include, transactional, transitional and transformational engagement, from the most basic to the most sophisticated level, respectively. Transactional engagement involves a philanthropic, top-down approach such as charity or nature conservation projects. Transitional engagement aims at community involvement via bidirectional dialogue. Transformational engagement aims at community integration by joint decision-making, and is perceived

² In this article we define 'industrial plantations' as monoculture of exotic tree species, managed on large scale by private or public companies for commercial purposes. See Chazdon et al., 2016 for a review of key definitions.

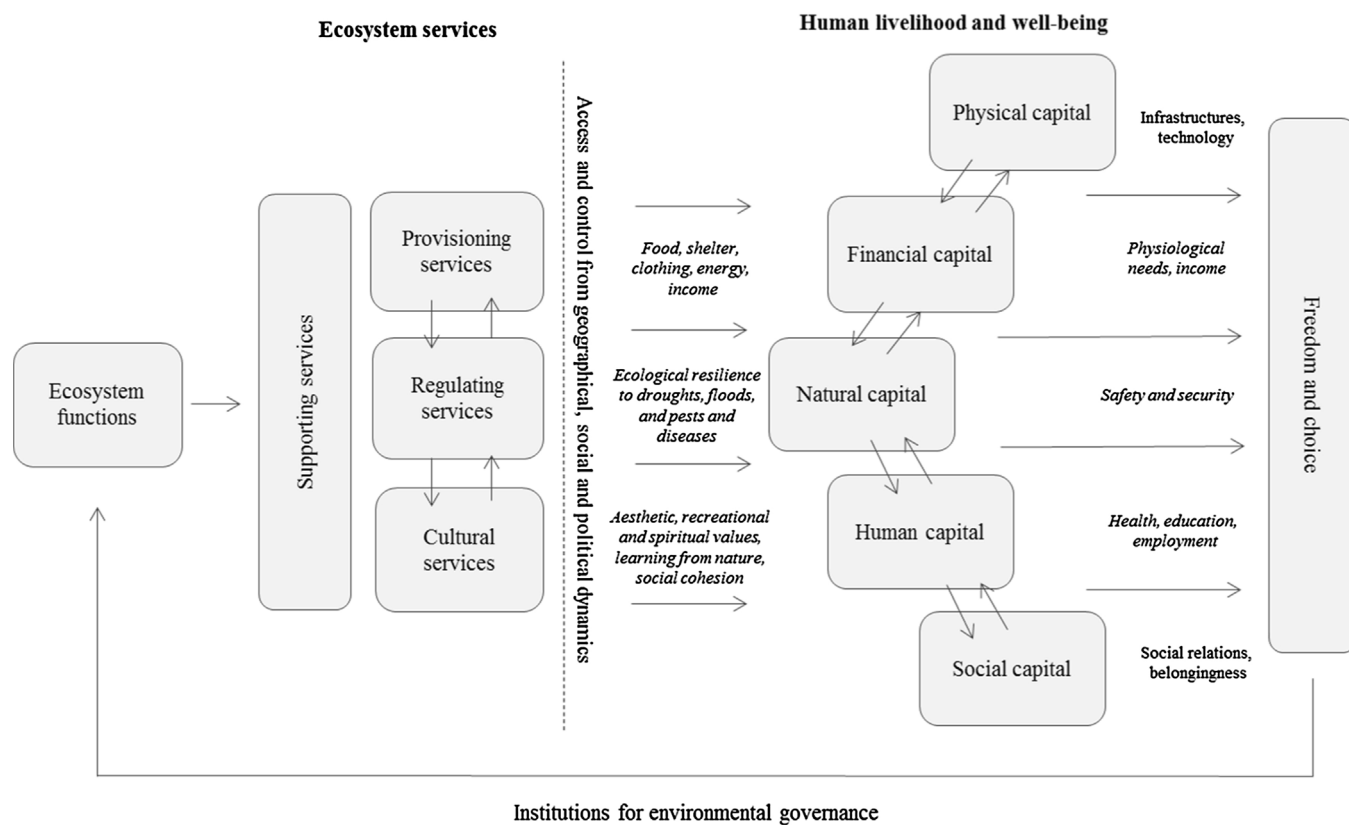


Fig. 1. Conceptual framework of ecosystem services and human well-being. Based on MA (2005) and Scoones (1998).

to be the associated with corporate long-standing socio-economic impact (see Toppinen and Korhonen-Kurki 2013).

Despite the increasing engagement of firms in sustainability and stakeholder issues (Brotto et al., 2016), there is a lack of consensus in the existing literature on the meaning of sustainability and how to achieve it in practice. For instance, a comparative analysis of opinions on plantation forestry recorded discordance among company internal and external stakeholders due to ideological differences and base-line expectations (Gordon et al., 2012). According to Nylund and Kröger (2012, p. 238) 'long-term business sustainability of forest industry must be more inclusive of local perspectives in management strategies'.

This rationale is in line with the concept of shared value proposed in business literature (Porter and Kramer 2011), according to which it is in companies' strategic interests to pursue activities that are inclusive and beneficial to all stakeholders and society overall. This concept includes an idea of partnership creation with relevant actors, including communities, NGOs and academia, rather than a vertical approach to value sharing. Critiques of this concept are made to the weak assumption that win-win solutions always exist and are simply implemented (Crane et al., 2014). In reality, there are almost inevitably trade-offs between economic, ecological and social sustainability dimensions (Hahn et al., 2010). Nevertheless, the concept of shared value provides inspirational perspectives that address the interdependency between businesses and society.

3. Methodology

3.1. Study area

Guangxi province is a mountainous region with a sub-tropical climate, which is suitable for plantation forestry. Like other areas in China, Guangxi has undergone a consistent reforestation process.

About 57% of the land area is classified as forest, more than half of which belong to commercial forests (Cossalter and Barr, 2005). The forest sector has greatly contributed to provincial industrial development, and to the overall economic and social development (Huang and Zhao, 2014). Other important land-use types include farming (including cash crops) that cover 30% of the province's area. *Eucalyptus* plantations represent an important element in Guangxi and China. *Eucalyptus* was introduced in China in 1890 for ornamental purposes. *Eucalyptus* has then been promoted after the founding of the People's Republic of China in three stages: an initial phase (1949–1977), a promotional phase (1978–2000) and a large-scale development phase (2001–present). Large plantation areas were developed from the 1950's onwards (Bai and Gan, 1996), followed by the 2000's rapid development of forestry and industrial plantations with consistent investments from domestic and international forest companies (Zhang et al., 2015).

Land is owned by the state in China, thus land use rights are assigned by the government to state-managed enterprises, collectives and households. Therefore, companies cannot buy land, but they can acquire land use rights through leasing land from the state or collectives of households. Several forestry companies operate in this province, and they mainly manage *Eucalyptus* plantations for commercial production. Land in China is typically parcelled (Tan et al., 2006), and plantations in lowland are embedded in a mosaic of villages and agricultural landscapes, while highland is not suitable for agriculture.

In the study area, industrial plantations have been managed by a company for about 14 years, covering about 0.7% of the provincial land area (UNDP, 2012). Even though substitution of natural forest in favour of plantations has been recorded in China (Zhai et al., 2013), this is not the case for the study area where forestry operations have excluded natural or protected areas. Specifically, the study area was already occupied by plantations before the arrival

of the company (UNDP, 2012). About 800 000 people dwell in the area interested by plantations (Appendix, Figs. A1 and A2).

3.2. Questionnaire design

Qualitative research design was regarded to be the most suitable methodological approach given the explorative nature of this study. The semi-structured questionnaire comprised both open-ended qualitative items and multiple choice questions, in order to collect qualitative perception data and simultaneously quantify some of the data on ES. This combination of question types can counteract the biases of single data sources (Tashakkori and Teddlie, 2010).

The questionnaire's design was inspired by the Toolkit for Ecosystem Service Site-based Assessment (TESSA) (Peh et al., 2013). TESSA guidelines are intended for assessing ecosystem services in sites of biodiversity and conservation importance, but we suggest that they can be loosely applied in our study to elicit people's perspectives of ecosystem services under conditions of intense land use transformation. Given a defined site, TESSA guidelines prescribe to identify the current situation, including policy context, habitats and drivers of changes, relevant ecosystem services and beneficiaries.³ They then propose to identify a future alternative state to the current situation. The comparison of current and alternative situations allows to identify eventual changes in benefit distribution. The research questions were therefore framed as follows: 1) What are the rural communities' perspectives of the changes in ecosystem services and local development after the establishment of industrial plantations? 2) What are the rural communities' perspectives of the community livelihood development and the relationship between the company and the community? These questions allow gathering information on the current and future situations.

To gather data about the current situation, open questions were used to elicit interviewees' opinions on the following topics: familiarity with the plantations; engagement with the company for plantation-related work activities or for leasing the land; frequency and reasons of visits to the plantation area; when and for what purpose plantations were established; what happened when plantations were established; the situation before the establishment of *Eucalyptus* plantations; changes after the establishment of *Eucalyptus* plantations; and any other issues. In addition, we employed closed-ended questions to quantify changes on selected ES. For this purpose we used a 5-point scale similar to the Likert-type, through which interviewees were asked to rank the seriousness of the consequence for selected ecosystem services and local development items on a five point symmetrical scale ('Improved' – 'No change' – 'Worsened'), with the extra option to indicate that they were not familiar with the issue ('I don't know'). Twenty relevant ecosystem services were selected for the questionnaire from the MA (2005) and TEEB (2010) classifications based on prior research and field observations in the area. The advantage of the ecosystem services approach is that it allows to assess the impacts on selected ecological items, by 'unpacking' the otherwise generic and bundled concept of 'environment'. The selected ecosystem services belong to four categories: 1) provisioning services, including quantity of water for domestic consumption and farming, farming opportunities, beekeeping opportunities, firewood and non-timber

products; 2) regulating services including water quality, soil fertility, occurrence of storms & typhoons, occurrence of droughts, forest fires, pest and diseases, air quality, local climate, noise, number of wild animals; 3) cultural services, including recreation, ecotourism, landscape-beauty, and spiritual-value; 4) supporting services, including maintenance of biodiversity (in our analysis approximated to 'number of wild animals'). In order to assess changes in local development and livelihood, we considered five items: income, road situation, health facilities, educational facilities, job opportunities.

The future of local communities, that we consider the alternative state, was elicited by open-ended questions on the following topics: perceptions on private or public support received by the community after the establishment of *Eucalyptus* plantations and suggestions on how to develop community livelihood in the future. This part of the questionnaire was inspired by a qualitative research method called event-based narrative inquiry technique (Helkkula and Pihlström, 2010). This technique is used in product and service innovation research and it allows the elicitation of information from interviewees under a hypothetical scenario. In the light of the conceptual context of this research, we thus aimed at identifying potential opportunities that might encourage development and forms of mutually beneficial partnerships between the company and the local people.

3.3. Sample and data analysis

Social science research in developing countries poses several challenges (Bulmer and Warwick, 1983). Precise census information is often lacking or unavailable, and boundaries of sample units (e.g. villages, households) are difficult to define, which hampers random sampling. Moreover, interviewees with a limited educational background may be unfamiliar with the vocabulary and numerical or statistic logic behind a questionnaire, including concepts such as areas harvested or yields. Interviewees may also be suspicious or fearful about the purposes of the research, and remote areas may be difficult to reach. Consequently, the response rate and the quality of the answers are difficult to predict and ensure. A convenience sample is recommended under such challenging working conditions. Despite the limitations related to representativeness of the desired population, this kind of sampling approach has the advantage of interviewing villagers that are fully familiar with the questionnaire's topics.

We selected 17 villages located nearby to industrial plantations for our sample. This selection was influenced by the travel distance, i.e. less than two hours from our location and included lowland and highland villages. The interviews were conducted in places of aggregation within the villages, such as small shops or commune courtyards. Interviewees were selected randomly on site among the people present at the time, but there was a component of snowball approach whereby some interviewees would suggest and prompt other villagers to talk. Men were generally more prone to being interviewed than women. The sample selection was also affected by villagers' willingness to be interviewed.

Each interview was conducted individually, despite the locals' tendency to assist and participate during all interviews. The interviews lasted between 10 and 60 min, with a 20 min average. The length was influenced by interviewees' knowledge and attitude towards disclosure. We collected 80 interviews in total, but had to discard 10 of them, because the interviewees had moved to the study area only after the establishment of the industrial plantations, and thus they could not provide reliable information on the before-after comparison.

Prior to data analysis, all interview notes were transcribed and translated in English. Numerical data were analysed using descriptive statistics and cross-tabulation. We also examined the

³ The study site was already familiar to the authors, as we conducted there previous research on managers' and experts' views of industrial plantations and ecosystem services (D'Amato et al., 2016b). Thus, we already had gathered insights on the local policy and administration. The overall Chinese policy context regarding forest conservation and resource management was covered in D'Amato et al. (2016a).

correlations between demographic variables and numerical data on ecosystem services and local development using Spearman's coefficient test. Qualitative data were treated with content analysis, and specifically coding. The unit of analysis was the interviewee, on behalf of his/her household.⁴ The interviews were read several times in order to develop codes and consolidate them into themes (Gioia et al., 2013; Krippendorf, 2003).

Existing literature and other material (e.g. corporate reports) was used to support the interpretation of data. Data validity and reliability were ensured by adopting the following measures: 1) The questionnaire was created in English and then translated into Chinese. Prior to the study, the questionnaire was evaluated for suggestions and amendments by five experts, including researchers and forest company managers; it was then pre-tested on 15 Chinese individuals from different cultural backgrounds, e.g. urban citizens to sub-urban and rural villagers. 2) The ecosystem services terminology and key concepts were simplified to be easily understandable for the targeted interviewees. 3) The questionnaire was interview-administered in order to minimize discrimination against the less literate. 4) The interviews were led by two Chinese-speaking researchers and the entire process was supported by local interpreters to mitigate the difficulties in understanding regional dialects. 5) Before each interview commenced, we explained that our aim was to collect local villagers' opinions for scientific research purposes only, and that informants would stay anonymous. 6) The interviews were recorded when allowed by the interviewee. 7) Small presents, such as food, umbrellas or mugs, were given to interviewees as recompense for their time and availability and also to encourage disclosure. Our gifts were rather symbolic, thus we assume that they did not affect interviewees' answers as postulated in methodological literature (Ahlheim et al., 2013). 8) Some data obtained from villagers' interviews were triangulated with five village-level interviews conducted with local villager leaders. These interviews included general questions about the village and the relations with industrial plantation operators. These data were not included in the analysis, but they were only used to cross-check and aid the better interpretation of the villagers' answers.

4. Results

4.1. Familiarity with industrial plantations

Our 70 interviewees comprised 15 women and 55 men between 18 and 86 years old (Table 1). The interviewed villagers' main source of income was from agriculture, including tending crops, animals and aquaculture. Furthermore, several households stated to receive money from their younger family members working in the cities. The interview data suggest that almost all interviewees were aware of the *Eucalyptus* plantations established for commercial use and managed by an international company operating locally. Only two-thirds of interviewees recalled the year when the company started its activities, and their answers ranged from 2004 to 2010. A small portion of interviewees worked for that company, and mostly as seasonal workers in plantations (e.g. fertilizing and removing weeds). Some interviewees had visited the company's plantations for work, to learn about plantation management, or occasionally to herd their livestock, or to visit graves situated inside the plantation area. Half of the interviewees stated that they had some experience with land-leasing to the company. Land-leasing agreements were not made directly between the company and individual vil-

lagers. Instead, contracts were made between the company and the production team comprising several households.

4.2. Perceived changes in ecosystem services and local development

Based on the answers to the open-ended questions, more than half of the interviewees (57%) considered the overall situation worsened after the establishment of the industrial plantations, 24% did not find any difference, 11% stated that the situation had improved; the remaining interviewees did not comment. Prior to being planted with *Eucalyptus* plantations, the lowlands were cultivated with agricultural crops; some hills were left barren or occupied by pines or 'local'⁵; *Eucalyptus* species. The villagers had a more positive attitude towards the 'local' *Eucalyptus*, but the *Eucalyptus* species planted by the company was mainly regarded negatively. Several villagers stated that they were obliged to shift from agricultural activities to *Eucalyptus* planting because the environmental conditions were no longer favourable for the growth of their agricultural crops (e.g. cassava, sugarcane, peanuts, sweet potatoes, beans and rice) after the company's establishment of *Eucalyptus* plantations, as illustrated in the following quotes: 'Once a household planted *Eucalyptus*, many households had to follow it because *Eucalyptus* plantations had some negative effects on the areas nearby' (male, 35); 'Because the lands near the plantations were no longer suitable for the other crops or trees, I followed the company's advice and also planted *Eucalyptus*' (male, 50).

Several villagers lamented negative environmental changes, especially regarding water quality, water quantity, soil and air quality. Two interviewees even thought that *Eucalyptus* was harmful to human health, 'After the establishment of the plantations, water has been badly affected. The colour of the water in my farmland changed to black or blue after the fallen *Eucalyptus* leaves dropped into it. I think the soil has been eroded.' (male, 30). However, two other villagers stated that these were just rumours: 'Last year a rumour was widely spread in our village that *Eucalyptus* is poisonous and very harmful to people's health, and that plantations would be prohibited next year. [...] I guess some people spread the rumour on purpose to get more land at a lower price [...]' (female, 43).

A few villagers mentioned additional reasons for establishing household plantations. *Eucalyptus* is more suitable than cassava for planting on hilly land. Furthermore, plantations require less labour and time than agricultural crops, and this is especially important considering the lack of young workforce in the villages. Some interviewees stated that they now had additional free-time to enjoy, but a few others perceived the additional free-time negatively. There seems to be no main change in income for those who have planted *Eucalyptus*, because several years have to elapse before harvesting. *Eucalyptus*, however, may provide more profit than agricultural crops in the long-run, if no typhoon occurs. 'There are two motives for us to plant *Eucalyptus*. One is economic benefit: if typhoons do not occur, we can get more profit compared to growing sugarcane and cassava. The other reason is to save labour: since young people went to work in cities or towns, only children and old people are left in the villages. *Eucalyptus* plantations do not need much of a labour force' (male, 35); 'It is hard to say if the situation is better or worse now. If there are no strong typhoons, *Eucalyptus* plantations could definitely bring better income, but unfortunately, there were two typhoons last year' (male, 42).

Based on the numeric data (Figs. 2 and 3), none of the interviewees considered the state of ecosystem services or local

⁴ The administrative structure of the population is as follows: the basic unit is a household, composed of a head and several other relatives; households aggregate into a production team; production teams compose a natural village; two or more villages form an administrative village.

⁵ The villagers drew a distinction between the *Eucalyptus* species planted before the establishment of industrial plantations, and the species introduced by the forest company.

Table 1
Demographic data of the interviewees.

	Female	Male	Tot	
Number of interviewees		15	55	70
Age (mean)		50	48.1	48.6
Household head		33.3%	74.5%	72.8%
People in household (mean)		6.5	7.2	7
Years lived in the area ^b		35.2	47.8	45.1
Education	None	13.3%	1.8%	4.3%
	Primary	46.7%	16.4%	22.8%
	Secondary	40%	50.9%	48.6%
	High school	0%	30.9%	24.3%
Ethnicity	Han	93.3%	92.72%	92.85%
	Hakka ^a	6.7%	7.3%	7.1%
Worked for the company		13.3%	5.4%	7.1%
Leased to the company		20%	60%	51.4%
Visit the company's plantations		20%	18.2%	18.6%

^a Hakka is a sub-ethnicity of Han.

^b Minimum 15 years.

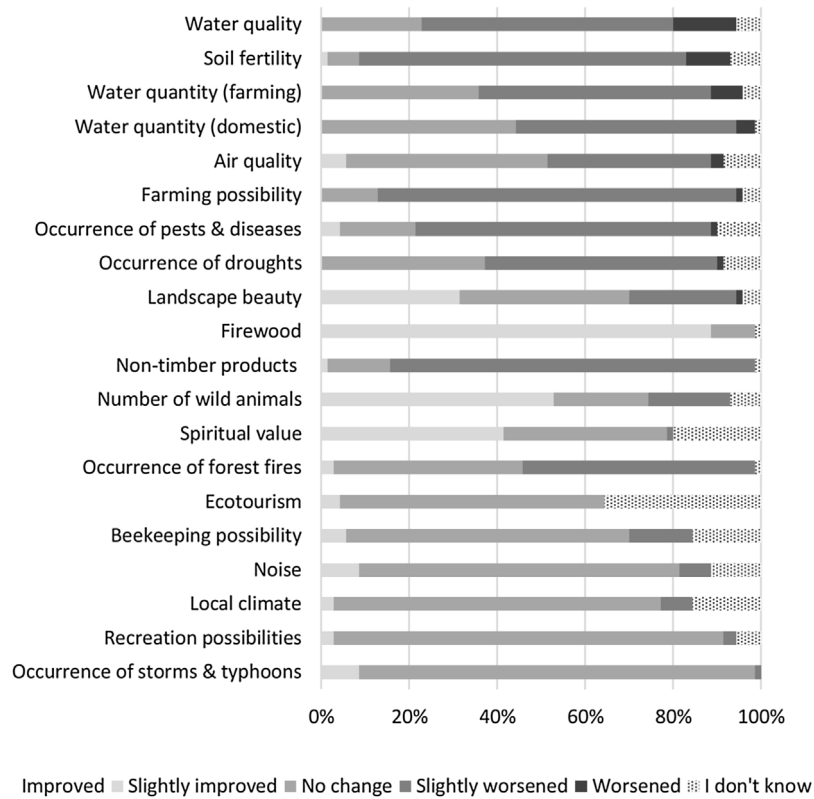


Fig. 2. Villagers' perspectives of changes in ecosystem services after the establishment of industrial plantations.

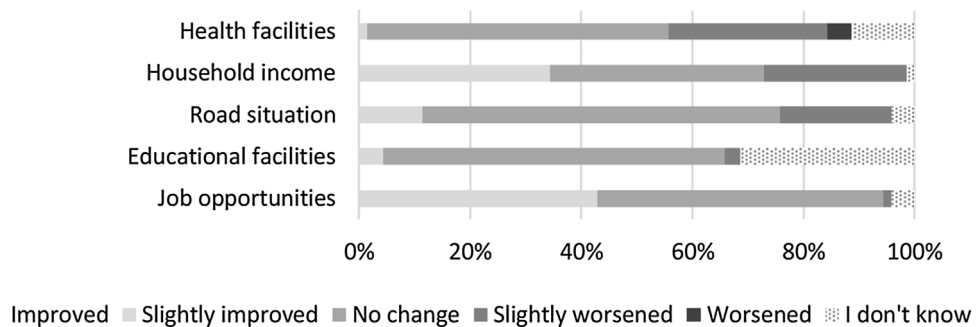


Fig. 3. Villagers' perspectives of changes in local development after the establishment of industrial plantations.

development indicators improved after the establishment of industrial plantations. Most interviewees opined that nine of the ESs had worsened slightly. These usually included changes in the quantity of non-timber wood products available for collection, farming and beekeeping opportunities/activities, quantity of water for farming, quality of water, fertility of the soil, and occurrence of droughts, crop pests and diseases and forest fires. The quantity of water for domestic consumption stayed the same for 44% of interviewees, while it slightly decreased for 50%. Air quality stayed the same for 46% of the interviewees, and slightly worsened for 37% of the interviewees. One interviewee stated that *'the air becomes more stuffy and hotter'* in the plantations.

The amount of firewood available for collection and the number of wild animals was considered to have slightly improved by respectively 89% and 53% of interviewees. Several interviewees, however, stated that they mainly use methane rather than firewood. Four interviewees commented that the numbers of birds had decreased, and one interviewee stated that only some species had increased in numbers. Landscape beauty remained the same for 39%, whereas 31% noticed a slight improvement and 24% a slight worsening. This finding was confirmed by the qualitative interviews: some interviewees appreciate the greener landscape more after the establishment of the industrial plantations; alternatively, some preferred the previous landscape, with 'local' *Eucalyptus* and pines. Moreover, 41% of the interviewees reported a slight improvement in spiritual value, whereas 37% found no change, and 20% could not provide a specific answer. The opportunities for recreation and ecotourism stayed the same (respectively 89% and 60%), but about one-third of the interviewees were not able to give a specific answer. Noise, local climate and occurrence of typhoons stayed the same for 73%, 74% and 90%, respectively.

The overall understanding was that the state of provisioning services worsened, with the exception of firewood. Regulating services showed different patterns: water quality, soil fertility, occurrence of droughts, pests, diseases and forest fires worsened, whereas other services stayed the same. Cultural services mostly remained the same, with the exception of landscape beauty for which contrasting opinions were expressed. The numbers of wild animals – proxy for the supporting service 'maintenance of biodiversity' – increased.

Interviewees' opinions about local developments after the establishment of the company's *Eucalyptus plantations* on household income varied. Similar proportions of interviewees stated that income slightly decreased (26%), stayed the same (39%) and slightly increased (34%). Job opportunities either slightly increased (43%) or stayed the same (51%) for most. Educational facilities did not change for 61%, but 31% of the villagers could not give a specific answer. Most interviewees stated that health facilities stayed the same (54%), though some opined a slight worsening (29%) or even a worsening (4%). Road conditions improved slightly for 11%, did not change for 64% and worsened slightly for 20% of the interviewees.

The villagers involved in land leasing to the company had a more negative opinion about the effects of industrial plantations on water quality ($p = 0.004$, $r = 0.337$).

4.3. Development of local community livelihoods

The great majority of the interviewees stated that they had not received any support for local community development from the company or from the government. Acknowledged support included building or repairing facilities and infrastructures for schools and roads. Almost all interviewees provided suggestions on how to develop community livelihood in the future, and these are listed in Table 2.

The interviewed villagers wished to receive more financial and local development support from either the government or the

Table 2
Desired measures for development of future community livelihood.

Agency	Measures
Government	Financial & local development support Capacity building
Company	Financial & local development support Capacity building Employment
Both government and company	Fixing the water problem No planting of <i>Eucalyptus</i> Planting other commercial crop species

company in the future, including road maintenance and subsidies for fertilizers. Furthermore, they suggested that capacity building would be important, e.g. how to plant and manage their own household-scale *Eucalyptus plantations*. A few interviewees also hoped to have more employment opportunities from the company. Some villagers suggested that *Eucalyptus plantations* should be substituted by agricultural crops, or by different species of pines or 'local' *Eucalyptus* trees.

The following quotes illustrate some of the villagers' expectations: *'I hope the company can send some experts or technicians to teach us how to fertilize more effectively, and some specific techniques (e.g. the distance between two trees), so that we can take better care of our own plantations with less input. Also financial support either from the company or the government is appreciated, for example subsidies for fertilizers'* (female, 54); *'I hope the company can provide some job opportunities. [As the Eucalyptus have replaced crops], villagers have now more spare time. I hope the government can take advantage of the increased spare time to increase our income'* (male, 36); *'I hope the company or the government can renovate the roads in our village [...]. Moreover, building an elementary school in our village would be highly appreciated, because currently my kid has to walk 3–4 km to go to school'* (male, 32).

Following the frequent concerns expressed about water quality, some interviewees expected a solution from either the government or the company for improving water quality. One of the interviewees suggested building a buffer zone between the reservoir and the plantations. Some interviewees felt negatively towards plantations, and they wished that the situation could go back to the time before the establishment of the plantations, or at least that no more *Eucalyptus* trees would be planted: *'In our village, quite many people breed/produce fish and shrimp, so water quality has a major effect on income. After the establishment of the industrial plantations, water quality has become worse due to the fallen Eucalyptus leaves. I hope that the government or the company can build some buffer zones between the reservoir and plantations which, I believe, will lead to better water quality'* (male, 59);

'Although I think the water is not poisonous, the colour makes me uncomfortable. I don't know whether the decrease in crop output is directly related to the water, but this phenomenon took place after the establishment of the plantations. I hope the company can provide us with information in simple language so that people of low education can understand' (male, 36); *'I don't know: it felt like all of sudden that all the lands were covered by Eucalyptus. I hope the typhoon can blow down all the Eucalyptus. [...]. No Eucalyptus, please! I hope the situation can go back to the past, before the establishment of those plantations'* (female, 38).

One of the interviewees even suggested an example of multi-functional management of plantations: *'I think that the plantations are currently suitable for keeping chickens and ducks. I hope the company can make their plantations more suitable for [these activities]'* (male, 72). Some villagers also mentioned their desire to plant some other commercial crop species. *'It would be best if the government could introduce some other projects, for instance, fruit trees (e.g. litchi, longan)'* (male, 30).

5. Discussion

5.1. Communities' perspectives of plantation forestry

This study dealt with local community's perspectives of the effects of industrial plantations on selected ecosystem services and local development in the context of southern China. We also investigated villagers' opinions on the future development of local community livelihoods. Because our sampling process was non-random and it excluded off-site villagers, the findings cannot be generalized beyond the sample, but need to be interpreted strictly in light of the context. Nonetheless, the validity of our data is confirmed, since the information obtained from villagers was found to be generally consistent with that obtained from village leaders, despite different levels of knowledge and perspective.

Most interviewed villagers expressed some negative opinions about environmental impacts of industrial-scale plantations, especially on soil quality and water quality and quantity. Several interviewees indicated that the industrial plantations had triggered a cascade effect by which nearby farmers started to establish household-scale *Eucalyptus* plantations, partly due to the fact that the environmental conditions after the establishment of industrial plantations were no longer suitable for agricultural crops. Although *Eucalyptus* plantations have been found in some cases to reduce productivity of adjacent crops, the establishment of household-level plantations is also likely to be motivated by financial drivers, since plantations can offer a more remunerative alternative to cash crops (Matthies and Karimov, 2014; Mekonnen et al., 2007), as also mentioned by some villagers during the interviews.

Furthermore, several villagers complained that falling *Eucalyptus* leaves darken the water, affect the taste, smell and quality of water. This phenomenon is scarcely discussed in literature. A study on terrestrial and aquatic fauna in *Eucalyptus globulus* plantations in Portugal (Canhoto and Laranjeira, 2007) reported that small pools of water get isolated from streams in summer, and change colour due to leaf leachates, which include tannins and phenols. Despite villagers' fears, however, such a phenomenon does not pose a threat to human health (UNDP, 2012).

Our results indicate that villagers involved in leasing agreements with the forestry-company were more negative when commenting on water quality. It is worth noting that irregularities have occurred in the land-leasing agreements between international companies and the local villagers (Li and Wang, 2014), where the presence of dishonest intermediaries hampered the rightful payments. This has resulted in some resentfulness from the villagers towards the company that manages the plantations. It is possible that villagers' views of plantation's environmental impact may be exacerbated by the already negative feelings they have towards the company. Otherwise, opinions among interviewees tended to be rather homogeneous within different demographic groups, even though previous studies have shown that environmental awareness is influenced by education and gender (Zhang et al., 2014). The recorded increase in timber availability is explained by the more abundant resources due to household plantations, and by the households' increasing use of commercial fuel (Qu et al., 2016).

In analysing the villagers' opinions on cultural ES, it is worth noting that within Chinese culture, people may have a different approach to valuing nature compared to their counterparts in western cultures. A comparative study between Swiss and Chinese respondents reported that Chinese participants did not have biodiversity-driven aesthetic preferences in forest ecosystems, unlike their Swiss counterparts. In Chinese culture, 'nature is commonly viewed as being alien and worthy of improvement by human manipulation', and environmental education has been low until recently. Furthermore, Chinese people may have 'a more

instrumental view of the natural world' (Lindemann-Matthies et al., 2013, p. 7). These considerations may explain why several of our interviewees showed aesthetic preferences for monoculture landscape rather than the barren native landscape.

The divergent opinions about incomes and roads can be explained by the fact that changes related to those items are likely to be villager- or village- specific. Perceived changes in household income depends on whether the villager had established her/his own *Eucalyptus*-plantation and/or whether he/she or a member of the household had ever been employed by the company. The road networks of different villages might also be subjected to different levels of maintenance by the government or the company, and/or overloading due to company's activities. The worsening of health facilities perceived by some interviewees can be interpreted as a misunderstanding of the questionnaire content by the interviewees. The villagers may have given their opinion about perceived changes in their own health, rather than about actual facilities.

Overall our findings reflect some of the social and environmental effects identified with plantation forestry worldwide in the available literature, including both positive and negative factors (Cossalter and Pye-Smith, 2003; Schirmer, 2006). Positive impacts generally include the revitalization of the rural economy, whereas negative impacts included adverse environmental effects. The results also reflected some context-specific social and environmental potential issues recorded for industrial plantations in the Guangxi region (UNDP, 2012) on water, air quality, biodiversity, safety risks from forest fire hazards and increased dust and noise levels.

5.2. Benefit sharing and development of community livelihoods

Our case study adopted a qualitative research approach, which is useful because it 'offers a grounded form of knowledge, which can address the full complexity of a situation, but also allows solutions to be tailor-made to unique circumstances' (Innes and Booher, 2010; p. 21). Some challenges associated with the plantation-based forestry, such as engagement of local communities (Mikkilä and Toppinen, 2008; Toppinen and Korhonen-Kurki 2013) are found to be common to several countries. Therefore, despite their context-specificity, our findings may have broader significance. The analysis of villagers' perspectives may also provide cues to further scientific investigations (Lugnot and Martin, 2013).

Most villagers stated that no support was received from the company or the government for their community development. According to the international company operating locally, however, there has been consistent corporate involvement in community development, with a focus on creating livelihoods and employment opportunities, supporting local infrastructure development and water stewardship (Water Guangxi, 2015). It is likely that the villagers are not aware of company's activities or are not able to distinguish between the company's and the government's involvement. In this regard, it seems there could be room for improving corporate communication about sustainability-related activities.

Moreover, it appears urgent to address villagers' concerns about perceived worsened environmental quality, especially the deterioration of water quality. Although fallen *Eucalyptus* leaves do not involve health hazards, water quality certainly represents a matter of direct well-being to local communities. A previous survey study on the water situation in Guangxi also revealed a great desire among the local population to improve the current condition of water resources, including drinking water quality and quantity, sewage treatment and water for irrigation purposes (College of Forestry department of Guangxi University, 2014).

To address such concerns, a water stewardship project set up by the company run from 2013 to 2015 in cooperation with local research centres and partners. Pilot sites were established to pro-

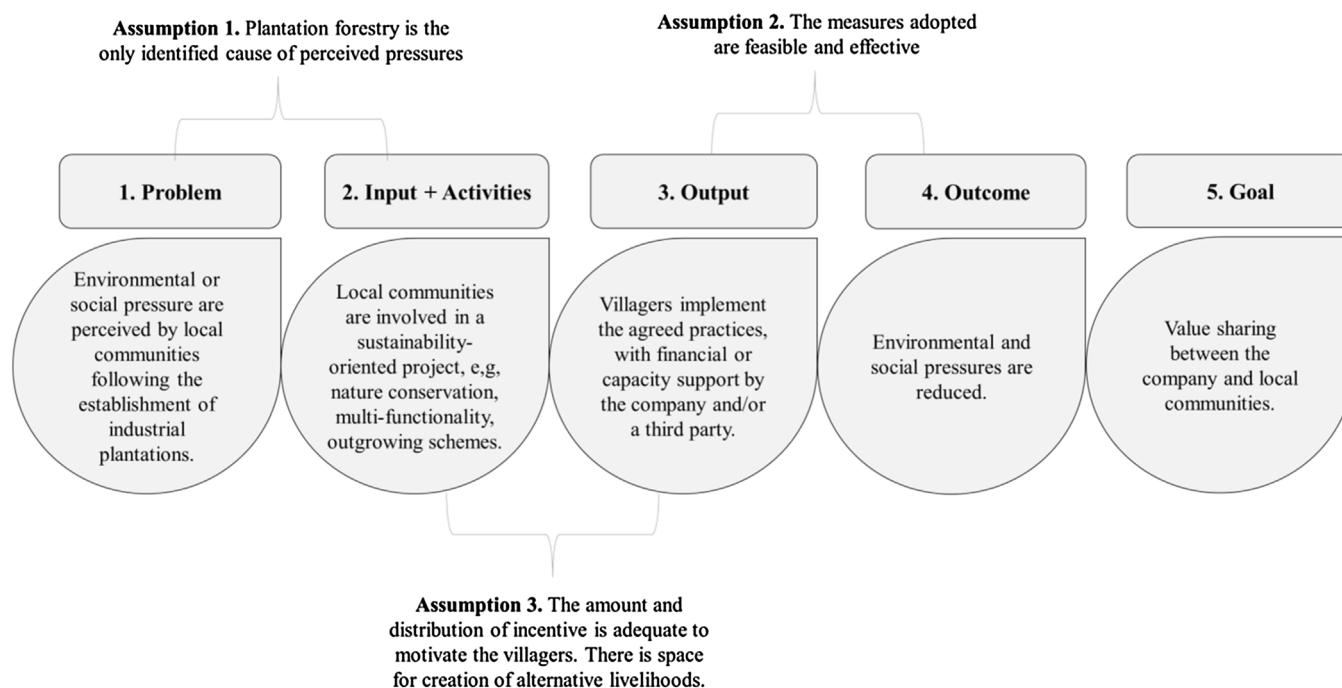


Fig. 4. A simplified scheme of inclusive community-engagement in the context of plantation-based forestry. The figure is inspired by The Logical Framework Approach used for designing and evaluating international development projects (Practical Concepts, 1978).

vide solutions for clean water provision and waste water treatment, by coupling artificial and natural-based solutions (e.g. development of sewage piping and constructed wetland). The project also included awareness building on water resource use among the population (Water Guangxi, 2015). Nonetheless, the problem requires further investigation into the state and dynamics behind water quality across the entire area where plantations occur.

Baral et al. (2016, p. 7) state that eventual negative effects on ecosystem services associated with plantations ‘are not the problem of planted forests per se but represent failures in policy planning, management and community engagement in the design and development of plantation estates. Although information on the occurrence of such impacts is vital to investors in plantations, their incidence can be minimised by proper planning and appropriate dialogue with stakeholders’.

A series of measures can be implemented to reduce such effects, including for example, limiting plantation area in each water catchment, reducing chemicals and fertilizers in use, as well as ‘incorporating biodiversity, habitat and social values into planted forest design and integrating with food production and/or conservation at local and landscape’ (see also Prejer et al., 2014).

In this regard, villagers’ feelings about the future of local livelihoods and the relations with the Eucalyptus plantations were found to be mixed. Many villagers wished for more support from the government or the forest industry operating in the region, either in terms of financial help (e.g. subsidies for fertilizers), local development (i.e. maintenance of roads, schools), or through capacity building for better household plantations management. Other interviewees, however, regarded the industrial plantations very negatively, even to the point of wishing for no further plantation activities.

To further develop corporate sustainability practices and the relations with rural communities, industrial plantation-based forestry may invest in monitoring of socio-economic effects, building partnerships for livelihood diversification, maintaining

employment equity and more actively employing local labour force (Landry and Chirwa, 2010; Muhtaman et al., 2000). Furthermore, ideas and pilots for stakeholder-inclusive business models or company-community partnerships at industrial scale have been emerging in several locations (Bowen et al., 2010; Greijmans et al., 2014; Prejer et al., 2014). It is worth further investigating the potential for community-engagement strategies which also better integrate the concept of ecosystem services (Cordonnier and Peyron, 2015). A simplified scheme is illustrated in Fig. 4. Such community-engagement may include: implementing environmental conservation projects on land surrounding industrial plantations (e.g. ecosystem restoration via a mosaic landscape approach); practicing multi-functional plantation management; designing alternative uses for adjunct buffer zones; joining out-growers schemes, where small-holders are contracted for timber or other resources.

The multi-functional management of plantations can draw on agroforestry practices, such as intercropping or the use of green fertilizers. Such practices can contribute to enhance carbon sequestration, soil quality, biodiversity, water quality and quantity, and other services, including cultural values (Jose, 2009; Wu et al., 2015). These mechanisms could result in better environmental practices by simultaneously fulfilling villagers’ need for employment opportunities and diversified livelihood structure. Improving management practices in the households’ plantations could also allow for the reduction in the aggregate *Eucalyptus* area. Moreover, the strategic benefit to the company is about securing legitimacy and co-developing innovative solutions (Bowen et al., 2010; Bernstein and Cashore, 2007; Halme and Laurila, 2009).

The proposed scheme in Fig. 4 is based on three assumptions. First, although causality is assumed to run between the company establishing the plantations and the environmental and social pressure perceived by the villagers, there might be multiple causes for the perceived environmental degradation in the study area. It is technically challenging to monitor different land uses at landscape

level and also take into account eventual negative impacts of surrounding agricultural or industrial activities. Second, it is necessary to determine whether and what kind of conservation or multi-functional management practices can be implemented outside the plantations and/or within the buffer zones that address different ecological and social goals. Multiple-purpose plantations are foreseen to be an important element in the future of forestry worldwide. They are however criticised for having insufficient transformational power when they only address biofuel production or carbon storage and exclude non-wood products or intangible values (Saturnino et al., 2016). Moreover, institutional feasibility is a main challenge to multi-functional land use in China and other emerging countries. In China, activities other than forestry may be limited by law, and also conflict with forestry operations. Third, community involvement requires sufficient incentives, capacity building and distributional equity, which has emerged to be a particularly critical issue due to the hierarchical power relations in rural communities in China (Li and Wang, 2014). It is therefore of fundamental importance to maintain a constant and open dialogue among the parties. It is crucial to acknowledge that 'an inclusive business model is tailored to the context in which it is operationalized' (Prejer et al., 2014; p. 98), and assessing context specific problems and developing new and creative solutions may call for local knowledge and a network of partners. Further development of partnerships with third parties, such as NGO's or consultants or governmental agencies, may be able to provide the needed intelligence and capacity for developing new projects, and ensure compliance with the pre-agreed conditions negotiated between the company and the villagers.

6. Conclusions

Environmental governance is shifting towards 'polycentric', 'multi-layered systems' (Gatzweiler, 2006) in which also the private sector plays a role by means of corporate sustainability. This requires that positive and negative impacts of private enterprises are comprehensively identified, acknowledged and addressed. This study investigated rural community's perspectives of social and environmental impacts at the presence of a plantation-based forestry company in southern China. The interviewed villagers perceived that, after plantation development, positive impacts on local development issues were coupled with negative environmental impacts.

This study is limited in that it only analyses subjective perspectives of local communities. These may not necessarily represent the objective reality, but they are fundamental to company viability through maintaining its reputation and social licence to operate. The value added of this article is that it addresses more comprehensively the interlinkages between environmental changes and human well-being, by disaggregating and assessing perceptions of several ecosystem services. This approach is rarely found in similar studies, which often focus on few environmental issues (water, soil erosion) (Suich et al., 2015).

The findings confirm the importance of assessing of benefit flows between beneficiaries groups to address 'potential social conflicts arising from the use of specific ecosystem services' by different individuals and stakeholder groups (Bennett et al., 2015; p. 78). In this context, key stakeholder groups may not necessarily be obvious or immediately identifiable (e.g. fishing communities affected by plantation development, cf. Van Holt, 2012). There is need for further assessments of gains/losses between actors in the context of land transformation (for instance across different land uses or plantation types, e.g. Pirard et al., 2017); and for improving corporate response mechanisms that integrate environmental and social values in plantation design and management.

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Appendix A.

Data collection in Guangxi, China (Article IV) (Table A1).

Table A1
Provenience of interviewees.

ID	Natural village 自然村	Administrative Village 行政村	Town 乡镇	Date 日期
1	旧桥 Jiuqiao	大岭村 Daling Village	廉州镇 Lianzhou Town	09.09.2016
2	罗屋 Luowu ^a	冲口社区 Chongkou Community	廉州镇 Lianzhou Town	09.09.2016
3	上峰/丰门 Shangfengmen	冲口社区 Chongkou Community	廉州镇 Lianzhou Town	09.09.2016
4	巫屋 Wuwu	青山村 Qingshan Village	廉州镇 Lianzhou Town	10.09.2016
5	李铺店 Lipudian ^a	大岭村 Daling Village	廉州镇 Lianzhou Town	10.09.2016
6	白鹤岐 Baiheqi	洪潮村 Hongchao Village	星岛湖乡 Xingdaohu Town	11.09.2016
7	枯江 Kujiang	洪潮村 Hongchao Village	星岛湖乡 Xingdaohu Town	11.09.2016
8	香炉面 Xianglumian	洪潮村 Hongchao Village	星岛湖乡 Xingdaohu Town	11.09.2016
9	上一/上塘 Shangyi/Shangtang	大岭村 Daling Village	廉州镇 Lianzhou Town	12.09.2016
10	旧村 Jiucun	大岭村 Daling Village	廉州镇 Lianzhou Town	12.09.2016
11	庆丰村 Qingfeng Village	庆丰村 Qingfeng Village	闸口镇 (Hakka) Zhakou Town	14.09.2016
12	虾公冲 Xiagongchong	闸口村 Zhakou Village	闸口镇 (Hakka) Zhakou Town	14.09.2016
13	下岭冲 Xialingchong	大岭村 Daling Village	廉州镇 Lianzhou Town	15.09.2016
14	黄塘根 Huangtanggen ^a	大岭村 Daling Village	廉州镇 Lianzhou Town	15.09.2016
15	大平/大平岭 Daping/Dapingling	珊瑚村 Shanhu Village	星岛湖乡 Xingdaohu Town	16.09.2016
16	潘屋 Panwu ^a	冲口社区 Chongkou Community	廉州镇 Lianzhou Town	17.09.2016
17	洪屋 Hongwu	冲口社区 Chongkou Community	廉州镇 Lianzhou Town	17.09.2016
18	下峰/丰门 Xiafengmen	冲口社区 Chongkou Community	廉州镇 Lianzhou Town	17.09.2016

Note: The levels of administrative divisions in China include: 1. Provincial; 2. Prefectural; 3. County; 4. Township; 5. Village; 6. Village communities/Natural Villages; 7. Production teams; 8. Households. Levels 6, 7 and 8 are not official, but hereby created to clarify the unit of analysis in Article IV.

^a These villages were not visited, but the collected data include interviews with informants from these locations.

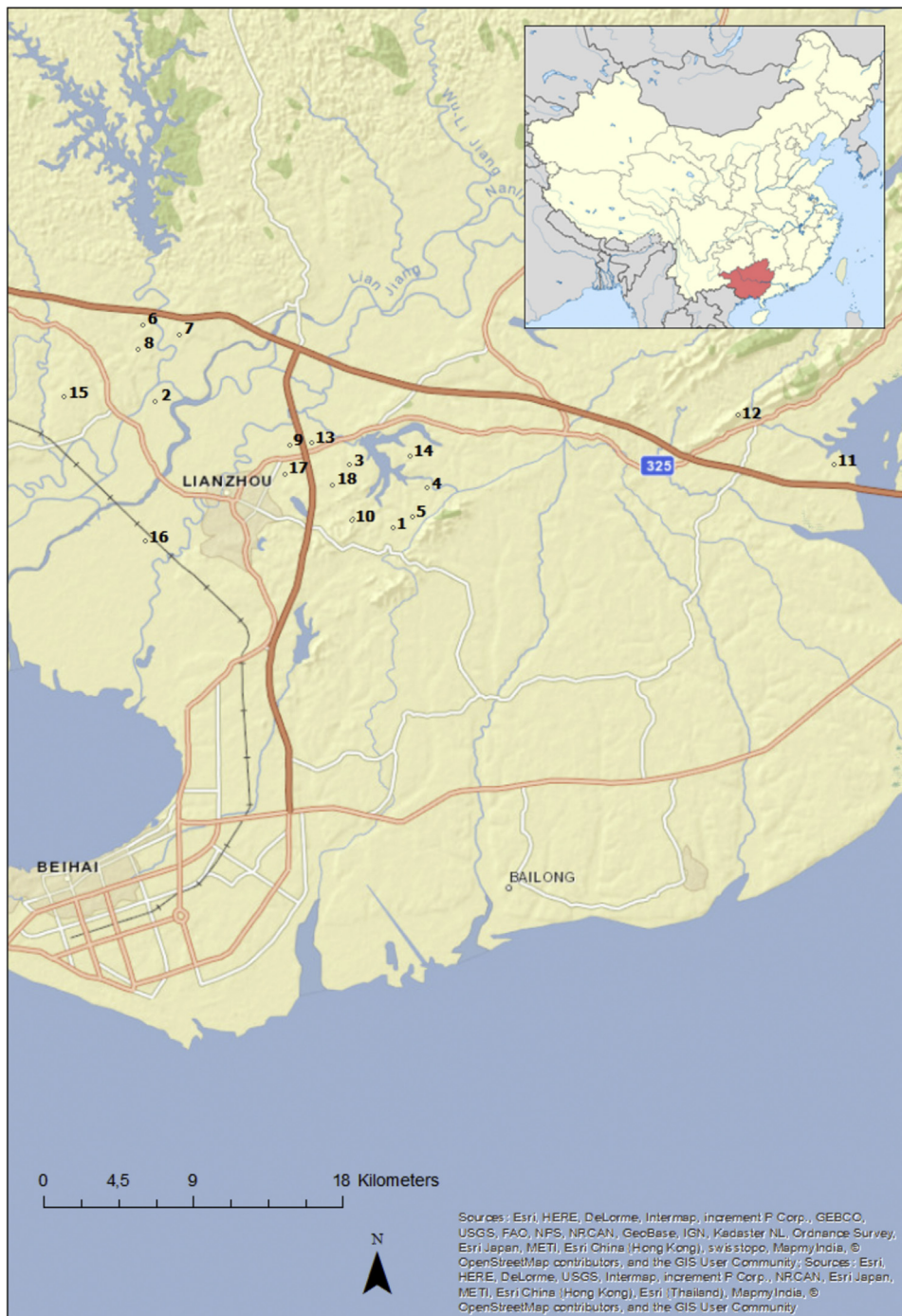


Fig. A1. Provenience of interviewees in Beihai area: villages from 1 to 18 (see Table 3). Top right: Guangxi province.⁶



Fig. A2. Forest cover in Beihai area based on satellite image.

Source: www.globalforestwatch.org (2016)

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