Dissertationes Forestales 221

The ecosystem services approach in corporate sustainability: results from industrial plantation forestry in China

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Academic Dissertation

To be presented, with the permission of the Faculty of Agriculture and Forestry of the University of Helsinki, for public examination in Auditorium XII of the Main Building, Fabianinkatu 33 - Päärakennus, Helsinki on the 19th of August 2016 at 12.00 noon.

Title of dissertation: The ecosystem services approach in corporate sustainability: results from industrial plantation forestry in China

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Dissertationes Forestales

http://dx.doi.org/10.14214/df.221

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ISSN 1795-7389 (online)
ISBN 978-951-651-532-1 (pdf)

ISSN 2323-9220 (print)
ISBN 978-951-651-533-8 (paperback)

Publishers:
Finnish Society of Forest Science
Natural Resources Institute Finland
Faculty of Agriculture and Forestry of the University of Helsinki
School of Forest Sciences of the University of Eastern Finland

Editorial Office:
Finnish Society of Forest Sciences
P.O. Box 18, Fi-01301 Vantaa, Finland
http:www.metla.fi/dissertationes

D'Amato, D. 2016. The ecosystem services approach in corporate sustainability: results from industrial plantation forestry in China. Dissertationes Forestales 221. 64 p. Available at: http://dx.doi.org/10.14214/df.221

ABSTRACT

The concept of ecosystem services, wide-spread in academia and policy making, emphasizes societal and economic dependence on natural systems for, among others, provision of food, fibres and water, regulation of climate and soil, and contribution to spiritual and cultural values. Anthropogenic pressures driven by rapid economic development are, however, causing a disruption in the benefits that humans obtain from ecosystems.

Several economic sectors both depend on and impact ecosystem services. There is therefore maturing expectation for the private sector involvement in environmental governance worldwide, as firms are increasingly motivated to pursue sustainability for financial or strategic opportunities.

This dissertation is among the first to address the current research void on the interactions between industries and ecosystem services. The topic is analysed in the context of extensive plantation forestry in the emerging economy of China. The main aim of this work is to investigate if and how the ecosystem services narrative can contribute to further develop corporate sustainability agendas and practices.

Based on the findings from this work, ecosystem services research can provide insights and tools to pursue a more comprehensive and holistic acknowledgement of and response to interlinked ecological and social issues in corporate sustainability. For instance it can enable the understanding of company impacts and dependencies on ecosystems, and associated business risks and opportunities; deepen the analysis of company stakeholders' perspectives and expectations; contribute to the design of sustainability-oriented practices; and enrich corporate disclosure practices.

Further operationalisation of the ecosystem services approach into corporate sustainability would require a more systematic assessment and comparison of the relations between relevant business sectors and ecosystems, the analysis of global-local trade-offs, the internalizations of concepts such as ecological limits and ecological resilience, and the elaboration of suitable corporate and industrial response strategies.

Keywords: China; Corporate sustainability; Ecosystem services; Forest sector; Plantations.

ACKNOWLEDGEMENTS

I am truly grateful to, and I wish to thank the following people:

My supervisors, Anne Toppinen and Mika Rekola, for having believed in me, and for their professional support and warm compassion.

Ning Li, Minli Wan, Dinglin Cai, and the team members from Nanjing Forestry University for their help and dedication during our joint research.

All the marvellous people I have met so far during my professional life, in particular Marianne Kettunen and Katja Lähtinen for the excellent advices and for their warm hearts.

The members of the 'Dork' club, Arttu Malkamäki, Brent Matthies, Jaana Korhonen, Jani Holopainen, Liina Häyrinen and Osmo Mattila.

All the people 'behind the scenes' that have contributed directly or indirectly to this work, including the interviewees, the anonymous reviewers and other colleagues and advisors.

My family and friends for their love and support.

I am also grateful to Finland, where I have been able to pursue my Life goals, and to Academy of Finland for funding this research.

Helsinki, August 2016

Dalia D'Amato

LIST OF ORIGINAL ARTICLES

This doctoral dissertation consists of five papers. Throughout the thesis, the papers are referred to by Roman numerals. Article I, II and III are accepted in peer-reviewed journals, and reprinted with the kind permission of the publishers. Articles IV and V are manuscripts in submission to peer-reviewed journals.

I D'Amato, D., Li, N., Rekola, M., Toppinen, A., Lu, F-F. (2015). Linking forest ecosystem services to corporate sustainability disclosure: a conceptual analysis. Ecosystem Services 14: 170-178. http://dx.doi.org/10.1016/j.ecoser.2014.11.017

II D'Amato, D., Rekola, M., Li, N., Toppinen, A. (2016). Monetary valuation of forest ecosystem services in China: a literature review and identification of future research needs. Ecological Economics 121:75-84. http://dx.doi.org/10.1016/j.ecolecon.2015.11.009

III D'Amato, D., Wan, M., Li, N., Rekola, M., Toppinen, A. (2016). Managerial views of corporate impacts and dependencies on ecosystem services: a case of international and domestic forestry companies in China. Journal of Business Ethics: 1-18. http://dx.doi.org/10.1007/s10551-016-3169-8

IV D'Amato, D., Rekola, M., Wan, M., Cai, D., Toppinen, A. (2016). Effects of industrial plantations on ecosystem services and livelihoods: perspectives of rural communities in China. (Manuscript).

V Wan, M., D'Amato, D., Toppinen, A., Rekola, M. (2016). Expert Stakeholder Perceptions of Forest Company Dependencies and Impacts on Ecosystem Services: A Case Study in China. (Manuscript).

DIVISION OF LABOUR IN CO-AUTHORED ARTICLES

	I	II	III	IV	V
Conception & design	DD, MR, NL	MR, DD	NL, DD	DD, MR,	DD, MR, MW
Planning & implementation	DD	DD, MR	NL, DD,	DD, MR, MW	DD, MW
Data collection	DD, NL	DD	NL, DD	MW, DC, DD	DD
Analysis & interpretation	DD,	DD, MR, NL	DD, MW	DD, DC, MW	MW, DD
Writing the article	DD, AT, MR, NL, LF	DD, MR, AT	DD, MW, AT, MR	DD, AT, MW, MR	MW, DD, AT, MR
Overall responsibility	DD	DD	DD	DD	MW

AT - Anne Toppinen; DC - Dinglin Cai; DD - Dalia D'Amato; LF - Lu FeiFei; MR - Mika Rekola; MW - Minli Wan; NL - Ning Li.

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1. INTRODUCTION

1.1 Motivation for this research

Sustainable development and sustainability have been keywords in the global research and political agenda for decades, striving for the simultaneous realisation of ecological, economic and social systems' goals[1] (WCED, 1987). So far, however, the maximization of these multidimensional and interrelated objectives has proved to be extremely challenging or impossible, also because of the vast differences in the interpretation and application of the sustainability concept (Costanza, 1996; Munda, 1997; Neumayer, 2003; Norgaard, 1989). Climate change, the global biodiversity crisis and ecosystems degradation are symptoms that anthropic pressures deriving from rapid economic development are exceeding the planet's carrying capacity (Rönnbäck et al., 2007). Furthermore, these environmental and ecological phenomena are linked to exacerbation of poverty and generational inequalities (IPCC, 2014; MA, 2005).

'Reversing ecosystem degradation while meeting increasing demands for their services […] involves a change in policies, institutions and practices that are not currently under way'. These conclusions were formulated by the Millennium Ecosystem Assessment (MA, 2005, p.1), a United Nation Environment Programme study on the global status and importance of ecosystems, and related services, to human beings.

The emerging concept of ecosystem services has gained momentum in sustainability discourses, as it emphasizes the societal and economic dependence on natural and semi-natural ecosystems. Ecosystem services include, for instance, the capacity of ecosystems to provide food, fibres and clean water, regulate local and global climate, maintain soil and nutrient cycles, control pest and diseases, and generate spiritual, aesthetic and cultural value (Fisher et al., 2009; Haines-Young and Potschin, 2010; TEEB, 2010).

The ecosystem services concept, bridging ecology, social sciences and economics, has been developed into a framework aimed at supporting nature conservation, in coexistence with sustainable development (Daily and Matson, 2008; de Groot et al., 2012). It therefore includes and expands the environmental leitmotifs of the past decades, such as halting climate change and biodiversity loss, and it addresses the sustainability trade-offs and benefit flows resulting from disparate human activities and ecosystem management (Bennett et al., 2015).

Ecosystem services research has particularly focused on developing meaningful indicators and assessing worldwide changes in ecosystem services, using qualitative, biophysical, mapping and economic approaches (Boyd and Banzhaf, 2007; de Groot et al., 2012; Fisher et al., 2009; Kumar and Kumar, 2008). Moreover, intense activity has been dedicated to investigating applications and limitations of this concept, especially in public environmental governance (Engel et al., 2008; Farber et al., 2002; Farley and Costanza, 2010; Fisher et al., 2008; Guerry et al., 2015; Primmer et al., 2015; TEEB, 2011;).

In the global political agenda, the ecosystem services approach is currently being mainstreamed under the concept of Green Economy, forwarded after the 2012 UN Conference on Sustainable Development in Rio de Janeiro (Rio+20) and the 2015

[1] According to Barbier (1987), ecological systems goals include e.g. genetic diversity, resilience, biological productivity; economic system goals include e.g. satisfaction of basic needs, enhancement of equity, increasing useful goods and services; and social system goals include e.g. cultural diversity, institutional sustainability, social justice, participation.

Sustainable Development Goals and its Agenda 2030. The approach is proposed as a (debatably) innovative framing and vehicle for nature conservation and poverty alleviation. The integration of biodiversity and ecosystem services values into public policies, through natural capital accounting and market-based instruments, is promoted simultaneously at international, regional and national level (EAA, 2013; UNEP, 2011; in Finland e.g. Jäppinen and Heliölä, 2015).

In addition, there is maturing expectation for the private sector to take a role in environmental governance worldwide (Bernstein and Cashore, 2007; Cashore et al., 2007; van den Burg and Bogaardt, 2014), as recently proposed in Rio+20 and the 2015 UN Climate Change Conference in Paris (COP21). The underlying logic is that since several economic sectors simultaneously depend and impact on ecosystems and society, directly or indirectly, it is in companies' interest to strive for a positive performance in the economic, environmental, and social dimensions (Dyllick et al., 2002; Houdet et al., 2012; Molnar and Kubiszewski, 2012; Winn and Pogutz, 2013).

In this context, the ecosystem services approach may offer tools and applications for deepening corporate sustainability goals and strategies. A range of reports, guidelines, tutorials and software on the linkages between business and ecosystem services have been issued in grey literature (GRI, 2011; Hanson et al., 2012; NCC, 2015; TEEB, 2012; Waage and Kester, 2014; WBCSD, 2011), proposing that company dependencies and impacts on ecosystems can lead to risks if ignored, or business opportunities if timely addressed. Some pioneering companies[2], together with non-governmental organisations (NGOs), consultants, or academia, have formed partnerships to explore corporate applications of the ecosystem services concept.

While the appropriate weight that the private sector should have on environmental governance is debatable and debated (Bernstein and Cashore, 2007; Gatzweiler, 2006), it is important to define its possibilities and limits. The relevance of the ecosystem services narrative to the private sector requires further scientific research (Armsworth et al., 2010; Whiteman et al., 2013).

For this purpose, context-specific approaches are attractive as they allow the exploration of the business-sustainability nexus by simultaneously addressing other gaps in ecosystem services and sustainability literature (Bennett et al., 2015; Braat and de Groot, 2012; Carpenter et al., 2006; Guerry et al., 2015). For example, a fairly abundant body of literature focuses on the benefits obtained by people from natural or semi-natural ecosystems (Landreth and Saito, 2014; Lugnot and Martin, 2013; Rönnbäck et al., 2007), while there is still potential for investigating changes in ecosystem services associated with intense land use transformation (Suich et al., 2015). Interesting studies in regard were conducted, for instance, by Anderson et al. (2013), Landry and Chirwa (2010) and Vihervaara et al. (2012).

These issues are especially relevant in light of the globalization and trade liberalization trends that have influenced global and local environmental management and governance (Aggarwal, 2006). The forest sector is an interesting example in this regard, as a resources-based industry which has experienced a great influence and transformation under globalization dynamics (Korhonen et al., 2014; Pätäri et al., 2015).

[2] Examples from the forest sector include international firms that have explored the role of the ecosystem services in corporate strategy (Fibria), in spatial mapping (Mondi), and in terms of developing sustainability reporting (Weyerhaeuser) (Hanson et al., 2012; Waage and Kester, 2014; WBCSD, 2011).

Public and private companies have had a significant role in driving the rapid propagation of fast-growing plantation forestry in the Global South, with consistent investments from Europe and North America to Asia and Latin America (Rudel, 2009; Toppinen et al., 2010). In particular, in the past decade, China has attracted investments from domestic and international companies (Zhang et al., 2014) as the fastest growing market for wood and paper products. This, coupled with national afforestation policies, has led to rapid reforestation and development of plantation-based forestry in China (FAO, 2015).

Managing industrial plantation forests, particularly in an emerging economy such as China, implies new challenges for meeting stakeholder expectations on corporate sustainability, from every day operations to broader social license to operate. Nevertheless, 'despite widespread discussion of the importance of understanding sustainability of plantations in China […] there remains little robust, documented research that documents and critically examines claims about many aspects of sustainability of China's large areas of tree plantations' (Schirmer et al., 2015, p. 158).

1.2 Aims

This doctoral dissertation investigates the linkages between ecosystem services, forest enterprises, and their stakeholders in the context of plantation forestry[3] in China.

The main aim of this thesis is to examine if and how the the ecosystem services concept and framework can contribute to further develop the concept and applications of corporate sustainability. More specifically, this dissertation includes the following individual articles with their respective research questions:

I. Which ecosystem services-related indicators are currently included in corporate sustainability disclosure, and how they could be further developed?

II. What is the state of the art of scientific research dealing with monetary valuation of forest ecosystem services in China, including methodological approaches and estimated monetary values?

III. What are the perspectives of managers from international and domestic companies on ecosystem services in plantation forestry in China, especially regarding company impacts and dependencies, and related business risks and opportunities?

IV. What are the perspectives of rural communities on the changes in ecosystem services and local development induced by industrial plantations in China; and what are the expectations for livelihood development?

V. What are the perspective of company external expert stakeholders (i.e. policy advisors, local authorities, industry associations and consultants, and NGOs representatives) on ecosystem services in plantation forestry in China, especially regarding industry impacts and dependencies, and related business risks and opportunities?

[3] Throughout this dissertation, plantation forestry is defined as fast-growing monocultures of (usually) exotic tree species for the production of fibres at industrial scale, established or managed by a public or private company. This excludes small-scale initiatives indipendently set-up by local communities. See Chazdon et al., 2016 for a review of key definitions.

2. THEORETICAL AND CONTEXTUAL BACKGROUND

2.1 Overall framework

This dissertation represents an attempt to integrate the concept of ecosystem services into that of corporate sustainability. Literature on ecosystem services is expanding rapidly (e.g. Fisher and Brown, 2014; Bennett et al., 2015), while a well-established body of literature already exists on corporate sustainability, (social) responsibility, and corporate citizenship (Crane et al., 2013; Dahlsrud, 2008). Nonetheless, these two research areas are only recently beginning to meet in scientific literature (Chaplin-Kramer et al., 2015; Othoniel et al., 2016; Winn and Pogutz, 2013). This section provides an overview of the theoretical backgrounds from both the ecosystem services and corporate sustainability literature. Furthermore, the contextual background of the research, focusing on the forest sector and plantation forestry in China, is also provided. Figure 1 represents the position of the individual articles across the concepts of corporate sustainability and ecosystem services, and across the contexts of plantation forestry and China.

The overall theoretical and contextual coverage of the dissertation is cohesive and covers complementary areas, since the individual articles were developed in the context of a specific research project. Article I deals with corporate reporting on ecosystem services in the context of the international forest sector and plantation forestry. Article II focuses on monetary values of ecosystem services in the context of forest ecosystems and expanding plantation forestry in China. Articles III, IV, and V all deal with corporate sustainability and ecosystem services from the perspectives of company stakeholders in plantation forestry in China.

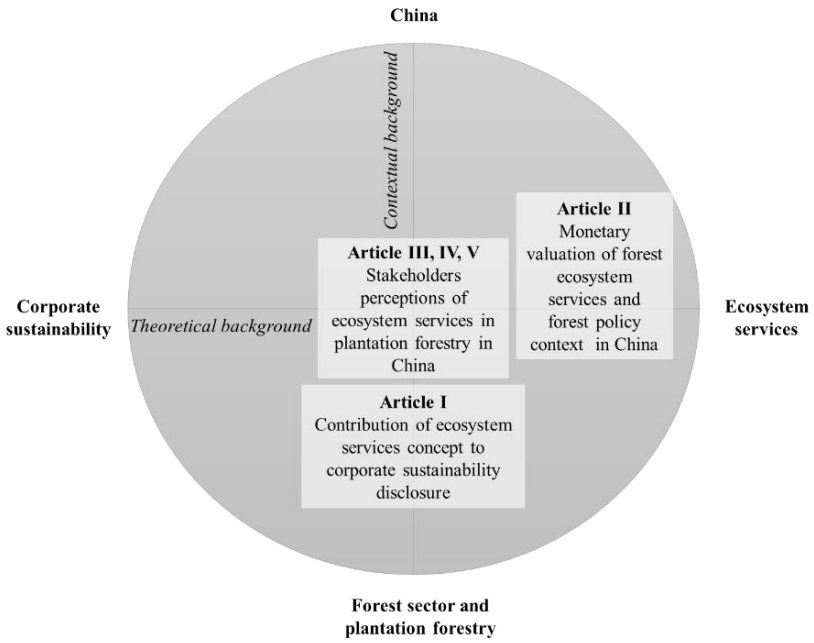

Figure 1. Position of individual articles I-V within different thematic areas.

2.2 The concept of ecosystem services

The concept of ecosystem services was coined in the 1970s to highlight societal dependency on ecosystem functions (Westman, 1977). Ehrlich and Mooney (1983, p.248) proposed that ecosystem services are disrupted as a consequence of biodiversity loss, and 'attempts to supply the lost services by other means tend to be expensive failures in the long run. [Thus] Maintenance of services through minimizing anthropogenic extinctions is recommended'.

Interest in the concept increased in the 1990s (e.g. Daily, 1997), with particular interest on monetary valuation methods to estimate the economic value of ecosystems (e.g. Costanza et al., 1997). In the 2000s, the concept was further popularized by the MA (2005) and follow-up international initiatives, such as 'The Economics of Ecosystems and Biodiversity' (TEEB, 2012, 2011, 2010). Research has since focused on strengthening the connection between biodiversity, ecological processes, and human benefits (e.g. Balvanera et al., 2006; de Groot et al., 2010; Haines-Young and Potschin, 2010); and on exploring the applications of the concept in policy making and governance, such as public and private market-based instruments and payments for ecosystem services (PES) (Engel et al., 2008; Wunder et al., 2008; Wunder, 2005). The concept of ecosystem services has thus evolved during the past four decades, with the formulation of different definitions and applications (cf. Gómez-Baggethun et al., 2010).

The idea of ecosystem services implies a utilitarian framing of nature, which emphasizes the relevance of natural and, in some cases, semi-natural ecosystems to economic and social well-being (Haines-Young and Potschin, 2010). This concept neither denies, nor excludes, the objective intrinsic value of nature[4]. Nonetheless, ecosystem services are only legitimized by the actual or potential existence of one or more beneficiary(ies). The existence of ecosystem services is therefore not universal, but determined by the geographical, natural, social, economic, and cultural context of the observer or beneficiary (Haines-Young and Potschin, 2010; Lähtinen et al., 2014).

According to the widely-recognized definition and classification proposed by MA (2005), ecosystem services are ecological processes deemed to be useful to humans, and can be classified in *provisioning services*, such as food, fibres, and genetic resources; *regulating services*, such as water purification and regulation, climate control, extreme events, and disease mitigation; *cultural services*, such as eco-tourism and recreation, aesthetic, and spiritual values. S*upporting services* underpin the previous categories by contributing to primary production and nutrient cycling. In this context, biodiversity enables the healthy functioning of ecosystems. Complementary classifications and understandings of ecosystem services also exist, such as the ones proposed by TEEB (2010), the UK 'National Ecosystem Assessment' (UK NEA, 2011), the European Environment Agency (Haines-Young and Potschin, 2013), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2014), and the US Environmental Protection Agency (Landers and Nahlik, 2013).

Despite the evident flourishing of this research area, the notorious cascade framework proposed by Haines-Young and Potschin (2010) is still the baseline reference for all the ecosystem services literature. The framework identifies a consequential flow of benefits between natural systems and human well-being (Figure 2), in a production-chain fashion.

[4] Some scholars argue that nature holds objective intrinsic value, i.e. value is inherent and not conferred by humans (Soulé, 1985; Rolston, 1982). Thus, nature counts 'whether or not there is anybody to do the counting' (Rolston, 1982).

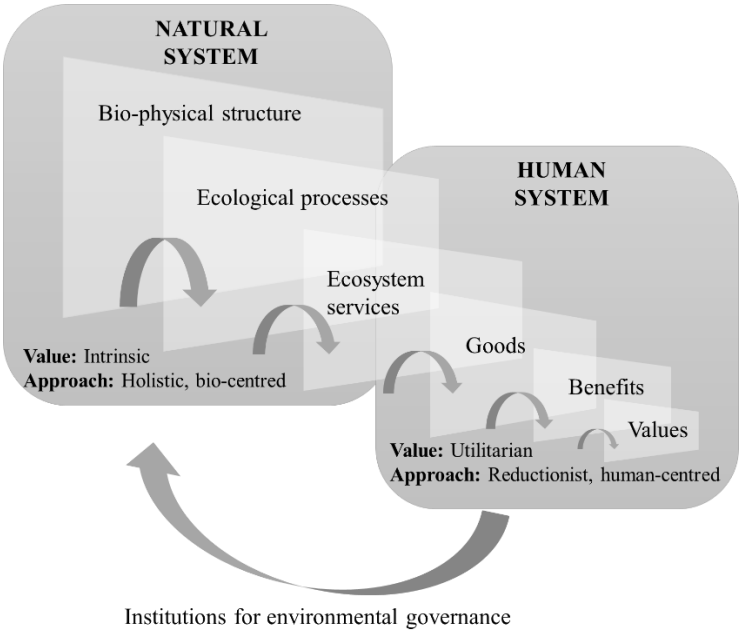

Figure 2. Ecosystem services conceptual framework. Adapted from Haines-Young and Potschin (2010).

The cascade framework shows the biophysical structures and processes proper of natural systems, and the services and benefits eventually derived by humans. Note the shift from a bio-centred, holistic approach to a reductionist, human-centred approach.

This basic idea can be applied to any human system, including business organizations or sectors, but it is more imminent for the livelihood of rural communities in developing or emerging economies, which have a strong dependence on natural or semi-natural ecosystems. A link was, in fact, observed between ecosystem services and poverty alleviation in rural areas (Angelsen et al., 2014; Fisher et al., 2014), as well as between ecological and social resilience (Adger, 2000).

The benefits people obtain from ecosystem services, and the values[5] attached to those benefits should, in theory, inform environmental governance. Since many ecosystem services are public goods, their value is often underestimated or ignored in decision-making. This may result in externalities, such as over-consumption of resources or degradation of environmental quality. This is exacerbated by the fact that ecosystem services' benefits are often distributed or accessed unequally (Bennett et al., 2015) due to spatial interactions (e.g. upstream-downstream) or to asymmetric power relations among actors (e.g. access rights, governance, land stewardship) (Felipe-Lucia et al., 2015). 'Changes in ecosystems typically yield benefits for some people and exact costs on others who may either lose access to

[5] The term value has often different meanings in social sciences and environmental/ecological economics. Held values are part of the cognitive system (e.g. altruistic, ego-centric) and inform assigned values via preferences (Brown, 1984; López and Cuervo-Arango, 2008; Stern and Dietz, 1994).

resources or livelihoods or be affected by externalities' (MA, 2005, p.13). Nevertheless, trade-offs between and within sustainability dimensions are sometimes inevitable in the pursuit of society's interests (MA, 2005; Morrison-Saunders and Pope, 2013).

One way to inform decision making is to explicit ecosystem services values and trade-offs by means of valuation (Spangenberg et al., 2014). According to the concept of strong sustainability, values and trade-offs should be accounted for from two perspectives (Neumayer, 2003): as ecological threshold values, and as people's preferences. There are therefore different types of valuation methods, including, for example, qualitative evaluation, biophysical assessment, benefit-flows assessment, mapping, and economic valuation (TEEB, 2011). These different techniques provide stratified levels of information and can be used to reinforce and complement each other.

Economic valuation, in particular, is argued to be a straightforward way to highlight the relevance of ecosystem services because it allows to synthesisise values in a single and comprehensible currency (Daily, 1997; de Groot et al., 2012). The concept of Total Economic Value provides an overview of use and non-use values associated with ecosystems (e.g. Adger et al., 1995; Kramer and Mercer, 1997; Pearce, 2001). Use value includes: the direct use of especially provisioning and cultural services, such as food, fibres, recreation, or tourism; the indirect use of regulating services, such as flood prevention or water purification; and the option value for future use of all services. Non-use value includes: bequest value for future generations; amd existence value benefiting from the knowledge of environmental preservation, especially linked to supporting and cultural services.

Economic valuation includes different tecniques: market and non-market valuation, revealed or stated preferences (Bateman et al., 2011; Kettunen and ten Brink, 2013). Market valuation draws from data on prices, quantities, and costs from actual markets. It is mainly used to assess provisioning services and cultural services, such as recreation and tourism. Non-market valuation addresses those ecosystem services for which market prices do not exist. In this case, values can be elicited with revealed preference (e.g. hedonic price, travel cost, or replacement cost) and stated preference (e.g. contingent valuation). These methods are particularly suitable to elicit values on regulating, cultural and supporting services. In addition, the benefit transfer approach allows the application of estimates from an original site to a secondary site, assuming an acceptable degree of ecological, cultural, demographic, and economic similarity between the sites (Riera et al., 2012).

Monetary valuation has been criticised to incur in numerous technical and conceptual limitations (Luck et al., 2012; Spangenberg and Settele, 2010; Vatn and Bromley, 1994). Values can be incommensurable, meaning that they cannot be ranked or traded-off and they cannot always be reduced to a single metric (Martinez-Alier et al., 1998; Rekola, 2003). In addition, individuals might be cognitively unable to make a decision, also because values often vary among and within different individuals (Kumar and Kumar, 2008; TEEB, 2010, pp. 3-29) according to the role they perform in a given context, as consumers, citizens, activists, or other (Sagoff, 1998).

Concerns also exist that focusing on the economic (thus instrumental) value of ecosystems might erode altruistic conservation interests and lead to nature commodification (Gómez-Baggethun and Ruiz-Perez, 2011). It has been suggested that monetary valuation should be more often supported by complementary valuation means, and that decision makers should consider the plural dimension of values through more information-based and deliberative processes (IPBES, 2014; Vatn and Bromley, 1994; Vatn, 2005; Wilson and Howarth, 2002).

2.3 The concept of corporate sustainability

Corporate sustainability is a multidimensional and stratified concept, often used interchangeably with precedent, overlapping or parallel terms, such as corporate (social) responsibility, corporate citizenship and triple-bottom-line (profit, planet, people) (Aguinis and Glavas, 2012; Crane et al., 2013; Malik, 2014; Werther and Chandler, 2006). Since these concepts have become intimately connected (Van Marrewijk, 2003; Montiel, 2008), in this thesis the term corporate sustainability is used to refer to the overall available literature in this research area.

According to Campbell (2007), three components can contribute to delineating the definition of responsible (or sustainable) corporate behaviour: 1. the adoption of either objective or subjective criteria (e.g. internationally accepted standard of social and environmental quality versus stakeholders' perceptions); 2. the historical time frame; and 3. the state of rhetoric against substantive action.

The generally accepted understanding of corporate sustainability implies the responsibility of a company for its impacts on stakeholders and/or society (Freeman, 1984; Van Marrewijk, 2003), within and beyond the legal framework (e.g. EC, 2001) in an inclusive way. According to the European Commission (2011), corporate sustainability should aim at maximising shared value for owners, stakeholders and society at large, by envisioning long-term strategies, as well as identifying, preventing, and mitigating possible adverse impacts.

Based on Donaldson and Preston (1995), corporate sustainability is greatly influenced by the motivations behind it (Table 1). Engaging in corporate sustainability can produce financial or strategic opportunities and help gaining competitive advantage (Carroll, 1979, Porter and Kramer, 2006). These include complying with and anticipating regulations and social expectations, securing social licence to operate and resource availability, reducing costs, improving efficiency and quality of existing practices, maintaining a good reputation, and engaging with relevant groups of stakeholders (Brody et al., 2006; Dyke et al., 2005; Li and Toppinen, 2011; Peloza and Shang, 2011; Tuppura et al., 2013). In this context, a great body of research has investigated the relation between corporate sustainability and economic performance, obtaining mixed outcomes (Clarkson et al., 2008; Orlitzky et al., 2003).

Some authors have also acknowledged the existence of a moral or ethical dimension of corporate sustainability, even though controversy exists (e.g. Brønn and Vidaver-Cohen, 2009; Graafland and van de Ven, 2006; Hemingway and Maclagan, 2004). Moreover, recent literature has called for the adoption of a more holistic view of corporate sustainability, which acknowledges the interdependence of business, society, and environment. This view is sometimes proposed along with the possibility to achieve synergistic and functional solutions or creating shared value within society (Hart and Milstein, 2003; Kurucz et al., 2008; Porter and Kramer, 2011, 2006; Van Marrewijk, 2003).

According to the shared value principle, companies' business strategy should seek choices that are inclusive and beneficial to all stakeholders (Michelini and Fiorentino, 2012). This idea has been criticized to be naïve (Crane et al., 2014; Hahn et al., 2010), and it is often based on the assumption that it is possible to identify win-win solutions. In reality, trade-offs make it difficult for companies to operate with a positive sign for all sustainability dimensions (Hahn et al., 2010). Nonetheless, the concept of shared value offers an ambitious and inspirational view of businesses role in society.

Table 1. Motives for business engagement in sustainability issues: a comparison of different ideas based on Brønn and Vidaver-Cohen, 2009; Kurucz et al., 2008; TEEB, 2012.

View	Driver	Risk / opportunity	Example
Utilitarian or Extrinsic	Institutional viability	Regulatory	Preventing regulations and criticism arising from civil society.
		Reputational	Improving reputation and legitimacy, integrating stakeholders' interests.
	Instrumental or strategic perspective	Operational	Securing resources and continuity of operations.
		Market	Gaining competitive advantage and attracting sustainability-driven customers.
		Financing	Attracting sustainability-driven financers.
Altruistic or Intrinsic	Internal believes	Moral	'Doing the right thing'.
Holistic	Interdependence of business, society and environment	May include some or all the above	'Contributing to the quality and continuation of Life'.

A well-established body of literature in corporate sustainability has been dedicated to explore corporate strategy in relation to sustainability issues (Baumgartner and Ebner, 2010; Engert et al., 2016). Carroll (1979) identified a spectrum of strategic responses towards sustainability, from doing less to doing more of what is required: reactive, defensive, accommodative, or proactive behaviour.

The level of responsiveness is influenced by both internal and external factors (Engert et al., 2015). Internal characteristics include, for instance, company size, scope and culture. Large companies with wide societal visibility are often found to invest in a more pro-active strategy towards sustainability efforts (Bondy and Starkey, 2014; Kim et al., 2015), while smaller firms are more responsive to value-chain, internal, and regulatory stakeholder pressures (Darnall et al., 2010). Strategy is also influenced by the company culture or values (e.g. Eccles et al., 2014; Morgan, 1993; Schwartz and Davis, 1981). External factors include, for instance, the industry context and the company's position, which are influenced by the regulatory and market incentives for sustainable behaviour.

A great part of strategic management literature on corporate sustainability includes analysing stakeholder expectations and involvement. Stakeholders are individuals or groups that 'influence or are being influenced' by the company's actions (Freeman, 1984; Freeman et al., 2004), and their role has been recognized to be pivotal in shaping corporate sustainability goals (Waddock, 2008).

Internal stakeholders include managers, employees, and owners, while external stakeholders include customers, suppliers, communities, governmental bodies, political groups, trade unions, and civil society (for example NGOs). In addition, stakeholders can be categorized as primary and secondary stakeholders (Clarkson, 1995). Primary stakeholders are essential to a company's survival (employees, customers, suppliers, and the government), while secondary stakeholders are indirectly influenced by or influence the company (communities, civil society, competitors, media). According to Driscoll and Starik (2004) the

environment is typically acknowledged in corporate sustainability only through stakeholders' voice.

Bowen et al. (2010) identify three approaches in stakeholder management: transactional, transitional, and transformational. Transactional engagement is the most basic strategy, involving philanthropic, top-down approaches such as charity donations. Transitional engagement aims at a deeper involvement of stakeholders, for instance through a two-way dialogue. The most sophisticated strategy is transformational engagement that aims at community integration by establishing joint channels of decision making. The relevance of stakeholder groups to corporate sustainability agenda and goals is demonstrated by the fact that corporate sustainability disclosure has changed in form and content over time: from information for shareholders to a communication tool for all stakeholders (Li and Toppinen, 2011; Vidal and Kozak, 2008).

Corporate sustainability can be disclosed in the form of principles, criteria, and indicators. Principles can be regarded as a declaration of intents or vision, criteria are more specifically defined and action-oriented, and indicators are intended for measurement, comparison, and evaluation of sustainability performance (Toppinen et al., 2015). Several international guidelines and frameworks exist for corporate sustainability (Labuschagne et al., 2005), such as those proposed by the United Nations (UN), the Global Reporting Initiative (GRI), the Organisation for Economic Cooperation and Development (OECD), the International Organization for Standardization (ISO) (GRI, 2011; GRI and ISO, 2014; GRI and UN, 2013; ISO, 2010; ISO, 2004; OECD, 2011). In addition, corporate sustainability can also draw from voluntary or mandatory certification schemes by independent parties, addressing one or more phases of the life-cycle (Auld et al., 2008; Levin et al., 2009). The most relevant certification schemes in the forest sector include the Forest Stewardship Council (FSC) or the Programme for the Endorsement of Forest Certification (PEFC) (Toppinen et al., 2015).

In conclusion, corporate sustainability can be driven by multiple motives, pursued through different strategic behaviours, and implemented through several disclosure means. Communicating and renovating their commitment to sustainability has come to be very important to companies. Notably, however, the environmental dimensions has historically received less attention within corporate sustainability compared to the social one (Carroll, 1999). In fact, the environment was not explicitly included in the early definitions of corporate sustainavility (Dahlsrud, 2008). Later definitions often refer to the Brundtland concept of sustainable development, thus implying a more embracing perspective of ecological sustainability (e.g. Dyllick et al., 2002). Even currently, corporate sustainability tends to address single environmental and social issues, while a more comprehensive discussion on biodiversity and ecosystems is still lacking (Lozano and Huisingh, 2011; Panwar and Hansen, 2007; Rimmel and Jonäll, 2013).

2.4 Forests and the forest sector internationally and in China

Worldwide increasing recognition of the importance of forest ecosystems, especially in the context of climate regulation, has promoted reforestation and afforestation pledges and initiatives internationally, such as the 2014 New York Declaration and the 2011 Bonn Challenge (WRI, 2016). Targeted global areas of restoration amount to ca. 850 mill. ha for degraded and deforested lands, of which 500 mill. ha is in the tropics (FAO, 2010; ITTO, 2002; Mansourian and Vallauri, 2014). Several forest-related projects, such as PES schemes and Reduced Emissions from Deforestation and Degradation (REDD) mechanisms, attempt to combine conservation and development goals (Sunderland et al., 2013).

Simultaneously, the global demand for industrial fibres is foreseen to increase (Barua et al., 2014; Bauhus et al., 2010; Hansen et al., 2014), while local communities and economies rely heavily on forest resources, especially in developing countries. Deforestation represents a major threat in tropical areas, with phenomena of illegal logging still taking place worldwide, driven by poverty or commercial purposes (Tacconi, 2008). Important land-use changes have also taken place in temperate and boreal regions (Hansen et al., 2014).

Forest policies and management, thus, are supposed to include strategies for meeting resources demand, while maintaining ecological functionality and supporting local communities and economies. Balancing such goals at different governance levels without incurring in leakages phenomena is extremely challenging, also given the fragmented and at times conflicting international, national, and regional policy landscape (Rayner, 2010; McDermott et al., 2010).

In this context, expanding industrial plantations are deemed to be an opportunity for the global community to meet the increasing resources needs without exacerbating the pressure on natural forest ecosystems, and to alleviate rural poverty by promoting local and regional development, infrastructure, and employment opportunities (Pirard et al., 2016; Rudel, 2009; Schirmer et al., 2015). Expanding plantation forestry currently covers 7% of the world and provides 50% of the global industrial wood and fibre supply (FAO, 2015; Barua et al., 2014).

Nevertheless, industrial plantations are specifically aimed at maximising the production of fibres, and sometimes also address business opportunities such as carbon markets and biofuel production (Borras et al., 2015; Pätäri et al., 2015). Industrial plantations typically consist of monocultures of non-native species, most commonly *Pinus*, *Eucalyptus*, and *Acacia* (Bauhus et al., 2010) and are therefore criticised to be ecologically impoverished systems, especially if established on land cleared from natural forests or other sensitive ecosystems (Schirmer et al., 2015).

As a consequence of the forest industry's internationalization, production has expanded in the southern hemisphere. This has also raised challenges related to legitimacy of forestry operations and ability of the industry to meet local stakeholders' expectations (Kröger, 2014; Mikkilä and Toppinen, 2008). Intensive management of timber production implies ecological trade-offs in the host and surrounding ecosystems. This, coupled with changes in land ownership or land-use rights, influences the status of ecosystem services and their access by local communities (Brockerhoff et al., 2013; Cossalter and Pye-Smith, 2003; Vihervaara et al., 2012). Relevant literature has also recorded cases of community displacement, conflicts and limited livelihood or employment opportunities (Charnley, 2005; Schirmer and Tonts, 2003).

China is a country of particular interest for the management of forest resources and plantation forestry (Table 2). Since the late 1990s, the government has developed a unique asset of reforestation policies in reaction to serious flooding and drought events caused by intense and prolonged deforestation (Yin et al., 2014; Zhen and Zhang, 2011). The two largest programmes are the Natural Forest Protection Programme and the Slope Land Conversion

Programme. In addition to reforestation, such programmes also target rural livelihood development. During the same time period, international enterprises have consistently invested in the forest sector in China (e.g. 600 mill. USD of Foreign Direct Investments in 2010), attracted by the growing domestic market and low-cost labour force, and encouraged by national policy opening to foreign investors (Zhang et al., 2014).

These combined phenomena have led to consistent reforestation, accompanied by the rapid development of plantation forestry. With 80 mill. ha, China currently hosts the largest plantation area in the world, corresponding to 38% of the country's forest area (FAO, 2015). Despite the suitable climatic conditions of the sub-tropical south, existing forests are young and hold low stocking levels (Yin et al., 2013). Forest certification, started in recent years, covers a rather limited forest area (FAO, 2015).

Land is state- or collectively- owned in China, but a long process of forest tenure reform (1980s to 2000s) has focused on land de-collectivization, with land use rights assigned by the government to households. Leasing arrangements, therefore, imply the transfer of use rights independently from land ownership (Chen and Innes, 2013; Yin et al., 2013). The land use purpose, instead, cannot be changed without permission by the authorities. Forest companies investing in China thus must acquire land use rights in order to secure raw material supply to their mills. A body of companies is located in the southern provinces, where the climate is optimal for developing fast-growing plantation forestry. These are also among the less wealthy provinces in China (Niu et al., 2012), with great development needs of rural areas.

Plantation forestry in China has been the object of attention from NGO's and media, after conflicts emerged between companies and local communities. Communities' dissatisfaction has been mainly due to issues with land pricing, transparency of transactions with local authorities, and related impacts on livelihoods (Gerber, 2011; Li and Wang, 2014). Opportunities for the forest sector in China are thus hampered by several challanges related to the complex institutional environment.

Table 2. Statistics of forest resources in China (FAO, 2015).

		1990	2010	2015	Annual change rate 1990-2015
Forest land	Primary (1000 ha)	na	na	11632 (5.6%)	na
	Other naturally regenerated (1000 ha)	na	na	117707 (56.5%)	na
	Planted (1000 ha)	na	na	78982 (37.9%)	na
Use rights	Public (1000 ha)	157141	115211	na	na
	Private (1000 ha)	0	85400	na	na
Forest purpose	Production forest (1000 ha)	114103	89346	92958	-0.8%
	Multiple use (1000 ha)	20093	40424	41706	3%
	Conservation (1000 ha)	2978	9847	10433	2%
Certification	Forest Stewardship Council (FSC) (1000 ha)	0	0	3144	na
	China Forest Certification Scheme (CFCS) (1000 ha)	na	26	667	na
Revenues & employment	Public revenues (1000 USD)	na	537335	na	na
	Employed (1000 FTE)	1870	1150	na	na

3. METHODS AND DATA

3.1 General overview

The five articles in this thesis employed literature review and/or qualitative research methods (Table 3). Article I is divided in two parts: part 1 is a literature review on environmental and social impacts and dependencies of plantation-based forestry; part 2 is a gap analysis of existing and missing corporate sustainability indicators related to ecosystem services, in the context of the forest sector. In particular, the article identifies the existing and missing links between the ecosystem services framework and the corporate sustainability indicators released by the GRI (2013); it then proposes a set of possible ecosystem services indicators for corporate sustainability reporting.

Article II is a literature review of studies dealing with monetary valuation of ecosystem services in China, including an analysis of the methodological approaches used in the reviewed papers, and a synthesis of monetary values across different ecosystem service types.

Papers III, IV, and V are interview-based case studies investigating stakeholders' perspectives of ecosystem services in the context of plantation-based forestry, including forest company managers, expert external stakeholders, and local communities.

Table 3. Methods and data employed in the articles.

Article	Analysis	Data
I	Part 1. Literature review. Part 2. Gap analysis of existing and missing corporate sustainability indicators in reference to the ecosystem services classification.	Part 1. Peer-reviewed articles and grey literature (N=23) on impacts and dependencies of plantation-based forestry, published between 2001 and 2014. Part 2. The ecosystem services' classification and the corporate sustainability indicators released by GRI (2013)
II	Systematic literature review.	Peer-reviewed articles (N=12) on monetary valuation of ecosystem services in China, published between 2000 and 2012.
III	Qualitative content analysis.	Perspectives of forest company managers (N=20). Data collected through interview-delivered questionnaires during March and July 2014 in Guangdong, Guangxi and Hainan provinces, China.
IV	Descriptive statistics and qualitative content analysis.	Perspectives of households (N=70) in rural communities. Data collected through interview-delivered questionnaires during September 2015 in Guangxi province, China.
V	Qualitative content analysis.	Perspectives of forest sector's external expert stakeholders (N=20). Data collected through interview-delivered questionnaires during March and July 2014 in Beijing, Guangdong, Guangxi, Hubei, Hunan, Jiangsu and Shanghai provinces, China.

3.2 Article I

This paper is based on a literature review of the environmental and social impacts and dependencies of plantation-based forestry, and on a gap analysis of the existing GRI indicators. The literature review included 23 sources including peer-reviewed articles and grey literature published in English, searched through relevant key words in Web of Science and Google Scholar. This was not meant to be a comprehensive review of existing literature regarding ecosystem services in plantation forestry. Rather, the review was functional to highlight the primary and most critical ecosystem services to plantation forestry in terms of impacts and dependencies at local, regional or global level.

Building on the review, a gap analysis was performed on the most recent set of corporate responsibility indicators (version G4) released by GRI (2013). Even though relevant guidelines and indicators for corporate sustainability other than GRI exist internationally, GRI framework was considered the most relevant framework in the context of the forest sector (Toppinen et al., 2012). GRI framework comprehends all dimensions of sustainability, aligns with other international frameworks and holds worldwide recognition (Brown et al., 2009; Kolk, 2010; Levy et al., 2010; Toppinen and Korhonen-Kurki, 2013).

The descriptions of the GRI indicators were examined in the content analysis (Krippendorff, 2004) to find potential links and gaps with the ecosystem services framework (MA, 2005). The analysis aimed to identify some indicators holding potentially relevant information regarding forest ecosystem services, as well missing indicators.

Ecosystem services-related indicators were divided into three categories: dependency, impact, or response. Indicators related to impacts bear information regarding the environmental or social pressures exerted by the company (e.g. emissions). Indicators related to dependencies include information on the ecosystem services that are relevant for company operations and performance (e.g. water usage). Indicators related to responses refer to actions or behaviour by the company that rectify negative impacts along any step of the supply chain (e.g. sustainably managed areas). The study is limited in that it only analyses indicators relevant to plantation forestry, which although representing an important part of the forest sector, is not necessarily of interest for all forest companies.

3.3 Article II

The literature review in Article II includes articles dealing with the monetary valuation of ecosystem services in China, either in natural, plantation, or urban forests. The review was conducted by following the guidelines of Khan et al. (2003): framing the research questions; identifying relevant work; assessing the quality of studies; summarizing the evidence; and interpreting the findings. Relevant articles were retrieved by searching Web of Science using relevant keywords. The search intercepted 12 peer-reviewed articles published in the English language between 2000 and 2012.

For each article the methodological approaches used and the monetary estimates obtained were synthesized. The units of analysis are thus higher (72) than the number of papers, since most of the reviewed papers investigated several forest ecosystem services and employed more than one valuation method.

Regulating services were the most commonly investigated services in the reviewed papers. Therefore the analysis focuses in particular on hydrological services, carbon storage, soil conservation and nutrient cycling. The valuation methods employed in the reviewed articles included market price, cost-based methods, contingent valuation and benefit transfer.

Despite the restricted sample of articles, some limitations occurred due to the wide variation in geographical scope, spatial scale, forest type and methodological approaches of the studies. This heterogeneity hindered full comparability between reviewed articles.

The operationalization of the ES classification was challenging, because many studies did not refer to an internationally recognized classification of ecosystem services. During the analysis the ecosystem services assessed in the studies had to be re-classified according to the corresponding (MA, 2005) category.

In addition, several studies provided the total monetary value of forest ecosystem services in the study site, but did not explicit the monetary value per unit area. Furthermore, the articles reported monetary values in different currency systems. The synthesis of monetary values in the review thus required calculating the per hectar value and converting monetary estimates to international USD (year 2013), which may have led to possible inaccuracies in the final results.

Forest ecosystem services and monetary values have received considerable research attention in domestic literature and played a role in raising awareness and supporting decision-making regarding forest management and conservation policies in China (Zhang et al., 2010). The majority of ecosystem services research in China is, however, inaccessible to the global community, since only a limited portion of Chinese research is published in English (Liu and Costanza, 2010). The review thus assumes that the sampled papers represent the most solid cohort in terms of research quality.

3.4 Articles III, IV and V

Articles III, IV, and V were based on content analysis of data collected through interview-delivered questionnaires proposed to forest companies' stakeholders in China (Appendices 1, 2, 3). Stakeholders' views regarding plantation forestry were investigated from the the emerging perspective of ecosystem services. The stakeholder groups selected included managers, experts and local communities (Figure 3). Qualitative research was considered the most suitable method to access peoples' perspectives in this context (Gummesson, 1991).

The selection of relevant stakeholders was based on existing theoretical and empirical literature which identifies and classifies relevant stakeholder groups, especially in the context of the forest sector (Etzion, 2007; Gordon et al., 2012). Managers represent the internal stakeholders of a company, and possess regional level knowledge and technical expertise on plantation-based forestry. Experts are companies' external stakeholders holding technical expertise. Collectively, they represent the national-level perspective on plantation-based forestry. Like experts, villagers are also a part of company external stakeholders. They have a lower education level compared to that of experts and managers, but their knowledge of plantation forestry is experiential and related to the local context. Overall, the analysis of the three stakeholder groups brings together technical and experiential knowledge of plantation-based forestry in China, as well as perspectives at national-, regional-, or local-level.

The unit of analysis was the individual interviewee for managers and experts, and the household for villagers (Table 4). Managers (N=20) were sampled from five international and domestic forest industry companies operating with a plantation-based business model in three provinces in Southeast China. Experts (N=20) were sampled from the following sub-groups, which are considered relevant in influencing decision-making in the context of the forest sector in China: policy advisors, local authorities, forest industry associations, and consultants and NGOs representatives. The locations of the interviews with expert stakeholders (seven provinces) are based on where they reside and work, generally metropolitan cities, away from plantation sites. The sample of local community representatives (N=70) included villagers living nearby industrial plantations, selected from 18 villages within Guangxi province (Appendix 4). The sample was composed of 15 women and 55 men, ranging in age between 18 and 86 years old .

The selection of interviewees was carried out with a mixtured of purposive and snow-ball sampling approach, by directly contacting relevant informants and asking suggestions on additional candidates from among their acquaintances. In particular, the interviews with villagers were conducted in places of aggregation within the villages, such as small shops or commune courtyards. Villagers were selected on site based on their availability to be interviewed.

Snow ball sampling is useful when a comprehensive list of the targeted population does not exist, is not easily accessible or inaccurate, and when the potential interviewees are difficult to approach due to the sensitivity of the topic or of the population. For example, in the case of experts, it is not possible to identify a systematic list of all policy advisors, local authorities, industry associations and consultants, and NGOs representatives working on plantation forestry issues in China. In the case of rural villagers, population census are often inprecise or difficult to obtain, and boundaries of sample units (e.g. villages, households) are difficult to define. Moreover, in China people are not used to revealing their individual views and may be suspicious or fearful if approached directly. Despite the limitations related to the representativeness of the desired population, snowball sampling presents the advantage of gathering the most relevant informants for the research purpose.

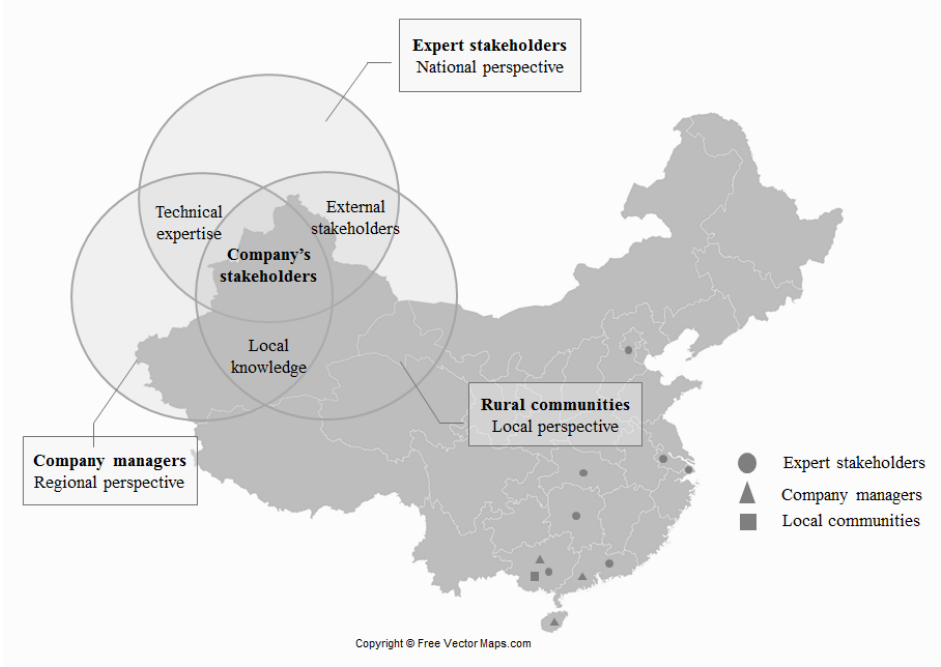

Figure 3. Location of interviews (provinces), and relation between stakeholders groups based on their knowledge and expertise.

Table 4. Composition of interview data from three stakeholders group collected in 2014-2015 in various locations of China.

Stakeholder groups	Type of interviewees	Number of interviewees	Time period	Location (provinces)
Company managers	International company A	4	03.2014	Guangxi
	International company B	4	03.2014	Hainan
	Domestic company C	1	07.2014	Guangxi
	Domestic company D	7	07.2014	Guangxi
	Domestic company E	4*	07.2014	Guangdong
Expert stakeholders	Policy advisors	9	03.,07.2014	Beijing, Guangdong, Jiangsu
	Local authorities	4	03.,07.2014	Hunan, Guangdong
	Industry associations and consultants	4	03.,07.2014	Guangdong, Guangxi, Shanghai
	NGOs	3	03.,07.2014	Guangdong, Hubei
Rural communities	Village households	70	09.2015	Guangxi

* Conducted as a group interview.

Sample size in qualitative research is typically small, and data saturation can be reached with 20 or 30 interviewees (Marshall et al., 2013), especially when the questionnaire deals with a narrow and specific topic which is familiar to and understood by all interviewees. In Articles III, IV and V, data saturation was determined by examining how the variation within the data can be explained by the theoretical framework (Saumure and Given, 2008). The small sample size in qualitative research allows for a deeper and more detailed analysis of a unexplored phenomenon.

The questionnaires included open- and close- ended inquiries. Content analysis was performed to analysise the transcribed interviews. Content analysis involves developing codes and consolidating them into themes based on the presence or absence of certain keywords, phrases, and concepts (Gioia et al., 2012; Mayring, 2000).

In order to ensure the validity and reliability of the findings, several precautions were taken during data gathering and analysis. Generally, the articles followed the methodological approach employed in similar studies on stakeholders' views (e.g. Gordon et al., 2012). The questionnaires were pre-tested with international and Chinese researchers and with Chinese individuals from different cultural backgrounds, e.g. urban citizens to rural villagers. The key terminology and concepts were simplified to be easily understandable for the targeted interviewees. The interviews were conducted in the native language of the informants and were recorded. The data were triangulated with other sources of information, such as scientific literature or corporate reports. The data collection and translation was performed by experienced researchers, whose mother tongue is Chinese. A team of international researchers analysed the data, and quotes from the interviews were largely used to authenticate the findings.

The main challenges and limitations include the following. Even though anonymity was assured to the interviewees, the possibility for some degree of social desirability bias cannot be ruled out (Börger, 2013). Given the geographically and numerically limited scope of the case studies, findings cannot be generalized beyond the sample and need to be interpreted strictly in light of the context. Some ecosystem services-related concepts were difficult to fully operationalize in stakeholder interviews because they were novel for some informants. These include the concept of corporate impacts and dependencies, as well some ecosystem services which are less intuitive, such as regulating and cultural services. Furthermore, different levels of loquacity, education, and other socio-economic factors inhibit full comparability of results between the interviewed stakeholder groups: managers, experts, and local communities.

In light of these limitations, qualitative research coupled with snowball sampling was confirmed to be the best method choice. Informants with a limited educational background are often unfamiliar with the statistical logic behind a fully quantitative questionnaire (Bulmer and Warwick, 1983), while qualitative research allows to open up new topic areas which are generally overlooked, to unravel the reasons behind interviewees' answers, and to simulate hypothetical situations. It is also particularly powerful in order to verify informants' familiarity with the topic, and to create a soliciting, open atmosphere for informants' disclosure. The collected data are thus considered sufficiently in-depth quality to fill the needs of an explorative study approach in a research area with no prior investigationg.

4. RESULTS

4.1 Article I

This study analysed the latest corporate sustainability guidelines released by the Global Reporting Initiative (version G4) in order to identify existing and missing indicators related to ecosystem services information. Based on the analysis, most of the ecosystem services-related indicators are classified under the GRI environmental indicators. However, significant information is also found in economic or societal indicators.

Based on the analysis, existing qualitative and quantitative indicators for corporate sustainability reporting focus separately on the social or the environmental dimension. Typically, critical issues in reporting are fibre sourcing, water uptake, waste, carbon, and pollutant emission. Some relevant ecological or social indicators are, however, still lacking.

Existing indicators particularly focus on corporate social or environmental impacts, while the strategic perspective, i.e. assessing possible response strategies, is insufficiently reported. To address these issues, future development of sustainability indicators could integrate information on, for example, land use changes and land use competition, genetic resources, soil maintenance and fertility, erosion control, biological control, and cultural values. These aspects are relevant to all natural resource-intensive sectors.

Moreover, current indicators – based on the triple-bottom line of economic, environmental, and social dimensions – fail to address the problem of compartmentalisation in reporting. This means that even though economic, environmental, and social issues are often related to each other, indicators are not discussed holistically. The ecosystem service approach, instead, highlights the synergies - positive and negative - among the sustainability dimensions, as many ecological processes are intertwined with each other (e.g. water, soil, nutrients), and with economic, cultural, and social aspects (e.g. property rights, management practices). Furthermore, a set of ecosystem services indicators could feed into sector-specific reporting guidelines. While GRI industry and sector-specific supplements exist for some sectors, such as mining, they are still lacking for the forest industry, despite its many sector specific characteristics.

In conclusion, the systematic development of corporate disclosure by applying an ecosystem services approach could therefore contribute to the progress of forest sector reporting practices and most importantly, to the achievement of enhanced sustainable use of forest resources.

4.2 Article II

This study was a systematic review of the empirical studies dealing with monetary valuation of forest ecosystem services in China. The analysis focused on: assessing methodological differences between studies; highlighting the variation of monetary values across different ecosystem service types; and identifying and discussing future research needs. The review identified 12 studies published in peer-reviewed journals in English, dealing with a total of 72 forest ecosystem services.

The studies presented a wide variation in terms of geographical distribution, spatial scale, and forest type. The studies focused on forest systems, including pine and mixed forests, at the city, protected area, province, or national level, mostly from eastern provinces. However, not all studies made a methodological distinction based on vegetation type. The number of ecosystem services investigated is different across the reviewed articles, ranging from a minimum of 1 to a maximum of 15 in a single paper. Importantly, the studies dealt mostly with regulating ecosystem services, as nine out of twelve papers evaluate at least one regulating service.

The reviewed papers employed mainly benefit transfer and market price methods. The papers using benefit transfer were also the only papers addressing temporal changes in ecosystem services' values. An analysis of the methodological approaches employed reveals that the identified literature was affected by elusive categorization of ecosystem services and methodological inconsistencies. A strengthened and more standardized methodological approach is therefore needed, also drawing from insights and solutions proposed in the domestic and international empirical and conceptual literature.

Furthermore, the reviewed literature showed a wide variation in monetary estimates. For instance, the value of hydrological services are found to range between USD 12 and 5000/ha. The range of values is, however, in the same order of magnitude as the existing global estimates for forest ecosystem services from Ninan and Inoue (2013). For example, the values for carbon storage, soil conservation, and nutrient cycling in Chinese forests are found to be very similar to global-level estimates. Instead, estimates for hydrological services in China are somewhat higher than global values (respectively USD 4938/ha and 1160/ha).

The exceptional ongoing reforestation efforts in China offer important research opportunities for monetary valuation. Future research directions may thus include the assessment of ecosystem services marginal values in land-use changes over time, and benefit flows among different stakeholders. It would be of interest, for example, to investigate how forest ecosystem services contribute to local communities' livelihood in developing areas.

4.3 Article III

This study was based on managerial views of corporate sustainability under the emerging concept of ecosystem services. A total of 20 managers were interviewed on: 1. familiarity with key concepts, including sustainability, biodiversity, ecosystem services, and ecosystem approach; 2. views of corporate dependencies and impacts on ecosystem services; 3. related business risks and opportunities; 4) viability of existing instruments and practices for detecting and addressing business impacts and dependencies on ecosystem services, and related risks and opportunities.

Based on the results, the concepts of sustainability and biodiversity were familiar to almost all managers. Managers from domestic companies had less familiarity with the concepts of ecosystem services and ecosystem approach, compared to managers from international companies. Managers who were at least partly familiar with the proposed concepts, regarded them as good and important, whereas those with no familiarity regarded them as neutral.

Managers viewed forest plantation as having negative impacts on biodiversity, provisioning and regulating services, such as nutrients, air, soil, water, and generally over-exploitation of natural resources and land degradation. Despite the anonymity of the interviews, managers were reticent to discuss negative impacts, which may suggest some influence of social desirability in their answers. Among the mentioned positive impacts there was timber production and carbon sequestration. Managers mentioned some positive dependencies towards provisioning and regulating services, such as biodiversity, energy, genetic resources, and water. Negative dependencies on natural systems were related to regulating services, and included forest fires, floods, typhoons, pests, and diseases.

Land was a recurrent and central element in the interviews, particularly associated with the engagement of and occasionally also conflicts with local communities. Land acquisition and maintenance was also mentioned as a business risk, together with, for example, changes in policies and regulation, disruption of operations due to natural hazards, the social issue and the relationship with local communities. Other identified business opportunities included compliance with and anticipatation of regulations, third-party engagement, and customer-driven certification. Opinions were positive, but cautious about carbon trading.

In general, the identified business risks and opportunities were a mixture of regulatory, operational, and reputational issues, while the role of markets (especially domestic) and sustainability-oriented financers was marginal. In comparison to managers working in domestic companies, managers from international companies were more aware of reputational risks originating from local communities' opinions and social pressure. They were also more prone to discuss voluntary assessment instruments and response practices. This may be explained by the fact that foreign companies operating in emerging economies are typically under closer scrutiny from governments and civil society.

Overall, the interviews reflected the current key issues in corporate sustainability management (i.e. fibres, water, carbon, and biodiversity), but new element of interest were recorded (e.g. genetic resources). The empirical findings of this study are context-specific and therefore non-generalizable. An inductive approach to the findings, however, allowed the development of an operational framework for assessing company responses to specific sustainability issues. Furthermore, the study reflects on the implications of the ecosystem services approach in CS in the context of the forest sector in emerging economies.

4.4 Article IV

This study investigated the views of local communities' on the changes in ecosystem services and local development occurred after land use transformation driven by plantation-based forestry in Guangxi province, China. A total of 70 villagers were interviewed on the following topics: 1. the effects of local industrial plantations on selected ecosystem services and on local development (e.g. income, roads, educational, and health facilities); 2. potential opportunities for future community livelihood development.

Based on the open-ended part of the interviews, most interviewees mentioned 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 could provide owners with some benefits, including more free time and higher returns. Industrial plantations provided some employment opportunities. Nonetheless, about 57% of the interviewees considered the current overall situation worsened compared to prior the establishment of the industrial plantations.

Interviewees were also asked to quantify changes on selected ecosystem services and local development items, by answering to close-ended, Likert scale-like questions. According to villagers' answers, provisioning services showed a worsening, with the exception of firewood. Regulating services showed different patterns: water quality, soil fertility, occurrence of droughts, pests, diseases, and forest fires worsened; other services stayed the same. Cultural services mostly stayed the same, with the exception of landscape beauty that collected controversial opinions. Regarding supporting services, the number of wild animals – proxy for the service 'maintenance of biodiversity' - increased.

Regarding local development, interviewees' opinions were divided. Similar proportions of interviewees stated that income slightly decreased, stayed the same, and slightly increased. Job opportunities either slightly increased or stayed the same to most. Road conditions stayed the same for most. Educational facilities and health facilities mostly stayed the same, but many were unable to answer specifically.

The interviewed villagers felt that external support to local development and livelihood was insufficient. Almost all interviewees were able to identify relevant measures which, if implemented by the government or the forest industry operating locally, could contribute to future livelihood development. Expectations and wishes for the future included: financial support and capacity building for households' plantations and crops; support to local roads and schools; and employment opportunities. Some interviewees suggested that solutions should be implemented for improving degraded water quality, while others suggested reducing forestry operations.

Based on the results, the articles discussed the potential of value sharing mechanisms between the company and the local communities that could contribute to respond to villagers' need for employment opportunities, better environmental quality, and diversified livelihood structure. These may include activities such as: ecological restoration or conservation projects on land surrounding industrial plantations; multi-functional plantation management; alternative design of buffer zones, such as intercropping, green fertilizers, or agroforestry; and implementation of out-growers schemes, with small-holders contracted for timber or other resources.

4.5 Article V

This study employed a qualitative approach to elicit company external expert stakeholders' viewpoint on ecosystem services in the context of the Chinese forest sector. The 20 interviewed stakeholders included policy advisors, local authorities, industry associations and consultants, and NGOs representatives. The interviews focused on three themes: 1) forest companies' dependencies and impacts on ecosystem services; 2) business risks arising from dependencies and impacts; and 3) strategies for turning business risks into opportunities.

During the interviews, the informants pointed out that the extent of company dependencies and impacts is largely influenced by the business portfolio of the company, i.e. plantation forestry versus wood products and pulp and paper companies. Identified dependencies of plantation-based forestry included land, timber, water, local climate, soil, and geographic conditions. By contrast, companies manufacturing wood products and pulp and paper were deemed to be less dependent on ecosystem services, with the exception of timber and water for industrial operations, because they are generally not directly involved in forestry operation.

Regarding impacts of plantation-based forestry, interviewees' opinions were divided. According to some, plantation-based forest companies may produce negative effects on biodiversity, water quality and quantity, soil quality, land, and ecosystem resilience to diseases and pests. A few stakeholders, however, mentioned positive impacts of plantations related to the natural environment, including increases in forest coverage and consequent landscape beauty, efficient fibre production, carbon sequestration, enhancement of soil and water conservation, control of pests, and prevention of forest fires. Interestingly, none of the interviewees referred to company impacts on local communities, for instance in terms of access or customary rights issues, land use competition, or cultural identity. These issues are, however, of relevance in developing and emerging economies, including China.

According to the interviewees, potential business risks for the forest sector may arise from changes in ecosystem services. Such risks can include, for instance, tightening competition for raw material supply, increasing labour, and logistics costs. These phenomena can affect forest companies' business plans, costs, and outputs. Some of the interviewed stakeholders were able to identify possible strategies for turning risks into opportunities. For instance, some suggested a widening of production portfolio, with changes in production focus including a shift to non-wood fibres or high value-added products. Some interviewees pointed out the importance of investing in research and development, and implementing regular assessments of corporate dependencies and impacts on ecosystem services. Most interviewed stakeholders were, however, skeptical regarding potential business opportunities for carbon trading.

Even though limited in scope, the findings of this study are of interest as they contributed to elicit and deepen expert stakeholders' views, concerns, and perspectives on plantation forestry in the context of China, with particular emphasis on the emerging concept of ecosystem services.

5. DISCUSSION AND CONCLUSIONS

5.1 Contribution of this research

This dissertation is among the firsts to address the research void on the interaction between industries and ecosystem services, especially in the context of the forest sector (for an exception e.g. Vihervaara, 2010). In particular, the topic is analysed in the context of China's vast plantation forestry. China has experienced a phenomenal increase in forest resources, including plantations, which may still be insufficient to address the domestic fibres demand of this emerging economy. Locally-operating forest companies therefore must face the expectations of the government, customers, civil society, and local communities.
The findings from the empirical studies in this work (III, IV, V) provide valuable insights from multiple stakeholders' perspectives, such as identified risks and opportunities for the forest sector and the companies operating in China, especially in regard to relations with rural communities. This is of interest in the context of the ongoing sustainability debate of plantation forestry in developing and emerging economies (Gerber, 2011; Rudel, 2009; Schirmer et al., 2015).

The broader contribution of this thesis, which responds to its main aim, is to shed light on the role of the ecosystem services concept in corporate sustainability. The results suggest that the ecosystem services narrative holds many unexplored applications – insights, recommendations, and instruments – for deepening corporate sustainability agendas and practices, especially for nature resources-based companies operating in the context of developing or emerging economies.

The ecosystem services concept can, in particular, contribute to create a deeper and more systemic ecological perspective, which is still largely missing in corporate sustainability. In fact, the environmental dimension has historically been less emphasised compared to the social one (Carroll, 1999; Dahlsrud, 2008), while currently corporate-level attention is especially focused on key issues such as carbon and water impacts, due to the high political and research interest globally (Canadell and Raupach, 2008; Launiainen et al., 2014).

The ecosystem services concept, instead, facilitates the unpacking of that bundle, which corporate sustainability often generically refers to as 'the environment', into several ecological items which are interlinked with human wellbeing. Furthermore, ecosystem services research provides a developing set of qualitative and quantitative tools to assess the distribution of benefits and related trade-offs, both in terms of ecological limits and people's preferences (Bennett et al., 2015). This opens up new themes in corporate sustainability, and may allow a more comprehensive and holistic acknowledgement of, and response to, intertwined ecological and social issues.

The articles in this dissertation explored the role of the ecosystem services concept in (Figure 4): 1. providing self-analytical tools for companies to deepen the understanding of their impacts and dependencies on ecosystems, and associated business risks and opportunities; 2. enabling the analysis of company stakeholders' perspectives and expectations; 3. informing the design of assessment and response strategies; 4. enriching corporate sustainability disclosure practices, for example by providing more comprehensive indicators for more accurate reporting. These avenues can contribute to the further development of the concept and scope of corporate sustainability.

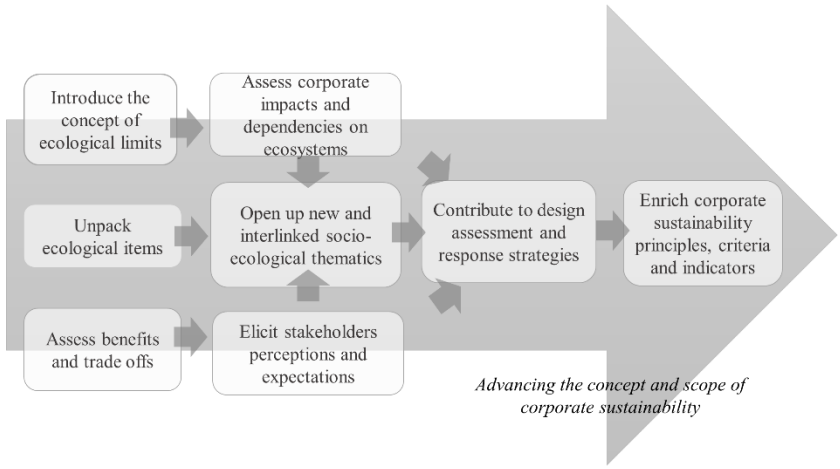

Figure 4. The contribution of the ecosystem services concept to corporate sustainability: potential avenues.

The assessment of risks and opportunities related to changes in ecosystem services is bound to become especially relevant for natural resources-based industries (Article III), as serious threats are foreseen to arise from global interlinked issues, such as resource scarcity, climate change, ecosystems degradation, and social inequity (NCC, 2015; TEEB, 2012). In the forest sector, these may regard productivity and quality, competition for resources, disruption of operations, higher logistics and insurance costs, tighter regulatory and societal scrutiny and financing requirements (Kirilenko and Sedjo, 2007; Pawson et al., 2013).

The analysis of perspectives and expectations of relevant stakeholders, such as regulators, managers, experts, customers, or local communities, is also increasingly pivotal to business viability. Specifically, sustainability challenges for forest companies in developing and emerging economies regard management of local conflicts and maintenance of social license to operate (Mikkilä and Toppinen, 2008; Schirmer et al., 2015). Empirical articles III, IV, and V in this work assess multiple stakeholders' views from the emerging ecosystem services perspective. This approach facilitated the acquisition of information on a broad set of ecological and social changes, and revealed that some of these are in fact interrelated. Identified business risks and opportunities, and stakeholders' needs and expectations can inform the design of assessment and response strategies, including for instance benefit sharing practices.

Finally, the ecosystem services approach could feed into future sustainability disclosure practices. Its integration in corporate sustainability has been proposed by e.g. GRI (2011). Even though some pioneering companies have started to explore the idea, the ecosystem services approach has not yet been formally integrated in any sustainability reporting framework or auditing system of company sustainability performance. According to Article I in this dissertation, an ecosystem services perspective could improve the currently poor and disarticulated discussion on biodiversity, land use, and resource stewardship (Panwar and Hansen, 2007; Rimmel and Jonäll, 2013). Moreover, it could provide a more comprehensive and holistic view of, and indicators for, the economic, social, and environmental dimensions (Lozano and Huisingh, 2011), also contributing to the development of currently missing sector-specific guidelines (Sinclair and Walton, 2003).

5.2 Limitations and way forward

A general methodological constraint in this thesis is the narrow geographical focus and dataset[6]. All articles deal with forest ecosystems and the forest sector, with a focus on plantation forestry in China. On the one hand, the context-specificity of the studies limits the ability to draw general inferences. On the other hand, local processes can sometimes provide relevant insights on regional or global trends. Furthermore, an explorative-type of approach with a narrowly framed research focus can in fact prove to be beneficial to investigate a novel research area, such as the interlinkages between business and ecosystem services.

Regarding the empirical articles based on stakeholders' perspectives (III, IV, and V), it is worth noticing that qualitative research is generally less resource consuming than collecting quantitative evidence (e.g. ecological or social data based on a representative sample), but may provide deeper insights to direct further investigation. A qualitative approach is also attractive because it 'offers a grounded form of knowledge […] that addresses the full complexity of a situation' (Innes and Booher, 2010, p.21) and it allows to envisage tailor-made solutions that may also be reproducible in similar contexts. Furthermore, the inferences drawn from each context-specific study can provide important stimuli for future research.

A constant challenge throughout the work of this thesis was the conceptualization and operationalisation of the ecosystem services concept. The ecosystem services research embeds an enormous interdisciplinary effort, and it has expanded rapidly in terms of theoretical conceptualization to practical applications (Braat and de Groot 2012; Fisher and Brown 2014), resulting in an eclectic availability of definitions and classifications. Despite the evident flourishing of this research area, the ecosystem services toolbox still presents several limitations, from its scarcely operational classification(s), to the approximate valuation methods (Article II in this thesis; Heink et al., 2015; Nahlik et al., 2012; Spangenberg and Settele, 2010). The conceptualization of ecosystem services is therefore a choice that depends on the research purpose. Specific challenges should be carefully addressed while further operationalizing this concept into corporate sustainability. An example is the integration of ecosystem services into meaningful quantitative indicators.

Furthermore, supplementary frameworks can be useful in further emphasizing the links between ecological functions and human well-being already, already established by the ecosystem services approach. For instance, the theoretical framework of article IV couples the concept of ecosystem services with that of sustainable livelihood approach (Scoones, 1998), proposing that provisioning, regulating and cultural services contribute to human well-being by fullfilling basic physiological needs and contributing to education, health, employment, security, social cohesion and sense of belonging.

A main problem in sustainability science includes the analysis of global-local trade-offs. Emphasizing global ecosystem services values can detract attention from local phenomena. In plantation forestry, global and local values and expectations need to be considered, even though may be conflicting, including fibre demand and natural forests conservation at global level and ecosystems and communities well-being and resilience at local level.

Despite the acknowledged limitations, this work confirmed the relevance of the ecosystem services-thinking in corporate sustainability proposed by grey literature (GRI, 2011; Hanson et al., 2012; NCC, 2015; TEEB, 2012; Waage and Kester, 2014; WBCSD, 2011), but not thoroughly examined in scientific research. Based on this thesis, the ecosystem

[6] Specific limitations of the individual studies are discussed thoroughly in the section on data and methods.

services approach can contribute to further developing corporate sustainability agenda and related practices by deepening the ecological perspective and providing a more holistic view of interlinked ecological and social issues. The concept of ecosystem services, incisive in ecological economics, natural, social, and political sciences, is likely to percolate more profoundly into business literature and practices in the near future.

Given the novelty of this topic, future research and business practices can unfold in several directions to further integrate and operationalise the ecosystem services and other related concepts into corporate sustainability at an organizational and industrial level. These include the more systematic assessment and comparison of corporate impacts and dependencies on ecosystem services across different business sectors, including other industries. Such effort will be subject to notable challenges related to data availability and comparability. Suitable corporate and industrial response strategies to identified impacts and dependencies are also to be developed, which address context-specific issues or situations, but may also contain reproducible elements.

The concepts of ecological limits and planetary boundaries (Armsworth et al., 2010; Whiteman et al., 2013; Rockstrom et al., 2009) and the related concept of ecological resilience (Brand, 2009) are areas that should be better integrated into corporate sustainability (Hahn et al., 2015). Often the natural environment has been seen in the corporate sustainability agenda as a passive actor that only eventually holds relevance through stakeholders' interests (Clarkson, 1995; Driscoll and Starik, 2004; Van Marrewijk, 2003). However, ecological limits are not necessarily embedded and expressed in stakeholders' preferences, although they are increasingly important to business performance in terms of concrete risks and opportunities (Hanson et al., 2012; NCC, 2015; Waage and Kester, 2014). In this regard, a systemic and long-term perspective is fundamental (Dyllick et al., 2002; Hahn et al., 2010).

Important critiques were raised to the involvement of the private sector in environmental governance via the ecosystem services narrative (Gómez-Baggethun and Ruiz-Perez, 2011; Spash, 2015). While offering pragmatic instruments, the ecosystem services and related concepts of Bio- and Green- Economy (D'Amato et al., 2016; Fairhead et al., 2012; Naeem, 2013) may be insufficient or inadequate to induce transformative changes needed in today's corporate sustainability agenda and practices (e.g. those outlined by Hahn et al., 2015; Shrivastava, 1995). The risks include distorting the existing language and values of strong sustainability and nature conservation (Gómez-Baggethun and Ruiz-Perez, 2011; Luck et al., 2012; Spash, 2015), and falling into rhetoric rather than developing concrete actions in corporate sustainability (Gray, 2010). Research should therefore continue to shine a spotlight on these issues, which question the fundamental ability of non-state governance mechanisms to operate towards societal good (Cashore et al., 2007; Falkner, 2003; Gatzweiler, 2006; Van den Burg and Bogaardt, 2014).

Language and its use from different parties is indeed important in critically evaluating, legitimizing or delegitimizing corporate behaviour, and in imagining new ways of thinking and acting towards sustainability (e.g. Joutsenvirta, 2009). Even though the ecosystem services concept has brought together different disciplines (economy, social and natural sciences) and different stakeholders on the basis of a *lingua franca*, sustainability is likely to be interpreted and employed in vastly different ways and in various contexts by different actors now and in the future. This calls for creating a shared and comprehensive sustainability language without renouncing to meaningfulness, which requires truly transdisciplinarily effort between economic, natural and social sciences, and between academia, policy, business and related stakeholders.

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APPENDIX 1. Questionnaire for company managers (Article III)

ECOSYSTEM SERVICES AND FOREST ENTERPRISES: A PERCEPTION STUDY

UNIVERSITY OF HELSINKI NANJING FORESTRY UNIVERSITY

Aim of the study and incentives for contribution

Environmental management is strategically and financially important to companies in terms of legal compliance, securing current and future natural resources, public relations, corporate reputation, and stakeholder relationships. Triggered by the rapidly increasing public awareness of environmental issues and demand for corporate environmental information, there is a growing body of research on corporate environmental management and practices. However, little is known about the interactions between forest resources and forest industry from an ecosystem service approach (see 'Forests benefits for society, economy and business' paragraph below).

Targeting multiple informants (e.g. managers, industry experts, policy makers), the proposed interviews aim to understand: 1) how corporate managers perceive changes in natural environment, corporate dependence and impacts on natural resources, business risks and opportunities, as well as challenges and barriers in adopting environmental strategies and practices; 2) how industry experts perceive the integration of environmental issues into corporate sustainability; 3) from a policy maker perspective, how current and future development in regulation and policy affect businesses.

Based on selected companies, this study aims at performing a qualitative, general analysis of the publicly listed multinational and domestic companies in China. The data collected within the interviews are confidential and will not be used for any other uninformed purposes. Company name or that of individual informants will not figure in the aggregate results in any form.

Forests benefits for society, economy, and business

Forests deliver important products and services that underpin human well-being and economy, including timber, fibers, fuelwood, and non-timber products. Forests prevent landslides, purify water, and offer recreation opportunities for people. Forests also sequester carbon dioxide—helping to regulate greenhouse gas concentrations in the atmosphere—and they are home for plants and animals and genetic resources. Beneficiaries of these services can be local, regional, or global and may include future generations. These benefits that nature provides to humans are called '**Ecosystem services**' by scientists and policy makers.

The linkages between business and the environment can be described through:

Dependencies: whereby an organization relies on natural resources for its operations, such as timber, water, and land.

Impacts: whereby an organization's activities cause a positive or negative change to natural environment at different scale (e.g. local, regional, global).

Responses: companies can adopt a variety of practices in response to risks and opportunities generated by environmental changes, such as sustainable forest management, certification, corporate reporting, community involvement, etc.

General vision regarding environmental issues

1. What is your familiarity with and opinion towards the following concepts?

Term	Are you familiar with these terms?			What is your opinion about these terms?		
	Fully	Partly	Not	Good and important	Neutral	Negative and useless
Sustainability						
Biodiversity						
Ecosystem service						
Ecosystem approach						

2. Among the issues below, could you name the three issues which seem more imperative and relevant to your company?
Climate change; Energy demand; Sustainable supply of materials and resources; Globalization; Competitiveness; Market development; Stakeholder engagement; customer demand and expectation; Social and equity issues; Public relations; Corporate reputation.

Company impacts and dependencies on ecosystem services

3. What is your company's core business? What are the natural resources used in production in your production? Could you name them in terms of priority?

4. What is your opinion about your company's local dependence and impacts on natural environment? Does your company implement any system or program (e.g., biophysical mapping, economic valuation) to assess such dependence and impacts?

5. Who are your company's key stakeholders (internal or external, local or international) from natural resource (fiber, land, water) supply perspective? Could you kindly provide some examples of the interactions between your company and stakeholders?

Risks and opportunities, challenges and barries towards changes in environment

6. What sorts of business risks and opportunities do you perceive from your company's dependencies on natural resources? On impacts on natural resources? On changes in natural environment? Can you mention some programs or practices within the company to address these issues? What sorts of challenges and barriers do you perceive in implementing such programs or practices?

Future prospects: integrating the ecosystsem services approach into corporate strategy

7. Do you think regular and systematic assessment of corporate impacts and dependence on natural resources is important? In what way could it play a greater role in your company's decision making in the future? To which stakeholder groups would information be (most) needed? Could you kindly identify some areas with growing importance as example?

8. What policies are in place regarding land tenure and rental agreements for plantation-based companies?

9. What policies or regulations (e.g. conservation, plantations programmes, logging bans) are in place regarding sustainable forest management in China? What business risks, opportunities and challenges do they impose to companies? *(e.g. Program for Conversion of Cropland to Forest, the Natural Forest Protection Program, the fast-growing and high-yield Timber Plantations Base Development Program)*

10. Is forest sector currently covered in the seven emission trading pilot schemes in China (e.g. Guangdong, Hubei, Beijing, Shanghai, Tianjin, Chongqing and Shenzhen)? In your opinion, would the forest sector become particular concern of the future national carbon trading?

11. Any other comments / ideas / opinions?

APPENDIX 2. Questionnaire for expert stakeholders (Article V)

ECOSYSTEM SERVICES AND FOREST ENTERPRISES: A PERCEPTION STUDY

UNIVERSITY OF HELSINKI NANJING FORESTRY UNIVERSITY

Aim of the study and incentives for contribution

Environmental management is strategically and financially important to companies in terms of legal compliance, securing current and future natural resources, public relations, corporate reputation, and stakeholder relationships. Triggered by the rapidly increasing public awareness of environmental issues and demand for corporate environmental information, there is a growing body of research on corporate environmental management and practices. However, little is known about the interactions between forest resources and forest industry from an ecosystem service approach (see 'Forests benefits for society, economy and business' paragraph below).

Targeting multiple informants (e.g. managers, industry experts, policy makers), the proposed interviews aim to understand 1) how corporate managers perceive changes in natural environment, corporate dependence and impacts on natural resources, business risks and opportunities, as well as challenges and barriers in adopting environmental strategies and practices; 2) how industry experts perceive the integration of environmental issues into corporate sustainability; 3) from a policy maker perspective, how current and future development in regulation and policy affect businesses.

Based on selected companies, this study aims at performing a qualitative, general analysis of the publicly listed multinational and domestic companies in China. The data collected within the interviews are confidential and will not be used for any other uninformed purposes. Company name or that of individual informants will not figure in the aggregate results in any form.

Forests benefits for society, economy and business

Forests deliver important products and services that underpin human well-being and economy, including timber, fibers, fuelwood, and non-timber products. Forests prevent landslides, purify water, and offer recreation opportunities for people. Forests also sequester carbon dioxide—helping to regulate greenhouse gas concentrations in the atmosphere—and they are home for plants and animals and genetic resources. Beneficiaries of these services can be local, regional, or global and may include future generations. These benefits that nature provides to humans are called '**Ecosystem services**' by scientists and policy makers.

The linkages between business and the environment can be described through:

Dependencies: whereby an organization relies on natural resources for its operations, such as timber, water and land.

Impacts: whereby an organization's activities cause a positive or negative change to natural environment at different scale (e.g. local, regional, global).

Responses: companies can adopt a variety of practices in response to risks and opportunities generated by environmental changes, such as sustainable forest management, certification, corporate reporting, community involvement.

General vision regarding environmental issues

1. What is your familiarity with and opinion towards the following concepts?

Term	Are you familiar with these terms?			What is your opinion about these terms?		
	Fully	Partly	Not	Good and important	Neutral	Negative and useless
Sustainability						
Biodiversity						
Ecosystem service						
Ecosystem approach						

2. Among the issues below, could you name the three issues which seem more imperative and relevant to the forest sector / industry?
Climate change; Energy demand; Sustainable supply of materials and resources; Globalization; Competitiveness; Market development; Stakeholder engagement; customer demand and expectation; Social and equity issues; Public relations; Corporate reputation.

Company impacts and dependencies on ecosystem services

3. What are the natural resources used in production of forest industry in China?

4. What is your opinion about forest industry's local dependence and impacts on natural environment? Are there any specification or guidance (e.g., biophysical mapping, economic valuation) to assess such dependence and impacts?

5. Who are key stakeholders of forest industry (internal or external, local or international) from natural resource (fiber, land, water) supply perspective? Could you kindly provide some examples of the interactions between forest industry and stakeholders?

Risks and opportunities, challenges and barries towards changes in environment

6. What sorts of business risks and opportunities do you perceive from forest industry's dependencies on natural resources? On impacts on natural resources? On changes in natural environment? Can you mention some programs or practices within forest industry to address these issues? What sorts of challenges and barriers do you perceive in implementing such programs or practices?

Future prospects: integrating the ecosystsem services approach into corporate strategy

7. Do you think regular and systematic assessment of industry/sector/corporate impacts and dependence on natural resources is important? In what way could it play a greater role in decision making in the future? To which stakeholder groups would information be needed? Could you kindly identify some areas with growing importance as example?

8. What policies are in place regarding land tenure and rental agreements for plantation-based companies?

9. What policies or regulations (e.g. conservation, plantations programmes, logging bans) are in place regarding sustainable forest management in China? What business risks, opportunities and challenges do they impose to companies? *(e.g. Program for Conversion of Cropland to Forest, the Natural Forest Protection Program, the fast-growing and high-yield Timber Plantations Base Development Program)*

10. Is forest sector currently covered in the seven emission trading pilot schemes in China (e.g. Guangdong, Hubei, Beijing, Shanghai, Tianjin, Chongqing and Shenzhen)? In your opinion, would the forest sector become particular concern of the future national carbon trading?

11. Any other comments / ideas / opinions?

APPENDIX 3. Questionnaire for local communities (Article IV)

UNIVERSITY OF HELSINKI

Questionnaire on Local Community Perceptions of Eucalyptus Plantations in Guangxi, China

This study is a part of scientific research executed by University of Helsinki and by Nanjing Forestry University financed by Academy of Finland and the National Natural Science Foundation of China. The purpose of the study is to analyze local community perceptions of industrial eucalyptus plantations in Guangxi province, focusing on the opinions of people living nearby the plantations regarding how the establishment of the plantations affected local environment and community livelihood. The information you provide will be anonymous and will only be used for scientific purposes and not shared with third parties.

Name of the village: Date:_____ Survey number:

Familiarity with eucalyptus plantations

1. Are you aware of any eucalyptus plantations managed by foreign companies near your community?
   ☐Yes ☐No

   If yes, have you or anyone in your household been engaged in the work related to these plantations?
   ☐Yes ☐No
   If yes, what kind of work have you done?

2. Has your household leased any land for the purpose of eucalyptus plantations? ☐Yes ☐No
   If yes, what kind of experience have you had in this regard?

Relations between local community livelihood and eucalyptus plantations

3. Do you visit eucalyptus plantations for a special purpose? ☐Yes ☐No
   If yes, a) what is your purpose to visit there? _____

   b) how often do you visit there? _____
4. a) Do you know when eucalyptus plantations were initially established?
   b) Do you remember what happened when those plantations were established?

   c) For what purpose are these plantations managed?

5. a) In general, what was the situation before the establishment of eucalyptus plantations? Good or bad?
   b) How has the situation changed after the establishment of eucalyptus plantations? Better or worse?

c) In detail, how has the establishment of eucalyptus plantations affected your household living from the following items? Select only one option per item.

Items	Improved	Slightly improved	No change	Slightly worsened	Worsened	I don't know
Quantity of firewood available for collection						
Quantity of non-timber wood products available for collection						
Farming possibility						
Fodder						
Beekeeping possibility						
Number of wild animals						
Quantity of domestic water consumption						
Quantity of water for farming						
Quality of water						
Quality of air						
Fertility of soil						
Noise						
Local climate						
Occurrence of droughts, storms/typhoons						
Occurrence of disease/crop's pests						
Occurrence of forest fires						
Recreation possibilities						
Landscape beauty						
Ecotourism						
Spiritual value (e.g., possibility to visit graves)						
Road situation						
Health facilities						
Educational facilities						
Job opportunities						
Household income						

d) Are there any other issues you would like to raise?

6. What kind of support has your community received after the establishment of eucalyptus plantations?

7. Do you have any suggestions on how to develop your community livelihood in the future?

Respondent's background

8. Gender: ☐Male ☐Female

9. Age:

10. Are you the head of your household? ☐Yes ☐No

12. How many members in your household comprise?

13. How many years have you lived here?

14. Education level:

14. Source of household income?

APPENDIX 4. Data collection in Guangxi, China (Article IV)

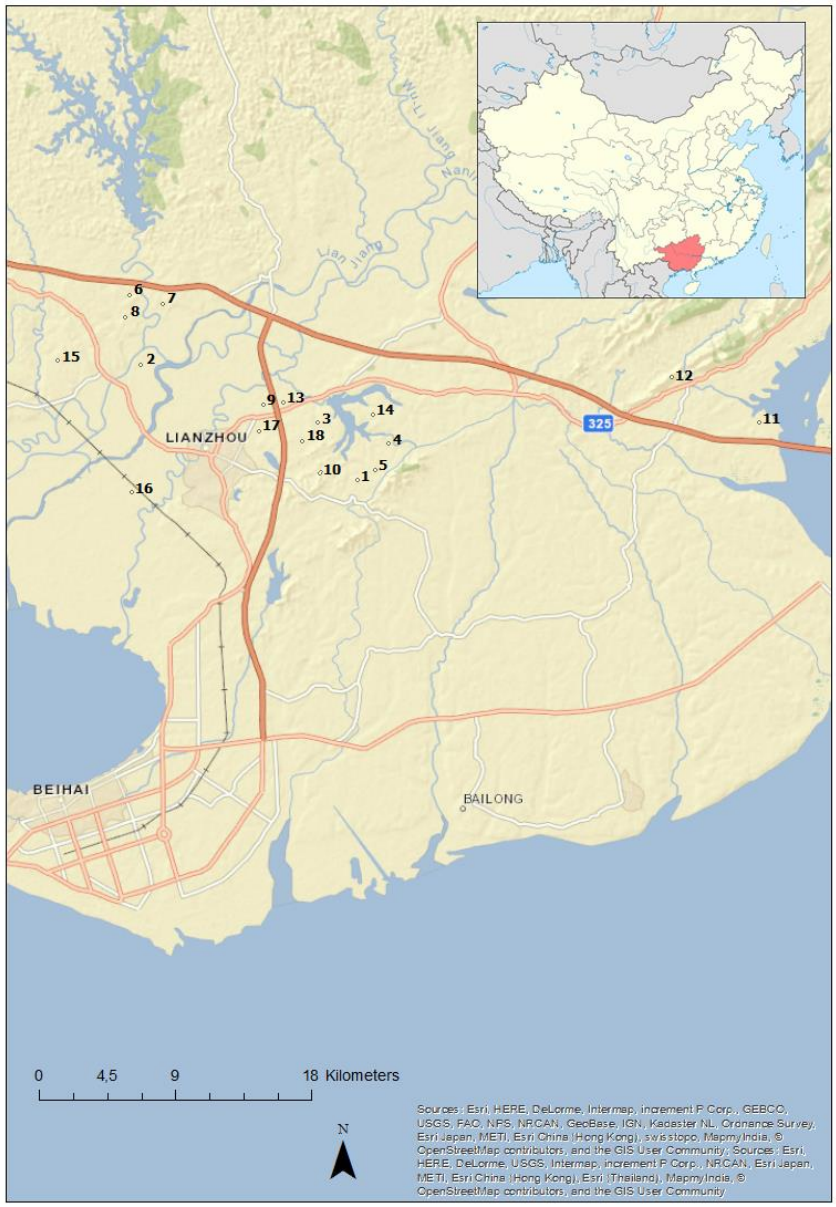

Figure 5. Provenience of interviewees in Beihai area: villages from 1 to 18 (see Table 5). Top right: Guangxi province [7].

[7] By TUBS [GFDL (http://www.gnu.org/copyleft/fdl.html) or CC BY-SA 3.0, via Wikimedia Commons (http://creativecommons.org/licenses/by-sa/3.0)].

Table 5. 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 *	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 *	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 *	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 *	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

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

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.