

Is a typology for planted forests feasible, or even relevant?

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Highlights

- Controversies about the expansion of planted forests develop amidst confusion about terminology, its scope and definition, and the fact that many terms are ideologically loaded.
- In this context, it is surprising to find that very few attempts have been made to propose typologies and to strictly define categories for such man-made ecosystems.
- There are conceptual and scope differences between definitions, categorizations and typologies. Specifically, typologies require mutually exclusive and jointly exhaustive categories, and are the focus of our analysis.
- It is important to have purpose-oriented typologies, i.e. defined to serve a given policy objective that provides flexibility in the design and use of such typologies to address specific questions, and avoids the great challenge of dealing with multidimensionality with many variables
- Our case study of the opposition between small-scale versus large-scale planted forests, which is a prominent distinction supposed to inform on impacts, actually shows confusion between scale and ownership as discriminative variables. In addition, this classic opposition fails to acknowledge the contrasting contexts as illustrated by case studies in Australia and Indonesia where small and large mean and imply very different things.
- There remains a need for both a universally recognized typology produced by consensus to enable the release of statistics and fruitful debates, and purpose-oriented typologies produced by stakeholders in given contexts to inform specific policies.

1. Introduction

Plantation forestry provides more than a third of global industrial wood demand, and is an increasingly important part of the timber industry. This share is expected to increase even further with declining production from natural forests that either disappear, are degraded or set aside for conservation purposes (Warman 2014). According to the Food and Agriculture Organization (FAO 2010), an additional 5 million ha of planted forests has been established annually in the decade to 2010. This figure does not say much about the diversity of situations across countries, with North America and Europe relying on long-established large estates, but other countries in Asia or Latin America pursuing aggressive strategies to develop their planted forests. Nor does it say much about the diversity of planted ecosystems or their purposes; yet together, the 264 million ha planted by 2010 included productive (e.g. timber, pulpwood, biofuel) and protective

(e.g. carbon, soil erosion, water regulation) plantations and covered a continuum of situations in terms of species richness and intensity of management.

Many controversies remain around the expansion of planted forests: such expansions are praised by some for their capacity to produce efficiently large amounts of wood products that alleviate pressure on natural forests, to create jobs that support rural development, or to provide a range of ecosystem services especially when established on degraded lands that require restoration efforts. However, others point to their negative social impacts, such as the many conflicts related to land tenure and the limited value provided to landowners and reinvested locally, and to their negative environmental impacts when a single species is planted on large estates, sometimes on previously forested areas.

In this context, terminology matters because it ensures that debates do not build on misunderstandings and that positive or negative impacts of specific land uses are not generalized to other land uses. Yet terminology

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in this field remains ambiguous, and confusion leads to misunderstandings and to suboptimal policies. Terms such as 'forest plantations,' 'timber plantations,' 'tree farms,' 'industrial plantations' and 'smallholder plantations' are commonly used. They are more or less specific and tend to carry assumptions with respect to the impacts that these terms impart.

Some argue that the term 'forest' should not be associated with plantations, as this may imply that they share characteristics with natural forests and hence could be (wrongly) viewed as substitutes. On the other end of the spectrum, some mention 'tree engineering' in order to emphasize the technology and man-made component of plantations. It all depends on the perspective because, e.g. forests can be seen as ecosystems made of trees or as much more complex ecosystems with a high level of biodiversity and multifunctionality. To resolve these issues – and for statistical purposes as well – a new term was proposed by the FAO: "planted forests" (De Lungo et al. 2006). It covers a range of ecosystems from semi-natural forests where trees were planted with subsequent light management, to strictly man-made tree plantations with short rotations.

In this piece, our goal is to analyze the need for and possibility of having a typology for planted forests that would propose a number of terms and categories that apply to more specific ecosystems, assuming they share key characteristics and collectively cover the entire spectrum. To do so we will discuss the concepts of typology, classification and definitions, review existing attempts, and assess the feasibility and relevance of a typology for planted forests, building on the high-profile case of small- versus large-scale plantations .

2. Definitions

According to the FAO, the most rudimentary and inclusive approach to defining planted forests is to define them as "trees established through planting and / or deliberate seeding of native or introduced species" (Brown 2000). Because of the specific case of plantations that were established long ago with low-intensity management and that were usually not included in statistics about plantations – a common case in Europe – the FAO (2004) further changed the scope to include semi-natural forests, i.e. forests established with native species or areas with intensive natural regeneration. In addition, the FAO (Brown 2000) also differentiate between plantation types, a subset of planted forests, based on their productive or protective functions.

Admittedly, the definition of plantations is constantly evolving and the definitions used most often are those produced by the Forestry Department of the FAO and disseminated through its Global Forest Resource Assessment (FRA) every 5 years. The status and mandate

of this institution places it in a perfect position to propose definitions and categories of planted forests based on broad consultations and to bring them into mainstream use. Plantations are most commonly interpreted as "forest stands established by planting and/or seedling in the process of afforestation and reforestation¹ and involving replacement of the previous crop by a new crop and essentially a different crop", according to an old but still relevant definition (FRA 1980 in Brown 2000).

FRA reports have progressively complicated the definition to include discriminating parameters such as (i) species mix at planting, (ii) even age class, (iii) regular spacing and (iv) new plantations² (Brown 2000). It may be concluded that these subdefinitions highlight the management aspect of plantations compared with the definitions proposed by a number of other authors (Sargent 1992; Pancel 1993; Sedjo 1997; Sohgen et al. 1997; Helms 1998), which emphasize the tangible (wood production) and intangible services from the forests. Note that these examples show that plantations can be defined from various angles with differing results.

Definitions can contrast much more starkly, as illustrated by Dunster and Dunster (1996), who assert that plantations arise out of human activity that meets predetermined social, environmental or economic goals. The World Rainforest Movement (1999) holds a divergent view and defines plantations as being focused first and foremost on their productive and profit-making functions for the companies that run them. These two opposite perspectives illustrate the influence of the reference point of the definition: depending on whether there is a positive or negative perspective, the definition tends to be biased toward a given ideological view. Indeed, as suggested by these examples, plantations can be seen as risky and detrimental to society and the environment compared with natural forest ecosystems, or alternatively they can be viewed as serving development and environmental goals. Intuitively, neither of these captures the entire story behind their expansion.

The web of confusion lies not only in the definitions but also in the use of terms: forest plantations, tree plantations, or simply plantations. Empirical evidence and discussions in the literature remain scarce with respect to the differences between, and various interpretations of these terms. As a result, questions such as the following arise: Are these terms equivalent?, How do we determine their scope?, Under what conditions should a particular term be used?

1 Forest Resource Assessment (FRA 2000) – defines afforestation as "Forests established artificially by afforestation on land which previously did not carry forest within living memory where there were no records, or within 50 years if records existed." Reforestation is defined as "land that carried forest within the previous 50 years or within living memory, and involved the replacement of a previous crop by a new and essentially different crop. The frequent changes included different species or superior genotypes."

2 New plantations is the land afforested in the last ten years.

Natural forest			Planted Forests		
Primary	Naturally regenerated forests	Semi-Natural	Plantation		
Forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed	Forest of naturally regenerated native species where there are clearly visible indications of human activities	<i>Assisted natural regeneration</i> through silvicultural practices	Planted component	Productive	Protective
		<ul style="list-style-type: none"> Weeding Fertilizing Thinning Selective logging 	Forest of native species, established through planting, seeding, coppice	Forest primarily introduced and native species, established through planting or seeding mainly for production of wood or non-wood goods	Forest of native or introduced species, established through planting or seeding mainly for provision of service

Figure 1. Scope and concept of planted forests by FAO: A classification example.

Source: FAO (2004)

The range of existing interpretations arguably creates complexities in the adoption of a single universal definition. Carle and Holmgren (2003) state that there is a need to harmonize these new adaptations and formulations, not just for the sake of standardization, but rather to increase “compatibility, consistency [and] comparability” when applied by various stakeholders. The answer may lie in developing a typology of planted forests and plantations that is both general enough to be applied globally, but also precise enough to refer to a diversity of situations.

3. Typology and classification

As a second step in our analysis, differences between typology and classification must be stated. These are mostly perceived as identical because both entail groupings. However, there lies a distinction of exclusiveness and exhaustiveness between them. Used mostly by archaeologists, social scientists and natural scientists (Krieger 1944; Elman 2005), “typology” is defined as the “classification or grouping that has explanatory (or meaningful) relationships with attributes that are not intrinsic to the classification or grouping itself” (University of Toronto 2014). In other words, the groups may not be defined by the most obvious parameters of their components, and might rely on their interpretation beyond their objective measurement.

Therefore, a typology may capture or represent a symbolic, functional, chronological, spatial and/or social context (University of Toronto 2014). For instance, a small-scale plantation in Africa or Australia might cover a few hundred hectares, while in India it might cover only several hectares;

thus, the ‘relative’ scale of the plantation is dependent on the social and geographical context. Additionally, Marradi (1990) states that these types must be mutually exclusive and jointly exhaustive. They might represent one or several attributes and include only those features that are significant for the problem at hand; in other hands they might be purpose oriented (Encyclopædia Britannica 2014).

Classification groups, on the other hand, are definitive and rule based. As such, they can be said to follow a black-and-white-model, unlike types that can accommodate shades of gray or variables that may be of a transitional nature. The multipurpose plantations that achieve both production and protection services exemplify the latter (University of Toronto 2014). Thus, flexibility in defining groups gives typologies an edge over classification for addressing a continuum of situations.

4. Reflections on existing typologies and classifications

In this endeavor, FAO (2004) developed a planted forest classification based on the services rendered by plantations as the rule of the groups (productive and protective), but also allowing space for those semi-natural forests that include a strong planted component (Figure 1). It has a very simple structure and may not necessarily qualify as a definition of a typology; rather, its intention is to reflect on the diversity of situations for planted forests. Its purpose is rather to make the point that there is a continuum of situations between primary natural forests and productive plantations, and that this needs to be accounted for in statistical matters.

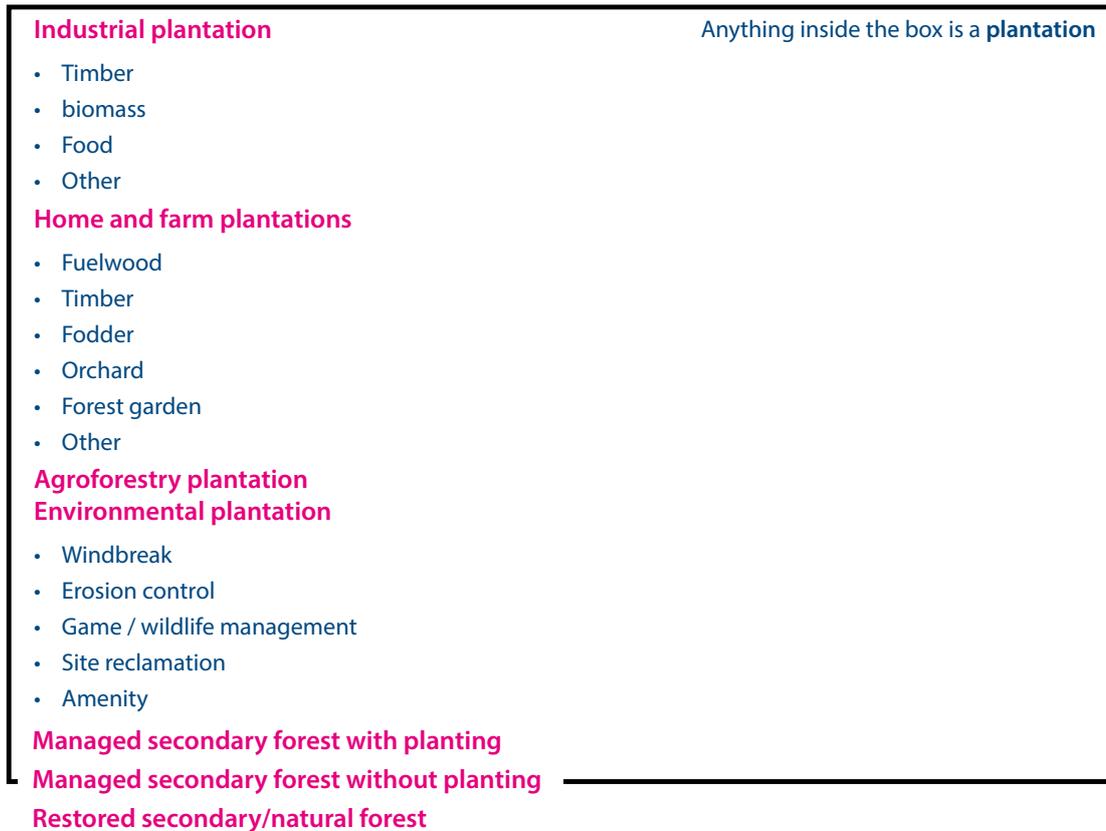


Figure 2a. The most quoted typology of planted forests in the literature (Ingles et al. 2002) in its original form.

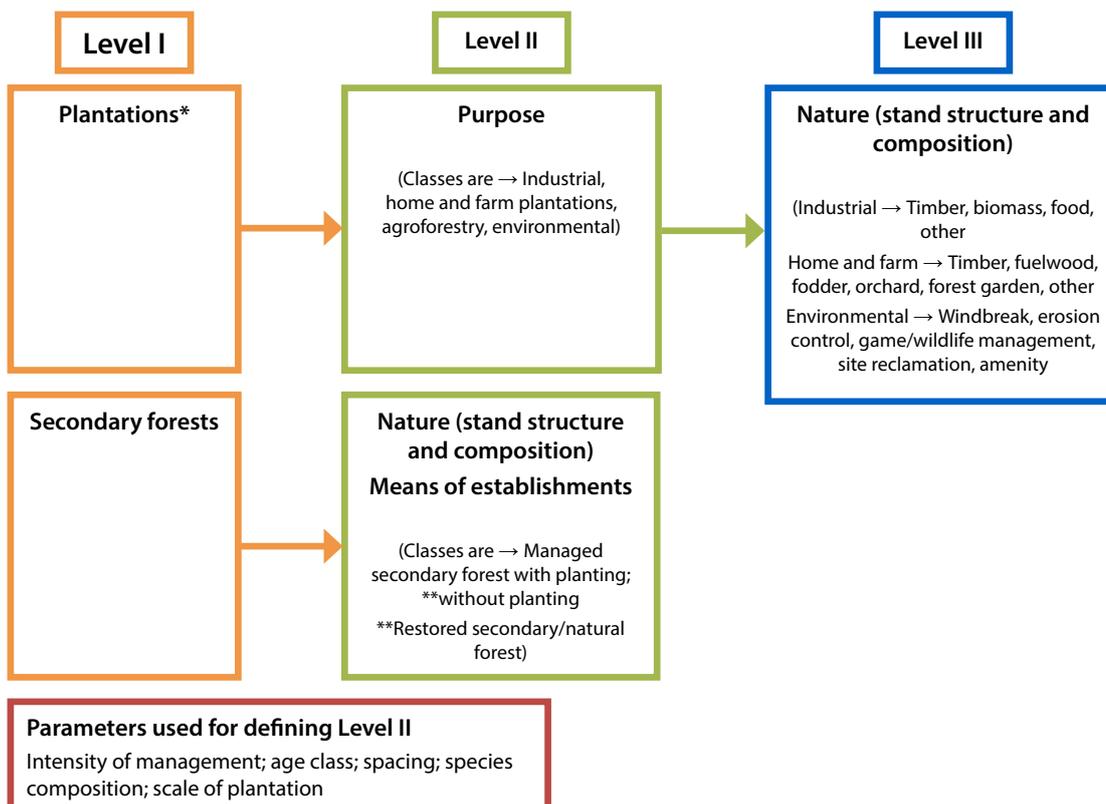


Figure 2b. The most quoted typology of planted forests in the literature (Ingles et al. 2002); processed by the authors based on Magdon et al.'s (2014) framework.

Similarly, the typology developed by Ingles et al. (2002), as illustrated in Figure 2, can lead to a debate as to whether the types are mutually exclusive and collectively exhaustive. Indeed, farm plantations may also qualify as agroforestry plantations, but their mutual-exclusiveness is uncertain, as the categories have not been explicitly defined in the typology. Moreover, a number of environmental services potentially provided by plantations, e.g. climate mitigation with carbon sequestration, are not included in the environmental plantation category, which does not support the collective exhaustiveness of the typology. Besides, other dimensions of plantations remain ambiguous in their treatment: Are 'home plantations' supposed to be privately owned, or small scale, and what makes a difference? Are 'industrial plantations' supposed to be large scale only given that smallholders can also cooperate to supply a given industry, and does it make a difference whether they are established on private land or operating on public land through concessions?

Admittedly the necessity and relevance of including all of these parameters in a single typology could at best appear to be a huge task with overly complex types of little practical use, and at worst prove just irrelevant and unachievable. However, we contend that for a mutually exclusive and exhaustive grouping of plantations, tenure parameters such as ownership and access rights should be explicitly addressed to increase its usefulness for policy making, as these parameters significantly shape the impacts.

In contrast, Donaldson and Gorrie (1996) (Figure 3) present a typology of plantations in Australia based on scale and production orientation, with ownership and the type of environmental service provided as additional discriminating variables. This approach adds to the clarity of the distinctions and also highlights the multiple services that plantations offer. While it might be concluded that within the limited scope of scale and timber production, the typology is exhaustive, it only partially represents the other variables such as ownership and environmental services from the plantations.

Clearly, and based on the above, it is challenging to represent the multidimensionality of planted forests and plantations in a typology, as the models can hardly be narrowed down based on a few criteria such as protection vs. production services, species composition and stand structure, scale of plantations and ownership. The challenge of creating a typology for planted forests may be equated with a task delineating the forest types where there exists a possibility of having a large number of classes based on many parameters. For instance, Barbati et al. (2007) propose seven different variables for a typology of forests. Using these variables, 35 sets of indicators emerge for assessing sustainable forestry management (SFM) in 44 European countries. This may not be directly relevant to the planted forests typology, but it demonstrates that in order to capture their variation and diversity, there may be a need for developing detailed and extensive variables sets similar to those of Barbati et al. (2007), to ensure the categories are collectively exhaustive.

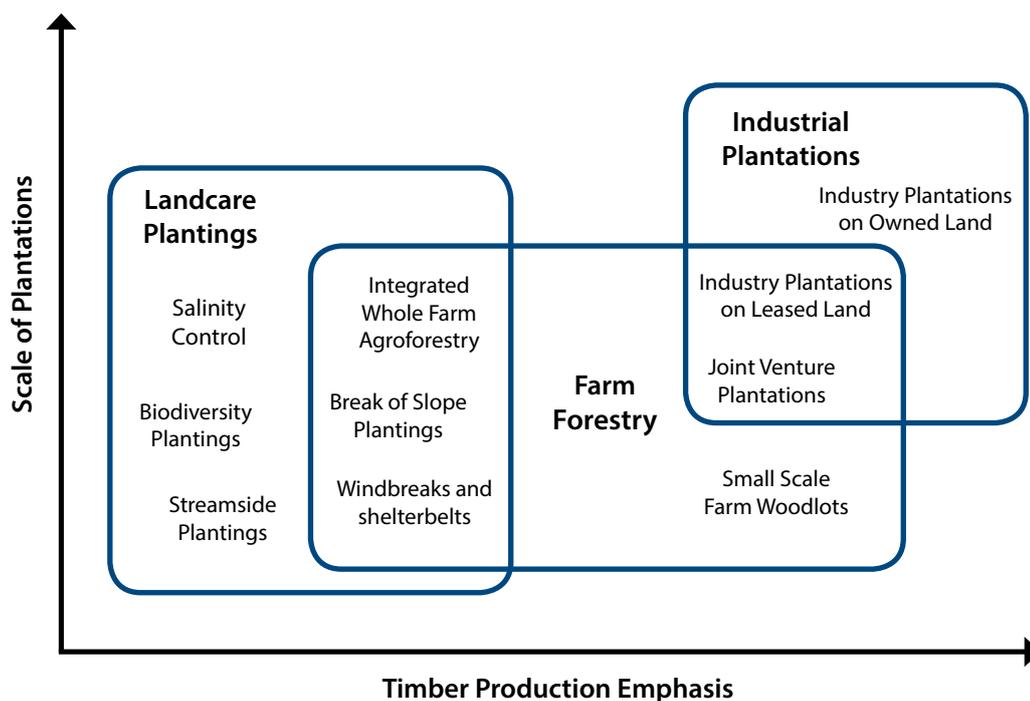


Figure 3. Plantation categories in Australian forestry.

Source: Donaldson and Gorrie (1996)

Surprisingly enough, in the context of controversies about plantation impacts and acknowledging their actual diversity, there are very few documents (from either peer-reviewed or gray literature sources) that present typologies and/or provide justifications or a rationale for the use or non-use of such typologies or even broad categories of plantations (or planted forests) from a social and management perspective. Numerous studies (e.g. Mercer and Underwood 2002; Brockerhoff et al. 2013) discuss the impacts of biophysical parameters such as the choice of species and species mix, but not the actual justification for a given categorization and how the primary stakeholders of the plantations prioritize the services provided, which in the end really matters.

5. The case of small- versus large-scale plantation forestry

Controversies have arisen around the notions of scale and ownership, both being often associated with each other. Small-scale plantations are usually owned by local villagers, whereas large-scale plantations are increasingly owned by private corporations (rather than parastatal companies), either on public land through concession regimes or on private land. Therefore, we use this emblematic categorization, or 'typology,' in a rather weak sense, to study the feasibility and relevance of typologies of planted forests using case studies in Australia and Indonesia. The very different contexts in which these plantations operate in both countries allow us to test and limit attempts at generalization in terms of social and other benefits.

The cases selected are based on the criteria that (i) the selected timber plantation case studies should clearly qualify according to the definitions of small- and large-scale plantations (based on landholding size), (ii) the plantations should have achieved the milestone of first rotation and (iii) data availability. On this basis, four cases studies were analyzed: one large-scale and one small-scale in each of Australia and Indonesia. It is pertinent to highlight here that the data collected from the case studies vary on a temporal scale. Due to the time constraints of the study, a large sample of case studies was not selected for the analysis, which therefore remains purely illustrative as opposed to representative. Although the degree to which results of the study can be generalized beyond the context is not scientifically apposite, the lessons provided by case studies are useful in a discussion of the relevance of the small- versus large-scale categorization.

5.1 Plantations' benefits across scales in Australia and Indonesia

The stated overall benefits generated by plantations across Australia and Indonesia are environmental with biodiversity conservation (Australia) and land restoration (both countries), contribution to subsistence and community services (Indonesia) and incomes generated by the sale of timber (both countries), rent and sale of land (Australia), or in the form of longer term cash reserves (Indonesia).

These differences in benefits across the plantations in Australia and Indonesia can be attributed to the difference in social capital, market integration and the impact on the demographic dynamics. The social capital of smallholders in both countries varies, and it is critical to understand whether the very notion of 'smallholders' applies similarly in both contexts. For instance, in Australia there is a knowledge network that involves planters and researchers and provides a platform for smallholders to share and innovate (Race et al. 1998). Apart from the knowledge network, the level of education attained among the farmers in Australia brings with it intersectoral knowledge and expertise, and analytical thinking, which are reflected in plantation management strategies, long-term investment in plantations and the quality of the timber produced and response to the changing markets (Bliss and Kelly 2000). In Indonesia, however, while a similar network exists with support from the government, research organizations and other agencies for knowledge dissemination, capacity building and extension services for plantations, there are hardly comparable practical implications, as smallholders still focus on fulfilling their subsistence needs from the plantations (e.g. plantations with teak play the role of a cash reserve).

Consequently, this affects the ability of Indonesian smallholders to obtain optimal prices for the wood produced. For instance, even though one studied site is strategically located near the teak furniture market in Central Java with potentially reduced transaction and transportation costs, the prices fetched for the timber are usually below the market price, presumably because of the limited ability to negotiate the prices with active middlemen. These factors significantly impact the amount of benefits received by the smallholders from the harvesting and selling of teak timber, and in turn, they affect the materialized socioeconomic benefits of the smallholder model (Roshetko et al. 2013).

In addition, large-scale plantations may variously impact the demographic dynamics through job creation or destruction. For instance, there is a resulting downward trend in demography in the Green Triangle region (Australia) because of the tenure arrangements, with a net change in population of approximately 3 percent decrease for leased land and 7–19 percent decrease for purchased land (ABP 2014). In contrast, Indonesia faces in-migrations during seasonal jobs generated by the large-scale plantations, and massive internal migrations between provinces to access land for cultivation purposes. This can have a negative impact leading to social conflict, stalling of plantation operations and economic stagnation (Obidzinski and Chaudhury 2009).

5.2 Implications for a typology

The significant differences in terms of benefits generated by plantations, whatever their scale or ownership, as demonstrated by the case studies of Australia and Indonesia, call for improvements and refinements in how plantations are characterized through a typology. The identification of the

parameters that matter is a prerequisite, and the case studies provide lessons in this regard with the following highlights: (i) tenurial arrangements; (ii) income versus subsistence-oriented plantations, and (iii) environmental benefits. This leads to the first implication, namely that a typology would be improved by combining these parameters in order to capture the differences between contexts (e.g. countries) in order to represent plantations globally. For instance, what matters most is the market integration and capacity to invest and innovate, rather than being small or large scale.

Furthermore, the definition determines the direction/way in which a typology can be developed. The case studies are built around the simplified dichotomy of small- and large-scale plantations. But there are multiple ways of defining plantations on the basis of scale. For instance, small and large plantations may either be defined by size of landholding (Schirmer 2007) or capital investment (Kröger 2012). However, a definition based on any single parameter may not take adequate account of the variations of scale along a continuum. For instance, smallholders may vary in asset size of a couple of hectares in Indonesia to around two dozen hectares in Malaysia and Thailand, and to a hundred or more hectares in Australia and Africa (Byerlee 2014). This leads to a second implication, that instead of just referring to scale as being small or large, a third classification of middle-scale plantations might be necessary to complete the picture. In addition, scale has to be interpreted in consideration of the context.

6 Policy implications

The comprehensive characterization of plantations, either qualitatively or quantitatively, presents an ongoing and important challenge (Magdon et al. 2014), especially as controversies about the impacts of planted forests are likely to remain intense and to affect the pace and nature of their development. This poses the challenge of establishing theoretical clarification, so that the information conveyed to policy makers is matched with practical understanding.

Broadly, forestry now represents a plurality of paradigms in society that range from the focus on economic goals and equitable growth to a focus on mitigating climate change, combating desertification, conserving biodiversity and supplying resources for global demand (Szulecka et al. 2014). There is a policy imperative to support the provision of services for society beyond the maximization of the resources to generate profits. It implies the search for a balance between paradigms rather than prioritizing one among the others. It also implies the need to support a harmonization of forestry policies at international, national and regional levels. Hence, the aim of a typology goes beyond plantations and embraces forestry at large.

That said, a critical dilemma remains between either a universally recognized typology that could serve the double objective of policy evaluations and fruitful debates that are

evidence based rather than ideology driven, or purpose-oriented typologies that inform specific decisions more purposefully. The way forward might be to have both, with the first produced by consensus under the responsibility of international bodies, and the second produced by stakeholders in more specific contexts.

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