Can't See the (Bamboo) Forest for the Trees: Examining Bamboo's Fit Within International Forestry Institutions

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Abstract Over the centuries, governments and international agencies have developed a wide range of institutions to manage timber resources and conserve values provided by treed lands. Concerns regarding the sustainable supply of timber have provided opportunities for the development of substitute resources; however, bamboo and other non-timber forest resources have not been a part of the development of these institutions. Bamboo is a unique Non-Timber Forest Product, as it is often classified as forest or timber, and therefore must adhere to the same regulations as timber. Given the recent global expansion of bamboo, it is timely to examine the interplay between bamboo and the traditional institutions of forest governance. This paper aims to contribute to debates regarding cognitive institutional constraints on the development of substitute natural resources using bamboo as a case study, with specific focus on the applicability of Forest Stewardship Council certification, timber legality verification and Reducing Emissions from Deforestation and Forest Degradation to bamboos.

Keywords Bamboo · Forestry · Forest certification · REDD+ · Timber legality verification · Institutions

INTRODUCTION

Growing resource scarcity and advances in technology have meant that bamboo is now an increasingly important product in the global forest products marketplace. In the context of sustainable development, challenges from climate change and population pressure mean it is essential to facilitate institutions to develop natural resources. For example, population is set to increase by 0.9 % per year to 8.2×10^9 in 2030, with the major consumption of forestry

resources coming from China and India leading to increasing pressure on natural resources and institutions (FAO 2011). Although not a panacea, bamboo is already contributing to (Lobovikov et al. 2012), and has significant potential to further contribute to global forestry resource deficits (Hunter 2002). Bamboo is emerging as an important substitute for wood and fiber. The world bamboo market is estimated at $\$10 \times 10^9$ and is expected to double in 5 years (Woodridge 2012). This is a consequence of new technologies that are enabling bamboo products to compete effectively as a substitute material for a range of resources such as timber, viscose, fiber-glass, and construction materials. Unlike silvicultural forestry, where over 1000 tree species have been developed for timber (Sutton 1999); relatively few bamboo species are utilized commercially: 58 species produce 'timber', 18 are used for pulp and paper, and 56 for edible shoots (Li and Kobayashi 2004). Table 1 shows the current estimates of global bamboo area. It highlights the two main bamboo nations, India and China, which will be the focus of much of this paper.

Bamboo's potential as a natural resource rests with its substitutability; however, this also acts as a constraint. Due to lacking a specific identity, bamboo products operate in markets with governance instruments designed for more established plant resources. Plants are natural and cultural artifacts, shaped by particular histories, local and global priorities, funding patterns, and institutional hierarchies (Schiebinger 2004). Furthermore, plants are not considered individuals, but collectives or assemblages (Head and Atchinson 2008). Bamboo is framed within the forestry assemblage, which in a global sense is largely based on European notions of treed landscapes governed within forestry institutions.

Institutions are, according to North (1990), the 'rules of the game in society', or 'the humanly devised constraints

Table 1 Bamboo area by country and region (1990–2010)

Country/region	Area of bamboo (1000 ha)			
	1990	2000	2005	2010
China	3 856	4 869	5 426	5 712
India	5 116	5 232	5 418	5 476
Total Asia	15 412	16 311	16 943	17 360
Total Europe	0	0	0	0
Total North and Central America	37	37	37	39
Total Africa	3 688	3 656	3 640	3 627
Total Oceania	23	38	45	45
Total South America	10 399	10 399	10 399	10 399
World	29 560	30 442	31 065	31 470

Adapted from FAO (2010) Forestry Resources Assessment

that shape human interactions’. Analysis of institutional frames allows for attention to be paid to the sources of constraints and inertia that keep policy discussions anchored in assumptions and models which do not necessarily have an adequate institutional fit (Hoffman and Ventresca 1999). This paper will examine the interplay between cognitive and regulative institutions.¹ It aims to examine how the management of bamboo fits with a selection of forest governance mechanisms designed to promote responsible management practices.

Bamboo Ecology

Bamboo is predominately perceived as a timber substitute. Bamboo is not a tree; however, it is a grass belonging to the Gramineae family, of the subfamily Bambusoideae (Jiang 2007). Bamboos are considered one of the fastest growing plants on earth (Kumar and Sastry 1999), and can grow on marginal land unsuitable for agriculture (INBAR 2003).

Bamboo species are distributed predominately within tropical and sub-tropical areas, with only a few commercially valuable species from temperate zones, but absent from the native floras of Europe (McClure 1966). From a socio-historic perspective, this is significant because European colonial powers predominantly shaped and enforced institutions of forest management that exist today. This has also been reinforced by the strength of the timber industry. For example, the US timber lobby quashed attempts by the US Department of Agriculture to develop a bamboo industry in the US South in the 1950s and 1960s

(Adamson et al. 1978). While many commercial bamboo species are not native to the US, advances in biotechnology have enabled companies to modify Chinese commercial species to be grown successfully in the US (PR Newswire 2013). The potential for large-scale plantations, backed by significant commercial investment across both the US and Latin America, could reinforce bamboo within the current forestry paradigm regarding its fit within forestry policy and certification. It is therefore important to examine how natural resources and their social constructions interact or conflict and the efficacy of governance instruments.

Compared to silvicultural forestry, academic research on bamboo cultivation is in its infancy. However, it is understood that as a grass, bamboo requires different management techniques to trees. Fundamentally, bamboos are classified according to three different rooting structures—monopodial (diffuse or ‘treelike’), sympodial (clumping), and amphodial (mixed)—which have distinct policy and management needs (Jiang 2007). Although a simplification, Table 2 demonstrates a clear differentiation between growth patterns, rooting structure, flowering patterns, competitiveness characteristics, fertility, and longevity.

Two key bamboo producing nations, China and India, have different management needs due to the nature of ‘running’ or ‘clumping’ bamboo. For example, the most important commercial species in China (*Phyllostachys heterocycla* var. *Pubescens*; commonly known as Moso), is a monopodial bamboo that faces challenges regarding monocultures, intensive harvesting, chemical residues (Fu and Lou 2002) and soil erosion (Xu and Jiang 2008) akin to intensive timber forestry or agriculture, whereas in India sympodial or clumping species suffer from challenges regarding the onset of flowering, propagation of species, lack of seed and planting materials. Like many other grasses, bamboos grow until they flower, produce seeds and then die. Flowering bamboo is either gregarious (periodic), sporadic (irregular), or both. Flowering intervals of gregarious flowering species range between 3 and 120 years (Shananker et al. 2004). Chinese experts claim either that Chinese Moso bamboo flowers at the longest interval of 120 years, or that management techniques have eradicated flowering altogether. In short, flowering is not a significant management concern in China. However, most commercial species are sympodial, therefore their management requirements differ from the Chinese ‘treelike’ species (which is similar to the forest structure of treed lands or plantations). This indicates that governance mechanisms need to accommodate sympodial specific management requirements in order for the sustainable development of the resource.

Although many sympodial species have more frequent intervals in flowering, monopodial ‘treelike’ species have challenges regarding ‘invasiveness’. This invasiveness is

¹ Institutions can be divided into regulative, normative, and cognitive models (Scott 1995). Regulative aspects are based on legal sanctions; normative aspects are morally grounded and cognitive aspects of institutions refer to the collective construction of social reality embodied within public activity.

Table 2 Key differences between bamboo and trees

Variable	Bamboo	Many timber producing species
Growth	Bamboo reaches its final height in 2–4 months Growth occurs in 1 year with a single cylinder	Trees keep growing throughout their whole lifetime Trees grow wood rings
Rooting structure	Rhizomes serve as the trunk, the culms are the branches off the trunk Bamboos have three distinct rooting structures: monopodial (diffuse), sympodial (clumping), and amphodial (mixed)	Trees have roots, trunks, and branches
Flowering patterns	The majority of bamboos are monocarpic flowering once in cycles. Depending on the species bamboos flower once in 3–120 years	Trees that are mature flower and set seed on an annual cycle
Competitiveness characteristics	Can outcompete trees or other plants for access to sunlight, nutrients and water through rhizomes and ‘invasive’ characteristics	Competes through height in the canopy
Fertility	Many bamboo species are infertile (or have infrequent flowering and therefore seeds are in short supply) and require vegetative propagation techniques	Trees are fertile
Longevity	Culms can decay after 5–8 years without harvesting. The mother plant tends to die after flowering	Trees can last centuries

Based on World Bamboo Organization (2012)

far from ‘treelike’ when analyzed underground. Sympodial bamboos develop in branched clusters close to the parent plant and have pachymorph rhizomes that turn upwards as soon as they are formed. Monopodial bamboos are, however, known as ‘runners,’ which can be invasive and difficult to manage. Running bamboos such as *Phyllostachys* spp. (the main Chinese commercial species) develop from long, leptomorph rhizomes, which grow horizontally under the soil. Rhizomes of monopodial (running) bamboos can grow to more than 10 m in a year (Shananker et al. 2004). This invasiveness potentially creates challenges if not managed adequately. While much attention is placed on Chinese monopodial bamboo, Table 3 demonstrates that of the nine most commercially valuable species, only one is

monopodial. This highlights the need to attend to the challenges associated with sympodial species which have very different management challenges to trees.

The Institutional Framing of Bamboo

Chinese utilization of bamboo for products such as paper dates back 5000–6000 years, predating the utilization of wood and pulp (Yang and Hui 2010). While China enjoys a positive historical and cultural connection with bamboo, the same is not the case with other nations. For example, in India and other developing countries, bamboo is considered ‘poor man’s timber’ and associated with lower castes or classes that have traditionally utilized the material from the cradle to the grave (Rao et al. 2009).

In India, colonial forestry impacted bamboo forestry significantly. In 2011, the Indian government overturned regulation which had listed bamboo as a tree under the Indian Forest Act since 1928. Bamboo being classed as a ‘tree’ ensured that cutting, selling, or trading in bamboo became the monopoly of the government and gave the forest bureaucracy control over an estimated US\$225 million trade. Now classified as a ‘grass,’ the change could have profound implications for forest dwellers who will not

Table 3 The key global commercial bamboo species

Species	Area	Use	Rooting structure
<i>Bambusa vulgaris</i>	Tropics	Construction medicine, shoots	Sympodial (diffuse/clumping)
<i>Chusquea culeou</i>	South America	Furniture, handicrafts, construction	Sympodial
<i>Dendrocalamus asper</i>	(Sub-)Tropics	Construction, pulp, shoots	Sympodial
<i>Dendrocalamus giganteus</i>	(Sub-)Tropics	Construction, pulp, shoots	Sympodial
<i>Guadua angustifolia</i>	South and Central America	Construction, furniture, handicrafts	Sympodial
<i>Melocanna bacfiera</i>	Southeast Asia	Construction, shoots	Sympodial
<i>Oxytenanthera abyssinica</i>	Africa	Construction, handicrafts, shoots	Sympodial
<i>Phyllostachys edulis/ Pubescens</i>	China	Industrial products, shoots	Monopodial (treelike)
<i>Yushania alpina</i>	East Africa	Construction weaving, furniture	Sympodial

Adapted from Hoogendorn (2012) INBAR Presentation WBC

be subject to the same strict controls and tax regulations (Sethi 2011).

While bamboo offers many opportunities as a substitute resource to timber (amongst other materials), historically this substitutability has also inhibited it from gaining predominance as a highly valued plant in its own right. Bamboo was not a native species to Europe and during European empire expansion may have presented little exotic charm, lacking the exoticness of ubiquitous plants such as sugar, cotton, potatoes, or tea. Europe already had local materials (e.g., willow, poplar) serving the main uses of bamboo. As a result, there was no economic incentive to trade bamboo or establish overseas plantations in European colonies.

As timber shortages became acute in the nineteenth century, preservation, conservation, and management of forestry became a key concern globally. At this time, romantic illusions surrounding the forest within literature were cultivated to aid the conservation drive (Radkau 1997). Unlike the cultural romanticism surrounding the institutional frame of treed landscapes, bamboo is known for its aggressive weedy tendency (Williams 1994). The advent of modern agriculture in the late nineteenth century changed approaches to plant management, framing a strong division between weeds and other plants. A weed is defined as: a herbaceous plant not valued for use or beauty, growing wild and rank, and regarded as cumbering the ground or hindering the growth of superior vegetation (Crosby 2004). However, a ‘weed’ is not a scientific term. All definitions of weeds regard them entirely from a subjective human perspective.

While Scott (1998) highlighted that plants that are valued become ‘crops’ and species that compete become ‘weeds’, bamboo is in a more complex situation. Bamboo nations have varying cultural relationships with bamboo and therefore different perceived ‘value’. The ‘radical

simplification’ of forests to a single commodity during colonial times allowed trees to become valued as ‘timber’ (Scott 1998). However, while forestry practices have developed to acknowledge the multi-functions of ecosystem services, bamboo has become valued as ‘timber’ and traded as such. This sense of institutional order is an epistemological space specific to a particular time period (Foucault 1966). While forestry science can no longer be considered the product of one school of thought, it is important to understand how inclusion within the forestry institutional frame affects bamboo development.

INTERNATIONAL INSTITUTIONS OF FOREST GOVERNANCE

International institutions of forest governance regulate forestry using different instruments for (a) sustainable forestry, (b) legality verification, and: (c) carbon sequestration. Three instruments will be examined: forest certification, timber legality verification, and Reducing Emissions from Deforestation and Forest Degradation (REDD+) (Table 4). It is important to discuss the implications of assigning a resource to an institution which: (a) has different ecological requirements, and (b) has been devised predominantly by countries without a cultural history of that resource.

Sustainable Forestry

In the late 1980s there was growing demand from environmental groups and industry for new policy tools to regulate forest conversion and legality within timber markets. Negotiations regarding an intergovernmental forest

Table 4 Bamboo within contemporary forest governance

Instrument	Actors driving the mechanism	Instruments governance	Definition of bamboo	Bamboo guidelines
Forest Certification	NGOs Industry	Environmental and social criteria Third-party auditing	Bamboos can be certified as a Non-Timber Forest Product (NTFP) within the matrix of a forest, or as ‘treelike’ within plantations or natural forests (FSC 2010)	Yes
Timber Legality Verification (Government procurement policies; Trade laws)	Global governments	Supply chain governance Third-party auditing ‘due diligence’ mechanisms	EU timber regulation “Covers almost all timber products-bamboo...[is] covered if part of listed HS codes” (Hinrichs 2011)	Yes
REDD+	Intergovernmental Organizations	Reducing Emissions from Degradation and Deforestation Plantation management Biodiversity conservation	Uses the IPCC definition of forests. “Includes bamboo...provided that height and canopy cover criteria [of trees] are met” (Eggleston et al. 2006)	No

Source Author

convention were originally on the agenda of the UN Rio Summit in 1992, but years of subsequent negotiations have failed to reach consensus. Growing skepticism of the capacity and willingness of intergovernmental bodies to regulate forests and forestry, combined with the rise of ethical consumerism prompted NGOs and timber retailers to initiate the creation of a forest governance mechanism independent of the state. This involved the founding of the Forest Stewardship Council (FSC), a standard-setting body governed by a membership of influential environmental organizations, notably the Rainforest Alliance, Greenpeace, Friends of the Earth, WWF, and large retail companies (notably IKEA, Home Depot and B&Q) (Klooster 2010). The major commercial players in the construction and pulp and paper industries now require certified materials (Baker 2012), leading to pressure in alternative timber markets. In 2012, 19 Forest Management (FM) and 351 Chain of Custody (COC) bamboo certificates existed, of which 13 FM were in China² and 6 in Colombia³ (FSC 2012).⁴

While FSC standards can be applied to bamboo, its application appears premature and unhelpful. Although smallholders globally have faced challenges reaching FSC standards regardless of the species, bamboo can be considered a unique case since it competes directly in timber markets. This creates market barriers for the majority of smallholder bamboo growers who lack access to funds to support the costs of hiring auditors and other associated costs of reaching standards.

In 2005 in Brazil, FSC passed a motion to improve and expand its guidelines on bamboo and rattan forest certification (FSC 2005). Subsequently, FSC's approach has not fundamentally changed. Their definitions continue to deploy a 'tree' as the benchmark for forestry understanding. For example FSC notes:

There are many species of bamboo, the larger of which may be considered treelike. Larger areas of bamboo are often referred to as 'bamboo forests'. Bamboos can be certified as a Non Timber Forest Product (NTFP) within the matrix of a forest, or as 'treelike' within plantations or natural forests (FSC 2010; 13).

Improvements in commercial intensive bamboo management in plantations are needed for the sustainable development of the resource related to monocultures, chemical use, biodiversity, and soil protection (Buckingham et al. 2011). Some efforts are underway, for example, under the Chinese State Forestry Administration, with the intention

to seek the Programme for Endorsement of Forest Certification (PEFC) accreditation, as well as individual initiatives of bamboo organizations in Latin America, Africa, China, and India to create bamboo specific certification. Issues of national autonomy, applicability, cost, and stakeholder acceptability represent major challenges for the development of a bamboo standard.

By mid 2010 about 56 % of the world's 355 million hectares of certified forests were in North America, 24 % in Western Europe, and only 8 % in Latin America, Asia and Africa combined (Bieri and Nygren 2011). The 'Northern' drive for certification has helped institutionalize the instrument. However, the majority of commercial bamboo is absent from these regions thereby underlining the need for frameworks suited to tropical and sub-tropical regions. Furthermore, if efforts are not made to create new certifications, with the rapid development of bamboo resources in Latin America and plans for the US, FSC certification is set to become further institutionalized for bamboo, meaning FSC bamboo is only set to increase on global markets.

Legality Verification

Certification was created primarily due to a lack of inter-governmental agreements to address legality of timber supplies (Arts and Buizer 2009). Since certification is particularly challenging in developing countries, timber legality verification offers the first step in improving forest management (FAO 2009). The EU and US recently amended their regulations to provide assurance against illegal logging. Within international trade, bamboo is often traded as timber and placed within the Harmonized System trade codes (Fig. 1). These provide data on trade flows and also ensure that bamboo adheres to timber legality verification, although bamboo legality has never been an international issue. Currently bamboo is included under some categories of the 'wood and articles of wood' section. The regulations could potentially be expanded to include bamboo under a number of other HS categories: 4418: Builder's joinery and carpentry, 4419: Tableware and kitchenware, and 4420: Statuettes and other ornaments (INBAR 2012). Bamboos ambiguity as a timber is illustrated under the EU Timber Regulation:

[EU Timber Regulation] covers almost all timber products, excluding recycled products, printed material - bamboo, rubber, rattan are covered if part of listed HS Codes (Hinrichs 2011: PPT)

There is currently no accreditation for legality verification systems because there is no common approach. While legality verification promotes national sovereignty, it relies on third-party verification like certification. A key and

² The first certificate dates from 2008.

³ The first certificate dates from 2011.

⁴ EcoPlanet Bamboo has FSC-certified plantations in Nicaragua, however, these are currently not listed on the database.

Fig. 1 Harmonized System (HS) bamboo trade codes. Adapted from Hoogendorn (2012) INBAR Presentation WBC

unanticipated consequence that has emerged from US and EU legislation has been the increased uptake of forest certification in Indonesia and Malaysia to provide assurances of legality verification. In the Indonesian case, the state-based forest certification scheme LEI has contributed to the development of the timber legality assurance systems TLAS (SVLK, *Standar Verifikasi Legalitas Kayu*) framed within Voluntary Partnership Agreements (Cashore et al. 2010). Although forest certification is not yet accepted as ‘due diligence,’ country studies are showing there is potential for mutual support between legality verification and certification in a number of countries (Cashore and Stone 2012). This mode of legality verification, at least in the short term, could reinforce the need for certification until specific verification methodologies can be created for bamboo.

Carbon Sequestration

Recent international forest policy has focused on the implications of tropical deforestation for climate change, biodiversity loss, and livelihoods. In particular, the efficacy of the REDD+ mechanism has dominated international discourse, with the ‘+’ denoting the enhancement of forest carbon stocks. As climate change is recognized as a global policy issue in need of immediate action, REDD+ is receiving growing attention for its potential role in abatement (Kanowski et al. 2011). The application of carbon mechanisms to bamboo is problematic because of bamboos ambiguous position regarding its relationship to timber.

According to the Intergovernmental Panel on Climate Change (IPCC) and FAO, bamboos are classified as trees, as long as they meet certain criteria (Eggleston et al. 2006; Lobovikov et al. 2012):

[A] forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters in situ. Areas under reforestation that have not yet reached but are expected to reach a canopy cover of 10 percent and tree height of 5 meters are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, which are expected to regenerate. Includes: areas with bamboo and palms provided that height and canopy cover criteria are met (Eggleston et al. 2006, p. 46).

It is not the first time bamboo’s fit within carbon mechanisms has been ambiguous. Previously, the Carbon Development Mechanism (CDM) placed the decision on countries Designated National Authorities (DNAs) to choose whether their forest definition for the CDM included bamboos. The CDM Executive Board decided in its 39th meeting:

Palm (trees) and bamboos can be considered equivalent to trees in the context of Afforestation/Reforestation (Lobovikov et al. 2012, p. 262)

When considering new carbon mechanisms such as REDD+, negotiating documents omit references to bamboo. Lobovikov et al. (2012) highlight that the definition of

bamboos is ambiguous under carbon mechanisms therefore many species will be relegated to the NTFP category, while others will be ‘treelike’. However, not considering bamboos as equivalent to trees under REDD+ might make bamboo stands vulnerable to conversion or degradation, which could contribute to national or international leakage. In spite of physiological differences between bamboos and trees, woody biomass of bamboos corresponds to that of trees and clearly differs from the biomass of grasses (Lobovikov et al. 2012).

DISCUSSION

In a world of globalization where the political economy has turned plants into commodities, we need to consider how natural resources and their social construction interacts or conflicts with other constructions in different societies. Instigating change within the cognitive field is challenging because the political and cultural nature of cognitive institutional models means the framing and boundaries of the institution are not always perceptible. In order to initiate change, efforts must incorporate strategies that address all aspects of institutions—regulative, normative, and cognitive (Hoffman and Ventresca 1999), particularly with regard to developing new ‘natural’ resources to substitute existing ones in light of increasing pressures for sustainable development.

Bamboo is not alone in its marginalization or cultural constraints on development. For instance, commercial cultivation of hemp in industrialized countries more or less halted in the early twentieth century when hemp became intrinsically linked with marijuana, the species’ other phenotype, which contains larger quantities of the commonly outlawed psychoactive compound. Recently, a renewed interest in hemp for industrial purposes has occurred due to environmental concerns, the over production of food crops, coupled with a need for new sources of fiber (Young 2005). However, political constraints ensue. For example, Halsey (1997) researched the production processes and legislation relating to the clear felling of old-growth forest and harvesting of hemp fiber for paper products. The article raised questions regarding the ecological utility of legislation that permits the destruction of a unique resource but prohibits the harvesting of a sustainable alternative.

We can no longer afford the luxury of abundance. Previously bamboo was not valued as a resource; however, we need to consider potentially less ‘desirable’—from a management point of view—resources, their biology and ecology, and to develop frameworks for their effective management in order that their utility is realized. By exploring the historical roots of bamboos’ marginalization,

this research aims to highlight the importance of this topic and the need to question the use and value of many other inadequately utilized ‘natural resources’. With the rise of China, India, and other developing economies, pressure on natural resources will be further exacerbated. The impending natural resource crisis calls for a fundamental reassessment of available resources and their cultural, ideological, and historical embeddedness in order to see past social constructions, to their potential utility value in the modern world.

Interdependence through globalization created the foundations for governance of natural resources. However, governance has largely been centered on western priorities, strategies, institutions, and cultural norms. The twenty-first century is characterized by greater global interdependencies coupled with new economic and cultural powers, namely China and India. This shift in power should enable a broadening of natural resource institutions and the diversity of actors that reinforce or contest the legitimacy of institutions scope. This is particularly the case for bamboo, a plant which has been largely outside the scope of European and northern management.

Some argue that the management of planted forests will increasingly parallel intensive agriculture, with the consequence that we may eventually get most of our wood from four or five species (Sutton 1999). The increasing importance of plantations for industrial wood could lead to as much as two-thirds of the world’s industrial wood supply coming from the dominant forest plantation species in the world—*Pinus* spp. and *Eucalyptus* spp.—by 2030 (Cubbage et al. 2010). Moreover, it is argued that forest certification for plantations legitimizes a political economic model of unsustainable development based on unlimited demands for wood and paper (Klooster 2010). If it is bamboo’s turn to be industrialized, it may be the case that bamboo will also face ecological simplification in management approaches. Certain species will be identified as ‘valuable’ leading to the predominance of commercial species. In this case, it is not a discussion about ‘trees’ and ‘bamboos’ with their vast diversity, it is more a case of the comparison of a valued commodity: ‘tree timber’ and ‘bamboo timber’. The pressing challenge is therefore to find an institutional space that both fits the commodity and the plant’s ecology.

As much as timber is valued as a ‘natural’ resource today, the utilization of timber was not fully realized within early forestry practices. Before the development of forestry under Henry the VI, in England a forest was largely considered to be an area or district reserved by the king for hunting; this was because of its value as a habitat for game animals, rather than the value of timber resources. During the demise of forests in medieval times, the idea of growing trees for timber production gradually took root,

hastened to a large extent by rapidly expanding naval requirements (James 1990). The timber crisis within sixteenth- and seventeenth-century Europe, when timber was the key energy resource, led to the development of coal as a fuel, which in turn made the technologies of the Industrial Revolution. It is argued that the Industrial Revolution occurred in the UK 50 to 100 years earlier than any other country because of the innovative response to scarcity of resources (Hobhouse 2004). This highlights, once again, that resources are a social construction. Furthermore, while we take trees and the timber industry for granted, the importance of resources throughout the centuries has changed. Bamboo therefore can fit into a new resource paradigm, in an age in need of innovative responses to scarcity of resources.

CONCLUSION

When considering the efficacy of different forestry governance instruments for bamboo, it is clear that a more inclusive certification programme is needed—certification that advocates clear changes in management for sustainable production. More research is required on the efficacy of forest certification for bamboo. Moreover, US and EU legality verification could further strengthen the need for certification as studies have demonstrated. To place bamboo within wood-timber legality verification systems (through HS codes) may allow for more comprehensive statistics of global bamboo trade; however, since illegal bamboo trading has never been raised as a pressing issue (unlike timber), legal verification appears unwarranted and may act as a further trade barrier before the industry is adequately commercialized. Finally, the omission of explicit mention of bamboo in REDD+ undervalues a potential contribution and further emphasizes the limited conceptualization of forests as treed lands.

At a micro level, being a predominantly tropical and subtropical plant, there are great gains to be accrued from developing livelihoods in regions of the world where bamboo grows. With the vast array of potential uses, there are many potential management and technology advancement opportunities that could contribute to poverty alleviation (Rao et al. 2009). The challenges of creating a frame for sustainable bamboo management are significant. Crisis in the past has provided the impetus for change; we are moving into an age where we need to fundamentally reassess natural resource use. The commercial opportunities bamboo presents are significant; however, an enabling institutional frame needs to be created to assist the plants development. At the macro level, this paper has aimed to demonstrate how plants, which become valued as natural resources, become institutionalized often within isomorphic frames without adequate attention to the efficacy of the framework.

Policy makers should encourage a policy process that will accord bamboo equal status to silviculture in future international forest regimes. Therefore, the perception and scope of bamboo resources needs to be extended, not just as a forestry crop, but also developed within agriculture or horticulture. Bamboo needs a new institutional space which separates it from trees as the default parameter for forests. A new space needs to be created for bamboo amongst its overlapping current institutional frames in forestry, agriculture, and horticulture that recognizes the challenges faced by flowering, propagation of sterile species, invasiveness and issues associated with monocultures (to name just a few). Many lessons can be learned from the timber and agricultural sectors, but difference needs to be recognized in order to provide enabling governance. In short, institutions should be created and adapted to facilitate the development of natural resources that reflect the reality and challenges of the twenty-first century.

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