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PERSPECTIVES ON PLANTATIONS

A Review of the Issues Facing Plantation Management

BACKGROUND PAPER TO THE FSC PLANTATIONS REVIEW

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The Forest Stewardship Council (FSC) is an independent, not for profit, non-government organisation based in Bonn, Germany.

The mission of the Forest Stewardship Council is to support environmentally appropriate, socially beneficial, and economically viable management of the world's forests.

FSC develops, supports and promotes international, national and provincial standards in line with its mission; evaluates, accredits and monitors certification bodies which verify the use of FSC standards; provides training and information; and promotes the use of products that carry the FSC logo.

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Abbreviations Used

FAO – Food and Agriculture Organisation of the United Nations
FRA – FAO Forest Resources Assessment Programme
FSC – Forest Stewardship Council
UNFF – United Nations Forum on Forests
WRM – World Rainforest Movement

1. Introduction

Plantation forestry counts as one of the more contentious issues concerning sustainable forest management. In more than ten years since the United Nations Conference on Environment and Development in Rio de Janeiro (1992) referred to role of planted forests in its Statement of Forest Principles, an extensive list of issues concerning plantation forestry has been raised by a diverse array of stakeholder groups. Many of the issues raised reflect the range of situations in which plantation management takes place and emphasise variability in plantations' effect on social, environmental and economic conditions. The conclusions reached at the most recent United Nations Forum on Forests (UNFF) intersessional experts meeting on planted forests are indicative of plantations' variability. Increased fibre production from smaller areas for example, is seen as a benefit of plantations that can help alleviate pressure on native forests. However it is also noted that plantations are no substitute for natural forests, especially where such replacement may adversely affect indigenous peoples who are dependent on the forest for their livelihoods (UNFF 2003). It is difficult to be categorical about plantations.

The Forest Stewardship Council (FSC) exists to promote environmentally appropriate, socially responsible, and economically viable management of the world's forests. FSC does this through forest management certification in compliance with its principles and criteria for forest stewardship. Over 5 million hectares of plantation have been certified under the FSC system. However FSC certified plantations, and the principles and criteria to which they are certified, are not immune to controversy. In recent years many stakeholders have voiced concerns and raised issues related to the standards met by FSC certified plantations.

In response to these concerns FSC is embarking on a comprehensive review of its policies and standards for plantations. The ultimate purpose of the review is to clarify global expectations for responsible plantation management. In support of the review this document aims to provide a synopsis of the issues facing plantations, certified or otherwise. The intention of this paper is to contribute to the discussion of what constitutes an environmentally appropriate, socially responsible, and economically viable plantation by identifying and undertaking some initial analysis of the issues and concerns being raised.

This analysis aims to provide an overview of the numerous issues facing plantations. Information used in this review is drawn from the complete spectrum of published literature as well as from FSC correspondence with stakeholders. A summary of approaches to defining plantations is provided prior to discussing issues within environmental, social, and economic categories. Discussion within each category is organised around broad headings because many issues are ill suited to distinct classification. Most issues merit in-depth analysis in their own right, however such an analysis is beyond the scope of this short paper. The aim is not to provide a definitive statement on plantation issues, but rather to identify issues of fundamental concern and thereby facilitate further discourse on their resolution.

2. Plantations Defined

Attempts to concisely define plantations reveal their variability. This is the first issue surrounding plantations. Two approaches to plantation definition are seen. One approach aims to specify the distinctive management characteristics of plantations in order to explicitly recognise plantations' variability. The second approach relies on a broad definition to implicitly recognise plantations' variability.

The preliminary conclusions reached by an expert meeting on harmonizing forest-related definitions are an example of the more detailed approach:

> "Forest plantation or plantation forest is understood to be planted forests that have been established and are (intensively) managed for commercial production of wood and non-wood forest products, or to provide a specific environmental service (e.g. erosion control, landslide stabilization, windbreaks, etc.). Planted forests established for conservation, watershed or soil protection may be subject to little human intervention after their establishment. Changes may occur in purpose, degree of management intensity, time scale and potential reversibility (to other land uses), which also merit consideration. The Meeting considered the FRA definition of forest plantation to be precise and recommended it for consideration by other organizations, fora and processes." (FAO 2003)

Poulsen *et al.* (2002) produced a *Typology of Planted Forests*, which outlines various planted forests and also plantation types. The various plantation types are distinguished according to management purpose and intensity, as well as by nature (stand structure and composition) and land use history:

> *Industrial plantation*: intensively managed forest stands established to provide material for sale locally or outside the immediate region, by planting or/and seeding in the process of afforestation or reforestation. Individual stands or compartments are usually even aged with regular spacing. Exotic species are predominant and/or one or two indigenous species. Usually large scale or contribute to one of a few large-scale industrial enterprises in the landscape. Management may be for timber, biomass, food or other purposes.
>
> *Home and farm plantations*: managed forest, established for subsistence or local sale by planting or/and seeding in the process of afforestation or reforestation, even age class with regular spacing. Usually small scale and selling, if at all, in a dispersed market. Management may be for fuelwood, timber, fodder, orchard or other purposes.
>
> *Environmental plantation*: managed forest stand, established primarily to provide environmental stabilization or amenity value, by planting or/and seeding in the process of afforestation or reforestation, usually with even aged class with regular spacing. Management may be for windbreaks, erosion control, game/ wildlife management, site reclamation, or amenity value.

Both of the above definitions emphasise management purpose as a distinctive characteristic in plantations, which influences management intensity and practices. These more specific approaches to defining plantations are part of broader attempts to define various types of planted forests, which, as Carle and Holmgren (2003) point out, tend to vary according to management intensity, which itself is a function of management objectives. Similarly, the UNFF experts meeting on planted forests

concluded that management objectives and the degree to which management approximates naturalness (i.e. management intensity) should be the basis for defining managed forests (UNFF 2003).

Any attempt to comprehensively define and categorize plantation types however, ultimately falls short of capturing all possible permutations. It may not be necessary, or practical, to explicitly state all variations on the plantation theme. In some cases, a broader approach is sufficient. Both FSC (2004) and FAO's *Global Forest Resource Assessment 2000* (FRA) employ a broader approach:

> "Forest areas lacking most of the principal characteristics and key elements of native ecosystems as defined by FSC-approved national and regional standards of forest stewardship, which result from the human activities of either planting, sowing or intensive silvicultural treatments" (FSC 2004).
>
> "Forest established by planting or/and seeding in the process of afforestation or reforestation. It consists of introduced species or, in some cases, indigenous species" (FAO 2001).

It is apparent that some purposes may require an explicit definition of plantations while in others a general definition is more appropriate. A rather broad definition for a study on the scale of the FRA is probably necessary because inconsistencies in data collection among countries make collecting data that distinguish plantation types impractical. However, distinguishing between industrial and environmental plantation types at the local level may be equally necessary for enabling responsible management decisions.

Overlap undoubtedly exists between categorized plantation types. However categories are still useful for conceptualising the spectrum of plantation management. Recognition of the range of situations included within the broad definition of plantation, and consideration of management purpose and intensity as key factors may facilitate discussion.

3. Environmental Issues

Much debate over plantation forestry concerns plantations' impact on ecological systems, both pre- and post-establishment. Stakeholders have voiced concern regarding biodiversity loss, and disruptions to soil hydrology and nutrient regimes. Issues related to plantations' effects on adjacent forest areas, and the spread of pests and diseases have also been raised. The use of genetically modified organisms is an issue for some, while others debate the merits of plantations' ability to sequester carbon and thereby help combat global warming. More than indicating the many challenges facing plantation management, these issues also suggest opportunities for improvement. This paper discusses environmental issues under three headings: biodiversity, soil and water resources, and global warming.

3.1 Biodiversity

A fundamental consideration in assessment of plantations' effects on biodiversity is its landscape context. Hartley (2002) suggests important factors are the size and location of the plantation within the landscape, surrounding land uses and/ or ecosystems, and the land use or ecosystem replaced. A central theme in the plantation discussion is the common assertion that intensive plantation management helps reduce pressure on

native forests through the production of greater fibre yields from smaller areas (e.g. Sedjo and Botkin 1997; Victor 2003). Others counter that most jurisdictions lack mechanisms to ensure forest conservation coincides with plantation establishment (e.g. Elliot 2003). Stakeholder concern also exists that economic rather than ecological rationale dictates which natural areas are not converted to plantation. Where plantations exist in a landscape of various land uses and ecosystems, stakeholders have raised issues regarding the maintenance of contiguity between natural forests. The potential for plantations to isolate the flora and fauna of native ecosystems by fragmenting natural forest and disrupting natural processes is of particular concern (Gill and Williams 1996; Estades and Temple 1999). Evidence also suggests plantations are capable of improving contiguity between ecosystems when compared with degraded and deforested lands (Parotta *et al*. 1997).

A key factor in the discussion over plantations' net effect on biodiversity is the ecosystem or land use replaced by the plantation. Native forests have been cleared to establish plantations in Vietnam, on *cerrado* (dry tropical savannah) in Brazil, and in floristically diverse grasslands in South Africa (Lang 2002; dos Santos André *et al.*2003, Owen 2004). Such concerns are especially pertinent where rare and endangered species or ecosystems are affected. Where plantations are established at the expense of native habitat, forests or otherwise, the net effect on biodiversity is likely negative. Plantations generally provide less suitable habitat for flora and fauna than the ecosystems they replace (Hartley 2002). This is especially true in even-aged monocultures of exotic species. Plantations however can also have a positive effect on biodiversity when established on previously degraded lands, especially where the plantation contains a mix of native species in a variety of age classes (Hartley 2002; Lamb 2003).

Ecological restoration is considered a benefit of plantation forestry in some circumstances (Lamb 2003). Plantations can have a 'catalytic effect', facilitating natural succession in their understories, and thereby enhancing biodiversity in degraded forests or lands. (Turnbull *et al.* 1997). Certain monoculture plantations for example, have been shown to alter microsite conditions such that species rich understories persist and native tree species become re-established (Lugo 1997). However as plantations harvest cycles proceed and replanting occurs, there is concern that plantations halt successional processes and are impediments to further ecological recovery.

The diversity of species planted within plantations is also relevant. Evidence exists in support of the view that mixed-species plantings sustain a greater diversity of flora and fauna than monocultures, especially where native species are concerned (Bibby *et al.* 1989; Butterfield and Malvido 1992; Tattersfield *et al.* 2001). Hartley (2002) notes several benefits associated with planting a mix of species such as greater efficiency in nutrient use, and reduced susceptibility to pest or disease outbreaks. Monocultures can be more susceptible to pest damage than mixed species stands leading some to argue that species diversity is essential to long-term ecosystem health (Jactel *et al.* 2002; Woods 2003).

The potential for catastrophic pest outbreaks in exotic monoculture plantations has raised concern among stakeholders. Carrere and Lohmann (1996) provide numerous examples of extensive tree death over large areas. However Nair (2001) found that while monoculture plantations are more likely to suffer outbreaks than natural forests,

the risk associated with exotic species is no greater than that associated with native species. Still, the threat of pests has lead in many cases to the use of chemical pesticides including herbicides, fungicides, rodenticides, and insecticides. Their use in plantations to control not only insect and pathogen outbreaks, but also problematic wildlife and competing vegetation is a concern of stakeholders. Underlying these concerns are pesticides' impact on non-target species and areas (e.g. Moraes 2003) and reduced species richness and structural diversity in sprayed areas (Hartley 2002). The ability of chemicals to accumulate in the water supply and in other biological organisms is another concern (Moraes 2003).

The use of exotic species and their impact on biodiversity is another contentious issue. A persistent criticism is that large areas of exotic species form unnatural forest types that are in effect 'biological' or 'green deserts' (e.g. Allen *et al.* 1995; WRM 2004a). Species adapted to habitat provided by native forests may be ill suited to habitat created by exotic species. Conversely, planting native species may be considered insurance for the majority of species for which little or no scientific knowledge exists. Exotic species can escape from plantations and reduce native plant and animal diversity of native forests and grasslands by out-competing indigenous species (Gill and Williams 1996; Menne 2003). Moreover, such escapes have also been shown to further strain water resources in areas with limited supplies (Le Maitre *et al.* 2002). However, evidence from the tropics suggests that the ability of exotic species to invade native forests is positively correlated with human disturbance when compared to undisturbed tropical forests (Fine 2002). Still, evidence suggests there are several management options capable of supporting diverse flora and fauna within plantation landscapes (Cannell 1999).

Genetic diversity of forest tree species is one particularly complex issue surrounding plantation forestry. Carnus *et al.* (2003) assert that no single measure exists to adequately assess the impacts of plantations on the intraspecific genetic diversity of forest trees. It is worth noting genetic diversity's relevance to many of the concerns referred to above. For example, breeding programs that improve growth rates and fibre production may narrow the genetic base of forest plantations, reducing their ability to withstand pest damage (Ciesla and Donaubauer 1994). Genetic resources may also be lost where native forests are cleared for plantation establishment, and gene flow inhibited where plantations limit dispersal. Conversely, Rajora and Mosseler (2001) suggest appropriately managed plantations can enable gene flow, dispersal, and connectivity between remaining tracts of indigenous forests and species.

Notwithstanding the above impacts, much concern over the genetic impacts of plantations involves the invasion of natural habitats (forests or otherwise) by plantation tree species. This issue is especially controversial where Genetically Modified or Engineered (GM or GE) trees are involved (e.g. Reuters 2004). In a discussion of advantages and disadvantages associated with GM trees, Matthews and Campbell (2000) note several benefits and risks associated with the spread of modified genes. Benefits for example include increased vigour and stress resistance such that trees are capable of tolerating drought conditions (Wang *et al.* 2003). However, the potential for GM trees to out-compete their indigenous counterparts due to enhanced tolerance to physiological stress is of concern where they escape plantations. As is the potential for genetically modified material from trees to become incorporated into populations of their wild relatives.

The present debate over the genetic engineering issue centres on risk and uncertainty, and the desirability of intensification itself. Proponents of genetic engineering admit numerous risks are involved but also argue that in certain cases, benefits may out weigh the risks (Matthew and Campbell 2000). However, evaluation of the tradeoffs is difficult because the scientific evidence necessary to enable informed decisions is seldom available (Asante-Owusu 1999; Cossalter and Pye-Smith 2003). The ban on GM trees in FSC plantations for example, has been criticised for being counterproductive because it limits certified companies from participating in field research aimed at resolving many of the uncertainties which presently surround the GM debate (Strauss *et al.* 2001). Others remain unconvinced (e.g. Cauley 2001).

Very low structural diversity in plantations is another concern of stakeholders. This issue is particularly pertinent where even-aged monocultures cover large areas. Management strategies that retain structural diversity best demonstrate these concerns. Retention of large native trees as well as patches of other native vegetation scattered throughout harvest areas provide coarse woody debris, and enhance plant community diversity (Sitonen *et al*. 2000; Ferris *et al.* 2000). Moreover, these patches are crucial for native species persistence. Conversely, even-aged monocultures without any structural diversity contain significantly less biological capital.

Another issue raised by stakeholder is the age at which plantations are harvested. On average the diversity of flora and fauna increase as the plantation ages (Donald *et al*. 1998). Therefore, the longer the rotation age, the greater the plantations' biological capital (Allen *et al*. 1995; Ferris *et al.* 2000). The economically optimum harvest age generally occurs prior to many ecosystems realising their ecological potential (e.g. Liu 1994; Greaves *et al.* 2003) although variability exists depending on financial objectives (Taylor and Fortson 1991).

3.2 Soil and Water Resources

Plantations' impact on soil and water resources may be considered relative to plantations' capacity for either degradation or restoration of the soils upon which they grow. Evaluation of plantations' relationship with soils requires consideration of characteristics such as stability and erosion, compaction and porosity, as well as nutrients and toxicity (Harrington 1999). These characteristics have important consequences for hydrological processes. Indeed, soil and water resources are arguably the most important considerations for assessing sustainability (Worrell and Hampson 1997).

The capacity for plantations to deplete nutrients has caused concern among stakeholders (WRM 1999). This issue manifests itself in the extent to which fertilisation is required. Where short rotation lengths prevail, the quantity of nutrients removed in the form of biomass may represent a net loss in nutrient capital from the system, thus requiring fertilisation to maintain productivity. Where planting trees has enabled improvements in site productivity and nutrient capital, Parrotta (1992) notes that early harvests can negate any nutrient benefits. Moreover, the use of fertilisers has also raised issues related to negative impacts on water quality where run-off occurs (HBRF 2002). Conversely, adjusting harvest regimes and planting a mix of species can conserve and restore site fertility within plantations (Stanley and Montagnini 1999). *Acacia mangium* for example, is able to fix atmospheric nitrogen thereby increasing its content in the soil (Galiana *et al*. 1998). The most important consideration relative to

plantations' impacts on soil nutrients is often the site quality where the plantation is established. Where site quality is low for instance, fertilisation may be essential if plantation establishment is to be successful.

Much concern over plantations' impact on soil relates to erosion. Examples of plantation establishment and management leading to erosion and sedimentation are available (e.g. Maathuis and Pinners 2004), as are cases where plantations enhance soil and nutrient accumulation (e.g. Parrotta 1992). Hydrophobicity in forest soils under *Eucalyptus globulus* and *Pinus pinaster* stands can reduce water infiltration and subsequently increase overland flow and erosion (Ferreira *et al.* 2000). Stakeholders have voiced concerns over extensive road networks exacerbating run-off and sedimentation, in addition to reduced infiltration stemming from soil compaction caused by heavy machinery (Weir pers. comm.; WRM 1999). Evidence also suggests that shorter harvest rotations can exacerbate erosion (Worrell and Hampson 1997). As such, stakeholder concern has focused on cases where inappropriate site management leads to severe erosion where the consequence of intensive site preparation can be declining site productivity caused by nutrient leaching (Hartley 2002). Management options are also available for enhancing nutrient retention within plantations (Bigelow *et al.* 2004).

Plantations' effect on hydrological conditions is a concern in many regions and has been for several years (Calder *et al.* 1991). Much controversy regards situations where plantation establishment may have reduced stream flows leading to water shortages (WRM 1999). Key factors in plantations' impact on water resources are water usage by certain species, and the ecosystem replaced by the plantation. Research in South Africa clearly demonstrates that planting fast growing evergreen species with extensive rooting systems on grasslands decreases streamflow significantly (Jacobson 2003). A study of *Eucalyptus grandis* planted on grasslands found streamflow was completely absent nine years after planting, and did not return until five years post harvest (Scott and Lesch 1997). This suggests that plantations not only have the ability to reduce stream flows but also draw down the water table, problems exacerbated in areas with pronounced dry seasons. Moreover, this study highlights the variation relative to which point in the harvest cycle water flows are measured. Evidence exists which shows increased peak flows following harvest, accompanied by decreases following planting (Fahey and Jackson 1997). In other situations plantations have also been shown to increase dry season flows (Calder 2004).

The issue of plantation establishment reducing infiltration and exacerbating peak flows, thereby causing flash floods has also been raised (Geasphere 2004). Conversely, plantation establishment has also been promoted for its ability to prevent flooding. Against these concerns however, evidence suggests forest management is of minimal importance when managing major flood risks in temperate regions (Robinson *et al.* 2003) or in the tropics (Hamilton 1991).

Stakeholders have also voiced concern regarding plantations' impact on riparian habitats, particularly where harvesting occurs to the edge of stream banks. Harvesting close to stream banks has been found to increase bank erosion, limit inputs of coarse woody debris, and increase stream temperature with negative implications for biodiversity and water quality. (Boothroyd *et al.* 2004; Kishi *et al.* 2004; Meleason *et al.* 2004). Quinn *et al.* (2004) for example found invertebrate community structure was significantly altered where reaches were clearcut to the bank compared with reaches

buffered from harvesting, and reaches where harvesting was completely absent. In this case logging impacts were strongly related to water temperature increases, changes to lighting, and bank instability leading to increased sediment.

3.3 Climate Change

Plantations' relationship with climate change has its origins in the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. Signatories to the Kyoto Protocol agree that a reduction in greenhouse gas emissions, particularly carbon dioxide, is necessary to combat global warming. In relation to forests, reducing atmospheric carbon dioxide occurs through either conservation or sequestration, although biomass fuel production is increasingly discussed. Forest conservation effectively prevents the addition of CO_2 to the atmosphere, a particular concern in areas where forests are readily cleared and burned for agricultural purposes. The aim of sequestration is to maximise the amount of CO_2 removed from the atmosphere by growing trees quickly and sequestering carbon within wood products. Although primary forests (i.e. those being conserved) also remove CO_2 from the atmosphere, it is argued the rate at which this occurs with young, fast growing trees, such as those grown in plantations, is much greater (Birdsey 1992).

A basic tension between conservation and sequestration underlies much of the controversy surrounding plantations' ability to help combat global warming. Under the Kyoto Protocol's Clean Development Mechanism (CDM), plantation projects that sequester carbon in one area may be used as credit to offset emissions created elsewhere. Plantation projects may be economical compared with reducing emissions at the source, thus creating an incentive for plantation establishment; incentives criticised for being perverse where they lead to the conversion of primary forests and negative socio-economic impacts for local communities (Brown 1998; Dudley 1998). Evidence suggests that the amount of carbon stored in old forests, and subsequently released during conversion, is far greater than the amount sequestered in any plantation project (Schulze *et al.* 2000). In Brazil for example, slowing deforestation is considered a much more effective strategy for combating global warming (Fearnside 1999; 2000). Conservation and sequestration projects ought to be complementary rather than contradictory, depending on local circumstances.

Biomass fuel production may be considered intermediate between sequestration and conservation projects. Plantations' relationship with biomass fuel production hinges on fossil fuel displacement by biomass fuels as a source of energy. It is reasoned that biomass plantations will sequester carbon at a rate approximately equal to which it is released during biomass fuel usage. As such, substitution of fossil fuels with biomass fuels should reduce CO_2 emissions. However, a recent review of biomass' contribution to the future global energy supply concludes that the utility of bioenergy as an option for mitigating climate change is uncertain (Berndes *et al.* 2003).

Plantations, when established as reforestation or afforestation projects on degraded lands, are considered an important tool for mitigating global warming, hence their inclusion in the CDM. However, much uncertainty surrounds their implementation under the CDM. Van Vliet *et al.* (2003) for example, note the persistence of uncertainties surrounding carbon measurement, the crediting system, and the difficult question of the extent to which plantation projects are, or may be considered "additional". For example, in order for plantation projects (or other project activities) to obtain emission credits, the

amount of carbon sequestered must be additional to that which would be removed in the absence of Kyoto mechanisms (Kyoto Protocol, art. 12. 5c). It is beyond the scope of this analysis to provide an in depth discussion of the many issues facing implementation of the Kyoto Protocol, or climate change in general; however, the potential for appropriately managed plantations to play a role in mitigating climate change is worth discussion.

4. Social Issues

The extent to which plantations enhance or create social benefits is another dimension of the plantations debate. Much controversy stems from instances where plantation forestry has created or exacerbated social conflict over land use. Important issues concern plantation ownership, its corresponding influence on management outcomes, and the positive or negative consequences for local peoples. Stakeholders have voiced concern over limited opportunities for local employment and poor working conditions. Impacts on indigenous peoples' livelihoods, and limited access to land are also important issues. Many of the issues raised reflect increasing social expectations from plantations. Where much discussion has (and still is) focused on the threat plantations pose to livelihoods, culture and communities, stakeholders are increasingly asking how plantations can contribute to the lives of people who live in and amongst them. To further explore the social dimensions of the plantations debate, this paper will focus on two aspects: land use rights and tenure, and local impacts.

4.1 Land Use Rights and Tenure

An important aspect of the plantations debate concerns the land upon which plantations are established, its use by local people, and their rights and access to the resources contained therein. Stakeholders have frequently expressed concern regarding the legitimacy of land tenures where plantations are established (WRM 2003). An issue complicated by widely different land use patterns and concepts of land title. Concepts of private property resources, and of transferring rights to leaseholders are foreign to many (traditional) societies (Morrison and Bass 1992). Customary rights may conflict with those supported by law, and issues have been raised over companies not recognising local rights to land use. Plantation establishment upon indigenous community lands in Chile for example, has been criticised for excluding local peoples from lands they have used and occupied for many generations (Armesto *et al.* 2001). Exclusion is particularly important where local peoples' use of forest resources subsequently becomes illegal (Veerawat 2002a, cited in Lang 2003). The absence of tenure security for local people is also problematic because their displacement can increase deforestation pressures (Barbier and Burgess 2001). Stakeholders will readily point out tenure security is a necessary condition for investment in plantations. At issue is the extent to which tenure security is established at the expense of others, regardless of state support.

More than question the legitimacy of certain tenures, stakeholders have also raised concerns over their legality where lands directed for redistribution to landless farmers, have instead been used to establish plantations (dos Santos André *et al.* 2003; TERRA 2004). Plantations' relationship with land reform in Brazil has been particularly contentious where plantation companies' economic capacity to expand their land holdings has complicated attempts at land reform (Overbeek 2004). Large and influential plantation companies have been criticised for opposing land reforms that

serve the interests of local communities. Moreover, some stakeholders contend that such companies have unjustifiably received FSC certification, and thereby legitimise their operations and further undermine democratic land reforms (WRM 2003).

A key determinant in plantations' relationship with social conditions is ownership and control. Much of the controversy surrounding land use rights and access to resources are non-existent where plantations are owned and managed by communities themselves. Where outside interests control management decisions the prevalence and severity of disputes between plantation companies and the local community is an important indicator of plantations' social impact. Intense conflict in Indonesia for example, which has lead to villagers setting fire to company logging equipment and employee accommodations, is indicative of a negative relationship (WRM 1998). Much controversy has been generated from cases where plantation management decisions appear to be taken irrespective of local concerns (e.g. Lang 2003). Evidence also exists however, that partnerships between communities and companies can enable the equitable distribution of benefits and reduce overt conflict (Mayers and Vermeulen 2002; Suyanto *et al.* 2004). Local participation in plantation management decision-making, especially where overlapping tenure and use rights exist, may be essential for socially responsible plantation management.

4.2 Local Impacts

A commonly cited social benefit created by plantations is local employment generation. However, controversy also surrounds the extent to which plantations generate employment benefits for local communities. Plantations are often capable of providing employment benefits where other land use options are limited. The land use system replaced by a plantation is an important factor in assessing the net impact on local employment. In certain areas of Australia for example, plantation expansion is considered one of the most significant and positive land use changes within the last twenty years due to their ability to provide secure employment (Mercer and Underwood 2002). Evidence from Uruguay however, suggests that plantations there generate fewer permanent jobs per hectare than raising cattle, which previously had been considered the least efficient form of land use by this measure (Galli 2004). Concern also exists that the majority of employment benefits occur during plantation establishment and then decline markedly following establishment (Morrison and Bass 1992). Stakeholders have raised issues over increased mechanization reducing the need for employees, and over the employment of migratory workers rather than local ones (WRM 2003).

Where plantations generate local employment, plantation companies' relationship with labour is also controversial. The subversion of workers' attempts to organise is of particular concern. In Brazil for example, stakeholders have raised the issue of plantation companies' blacklisting union and worker leaders (dos Santos André *et al.* 2003). Inadequate remuneration (Lang 2003) and few opportunities for skilled labour or anything more than seasonal employment are some of the strongest criticisms (Carrere 1999; dos Santos André *et al.* 2003;). As is the indiscriminate dismissal of workers and the impact this has on community stability where local workers have few other options for subsistence. The absence of worker protection measures such as assisting dismissed employees in re-entering the labour market is also important.

It has been suggested that plantation companies' tendency to outsource work through contractors and sub-contractors is one means of hampering attempts to organise labour.

Rather than employ individuals directly on a full time basis, it is argued that outsourcing enables companies to pay lower wages than would be required of full time staff as well as relieves companies of the responsibility to provide additional health benefits. At issue is the increasing prevalence of outsourcing work on plantations and the negative impacts on the ability of plantation workers' to maintain an adequate standard of living. Issues have also been raised over the negative impacts of outsourcing on working conditions and safety where contractors and sub-contractors, who are not direct employees of the company, are allowed to operate in violation of labour laws.

Issues of working conditions and safety extend to direct employees. Absent or inadequate training regarding safety equipment and safe working practices for workers operating under potentially dangerous conditions are additional concerns. Especially important are instances where safety equipment is either not required or simply not provided (Lang 2003). Issues also exist where inadequate safety measures cannot ensure effective responses to workplace accidents such that serious injury and death can occur that may otherwise be preventable (Carrere pers. com.). Further, dos Santos André *et al.* (2003) note instances of worker intimidation such that work-related accidents and illness are either seldom reported or, when reporting occurs, almost always dismissed as the fault of the worker without compensation. Excessively long working hours, unhealthy working conditions as well as the inequitable treatment of female workers are also issues (dos Santos André *et al.* 2003).

Issues related to local impacts often extend beyond the boundaries of plantations. Integrated plantation companies often maintain processing facilities such as pulp or saw mills that provide additional local employment benefits. Tax revenues associated with such facilities offer additional social benefits. Such facilities however are often a flash point for controversy. Many of the same criticisms over questionable working conditions on plantations have been levelled at pulp mills and charcoal production facilities (e.g. dos Santos André *et al.* 2003). Pulp mills in particular have been criticised for polluting the air and water, and for consuming vast quantities of water. Stakeholders have expressed concern over the potential for these impacts to negatively affect the health of local peoples directly, and indirectly by affecting agricultural yields (WRM 2004b).

Issues have also been raised that employment is often the only socially beneficial contribution made by plantation companies. Morrison and Bass (1992) suggest lasting benefits only occur where plantations foster job and skill creation such that communities are not overly dependent on the plantation industry alone. Employment and wages may not be the most appropriate indicators with which to judge social benefit. Veerawat (2002b, cited in Lang 2003) suggests plantation benefits must be viewed in the context of their effect on culture, livelihoods and community. Management decisions without due consideration for local land use may have negative consequences for local communities. Rather than minimise or eliminate negative consequences of plantation establishment, at issue is the extent to which profitable businesses should contribute to local communities. Infrastructure such as schools, clinics, roads and housing are examples of additional benefits plantation companies may contribute (Morrison and Bass 1992). Even supposed benefits may not be free of controversy. Concern exists for example, that worker accommodation provided by plantation companies may be inadequate (Carrere 1999).

Forest plantations are capable of providing benefits and services such as recreational opportunities, environmental protection and rehabilitation, as well as non-timber forest products such as oils and tannins (Kanowski 1997). At issue is plantations' impact on standards of living, both for individuals and the community at large. Outgrower schemes and company-community partnerships offer potential benefits for communities. Under such schemes local smallholders grow trees on their land, which are then sold to larger companies for processing. In addition to cash income, silvicultural skills and greater tenure security are potential benefits (Mayers *et al.* 2001). Still, problems associated with inequitable land distribution, the exclusion of disadvantaged peoples, and misunderstandings leading to conflict between parties are also issues for such schemes (Mayers and Vermeulen 2002).

Environmental considerations play a key role in determining plantations' impacts on local peoples. Relative to plantations' capacity to degrade biodiversity as well as soil and water resources, stakeholders point out that an impoverished natural resource base also has implications for cultures and communities by limiting land use options (Geasphere 2004). It is argued that limiting land use options not only threatens local ways of life, but also indigenous knowledge systems. Concern has focused on plantation landscapes that are unsuitable for grazing livestock, and no longer provide edible or medicinal plants or other benefits. Stakeholders also point out that negative environmental impacts can extend beyond plantation boundaries. For example, where plantations reduce water quality and availability there are negative consequences for local agriculture (Lohmann 1996). The definition of "degraded forest" when used to justify plantation establishment is an additional concern because of the capacity of lands defined as such to provide more benefits to local communities than the plantations which replace them (Kuaycharoen 2004).

5. Economic Issues

Many of the aforementioned social and environmental issues relate primarily to industrial plantations driven by economic objectives. The drive to maintain financial viability and increase profit margins has undoubtedly sparked environmental damage and social conflict. However, financial viability is an essential decision criterion for most plantations and economic realities influence management outcomes that ultimately reflect tradeoffs between economic, social and environmental objectives. In many cases the economic issues facing plantation managers revolve around balancing the necessity of increasing wood fibre production, with the reality of decreasing land availability for other objectives. Wood product markets are an important factor in this equation, and affect both the establishment and subsequent management of plantations. Simultaneously, governments have a keen interest in fostering economic activity as well as meeting social and environmental objectives. In many cases governments have played key roles in facilitating plantation industries. Economic issues will be discussed within two broad categories: wood product markets, and the role played by the public sector in plantation development.

5.1 Wood Product Markets

Demand is a fundamental economic consideration affecting plantation development. Much concern surrounds how forest management will (and whether it should) meet what appears a growing demand for wood products; demand driven by increasing per capita

consumption and a growing global population (Leslie 1992; Sedjo 1999). Certain stakeholders indicate consumption is the problem (e.g. Calazans 2003) and concern has been expressed that increased per capita consumption is not wholly driven by market forces or by societal desires, but rather by pulp and paper industry efforts to stimulate demand (Lohmann 1995). However evidence suggests demand will only increase, in which case plantations' ability to contribute greater volumes of wood from smaller areas is unlikely to decrease in importance (Brown 2000).

On a global scale, markets for plantation products are increasingly internationalised due to efforts to liberalise trade barriers (Kanowski 2003). Open markets have facilitated the establishment and expansion of plantation industries, and many plantation projects are set up with the intention of establishing an export industry (e.g. Mercer and Underwood 2002; Prado and Weber 2003). The most significant financial costs associated with plantations are often harvesting, labour, and land, although costs related to financing plantations are also important (Brown 2000). Increased competition creates ever-increasing pressure to reduce costs, which favours economies of scale. This reality not only compels large companies to increase their land holdings and improve productivity, but also represents barriers to smaller scale, local or community plantation management on its own. Under such circumstances, out-grower schemes offer potential benefits to both large plantation companies and local communities (Mayers and Vermeulen 2002). As discussed, such schemes can generate income and wealth for rural communities and help meet industrial requirements for raw materials (Smit and Pitcher 2003). Despite their potential, significant challenges exist for such ventures to form equitable partnerships (Desmond and Race 2000).

Markets also affect plantations' ability to reduce harvest pressures on native forests. The world's plantations produce a diverse array of products although their production may be of limited effect in reducing harvest pressures on natural forests if they are no substitute for natural forests products. Where direct substitution occurs, low cost products from plantations can undermine prices, discourage investment in natural forest management, and thereby threaten communities dependent on natural forest management (White 2003). This is the reflection of the argument that plantations can, in fact, take pressure off natural forests. However, the emergence of new markets for plantation wood products can in some circumstances also increase pressure on natural forests. Exotic plantations in Chile for example, have exacerbated economic pressures on native forests because of their contribution to the emergence of an international market for hardwood chips which are readily produced by indiscriminate harvesting of native forest (Clapp 2001).

Despite trends towards increasingly liberalised markets, trade barriers such as tariffs remain in place over much of the globe, and domestic markets drive much of the demand for forest products (Sarre 2003; White 2003). Export restrictions, such as requirements for domestic processing, can undermine prices by increasing the volume of wood on the domestic market, leading to issues described above. Import restrictions are an issue for many developing countries who perceive such restrictions as barriers to economic development and consequently sustainable forest management (Sarre 2003).

5.2 The Role of the Public Sector

A central theme influencing plantations' economic picture is the role of, and relationship between, the public and private sectors. This debate has taken shape around incentives

provided by governments such as investments in infrastructure, afforestation grants, tax system changes and the relaxing of export restrictions. Rationales for subsidising plantations include increasing the rate of return on investments that would be marginally profitable but offer social benefits, and for generating a "critical mass" of plantations required to establish a large-scale competitive industry (Keipi 1997). Environmental benefits associated with reforestation of degraded lands are also reasons for plantation incentives. Conversely, stakeholders have voiced concern that plantation incentives facilitate environmental degradation, and give public money to private companies whose interests in social benefits are uncertain at best. It is clear that incentives have made significant contributions to the proliferation of plantations in developing and developed economies (Keipi 1997; Lawrence and Grant 2003). Less clear is the extent to which incentives are a good public investment from either a social, economic or environmental perspective.

Incentives exist to facilitate plantation establishment, and encourage investment in existing operations. The ecosystem or land use system in place prior to plantation establishment is an important aspect for evaluating the impact of incentives. *Imperata* grasslands on areas of former forest in Indonesia for example, require significant investment to establish plantations considered economically and environmentally important (Kosonen *et al.* 1997). In some cases such plantations are marginally profitable in financial terms and governments may provide incentives to help realise potential improvements to local socio-economic conditions. Evidence from Costa Rica suggests incentives programs, when coupled with good technical advice, are necessary to stimulate reforestation on small and medium-sized farms whose owners have limited financial resources and few other land use options (Piotto *et al.* 2003). Incentives to establish plantations are, however, not without controversy. Stakeholders also point out that incentives have enabled large companies to convert vast swaths of natural forests in Costa Rica to plantation (IUCN/ WWF 2002 cited in Cossalter and Pye-Smith 2003). Moreover, incentives have been criticised for enabling plantations to proliferate in areas where economic considerations would otherwise favour alternative land uses, such as agriculture or natural forest management (WRM 2001).

Ownership is another key economic aspect of plantation incentives, not only for its effects on plantation management but also because stakeholders have voiced concerns regarding public money contributing to private sector interests. Durst and Brown (2000) note the existence of three plantation establishment models lead by (1) governments, (2) the private sector, or through (3) community-based development. Where government agencies, or local communities establish and manage plantations directly, the issue of incentives is often less controversial because such schemes are assumed to be in line with the public's best interest. Where public and private sector plantations compete a slightly different issue arises of the extent to which private sector plantations are at an unfair disadvantage to their public counterparts (Enters *et al*. 2003). Economic incentives are often most contentious with significant private sector involvement because the public interests they serve may be unclear.

Investments in plantations are in many cases long-term ventures with greater financial risks than their shorter-term counterparts (Mydin and AbdulRahim 2003). Governments often play important roles in establishing industrial plantations whose ownership and control often remain in the hands of the private sector. Indeed, incentives are often justified for their contributions to establishing a competitive, export oriented plantation

industry capable of repaying the public investment through tax revenues. Evidence from Australia for example, suggests the government played a key role in establishing a plantation industry but that increasing private investment in plantation forestry remains an important policy challenge (Lawrence and Grant 2003). McLean (2003) suggests the focus on commercial returns is intensifying due to changes in ownership of the industrial plantations estate. Investor expectations for early returns on investments increasingly favour shorter rotations, with important implications for products characteristics and environmental impacts (Kanowski 2003). In light of these aspects, much concern surrounds plantations managed with the sole aim of maximising profit margins, in which case, incentives may help mitigate between public and private interests and thereby provide additive social benefit (Enters *et al*. 2003).

It is difficult to be categorical about plantation incentives, in part because of their wide variation in type and effect. Stakeholders contend that incentives are only justified where they produce demonstrable public benefits (e.g. Meijerink 1997). Conversely, stakeholders have also argued that incentives are increasingly required to encourage necessary investments in plantations (e.g. Pinso and Vun 2000). Arguments for and against incentives often turn on the question of public benefit. Plantations can be combined with other agricultural land-use practices to improve economic returns for indigenous peoples, without further degrading the lands upon which they are grown (Tyynela *et al*. 2003). Under such circumstances criticism of incentives is often muted. Rather than argue for or against incentives, stakeholder concern has more recently focused on the conditions under which various incentives are effective in achieving socio-economic and environmental goals (e.g. Enters *et al.* 2003). The likelihood of incentives contributing to appropriate plantation management appear greatest where investment decisions are supported by political and macro-economic stability, credible governments capable of enforcing laws, liberalised trade markets, sufficient infrastructure, and clear property rights (Constantino 1995). The prevalence of incentives is summarised by Brown (2000), who concludes that government policies and incentives mask any competitive advantage in the plantation sector, and that these incentives are as important as economics in influencing plantation development.

6. Conclusions

This paper does not argue for or against plantations. Nor does it aim to propose solutions to the numerous issues that presently characterize the plantations debate. Rather, the intention is to identify the full range of issues facing plantation forestry in hopes of fostering further debate around their resolution. Many of the issues raised are multifaceted and escape distinct categorization. Different contexts pose different challenges. Expectations of what constitutes sufficient resolution of an issue are likely to differ among stakeholders.

Much uncertainty characterizes global expectations for responsible plantation management. Plantations have the capacity to benefit local communities, alleviate harvest pressures from native forests, and generate acceptable returns on investment. Plantations may also be financially unviable in the absence of incentives, and cause environmental degradation and social conflict. The ultimate purpose of FSC's plantations review is to provide clear, authoritative and widely accepted social, environmental, and economic standards for responsible plantation management. To this

end FSC welcomes comment on this paper, and on any of the issues raised within it or elsewhere.

FSC does not have a “magic bullet” with which to provide definitive answers to the issues raised. We propose that the route to lasting solutions is broad stakeholder involvement in a fair and transparent process, which seeks solutions based on consensus. By fostering discussion of the issues facing plantation forestry, it is intended that this paper will contribute to such a process.

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