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Improving Brazilian Land Use Law: A Case Study of Plantation Forestry in Southern São Paulo

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Years before this study began, I was an environmental educator a few miles north of the study area. My daily commute involved crossing a stream that was so laden with human waste from nearby slum settlements that the stream bubbled with methane — and this stream flowed straight into the municipal water supply. Local knowledge holds that the slums were the direct result of overly-restrictive zoning laws intended to protect the watershed in the 1970s. These laws prohibited essentially all productive uses, eliminating any economic incentive for landowners to manage their property. After private owners lost interest in their land, the slum settlements took over. Because the slums were illegal from the beginning, no sewer lines or other infrastructure was ever installed.

The desire to protect the watershed thus resulted in unintended human and environmental consequences, demonstrating the need to integrate both economic and environmental perspectives in solving many of São Paulo’s most pressing problems. Sustainable forestry offers one such solution. Local law however must be carefully formulated to support sustainable forestry within the context of regulating land use. This case study directly addresses the regulatory issues that must be addressed in southern São Paulo. I hope it also sheds useful light on the myriad other situations in which environmental and economic issues require integrated, pragmatic solutions.

Geographically, the study area provides a buffer between São Paulo and the Serra do Mar State Park, the largest legally protected tract of Atlantic Forest, a global biodiversity hotspot (Meyers et al., 2000).

The Capivari–Monos is classified as an Environmental Protection Area (APA), a participatory governance system in which municipal officials and local representatives share authority for land use regulation. Land uses in the study area include small farms, native secondary forest, native primary cloud forest, natural grasslands, and active and abandoned commercial plantations of pines (Pinus spp.) and eucalyptus (Eucalyptus spp.).

By focusing on the regulations governing plantation forestry in the Capivari–Monos, this article explores the use of the term “sustainability” as a legal test in Brazilian environmental legislation. While the area is subject to unusually restrictive environmental legislation, this study shows that “sustainability” does not adequately guide land use classification, and proposes that standards from independent certification organizations be adopted instead.

Sustainability in Brazilian Environmental Law

Brazilian environmental law frequently uses sustainability as a legal test to determine whether a given land use is permitted. In the study area, the most restrictive land use regulations are defined in terms of sustainability, and are applied to zones in the study area that contain a large proportion of São Paulo’s natural land cover and commercial plantation forestry (Figures 1 and 2).

In the Capivari–Monos, two zones are of particular importance and cover a majority of the area. The Wildlife Zone (ZVS) is defined as “portions of the municipal territory of great importance for the protection of hydrological resources and biodiversity, such as alluvial planes, significant remaining patches of Atlantic Forest herein delimited, as well

Background

São Paulo, Brazil, is the world’s third most populous city with over 18 million residents (Torres et al., 2005), and southern São Paulo in particular experiences population growth in excess of 8% per year (Tesch, 2008). The area of study, the Capivari–Monos Environmental Protection Area, occupies the southernmost 25,000 ha of the city. This area is an important source of ecosystem services; its watershed provides approximately 24% of the city’s potable water, as well as wildlife habitat, carbon sequestration, and soil protection (Braga et al., 2006).
<table>
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<th>Law or Legal System</th>
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<td>National System of Conservation Units (Federal Law 9,985 / 2000) orders types of natural preserves (including APA and State Park, below)</td>
<td>• Establishes criteria and norms for the creation, implementation and management of Conservation Units. • Objective IV: “encourage natural resource-based sustainable development”</td>
<td>• Defines sustainable use as: “use of the environment such that the permanence of renewable environmental resources and ecological processes is assured, maintaining biodiversity and other ecological attributes, in a socially and economically viable manner. • Several types of Conservation Units are defined in terms of sustainability: National forest: “basic objective is multiple sustainable use of forest resources and scientific research, with an emphasis on methods for the sustainable use of native forests.” Extractivist Reserve: “commercial use of timber resources is permitted only on a sustainable basis” Wildlife Reserve: appropriate for scientific research on “sustainable economic management of fumal resources” Sustainable Development Reserve: home to local peoples “whose livelihoods are based on sustainable systems of natural resource use” Bioskphere Reserve: an international model for “integrated, participatory, sustainable management of natural resources”</td>
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<td>“Law of the Atlantic Forest” (Federal Law 11,438 / 2006)</td>
<td>“The general objective of the protection and use of the Atlantic Forest Biome is sustainable development, the specific objectives are protection of biodiversity, human health, landscape, aesthetic and tourism values, the hydric regime, and social stability.”</td>
<td>• Defines sustainable use as: sustainable agroforestry activities practises on small or rural family landholdings that do not fundamentally change the character of the vegetative cover and do not harm the environmental function of the area • Agencies must “assist traditional populations and small landholders with the sustainable management and use of native plant species.” • The government shall “encourage, with economic incentives, the protection and sustainable use of the Atlantic Forest Biome.”</td>
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<td>Serra do Mar State Park (2006)</td>
<td>To ensure the full protection of the flora, fauna, and natural beauty.</td>
<td>• Buffer zone (APA Capivari-Monos): intended to “create and implement projects and activities that seek sustainable development for the region”</td>
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<td>APA Capivari-Monos (Municipal Law 13,136/2001)</td>
<td>Encourage the sustained use of natural resources; protect biodiversity; protect hydrological resources and remaining patches of Atlantic Forest, among others</td>
<td>• Wildlife Zone and Sustained Use Zone: permits “sustainable agroforestry management activities” • Agricultural Use Zone: “intended to encourage the sustainable development of resident communities in the APA”</td>
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<td>Municipal Zoning (Municipal Law 13,855 / 2004)</td>
<td>“To encourage regional development based on economic activities that are compatible with the production of water, watershed infiltration areas, and sustainable rural activities; expansion of protected lands... [and] to ensure water quality and a water supply.”</td>
<td>• Special Agricultural Protection Zone: permits “sustainable management” without further clarification • Protection and Sustainable Development Zone: permits “uses that are environmentally compatible with sustainable urban development... sustainable management [among others].”</td>
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<td>Executive Decree 45.817/2005</td>
<td>“To define and detail the classification of given activities within different [zoning] categories of use and groups of activities.”</td>
<td>“Nonresidential uses compatible with sustainable development” include “sustainable forest management” and “sustainable management activities... such as agroindustry, agroforestry activities, and agriculture”</td>
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<tr>
<td>Directive 01/2006</td>
<td>Regulates forestry in the region of study within the above legal regimes</td>
<td>“Necessary environmental measures will be determined in order to ensure the retention of cover and sustainability of the property.”</td>
</tr>
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Figure 1. Brazilian environmental law formulated in terms of sustainability.

as the headwaters of waterways of special interest to the water supply.” Similarly, the Conservation and Sustained Use of Natural Resources Zone (ZUS) is defined as “areas in which the moderate and self-sustaining use of the biota may be permitted, when regulated to ensure that natural ecosystems are maintained.” Both zones permit “sustainable agroforestry management activities, duly licensed by the appropriate agencies” (italics added).

The question of what constitutes sustainable agroforestry management is problematic. Applied to forestry, sustainability can be viewed either in a narrow sense, focusing strictly on the ongoing yield of products from a single plot, or broadly, by considering the social, economic and environmental effects locally and at the landscape scale (Evans, 1999). Brazilian law defines sustainability broadly; in the National System of Conservation Units (Federal Law
9.985/2000) — which regulates the APA and thus governs the CVS and ZUS — sustainability is defined as “use of the environment such that the permanence of renewable environmental resources and ecological processes is assured, maintaining biodiversity and other ecological attributes, in a socially and economically viable manner.” This definition fails, however, to provide a meaningful legal test in differentiating between the fine, but significant, gradations within land uses such as plantation forestry. The following examinations of “industrial” forestry (intensively–managed exotic monocultures) and “native” forestry (commercial plantation forestry using native timber species, sometimes incorporating mixed species designs) illustrate this problem.

**Overall sustainability of forestry**

Working with a narrow definition of sustainability, which considers only the permanence of timber productivity on a given piece of land, most forestry can be considered sustainable. Although soil nutrient loss threatens future productivity in some systems, this is often a consequence of management decisions, rather than the intrinsic nature of forestry (Evans, 1999). However, under a broad definition that considers social, economic, and environmental impacts, forestry may or may not be considered sustainable depending on specific management decisions. A determination of “sustainability” is further complicated when forestry is compared to other possible land uses; measured in terms of overall environmental services for instance, plantation forestry represents a more sustainable land use than degraded pasture, but a less sustainable land use than maintaining natural forest (Evans, 1999).

With proper management, plantation forestry can have several positive effects. First, it can provide ecosystem services by enhancing watershed function and biodiversity (Montagnini, in press). Second, forestry provides economic returns, increasing property values and counteracting the trend toward subdivision and occupation of land, providing a key argument for the retention of this land use in southern São Paulo. Third, managed forestry reduces pressure on native forests by producing timber at higher rates than do natural forests, although complete product substitution is unlikely (Sedjo and Botkin, 1997; Oliver and Mesznik, 2005). Last, forestry can provide a buffer zone for protected lands, thus reducing anthropogenic and physical edge effects (Ries et al., 2004).

**Industrial plantation forestry**

Heavily–managed monocultures of exotic species represent one extreme of a spectrum of plantation strategies. Pine and eucalypt plantations are present in the study area and much of tropical Latin America. Both species, however, interfere with the biodiversity of native land cover in the Atlantic Forest biome. In the adjacent Serra do Mar State Park, pines and eucalypts are considered invasive species (PESM, 2006) posing a particular threat to the biodiversity of natural montane fields. Marsden et al. (2004) found only eight species of birds in 31 eucalyptus plantations located within 7 km of intact Atlantic Rainforest, compared to 111 species encountered in adjacent intact rainforest and 59 species encountered in fragments of native forest.
Eucalypt plantations also threaten watershed function. In southeastern Brazil, the water table fell 2.5 m over the first nine years of a eucalyptus plantation (Soares and Alameida, 2001). In a review of the effects of forestation in the tropics, Scott et al. (2005) report consistent evidence that water use exceeds annual precipitation considerably when eucalypt plantations occur on deep (>8m) soils, particularly in seasonal environments, as well as “overwhelming evidence” of reduced annual surface water yield relative to grassland and scrub in the subhumid tropics, subtropics, and temperate zones.

Given that the legal objectives of the APA Capivari–Monos are to “protect biodiversity; hydric resources, and remaining Atlantic Forest”, and considering these plantations have negatively affected these ecosystem functions within and near the study area, they appear incompatible with management goals for the area. Whether they should be permitted by land use regulations should be reviewed.

**Native plantation forestry and mixed plantations**

In contrast to industrial plantation forestry, commercial plantation forestry using native species in the neotropics can improve soil nutrient content, provide habitat for birds, insects, and mammal species, increase native seed rain and recruitment, protect soil nutrients, repress invasive grass species, and provide positive financial returns (Montagnini, 2001; Montagnini, in press). The Manequinho Lopez and Cotia nurseries, which are owned by the municipal government of São Paulo, grow many species recommended for reforestation in the Atlantic Forest Biome, indicating the potential viability of their use in the study area (Figure 3).

**Scientific Name** | **Local Name**
--- | ---
Aspidosperma sp. | peroba
Astronium sp. | guariti
Bauhinia riedelianum | marfim
Bombax sp. | paineira
t |
Cedrela sp. | cedro
Cabralea canjerana | canjerana
t |
Caesalpinia echinata | pau brasil
t |
Codilia sp. | louro
Dalbergia nigra | jacarandá negra
Enteroxylum sp. | tamboril
Hyeronima alchorneoides | licurana
Hymenaea sp. | jatoba
Inga affinis | ingá
Inga veriscens | ingá
Nectandra sp. | canela
Platypodium elegans | jacarandá
Schizolobium sp. | licurana
Tabeuia sp. | ipé
Maytenus ilicifolia | espinheira santa
Peltophorum dubium | faveira
Bastardopsis densiflora | louro-branco
Parapiptadenia rigida | paraguaio
Anadenanthera macrocarpa | angico

**Figure 3.** Native timber species of the Atlantic Rainforest (Barth, in press; Brewer et al., in press). *Species currently available at municipal nurseries of Manequinho Lopez or Cotia. * Nitrogen fixing species.

Heart-of-palm seeds are an important food source for key seed dispersers such as toucans, which may increase seed dispersal of other native plant species. This dispersal makes heart-of-palm systems catalysts of forest restoration by increasing natural regeneration in nearby degraded areas and within plantations (Parrotta et al., 1997; Montagnini, in press). This second generation of natural regeneration — facilitated by improved growing conditions and increased seed dispersal — can be retained in the forest understory. Like natural rainforest understory trees, this natural regeneration is “released” when the first generation of plantation trees is harvested, and can be managed as a productive semi-natural forest or conserved for other values.

**Discussion**

Brazil is commonly considered to have an exemplary environmental legal regime, which is ineffective primarily because it is unenforced (Laurence et al., 2001; Soares–Filho et al., 2006). In the study area, however, the current legal regime is ineffective partially because of language which is too ambiguous to provide guidance regarding land use. Sustainability provides an especially problematical legal test in relation to borderline land uses, such as plantation forestry, which may be either sustainable...
or unsustainable based on the definition of the term and the management of the forest. In the study area, improving the coherence and enforceability of the legal structure, rather than its restrictiveness and enforcement per se, is key to improving environmental governance. This interpretation follows other studies, which concluded that streamlining policy and governance is important to reducing illegal forest activities worldwide (Tacconi et al., 2003).

The current regulatory structure requires that sustainability be considered a single variable with only two categories: sustainable and unsustainable. Sustainability, however, is a composite of different environmental services such as habitat value, watershed protection, soil protection, carbon sequestration, seedling recruitment, and cultural values (Figure 4). Each service varies along a continuous gradient because outcomes depend on specific management decisions, even within a single land use type. Further, land uses may be ranked differently depending on the weight given each environmental service. This makes simple yes-or-no determinations impossible, reducing the viability of sustainability as a legal test. An approach is needed that bridges the gap between means and ends — one that allows the goal of sustainability to be approximated despite the elusiveness of a definition of sustainability that meets the complexities of real world situations.

**Recommendations**

Given the recognized importance of the study area as a source of ecosystem services, and considering the problematic structure of current regulations, the City of São Paulo needs greater specificity in its regulations on permissible forms of land use. Because numerous management decisions — including choice of species, planting density, use of chemical inputs, thinning regime, understory clearance, rotation length, harvest methods, and treatment of slash — affect the ecosystem services provided by forestry, regulations to address all of these decisions would be highly complex, making voluntary compliance and enforcement difficult. Such regulation would also increase plantation costs without providing additional financial returns, undermining the efficacy of these forests as an economic barrier to human occupation.

Rather than create independent forestry regulations, the City of São Paulo should consider incorporating a forest certification system (such that of the Forest Stewardship Council) into local legislation for zones in which the stated purposes of existing legislation aligns with certification requirements. In other words, São Paulo should make otherwise voluntary standards mandatory in key watershed areas. This approach is modeled on the increasing incorporation of green building standards (such as Leadership in Energy and Environmental Design — LEED) into municipal law in the United States. Boston, MA, for example requires that certain classes of buildings be LEED certifiable (Sussman, 2008). Such an approach may offer important advantages to the city, certifying organization, and landowners. The city would benefit because the certifying organization would take responsibility for site inspection, enhancing the enforceability of standards and providing key human
resources. Additionally, refinements in best practices are incorporated into municipal law automatically as the certification standard is amended. The certifying organization would benefit from increased participation, especially in Latin America, where participation is limited because the costs of improved management typically outweigh the financial benefits of certification (Gullison, 2003). Finally, although both traditional regulation and mandatory certification impose regulatory and economic burdens on landowners, mandatory certification is preferable because it can increase the market value of timber products, partially or completely offsetting the economic burden of regulation. In environmentally sensitive areas, such as southern São Paulo, which require some form of regulation to protect environmental services, such as habitat and watershed function, mandatory certification can provide a preferred option to multiple stakeholders.

Notes

[1] Area de Proteção Ambiental
[2] Zona de Vida Silvestre
[3] Zona de Conservação e Uso Sustentado dos Recursos Naturais

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References


