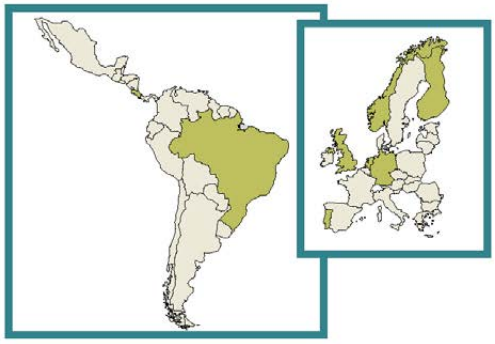

REPORT

Issue No. 3/2012

POLICYMIX - Assessing the role of economic instruments in policy mixes for biodiversity conservation and ecosystem services provision

Assessment of existing and proposed policy instruments for biodiversity conservation in São Paulo - Brazil: a coarse grain analysis

Ademar R. Romeiro, Paula Bernasconi, Bruno P. Puga, Daniel C. Andrade, Ranulfo P. Sobrinho

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About POLICYMIX. POLICYMIX focuses on the role of economic instruments for biodiversity conservation and ecosystem services provided by forest ecosystems. POLICYMIX evaluates the cost-effectiveness and benefits of a range of economic versus regulatory instruments in a variety of European and Latin American case studies.

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Abstract

This report brings the findings of a coarse grain analysis for the Atlantic Forest case study carried out under the POLICYMIX project. The main objectives are: i. to know the current status of Brazilian Atlantic Forest preservation and the conservation targets set for this biome; ii. revise the main regulatory and economic instruments in place whose aims are biodiversity conservation and ecosystem services preservation; iii. propose new economics instrument that might reinforce the role for existing instruments in achieving conservation targets; iv. better understand how the environmental policy instruments may interact with each other; v. contribute for the designing of policymixes aimed at biodiversity conservation in the Sate of São Paulo as well as deepening/fostering the comprehension on the potential role of economic instrument already foreseen by environmental but whose utilization is not fully explored.

Index

1 Summary and conclusions

1.1 Case study location and conservation characteristics

The most important characteristics of the Atlantic Forest ecosystems besides its biodiversity richness is the pressure it suffers. So, the main policy objective is related to protect every small remnant since it may be important for the conservation of certain species regardless of size. The recovering of the biome is an urgent need especially addressing the connectivity of the existing fragments and the creation of corridors. The focus of preservation strategies is on private areas since they are under direct control of private owners who suffers from opportunity costs. In the State of São Paulo (Southeast region in Brazil - figure 1) this trade-off between conservation decisions and land opportunity costs is especially relevant as this State is of the richest in Brazil. So the main challenge to be faced is to find effective policy instruments in order to ameliorate the current situation of noncompliance with existing regulatory instruments (Brazilian Forest Code).

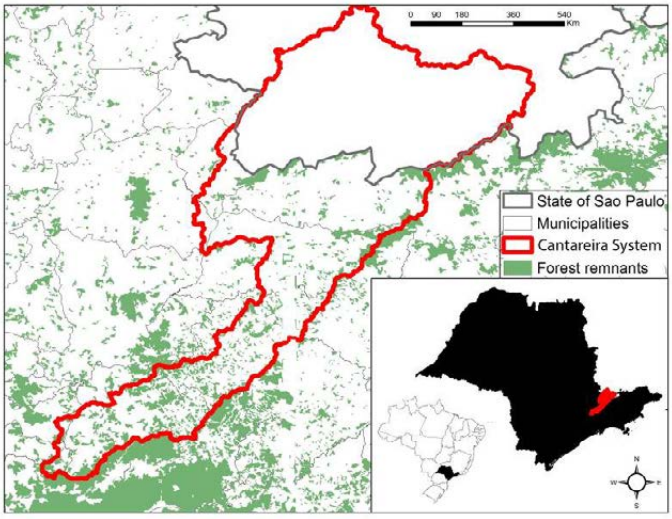


Figure 1 – Cantareira Region and the forest remnants

1.2 Current economic instruments in biodiversity conservation

As for existing economic instruments in place our coarse grain analysis has focused on the so called ICMS-Ecológico (ICMS-E) in São Paulo, as well on some pilot experiences on Payment for Ecosystem Services (PES) within this State. Regarding the first economic instrument, it can be considered the first one to pay for ecosystem services, aimed at encouraging conservation actions. At its inception the primary motivation was to compensating the municipalities for economic losses by the constraints of land use. As for PES in São Paulo State we can point out the existence of the ”Mina D´água” Project which is aimed at the protection and rehabilitation of springs for public supply. The project's first stage objective was to develop and evaluate methodologies and institutional arrangements in partnership with 21 municipalities (representing each of the State Water Management Units). The financial resources came from the State Fund of Pollution Control (FECOP). The budget for the actual stage is around $ 3.5 million for five years.

There are few evidences on the relative effectiveness of the current economic instruments implemented for the Atlantic Forest in São Paulo State. Considering the ICMS-Ecológico in São Paulo there are no studies measuring the real effectiveness of this instrument for creation of new protected areas and biodiversity and water sources conservation in the state. The PES pilot experiences in São Paulo are very new and again there are no studies dealing explicitly with their effectiveness. However, in a preliminary way we can say that these economic instruments should be more effective than the regulatory approaches (Forest Code mainly) as they have a history of noncompliance.

1.3 New and potential economic instruments

Our coarse grain analysis has provided a description and a preliminary assessment of two potential economic instruments. The first one (PES) was chosen due to its potential to improve the ecosystem service of water provision for the São Paulo Metropolitan Area. The second is the Tradable Development Rights (TDR) which has the potential to reduce the compliance costs with Forest Code requirements. It is important to say that TDR is already foreseen in the Forest Code but due to its scarce implementation it was considered as a potential economic instrument. Both instruments will be analyzed in more details in our fine grain study (local level in the PES case and São Paulo level in the TDR case).

Generically, one can say that PES utilization became popular through the well-known Costa Rican *Pagos Por Servicios Ambientales (PSA)*. Although there are huge differences between the Brazilian and Costa Rican realities no one should deny that the experience in Costa Rica is a concrete benchmark. In a more specific terms, the potential use of PES in the Cantareira Region[1] draws upon other experiences on PES in Brazil (mainly pilot experiences in the Amazon and Atlantic Forest biomes). The PES already implemented in the municipality of Extrema (part of the Cantareira Region and located in the South portion of Minas Gerais State) is considered a well-succeeded case for PES and there are arguments (from private and public stakeholders) for its replication in the whole region. Regarding TDR scheme, the main motivation is the scenario of high costs for compliance with the Forest Code, including opportunity costs and restoration costs. The instrument aims to establish a market for forest credits that will help reduce the opportunity costs of areas which have high agriculture productivity and help finance the protection of areas with very low agriculture suitability.

1.4 Instrument interactions in the federal/national/state policymix

In order to assess the interactions among the instruments analyzed we used a qualitative approach and results from available studies, trying to point out obvious complementarities/synergies/overlaps, etc. based on instrument design issues. It is worth mentioning that we attempted to consider only the direct interactions. All of the analyzed instruments interact indirectly, more or less intensively, as they are all policy instruments for conservation. For the proposed instruments (PES and TDR) we assessed potential interactions based on their expected roles and objectives.

In a nutshell, our analysis pointed that the regulatory instruments interact positively with each other. Emphasis was given to the Forest Code (main Brazilian regulatory instrument) which was well

[1] The Cantareira Region was selected as one of our sites for the fine grain analysis. This is a water catchment basin partially located in the south of the States of Minas Gerais and São Paulo and is responsible for supplying water for the São Paulo Metropolitan Area. Further details in the next sections of this summary.

complemented by more recent command-and-control instruments (Environmental Crimes Law, for example). Moreover, the Forest Code has a potential complementing interaction with PES and TDR, although we did not detect any interaction between ICMS-E and the Forest Code. The two proposed instruments, PES and TDR, could be overlapped in the same area. The interaction could reinforce the role of these instruments, since both aims to bring incentives for conservation of natural areas. But their roles are not redundant as it may seem at first. TDR is more focused on the target achievement of a biome area under protection whereas PES is more focused on remunerating the provision of a defined ecosystem service.

1.5 Local fine grain analysis – research questions and challenges

1.5.1 Fine grain case study site description

Our fine grain study will be divided into two parallel studies. The first one is mainly focused on PES in a local level scale (Cantareira Region - figure 2) and the second study will be at the state level (São Paulo) addressing TDR as the main instrument to be analyzed. It is clear and well recognized that in Cantareira Region the main ecosystem services threatened are water related services and there is no doubt about the positive role played by forest coverage (figure 3) in providing those services. As for São Paulo State as a whole one can observe a defragmented landscape in terms of forest cover as the State has a high land opportunity cost. So one important policy objective for this State is to promote the natural forest recovering in the whole State following the guidelines established by the Forest Code.

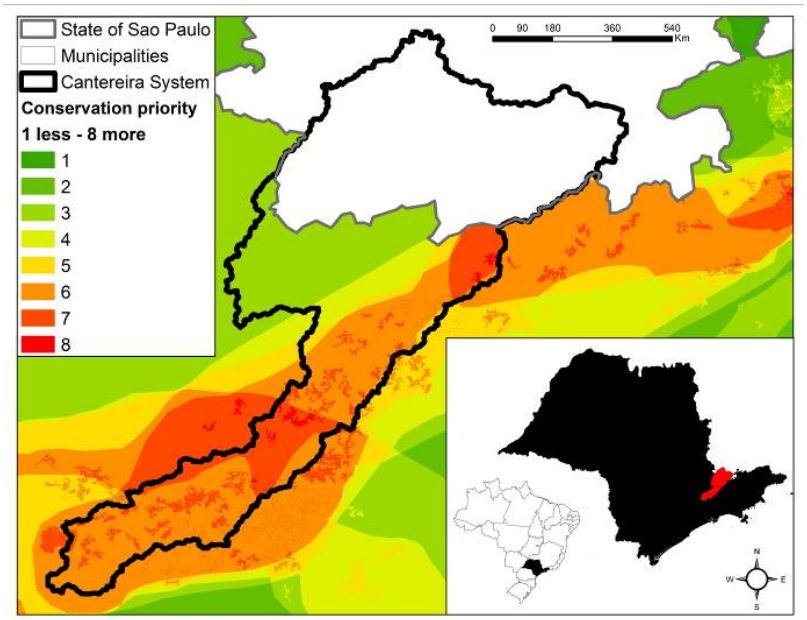


Figure 2 – Cantareira Region and the priority areas for conservation (BIOTA-FAPESP)

Figure 3 - Atlantic Forest in Cantareira Region

1.5.2 Economic instrument effectiveness

As for the local level analysis (Cantareira Region) we intend to figure out the current state of Permanent Protected Areas (APP) by overlaying the stream map and land-use map for the region. The desirable outcome will be an estimate of the water provision service. The main methodological challenge is this stage will be maps production which will be performed through some partnerships our team has signed (e.g. Institute for Ecological Research).

In the state level case the main expected outcome is to know how far the rural properties in the state are from the biodiversity target set by the Forest Code regarding Forest Reserve. To do so we will calculate the deficit/surplus of Forest Reserve to be able to estimate the amount of the forest credits that could be traded and also the size of the market.

1.5.3 Economic instrument costs and benefits

Regarding Cantareira Region our task is mainly related to obtaining estimates of the opportunity costs involved in the scenario of compliance with Forest Reserve (20% of the farm area). The methodological procedures will be based on the farmers typology analysis to be conducted in partnership with the Brazilian Agricultural Research Corporation (EMBRAPA) and the Institute of Agricultural Economics. This latter agency will provide the data necessary to conduct this analysis.

For the state level analysis our primary outcome will be an opportunity cost map at UPA (agricultural production unit) level for the whole state of São Paulo. Such a map will be used to run Marxan to simulate the allocation of forest reserve deficit by the market selecting the areas with lower opportunity costs. This will be based on areas with the greatest opportunity cost differentials, in three different scenarios of market scope (state level, only restricted by the biome; only in the same

watershed and biome; only in priority areas for conservation (BIOTA – eight classes of priority) and biome).

1.5.4 Economic instrument equity and legitimacy

Our analysis will face the challenge to target different approaches for different stakeholders. This is will be possible through the design of a farmers typology, which will be done by the use of multivariate statistics techniques (factor analysis and cluster analysis). For this we will use a data source called LUPA to get variables that depicts economic, social, and technical aspects regarding the farmers. This analysis will be conducted in the Cantareira Region.

Considering the whole state of São Paulo (TDR analysis), our main research question is: *"how is the potential participation of small farmers in the TDR market?"*. As small farmers (those with farmers smaller than four fiscal modules) are exempt from having forest reserves, the area of forest they have can be totally converted into credits and traded. However no one is certain about the incentives this type of farmers will have for taking part in this potential market. The information considered as prerequisite is the assessment of the current situation of forest coverage in those farmers. This will be possible using a data source from the Brazilian Institute of Geography and Statistics (IBGE).

1.5.5 Institutional opportunities and constraints for economic instruments

Our analysis in the local level (Cantareira Region) will start with a deep study on a previous PES experience in the municipality of Extrema. Although this municipality is located in another Brazilian State (Minas Gerais), it is part of the Cantareira System. In the institutional dimension our main research questions will be: "*what lessons can be learnt from Extrema's experience? What are the institutional factors that may contribute or jeopardize a PES scheme for the whole Cantareira Region?*" Our methodological procedures will be field trips and interviews with key stakeholders in Extrema.

An institutional analysis will also be conducted in the state level. In this case our main challenge is to assess the financial feasibility of a TDR market given the trade-offs between spatial size of the market and the transaction costs. The distribution of opportunity cost differentials for different spatial extents of the market will show the maximum transaction costs that could be justified for establishing a TDR market.

1.5.6 Integrated policymix assessments

This part of our fine grain study will perform a more accurate analysis on the interactions between the two main instruments under consideration (PES an TDR) as well as their interactions with regulatory instruments (Forest Code mainly). Is worth to mention that our fine grain analysis will use the multicriteria methodology (MCDA analysis) to evaluate the role of PES in achieving the objective of enhancing the water-related services provision in Cantareira Region. Specifically, the multicriteria methodology will be used to indicate the better composition of a policymix aimed at forest restoration in the Cantareira Region. The main stakeholders believe PES is a good option but the decision conference will support us in better understanding whether a single instrument (PES) or a combination of policy instruments (policymix) are more suitable for Cantareira Region.

In our TDR analysis we expect to find that the mechanism has a great potential due to the non-compliance scenario in the State of Sao Paulo and in the rest of Brazil. The importance is because of the heterogeneity of the remnants spatial concentration and also heterogeneity in the opportunity costs spatial distribution. Our hypothesis is that the larger the spatial scope of the market the greater

the arbitrage possibilities and then, the less cost-effective the instrument. On the other hand, a very broad market scope could concentrate the selected areas for restoration not in the priority areas for conservation. For this analysis, our main methodological challenge will be to find data in a property level, also to find data in a state wide approach, due to the state scope of the market. We plan to use the software Marxan to simulate the allocation of the forest reserves in three different scenarios, then we could evaluate the effectiveness in terms of costs and ecological results of the chosen criteria.

2 Introduction

2.1 Background

The topic of ecosystem services and its relation to human well being has become central in any debate about environmental policies aimed at preserving living conditions for future generation. This is also related to the issue of biodiversity loss since it is considered the structuring foundation for ecosystem services provision.

Indeed, we can consider ecosystem services the main interface between natural capital and human welfare. Halting biodiversity and ecosystem services may be one the big challenges faced by humankind in this new century, and designing effective intervention mechanisms to address the problem has being viewed as a top priority issue for policy makers around the world. Economic instruments might be a good option since they can potentially harmonize economic needs and nature preservation. More than this, the traditional literature on environmental policy tends to consider economic instruments as a more efficient way to tackle environmental degradation. However, it is not clear the role of economic instrument in policymixes aimed at conserving biodiversity and ecosystem services.

POLICYMIX Project has as its main goal the assessment of economic instruments and its interactions with the more traditional regulatory instruments in the context of environmental policies. It is a project supported by European Commission and one of its purposes is to facilitate the exchange of experience among European and Latin American countries in terms of adoption of environmental policy instruments. This report is a deliverable under WP7 (POLICYMIX Case Studies: coarse grain analysis) and it is aimed at providing an overview of environmental policies adopted in Brazil (mainly direct regulations) and particularly in the São Paulo State (economic instruments). The report is focused on the *Mata Atlântica* (Atlantic Forest) biome and brings further research questions for a fine grain analysis to be undertaken in the State of São Paulo.

2.2 Research questions and objectives

This coarse grain study is a first step towards a more refined study (fine grain level) to be developed in the State of São Paulo. Our general objectives can be outlined as follow:

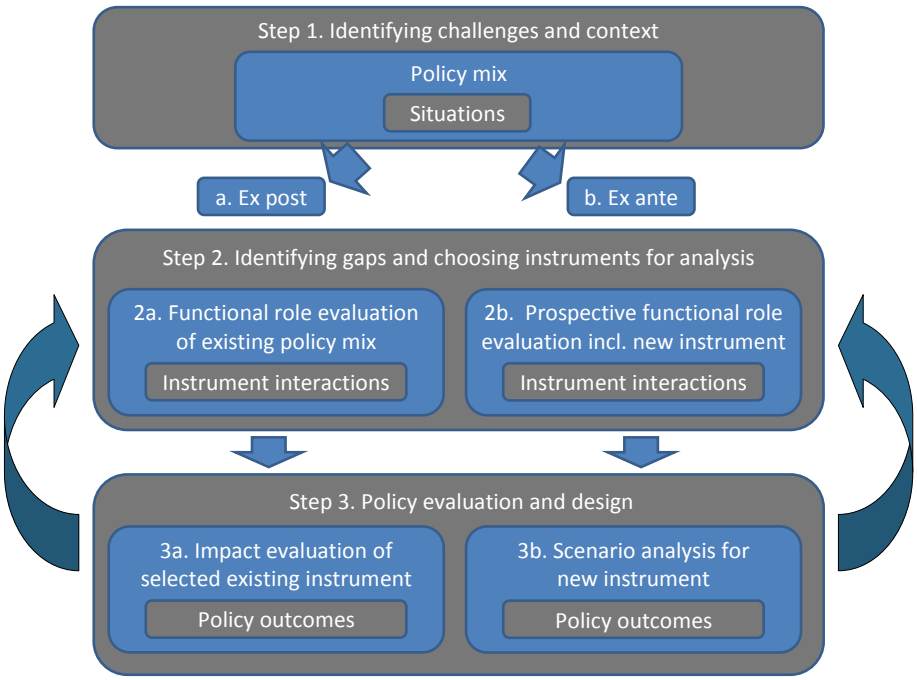
- Conduct a **scientific assessment of the role of economic instruments** in policies for forest biodiversity conservation and sustainable use of ecosystem services;
- Describe the **legal and institutional context** of these economic instruments to be assessed at the fine grain, more local, landscape and/ or site specific level;
- Provide the **basis for cross-case comparisons** of legal and institutional context, and instrument roles by using the POLICYMIX analysis framework (WP2) and assessment criteria proposed in the draft guidelines (WP3-WP6);
- Provide **recommendations on improving POLICYMIX analysis methodology** and assessment criteria as a basis for updating draft Guidelines;
- Contribute policy impact and design conclusions to the EU , federal and national **science-policy dialogue** on economic instruments in biodiversity conservation.

The specific objectives may be described by the following:

- to know the current status of Brazilian Atlantic Forest preservation and the conservation targets set for this biome;
- revise the main regulatory and economic instruments in place whose aims are biodiversity conservation and ecosystem services preservation;
- propose new economics instrument that might reinforce the role for existing instruments in achieving conservation targets;
- better understand how the environmental policy instruments may interact with each other;
- contribute for the designing of policymixes aimed at biodiversity conservation in the Sate of São Paulo;
- fully explore the potential role of economic instrument already foreseen by the existing environmental law.

2.3 Methods and clarifications

The general methodological guidance to be utilized in this study will be the three-steps-two-pathways model developed by POLICYMIX (se figure bellow).



The POLICYMIX evaluation framework

The coarse grain study reported herein will be based on literature review as well as qualitative analyses. After identifying the context and main challenges related to biodiversity conservation in the Atlantic Forest biome we revise the main existing regulatory (command and control instruments) instruments, which are the Forest Code, the Environmental Crimes Law, and the Atlantic Forest Law. ICMS Ecológico (a kind of Ecological Fiscal Transfer) and Payment for Ecosystem Services initiatives are the two existing instruments revised in order to complete step 2a in the overall POLICYMIX evaluation framework. It is important to say that the analyses are far from being comprehensive. The other Brazilian case study under POLICYMIX project (focused on the Amazon biome) may be complementary to this one and future efforts will be devoted on integrating both analyses.

Besides the description of some instruments already implemented the report also brings an initial analysis of two potential/proposed instruments that might play an important role in complementing the environmental policy set in São Paulo state. They are the Payment for Ecosystem Services (PES) and Tradable Development Rights (TDR). This latter one is considered here as a proposed instrument as its application has been rare, albeit the Forest Code (the main Brazilian regulatory instrument) has already foreseen it. The discussion about these instruments is followed by a qualitative analysis of the interactions that may occur among existing/potential/proposed instruments.

2.4 Case study comparisons - instrument, methodology and ecosystem services clusters

POLICYMIX has seven case studies being conducted in six different countries. The table bellow is an attempt to demonstrate commonalities among these case studies as the project aims at facilitating scientific dialogue among diverse national experience on environmental policies.

Elements of commonality and synergies between case studies

Case clusters			Costa Rica	Mato Grosso	São Paulo	Portugal	Fin-land	Germany	Norway
Instrument		**Specification**							
	REDD+	international/national	P	P					
	EFT	national/state		C&P	C	C&P		P	P
	Certification	national/state	C	C					C
	Offsets/TDR/HB	National/state		C	C&P				
	PES	national / state agri-env.	C	C&P	C&P	C	C	C	P
		project /local		C	C&P				
		C=current, P=proposed or potential. Table includes only economic instruments addressed in 2 or more case studies							
Methodologies		*Only methodologies addressed in 2 or more cases studies*							
WP3	**GIS mapping**								
		Composite B&ES indices	?	?	X	?		?	X
		Biodiversity & habitat quality	X	X	X	X	X	X	X
		Pollination&pest control	X	X					
		Carbon & timber	X	X		X	X	X	X
		Run-off &infiltration&erosion	X			X		X	
		Non-timber forest products	X	X					
		Recreation	X					X	X
		? = subject to findings of the coarse grain analysis							
	Landowner & forest user surveys								
WP4 & WP5		Value transfer - available datasets	?	?					X
		Choice experiment - contract design				X		X	
		Opportunity costs	X	X	X	X	?	X	X
		Transaction costs	X	X	X	?	?	X	X
		Social impact & legitimacy			X	X	X		X
		? = subject to findings of the coarse grain analysis							
WP6	**Existing instrument evolution, path dependency**		X	?		X	?	?	X
	Proposed instrument architecture		X	X	X	X	X	X	X
WP3-WP4..WP9	**BACI:Before-after-control-impact evaluation**		PES	EFT		?			
WP3-WP6..WP9	**Scenario evaluation, incl. GIS mapping**			EFT	PES, TDR			EFT	
WP3-WP6..WP9	**MCA: Multi-criteria analysis**				X				
		MacBeth , other MCA software	?		X		?		?
		Marxan - spatial site selection	X		X	?	?		X

Notes to Table 1 above:

Composite B&ES indices: Case studies that plan to combine data layers on B&ES for MCA, site selection, targeting or scenario analysis will probably be using composite indices requiring

2.5 Outline of report

This report has the following structure:

- Chapter 2 provides an overall picture of the context and challenges in preserving the Atlantic Forest biome in Brazil. This chapter also aims to present the conservation targets for this biome;

- Chapter 3 presents a review of the main Brazilian regulatory and economic instruments in place. The first category (direct regulation) encompasses the Forest Code, Environmental Crimes Law, and the Atlantic Forest Law. The second category analyzed includes PES initiatives and the experience provided by the adoption of ICMS-Ecológico in the state of São Paulo;

- Chapter 4 initiates the task of studying new economic instruments that may be adopted in São Paulo State. As this state is very heterogeneous our analysis aims to show the importance of considering different tools for different contexts. The instruments analyzed are PES and TDR, which role will be fully explored in the fine grain analysis (in progress);

- Chapter 5 brings a qualitative analysis of the interactions that may be occur among existing and proposed/potential instruments

- Chapter 6 can be considered as a description of the fine grain study to be conducted in São Paulo State. It draws from chapter 4 as it points out the potential role of PES and TDR. So chapter 6 is a plan for studying in more details the instruments pointed out as relevant for São Paulo context.

As it is indicated in the chapters' headings, each of them aims to cover one of the steps included in the POLICYMIX evaluation framework, although we did report an impact evaluation of existing instruments.

3 Identifying biodiversity status, challenges and context (Step 1)

3.1 Biodiversity status

The Atlantic Forest was one of the largest rainforests in the world covering nearly 150 million ha(Fig. 1). It is recognized as one of the 5 world's hotspots which means it contains endemic plants and vertebrates amounting to at least 2% of total species world-wide, but summed with the other top 4 hotspots comprises a mere 0.4% of the Earth's land surface (Myers et al., 2000). The state of São Paulo was originally covered by Atlantic Forest in 83% of its territory (Victor, 1975) and now it´s fragments account for only 14% of the original area (Nalon et al., 2008). The process of deforestation is not recent, it started with the expansion of coffee plantations from 1810 until the beginning of the last century (Kronka et al., 2005). Only between 1907 and 1934 it has been destroyed 7.9 million hectares of natural vegetation in SP (Dean, 1996).

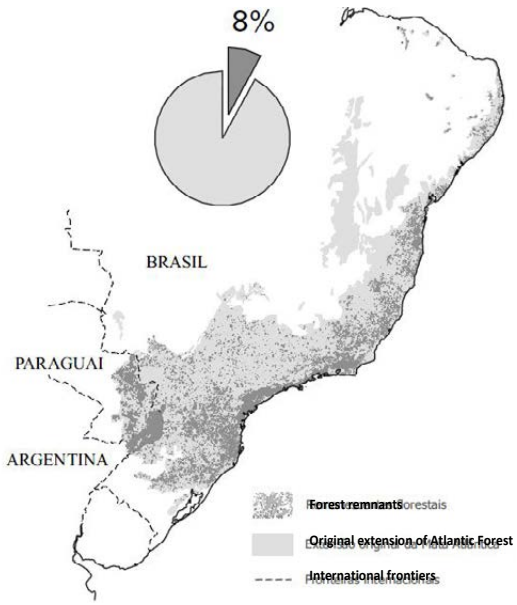


Figure 1 – Atlantic Forest original and current status

Source: Galindo-Leal and Câmara (2005)

Its highly heterogeneous environmental conditions produces differences in forest composition due to its latitudinal range, around 29º, extending into tropical and subtropical regions and also to its longitudinal range that decreases rainfall away from the coasts. Coastal areas receive large amounts of rain year-round, reaching more than 4000 mm, while inland forests receive around 1000 mm/year (Galindo-Leal & Câmara, 2003). These geographical characteristics, combined with the large altitudinal range, have favored high diversity and endemism, including more than 20,000 species of plants, 261 species of mammals, 688 species of birds, 200 species of reptiles, 280 species of amphibians, and many more species that still require scientific description (Ribeiro et al., 2009). It contains endemic plants and vertebrates amounting to at least 2% of total species world-wide, 8,000

endemic plants (2.7% of world) and 567 endemic vertebrates (2.1% of world), but summed with the other top 4 hotspots comprises a mere 0.4% of the Earth's land surface (Myers et al., 2000).

Most of the remaining Atlantic Forest exists in small fragments (<100 ha; Ranta et al., 1998 apud Ribeiro et al., 2009) that are isolated from each other and are composed by second-growth forests in early to medium stages of succession (Metzger et al., 2009 apud Ribeiro et al 2009). The few large fragments survived in locations where the steep terrain made human occupation particularly difficult (Silva et al., 2007 apud Ribeiro et al 2009). Nowadays fragmentation has led to a large proportion of the forest's vast biodiversity being threatened to extinction; for example more than 70% of the 199 endemic bird species are threatened or endangered (Parker et al., 1996; Stotz et al., 1996; Goerck, 1997, apud Ribeiro et al., 2009).

The data available for the entire Atlantic Forest region is the percentage of the remaining forest, but there are huge discrepancies among the different methods employed. Ribeiro et al (2009) did a survey that found several different ratios: 7–8% of the forest remains according to SOS Mata Atlântica/INPE (1993, 2000) and Galindo-Leal and Câmara (2005); 10.6% according to SOS Mata Atlântica/INPE (2008); and 27% according to IESB et al. (2007); Cruz and Vicens (2010), 11.7% according to Ribeiro et al (2009) and 17% according to (IEA, 2008). Differences could be caused by several factors, including mapping errors, inclusion of secondary forest and small fragments.

The deforestation dynamic in the state is now stabilized, and even show signals of tendency reversion (Table 1), but still there is still the need for a more intense restoration effort.

Table 1– Forest area in São Paulo State (1910 – 2000)

Year	% of natural forest	% of exotic forest	Total % Forest
1910	60		60
1920	51		51
1930	41		41
1940	30		30
1950	20		20
1960	16		16
1962	13.7	1.5	15.2
1970	11.25	2.4	13.7
2000	13.9	3.1	17.0

Source: IEA (2008)

In a recent study, landscape structure parameters were used as surrogate indicators to establish general guidelines for conservation planning in the Atlantic Forest, and the main results were that more than 80% of the fragments are <50 ha, almost half the remaining forest is <100 m from its

edges, the average distance between fragments is large (1440 m), and nature reserves protect only 9% of the remaining forest and 1% of the original forest (Ribeiro et al., 2009).

The second most important biome in São Paulo is the Cerrado (a kind of savanna), which is also recognized as a biodiversity hotspot (Myers et al., 2000), that originally covered 14% of the state´s territory. Its deforestation is more recent but more intense, it has lost 90% of its area between 1960 and the end of 2000, with the sugar cane expansion incentivized by the Pro-alcohol policy in the 70´s and the expansion of citrus in the 80´s.

3.2 Biodiversity policy goals, targets and key issues

The most important characteristics of the Atlantic Forest ecosystem besides its biodiversity richness is the pressure it suffers. The biome area in Brazil has been the most populated and degraded area since the beginning of Brazil's history that today is responsible for 80% of national GDP and nowadays there are more than 100 million inhabitants (Galindo-Leal & Câmara, 2005).

It influences a lot the applicability and success of the conservation policy instruments since in this area are concentrated in the biggest cities, industries and ports, and also modern agricultural production. However, it also offers a great opportunity for payment for ecosystem services (PES) schemes since we have lots of beneficiaries of the services provided by its biome.

The main policy objectives are related to protect every small remnant since it may be important for the conservation of certain species regardless of size (Turner & Corlett, 1996). However, not all species are able to be preserved in small fragments. The Jaguars, for example, require areas larger than 10.000 km^2 to maintain long-term viability of populations, which is more than 500 individuals. In the Atlantic forest hotspot there are only two areas that reach this extension: the Serra do Mar corridor, in the states of São Paulo and Paraná (Brazil), and the forests that stretch from the province of Misiones (Argentina) to the Iguaçu National Park (Brazil) (Figure 2) (Galindo-Leal & Câmara, 2005).

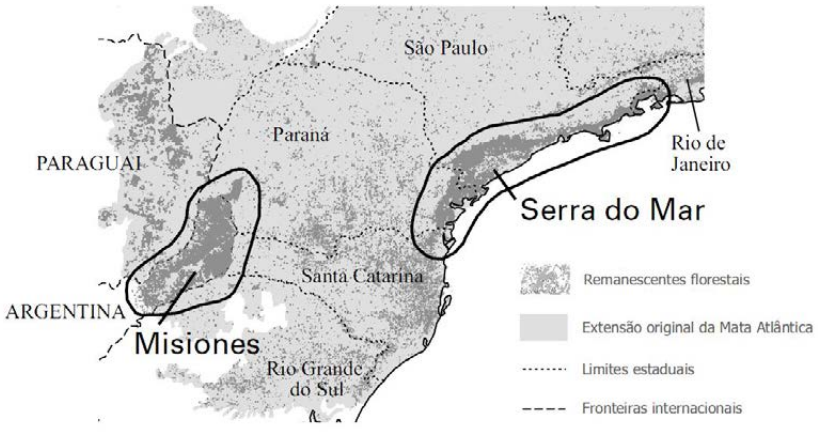


Figure 2 - Areas with forest fragments bigger than 10.000 km2 in the Atlantic Forest hotspot

Source: Galindo-Leal & Câmara (2005)

So, the recovering of the biome is an urgent need especially addressing the connectivity of the existing fragments and the creation of corridors.

The objective of conservation is mainly tackled by defined Protected Areas (PA), including public or private PA, with the second being just a small percentage. The institutional framework for this is given by the Federal System of Protected Areas (SNUC in Portuguese acronym)[2] created in 2000 to unify the legislation about protect areas in Brazil. In 1992 Brazil hosted the United Nation Conference on Environment and Development where it also signed the Convention on Biological Diversity and ratified it[3] in 1998, setting national targets[4] in 2006. For the Atlantic Forest, Brazil has set a target of 10% of the biome under protected areas. By now, 89.2% of the target was achieved (Table 2). But the protected areas do not guarantee the complete biodiversity conservation, whereas many of them lack the basic apparatus necessary to effectively maintain biodiversity, such as financial resources, infrastructure, insufficient technical personnel and equipment to direct and guard the units, problems related to land tenure documentation, and management plans to guide the actions of managers (Fonseca et al., 2010).

Table 2 - Protected area status by biome in Brazil compared with Biodiversity Convention target

	Public Protected Area		Private Protected Area		Total	National Target 2010	Achieved
Biomes	Km^2	%	Km^2	%	%	%	%
Mata Atlântica	97,888	8.82	1,147	0.1	8.92	10	89.2
Pampas	6,139	3.48	12	0.01	3.49	10	34.9
Pantanal	6,528	4.35	2,610	1.73	6.08	10	60.8
Marine/Costal	54,389	1.53	--	--	1.53	10	15.3
Amazon	1,135,006	27.05	396	0.01	27.06	30	90.2

Source: Adapted from Sparovek et al. (2011)

Besides the legislation regarding protected areas (public or private), Brazil has also a very complex and restrictive legislation scheme addressing conservation on private areas. This issue is very important since more than 90% of remnants of Atlantic Forests are in private areas (Ribeiro et al., 2009). The most important law in the policymix of conservation in private areas is the Forest Code[5], first set in 1965 and edited several times. Its main requirements is the protection of fragile areas such as riparian, hilltops, mangroves and wetlands (called Areas of Permanent Preservation – APP) and also requires that each rural property preserves a percentage of its area as Forest Reserve (FR). The amount depends on the type of biome and geographical localization in the country, which in the Atlantic Forest is 20% of total area, not including APP areas. These targets are the most difficult to map since there is not any kind of centralized digital register of the rural properties. The conservation policies and targets on private properties are very relevant because most of the natural vegetation remnants of almost all Brazilian biomes are in rural properties under private management and under

[2] SNUC - Law N° 9.985, July 18th, 2000.
[3] Decree Nº 2.519, March 16th, 1998.
[4] CONABIO Resolução Nº3, December 21st, 2006.
[5] Law nº 4.771, September 15th, 1965 (actual version).

no legal protection. In the Atlantic Forest, only 3% of the remnants are in protected areas (Sparovek et al., 2011) (Table 3).

Despite the Forest Code, in 2008 was enacted the Atlantic Forest Law[6] that was the first law that was designed especially for a biome in Brazil and aimed at enhancing the preservation and protection of natural vegetation in the Atlantic Forest.

Table 3 - Location of natural vegetation in Brazil by biome

Biomes	Protected Areas/ Indigenous Lands (IL)	Outside PA/IL
Mata Atlântica	3%	97%
Pampas	1%	99%
Pantanal	7%	93%
Amazon	37%	36%
Caatinga	1%	99%
Cerrado	7%	93%

Source: Adapted from Sparovek et al. (2011)

In the Atlantic Forest hotspot the drivers of biodiversity loss and ecosystem degradation are very complex, historically driven by an unequal system of land tenure and local trade, national and international. Specific causes of this loss include both short-term incentives to the livelihoods of local producers and political broader national and even global market, since the colonization.

The large latitudinal extent that makes the Atlantic Forest heterogeneous also creates heterogeneous socio-economic conditions and pressures over the biodiversity (Galindo-Leal & Câmara, 2005).

The main current drivers are the unsustainable extraction of timber, firewood, coal and plant species, hunting and fishing; intensive use of soil in agriculture and pastures; construction of dams to hydroelectric power; introduction of exotic species; tax incentives and credits for agricultural conversion (Young, 2005). Serious drivers are also the uncontrolled urban expansion that leads to real estate speculation and road building, and the expansion of tourism infrastructure that had a negative and significant impact on coastal environments.

Facing this scenario, the main goals in Atlantic Forest biodiversity conservation and ecosystem services provision is to guarantee the conservation of the forest remnants and to focus on the recovering of the riparian areas, both located in private areas. To address this, the first step would be to assure the enforcement of the existing regulatory instruments, which can be a challenge due to the high costs of compliance and enforcement considering the continental size of the biome.

With the contribution of the science (section 2.5) two main general objectives has been considered as the conservation priorities in the Sao Paulo state (Metzger and Rodrigues, 2008). The first is to preserve every small fragment due to the intense degradation process that had occurred and due to the importance of the fragments to the biodiversity conservation that granted them a high biological

[6] Decree Nº 6,660, November 21st, 2008.

value and important role in ecosystem services provision. The second objective is to promote the restoration of all degraded riparian areas given the important role they play in ecosystem services provision and facilitation of natural connectivity of fragments.

3.3 Data gaps in evaluating instruments' effectiveness

In spite of the great amount of biodiversity data generated in the Atlantic Forest region currently, the lack of standardized inventory protocols and sampling efforts with poor spatial distribution have resulted in significant geographical data gaps, making it particularly difficult to use this information for conservation planning by the usual methods (Ribeiro et al., 2009). At local scales, enough biological data is available for some areas to support conservation plans, but great difficulties arise in planning conservation actions for large regions. Moreover, most of the data are insufficient to properly support conservation planning, and thus, abiotic surrogates such as landscape structure parameters are in most cases the only alternative (Ribeiro et al., 2009).

Werneck (2011) analyzed distribution and endemism of angiosperm (94% of all vascular plants in the Atlantic Forest) and found that the areas with higher number of endemic species correspond to major herbaria or research centers (north to south), so potentially there is a strong sampling bias in these results (Figure 3), a "museum effect", implying that for historical reasons of efficiency, logistic, and convenience, collectors tend to over-sample near these institutions.

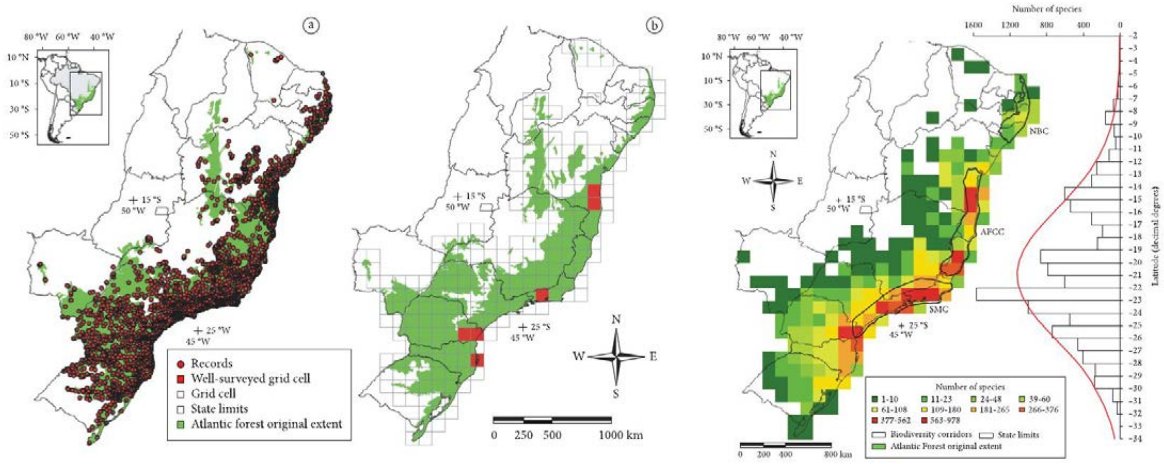


Figure 3 – Comparison between samplings (a) all species records , (b) well-surveyed grid cell and (c) number of registered species - Source: Werneck et al. (2011)

This sampling bias is very relevant for conservation policy making, since this information is one of the main data used to map priority areas for conservation, as well as the creation of new public protected areas and many other policy instruments that are based on those areas (MMA, 2007).

To improve this database and reduce bias, the BIOTA program (section 2.5), has already established a standard protocol for sampling that has made it possible to construct the Environmental Information System (SinBiota), which registers and integrates the collection of plants, animals or microorganisms carried out in the State of São Paulo. As one of the mandatory fields is the geographical coordinates of sampling places. To make possible the expansion of this tool for the whole area of the Atlantic Forest and Brazil, the National Council of Technological and Scientific Development (CNPq) recently

released a call for projects[7] expected to spend $28.8 million to expand the knowledge of Brazilian biodiversity. The actions to be financed in the coming years include: i. studies on the synthesis of existing knowledge and identifying gaps; ii. strategies to cover the gaps of knowledge about biodiversity; iii. expansion of knowledge in addition to species diversity, genetic diversity of intra and inter, phylogenetic diversity, functional diversity, morphological diversity; iv. expansion of network inventory with emphasis on regions poorly studied or not, enabling the expansion of regional skills; v. increase the level of collection of the major taxonomic groups at national and standardization of research methodologies.

3.4 Historical Policy Context

Compared to other Brazilian sectorial policies, the Brazilian environmental policy occurred so late. The first environmental official reference was done in 1934 with the establishment of the Forest Code and Water Code. The first established, among other concepts, the notion of protective forests and a kind of "forest reserve", in order to ensure supply of coal and wood for industrial activities. Furthermore, allowed the replacement of native forest for homogeneous forests in order to supply such activities. The water code established standards of use of water resources, with the objective to ensure the development of hydroelectric power.

In 1965, the new forest code was the crystallization of environmental concern, especially related to to forest resources, with the creation of the typology of protected areas, Areas of Permanent Preservation (APP) and Forest Reserves (FR), transferring the responsibility of protection to the landowners.

In 1973, following the recommendation of the United Nations Environment Program (UNEP), it was created the Special Secretariat for the Environment (SEMA), considered the first step towards a more appropriate and independent treatment of environmental issues. The main objective was focused on pollution control and the creation of conservation units, with its structure based on the US Environment Protection Agency, characterized by decentralization and intensive use of command and control, which demands human and technical resources on a large scale. Concomitant with the establishment of SEMA, there was the creation of several state environmental control agencies.

However, only with the promulgation of the National Environmental Policy (PNMA), the creation of the National Environmental System (SISNAMA) and the National Environment Council (CONAMA), through the 6938 law in 1981, the environmental issue was introduced institutionally within the government programs and policies. CONAMA is the consultative and deliberative organ SISNAMA, consisting of government officials and civil society, composed often by permanent cameras and eight temporary technical, discussing and proposing guidelines for the Brazilian environmental policies.

This law established the objectives, principles and tasks of environmental policy, beyond the creation of institutions and management instruments. Within the tools could be highlighted the environmental impact assessment and review and licensing of polluting activities, the establishment of environmental quality standards, environmental zoning, the establishment of stations and areas of ecological environmental protection, the national environmental information system, instruments for environmental protection and disciplinary penalties.

After a long period of military dictatorship, Brazil has approved its Constitution in 1988, which defined the environment as a public good and sets the obligation of the government and people for its preservation. In 1989 was created the Brazilian Institute of Environment and Renewable Resources (IBAMA), which assumed the task for controlling and supervising the activities related to

[7] Edital MCT/CNPq/MMA/MEC/CAPES/FNDCT – Ação Transversal/FAPs Nº 47/2010

the (possible) environmental degradation. In 1997 was created the National Water Resources Policy and the National Water Resources Management, complementing the national policies.

By the recognition in 80´s that conservation units areas were quantitatively insufficient to protect biodiversity, it was established the Bill 2892 proposing the National System of Conservation Units (SNUC), approved later in 2000 (Law number 9985). The SNUC has as its main objectives: i. to contribute to the maintenance of biological diversity and genetic resources within the national territory and territorial waters; ii. to protect endangered species; iii. to preserve and restore natural ecosystems; iv. to promote natural resource based on sustainable development; v. to incentive scientific research and environmental monitoring; vi. to protect the natural resources essentials for traditional communities.

Since the SNUC promulgation, the government has to consult the society and the local population about the management of protected areas. It created a division between full protected areas and sustainable use, where there are several types and class. It also regulates the requirement for environmental compensation in compulsory environmental licenses with significant environmental impact, where the resources are destined for the maintenance or creation of protected areas.

The Pilot Program for the Protection of Tropical Forests (PPG-7) in Brazil started by an initiative of the international community, which aims at the development of innovative strategies for the protection and sustainable use of the Amazon Forest and Atlantic Forest. The program is funded by donations from countries of the former Group of Seven, the European Union and the Netherlands, complemented by increasing contrast of the Brazilian government, state governments and civil society organizations. The Ministry of Environment (MMA) is responsible for overall coordination. The Pilot Program was proposed to meet with the Group of Seven industrialized countries (G-7) in the U.S. in 1990. It was approved by the G7 and the European Commission in December 1991. In 1992, during the UN Conference on Environment and Development (Rio-92), the program was officially launched in Brazil.

Despite the criticism that PPG-7 was a movement of deepening international control over the Amazon, the program contributed to institutional strengthening and decentralization of environmental management in the Amazon states. In addition, helps on creating new protected areas, the demarcation of 29 million hectares of indigenous lands, and the establishment of 2.1 million hectares of extractive reserves of sustainable production (Antoni, 2010).

3.5 Science and policy articulation for priorities definition

One group of Brazilian scientist prompted by the challenge of the threats that Brazil´s rich biodiversity was suffering (Joly et al., 2010) founded in 1999 the Virtual Institute of Biodiversity, BIOTA-FAPESP. They have been supported by FAPESP, the State of São Paulo Research Foundation, which is a non-political and taxpayer-funded foundation, one of the main funding agencies for scientific and technological research in Brazil.

In more than ten years of research, a great amount of information has been produced by the BIOTA researchers, that could be seen in more than 151,000 records of 9,405 species, as well as landscape structural parameters and biological indices from over 92,000 fragments of native vegetation (Joly et al., 2010).

But, even as much important as the effort in producing data about the São Paulo biodiversity is also the successful link done between science and policy. According to Joly et al. (2008) “it represents, undoubtedly, a new conception between the crucial step of São Paulo biodiversity inventories and a program of research in conservation and sustainable use of this biodiversity.

This link was possible due to a concerted effort to synthesize data conducted in 2006 and 2008 when BIOTA-FAPESP researchers made it for use in public-policy-making (Joly et al., 2010). The joint work between the Environmental State Agency (SMA) and the BIOTA researchers has produced three main important maps, that have been adopted by São Paulo State as the legal framework for improving public policies on biodiversity conservation and restoration, such as prioritizing areas for forest restoration (as one means of reconnecting fragments of native vegetation) and selecting areas for new Conservation Units. The maps are quickly described in the following.

The first one is the mapping of large fragments of natural vegetation, well connected in the landscape, with a high proportion of target species and which were not included among the System of Public Protected Area established in the State of São Paulo (Figure 4). These areas have been suggested to integrate this system, through the expropriation of these fragments by the state and its transformation into Integral Protection Units (Metzger & Rodrigues, 2008).

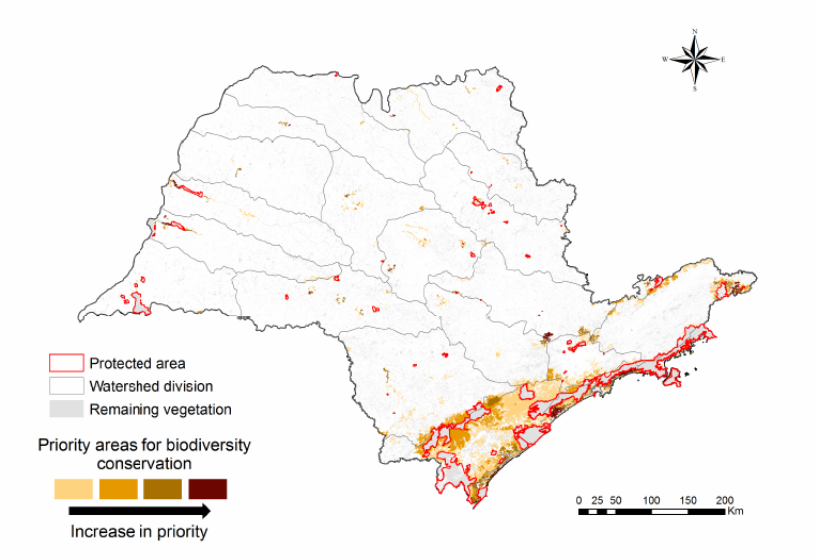


Figure 4 - Priority areas for the creation of new Conservation Units in São Paulo.

Source: Joly et al. (2010)

The second map (see figure 5) includes the other areas not so rich in biodiversity as the above, but that have the presence of relevant species, and present a landscape configuration formed by fragments of intermediaries size and degree of connectivity, not as good as the previous, but not too isolated in the landscape. Both maps can be used as suggestions actions to increase connectivity by the private sector (Metzger and Rodrigues, 2008). To this end, these authors suggest the application of Brazilian law, including the registration of the RL, which represents 20% of each farm, and restoration of riparian corridors that may result in a significant increase in the connectivity of these fragments in the landscape.

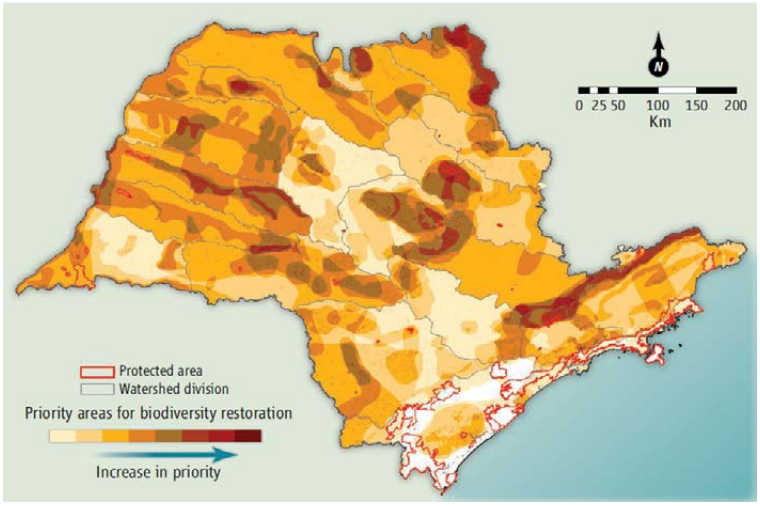


Figure 5 - Priority areas for biodiversity restoration in São Paulo. The figure also shows the existing network of state parks (red lines) and the state's division of Water Management Units (gray lines)

Source: Joly at al.(2010 – SOM)

Finally, the regions which have not enough biological data to allow support of adoption of more effective actions for remaining biodiversity conservation have been suggested as important regions for enhancement of biological inventories (Metzger and Rodrigues, 2008), where there should be focused the financial support by agencies of scientific research in the State of São Paulo, especially FAPESP (see figure 6).

Reflecting on the importance of these joint work for policy recommendation, there have been enacted four governmental decrees and 11 resolutions that quote the BIOTA-FAPESP guidelines. Before this effort was made, most policy decisions were based on secondary data of heterogeneous quality, not evaluated by a scientific committee (Joly et al., 2010). Among these laws, two worth mentioning are the agro-ecological zoning ordinance[8] that prohibits sugarcane expansion into areas that are priorities for biodiversity conservation and restoration and the requirement[9] that any suppression of native vegetation for land parceling or any building in an urban area should also be based on the categories created by BIOTA.

[8] SMA nº 14 / 2008.
[9] SMA-SAA nº 04 / 2008.

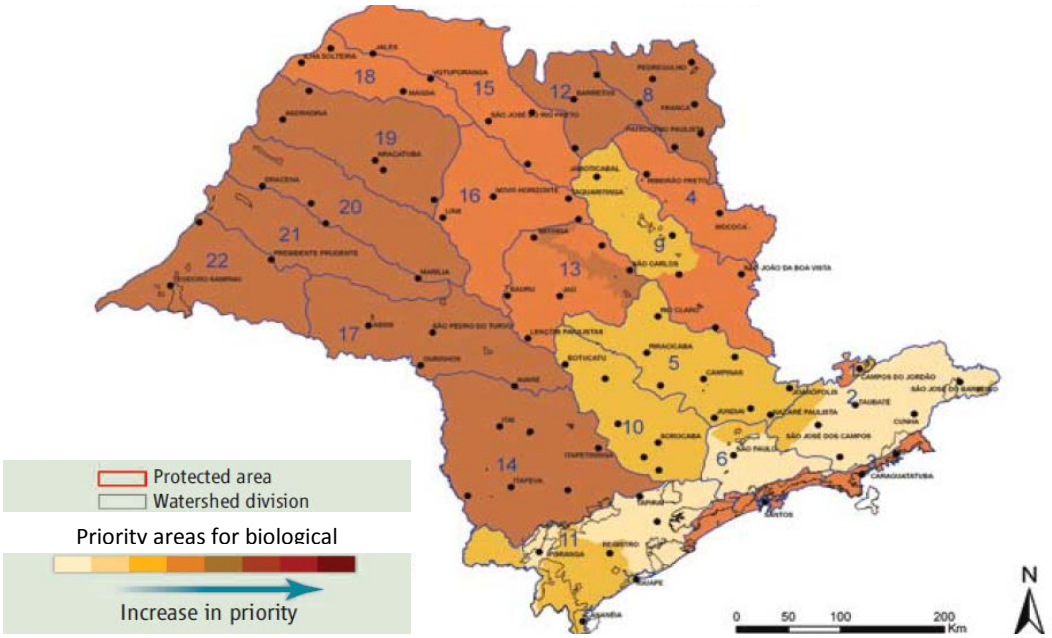


Figure 6 – Priority areas for biological inventories

Source: Metzger & Rodrigues (2008)

It is necessary to recognize the great value of initiatives such as BIOTA Program. Unfortunately several challenges jeopardize the replication of these experiences in other Brazilian States. It is also important that social and natural scientists joint efforts in order to translate all the information generated in effective and

3.6 Choosing instruments for analysis

As can be understood by this chapter, the historical context for environmental policy in Brazil is not very long. However, there have been notorious advancements in recent years, although we can point out huge challenges to be faced due to the variety of biomes and different social and economic contexts throughout the country. The existence of the Forest Code can be considered one Brazilian peculiarity due to its relevance in terms of institutional guidance for forests conservation at national level. We assume that any instrument (economic or command and control) must be planned under the Forest Code desideratum. Having this is mind the two following chapters are aimed at describing existing and proposed instruments (direct regulation and economic ones) at national scale and São Paulo scale.

Under the existing instruments review (chapter 3) we will focus on direct regulatory considering the national scale (Forest Code, The Environmental Crimes Law, and the Atlantic Forest Law). As for existing economic instruments in place the focus will be on the so called ICMS-Ecológico in São Paulo, as well on some pilot experiences on PES within this state. Chapter 4 describes two proposed/potential economic instruments (PES and Tradable Development Rights) for the Sate of São Paulo.

4 Role of existing instruments (Step 2a)

4.1 Direct Regulation

4.1.1 Forest Code

As previously noted, the first design of the forest code was in 1934 (Decree 23,793) and at this time it was established the concept of protective forests and the requirement for a forest reserve in the farms. However, the use of these reserves was not thought in terms of environmental protection, but as a way to ensure firewood supply. This explains why the replacement of such forests by homogeneous planted forest was allowed.

The "new" forest code was enacted in 1965 (Law 4771), defining, among other issues, the landowner limitations about the land use, and the management of forests and others kind of vegetation. Among the instruments, two are worthy to mention: the Forest Reserve (FR) and the Permanent Preservation Areas (APP). The RL is an area located within the property "necessary to the conservation and rehabilitation of ecological processes and biodiversity conservation" [SET]. The APP was defined as a protected area, or not, covered by native vegetation, with "the environmental function of preserving water resources, landscape, geological stability, biodiversity, gene flow of wild fauna and flora, soil protection and ensure the well-being of human populations "(Brazil, 1965). They are priority areas for water resources and their recharge, and follow along the rivers, springs, lakes and water reservoirs and hilltops. [GERD] Initially it was required rural properties in the Amazon and in the savannah ("Cerrado") region to maintain 50 percent of the native forest on the property and also 20 percent for the rest of the country.

In 1986, Law 7511 modifies the concept of forest reserve. By this alteration it was no longer allowed the deforestation of native forests, although this the new piece of the Forest Code permitted restoring deforested areas with exotic species. This law also changed the boundaries of APP, leaving 5 to 35 meters. Also, for the rivers with more than 200 meters the APP areas were equivalent to the required width of the river. In 1989, the obligation of the RL was extended to other regions and its registration was officially required. In 1996, the forest reserve requirement in Amazon region raised to 80 percent, through a “provisory measure”, an act that has the effect of law but without riddled by politicians vote.

During all this period several laws were enacted in the State level that also addressed the conservation, but regarding the direct regulation they were complementary of the federal level laws. The one of great significance and importance is the Decree enacted in 2009 that regulates the maintenance, restoration, natural regeneration, compensation, and composition of the RL area in rural properties in the State of São Paulo.

The actual Forest Code (and also the State Decree cited above) provides three options for the landowners who are not compliant with the RL:

- Recover the RL of its property by planting with native species every three years at least one tenth of the total area required for its completion;
- Conduct natural regeneration of the RL, but only when the viability is proved by a technical report and approved by the state environmental agency;
- Compensate RL areas in another property in area with equivalent extension and ecological importance, only if there is an equivalent ecosystem and if it is located in the same watershed, according to criteria established by regulation.

However, all these option imply high costs, which includes opportunity costs and also restoration costs. According to IEA (2009), the reduction in the revenues from agriculture in São Paulo due to the total compliance with the law (APP + RL) would be of US$3.2 billions, which means a reduction in 17.7% of the sector income. The estimated recovering costs were calculated in US$8.2 billions, totaling US$11.3 billions, which represents 65% of the total revenue from the agriculture sector in 2005 (IEA, 2009).

4.1.2 Proposed reform of Forest Code

A revision to the Forest Code, the main Brazilian environmental legislation on private land, has just been voted by Congress and sanctioned by the President with some amendments through Provisory Measure. The revision raised serious concerns in the Brazilian scientific community, which were largely ignored during its elaboration. The new rules will benefit sectors that depend on expanding frontiers by clear-cutting forests and savannas and will reduce mandatory restoration of native vegetation illegally cleared since 1965.

Brazil has a high potential for achieving sustainable development and thereby conserving its unique biological heritage. Although opposed by the Ministry of the Environment and most scientists, the combination of traditional politicians, opportunistic economic groups, and powerful landowners may be hard to resist. The situation is delicate and serious. Under the new Forest Act, Brazil might be at risk of suffering its worst environmental setback in half a century, with critical and irreversible consequences beyond its borders (Metzger et al., 2011).

One of the most recurrent criticism in favor of the Forest Code reform is the arbitrarily choice of the preservation target in different biomes. Somehow, the scientific knowledge about benefits, limits and particularities of the Brazilian forest ecosystems was incipient when those targets were set. However, Metzger (2010) states that the scientific basis about it has increased since then, and affirms that not only it must sustain those values as would need to increase them (for the extension of the APP) for at least 100m (50m on each riverbank).

It is important to follow-up the discussions of the Forest Code since it guides almost all actions contemplated here, from the main command and control policies to the use of market-based instruments. However, until now the proposals did not cover a significant change in the way that environmental policy was made. The reforms seem to aim to solve problems related to inefficiency in the past instead of providing a better setting for new instruments studied.

4.1.3 Environmental Crimes Law

The Environmental Crimes Law (ECL)[10] was published in 1998 and is considered a great innovation in the Brazilian policymix for conservation. The new law greatly broadens liability for environmental violators. Despite its name, the law is not restricted to established penalties for environmental crimes, but it also addresses administrative violations and international cooperation (IPEA, 2011).

The new law improves the ability of administrative agencies to apply administrative sanctions; establishes the responsibilities of corporations for environmental violations and damage; turns more environmental violations, such as illegal logging into crimes with higher penalties (up to US$ 16 millions); and provides quicker judicial procedures for many environmental crimes.

In 2008, a Decree[11] was published to regulate the infractions and administrative penalties to the environment and to establish the administrative procedure for verification of these federal offenses.

[10] Law Nº 9.605, February 1998
[11] Decree Nº 6.514, 2008.

One of the infractions included in the Decree, and the one that is more relevant for the conservation in private areas, our focus, is the non-delineation of FR in the rural property documents. For this infraction, the Article 55 imposes a daily penalty from R$50,00 to R$500,00 per hectare, and the punished has 180 days to present a term of commitment to regularize FR through one of the alternatives procedures prescribed by law. If implemented, the punishment from the Article 55 would affect thousands of properties that do not have their forest reserves delineated, and could be a very powerful instrument to improve the enforcement of the Forest Law. However, the very strong pressure from the Brazilian federal rural caucus pressured the president to postpone 4 times[12] the validation of this Article, and since 2008 this infraction has not been valid. The last Decree postponed its validation to April 11th 2012, and the rural caucus wants it to be valid only after the decision about the Forest Law reform.

4.1.4 Atlantic Forest Law

The establishment of a law for the most threatened biome in Brazil was the result of a joint of 14 years by intensive debate between NGOs, environmentalists and farmers. It was first proposed in 1992, four years after Atlantic Forest was declared National Patrimony by Federal Constitution. The Atlantic Forest Act was thought to ensure the conservation of vegetation remnants and determined criteria for its use and protection. Furthermore, it imposed rules and restrictions in differentiated ways for these remnants, considering the primary and secondary vegetation and initial, intermediate and advanced regeneration stages.

However, some argues that it was a regression. According to Varjabedian (2010), the Atlantic Forest Law removed the protection from this biome and expanded the risks hanging over it. One concern is related to the permission to cut and remove vegetation at the intermediate stage. This does not recognize its value, its functions and environmental services, which represent a significant impairment to an ecologically balanced, besides being subject to future development of this vegetation in advanced stages of regeneration. The author argues that, generally, its clauses promote varied possibilities for exploitations of rainforest products, such as lumber, firewood, with differing levels of control from authorizing agencies (including their absence) in the biome of the Atlantic Forest, going beyond even what is much more permissively allowed before. Thus, it is argued that it may open possibilities for suppression of advances or apex stage regeneration, threatening the Atlantic Forest remnants.

4.2 Main economic instruments in use in São Paulo

This context proves that the simple existence of a regulatory instrument is not enough to assure its implementation, especially in a country of continental size and with considerable law enforcement and implementation problems such as Brazil (Fearnside, 2000). In order to better address conservation in a context of private interests it is necessary to add instruments of incentives and flexibilization of the strict targets. The conventional literature on environmental policy claims that economic instruments can be more effective than traditional regulatory instruments (command and control policies). However, assessing the role of economic instruments in the context of environmental that combines both instruments can be viewed as a gap. POLICYMIX project embraces this challenge by focusing on the interaction among several policy environmental instruments.

The conservation of the São Paulo and Brazil´s biodiversity is also depending on the private actors, but private decisions on biodiversity conservation are primarily taken based on financial cost-benefit

[12] Decrees Nº 6.686, 2008; Nº 7.029, 2009 and Nº 7.497, 2011.

considerations (Oosterhuis, 2011). Although the environmental importance and economic potential of RL are in the research agenda (Ferreira et al., 2007a; Snowareski, 2006; Rodrigues, 2007; IEA, 2008; Pompermayer, 2006) which recognizes it as an important tool for biodiversity conservation, there are cultural barriers, regulatory, technical and economic for such legal requirements are met by landowners (Rodrigues, 2007).

So, facing that historically there has been a total non-compliance context to a non-enforced legislation that has changed many times it is necessary to consider the role of other complementary instruments in order to support the achievement of conservations targets in Brazil.

This complementation could be done by incentives and/or approaches that aims to provide positive incentives (subsidies, tax reliefs, fiscal transfers or payments) to agents that help biodiversity conservation and ecosystem services provisioning, or by burdening biodiversity-harmful activities and (excessive) use of ecosystem services (environmental taxes, necessity to hold a permit, obligation to buy offsets) (Schröter-Schlaack & Ring, 2011).

4.2.1 ICMS-Ecológico

The ICMS-Ecológico (ICMS-E) is an instrument based on Ecological Fiscal Transfers (EFT), started in Paraná State in 1992. Since then it has been adopted by other thirteen states in Brazil. It can be considered the first instrument to paying for environmental services, aimed at encouraging conservation actions. At its inception the primary motivation was to compensating the municipalities for economic losses by the constraints of land use (May et al., 2002).

The ICMS[13] is an interstate and intermunicipal tax on circulation of goods and services, which is the most substantial source of state revenues. The Brazilian Constitution allows the states to fix a percentage of the value added taxes. From the total, 75% is transferred to State and 25% for the municipalities. From this amount, three quarters are distributed according to their value added and the remainder could be managed according to State criteria. Therefore, the total percentage of the ICMS-E varies among the states, as shown in table 4.

Unfortunately, there are still states within the Atlantic Forest that have not been adopted the ICMS-E, such as Alagoas, Bahia and Santa Catarina. These states have rich remaining fragments and the instrument, if would adopted like in Paraná, could foster the creation of new protected areas and could enhanced the protection of the remnants.

[13] Tax on circulation of goods and services and its value varies among the Brazilian states.

Table 4 - Distribution percentage and total amount generated by ICMS-Ecológico in Brazilian States

State	Percentage of ICMS-E	Value of ICMS-E in 2009 (R$ mi)
Acre	5%	-
Amapá	1.4%	1
Mato Grosso	5%	-
Mato Grosso do Sul	5%	39.4
Minas Gerais	1%	45.4
Paraná	5%	124.1
Pernambuco	15%	-
Rio de Janeiro	2.5%	37.9
Rondônia	5%	90.7
São Paulo	0.5%	78.2
Tocantins	13%	29.7

The effectiveness of biodiversity conservation has not been rigorously evaluated in the literature. Despite this, Paraná has shown how to get the potential of the instrument to incentive the creation of new protected areas. Also, it has been the only state that uses quality-related criteria and provides incentives for enhancing the management of those areas. Some studies have shown that, in some states, occured an increase in protected areas after implementation of the instrument (Ribeiro, 2008). However, it was based on simple comparison and there is still a lack of studies regarding this.

Grieg-Gan (2000) analyzes the impacts of the instrument in Rondonia and Minas Gerais and have concluded that there are different results regarding the incentive impacts and as an instrument of compensation as well. Moreover, this author points out that there is an urgent need to include a system for evaluating the quality of protected areas.

Ring & Schlaack (2011) point correctly a crucial question regarding the efficiency of the instrument: “what is the incremental money used for?”. May et al. (2002) state that, as the money can be used for anything, such revenue could even be used as a perverse incentive, acting in favor of activities that could threaten the protected areas.

- **ICMS-Ecológico in São Paulo**

Despite it has been the second state to create a law about the ICMS-Ecológico, São Paulo´s law is now considered outdated. The main reason for such an affirmative is that it does not include several categories of protected areas according to the SNUC and excludes those that are not state as conservation units. In opposite of Paraná's case, and other states, it has been excluded the Private Nature Reserves (RPPN) since the beginning.

Since 2007, there is an attempting to change the law. It demands, among others modifications, the updating of categories to match with the SNUC typology. Moreover, it is desirable the inclusion of quality indicators, as well as RPPN and water sources.

The redefinition of transfer percentage (0.5%) is politically difficult, mainly in a context of strong demand in other sectors. This is due to the character of the instrument; if one criterion gains more resources, another necessarily loses at the same proportion. Furthermore, the distribution criteria also contribute to a scenario of concentrating resources on already consolidated areas, not contributing to create additional areas.

We can say this instrument presents a greater relevance for municipalities that have most of its areas as state UC, especially along the coast, and the ICMS-E is the main source of revenue. The ideal use of the resources could be exemplified by the municipality of São Miguel do Arcanjo, which defined by law the earmarking/distribution of the revenue. At least half of the transfer must be allocated to environmental-related issues, as education, and to the maintenance of protected areas. However, most of the municipalities that receive the resources used them as another source of funds to cover administrative expenses and budgetary in general. There are no studies measuring the real effectiveness of this instrument for creation of new protected areas and biodiversity and water sources conservation and in São Paulo State. Figure 7 shows the distribution of resources by municipalities in annual values.

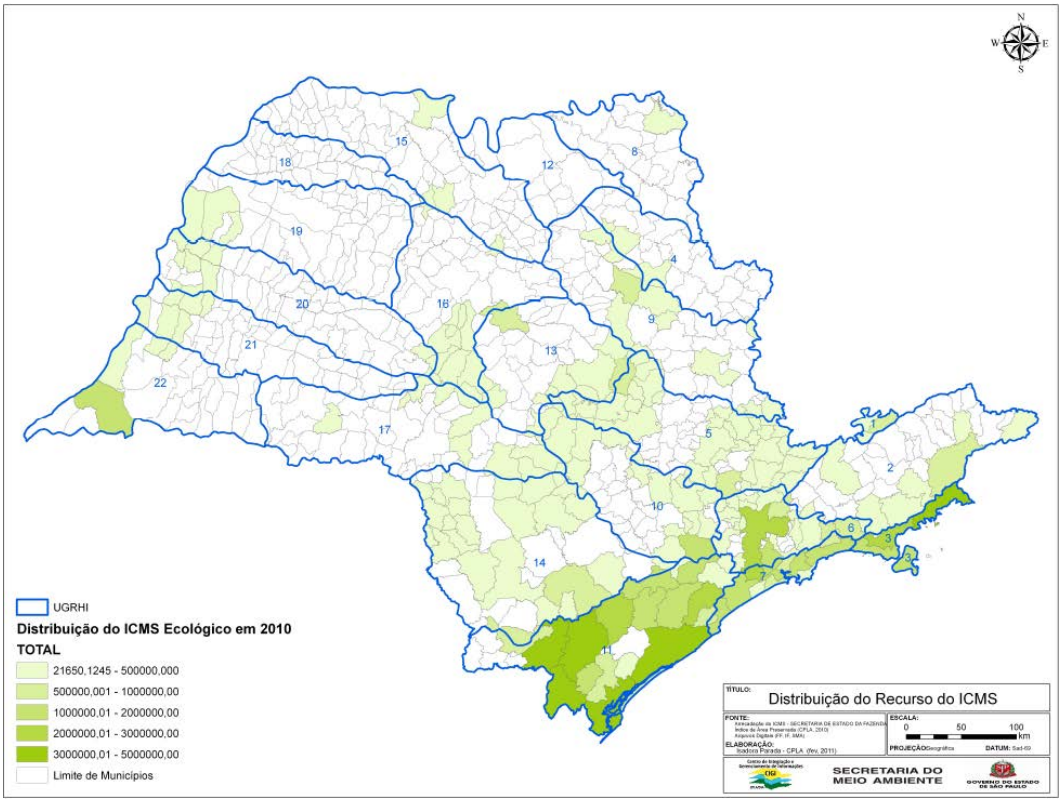


Figure 7 – ICMS-Ecológico Distribution.

Source: SMA (2012)

4.2.2 Payments for Ecosystem Services (PES)

PES schemes have been spread rapidly throughout the world as a new management tool, accompanied by a valuation of ecosystem services and good practices that could enhance them. In Brazil there are many demonstrative projects and initiatives throughout the country. From these initiatives some states and municipalities have taken the lead in consolidating public policy in favor of PES schemes.

As in other developing countries, the Brazilian PES programs do not focus exclusively on the ecosystem service per se, but on how different agricultural practices and land use affect certain

services. As can be seen in Table 5, there are about 24 PES projects in operation across the Atlantic Forest biome, 15 related to carbon (mostly planted forests), 8 for watershed service and only one for biodiversity. Most projects are concentrated in South and Southeast Brazilian Region (the richest ones). Below, we have highlighted and described some public policies developed by different levels of government.

Table 5 – Initiatives of PES in Mata Atlantica

Status	PES carbon	PES water	PES biodiversity
Working	15	8	1
Developing	15	20	0
Designing	3	12	4
Total	33	40	5

Source: Becker & Seehusen (2011)

"Bolsa Verde" – It is an initiative of Minas Gerais State Government aimed at enhancing the forest coverage by PES provided to landowners. In 2008 the State enacted the 17.727 Bill, choosing the use of economic instruments to achieve the targeting of 35% of State area as natural vegetation. The amount invested in the first stage (2009-2011) was around US$ 8 million, with up to 1,000 landowners.

"Produtor de Água" (National Initiative) - The diffusion of PES for water resources has gained momentum with the establishment of the "Produtor de Água" (Water Production Program), from National Water Agency (ANA). This program allowed a greater recognition of ecosystem services provided by farmers where, through certain agricultural practices, prevent the damage caused by soil erosion and the supposed improvement in quality and production of water.

The water-related PES schemes have legal and institutional framework better defined, based on the National Water Resources Policy (PNRH) enacted in 1997, which allowed the recognition of water as a public good, and provided the water-use charges, with the allocation of these resources for maintenance or improvement of the watersheds. To ensure local participation the payments are to be assessed and distributed by local committees, whose role is to assess the charges and then distribute payments to reforestation or environmental conservation projects within their watershed.

The first demonstrative project of this initiative has been held in Extrema (Minas Gerais State) since 2005. Moreover, the municipality was the first one to establish its own law related to PES in Brazil. Nowadays the project counts with up to 150 landowners, which are paid for the remnants conservation. Extrema[14] is located upstream of the Piracicaba-Capivari-Jundiai watershed, which was one of the first water committee to charge the water use. Its importance for the Metropolitan Region of São Paulo is high as it is part of the Cantareira System (more details in section 4.1).

[14] As it will be presented in chapter 6, the deep analysis of Extrema's case is a prerequisite for our fine grain study.

4.2.3 Public Policy for PES in São Paulo State

In 2009 the State of São Paulo enacted the Climate Change State Policy (PEMC), which previews the use of economic instrument as a tool for reducing the impacts of climate change. From this law, it was launched the Forest Remnants Program (PRF), in which the PES was officially established as one of the instruments of the policy, supposedly acting as a complement to the existing framework of different instruments.

With this legal framework the state of Sao Paulo established guidelines and requirements for PES projects, which are defined in the Resolutions of the Environment Secretariat (SMA). This format allows greater flexibility in the establishment of PES programs and could be changed according to the criteria defined for each demand. One of the barriers of Brazilian law is receiving monetary transfers for individuals. In São Paulo this situation was dealt with the creation of the State Fund for Prevention and Control of Pollution (FECOP), which was defined as an instrument of financial management of the PES.

- **PES initiatives in São Paulo**

Within the context described above it has been created the ”Mina D´água” Project which is aimed at the protection and rehabilitation of springs of public supply. The project's first stage objective was to develop and evaluate methodologies and institutional arrangements in partnership with 21 municipalities (representing each of the State Water Management Units). The financial resources came from the State Fund for the Control of Pollution (FECOP). The budget for the actual stage is around $ 3.5 million for five years executable rights.

One of the newest modality of PES in São Paulo is aimed for Private Nature Reserves (RPPN). The RPPN´s are areas of environmental conservation on private land recognized by SNUC as Conservation Units (UC). The RPPN´s are created voluntarily by the landowners who are committed to conserving nature, ensuring that the area is protected forever because of its perpetuity. The economic stimulus to transforming areas into RPPNs is the exemption from the Rural Land Tax (ITR), but could be considered a weak incentive due to low value of this tax. The main objectives of this initiative is to contribute to biodiversity conservation in priority areas, stimulating the creation of new RPPNs on priority areas and improving the effectiveness of management of the existing ones.

Currently there are 47 RPPNs in São Paulo, covering an area of 6,787.12 hectares. The requirements for participation are: i. the landowners should not have financial debts with the State; ii. the agent must follow the environmental law or sign a statement of commitment to fulfill the requirements of the legislation. The prioritization of RPPNs is carried by a series of factors such as biome priority; if it is under a Environmental Protected Area (APA), inserted in Buffer Zone for UC, or in a priority area for the creation of UC for connectivity.

Funding is through the State Fund Pollution Control (FECOP), which consists primarily of official transfers and donations. The monitoring is done from the achievement of the actions foreseen in the Action Plan, a document signed with the owner describing the key actions they should take. Although the value is in majority smaller than the land opportunity cost in surrounding areas, it could be considered a recognition of these voluntary efforts and an important step to strengthen the concept of PES in São Paulo.

5 Role of proposed and potential new economic instruments (Step 2b)

This chapter provides a description and a preliminary assessment of two potential economic instruments. The first one (PES) was chosen due to its potential to improve the ecosystem service of water provision for the São Paulo Metropolitan Area. The second is the Tradable Development Rights (TDR) which has the potential to reduce the compliance costs with Forest Code requirements. This latter instrument will be evaluated in the state level (São Paulo) whereas the potential role of PES will be analyzed at local level (Cantareira Region). Both instruments will be focused on our fine grain analysis and this chapter is aimed at providing the background for this. Other research questions and planned methodologies are presented in chapter 6.

The description of these instruments tries to take into account the four criteria of conservation effectiveness, cost-effectiveness and benefits, distributive impacts and legitimacy, and institutional options and constraints.

We guided our assessment by the following structure:

- brief description of how the instrument would work in the defined context;
- brief assessment of the instruments according to the four assessment criteria;
- brief conclusion in terms of delivering on the challenges identified in Chapter 2.

Finally, we provide a quick synthesis of the role of the two instruments (section 4.3).

5.1 Payment for ecosystem services (PES)

As seen on the previous chapter, there are several initiatives but few effective results of policies related to PES programs. The great challenge is to learn with them and to integrate the initiatives in a common framework. The last could be possible with the National PES Law and its PES National Policy. Like others economic instruments, it has potential and requirements that must be taking into account. The choice of the region and targeting ecosystem services must be done with clear criteria.

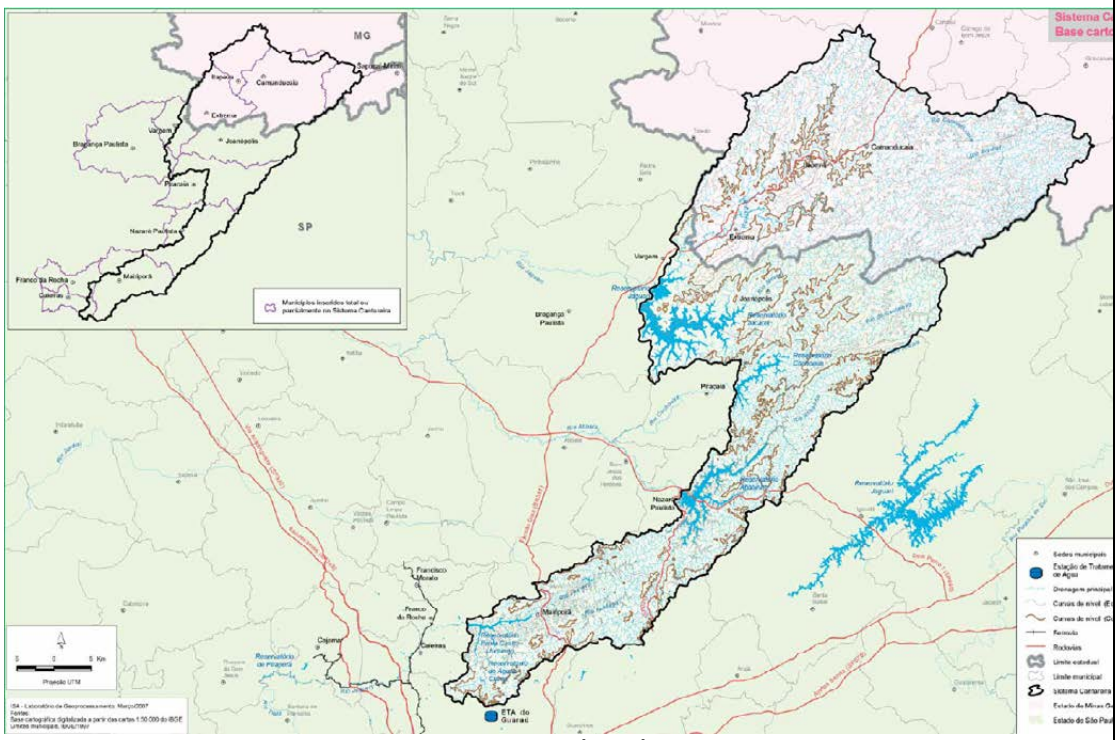
In São Paulo State, we have found great potential in the Cantareira System Region (see textbox 1), which is the region selected on our fine grain analysis. The region has two demonstrative projects that have shown the region difficulties and needs. Also, the Environmental State Agency, the watershed committee and Sabesp (System's Water Company) recognized the potential role of PES as important tool for restoring and maintenance of forest cover.

There is a lack of studies of impact evaluation and effectiveness of PES in Brazil. Most projects are accompanied by poor monitoring and the results are commonly evaluated only based on a few or even single indicator. Despite of this, the environmental effectiveness could be enhanced by a detailed prioritization, as foreseen in the law. The instrument could stimulate the fragments connectivity and formation of biodiversity corridors by selecting areas with most potential effectiveness regarding biodiversity. Also, the prioritization of landowners that are located upstream could have more benefits for water production.

Box 1: The Cantareira System Region is responsible for providing about 50% of the water consumed by the São Paulo Metropolitan Region (RMSP, in Portuguese acronym). Moreover, it is one of the largest systems to produce water in the world, producing 33,000 liter of water per second in an area of approximately 228,000 hectares (incorporating five watersheds). It encompasses 12 municipalities (four of them in the State of Minas Gerais) and the majority of the water produced comes from Piracicaba River Basin which is carried to the Alto Tietê watershed. Figure 8 shows a map of Cantareira Region.

It is clear and large recognized that the main ecosystem services threatened in the region are water related services and there is some evidence about the positive role played by forest coverage in providing those services. That is why our fine grain analysis for this region will mainly focus on instruments that can potentially preserve remnants an/or encourage reforestation. In Cantareira Region the deforestation was been historically caused mainly by urbanization and real estate speculation due to the proximity to RMSP and to the beauty of landscape, respectively. If policies or policymixes aimed at preserving the forest remnants in the region are no taken seriously, the Cantareira System will be at risk of suffering from over pollution due to disorderly occupation of the watersheds that form it. Also, the production of water is seriously affected by the land use and agricultural practices upstream.

Figure 8 - The Cantareira Region



Source: ISA (2006)

Cost efficiency of PES programs highly depends on opportunity and administrative costs. The opportunity costs are mainly affected by the alternative agricultural use. As Cantareira System Region has mainly a sloped landscape, the agricultural practices are quite different of the dominant model seen in the rest of the State (mainly extensive sugarcane plantation). This results in an

expected low opportunity cost region with a clear defined ES (water provision). Engel et al. (2008) recognize that the most efficient PES programs are those where the buyers are the final users of the service. The region seemingly has low likelihood of new deforestation areas and its great challenge is to create incentives to recover the priority areas. The main difficult could be the reforestation costs, which are in general high.

Generally speaking, distributive impacts and legitimacy are not fully taken into account as PES initiatives in Brazil have been mainly focused in environmental potential. However, the instrument could be part of a strategy of rural development, bundled in other policies. The agricultural of region is traditionally familiar, which could gain more economic benefits if they would be target of a sectorial policy PES. Also, there is a claim of more participative and legitimacy. The methodology presented in our fine grain analysis aims to fulfill this gap.

Regarding to institutional context it is necessary to know the incentives that are perceived by landowners. In Brazil we have faced several changing in the rules and institutions regarding to environmental law. The governance is extremely required to frame and enforce it. Also, we must identify if those institutions are compatible whit the targeting of ecosystem services provision and how the providers will deal with these new way of using the land.

Usually the nature conservation in Brazil has been seen as an onus from landowners' perspective. The recognition of the bonus of conservation (i.e. valuation of ecosystem services) by society is a step to justify a PES policy. The establishment of PES laws in São Paulo and related policies could be a step for strengthening the institutions involved in the Atlantic Forest conservation as well. PES (and TDR also) has a good potential as a tool of sharing costs with the beneficiaries in general.

There is great amount of areas that must be reforested to fulfill the law requirements. The debate around the Forest Code is still open and one main question refers to the needs of recovering these areas. Within this, one concerning issue is in what extent the landowners would be obligated to recover and what would be the role of state.

5.2 PES National Policy

Despite various initiatives have been resulted in some public policy, mobilized various actors and fostered a positive agenda in relation to the PES, there is still legal insecurity about no-standardization and the lack of specific legal at national level. This uncertainty can result in a barrier for extending the range of PES designs, thus being necessary the urgent creation of legal and institutional framework for the different agents. The integration of multi-level policy could be a good step for the improvement of PES.

The proposed National PES Law (Bill 792/2007) establishes the National Policy of Ecosystem Services (PNPSA) and proposes the Federal Payment for Ecosystem Services, also setting out the general lines of control and funding. Under the proposal, the program will use resources from a federal fund created by the government to pay for conservation initiatives and environmental restoration.

This Policy aims to regulate the activities of the Government related to environmental and ecosystem services, in order to promote sustainable development and increase the provision of such services nationwide. The decree also specifies which services are adherents to the program (provision, support, regulation and cultural) in order to pay for maintenance, restoration and improvement of ecosystems that generate such services.

It was proposed originally by division into three schemes: Forestry, Private Reserves and water-related. The Forestry program aimed forest management actions for payment to the peoples and traditional communities, with reforestation of degraded areas, conservation and development of priority areas and ecological corridors. The RPPN program aims to encourage the creation of protected areas in a similar way to São Paulo policy. The water program has focus on watersheds with low water availability and vegetation cover deficit.

5.3 Tradable development rights (TDR)

Considering the direct regulation that the Forest Code requires, one important role to be played by an instrument is to provide some mechanism of flexibility in order to make possible the achievement of the conservation target and objectives.

One of the options for compliance proposed by the Forest Code is the compensation in another rural property. The landowner which has deforested more than allowed by law can compensate its deficit in another property which has more natural vegetation than required, working as a Tradable Development Rights (TDR).

Although TDR has been present in the Brazilian policy mix for conservation for more than 10 years it still has a very low implementation all over the country. Bernardo (2010) verified that at least in 11 states there was the option to participate in TDR according to the legislation, although some of them it is not possible in fact. In addition, even in the States where the trade exists, the implementation is very low: the rate of the properties with Forest Reserves (FR) compensated by TDR represented 7 to 9% of the registered properties (which are 1 to 4% of total properties).

The TDR in the Forest Code aims to reduce the compliance costs to the targets of FR defined by the Forest Code to private properties and also remunerates the landowners which have natural vegetation in its rural properties above the target. Thereby it is possible to address heterogeneities in the agricultural suitability and in the opportunity costs of conservation of the properties and at the same time it ensures the minimum target required to the biodiversity and ecosystem services conservation.

The potential of the TDR as a market-based instrument to contribute in a policy mix of biodiversity conservation has been recently assessed and recommended by many studies (Santos et al., 2011; Bovarnick et al., 2010a; Eftec et al., 2010). What regards the use of TDR in Brazil some studies are more general in a national context (Madsen et al., 2010; Bovarnick et al., 2010b; Eftec et al., 2010-appendix, Sparovek, 2011) and some focused on simulation of the instrument in local level (Chomitz, 2004a and 2004b; Hercowitz, 2009).

The instrument is not a separate policy that was incorporated to the policy mix, but rather is an incentive that was included inside the direct regulation instrument during its historical process of development. The first time it appeared in the Forest Code was in 1998[15], in one of the Provisional Executive Order reedited between 1998 and 2001.

Although there is no legal instrument dedicated to regulate the TDR, it has some defined criteria included in the Forest Code law:

[15] Provisional Executive Order nº 1.605-30/1998.

- The possibility to compensate the FR in another property is only allowed for compliance purposes and only for those landowners who deforested more than allowed before the year of 2008. Thus, it is not a regular offset because the landowner cannot deforest and then offset, it is only valid for past deforestations. This part creates the demand of the market;

- A landowner can voluntarily resign, permanent or temporary, to its right to exploit the surplus of native vegetation and offer such an area in excess of other landowners, being contemplated with exemption of the ITR (the Brazilian land tax). This surplus, for purposes of compensation must be annotated in the registration of the property as servitude forest. This part creates the supply;

- The areas used for compensation must have equivalent extension and ecological importance, must be located in the same micro-watershed and be part of the same ecosystem. On the impossibility of compensating in the same micro-watershed, may be accepted the compensation in areas located in the same watershed, observing the criteria of as much proximity as possible between the property FR and the area chosen for compensation complied with, if any, Watershed Plan;

Recognizing the cases where there are lack of supply of FR for compensation, the law allows that areas with degraded vegetation to be used, but ties the acceptance of the compensation to the previous recovering of the area.

The instrument can improve the biodiversity **conservation effectiveness** with the incentives to concentrate restoration efforts and promote connectivity between fragments, since it will allow the forest reserve to be placed where it is more relevant for biodiversity conservation. It also allows landscape planning through the consolidation of agriculture activities in opened areas and increase the amount of forest area under law protection. Simulating a market in a national scale with less restriction than there is in the law (only restricted to the biome not watershed), Sparovek et al. (2011) found that the deficit of forest reserve on Atlantic Forest that today is around 9 million hectares would be reduced to zero. At the same time, it would ensure legal protection to 9 million of hectares of remnant forests that today have no legal protection. But, the demand that stimulates the TDR market is created by regulation of a cap on development or a minimum reserve requirement, and there should be a difference in the opportunity costs between the location seeking to purchase the TDR and the off-set site (Barton et al., 2011). The environmental protection of such a system lies in the cap (Vatn et al., 2011), so, if there is no enforcement, there is no cap, and there is no demand, but also there is no biodiversity conservation effectiveness.

The cost-effectiveness of the instrument is one of the most advantages cited by the literature. Some of the arguments Bernardo (2009) has found are:

- Good incentives for the preservation of forest remnants by increasing its value and reducing the opportunity cost of its maintenance;

- Enable revenues to reward landowners who have maintained native forest;

- Good economic alternative for both buyer and sellers;

- Allow revenue transferences to regions that have low agriculture suitability and large forest areas reducing social inequalities;

- Incentive forest coverage in areas with low agriculture suitability.

Regarding the last point, one should question whether the areas with low agriculture suitability are ecologically equivalent to those with high agricultural equivalence. Some studies showed that the agriculture feasibility is low in rich biodiversity areas. Gorenflo and Brando (2005) conducted a worldwide assessment in the hotspots and concluded that most of the land valuable or conservation has low suitability for crop production. The authors argued that in forested parts of the most biodiversity-rich regions in the world, maintaining natural habitat does not usually come at the expense of high agricultural production and stressed the importance of the planning to enable the coexistence of agriculture and biodiversity without compromising either. In a study in Mexico, Brandon et al. (2005) found that the productive agricultural potential in many proposed areas for biodiversity conservation in Mexico is low. As the study was conducted in a developing country, such as Brazil, they claim that long term conservation will succeed only when species are protected in reserves networks that can meet species need while minimizing the opportunity costs of conservation for rural residents. Brandon et al. (2005) suggests that reserve selection that first incorporates biological criteria, and then supplements it with data on the rural sector, such as agricultural suitability, can help planners meet conservation goals without substantial conflict with current human settlement, land use, or future agricultural development. However, Gorenflo and Brandon (2005) acknowledge the need for more detailed local analyses in specific contexts. They highlighted the case of regions which have a very rich biodiversity with higher productivity, such as Brazilian Cerrado, where conservation success will require careful attention in rural land use planning.

IEA (2009) also stressed the positive benefits of the TDR: " In a hypothetic example, the advantages could be for both landowners: the one with a land with total suitability for agriculture could become compliant without the need to lose 20% of fertile area or to pay high restoration costs. The other landowner of a property in a mountain region could have revenue from the TDR and also promote alternative economic activities such as ecological tourism and carbon sequestration''.

Regarding the **distributive impacts and legitimacy** there is very little discussion in the literature. Some questions that remain open are mainly about how to ensure social fairness in the conservation requirements with differences in targets for the small rural properties without compromising the conservation effectiveness of the instrument. The Forest Code exempts the landowners who have properties smaller than 4 fiscal modules[16] to have Forest Reserve, since the 2012 alteration. But, the land owners which have properties bigger than that are splitting their properties I order to also skip the obligation (Avialli, 2011; Neves & Pitella Jr., 2011). Other issue that has to be better assessed is the potential of the small properties to participate in the TDR market, because by the law they are not required to keep a target of 20%, but all forest area that they have can be used in the TDR market, so they can be recompensed to keep forest stand.

Some of the main worries about the implementation of the TDR are related to the **institutional constraints**. Despite the potentially promising opportunities presented by the compensation mechanisms, Fearnside (2000) notes that Brazil faces considerable law enforcement and implementation problems to ensure that they are effective and do not lead to perverse outcomes. These problems include difficulties in regulation and monitoring of compensated areas and the lack of a single approved authority in each state to judge the merit of individual cases (Madsen, 2010).

The role of the government is also a point of attention since the use of market based instruments seems to carry with it expectations of a reduced role of the state compared to other instruments so-

[16] Fiscal module is a unit of land measurement used in Brazil, established by law in 1979. It is expressed in hectares and is variable, determined for each municipality. It corresponds to the minimum area required for a rural property that their exploitation is economically viable, and ranges from 5 to 110 hectares. In metropolitan areas, the rural module is generally much lower than in remote regions.

called “traditional” or “command-and-control” instruments, which are characterized as “regulatory”. The state is nevertheless the central actor in the design and implementation of public policy towards a predefined objective (including regulation of the development cap), which can be expressed through “materially identifiable practices”, such as monitoring, construction work, the maintenance of infrastructures or the allocation of subsidies, or “more immaterial practices”, such as institutional communication campaigns, speeches, and the spreading of norms and cognitive frameworks (Broughton & Pirardi, 2011).

The role of the State as a regulator and to ensuring the enforcement is crucial for a good design and implementation of a TDR scheme. As showed in the Eftec et al. (2010) study, it is essential that offset and habitat banking systems are developed hand in hand with appropriate regulations and the establishment of adequate administrative capacities as habitat banking is entirely the product of the regulations that establish it.

As seen, due to the very low implementation of the instrument, it can be considered more as a potential instrument than as an existing. Regarding the main challenges defined by the state environmental agency and the scientists, the TDR is a good instrument that could address both. The first one, to protect every small fragment of forest, can be reach with the creation of the market for forested areas. As in São Paulo there are very few remnants and a high rate of non-compliance that will make the forest areas become more valuable and will increase the chances of its protection. The second challenge, of increase recovery and connectivity, TDR could help reducing the total costs of the compliance and stimulates the recovering, since the land owner will be allowed to recover its deficit in other property, reducing opportunity costs.

5.4 Synthesis of the role of the proposed instruments

The state of São Paulo comprises many different challenges to be addressed regarding the conservation of biodiversity and ecosystem services. It reinforces the need for comprehensive analysis to be conducted in fine grain scale to find the best instruments for each context. Besides, most of the conservation policies exist at state or federal level, so it requires that the environmental agencies in these two levels be aware of the different impact of the instruments according to the region. The next table (Table 6) is an attempt summary analysis of the performance of the selected instruments (PES and TDR) for biodiversity conservation in the defined context, using the framework proposed by Schröter-Schlaack & Ring (2011).

Table 6 - Hypothesized performance of selected single instruments for biodiversity conservation in São Paulo

Instrument	PES at Cantareira region	TDR
Ecosystem services provided, characteristics and beneficiaries	Water provision for at least 8 million inhabitants - very crucial. Also the maintenance the sustainability of Atlantic Forest and its related biodiversity and services - Very diffuse beneficiaries	Maintenance the sustainability of Atlantic Forest and its related biodiversity and services - Very diffuse beneficiaries
Main rural activities	Cattle raising, Silviculture, Potatos plantation	Sugar-cane, coffee, pastures
Goal	Compensate / Incentive landowners to keep natural vegetation to ensure water provision (quality and quantity)	Reduce the costs of compliance with FR and increase connectivity
Actor addressed	Private (land users) and public (	Private (land users) and public (regulators)
Baseline and policy context	Land-use practices without incentives by PES schemes	No compliance and high compliance costs
Conservation effectiveness	Low to high – depending on instrument design regarding baseline, and additionally, leakage, permanence and participation	High – at least will ensure compliance and avoid natural vegetation of being legally deforest, and can also improve connectivity
Associated costs and proxies for cost-effectiveness	Medium to high – find funding sources, establishing arrangements with landowners and monitoring costs	High, transaction costs may be high in the implementation of monitoring systems and structuring of the enforcement
Social impacts	Medium – High – usually the projects are focused in small properties and also provide technical assistance for other activities	Medium - High – may allow revenue for low income small properties, especially those in low agriculture suitability areas
Legal and institutional requirements	Medium to high – definition and enforcement of property rights key for programme success, more effective programmes require high up-front costs for baseline setting, negotiations, fund- and awareness raising	High – strong public sector involvement necessary in standard setting and monitoring of mitigation measures, high up-front investment for trading architecture

Source: Produced with data from the study using the framework adapted from Schröter-Schlaack & Ring (2011)

6 Interactions of economic instruments and the policymix (synthesis of Step 2assement)

In the chapters 3 and 4 we provided a description of the functional role of some existing and proposed policy instruments. However, besides their individuals' roles it is essential to assess how the interactions between those instruments are (POLICYMIX Project's main objective).

This chapter aims to evaluate the functional roles and interactions of the policy instruments described before. Our evaluation is superficial because we assessed functional roles and interactions for general types of land use types/stakeholders, not accounting for local/regional differences due to coarse grain.

We used a qualitative approach and results from available studies, trying to point out obvious complementarities/synergies/overlaps, etc. based on instrument design issues.

It is worth mentioning that we attempted to consider only the direct interactions. All of them interact indirectly more or less intensively as they are all policy instruments for conservation. For the proposed instruments, PES and TDR we assessed potential interactions based on their expected roles and objectives. Table 7 summarizes our results and it is followed by a brief description of each interaction.

Table 7 – Hypothesized interactions between existing and potential policy instrumentsat state level

	Forest Code	Environmental crimes law	Atlantic forest law	SNUC	ICMS-E	PES	TDR
Forest Code		**i +**	**I**	**n.i.**	**n.i.**	**i +**	**i +**
Environmental crimes law			**i +**	**i +**	**n.i.**	**n.i.**	**n.i.**
Atlantic forest law				**n.i.**	**n.i.**	**n.i.**	**n.i.**
SNUC					**i +**	**i +**	**i +**
ICMS-E						**n.i.**	**n.i.**
PES							**i +**
TDR							

i = interact / + = interact complementing / n.i. = do not interact

The interaction of the Forest Code law and the Atlantic Forest Law (AFL) is complementary, since the AFL addresses one specific biome and the Forest Code is for all of them. The AFL brings more detailed guidelines about conservation and management of the Atlantic Forest, and has a strong focus on recovering rules and secondary vegetation. There are controversies in this last point (mentioned in the chapter 3) regarding the possibility of reducing protection for secondary vegetation.

The Forest Code mainly regulates conservation in private areas, whereas the SNUC focus in the regulation of public protected areas. However, there is one category of protected area that is the Private Nature Reserve (RPPN), which is voluntarily created by land owners in private areas. Once created the RPPN usually overlaps with the Forest Reserve of the rural property and has to follow both regulations, the Forest Code and the SNUC.

Besides this interaction, the recently approved legislation of PES in RPPN in the State of São Paulo also establishes interaction between these two instruments. In this case, the PES complements the SNUC providing incentives for private land owners to establish RPPNs and reduces the costs for maintenance. PES could also potentially interact with SNUC in a complementary way. Some studies show that instruments which remunerate the provision of ecosystem services by protected areas could be good mechanisms of source of financing for the maintenance of such areas (see Andrade et al., 2010 for a purpose of financing by REDD).

The potential complementary role of TDR and PES with the Forest Code was already assessed in the Chapter 4. Also, it will be object of a detailed assessment in the fine grain analysis, described in Chapter 6. Both instruments aim to offer incentives for compliance to the Forest Code. One could evaluate their role as redundant, as they are incentivizing the compliance of a legal obligation, maintenance and recovering of APP and Forest Reserve. However, as explained before, the historical path of the Forest Code has been very confused, with many changes of targets and perverse incentives. All of this resulted in a current high rate of non-compliance and high costs for compliance that justifies incentives the complementary role of instruments such as PES and TDR.

The Environmental Crimes Law (ECL), as mentioned, establishes penalties for environmental crimes and addresses administrative violations, so it interacts positively complementing the Forest Code, the Atlantic Forest Law (AFL) and the National System of Protected Areas (SNUC).

The instrument ICMS-E has, by definition, the role of compensating the municipalities which have protected areas. Also, the criteria for the compensation amount to be received is the size of the protected area and the level of protection, defined by the category of SNUC. So, both instruments interact in a complementary way, where the ICMS-E works as a financial incentive/compensation for the protected areas.

The public protected areas in Brazil have a particularity that many of them are enacted and not all the land owners are compensated financially by the government. So, the regulation of TDR allows those land owners to use the lands that have not been compensated to offset the Forest Reserve of another property. This mechanism is still not regulated and is another potential role of the TDR that needs more studies to subsidy a better regulatory framework design. This potential mechanism stresses the need for taking into account the interaction between TDR and SNUC.

The two proposed instruments, PES and TDR, could be overlapped in the same area. The interaction could reinforce the role of the instruments, since both aims to bring incentives for conservation of natural areas. But their role are not redundant as it may seem at first. TDR is more focused on the target achievement of a biome area under protection whereas PES is more focused on remunerating the provision of a defined ecosystem service. The first one has a wider scope, state level, and seeks to create a market that guarantees the self financing by land owners as sellers and buyers. PES usually requires a more focused approach and, as mentioned in the Chapter 4, the sources of financing and economic sustainability of the instrument is one of the main issues for its implementation.

As seen, our evaluation did not find any relevant contradictions or perverse incentives. One reason is that we focus our interaction assessment on the policy instruments described before, which have conservation objectives, so they are more complementary in general.

7 Impact evaluation (Step 3b) – fine grain analysis[17]

This chapter provides a more detailed description of Mata Atlântica case study in the fine grain level, to be conducted in the Sate of São Paulo (Brazil). Here we seek to complement our analysis started in chapter 4, scoping research questions to be addressed in the next phase of the project. We also try to link our methodological procedures to the POLICYMIX framework developed in the first phase of the project (methodological guidelines developed within WP3-WP6). Moreover, in section 6.15 we will describe the methodological procedures to be adopted in order to apply a multicriteria analysis, which is considered by FUNDAG's team as an "umbrella methodology" that somehow addresses the criteria elected by POLICYMIX as relevant ones for evaluating environmental policies.

7.1 Payment for ecossystem services - the case of Cantareira System

Our fine grain analysis for this region will include an ex-post analysis of one pilot experience on PES in a small municipality of the Cantareira Region, covering eight cities in Sãoo Paulo and four in Minas Gerais. This is the case of Extrema (state of Minas Gerais) whose know how on conducting a PES scheme can be extremely valuable for assessing the possibility to replicate PES for the whole region. Thus a deeply study of Extrema's PES will be a prerequisite for our fine grain analysis and this will be possible by field trips to be conducted between September and December 2012. FUNDAG's team has signed a partnership with the Institute of Ecological Research (IPE), an NGO with an extensive experience in working on that region. Moreover, FUNDAG's team has a master student (Bruno P. Puga) and a PhD student (Oscar Sarcinelli) whose thesis/dissertation in progress will be inputs for this case.

In a nutshell the main research questions for our fine grain analysis in the Cantareira Region will be as follow:

- *1. Is it possible to scale up pilot PES experiences such as Extrema's case for the whole area of Cantareira region? If yes, what would be the necessary changes to make it work properly?*
- *2. Is a PES scheme a suitable and cost-effective instrument for the region? In another words, is a PES scheme a good instrument capable to meet the needs in terms of enhancing water-related ecosystem services?*
- *3. How would a PES scheme for Cantareira System interact with preexisting instruments (regulatory mainly)? How would a productive and effective policymix for the region look like?*
- *4. Does the region's population have willingness to accept a proposal for PES as a good way to balance their economic, social and environmental needs? Is a PES scheme capable to deliver fairness and legitimacy?*

[17] We did not perform any impact evaluation of existing instruments so that step 3a of POLICYMIX's framework is not included in our report.

7.1.1 Conservation effectiveness (WP3)

In terms of conservation effectiveness (related to POLICYMIX WP3 draft guidelines), the fine grain analysis for the Cantareira Region will use as main input all material and knowledge produced by BIOTA Program, supported by the funding agency of the São Paulo State (FAPESP). However, it will be necessary to build a finer map for priority areas to be protected in Cantareira Region. Again, a partnership among FUNDAG, University of São Paulo, IPE, and other state agencies was signed and researchers from those institutions will be responsible for producing such a map.

FUNDAG's team will benefit from the accumulated experience by the group of natural scientists (ecologists/biologists) involved in this fine grain analysis through the partnership mentioned above. At the moment of this writing some members of FUNDAG's team are checking data availability using data sources in São Paulo state and NGOs such IPE.

We are planning to build two scenarios for the recovery of priority areas in Cantareira system. The first scenario is related only to the recovery of APPs in accordance with legislation (Forestry Code). The second would include, in addition to APPs, the recovery of other areas to achieve the target of 20%. The allocation of areas of recovery in the latter scenario is based on parameters of landscape ecology, emphasizing the connection of existing forest fragments, creating biodiversity corridors.

In order to have an estimate of the provision of ecosystem services related to water provision in the Cantareira Region, we will use data on the degradation of riparian vegetation as surrogate indicator. This will be obtained by the following steps (summary provided in figure 9):

- Step 1: to build the stream map and calculate the riparian areas (buffer) plus other types of APP;
- Step 2: to build the land-use map;
- Step 3: overlay the first and second maps which would generate the scenario about current status of APP areas;

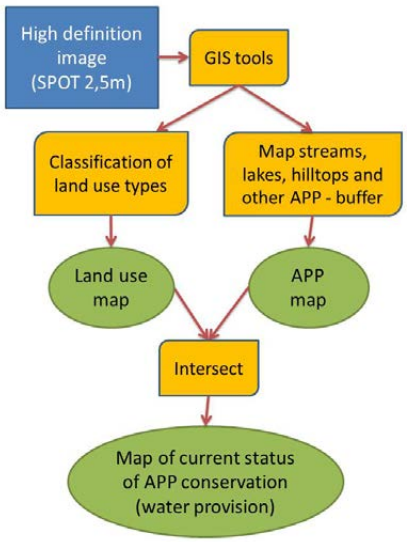


Figure 9 –framework of PES regarding conservation effectiveness

7.1.2 Cost-effectiveness and benefits (WP4)

After building the two scenarios about priority areas it will be necessary to know the opportunity costs involved in the land-use changes. We are planning to obtain an estimative for this opportunity cost using data derived from secondary sources (income generated by each cultivation provided by IEA and production costs). Combining this analysis with the land-use map we will have the opportunity cost for each restoration scenario defined above. This procedure will raise the following question: *is a PES instrument that remunerates only the opportunity cost efficient?* The approach to be used for answering this question is still under discussion. Figure 10 summarizes our planned activities for assessing cost-effectiveness and benefits.

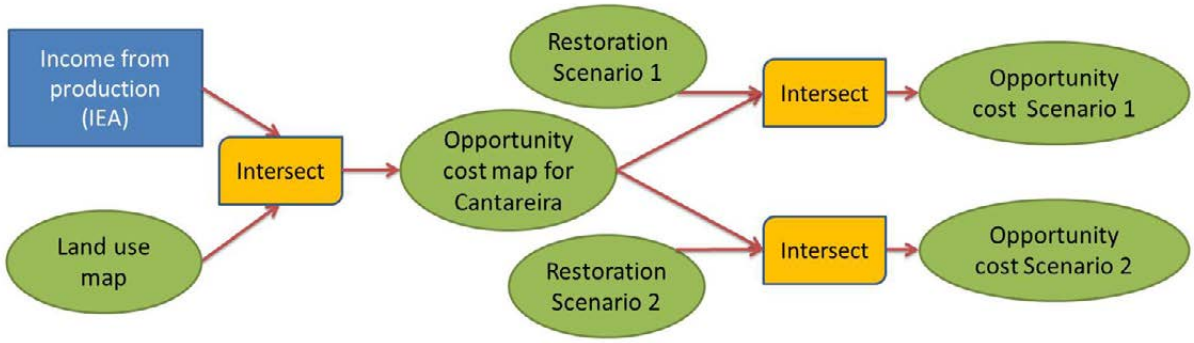


Figure 10 – Framework for PES analysis regarding cost-effectiveness and benefits

Another issue of our analysis is the assessment of transaction and set up costs. Both of them will be analyzed based on pilot PES experiences in the region (Extrema's case mainly).

7.1.3 Distributive impacts and legitimacy (WP5)

One of the requirements in designing conservation policies is to address fairness, justice and legitimacy. In order to take this into account our analysis will face the challenge to target different approaches for different stakeholders. This is will be possible through the design of a farmers typology, which will be done by the use of multivariate statistics techniques (factor analysis and cluster analysis). For this we will use a data source called LUPA to get variables that depicts economic, social, and technical aspects regarding the farmers.

This procedure will be performed in collaboration with the Brazilian Agricultural Research Office (EMBRAPA). The results to be obtained can potentially be used as input to the multicriteria analysis (see section 6.1.5).

7.1.4 Institutional options and constraints (WP6)

We have assumed that understanding Extrema's pilot case is vital to answer the first question stated in WP6 guidelines: "how have existing institutions contributed to the design and implementation of current policy instrument(s) and instrument mixes?". Basically this will be done by interviewing stakeholders (specially the policymakers and farmers).

Based on the Extrema's case two other questions will be raised: i. how would the current institutions and instruments shape the introduction of PES on Cantareira Region? The draft guidelines produced by WP6 will be used as our main source.

7.1.5 The application of MACTBETH in the Cantareira Region

The Cantareira System supplies water for around 55% of the Metropolitan Region of São Paulo and provides one of the best water on the planet, with quality standards higher than those required by the World Health Organization (WHO). This system is one of the largest water producers systems in the world. The six dams that make up the complex are at different levels and are linked by 48 km of tunnels to benefit from the slopes and the accumulation of water by gravity (source: http://daescs.sp.gov.br/index.asp?dados = teach & teaching cantatrice =).

We must clarify that the stakeholders who are mobilizing to find solutions to problems related to the headwaters of the Cantareira System are representatives of public interests, ie, municipalities, NGOs, government research institutes. We still have to figure out what the stakeholders representatives of private interests that operate at the head of this system. Once they are indicated, they will be consulted so that the same process that will be described below, involving stakeholders representing the public interests identified to date, which are:

• NGOs - IPE (Institute for Ecological Research), TNC (The Nature Conservancy), Third Way.

• universities and research institutes of government - IAC (Agronomic Institute of Campinas), USP - Universidade de São Paulo (ESALQ, LEPAC), UNICAMP - University of Campinas (Institute of Economics).

• Municipalities - Extrema, Piracaia, Joanópolis, Itapeva, Nazaré Paulista, Braganca Paulista.

• State Agencies - Houses of Agriculture, Department of Environment of the State of São Paulo, EMATER regional Camanducaia.

• Representatives of the Technical Committee of the Rural Watershed Piracicaba, Capivari Jundiaí (PCJ).

• SABESP.

There is recognition on the part of those stakeholders that there is a problem to be solved, however, they have difficulties in identifying what are the goals to be achieved in order to achieve success, nor which priority actions that must be taken. It is ill-defined problem (Keeney, 1992) and in this case it is necessary to assist stakeholders to better understand their problem, identify what are the values they consider important, turns them into goals and goals differentiate between means and fundamental objectives .

Despite this difficulty, each of the identified stakeholders have an understanding of the problems that occur in the headwaters of the system Cantareira and from that individual understanding, through a conference decision (Philips, 2007), will build a shared understanding with stakeholders that will participate in the process of socio-technical MACBETH multicriteria decision support. These stakeholders aforementioned will choose their representatives who will participate in that process.

This new understanding will help identify what is the problem to be solved, which are the most important values shared by stakeholders, values which are expressed in the fundamental objectives (criteria) and their respective descriptors impacts. More details can be found in Bana e Costa & Beinat (2005).

After the goals have been identified, we can identify new policy instruments that can be used to help achieve the fundamental objectives. At this stage it may be necessary to perform AIDA (Analysis of Interconnected Decision Areas) (Friend & Hickling, 2005), aimed at identifying which policy instruments are complementary.

The socio-technical process MACBETH allows identifying new alternatives (policy instruments) because it is based on the structuring of the problem focuses on reasoning focused on values (value focused thinking - Keeney, 1992) which is a constructivist approach that allows decision makers to increase understanding about their problem in order to find the best solutions[18]. Readers interested in expanding their knowledge of multicriteria method of decision support (MCDA - Multiple Criteria Decision Analysis or MCA) mainly on creating alternatives should consult Keeney (1992), Gregory (2012). Details on socio-technical process MACBETH are presented in BANA and COSTA et al. (2012).

Once identified such instruments is possible to evaluate policies the impact of each of them, further including PSA, TDR and other instruments listed in Table 7, in order to choose which of them is the most suitable, or which complement with each otherThe meaning of assessment in this context is to judge in what extent an instrument contributes to reach levels more preferable (more attractive) on a given criterion. The evaluation is done by means of functions values(Kirkwood, 1997; Belton & Stewart, 2001), which will be calculated using the M-MACBETH software (www.m-macbeth.com). Details of the calculation of functions values, and the calculation of weights that are used in additive multicriteria function using the M-software MACBETH can be found in Bana e Costa et al. (2012).

Performance evaluation of an alternative against each criterion can be done individually or in groups, in this case via conference decision with stakeholders involved in socio-technical proccess.

Furthermore, the evaluation phase of the alternatives is performed with the M-MACBETH software, whose operation is friendly to the end user, has a solid theoretical consistency, helps decision makers to calculate the weights of the multicriteria additive model avoiding the most common critical error (Keeney , 1992, p. 147).

As mentioned at the beginning of this section, the aim is also to identify the stakeholders representatives of private interests, farmers, etc., operating in the headwaters of Cantareira System. We have plans to apply the same procedures involving socio-technical MACBETH so that they can evaluate the policy instruments initially identified by stakeholders representing the public.

7.2 Tradable development rights

In the recent approved Forest Code, the trade of the forest reserve credits is restricted in the same biome and State. In the case of São Paulo there are two biomes (Cerrado and Atlantic Forest). However, one can offset out of the state (but in the same biome) if it chooses a priority area for conservation defined by the state or by the federal government. So, all analysis that aims to simulate the allocation and conservation goals in a TDR scheme get more difficult and require wider approaches. As the efficiency and efficacy of this instrument is mainly dependent on the scope of the market, the wider we analyses the market better we know how it will work. So, we will assess the

[18] We highly recommend those interested in expanding their knowledge of multicriteria method of decision support (MCDA - Multiple Criteria Decision Analysis or MCA) to consult Keeney (1992), Gregory (2012). Details on socio-technical process MACBETH are presented in BANA e COSTA et al. (2012)

role of the TDR in a State level, even though we lose the refinement of the results. In the following sections we point our main research questions and describe the proposed methodology of analysis.

7.2.1 Research question 1 (WP3)

- *How far are the rural properties in SP from the biodiversity target set by the forest code regarding Forest Reserve?*

Methodology: We will use the agricultural census data (LUPA) to get the area of forest in each rural property. After, we will calculate the amount of deficit or surplus of forest reserve according to the Forest Code requirements (20% in São Paulo). The unit of the analysis will be the unit of production (UPA), a smaller level than the rural property, which is the data level of LUPA. The results will not be spatially explicit, since the spatial data of each UPA is limited to only one GPS coordinate. In order to have an estimative of the surplus or deficits location, the data will be aggregated in a micro watershed level (22 watersheds in São Paulo). Figure 11

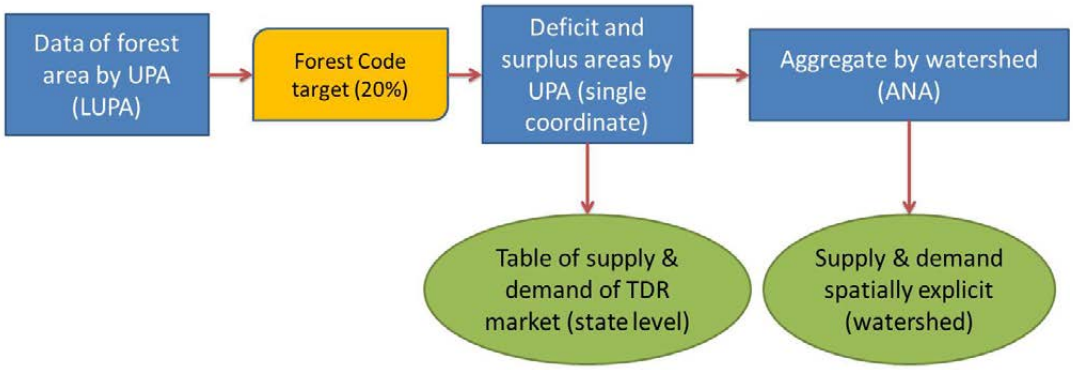


Figure 11 – Framework of TDR analysis regarding conservation effectiveness

7.2.2 Research question 2 (WP3/WP4):

- *For a given conservation target (e.g. 20% reserve of each biome) what are the differences in the biodiversity conservation expected results (connectivity indexes) considering three scopes of scenarios allocation of forest reserves allocation? What are the differences in the costs of each scenario?*

Methodology: Based on UPA database we will assess the land use (types of cultivations and crops) and estimate the opportunity costs using the average net return to each crop production. This will result in a map of opportunity cost in a UPA level. In this map we will remove the actual forest cover of São Paulo and then run Marxan to simulate the allocation of forest reserve deficit by the market selecting the areas with lower opportunity costs. This will be based on areas with the greatest opportunity cost differentials, in three different scenarios of market scope:

- State level – only restricted by the biome;
- Only in the same watershed and biome;
- Only in priority areas for conservation (BIOTA – eight classes of priority) and biome.

Due to difficulties in making the land use data spatially explicit, other possibility is to run a correlation between GIS land use type and their crop production data. It can give a probability

distribution for crop productivity for each land use type, agricultural suitability class and land use capacity class, and property size. Then we can extrapolate this data to the study area. Using this strategy we will not have precise data on agricultural opportunity costs of specific locations, but rather a probability distribution (or a mean with variance) that could be used (see figure 12).

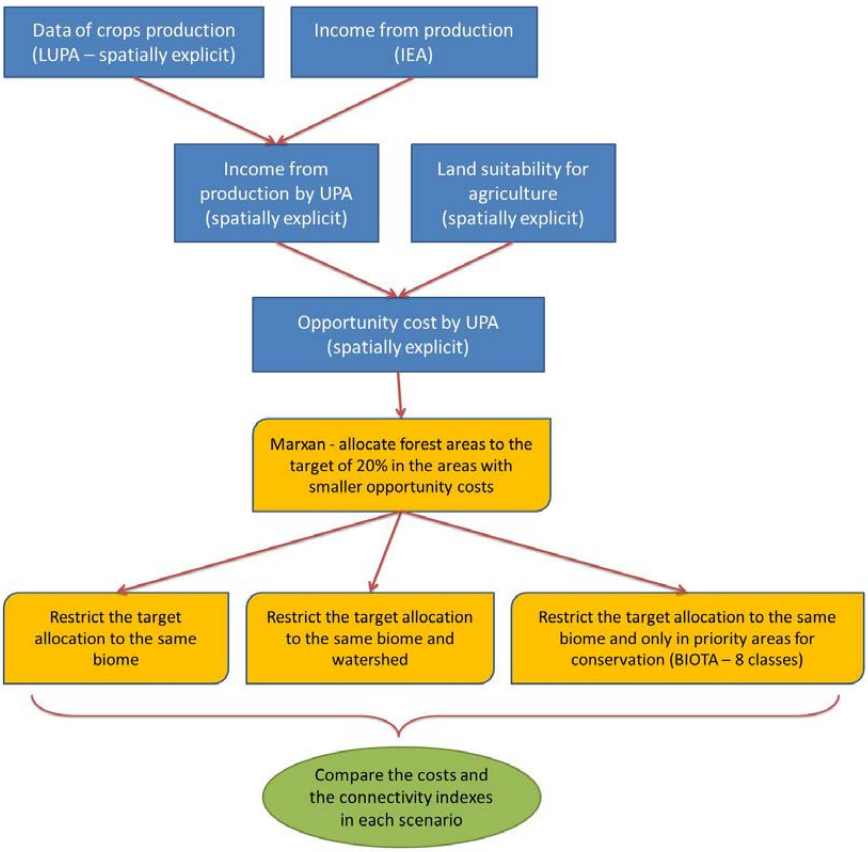


Figure 12 - Framework for TDR analysis regarding cost-effectiveness and benefits

7.2.3 Research question 3 (WP5)

- *How is the potential participation of small farmers in the TDR market?*

Methodology: Small farmers (which have areas smaller than 4 fiscal modules) are exempt from having forest reserve, but are allowed to participate in the market. In this case all the forest area in those properties is considered a surplus and could be sold. In our main database (LUPA) we cannot perform any analysis regarding property size because the unit of the data is the unit of production, not the property. Thus, one big farm could be formed by many small UPAs. So, for this analysis we propose to use the data from IBGE (Brazilian Institute of Geography and Statistics), which is not spatially explicit and only have aggregated values, but differentiates the size of the properties. We will assess the number of properties smaller than 4 fiscal modules in the State of São Paulo and the area of forest they have. Further discussion will be developed based on the results obtained.

7.2.4 Research question 4 (WP4/WP6)

- *Is a TDR market limited to São Paulo state large enough for TDR trades to be profitable for 3rd party financial institutions?*

Methodology: Our analysis will focus on discussing the financial feasibility of a TDR market given the trade-offs between spatial size of the market and the transaction costs. The distribution of opportunity cost differentials for different spatial extents of the market (research question 2) will show the maximum transaction costs that could be justified for establishing a TDR market. We expect to find that the larger the spatial market (allowing outside State trades in the same biome) the greater the arbitrage possibilities. However, the larger the market the higher the transaction costs (see Vatn et al., 2011 for a discussion of these trade-offs). We will discuss whether the differentials are large enough for each trade, relative to administration costs we would expect a financial institution to have.

8 Conclusions and recommendations

Both instruments assessed in this study (PES and TDR as proposed instruments) show a great potential as complementary instruments within the wider conservation policy mix in São Paulo and Brazil, which is strongly based in direct regulation and command and control. However, in the policy design and implementation issues analysis we could see many constraints that have to be addressed by policymakers and also receive more empirical studies on an ex-ante basis.

The State of São Paulo is a national, or maybe even world, example in the science contribution for policy design. Nonetheless the efforts towards a better policy design and implementation are still more focused on ecological issues, being necessary similar contributions on the economic and social sides. The coarse grain analysis undertaken allow the overall conclusion that although Brazilian authorities have been worried about Atlantic Forest preservation (the main example being the establishment of the Atlantic Forest Law, which recognizes it as a National Patrimony) the potential of economic instruments is not fully explored. Even it is foreseen by the Forest Code, the low rate of TDR adoption can be a prove of the previous statement. As for PES schemes we can point out two main considerations: i. the need to design PES in strategic areas where ecosystem services provision is highly relevant for the sustainability of economic activities as well as for human wellbeing. Cantareira Region is an example since the surrounding population is deeply dependent on the water services provided; ii. the necessity to offer a better and clearer institutional framework for PES implementation.

It is certain that Brazil is now going through a particular moment as the debate over the Forest Code revision is not completed. This may jeopardize attempts towards analyses aimed at assessing the role of economic instrument to the extent that the Forest Code and its desideratum surely provide the main guidance for any instrument to be applied. However it should not be used as an excuse for not devising new and better alternatives for the Atlantic Forest conservation. The fine grain analysis will tackle these issues and will provide important inputs for the Brazilian biodiversity conservation.

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