Master's Thesis

The cost-effectiveness of ICMS-E in Mato Grosso: A comparative analysis with Paraná.

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Acknowledgments

This Thesis handles mainly about life. Social Sciences have made great contributions to the humankind's self-understanding over its evolution. From my limited condition as a mere observer, I believe that I have learned a bit of what the value of life means, not just for the present, but for the future generations. Therefore, I could never forget to mention the two greatest lessons about how the journey of life can be awe-inspiring. For that, I thank my Mother, tenderly called as Dorinha, who taught me the importance of sharing and the intrinsic power that emanates from both equality and mutual respect, especially towards those unprotected; I also wish to thank my Father, Cosme, the most enthusiastic supporter of my endeavors, from whom I've learned much of what I know about the value of nature. For me, those are unspoken lessons that will always rest in my heart: *"vou estar sempre perto de vocês…"*

I take the advantage to recognize, hereby, the greatness of the efforts promoted by Professor Geir Asheim in pushing the boundaries of the Sustainable Development studies even further. Moreover, I also take this opportunity to thank my Supervisor, David Barton, not just for his motivating and demanding guidance, but also for the support that he has deposited in my work. At last, but not least, I'd like to specially acknowledge, possibly, two of the brightest minds that I have ever encountered in the "Economics Avenue":

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Summary

1. What is the policy problem that gives rise to this study?

The problem that has originated this research is to identify aspects of this REDD strategy that may provide an assessment of whether this fiscal policy is either efficient, effective or both. The Ecological ICMS is a Brazilian environmental policy implemented in a state level. Thus, the financial outcome of this program relies within the limitations of the state budget in order to earmark payments to compensate for environmental restrictions. The higher is the cost of land, the bigger is the challenge to compensate the municipalities for their services. Therefore, the central concern of the research is to determine whether we can see a welfare gain in those communities recieveing ICMS-E versus municipalities not recieving ICMS-E. The evidences of welfare improvement can be expressed in various forms such as: maintenance of land coverage, reduction of forest degradation, more intact original vegetation, increment of local revenue, increased input and output of public spending that counter-weights forest depletion, improvement of social services and correlated factors, external effects that reward the effort of protecting the local biodiversity, evidences of improvement in the social indicators, etc. As an example, the literature has discussed that better educated population, in regions with higher GDP per capta, tend to protect more the environment. Thus, within this context, it's necessary to understand the performance of the municipal schools, where the local budget is accountable for both the receipt and spending of the fiscal transfer. This is a central premise as we shall deal with public investment as to the 141 municipalities to be studied. Obliviously, the spatial distribution of resources is an important factor; making one region poorer, as a result of another become wealthier, due to reallocation of a fixed budget, possibly implies in a non-beneficial offsetting; an outcome that may even push regional inequality further, which is considered a federal challenge in Brazil. Closing access to public areas needs, therefore, to be considered as an investment.

2.What are the specific research questions in this regard?

a) History of ICMS-E impacts

(i) What have been the measurable conservation effects of ICMS-E in Mato Grosso as compared to Paraná? (ii) Have areas of preservation increased with the incentives? (iii) Has the income generated with ICMS-E decreased as new municipalities joined the programme?

b) Legal basis for ICMS-E

(iv) What is the legislation regulating ICMS-E implementation by the state at local level in Mato Grosso and Paraná?

c) Opportunity costs and Welfare

(v) Are the discrepancies in the opportunity cost of land use (qualitative discussion) a significant factor on the relative success of ICMS-E at the municipality level? (vi) Has the ICMS-E improved the welfare in Mato Grosso? (vii) Have the ICMS-E payments impacted any municipality's quality of municipal educational provision (in this study, this is measured by the Prova Brasil index)? (viii) Is there any findings suggesting that the Ecological ICMS an efficient fiscal policy?

3.How does answering the questions contribute to the existing literature?

The findings of this thesis are expected to add more information around the economic strength of this ecological fiscal transfers in the Mato Grosso state. Previous research has criticized the effectiveness of the ecological ICMS. Nevertheless, we should never dismiss that the core contribution of the program itself is to protect local biodiversity through impediment of public entrance to those protected areas. Moreover, this research contributes to fill the information gaps found in the mosaic of the federal policy as to its financial outcomes; not only in quantitative terms but also in qualitative terms. Because the longest inter-temporal data (both as to Paraná, our benchmark state, and as to Mato Grosso) are relatively recent (between 10 to 20 years), much of the initial researches on the topic, specially beyond Paraná, had to deal with short time trajectories, lack of data, regional constrains and peculiarities and, in some cases, analysis based on empirical expectations.

4.What are the testable hypotheses?

This investigation, since the beginning, has worked with the hypothesis that the overall outcomes of the policy are indeed positive such as follows:

H1: The Ecological ICMS-E contributes to increase welfare levels in the communities that have joined the strategy.

H2: The fiscal transfer policy is not a "Jogo de Soma Zero" (Zero-Sum-Game), that is, the more participants enter the membership, less payment amounts are transferred to each municipality.

H3: The policy has a positive effect on the financing of public municipal schools as a concrete improvement of public service in a local level.

H4: The ICMS-E increased the number and the area of Conservation Unities as well as keeping local biodiversity intact by reducing deforestation levels.

H5: Regional economic growth has a positive impact on the financial results of the ICMS-E.

5.How is the hypotheses/ methodology tested?

The hypothesis above can be tested through quantitative and qualitative analysis. The qualitative analysis attempts to interpret the differences and analogies between the policy model in Paraná, where a "quality factor" has been implemented, and in Mato Grosso, where the conservation coefficient is established through the type and importance of the protected unities and their areas. This analysis is expected to provide insights about the commitment and obligations of the local municipalities. Furthermore, the quantitative analysis attempts to summarize and establish the relationship of significant statistical outcomes (i.g: increase of protected areas, evidences of efficient distributional impact, etc.). This is method is tested for hypothesis H1 and H2.

Hypothesis H4 and H5 are tested by the covariance of the factors disclosed with the data and are analyzed as to their trajectories, performances and correlations.

In addition, for hypothesis testing H3, an estimative OLS model, suggested in previous investigations, is tested in order to depict the dependence of influential determinants such as ICMS-E transfers, added-value tax revenue, local education improvement, etc.

6. What data has been collect to test the hypothesis?

Data has been collected from different institutional sources. There are mainly four types of raw data that have also contributed with further calculations: (i) The social-economic indicators have been acquired from the Brazilian Institute of Geography and Statistics, IBGE (Instituto Brasileiro de Geografia e Estatística) and the Brazilian Institute of Applied Economics Research, IPEA (Instituto de Pesquisa Econômica Aplicada). (ii) The statistics on deforestation is provided by the National Institute of Spatial Research, INPE (Instituto Nacional de Pesquisa Espacial) and available at the Mato Grosso's Department of Environement, SEMA-MT. (iii) The data as to the state level revenue and transfers paid to the municipalities is provided by Mato Grosso and Paraná State Departments of Finance and Environment, SEMA-MT, SEFAZ-MT, SEMA-PA and SEFAZ PA. (iv) The indicators of municipal school performances (Prova Brasil) has been provided by the Brazilian Ministry of Education and Culture, MEC (Ministério da Educacão e Cultura). Deforestation rates had to be manually calculated as secondary data. All statistics and data sets are publicly accessible at the websites of the institutions listed above and referred at the end of the study.

7. Results: Where have the hypotheses rejected with statistical significance?

Several empirical studies have rejected the hypothesis that the entry of new members could keep the level of municipal revenues at least constant. This finding has been clearly rejected in this study.

The municipal area is an important factor both in the ICMS-E revenue as well as in levels of absolute deforestation. But most importantly, the deforestation rate is lower in municipalities participating in the PES where their average territorial size is bigger. It means that deforestation is not necessarily a consequence of forest areas.

GDP per capta is, in average, lower in municipalities where deforestation is higher. This is also confirmed when we verify this trend by comparing the municipalities not participating in the program with the group of municipalities that are members. Under the limited scope of this study, this trend leads to an inefficient outcome. The poorer municipalities are also the ones loosing local biodiversity in a faster rate. Not to mention that they have their revenue share reduced once the state's budget has to compensate the municipalities that

have implemented the policy. Finally, the study also rejects the hypothesis that relative high economic activity is necessarily correlated with high levels of forest depletion.

8. What findings in the literature have been confirmed or rejected?

This study has confirmed positive outcomes found in previous investigations such as increase in the number and surface of Conservation Unities; Strong incentive for creation of municipal protected areas; Positive impact on municipal finances; Introduction of the environmental agenda in small towns. The Thesis rejects the finding that the benefit (payments) decreases as new entrants join the program. Higher GDP per capta as a driver of deforestation also rejects previous literature postulations.

9. What is the policy relevance of the findings?

The findings in this Thesis are expected to contribute with the Ecological ICMS's policy assessment in Mato Grosso in various ways. The work has focused on finding both quantifiable and qualitative arguments to support the performance of this REDD strategy in a region with strong biodiversity degradation due to industrial and agricultural stress. The results of this study respond to the questions that other investigations have not attacked in Mato Grosso, such as inter-temporal analysis of the revenue combined with deforestation outcomes and the significance of welfare improvements. In other words, the analysis was based on the question of whether it was worth to implement this mechanism in Mato Grosso as to its environmental, financial and social benefits.

10. What are the research questions for the future that come out of this study?

(i) Has the extra public financing, in local level, benefited the communities in terms of investment in environmental services?

(ii) How does the ICMS-E cause imbalances in the fiscal revenue distribution?

(iii) Have public services (e.g. healthcare, sanitation, water supply, conservation of protected areas, etc.), in a local level, improved with the ICMS-E implementation?

(iv) What's the relationship between ICMS-E and improvement of social indicators in the communities joining the program?

(v) How much of the local budgets are earmarked back into the local environmental policies?

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Introduction

Public Policies, the Effects of Forest Depletion and Climate Change: the big picture[1]

The search for specific answers around the correlations of public policies and their economic outcomes has become increasingly important to the preservation, or optimal use, of numerous natural resources and local biodiversity. Whereas my investigation will treat very restricted questions related to the implementation of the ICMS-E (an instrument for fiscal revenue transfer in Brazil)[2], I should not dismiss the three conceptual pillars that sustain the basis for this study: The Economics of Natural Resources and Welfare, the Science of Climate Change and Sustainable Development. Thus, the grounds that have motivated me to analyze the attributes of Payments for Ecological Services[3], and their implications, are intrinsically connected and/or interdependent of those scientific research lines mentioned above.

Although the challenges regarding the protection of local biodiversity have become dramatically notorious over the past two decades, we should observe that, within this context, Resource Economics have made significant progresses over the past century. One of the objectives in this examination is to discuss few assumptions related to the specific features of an innovative payment mechanism for ecological benefits (ICMS-Ecológico) without neglecting some relevant postulations within Environmental and Resource Economics (HOTELLING, 1932; ASHEIM, 1994; BURROUGHS, 2007; POLICYMIX, 2009; ANGELSEN, 2009).

[1] Figure 14 illustrates some of the components of a multi-tiered policy framework.

[2] See more detailed definition on section 2.1, page 17.

[3] PES - Payments for Environmental Services (or Benefits), in short, is the practice of offering incentives to landowners (public of private) in exchange for managing their land to provide some sort of ecological service. These programs promote the conservation of natural resources in the marketplace.

In order to move further, it is essential to comprehend the international context and point in time at which my reasoning takes place. This investigation, however, needs to be dared to ponder the discussions around the effectiveness of local environmental economic policies that fall into a much broader framework. The challenges around biodiversity conservation and its impact on the worldwide climate change are likewise questions about economic development (VICTOR, 2008). Could economic policies be really influential as to the global ecological balance? For the past decades, scientists, politicians and civil society's representatives have engaged in numerous debates aimed to seek answers for the global challenges raised with the systematic alterations of the climate patterns and their effects. Conclusions vary absolutely from country to country, within the sciences and among publicly empowered leaderships. In particular, forests impact the climate mainly in four important ways: Estimates show that they are responsible for one-sixth of the global carbon emissions while being depleted, overexploited or degraded. Land coverage and forest burning respond considerably to changes in temperature. They are source of wood fuels which is a positive substitution for fossil fuels, as long as they are output generated from sustainable production. And last but not least, forests can be used to absorb one-tenth of global carbon emissions (predictions for the next 50 years) into their bio-systems as well as into their soil. Due to their storage capacity, this process can even perpetuate (FAO, 2012). The discussion about the need to control the rise of temperatures around the world is not only intricate from the perspective of how changes take place; it is also complex from the perspective of achieving binding cross-nation solutions to address the consequences of global warming, especially when it concerns sovereignty, development and the economic growth of nations (BARRETT, 2008; FREITAS, 2011). Burroughs (2009) postulates that the only way to address the challenges ahead is through a multidisciplinary approach that embodies the contributions of distinct sciences such as sociology, physics, mathematics, economics, politics, biology, etc. Having affirmed that, Arrow (2007) argues, further on, that the factual truth is that the climate has always changed throughout the times. This imposes an extra difficulty; how to interpret the phenomena without overestimating the threats to the sustainable balance of the numerous ecosystems. If these forecasts are overestimated, their related policies could lead to a disorganization of social structures within the various realities

of the different regions in the world. Furthermore, much of the current aggregated impact on the climate is indeed a result of the human activities and their need to consume. According to Arrow (2007) on the Stern Report[4], economics and climate change are interconnected studies as matter of fact (ARROW, 2007; FREITAS, 2011).

> *"Critics of the Stern Report don't think serious action to limit carbon dioxide (CO2) emissions is justified because there remains substantial uncertainty about the extent of the costs of global climate change and because these costs will be incurred far in the future. They think that Stern improperly fails to discount for either uncertainty or futurity. I agree that both futurity and uncertainty require significant discounting. However, even with that, I believe the fundamental conclusion of Stern is justified: we are much better off to act to reduce CO2 emissions substantially than to suffer and risk the consequences of failing to meet this challenge. As I explain here, this conclusion holds true even if, unlike Stern, one heavily discounts the future."*
>
> (ARROW, 2007)

The activities of the Earth's climate are driven by a varied range of elements that are interlaced in a complex web of physical developments. Furthermore, Burroughs (2009) advocates that sciences need to adjust themselves into a much broader picture and not just focus the discussion in that they perceive as a fundamental debate. We are all frequently guided by dramatic information on how the climate is changing. Because the information sources are provided by institutions around the globe, with some imprecise error margin, the first logical step to take would be to understand the distinction between the variability of climate and the change of climate. It is recognized that, within the theories of weather and climate, changes in the climate represent shifts in the meteorological schedules; and they can keep their dynamics for years (BURROUGHS, 2009; FREITAS, 2011). Those effects may involve as few as just a single indicator such as temperature or rainfall. On the other hand, they could also be influenced by shifts in weather conditions that may lead to changes in temperature, moisture, clouds and winding conditions. Due to the connection with global weather patterns, these changes can result in compensating shifts in different parts of the world. So, it is expected that they can be linked to a warming or cooling movement of the world climate. However, when we look into the consequences of the variations in climate

[4] Stern Report: The Stern Review on the Economics of Climate Change is a British governmental document written by the economist Nicholas Stern that addresses the effects of climate change on the world economy. The report was issued on 30 October 2006. Stern is the chair of the Grantham Research Institute on Climate Change and the Environment at the London School of Economics.

change, the regional outcomes are the ones that provide researchers with the most significant materials, if they are proven to be related to the issues of global warming. One aspect of the climate change is that everything in the system is connected. So, although processes may be separately analyzed, it is important to have a bird's eye view of how facts interact and how they are linked (ARROW, 2007; BURROUGHS, 2009). In addition, this study examines the prospects of a financial compensation aimed to halter the loss of local biodiversity; a process that is even irreversible in some cases. Within this context, deforestation is considered doubly harmful. It does not only account towards the loss of biodiversity but as a factor for increased carbon dioxide in the atmosphere, through the reduction of aggregated photosynthesis. Some of the drivers of the loss of biodiversity include land conversion for economic use, exploitation of wild species, insertion of exotic species into new habitats, natural environment pollution and, redundantly, climate change itself. Their consequences have negative impact not only on the trends of the world's climate, but, essentially, on the existence of life in its most elementary notion (PIMENTEL, 1997) . As of January 2012, the world's rate of deforestation was estimated around 25 hectares per minute (CIFOR, 2012). Fertile soil is a crucial element of the world's biotas because all plant and animal species need either land or products that are cultivated in soil for their subsistence. More than 99% of the total worldwide human food supply is produced on land, whereas only 0.6% comes from oceans and other aquatic ecosystems (FAO, 2012; PIMENTEL, 1997). In spite of the soil preparation with mechanic mixing for agriculture purposes, soil formation on cropland is a gradual and long process. But it is even slower when the soil is under natural forest and grassland. Pimentel et al. (1995) highlights that, under agricultural conditions, approximately 500 years is required to form 25 mm of soil, while under forest conditions, it takes around 1000 years to produce a similar amount of soil. Taking this concern into account, the Department of Environment of Mato Grosso (SEMA-MT) considers that an affirmative agenda that promotes the protection of biodiversity must contemplate the equilibrium of the ecosystems and restoration of degraded areas (SEMA-MT, 2011). The Mato Grosso state has registered 23 federal, 46 state and 33 municipal Conservation Unities (see figure 16). Although deforestation has decreased consistently in recent years, as a whole, understanding whether the ICMS-E is an effective economic policy remains an important debate (MAY, NETO, DENARDIN, & LOUREIRO, 2002).

1- Objectives

ICMS-Ecológico as Payment for Ecological Services

Several policies worldwide have tried to establish the balance between consumption of natural resources, whether they are legal or not, and the ideal practice of economic activities (Ring 2007). As a result, a number of industrialized countries have committed to contribute with payments for forest conservation since the UN's meeting in Bali in 2007. Within this context, Payment for Environmental Services (PES) has been proposed as an effective complement to other regulatory conservation policies in the fight for forest protection (see e.g. records of Ring, 2007; May, 2002; POLICYMIX[5], 2009). In spite of this, a number of scientific studies question the consistency and effectiveness of REDD[6]'s actions in jointly increasing forest protection and local livelihoods (see e.g. Börner et al., 2009).

The objective of this study is to identify the efficiency and cost-effectiveness levels of a Payment for Ecological Services in Mato Grosso. Thus, we shall attempt to verify the reasoning behind two fundamental outcomes. First, it's imperative to understand if the implemented mechanism complies with its core purpose, that is, to safeguard local biodiversity through creating and augmenting protected areas (MAY, NETO, DENARDIN, & LOUREIRO, 2002). Second, the study shall try to find evidences, as well, on the improvement of public services provided by the municipal administrations. Specifically, here, I consider the performance of students from the public municipal schools, in elementary years. Overall communities' level of education is considered as an important social determinant in the

[5] According to the International Institute for Environment and Development, "the POLICYMIX Program aims to contribute to the EU's goals of reversing trends in biodiversity loss beyond 2010 through the use of cost-effective and incentive-compatible economic instruments". POLICYMIX focuses on the role of economic instruments in a mix of operational conservation policy instruments (NINA, 2011).

[6] United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries: UN-REDD Programme. For further reading, on this topic, see the journal article "Reducing Emissions from Deforestation and Forest Degradation (REDD) and decentralized forest management." (IRAWAN & TACCONI, 2009).

course of actions aimed to diminish deforestation rates (EHRHARDT-MARTINEZ, 1998; EWERS, 2005). The latter problem is the central question to be answered, if possible. Additionally, an effective and efficient public spending is expected to develop the welfare in communities granted with the compensation through rationally earmarked financial resources (MANDL, DIERX, & ILZKOVITZ, 2008). Our starting point is the distribution impact caused by a fiscal compensation aimed for environmental purposes, the ICMS-Ecológico. This incentive follows the principles of Fiscal Federalism; a dimension included in the public finances to support efficient allocations of resources and management of government's functions to central, state and local administrations. The ICMS-Ecológico is a revenue bundle captured from the state's largest source of taxation in Brazil, the ICMS (an added value tax). This added-value tax has been applied on goods and services since the Brazil's 1988 Constitution. At present times, it accounts for approximately 90% of the state tax revenues (RING I. , 2007). Considering it as a type of incentive, ICMS-E is an opportunity for municipalities to increase their share in tax revenue based on environmental performance indicators. The transfer of payments is made from the state budget to the municipalities, with spending primarily suiting the priorities of local public authorities thereafter. But, as a side effect, other public-private initiatives also stimulate the usage of directly and indirectly protected areas in a positive manner (RING, 2007).

May & Neto (2002) study the implementation of ICMS-E in several states in the country. Their figures show that the outcomes appear to differ from state to state. This could be related to many distinct factors such as transparency, opportunity cost on the ground, legal framework, tools for measurement or even prioritization and urgency of communities' representatives across legislative, executive and justice powers. Börner et al. (2009) observes that the implementation of a global policy that expects change in how local community actors perceive the value of original vegetation is a great challenge. Furthermore, this only makes sense when sustainable development is kept as goal (Börner et al., 2009). Looking at the Amazon Forest, it is clear that additional incentives for areas highly protected make a lot less sense than it does for areas where forest is at risk. This logic follows the concept of the opportunity cost of land usage. The more deforestation is avoided, higher is the cost in the form of displaced economic activities. Besides that, it also implies that much of PES (Payment for Ecological Services) will be concentrated in the hands

of large landowners because they are the ones harming more the forest (Börner et al., 2009). The research project will try to observe the ability of the state to implement legal framework of ICMS-E and to earmark the spending of the revenue generated on reducing deforestation.

The research will be based on the comparison of how two different states have implemented the ICMS-E as a response to forest degradation and in promotion of rational land use. One of the reasons for choosing this strategy is connected to the need of establishing a link among the various levels of political implications (e.g. MAY & NETO, 2002). The public decisions regarding quality of the investments and the jurisdiction established in Paraná and Mato Grosso are largely autonomous from federal policies. A comparative analysis here will not only attempt to disclose relevant data about public finance and trends. It shall also help understand what encourages, or prevents, municipalities as to increasing their conservation unities and others to become eligible to access the revenue generated with tax transfers in Mato Grosso state.

Paraná, the first state to implement this compensation for municipalities (State Law No. 59/1991), will be used as a benchmark. This preference is justified by the fact that Paraná has implemented qualitative and quantitative measurements to determine the allocation criteria for its municipalities (MAY & NETO, 2002). In that state, the municipality's right to revenue transfers follows the performance obtained by an environmental index. The CCB (Biodiversity Conservation Coefficient)[7] calculates the amount of physical quality (this can mean areas being recuperated) and the protected surface area of the CUs (Conservation Unities)[8]. This process is controlled by the Paraná Environmental Institute (IAP, Instituto Ambiental do Paraná). May & Neto (2002) affirm that these criteria can stimulate the CCB to consider improvements in the qualitative aspect of the CUs and their interactions with the communities around them. We will use Paraná's experiences as a point of reference for Mato Grosso's implementation of ICMS-E. The results are expected to contribute to the illustration of the "policy mosaic" of Brazilian state and federal level conservation policies.

[7] The Biodiversity Conservation Coefficient is a formula that measures the percentages of revenue defined for each municipality, so the distribution of the Ecological ICMS (PES Policy) is simplified and standardized.

[8] Conservation Unities are usually rural areas with relevant and/or concentrated levels of biodiversity. Further explanation about this term and official classifications on section 2.2, page 18.

The M.Sc. empirical analysis concentrates in the characteristics of the program in the State of Mato Grosso, Brazil. The state makes part of a region called Legal Amazon and concentrates one of the highest biodiversity levels per hectare in the world (POLICYMIX, 2009). For the last two decades, Mato Grosso has also become a major producer of crops and other agriculture activities, leading to rapid deforestation rates and frustrating conservation actions (Andrade and May, 2002).

Although the study will concentrate on the economical features of the ICMS-Ecológico (see Grieg-gran, 2000), the final goal of this research proposal is to determine whether allocation of fiscal resources is capable of improving sustainability at a regional level. Thus, a more complete analysis of the reality in the region would be intuitively more accurate if it considers a multi-dimensional approach, including cost, conservation effectiveness and distributional impact factors as to the implementation of ICMS-E.

2- Literature Review

In this section, I shall attempt to shed light on the features of a Payment for Environmental Services, the ICMS-E, that fit within the scopes of the REDD[9] strategies. The legal framework that has enabled and formalized the implementation of the mechanism throughout the country is regarded as determinant to the policy's outcomes. Given that my goal is to establish the analogies and differences between two states' fiscal incentive schemes, it is, indeed, relevant to understand the historic aspects towards their applications. Moreover, I underline the effects of the Opportunity Costs as to the evaluation of the mechanism and its perception by local decision makers and land owners. The fiscal distribution impact and the quality of preservation are also discussed in this review.

2.1- The Ecological ICMS in Mato Grosso

As mentioned earlier in this document, by synthetizing the conception, the Ecological ICMS or ICMS-E handles mainly about a state's financial mechanism to reallocate revenue generated through an added-value tax, the ICMS[10]. This dynamic follows the concept of the ecological fiscal transfers. That is, the transfers that concern any payment transaction, within the PES scope, regarding compensation for biodiversity protection purposes. These transactions usually take the form of lump-sum or specific transfers based on indicators.
However, as we shall see, its properties are quite peculiar if we consider that this PES modality has been implemented in a political environment that follows a Fiscal Federalism

[9] REDD is the United Nations' strategic program for reducing emissions, from deforestation and forest degradation, and for the support of conservation and sustainable management of forests. The abbreviation also derives the concept that denotes the program for enhancement of forest carbon stocks in developing countries (REDD+).

[10] Being able to differentiate between ICMS and ICMS-E is imperative. Although they look and sound like similar acronyms, payment wise, they just represent opposite transactions. While ICMS is an operation, in financial terms, that collects tax revenue, the ICMS-E is a credit transferred to stakeholders in order to compensate for ecological services.

context. Any positive outcome extracted from this experience deserves to be analyzed and cherished, since its objective is, indeed, the full protection of natural land cover. Furthermore, this opportunity is founded on the firm grounds of the 1988 Constitution, which conceived that 25% of each state-level-revenue should be reallocated according to the needs of the states. Brazil's Constitution, moreover, determines that 75% of the amount transferred to the local municipalities must be distributed following their performance in generating the added-value tax. This scope sets the overall conditions in which the Ecological ICMS operates in every state, whether they are members of the program or not. Paraná´s experience in implementing the payment for land services became an inspiration to other important states, as to their economic weight (e.g. Minas Gerais and São Paulo) to follow. These two states implemented the policy in 1996. In the subsequent fiscal year, Rondonia, the fourth state to adopt the ICMS-E, also became an important reference, given the relevance of its region (the North Region) where much of the land cover belongs to the Amazon Forest (GRIEG-GRAN, 2000; LOUREIRO W. e., 2008; RING I. e., 2009; MAY, NETO, DENARDIN, & LOUREIRO, 2002). Next, I try to thoroughly introduce the historical and legal development of this policy in Paraná and Mato Grosso states.

2.2- Legal Framework of ICMS Ecológico

Legislative terms in Paraná:

The *ecological* ICMS as known in literature today was legally framed from the new federal laws established by the Brazil's Constitution, in 1988. This fiscal transfer policy, at the time, surges as a response to the municipalities' demands that there should be compensation for the increase of restricted areas due to environmental purposes. Within this context, Paraná became the first state in the federation to implement an incipient concept of what would later turn out into a fiscal policy. LOUREIRO (1998) emphasizes that the state used to transfer revenues as payment for services varying up to 175 distinct conservation ends. This trend pushed the state to adopt a framework that could cover the losses of municipal open areas. That setting ended up limiting investments and use by both public and private land owners.

May (2002) reminds us that Piraraquara was one of those cases. The municipality used to have 90% of its entire territory as protected area containing a relevant watershed aimed to supply Curitiba's metropolitan region, the capital of the Paraná State. The imbalances caused by the unfair distribution of land, as to their services provided, and the gains, by more populated areas, led the affected municipalities, in the surroundings, to become more politically engaged and intensify their legislative demands. As a result, local and state administration's representatives started to become more sensitive to the debate regarding necessary rewards to both voluntary and, in some cases, involuntary protected areas.

So, the central idea was to compensate the protected regions given the constrains caused by these utilizations. Consequently, an amend to the Constitution, dated from 1989, expedited the implementation of the ICMS-E as a Paraná's state law (Law No. 59/1991) [11]. Thereafter, other amends and state laws helped the evolution of the tax transfer as to its criterion. May (2009) points out that the legal details and demands were further specified, so the state could better organize its revenue-sharing reallocation system. The progress in the provisions of the law enabled the government agencies to better operationalize the distribution of the payments according to the criteria which basically incorporated the conservation areas and quality of preservation (MAY, NETO, DENARDIN, & LOUREIRO, 2002).

Since the implementation of the environmental criterion, also referred to a "quality clause", the amount reserved for payment resulting from a simple straight-forward calculation (considering the percentage of the value added tax) was reduced from 80 to 75%. Today, 5% of the ICMS (added value tax) must observe the environmental conditions (other criteria such as area and population have been kept unchanged).

The Biodiversity Conservation Coefficient (Coeficiênte de Conservação da Biodiversidade, CCB) is an environmental index that estimates the factor that supports the sums endowed to the municipalities that maintain the protected areas, also known as Conservation Unities. The CCB considers the preservation of the surface area and the surface area of the local community in which the intervention takes place. The surface area can be classified due to the physical quality of the preservation, assuming that the better the nature is preserved, the higher the value is achieved from the coefficient. This measurement also applies to the

[11] The original Portuguese version of the State Decree 2.791/96 law text can be found at: http://www.meioambiente.pr.gov.br/arquivos/File/cobf/compilacao_legislacao_icms_ecologico.pdf

areas in the process of being recuperated. The surface area of the municipality is also impacted by a conservation factor related to the management inputs (LOUREIRO W. , O ICMS Ecológico na Biodiversidade, 2002).

Paraná's criteria has been adopted as a benchmark in several other states in Brazil. May (2009) examines that the approach concerning qualitative control, besides the calculus regarding the preserved areas (dimensions of Conservation Unities), is a significant progress. This measurement has enabled communities to both evaluate improvements over time and mitigate inappropriate management of the conservation unities. The result of the municipal conservation coefficient is the sum of the conservation coefficients of each municipality by the total of the state. These factors are then calculated into the allocated ICMS-E as to biodiversity protection (50 per cent). Municipal rights under the ICMS-E regime are accumulated with their regular revenue shares from the ICMS (added-value tax) taxation system, and are passed on to municipal governments on a weekly basis. The distribution also accounts in the annual ICMS added-tax revenue. Thus, the index is calculated as follows:

Procedures to calculate the ICMS-E in Paraná:

Our first step is to clarify the definition toward the concept of Conservation Unity. Loureiro et al. (2008) highlight that the Conservation Unity may receive special treatment to its coefficient, which is calculated by the guidelines stated at the Paraná Environmental Institute's ordinance (ruling established by the second paragraph of the state law). The decision stresses that the forest management categories must be observed as the following sequence (prioritization):

a) Municipal Conservation Unities
b) State level Conservation Unities
c) Federal Conservation Unities

The law enforces that all Conservation Unities must be registered in the state's registration database which is maintained by the Environmental Institute of Paraná (IAP – Instituto Ambiental do Paraná). Nevertheless, the second paragraph of Article 4 also determines that the registration procedure, in order to meet the objectives laid out in its law's caput, must consider a Conservation Unity as: portions of national territory, including territorial waters,

with natural features of significant value, public or private, legally imposed by the Represented Public Power with goals and limits, under special administration regime, which guarantees appropriate conservation practices" considering the following Management categories:

Biological Reserve	**Private Reserves of Natural Heritage**
Ecological Station;	**Forestry**
Parks	**Fauna Reserves**
Natural Monuments	**Extraction Reserves**
Wildlife Refuges	**Areas of Environmental Protection**

Next, I shall attempt to introduce the schedule of calculation of the conservation index established by the Paraná´s State Decree 2.791/96 (artigo 3.º do Decreto Estadual n.º 2.791/96): The basic calculation is represented by the ratio of the surface protected and the total area of the municipality times the Conservation Factor. This component relates to the various categories of Conservation Unity Management and other protected areas. Where CCBij denotes the Basic Biodiversity Conservation Coefficient (Coeficiente de Conservação da Biodiversidade básico);

$$(1) \qquad CCB_{ij} = \frac{Auc}{Am}\ x\ FC$$

The variable Auc is the Area of the Municipal Conservation Unity, according to physical quality (from the Portuguese description "*área da Unidade de Conservação no município, de acordo com sua qualidade física"*); Am is the Area of the Muncipal total territory (área total do território municipal); Fc denotes the variable Conservation factor attributed to the Conservation Unities as to the respective management categories (*fator de conservação, variável, atribuído às Unidades de Conservação em função das respectivas categorias de manejo*);The next equation introduces the qualitative variables measuring each Conservation Unity. Notably, the relationship of these qualitative variables presents a relevant incremental effect. In other words, the equation below reflects an important positive correlation, also known as a "vertical feedback"; that is, the better a *CU* is kept preserved, the higher the transfer provided by the state to the municipality (Governo do Paraná, 2012).

(2) $$CCBI_{ij} = \left[CCB_{ij} + \left(CCB_{ij}\ x\ DQuc\right)\right] P$$

Where $CCBI_{ij}$ depicts the Interface Biodiversity Conservation Coefficient (*Coeficiente de Conservação da Biodiversidade por Interface*); $DQuc$ denotes the Conservation Unity's variational quality (*variação da qualidade da Unidade de Conservação*); and P is the weighting rate introduced in paragraph 2 (*peso ponderado na forma do parágrafo 2º*);

(3) $$CCBM_{ij} = \sum CCBI_{ij}$$

$CCBM_{ij}$ represents the Municipal Biodiversity Conservation Coeficient and is equivalent to the sum of all Interface Conservation Coefficients estimated to the county (*Coeficiente de Conservação da Biodiversidade para o Município, equivalente a soma de todos os Coeficientes de Conservação de Interface calculados para o município*);

(4) $$FM2_i = 0{,}5\ x\ \frac{CCBM_i}{\text{å}CCBM_i}\ x\ 100$$

Where $FM2_i$ denotes the payment share gained by the municipality as to the Conservation Unities and å$CCBM_{ij}$ expresses the aggregated Municipal Biodiversity Conservation Coeficient. Since the total amount of state revenue, originated with ICMS (the added-value tax), is limited to the yearly state's tax yield, the level of revenue attainment reached through the Municipal Factor 2 is accordingly subject to the aggregated transfer of ICMS-E revenue made by the state administration (*percentual calculado, a ser destinado ao município, referente às Unidades de Conservação, Fator Municipal 2*); Thus, the ratio of revenue earmarked to the municipalities (both new and old entrants) through this policy may possibly face a decrease if the rate of change in relation to the total state's collection of ICMS does not increase at least as fast as the rate of the new entries changes (see increase in tax revenue due to economic growth in "Revenue" and "Government Measurement" in Hindricks & Myles, 2006). Intuitively, an example of a situation where this condition would not hold is the case in which the rate of change, occasioned by the new municipalities entering the policy's membership, is the same as the rate of change that the revenue increases due to an aggregated expansion in commerce and services as taxable economic activities (HINDRIKS & MYLES, 2006). At a first glance, in the equation above, new entrants into the policy membership would diminish the other participants' share of ICMS-E, in some cases, even if the latter had augmented their protected areas and/or improved their quality

control standards. However, it is also true that an increase in the state's ICMS revenue would also offset that trend (assuming that both rates of change turn out equivalent). Furthermore, inversely, there could be even a surplus, in the case that the rate of change that depicts the taxable economic activity is greater than the rate of new entries in the policy membership.

Legislative terms in Mato Grosso:

According to SEMA-MT[12], the state of Mato Grosso, institutionalized the complementary decree N. 073 (Lei Complementar nº 073), on December, 07th of 2000; This law institutes the ICMS Ecológico in that state. Thereafter, the law was regulated through the state decree nº 2.758 (Decreto Estadual nº 2.758), on July 16th 2001 (VIANA, 2000). Thus, the oldest primary dataset regarding the implementation of ICMS Ecológico in Mato Grosso, until the present date, has accumulated information for no longer than ten years.

According to the ICMS Ecológico state law, we observe that the criteria to calculate the index of Municipal Participation (Índices de Participação dos Municípios no ICMS) states two major environmental conditions:

- Unity of Conservation/ Indigenous Territories (CU/IT), in which 5% of the ICMS revenue, related to each municipality, is distributed as the first year of the program membership acceptance (2002).

- Environmental Sanitation (Saneamento Ambiental), in which 2% of the ICMS revenue, related to each municipality, is distributed to each location, starting at the third accounting year as from the program membership acceptance (2004).

However, an amend in January 2004 (Lei Complementar nº 157. Art. 2º.), inaugurated a new criteria for the municipalities' participation index with regard to the added value tax ICMS, the origin of the ICMS Ecológico. The new law eliminated the Environmental Sanitation criteria and preserved the Conservation Unities/Indigenous Territories criteria, with a compensation of 5%.

[12] SEMA MT – Mato Grosso State's Department of Environment.

(5) $$\frac{CU\ Index_i\ x\ \ Earned\ Participation\ Fund_i}{State\ CU\ Index}$$

In 2004, the State Law arbitrated the Revenue as we can see in the table 4; Added-value (75%), Own Fiscal Revenue (4%), Population (4%), Municipality Area (1%), Social Coefficient (11%) and Conservation Unities/Indigenous Land (5%).[13]

Other paragraphs of the amend State Law n.º 73, 2000 (Lei Complementar n.º 73, de 07 de dezembro de 2000) expressed the following:

Caput 3: In order to calculate the Own Fiscal Revenue index, take into account the ratio provided by the fiscal revenue budget of each municipality subjected to the sum of all fiscal revenues to all municipalities. The fiscal term is based on the second accounting year prior to the antecedent year; this is supplied by the State's Court of Auditors.

Caput 4: As to attaining the Population Criterion, take the percentage resulting from the population living in the municipality divided by total population in Mato Grosso; this is supplied by the Brazilian Geography and Statistic Institute – IBGE.

Caput 5: The computation of "Área do Município" (Municipal Area) is the result of percentage of each municipal area and the total area of the State; this is supplied by any official Mato Grosso state's department.

Caput 6: Estimating the "Cota Igual" (Equal Share) requires the calculation of the result given by the percentages pre-established in the "Parágrafo Único" (unique paragraph), found in the second caput of this Act, times the total number of municipalities in the state (number of municipalities considered up to December the 31st of the previous year).

Caput 7- The "Saneamento Ambiental" (Environmental Sanitation) criterion must observe the capitation, treatment and distribution of the water supply system and garbage collection besides the treatment and disposal of solid wastes and the sanitary sewage systems in the municipalities. (SEMA-MT, 2011)In Mato Grosso, the Conservation Unities are constituted as follows:

[13] See tables 4 and 10, "ICMS-E in Mato Grosso and Fiscal Allocation Criteria" , in the Appendix.

Biologic Reserves	**Private Reserves of Natural Heritage**	**Environmentally Protected Areas**
Ecologic Stations	**Forests**	**Sustainable Developed Areas**
Parks	**Fauna Reserves**	**Park Roads**
Natural Monuments	**Extraction Reserves**	**Specially Protected Areas**
Wild Life Refuges	**Highly Relevant Ecologic Areas**	

According to the complementary decree N. 073 (Lei Complementar nº 073), the Conservation Unity calculation schedule must follow the calculation schedule:

Conservation Unit/ Indigenous Land (referred in Article 8, "caput" of the Complementary Act). To calculate this criterion, one should obtain the product of the percentage (specified in paragraph of article 2 of the Act: see table 10 in the appendix section) and the ratio between the Conservation Unit of the Municipality factor ($\mathrm{FCM_i}$) multiplied by the State's Conservation Factor (FCE), defined as below:

(6) $IUC_i = FCM_i \; x \; FCE$

Where $\mathrm{IUC_i}$ is the index of the Conservation Unit / Indigenous Municipality "i". $\mathrm{FCM_i}$ factor is the Conservation of the City "i". $\mathrm{FCE} = \mathrm{S}$ denotes the summation of all municipality's Conservation Factors FCM_i. X is the percentage set for the criterion Conservation Unit / Indigenous Land. Thereafter, calculate the Conservation Unit factor ($\mathrm{FCU_{ij}}$) for each unit of conservation, or indigenous land, through the relationship between the area of conservation units or indigenous land and the total county area, weighted by the correction factor (FC):

(7) $FCU_{ij} = \frac{Area\ UC_{ij}\ x\ FC}{Area\ M_i}$

Where $\mathrm{FCU_{ij}}$ Factor = Conservation Conservation Unit "j" or Indigenous Land "j". in the City "i". $\mathrm{Area\ UC_{ij}}$ = Area of conservation "j" or indigenous land in the county "i". $\mathrm{Area\ M_i}$ = Area of the City "i". FC = Correction Factor for the type of management of conservation areas:
Calculate the factor of the Municipality of Conservation ($\mathrm{FCM_i}$) by summing up all of Conservation Unit/ existing indigenous lands factors in the municipality "i":

(8) $FCM_i = \sum FCU_{ij}$

2.3- Property Rights and Opportunity Costs

Whenever land owners, whether they are private or public, save their properties to protect forest resources, they give up the possibility to receive additional payments for the services or goods that they could extract from that space. Those foregone benefits are named the opportunity costs. In this section, I shall try to provide readers with a coarse explanation of how these costs influence decisions made by the land owners. BöRNER et al. (2009) propose a model to calculate the opportunity costs derived from the protected forests in the Amazon Region. Their model takes into account few pre-defined assumptions so a calculation schedule can be processed using data generated by Brazilian institutions and researcher's analysis. Moreover, in a pilot project with local observations, Börner et al. (2009) have analyzed the deforestation impact and its response followed by benefits paid in a municipal level. Conversely, the aggregated level estimates costs considering the Amazon Federal States (all combined form the so called Legal Amazon). Here, deforestation is expressed in terms of agricultural expansion. Taking land owner's profit margins into account in the equation, their estimative provides policymakers with a close picture of what the costs to protect areas and their biodiversity are. Therefore, we need to define the Net Benefits as output resulted from the land services; i.e.: cattle ranching , timber extractions, etc. As mentioned earlier in this document, both cattle ranching and crop plantations are considered increasing and devastating threats to the natural forests in Mato Grosso. These trends clearly resemble the postulations of the Open Access theory[14] as well. Furthermore, the quality of documentation regarding local development and economic growth, by sectors, is essential so an accurate estimate can provide analysts with robust data about the reality on the ground. However, measurement of economic activity dependent on land tenure terms is not always so accurate throughout the Amazon region; what imposes serious difficulties so a fine estimate can be made. Although a precise and detailed database analysis is possible (AZZONI & ISAIB, 1994; BöRNER, 2009), our objective in this section is rather to register the model utilized to determine the opportunity costs and benefits to all major

[14] Find further definition and approach to the Open Access problem in Gordon, H.S.(1954).

categories of land owners than to properly offer a reasonable estimative of the opportunity costs in Mato Grosso and Paraná. In the model set up by Börner et al. (2009), we shall see that, for simplicity, the benefits generated with untouched natural forestry are not considered (standing forest services). Moreover, the discount factor applied over time suggests that the estimates should reflect a sequential calculation schedule. The effects of multiple usages of land and their cycles can be illustrated by the dynamics of the timber extraction that usually follows a sequence: short period of cropping prior to land becomes meadow for cattle and annual cropping (permanent or itinerant). Thereafter continuing cropping takes place. Studies indicate that these land-use trajectories, where deforestation has occurred, show similar paths (VOSTI, WITCOVER, & CARPENTIER, 2002). The Net Present Value allows us to estimate the level of economic returns to the land usage over time. Thus, the calculation can be done as follows:

$$(9) \qquad \Pi_{ik} = GR_{ik}\left(1 - \frac{c_k}{b_k}\right)$$

The net profit per hectare of crop k that belongs to the municipality "*i*" is represented by Π_{ik}. Where GR_{ik} expresses the annual gross returns per hectare in "*i*" estimated from the PAM/PPM/PEV data. "*b*" denotes the gross returns. Variable "*c*" accounts for the total costs extracted from data sets containing: deforestation level, per hectare returns, municipal-level per hectare biomass, deforestation forecasts as well as location and size of land-reform settlements and protected areas.

$$(10) \qquad NPV_j = \sum_t \frac{\Pi_{k=1,t=1}}{(1+r)^{t=1}} + \frac{\Pi_{k=2,t=2}}{(1+r)^{t=2}} + \cdots + \frac{\Pi_{k=k,t=T}}{(1+r)^{t=T}}$$

In the expression above k denotes the cropp type/land uses and NPV depicts the Net Present Value of land-use "*j*" per hectare in municipality "*i*", within the trajectory, and having terminal period *T* equal to 10.

$$(11) \qquad NPV_i = \sum_t \frac{\sum_j s_j NPV_{ij}}{(1+r)^t}$$

Where NPV_i is the Net Present Value per ha in municipality "i"; "s" is the share of land-use trajectory "*j*" in the total municipality's annual land-use expansion. The NPV_{ij} represents the net present value of a ten-year-period of trajectory "*j*" in municipality "*i*". The interest rate is depicted by "*r*". An important feature of the ICMS-E as a PES policy is that the ultimate seller

of the services is the municipality where the protected area is located. However, this interpretation must be further defined since the constituency of the land tenure may vary among actors and land use purposes.

(12) $$NB_T = NB_{IL} + NB_{SU} + NB_{RS} + NB_{SL} + NB_{LL}$$

Börner et al. (2009) postulate that in order for policy makers to adopt PES as a candidate for their REDD strategy, a distributional impact analysis needs to shed light on the characteristics of the chosen beneficiaries. The total Net Benefit, thus, becomes the summation of Net Benefits shared by the potential recipients represented above by Indigenous Lands (IL), Sustainable Use Areas (SU), Land Reform Settlements (RS), Small Landholders and Community Lands (SL) and Large Landholders (LL). However, if the Net Benefit considers the public representative (e.g.: a municipality allocating Conservation Unities) as the sole beneficiary, it logically implies that there is no benefit being distributed to any other seller category. This comprehension falls perfectly into the study of the ICMS-E case for instance.

(13) $$NB_i = AD_i * (P - OC_i)$$

Net Benefits for each service provider category is expressed in the equation above, where "*i*" is the type of seller. Moreover, *AD* is the amount of additional REDD each seller category can supply, whereas *P* is the per hectare price paid to avoid deforestation or ton of emissions. *OC* denotes the opportunity cost per seller classification. (e.g.: the correspondent to NPVj in equation (10)). Since the Net Benefits of service providers are the product of amounts received as payment less the opportunity cost, disregarding the transaction costs, the rewards substantially differ among the seller's categories. Pricing is, for instance, a factor that hints why the solution for the social problem is not so trivial. Other mechanisms also play an impact such as governments and other institutional funders trading for emission offsets. In Mato Grosso, 56,3% of the territory is included in the region known as Floresta (Amazon Biome). Deforestation in the Amazon Region is widely understood to take place in the stretch best known "arc of deforestation" (see figure 12). This territorial stripe goes all the way from the southeastern borders to all the northeastern borders of the Brazilian Amazon forest. The open access to the region, stimulated by traffic on important inter-state roads, is also considered a factor of deforestation (eg.: Transamazonian Highway). However,

one question remains unanswered. As to the distributional impact caused by the ICMS-E, can the Opportunity Cost determine any economic preference when the PES Net Benefits are not related to direct payments to private/organizational land-owners? According to the Brazilian Fiscal Federalism revenue structure, in fact, when Municipalities prohibit access to any area in their constituency, the revenue generated with the added-value tax ICMS, mainly from land-use[15], may decrease (SEFAZ- MT, 2012). Azzoni and Isai (1994) evidence the impact of the foregone benefits by municipalities. This happens in the form of less tax revenue as a result of restricted economic activities.

In an aggregated level, the result of the ICMS is expressed by the accumulated commerce and service activities generated in a state (the added-value tax is largest revenue source of the states). From a pure financial perspective (no other aspect taken into account such as environmental policies, etc.), the membership of the municipalities in the ICMS-E Program only makes sense if their PES Net Benefits exceed the Opportunity Costs of the area to be protected. Thus, the indirect benefit of promoting any taxable activity also influences the decision of policy makers, not only in a municipal-state level but also in a federal level. Such development takes place especially in states like Mato Grosso where farming and agribusiness activities are intense and threatening to the local biodiversity. Börner et al. (2009) show that forest loss has a history of being most aggressive in Mato Grosso and Pará states, where cattle and crops have been handled in an expansive manner. These economic interests have hardly ever been so openly expressed as in the current debate for the reform of the "Código Florestal" (Forestry Code)[16]. Partisan negotiations have been dominating the agenda of the Brazilian Congress for the past two years and clearly justify why cropping and ranching have become an increasing share of the product-mix-revenue to the local administrations in those states (Câmara, 2012). Thus, limiting access to land may impose constrains related to the economic development of certain protected area's categories. Moreover, this dynamic may result in increased opportunity costs. In other hand, production

[15] Assume business-as-usual: to support the argument, we disregard any increase in per ha. Productivity, which could offset losses from the reduced areas for plantation and ranching.

[16] The current Forestry Code (Código Florestal Brasileiro) was established in September of 1965 (Federal Law 4.771/65) and determines that limitation to the land use for private purposes. The land use must also be subjected to the common and public interest so the natural vegetation on Brazilian soil can be protected. The first Brazilian Forestry Code was launched through the Decree 23.793 in January of 1934.

costs are not relevant for ecological fiscal transfer because they are defined as costs of current protection measurements. Usually, these costs are not related to policies earmarked to directly finance biodiversity conservation. In practice, it is hard to precisely determine the total costs (management, opportunity and transaction costs) and benefits at different spatial levels associated with protected areas (RING I. e., Assessing Fiscal Transfers for Conservation Policies, 2011).

2.4- Distribution Impact and Discussion

The combination of the various economic factors and the criteria as to the various applications of this policy in different states is what actually determines the fiscal impact of this mechanism. The alteration of the value added tax (ICMS) is an important and considerable driver of how the index can vary substantially. As an example, in a municipality named Jamari (located in the Rondônia State), the revenue showed a drastic variance due to the increase of the value added tax (about 500%) concerning that municipality in 1995. As a response, the total Jamari's ICMS-E index for the years 1997 and 1998 rose extraordinarily. Thus, a close look at how the economic factors are affected by the environmental criteria's weight is necessary and vice-versa (GRIEG-GRAN, 2000). There are both endogenous and exogenous determinants that may influence the overall result of the benefit to be transferred to each municipality. Minas Gerais State, for instance, promoted an important restructuring of the added-value taxation system before the state introduced its environmental criterion. These changes in the fiscal law became widely known as the Robin Hood Law[17].

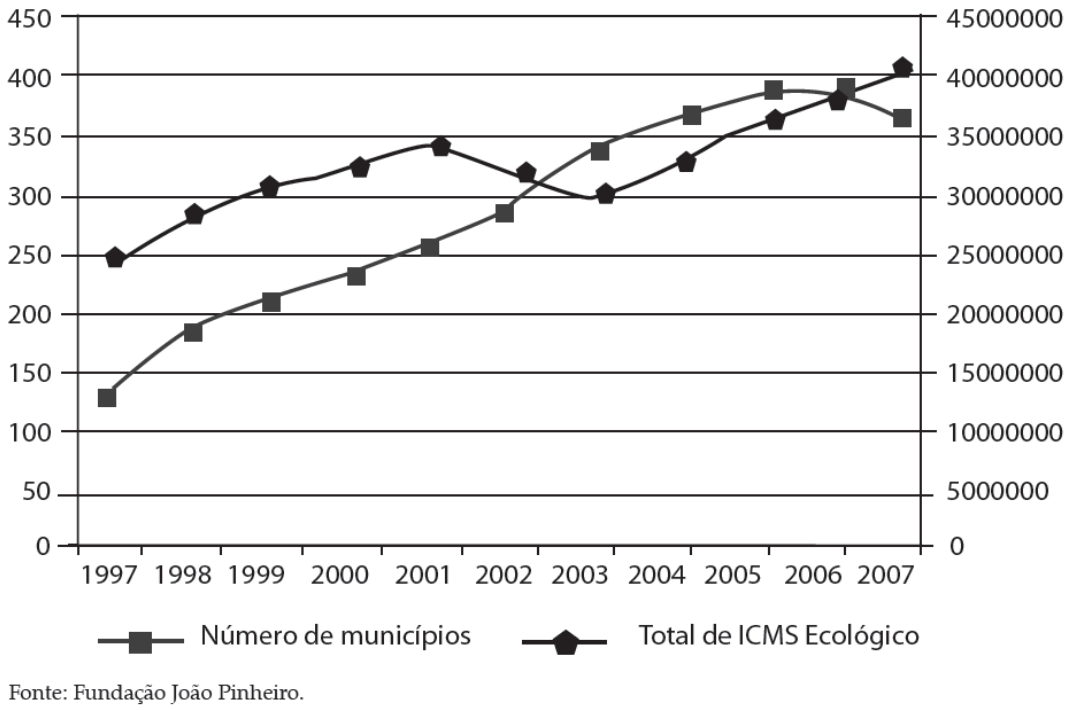
The distribution impact resulting from the adoption of the ICMS-E is the topic of a controversial debate of whether the growth of the economic activity within the state should be taken as a setback as to the revenue participation of the municipalities or a driver for conservation consciousness. FERNANDES et al. (2010) provide a probabilistic model about the likelihood of municipalities to join the ICMS-E program. In the model, it is claimed that the value received by the municipalities (where VA_i is the "Added-Value Criteria") is a

[17] A fiscal distribution system intended to diminish the allocation to the wealthier districts and contribute more with the poorer ones (FERNANDES L. L., COELHO, FERNANDES, & LIMA, 2011).

negative coefficient since the higher the municipality's economic activity, the higher is nature degradation. This outcome, thus, is considered as a negative variable towards biodiversity protection which, in their model, is used to reduce the probability of the municipality to receive the benefit. However, in practice, this seems to be the case when we look at the data provided by the São Paulo State's Environmental Secretary, for instance. Historically, São Paulo is a widely known as a state with intense industrial activity. From 2006 to 2010, the number of municipalities receiving the ICMS increased just from 180 to 185[18] while the total ICMS-E transfers received by the cities increased 49%, in average, for the same period (SMA - SP, 2012). While the national GDP increased 24,3% from 2006 to 2010, the São Paulo GDP increased 23,4% (IBGE, 2011). This leads to the argument that an increased aggregated value of economic activity in the state has rather increased the added-value income base, which, consequently, contributed with the increase of the sums passed over to the municipalities. Is the quantitative aspect of the state economic growth enough to determine whether the value-added criteria should be taken as negative driver? Or does the quality of the economic drivers also matter as to the implementation of Payments for Ecological Services? There is robust evidence of positive influences of GDP on the rate of forest conservation. Findings show that the effect of forest protection on the rates of forest cover change relies on economic development (EWERS, 2005). These questions certainly remain as the debates toward the Distributional Impact of the ICMS-E evolve but I shall not attempt to discuss them here. Fernandes et al. (2010) suggests that, in the beginning of the policy implementation, the small and medium communities (up to 100.000 inhabitants) had an advantage over the large base of ICMS collected in Minas Gerais. However, this distributional weight changed as from 2000 when new municipalities started to become eligible to receive the ICMS-E, thus, reducing everyone's share.

[18] Namely, the five municipalities in São Paulo that joined the ICMS-E fiscal transfers between 2006 and 2010 were Anhembi, Campo Limpo Paulista, Itupeva, Indaituba, and Jarinu.

Figure 1: History of ICMS-E in Minas Gerais: Ecological ICMS transferred to the Minas Gerais municipalities, in Brazilian Real (R$) and number of municipalities that received the benefit from 1997 to 2007.



Fonte: Fundação João Pinheiro.

Figure 1

Nevertheless, figure 1 depicts another outcome; both the expansion of municipalities joining the policy and the total value of ICMS-E being distributed increased (FERNANDES L. L., COELHO, FERNANDES, & LIMA, 2011). But, the average amount transferred by the state, per municipality, declined over time. Given the low Conservation Unity Criteria's percentage with respect to value earmarked for the ICMS-E, in Minas Gerais[19], this evidence strengths the argument that the more municipalities joining this PES modality would reduce the absolute value transferred to each member. Therefore, the Ecological ICMS has been characterized as the "Jogo de Soma Zero" (Game of Zero Sum); as municipalities join the incentive, the *per-capta* percentage is reduced (JOÃO, 2004). This might be the case in the short run. However, achieving efficiency in distribution requires that marginal increase in value received by each municipality equals the increase in the number of municipalities at

[19] See table 2 in the appendix section of this Thesis.

the margin as well (PERMAN, MA, Mc GILVRAY, & COMMON, 1996). Assuming that all municipalities in any state joins the program, at once, the average transfer would fall sharply. But the increase in the number of new members would obviously stabilize at zero leading to a more equal spatial distribution of the resources.

In the rank of states that have earmarked the Ecological by the Conservation Unity Criteria, Rondonia comes first. Out of a total amount paid in transfers in 2009 of R$ 402,7 millions, Rodnônia earmarked R$ 90.7 millions. Mato Grosso and São Paulo came in second and third places. They earmarked respectively R$ 78 million and R$ 68,4 million. Although Paraná is the first state in total earmarked ICMS-E, Rondônia distributed more with respect to the Conservation Unity Criteria due to the 5% coefficient (MEDEIROS, YOUNG, C.E.F., & PAVESE, 2011).

Grieg-Gran (2000) claims that the comparison carried on her studies, between Minas Gerais and Rondônia, shows how the distribution system needs to be analyzed and comprehended prior to the implementation of the ICMS-E. For instance, in Minas Gerais, in order to implement the new criteria, it was possible to reduce the weight given to ICMS (added-value tax) because this was greater than the 75% minimum required by the Constitution. Whereas, In Rondônia, the weight given to the ICMS was already at 75% at the time the norm was instituted. Without redistribution on the weight of the necessary criteria, the ICMS-E calculation would hit all municipalities, including those with protected areas. Although the ICMS-E is considered as an incremental fiscal transfer policy, it is needed to be clear that it also imposes a task to the public finances of all localities due to their budget planning (NETO, 2008; SEFAZ- MT, 2012).

Furthermore, Grieg-Gran (2000) ponders that the history of ICMS-E in Rondonia and Minas Gerais, at the time of the data analysed, had showed similar paths as to their distributional impact. Barely, 60% of the municipalities had turn out to be better-off as result of their program membership. She claims that for the approximately remaining 40%, the negative counter-weight, pressured by the diminishing value that was observed in Rondônia due to the “equal share criterion” and in Minas Gerais due to the added-value tax revenue, offset the rewarding performance of the conservation criterion.

2.5- Quality of Preservation – A Determinant Criterion?

"The primary aim of ecological fiscal transfers is to compensate the relevant jurisdictions for the land-use restrictions imposed by protected areas that in economic terms relate to the opportunity costs of these protected areas. Due to this compensation the provision of the related public good 'protected areas' may or may not increase (there is no earmarking or contingency, except in Paraná due to quality assessment)."

Ring et al. (2011)

The ecological ICMS presents higher levels of effectiveness when the cycle of biodiversity protection and investment in environment promotes sustainable development at the local level. Thus a balanced investment of the attained resources in social welfare and improvement of the quality of public provisions is as much necessary as the full protection of biodiversity (SILVA, FREITAS, & WEISS, 2009). Therefore, an important factor that can further increase the dividends of the municipalities as to all the frontiers cited above is the quality of protection. In Paraná, as we have overseen, the quality of preservation is safeguarded by the state law. So far, this is not the case in Mato Grosso. This binding legal mechanism is determinant to increment the reinvestment of the incentive in activities that raise environmental awareness. Otherwise, the outcome may cause distortions. Emblematically, Novo Santo Antonio (municipality located in the Cerrado Biome) received the highest absolute ICMS-E transfer in Mato Grosso R$ 2.042.285,00 in 2009[20]. An outstanding result that, considering the ICMS-E per capta, puts the city on top of the state's rank with R$ 967,71[21]; the average per-capta ICMS-E of the state is R$ 88,03. The reason why the municipality, while having an area of 4.368 Km^2 (average area of the municipalities receiving the incentive in Mato Grosso is 8.598 Km^2), presents such an expressive performance is rather connected to the fact that much of its territory (approx. 230.000 hectares) lies within the Araguaia State Park. Although the Araguaia state is managed by the FEMA-MT (Mato

[20] See tables 5,6 and 7, "Winners and Losers Analysis", on pages 78-80 .

[21] Value follows my own calculation schedule based on data acquired from SEMA-MT.

Grosso's Enviromental Foundation), it lacks adequate infra-structure and administration to monitor the conservation quality. Its big environmental concern is the recurrent forest burning within the Park limits. The Araguaia State Park was the third most frequent Conservation Unity's fire focal point in 2010 (SEMA-MT, 2011). Without the necessary law enforcement, a solution to the distortions caused by this policy implementation hinges on the dynamic and commitment of the local authorities to pursue the best or, at least, reasonable results. This aftereffect seems to be reduced in Paraná. A simulation shows that a Conservation Unity classified as "Park Management" (local management) and located in the north of the state, that extends for 40 hectares, may reach a maximum quality assessment that accounts for approximately 1.200 hectares in the ICMS-E calculation schedule (LOUREIRO W. , O ICMS Ecológico na Biodiversidade, 2002). The first equation (1), which was presented here earlier, introduces the qualitative variables measuring each conservation unity. Such variables present an incremental effect and provides an "vertical feedback", that is the better a CU is kept preserved, the higher is the income provided to the municipalities. This Conservation Unity would score as up to 30 times more what a Conservation Unity would have achieved if its assessment was based only on area (without applying the quality variables). Thus, municipalities are better-off when they protect the biodiversity in those areas than just acquiring more land, for conservation purposes, and then abandoning them afterwards (Governo do Paraná, 2012). However, Peter May (2002) provides some relevant considerations about the quality factor. In Paraná, technicians and public agents have learned from their past experiences since the policy was implemented. By improving their quality of protection, municipalities improve their performance which consequently leads to increase their participation in the state's added-value taxation stake. Furthermore, the ICMS-E can help promote what has been perceived to be a "virtuous cycle", a process in which expertise, environmental awareness and social transformation are shared by all actors (communities, policy makers and public representatives) (MAY, NETO, DENARDIN, & LOUREIRO, 2002; Governo do Paraná, 2012). However, May et al. (2002) question about the transparency on accessibility of the financial records and data sustaining the ICMS-E transactions (rewards regarding the Conservation Unities) in all cases; no matter the state has introduced the quality factor or not. Nevertheless, the quality criterion needs to be applied as a dynamic element of the mechanism. Thus, a recurrent evaluation can push the improvement of UC categories, reward localities, punish negligent municipalities,

instruct the allocation of financial resources and induce local environmental planning (MAY, NETO, DENARDIN, & LOUREIRO, 2002).

Quality of biodiversity preservation is not a trivial criterion to be estimated. JOÃO (2004) provides an in depth description of the parameter to be considered in the quality factor analysis of the Conservation Unities. Her scheme proposes a calculation of the **Vegetation Coverage Variable** through the arithmetic mean of two components: the **Quality Variable** and **the Diversity Variable**s. So a good quality performance (Vegetation Coverage) can be achieved, Conservation Unitie's administrations should invest in maintenance and restoration of the natural habitat diversity by keeping its features simultaneously (JOÃO, 2004).

Furthermore, biological diversity is built upon an extensive set of livelihood characteristics. Capturing all these features is an enormous challenge due to the complex detail matrix; interlaced information web (LOUREIRO W. , O ICMS Ecológico na Biodiversidade, 2002). Biodiversity protection clearly requires the preservation of both the extension and the quality of the natural environment. Structural losses, modification and fragmentation alter the nutrients found in the vegetation and watersheds leading to a reduction of the ecosystem's resilience and adaption capabilities. These claims push the need for proper and rational investments of financial resources even further (JOÃO, 2004; MAY, NETO, DENARDIN, & LOUREIRO, 2002).

3- Environment and the Welfare Theory

"Welfare economics is the branch of economic theory which has investigated the nature of the policy recommendations that the economist is entitled to make."

Baumol (1977), p. 496

In Public Economics, the procedure to analyze a policy is conducted by the development of a model and determining its equilibrium level. Therefore, Policy Analysis determines the effects of publicly empowered representative's plans and actions. It helps to trace the relative changes of the economy's equilibrium as to given patterns (PERMAN, MA, Mc GILVRAY, & COMMON, 1996). Furthermore, according to Barbieri and Lage (2001), regardless the intentions of any economic development policy, one should never disregard the global challenges. If policies are implemented to benefit any locality or region, it must consider the impacts that their outcomes can cause as to the worldwide ecological system's equilibrium.

While carrying out a policy assessment, one should understand the concepts of positive and normative analysis. The first (e.g.: positive analysis of government) investigates themes such as why and how a public sectors respond to the government's interests and priorities. The reason why some policies are preferred, followed by their effects on economic development, is also spotted here. In other hand, normative analysis helps to identify the best policies. Thus, its objective is to defend the guidelines for reasonable and/or ideal government practices (PERMAN, MA, Mc GILVRAY, & COMMON, 1996). Eventual projects involving the two alternatives above are not necessarily disconnected from each other; a positive analysis is needed in order to run a normative analysis. It would be impossible to defend a policy as being good without considering alternative policies' effects. A recurrent argument is that a positive analysis has no significance until it is put into practice as a guided policy.

Normative analyses are assumed to provide governments with the best options related to practices within a set of goals. In spite of that, Laissez-faire policies and other alternative ones need to be analyzed under the scope of the positive analysis. Additionally, the optimal policy is the one that seeks to achieve the best outcomes within the government's goals. This expected optimal state is assessed once each of the several policies' equilibriums are determined and analyzed (PERMAN, MA, Mc GILVRAY, & COMMON, 1996).

3.1- Social Welfare function and Optimality

"Losing forest diversity means missing opportunities for medicines, food, raw materials and employment opportunities, in one word: welfare."

FAO, Food and Agricultural Organization
of the United Nations

So the choice modeling can make sense within this study, we need to dominate the concepts behind the Social Welfare Function[22]. The relationship extracted from its reckoning can help us put this discussion under the perspective of allocation priorities. The Social Welfare Function has a parallel with that one of the individuals' indifferences. But instead of proposing an expression of everyone's preference, it represents everyone's perception as to the social collective choices. An important aspect of the social welfare function is to specify how similar it is to any individual's ordinary utility function when it faces minimum

[22] A social welfare function is a worth-weighted function that rates feasible social states (alternative complete descriptions of the society) from lowest to highest. Entries of the function incorporate variables thought to influence the economic welfare of a society (SEN, Collective choice and social welfare, 1970). It turns out that the social welfare function becomes conceptually individualistic in its format, as we use it to quantify a person's welfare measurement as to the need of goods or consumption of inputs. A conceivable application to this approach would be to exploit the social welfare function in order to discuss prospective models representing collective choices aimed to support alternative social positions (SEN & NUSSBAUM, The quality of life, 1993).

constrains that are often scrutinized in Welfare Economics (PERMAN et al. 1996). Thus, we examine an economy with two individuals where the SWF is generally expressed as:

(14) $W = W\ (U^A, U^B)$

The Welfare is assumed to be a non-decreasing function in $\mathrm{U^A}$ and $\mathrm{U^B}$. Following this property, for any given level of $\mathrm{U^A}$ welfare can not decrease when $\mathrm{U^A}$ is expected to rise. For this reason, we embrace that $\mathrm{W_A} = \frac{\partial \mathrm{W}}{\partial \mathrm{U^A}}$ and $\mathrm{W_B} = \frac{\partial \mathrm{W}}{\partial \mathrm{U^B}}$ are similarly positive. Hence, our SWF responds equally to the characteristics of the utility function. Given that the utility function relates numbers for value with combinations of consumption levels X and Y, a Social Welfare Function associates numbers for social welfare with combinations of utility levels $\mathrm{U^A}$ and $\mathrm{U^B}$. Likewise, in the same way that a utility function can be illustrated with the indifference curves instrumental, so we can demonstrate the effects a Social Welfare Function. Maximization of welfare occurs where there is equivalence of the slopes of the social indifference curve, the utility curve and the utility possibility frontier; all these conditions must be satisfied, correspondingly (PERMAN et al. 1996). Furthermore, this expression can be stated as such:

(15) $\frac{W_A}{W_B} = \frac{U_X^B}{U_X^A} = \frac{U_Y^B}{U_Y^A}$

From the equalities above, we shall have the slope as to social welfare indifference curve on the left whereas the two other expressions represent slopes of the utility frontier. All slopes (indifference curve and utility frontier) are equal when social welfare is maximized. Moreover, it is impossible to reallocate goods and utility in order to increase social welfare between the consumers. Moving from a point, which is not efficient, to another that is efficient, to other person, does not necessarily result in a welfare improvement, although distributive efficiency is a necessary condition for an optimal outcome. It may even end up being a decreased level of social welfare. Considering that the SWF is non-decreasing in $\mathrm{U^A}$ and $\mathrm{U^B}$ rising $\frac{\mathrm{U^A}}{\mathrm{U^B}}$ without decreasing $\frac{\mathrm{U^B}}{\mathrm{U^A}}$ leads to an enhanced social welfare (see PERMAN et al. 1996). If the allocation of two goods is considered fair among individuals, a Pareto improvement can be denoted as a fair outcome or a result that promotes equity. But this scenario is relativized as to the restrictions discussed within the utilitarianism approach.

3.2- Efficiency, Effectiveness and Public Financing

"But still more definitely than patron saint of the modern theory of value is Pareto the patron saint of the "New Welfare Economics.""

(Joseph Schumpeter, "Vilfredo Pareto, 1848-1923",
Quarterly Journal of Economics, 1948)

Literature considers the input-output ratio as the most elementary way of measuring efficiency. An example of this approach is to take education spending as an input that affects educational attainment rates; the latter is, then, understood as output. The concepts of efficiency and effectiveness combine the relationship among input, output and outcome as we can see in figure 2. Yet, contrasted to productivity measurement, the efficiency concept features the idea of the production possibility frontier, which implies feasible output levels given the scale of actions.

> *"The greater the output for a given input or the lower the input for a given output, the more efficient the activity is. Productivity, by comparison, is simply the ratio of outputs produced to input used".*

(MANDL, DIERX, & ILZKOVITZ, 2008)

Figure 2: Conceptual Framework of Efficiency and Effectiveness

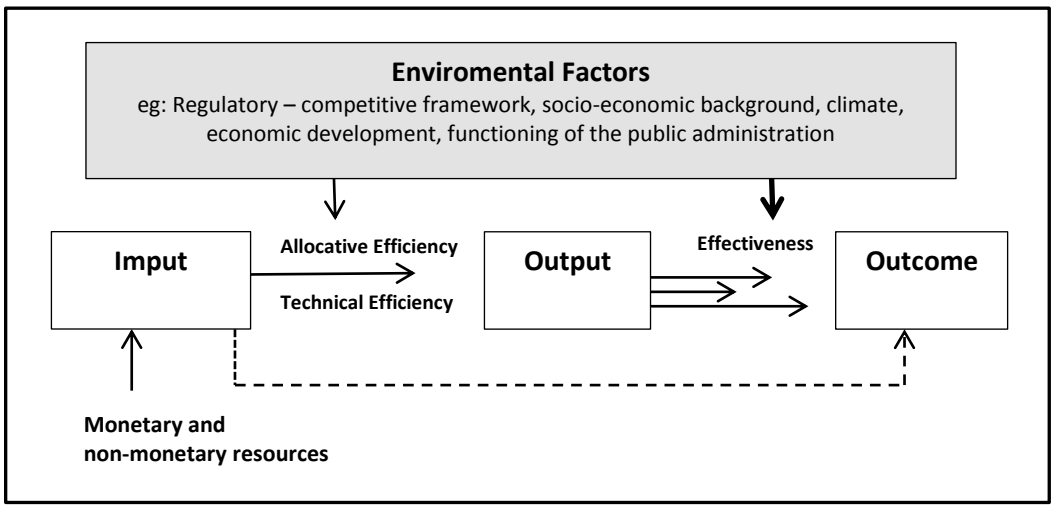


Figure 2

The difference between effectiveness and efficiency can be underlined by the type of result that we are analyzing. For instance, effectiveness is connected to the ultimate objectives of a policy or project. The outcome of such an experiment is, however, associated with the level of welfare or growth to be attained. Thus, effectiveness, as an aim, can be translated into a measurement of dynamics that are often influenced by complex factors. Therefore, due to interference of political preferences, effectiveness may be harder to estimate than efficiency (PERMAN, MA, Mc GILVRAY, & COMMON, 1996; MANDL, DIERX, & ILZKOVITZ, 2008).

Mandl, U. et al. (2008) postulates that, although, output and outcome are two distinct ideas, their concepts remain vague. Yet, even when it is possible to differentiate both terminologies, there might not be the case that both expressions shall be applied separately in every circumstance. For instance, the outputs of an education system are frequently measured in terms of accomplishment or attainment rates of scholars of a selected age. The concluding outcome, however, may well be the educational qualifications of the overall working-age population. Additionally, the proper use of resources can be qualified as positive or effective as to the initial goals. Thus, this possibility shows that effectiveness and efficiency are not so simple to distinguish. Likewise, outputs and outcomes are often subject to the regulating influence of policy makers.

However, one unique outcome may differ when analyzed under two distinct approaches: as we study the efficiency of education funding, the overall behavior of wages is taken as an exogenously given influential aspect. On other hand, for public administration analysis, wages represent a measurement or determinant of efficiency. The level of outcome aggregation also plays an important role while policy makers are relying on consolidated results so they can move on with their decisions. This component also influences how the results are handled; whether they are interpreted as exogenously given or under control of administrators. The more grouped the results are, the higher the chance for unrevealed inefficient outcomes. In contrast, this applies to the cases where a more detailed comprehension of how inter-sector drivers work such a combinations of inputs within the utilization of an item (e.g. allocation of funds). Thus, delimiting the concept of effectiveness and efficiency is not trivial. While estimating the level of efficiency, one should be able to distinguish between technical and allocative efficiency (MANDL, DIERX, & ILZKOVITZ, 2008; PERMAN, MA, Mc GILVRAY, & COMMON, 1996). Technical efficiency estimates the behavior

between inputs and outputs considering the production possibility frontier. Technical efficiency achievements are steps towards this “best practice” (production possibility frontier). However, not every form of technical efficiency makes economic sense, and this is captured by distributive efficiency, which introduces costs and benefits (PERMAN, MA, Mc GILVRAY, & COMMON, 1996; MANDL, DIERX, & ILZKOVITZ, 2008).

Distributional efficiency depicts the relationship between the combination of inputs in a cost-benefit approach and the output attained. For example, to instruct pupils, there is a mix of resources necessary, such as teachers, books and facilities. The success of this experience could be maximized by an optimal combination of these inputs. Thus, the measurement of distributional efficiency demands in-depth analyses of the field to study.

High level of efficiency, from an individual scale, attained by a single input can not be directly translated into high public and collective levels of output when alternative solutions can attain better results.. A result that is considered efficient by an individual does not necessarily reflect efficiency as we look into the overall expectations of public service responsibilities. Parallel combination of inputs can lead to more rewarding outputs.

Other challenges around assessing efficiency are the situations where services provided by public actors, thus their outputs, may be used as inputs by other public agents. This makes the exercise of differentiating effectiveness and efficiency of gains resulted by the utilization of inputs and outputs. A suitable example is the increased offer of public transportation system as a result of investment in infrastructure. The allocation of financial resources in one service may affect the investments in education, which is expected to reduce its quality as whole. Contrary to the private sector, the public sector cannot simply be analyzed upon a direct input – output relationship (MANDL, DIERX, & ILZKOVITZ, 2008).

3.3- The Rondônia's ICMS-E Schedule: a simple case

The ICMS-E calculation schedule of the Paraná state is considered quite sophisticated when compared to other federative member's indexes and ICMS-E policy schemes. Nevertheless, for the sake of simplicity, a handy intuitive example of how the ICMS-E can be much more comprehensive in its form is the Rondônia case (GRIEG-GRAN, 2000). If we accept this attempt as a mere introductory presentation, quite out of this project's scope, we shall see that the calculation of the Rondônia's ICMS-E is much more straight-forward than Paraná's and Mato Grosso's:

(16) $$EI_i = \frac{MCF_i}{SCF}$$

Where $\mathrm{EI_i}$ is the ecological index of county i and $\mathrm{MCF_i}$ denotes the conservation factor of county i . The index $\mathrm{MCF_i}$ is the result of the factor $\frac{\text{Area CU}_\text{i}\ (ha)}{\text{Area M}_\text{i}\ (ha)}$. $\text{Area CU}_\text{i}\ (ha)$ depicts the total area of conservation units in county i in hectares. The area of county i is denoted by $\text{Area M}_\text{i}\ (ha)$. Furthermore, the denominator SCF (the State Conservation Factor) is equivalent to the sum of all Municipal Coefficient Factors, and is represented by aggregated coefficient factor $\sum MCF_i$. Is there an optimal solution where the policy is efficient for all? Where MRT_L is the marginal rate of transformation for land, and MRT_K is the marginal rate for transformation for capital. In order to achieve economic efficiency, we still need to achieve the following necessary conditions: $MRT_L = MRT_K = MRUS^A = MRUS^B$. In short, all marginal rates of transformation and all marginal rates of utility substitution must be equivalent. Although these conditions are rather conceptual, as to the scope of this empirical academic study, the claim that a fiscal policy needs to observe these assumptions, in order to be considered an efficient compensational mechanism, is an orientation. Since, it's possible to observe distributional discrepancies in the consumption patterns followed by the allocations in Mato Grosso, a fully-efficient-outcome does not seem being achieved. This is, however, only an assessment based on a single microeconomic approach. The overall analysis of the Ecological ICMS as a compensatory transfer, in reality, is far more complex due to the problem's environmental, financial, political and macroeconomic dimensions (AZZONI & ISAIB, 1994; NETO, 2008; MEDEIROS, YOUNG, C.E.F., & PAVESE, 2011).

4- Methodology and Data Analysis

The research project will be divided into three phases. I've started it by reviewing the history of impacts of ICMS-E in Paraná and Mato Grosso. Initially, it is important to understand the legal characteristics as to the application of this environmental compensation. To what extent is there compliance of the municipalities and the state with the current legislation? Ring (2007) & Börner et al. (2009) suggest that without having an outlook of the legal settings, a lot of the contextual binding commitments of local and state authorities would not be well-defined.

The next step in this research is consisted of collecting data about the finances of the state and its municipalities. Much of the financial analysis will consider the revenue generated with the ICMS-E both in Paraná and Mato Grosso. These public finance records are expected to show how the state has been investing and transferring its tax revenue. In Mato Grosso, as to 2009, around 38% of the total number of municipalities was not being granted with the tax transfers of the program. In six years, from 2002 to 2009, 17 municipalities joined the ICMS-E program, which corresponds to an increase of 25% as to the initial base. As a result, the number of Protected Areas increased only 26% in that period. As to 2012, the number of municipalities using the incentive seems to have stabilized around 60% of the state's total. One of the steps of my objective is to investigate the logic behind the constrains of the ICMS-E in Mato Grosso. Conflicting economic activities, whether they are private or public, could be impacting local level political decisions. The research will try to disclose as many as of evidences regarding the factors that either block or foster all municipalities of receiving the benefits from the state. This part of the research will be quite concentrated on the history of financial reports. In a counter-point, we will over-see the returns, in a quantifiable fashion, for each municipality that is being granted with the program and confront with those that are not being.

In a more qualitative approach, I shall attempt to revise the structure of local policies and try to find whether local policy makers have been committed in terms of, not only attaining the revenue through the ICMS-E, but also in promoting biodiversity conservation; e.g: are there

evidences as to how efficient the budget has been earmarked back to sustainable determinants?

The second phase of the analysis consists of data analysis and hypothesis testing. This stage is divided into the following approaches: first; the evolution of the behavior and characteristics of the ICMS-E's distribution is analyzed specially during the years between 2002 and 2009. In other hand, I also try to disclose information about the history deforestation levels in Mato Grosso. Through 2001 and 2007, the aggregated average deforestation level has achieved 8,6% in 2004, against 0,56% of 2007. Therefore, it is necessary to investigate what may have be influential drivers in this drastic reduction of forest damage. Next, I provide an analysis on the bivariate correlation on the performances of members and non-members of ICMS-E as a fiscal policy. The hypothesis is that extra financing has improved the quality of a social service that can be regarded both as a development and environmental determinant (MANDL, DIERX, & ILZKOVITZ, 2008; EHRHARDT-MARTINEZ, 1998). This is the case of the the IDEB and Prova Brasil indexes. These two indicators apply standardized and methodological criterion throughout Brazil and have been considered a breakthrough in the recent Brazilian Education Plan to reduce inequality. Although, it's clear that reinvestment of the financial resources in core biological services is preferred by environmentalists and biologists, improvement of the social welfare function of the fiscal transfer can, nevertheless, improve protection through ecological awareness, for instance. Higher GDP per capta has also proved to be an effective determinant in diminishing levels of deforestation. Moreover, I seek to understand the dependence, if there is any, between the financing of local public municipal schools and the improvement of the student's performance measured in the "Prova Brasil". This is to test the relationship between the evolution of the elementary school indexes (data available between 2005 and 2009) by each municipality and the effect of their extra revenue share if the recipients are members of the program. This result is also confronted with the performance of education in municipalities that do not receive the PES (Payment for Ecological Services) (MEC - Ministério da Educacão, 2012; IBGE, 2011; EWERS, 2005).

Then, the test runs the model's covariance matrix with the following definitions.

1. **Model to be tested:**

$$\mathrm{Y_{it}} = \beta_1 + \beta_2 AREA_i + \beta_3 DEF_{01-07}^{rate} + \beta_4 VA_{it} + \beta_5 \Delta PROVABRASIL_{09-05}^{municipal} + D1_i$$

Where:

a) $\mathrm{Y_{it}}$= is the quality of elementary education as a result of financing and investment in local municipal schools.

b) $\mathrm{AREA_i}$= area of the municipality "i". Municipalities with bigger areas have joined the ICMS-E program more than municipalities with less territory. Thus, it indicates the municipalities participating in the PES are actually receiving a share that should be also distributed to smaller district, which promotes an unfair distributional effect.

c) $\mathrm{DEF_{01-07}^{rate}}$ = is the deforestation rate measured in each municipality "i" between 2001 and 2007.

d) $\mathrm{VA_{it}}$ = is the ICMS received, by the municipality "i" in period "t", through the added-value fiscal revenue (measured in Brazilian Reais); the higher is ICMS received through it is added-value criteria, the higher is its economic activity, the less area is being protected (FERNANDES et al 2011). It has to be analyzed as to the local characteristics. ICMS (Imposto sobre Comercializacão de Mercadorias e Servicos).

e) $\Delta PROVABRASIL_{09-05}^{municipal}$= is the change, or improvement, of an index based on a complementary evaluation provided by the "Sistema Nacional de Avaliação da Educação Básica (Saeb)" and one of the components of the IDEB, Elementary Education's Development index (Índice de Desenvolvimento da Educação Básica). It's assessed through the examination of two basis disciplines: Portuguese and Mathematics. The Prova Brasil index was launched in 2005. It is considered as a major Brazilian federal measurement towards performance in public education.

f) $D1_i$= denotes any possible dummy variable. In the test presented here, this independent variable is not being applied.

Recent Trends and Drivers of Deforestation and Degradation in Mato Grosso

As we can see on the map, page 73 (figure 18), the Mato Grosso covers three different Biomes: The Amazon Forest (Floresta), The Cerrado and The Pantanal. A good sample for a distributional analysis as to the municipalities should take into account the aspects of the spatial characteristics of the ground. The type of coverage is an important aspect when we consider the motivation for local conservational policies. According to SEMA-MT Deforestation in Mato Grosso is higher in the Cerrado.

Figure 3. Deforestation in Mato Grosso from 2001 to 2007

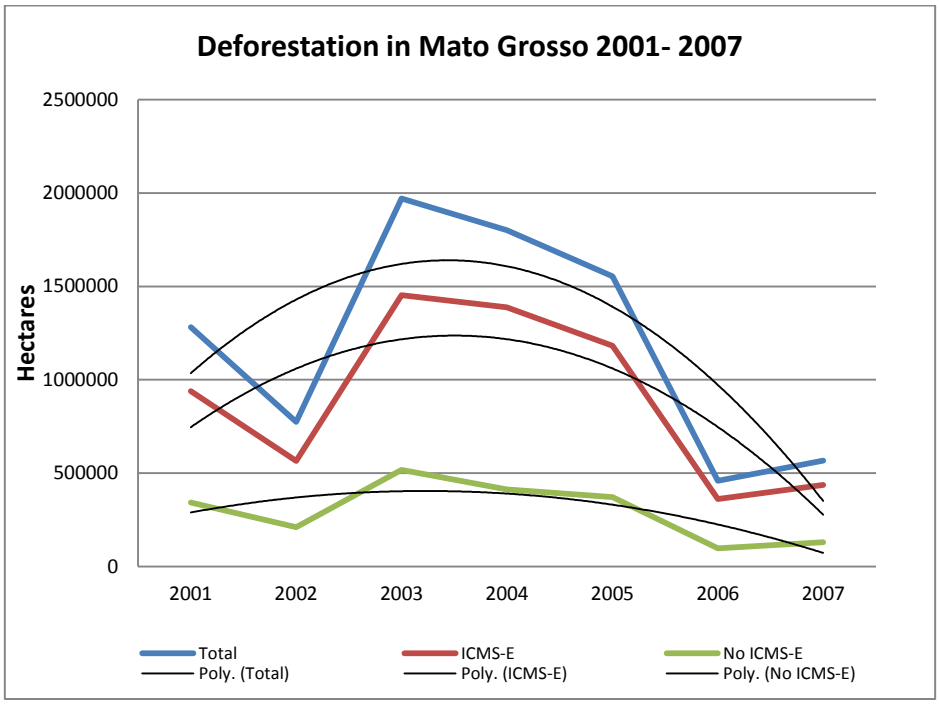


Figure 3

Source: SEMA-MT and own calculations.

Although recent reports show important decline in forest depletion rates, open access in Mato Grosso has facilitated illegal occupation and logging activities, which accounts for the first stage of deforestation. These activities are concentrated mainly within the so called Arc of Deforestation; a stretch that extends from Pará to its southern boundaries along Tocantins, Mato Grosso, Rondônia and Acre states (see figure 13). These new occupation patterns have determined the structuring of that region's economic development. Illegally occupied lands have even worked as collateral to finance later clear-cutting for other land

uses. It has also reshaped the social structures within those areas. Paving and construction of new roads are considered influential drivers in the deforestation trend of the past decade. The Cuiabá-Porto Velho highway (BR-364), linking the capitals of Mato Grosso and Rondônia states, is a good example of infrastructure building-up pressures in a region facing serious conservation challenges. The road is part of a major production flow scheme connecting Santarém in Amazon, where a new soybean cropping pole has rose. (CIFOR, 2010)

Figure 4. Observations of deforestation rate* and the ICMS-E membership in Mato Grosso:

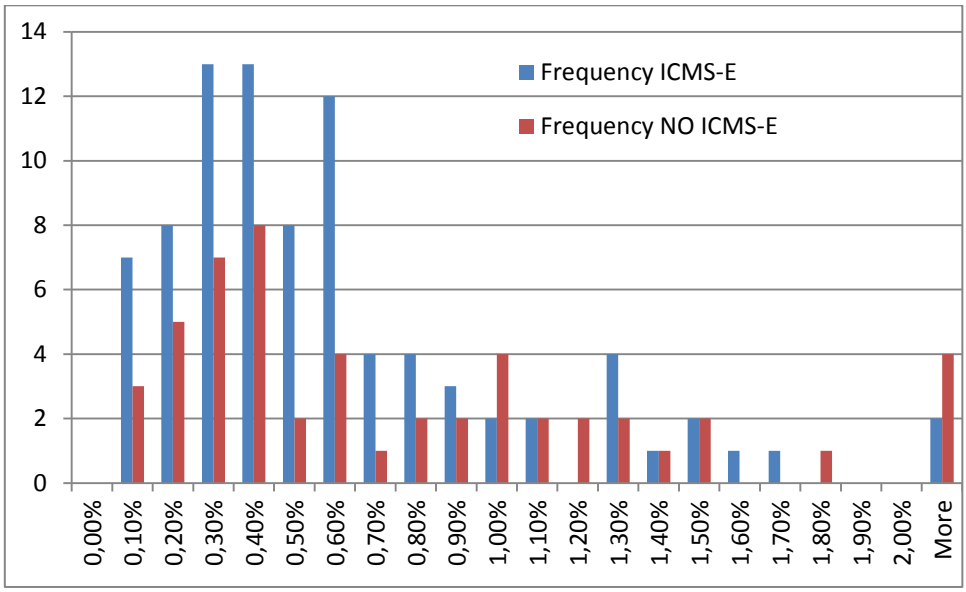


Figure 4

Source: SEMA-MT and *own calculations.

In the graphic above, figure 4, I split the set of the total number of municipalities into the groups that have recurrently received the financial benefits (87 observations) of conservation unities and the cities that are not members (52 observations). Clearly, it is possible to identify that the rates of deforestation[23] of these two groups differ significantly. As expected, the group that is not enrolled in ICMS-S program displays, in average, a higher rate of deforestation. However, the histogram above introduces a coarse analysis of the Mato Grosso's deforestation paths. Moreover, we should be able to observe if there are distortionary or spill-over effects caused by the implementation of this policy, as to the

[23] *The rate of deforestation used is the ratio of the deforested area divided by the municipality's total area.

different municipalities spread over the three major biomes of Mato Grosso; E.g: Does the sense of protection towards the Conservation Unities increase production in areas not protected? However, in order to analyze the effectiveness of the Ecological ICMS as a whole, it is crucial to understand the development of the outcomes achieved by this environmental policy and the level of biodiversity protection over time. Although, the absolute deforestation levels have decreased through the past decade, the relative rate of deforestation remains high (see figure 18, page 73) and imposes a challenge to policy makers (SEMA-MT, 2011).

Have areas of preservation increased with the tax credit?

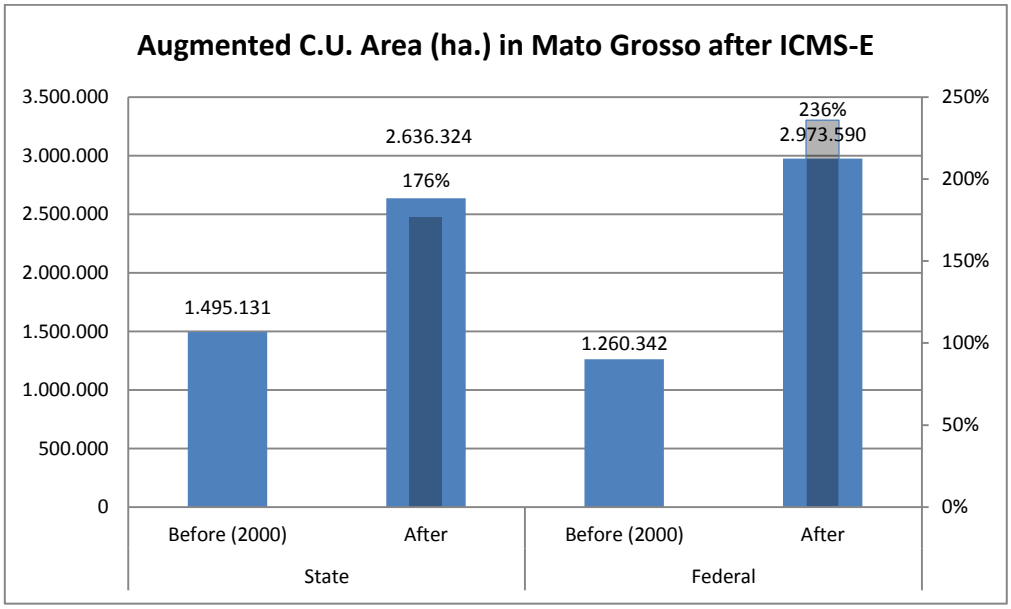


Figure 5

Source: IPEA and own calculations.

In the figure above, we see that the aggregated area's protected surface, measured in hectares, has augmented considerably after the Ecological ICMS. After 2000, year of the implementation of the legislation, these changes in Mato Grosso show an increase of 176% in the state's conservation unities and 236% in federal protected areas. This scenario contradicts one of the most discouraging assumptions about the Conservation Unities. That is, their marginal increase in revenue does not follow the marginal changes in augmented area. In Mato Grosso, it is evidenced, by all different sources of data, that it is not the case. Furthermore, the Federal University of Rio de Janeiro's Research Group for Environmental Economics (Grupo de Pesquisa em Economia do Meio Ambiente IE/UFRJ) has carried out an

important economic research to determine the net benefits of the preservation promoted by Conservation Unities (MEDEIROS et al. 2011). The idea is that augmented protected areas show positive correlation with enhanced green services, such as eco-tourism, for instance. Although private entrepreneurship certainly needs further investigation, in this study, I try to approach it coarsely, at most. Indeed, this research's objective is to introduce the social implications and changes in welfare as a response of the environmental protection. But, if sustainable development is kept as an ultimate goal, we also need to position the Conservation Unities under the perspectives set by the concepts of development, either it is social, environmental or economic. The policy, therefore, has far more likelihood to be successfully implemented if nature and society concomitantly gains with the restrictive changes proposed by regulators in this fiscal federalist model.

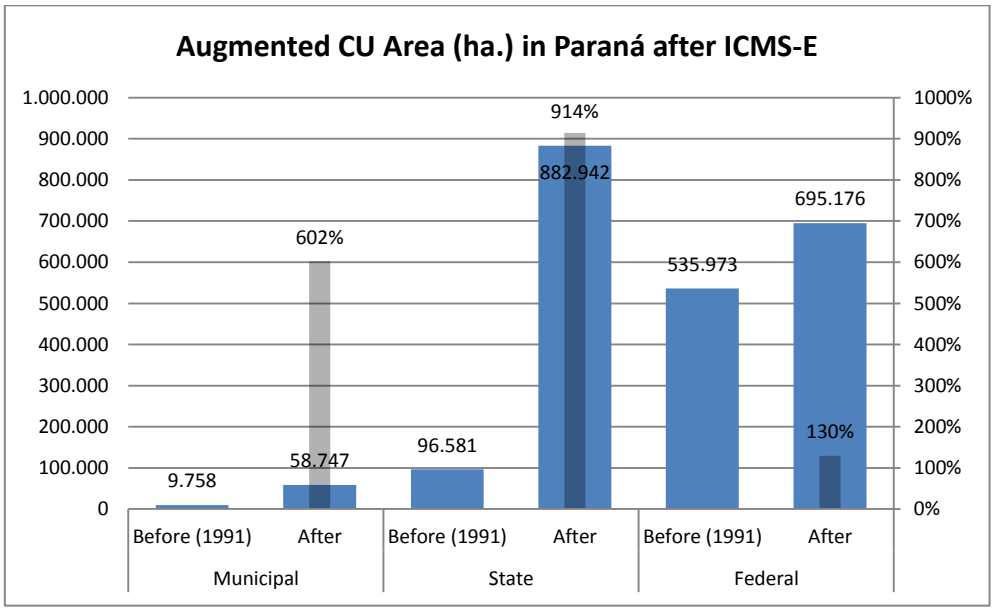


Figure 6

Source: IPEA and own calculations.

The positive outcome observed in Mato Grosso can also be observed in Paraná. After the year that the state law was implemented, through their pioneering legislation, the quantity of municipal conservation unities increased considerably. They have increased as much as 602% within a period no longer than 20 years. Although this increase in area sounds remarkable, it is important to take into account that it represents a relative improvement since the initial base of evaluation was low. Nevertheless, the increase is significant and shows definitively an important change towards conservation of fully protected areas in the

state. The ratios of increased protected surfaces, both in the state and municipal cases, show similar patterns as opposed to the 130% of the federal increase. But, interestingly, the increase of state protected areas is higher than the federal unities. This outcome differs from what we find in Mato Grosso. The reason is quite obvious, if we take into account that the Mato Grosso state lies on the stretch widely known as Deforestation Arch in the Legal Amazon. This is a region where the federal command-and-control policies, against deforestation, play a significant and decisive role. Is the rate of deforestation higher, equal or less than the one observed in municipalities that haven't joined the Ecological ICMS program?

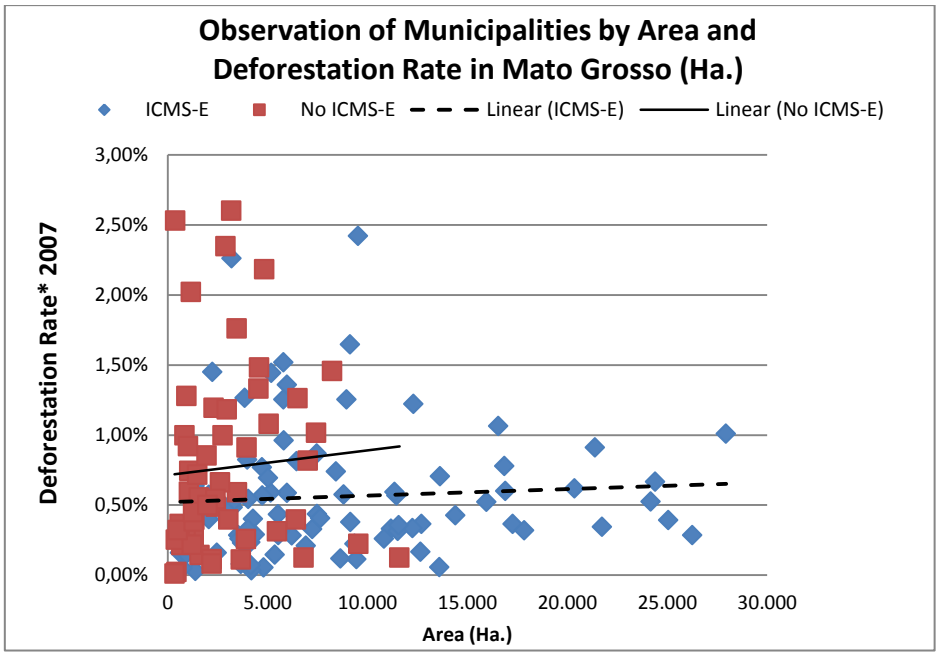


Figure 7

Source: INPE and *own calculations.

The municipalities analyzed in the figure above are separated into two groups; the receptors of ICMS-E and non-receptors. I have preferably labeled them as members throughout this study. The number of municipalities under the 1% deforestation rate threshold accounts 85% for the ICMS-E members against 71% of non-members. This is a vital finding in this project. Without an important contribution provided by the mechanism, in quantitative environmental terms, all other assumptions, whether they were factious or hypothetical, would naturally be considered rather under subjective scrutiny (see table 8). Expectedly, the deforestation rate in the municipalities within the ICMS-E is lower than the ones without; average of 0,56% against 0,77% respectively. However, the scenario is not static. There is an

increasing number of municipalities that have filed for the state and federal analysis on new protected areas. Those applications are currently waiting for the licensing procedures and necessary documentation. The municipalities that haven't joined the program, up to date, are generally smaller in territorial size than the ones receiving the fiscal transfers. In figure 7, we can see the aggregated deforestation rate analyzed from 2001 to 2007. The continuous trend-line depicts the observations regarding municipalities not participating in the Ecological ICMS, while the dashed line depicts the member's.

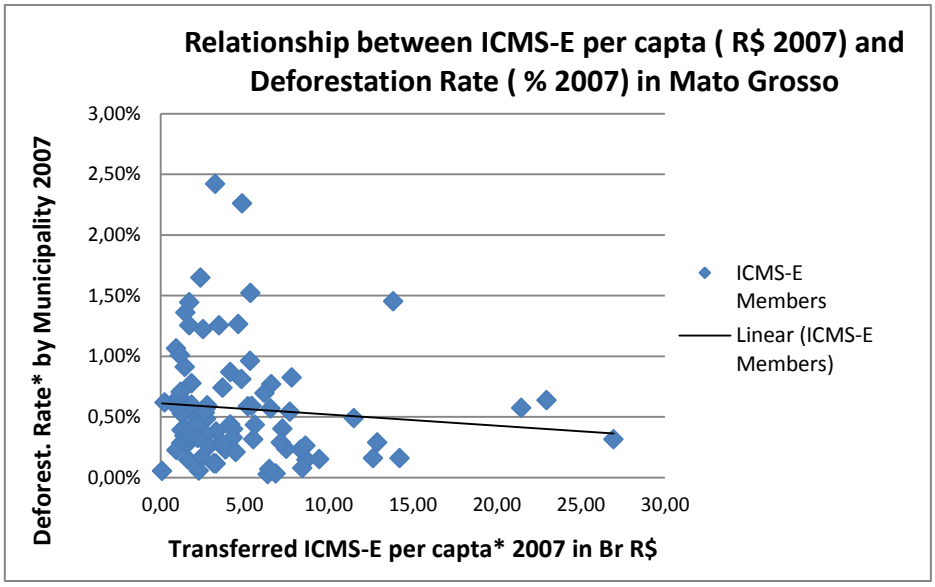


Figure 8

Source: SEMA-MT, INPE and *own calculations.

An important indicator of the cost-effectiveness to the ecological ICMS can be perceived in the scatter plot above. As to 2007, we can observe the inverse relationship of the per person paid compensation rate as to 86 municipalities. Within the observations in figure 8, municipalities protecting more area also attain a higher return in overall reduced deforestation. In other words, the deforestation registered in open access areas, combined with restricted areas, tends to diminish. In this case, clearly, the money spent on conservation unities would be already worthy if deforestation rates could be kept constant. However, as matter of fact, for each monetary unit paid, there is a gain in terms of environmental value. In average, the deforestation rate was as high as 0,62% for municipalities paying a monetary compensation per capta close to zero; in other hand, municipalities paying R$26,95 per inhabitant would have, most likely, achieved a natural forest degradation rate as low as 0,32%.

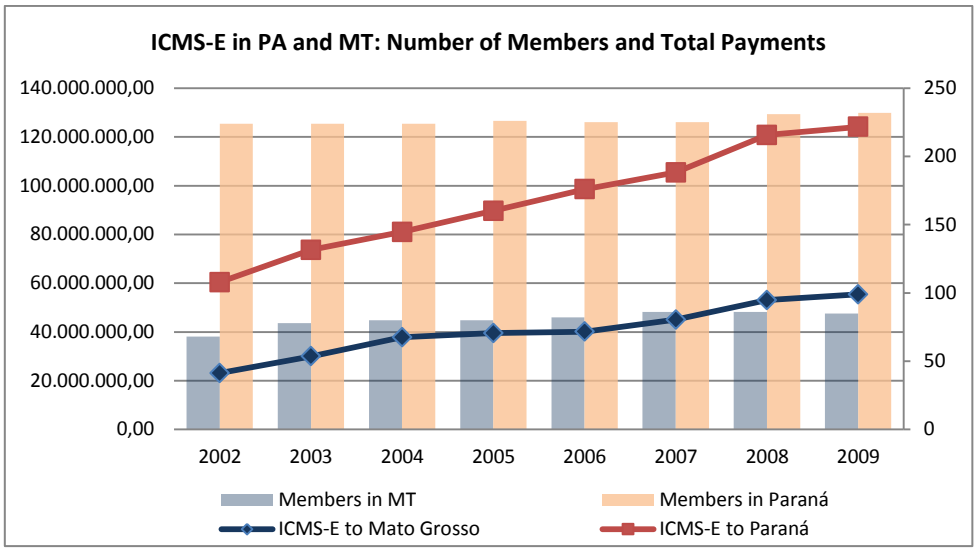


Figure 9

Source: SEMA-MT and own calculations.

In figure 9, both the states of Paraná and Mato Grosso contradict the hypothesis that an increased number of municipalities cause diminishing returns to the members. It hasn't proved so in this investigation, nor does it keep the gains at same levels of the rate of change as to members entering the compensational policy. In the Paraná, the total ICMS-E increased 105% as from 2002 to 2009 (not discounted inflation). With the discounted accumulated inflation in the period (2002-2009) of 63,71%[24], the transfer would have valued over 75 million Brazilian Reais back in 2002. In Mato Grosso, this gain was even higher with an improvement of 140%. When the inflation in the same period is discounted, the amount transferred to the state in 2009 accounts for over 33 million reais; back in 2002. Thus, taken the inflation as discounted, both states increased their compensations as much as 25,6% and 46,6%, respectively. The analysis has showed quite a steady growth in terms of payments received by the members. Literature, up to date, has obviously addressed the ecological ICMS with the deserved skepticism of any investigation. Much of this questioning regards the ability of the policy to achieve constant or increased returns to scale. This concern led even authors to use the term "zero-sum-game-policy"; a metaphor to explain the counter-

[24] The inflation index used to this discounting simulation is the IGP-DI (2002-2009) measured by the FGV (Fundacão Getúlio Vargas) and reported by IPEA (Instituto de Pesquisa Econômica Aplicada). It can be formaly expressed such as: $\int_{2002}^{2009} K(t)e^{-rt}dt$; is the discounted present value and where r is the compounded interest rate and $K(2002)$ is the capital (Brazilian Reais) rate at beginning of the period.

effect of the increased base of the fiscal transfer's receptors. The Minas Gerais and São Paulo cases are good illustrations of how this effect may take place. The incremental share of the ICMS-E was not enough to overcome the effects of the enlarged quantity of members and the monetary consequences of capital devaluation. My own assumption, as far as this study goes, is that the weights of these states' allocation indexes are too weak to compensate changes occurred due to macro-economic circumstances. This loss of compensation strength seems to casually impact the financial outcomes of the sums transferred to the municipalities. That is the scenario in São Paulo, where the allocation criterion rewards merely 0.5% of the total ICMS, and in Minas Gerais, where the allocation criterion recompenses just 1%. Moving ahead, what to expect next in Paraná and Mato Grosso? Since roughly 60% of the municipalities have already joined the program as to 2012, in both states, the effects caused by the addition of new entrants are expected to be only marginal. Even if there are minor short-run constrains, in the long-run, economic growth tends to eventually off-set current losses. This implies that municipalities could have more flexibility to plan their budgeting accordingly.

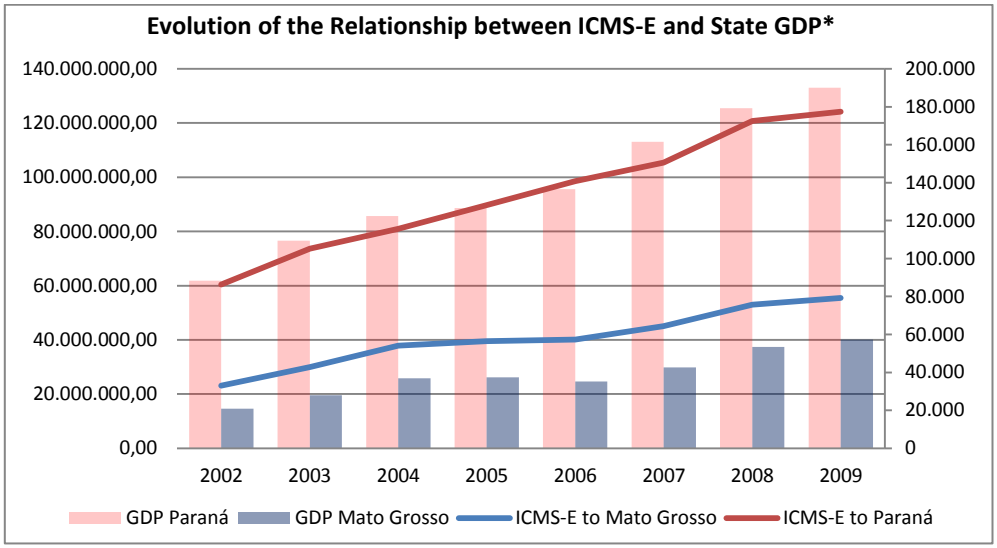


Figure 10

Source: IPEA, IBGE, SEMA-MT and own calculations.*(million).

Figure 10 shows the evolution of the GDP and ecological ICMS in both states. It's clear that, despite two states that have implemented the compensation to the municipalities at different points in time, based on different set of laws, not to mention the political aspects involved, and with distinct patterns of economic activities, present so similar growth paths. A

feasible hypothesis would be that since the source of capital stock is the ICMS (added-value tax), a fiscal policy based on commercial and industrial performance, the impact caused by the influences of economic growth is inevitable, thus, generating a positive effect on the ICMS-E.

Regression Model – Expected Ecological ICMS.

Data Analysis

In this test, I run an OLS (Ordinary Least Square) model, widely applied in Social Sciences, to determine the impact of drivers that may interfere in the results achieved with the ecological ICMS (WATSON, 2007). The objective is to identify potential outcomes as to the rate of change in the expected value of the ecological ICMS for each of the receptors. The most important goal is, in fact, to identify whether changes in education patterns provided by the measurements of the education quality recently implemented in Brazil, in a federal level, are relevant outcomes with the conservation unity's context. The performance index, named Prova Brasil, is isolated from the biannual data report of the MEC (Brazilian Ministry of Education). From which I could extract the performance of the public schools financed strictly, under jurisdiction terms, by the municipal budget. The first release was in the year of 2005 and the last available release is 2009. The examination's index results are filtered according to the following specifications*: Ensino Fundamental Regular - Séries Finais-5ª a 8ª série; Recalculado em Junho de 2011; Prova Brasil -Nota Média Padronizada (N); Rede Municipal*. The index expresses the means of the grades achieved by students, in elementary scholar years, in standardized methodological examinations in Portuguese and Mathematics. First, I tested for the bivariate correlation of independent and independent variable. Their relationships have showed a consistent parallel within previous expectations mentioned in the explained covariance matrix. Furthermore, all tests used a 95% confidence interval. The data used relies on five major determinants. The area of the conservation unities is provided by annual accounting reports released by the Environmental Department of Mato Grosso (Memória de Cálculo do ICMS-E). The larger is the area, the higher is the expected value by each municipality, but this number is corrected by other coefficients; i.e.: the ICMS (value-added tax generated in each municipality). Although the complete universe of municipalities includes 141 municipalities, I have only considered the ones that provide municipal education to the local population. In total, they comprehend 94 municipalities, all from

which 65 received the fiscal incentive and 29 are not enrolled in the program. Checking for the reduction on the uncertainties provided by the original data, we can see that it has reasonably returned with an R^2 of 0,32. Although this result has been enhanced in other tests, I stick to the variables used here due to their literal and contextual relevance. Although GDP per capta is an index commonly used in studies on land coverage and changes in natural forest patterns, I use the ICMS-E per capta in order to capture the distributional influences of this municipal outcome in my set of parameters.

Result Analysis

a) Test 1: Dependent Variable ICMS-E and independent variables with no treatment.

Regression Statistics	
Multiple R	0,57
R Square	0,32
Adjusted R Square	0,29
Standard Error	537001,62
Observations	94

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	378332,73	138569,85	2,73	0,01	102997,40	653668,07
Area CU	0,36	0,06	6,28	<0,001	0,24	0,47
Def. Rate	-766348,70	1109405,59	-0,69	0,49	-970713,96	1438016,57
Melhor. P.Brasil	56370,84	103000,79	0,55	0,59	-148289,53	261031,22
ICMS	0,00	0,00	0,20	0,84	-0,01	0,01

b) Test 2: Dependent Variable ICMS-E and Log 10 transformation for the independent variables Area CU and ICMS (added-value tax)

Regression Statistics	
Multiple R	0,66
R Square	0,44
Adjusted R Square	0,42
Standard Error	486004,82
Observations	94

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1215549,07	897519,09	1,35	0,18	-567802,25	2998900,39
Log_{10} Area CU	183790,72	22651,74	8,11	<0,001	138782,19	228799,25
Def. Rate	1304364,19	1001609,42	-1,30	0,20	3294540,78	685812,40
Melhor. P.Brasil	18347,67	95114,68	0,19	0,85	-170643,17	207338,50
Log_{10} ICMS	-188784,45	135723,17	-1,39	0,17	-458463,50	80894,59

In both cases, it is important to see that the “Melhor Prova Brasil” (changes in performance, either improvement or decay) is a positively relevant, although not determinant, parameter in the composition of the expected transfers. These findings support evidences showing that more robust municipal capitalization, capable of minimizing financial burden, such as cash flow management, have an impact on social welfare, or at least, on welfare services. Municipalities that are not members of the Ecological ICMS-E finance their educational expenses with the regular annual budget calculated upon their fiscal revenue. Thus, the value within the ICMS-E received is zero. The relationship between the ICMS-E and area is clear. Conservations unities in Mato Grosso attain their index based on the classification of the unities by the territorial surface (national parks, indigenous land, biological reserve, etc.) as opposed to Paraná, where the quality indicator plays a bigger weight than the area itself. Likewise, the deforestation rates are expected to be reduced when the conservational and economic factors are positively correlated (EWERS, 2005). That is, municipalities with higher per capta income, depicted here through the ICMS-E per capta, combined with higher GDP (depicted here through the Added-Value activity) tends to reduce negative forest changes and/or increase forest coverage. Note that a more elaborated analysis would possibly take other factors into account such as inequality levels, industrial stress, modernization and etc. In the second test, it follows that, in order to correct the skewness and kurtosis effects on the distributions as to the municipality’s areas in hectares and ICMS (tha added-value revenue), I use a log transformation of these independent variables. This returns a higher R^2 with a reduced t-stat as to the intercept. Ideally, we should be looking for a t-stat equivalent or superior to 1,99, for two-sided distribution with 5% significance level, given the sample size and the confidence intervals. However, the significance probability in both tests show important responses in the “Melhor Prova Brasil” parameter. That is, the null hypothesis should not be rejected. Both regression tests return 89 residuals and 4 perfect linear fits (WATSON, 2007).

5- Conclusion

Considering the state level extension of this PES mechanism, any new finding would make more sense if critical questions in the literature, few of which unsolved, could be examined in Mato Grosso. This has a reason. Mato Grosso is a strategic territory covering three different biomes (all presenting high levels of biodiversity), one of which is the Amazon forest, and under intensified industrial and agricultural stress. Thus, passing the test there can eventually be considered a credential for the ICMS-E as an environmental policy. As to this regard, the improvement of welfare levels was a central concern of this study, right from the beginning. The importance of this point was, for instance, evidenced through the commitment of several communities adopting this pioneering strategy to solve for their environmental challenges, where not so seldom, relative inequality levels are high and social indicators are low. Both quantitative and qualitative analyses suggest that the social trends play a role in the final result of this PES mechanism. Intrinsically, the question is indeed what drivers are weightier. Given that the priorities of the local public decision-makers must be determined based on "vis-à-vis" and "door-to-door" political negotiations, the reinvestment of financial resources, purely into ecology, is not likely to take place without any binding jurisdiction. This, however, might not be exactly considered a tragedy, even in the extreme cases, where environmental concerns are factiously set aside. In Brazil, the institutional and legal framework (in the municipal, state and federal levels and in all three federative powers) strictly determines that the public budget, for the subsequent fiscal year, must be planned and approved ahead; the well-known "Lei de Responsabilidade Fiscal" (Fiscal Responsibility Law). So, it's imperative to shed light on the transparency[25] of the local budgets, key components of ecological ICMS-E compensations. Thereafter, demonstrating the features of the financial (quantitative) relationship between capital and public welfare spending is quite straight forward; the doubts are raised, nevertheless, when we look rather into the efficiency and effectiveness aspects of these payments. Moving ahead, the study

[25] The "Lei de Acesso à Informacão" (Information Access Law), "Lei Federal nº 12.527", passed on May, 16th of 2012, safeguards full and unrestricted access to any public information in all federative levels and powers (Brazilian Government, 2012).

has also verified that regional economic growth has an important influence in the financial outcomes of the program. A positive trend here guarantees that the current and future attractiveness of this PES strategy by the municipalities, and moreover, by country-level policy makers, is preserved. This perception has been well documented in the up-to-date literature. From the data analysis, in Mato Grosso, the figures show that the state's economic growth has rewarded the ICMS-E stakeholders. Even with new members being added into the calculation base, the amounts have not diminished since the ICMS-E implementation. This has also been the case in Paraná, for instance, where the weight of the conservation factor, in face of the allocation criteria, allows first: an increasing compensation level over time; and second: a reduced exposure of the transfers, from the state perspective, as to exogenous effects of the Brazilian economy. Thus, if economic activity is not conflicting with environmental objectives, then, economic growth (i.e. either through increase in productivity and/or improvement of technologies) has a positive effect on the ICMS-E compensation and on reducing non-beneficial off-setting. Deforestation rates in municipalities, eligible to the compensation, are lower than in those not participating in the program between 2001 and 2007. Another important indicator, fire incidents have been more intense in regions with open access but, whatsoever, not strict to them. Evidencing this conclusion, the spatial forest burning analysis is a good bird's eye view. It leads to the comprehension that the logic of obstructing access to areas might not be sufficient to completely halt deforestation inside the conservation unities. However, the ICMS-E certainly encourages biodiversity protection through environmental awareness and community engagement; an outcome widely discussed in previous investigations as well. The combination of these factors, often inseparable, needs to be further analyzed. In the municipalities where there are ICMS-E transfers, financing of municipal public schools shows modest, but relevant, relationship with the improvement of education. My hypothesis is that the ICMS-E is an important financial inflow, not just augmenting the budget, but also alleviating eventual cash flow burdens in those communities. At last, within the limited scope of this project, it's not clear that the ecological ICMS can be considered an efficient fiscal policy, but it seems to be an effective environmental mechanism. It thoroughly deserves further investigation.

6- References

Bibliography

Governo do Paraná. (2012). *http://www.uc.pr.gov.br/modules/conteudo*. Retrieved from Unidades de Conservacão Governo do Paraná: http://www.uc.pr.gov.br/modules/conteudo/conteudo.php?conteudo=56

ALMEIDA, P. e. (2010). Análise sobre a eficiência socioeconômica e ambiental no uso do ICMS Ecológico.

ANGELSEN, A. (2009). *Realising REDD+.* CIFOR.

ANGELSEN, A. e. (2009). *Reducing Emissions from Deforestation and Forest Degradation (REDD): An Options Assessment Report.* Meridian Institute.

ARAUJO, C., BONJEAN, C. A., COMBES, J.-L., MOTEL, P. C., & REIS, E. J. (2006). Land Reform and Deforestation in the Brazilian Amazonia.

ARROW, K. J. (2007). Global Climate Change: A Challenge to Policy. *Berkeley Eletronic Press*.

ASHEIM, G. (1994). Sustainability - Ethical foundations and economic properties. *World Bank Policy Research Working Paper* , 1302 .

ASHEIM, G. (2000). Green national accounting: why and how? . *Environment and Development Economics* , 5.

AZZONI, C. R., & ISAIB, J. Y. (1994). Estimating the costs of environmental protection in Brazil. *Ecological Economics*, 127-133.

BARBIER, E. B. (2004). Agricultural Expansion, Resource Booms and Growth in Latin America: implications for long-run economic development. *World Development 32*, pp. 137-157.

BARBIER, E. B. (2004). Explaining Agricultural Land Expansion and Deforestation in Developing Countries. *Oxford Journals* .

BARBIER, E. B., & C., B. J. (2001). The Economics of Tropical Deforestation. *Journal of Economic Surveys 15*, pp. 413-32.

BARBIERI, J. C., & LAGE, A. C. (2001). Conceitos, problemas e pontos de partida para políticas de desenvolvimento sustentável. *ENANPAD*, (p. 25). Campinas.

BARRETT, S. (2008). A Portfolio System of Climate Treaties. *The Harvard Project on International Climate Agreements*.

BRAGA, T., & MIKHAILOVA, I. (2004). Local Sustainability Measurements and Determinants: Investigating Industrial Stress, Economic Performance and Local Governance at Piracicaba Basin (Brazil). (pp. (p. 79 – 95)). CEDEPLAR/UFMG In: Klaus Jacob, Manfred Binder and Anna Wieczorek (eds.).

BURROUGHS, W. J. (2009). *Climate Change: A Multidisciplinary Approach.* Cambridge.

BöRNER, J. e. (2009). Direct Conservation Payments in the Brazilian Amazon: Scope and Equity Implications, Ecological Economics (2009). *Ecological Economics*.

Câmara, E. N.-T. (2012, 03 14). *Expressão Nacional discute o novo Código Florestal.* Retrieved from Câmara dos Deputados - TV: http://www2.camara.gov.br/tv/materias/EXPRESSAO-NACIONAL/411522-EXPRESSAO-NACIONAL-DISCUTE-O-NOVO-CODIGO-FLORESTAL-(BL.2).html

CEDEPLAR. (2011). *Home*. Retrieved from Centro de Deselvovimento e Planejamento Regional - UFMG: http://www.cedeplar.ufmg.br/index.php

CIFOR. (2010, July). *Learning from REDD: A Global Comparative Study - Country Profile Report: Brazil.* Retrieved 2010, from Center for International Forestry Research (CIFOR): http://www.cifor.org/

CIFOR. (2012, January 20). *Home*. Retrieved January 20, 2012, from Center for International Forestry Research (CIFOR): http://www.cifor.org/

EHRHARDT-MARTINEZ, K. (1998). Social Determinants of Deforestation in Developing Countries: A Cross-National Study. *Social Forces* , 77(2):567-586.

EWERS, R. M. (2005). Interaction effects between economic development and forest cover determine deforestatoin rates. *Global Environmental Change*.

FAO. (2012). *Forestry*. Retrieved 2011, from Food and Agiculture Organization of the United Nations: http://www.fao.org/forestry/en/

FEARNSIDE, P. M. (2007). Amazon Forest Maintenance as a Source of Environmental Services. *Instituto Nacional de Pesquisas da Amazônia (INPA)*.

FERNANDES, L. L., COELHO, A. B., FERNANDES, E. A., & LIMA, J. E. (jan./jun.2010). Efeitos Redistributivos e Determinantes de Recebimento do ICMS Ecológico pelos Municípios Mineiros. *Textos de Economia, Florianópolis*, v.13, n.1, p.75-118.

FERNANDES, L. L., COELHO, A., FERNANDES, E. A., & LIMA, J. E. (2011). Compensação e Incentivo à Proteção Ambiental: o caso do ICMS Ecológico em Minas Gerais.

FREITAS, A. L. (2011, May). Science and Politics of Climate Change. *Climate Change: A Contextual Overview*. Oslo, Norway: SUM - UiO.

GORDON, H. S. (1954). The Economic Theory of a Common-Property Resource: The Fishery. *The Journal of Political Economy, 62(2)*, 124–142.

GRIEG-GRAN, M. (2000). Fiscal Incentives for Biodiversity Conservation: The ICMS Ecológico in Brazil. *International Institute for Environment and Development – IIED*.

HICKS, J. (1939). The Foundations of Welfare Economics. *Economic Journal*, 49 (196): 696–712.

HINDRIKS, J., & MYLES, G. (2006). *Intermediate Public Economics.* The MIT Press.

IBGE. (2011). *Home*. Retrieved from Instituito Brasileiro de Geografia e Estatística: http://www.ibge.gov.br/home/

INPE. (2011). *Home*. Retrieved from Instituto Nacional de Pesquisas Espaciais: http://www.inpe.br/

IPEA DATA. (2011). *Home*. Retrieved from IPEA DATA - Instituto de Pesquisa Econômica Aplicada: http://www.ipeadata.gov.br/

IRAWAN, S., & TACCONI, L. (2009). Reducing Emissions from Deforestation and Forest. *International Forestry Review Vol.11(4)*.

JOÃO, C. G. (2004). ICMS-ECOLÓGICO. Um Instrumento Econômico de Apoio à Sustentabilidade. *Tese (Doutorado em Engenharia de Produção)*. Santa Catarina: Curso de Pós-Graduação em Engenharia de Produção. Universidade Federal de Santa Catarina.

KALDOR, N. (1939). "Welfare Propositions in Economics and Interpersonal Comparisons of Utility.". *Economic Journal* , 49(145): 549–52.

KLEIN, F. B., DE SOUZA, M. S., & ALMEIDA, P. S. (?2009?). Análise sobre a eficiência socioeconômica e ambiental no uso do ICMS Ecológico.

KÜTTING, G., & LIPSCHUTZ, R. (2009). *Environmental Governance.* New York: Routledge.

LOUREIRO, W. (2002). O ICMS Ecológico na Biodiversidade.

LOUREIRO, W. e. (2008). *ICMS Ecológico por Biodiversidade.* SEMA - Secretaria de Meio Ambiente do Estado do Paraná.

LOUREIRO, W., & MATINEZ, A. (2009). ICMS Ecológico como instrumento de apoio as RPPN no Paraná.

LOUREIRO, W., PINTO, M., & MOTTA, M. (2008). Legislacão Atualizada do ICMS Ecológico por Biodiversidade. *Projeto ICMS Ecológico por Biodiversidade*. Paraná, Brasil: Secretaria de Estado do Meio Ambiente e Recursos Hídricos .

MANDL, U., DIERX, A., & ILZKOVITZ, F. (2008). The Effectiveness and Efficiency of Public Spending. *Economic Papers by the Directorate-General for Economic and Financial Affairs of the European Commission*.

MARQUES, D. (22). A Cidade que Ganha para Conservar a Natureza. *Revista Horizonte Geográfico*.

MAY, P., & BRENT, M. (2010). The Context of REDD+ in Brazil; Drivers, agents and institutions. *Center for International Forestry Research*.

MAY, P., NETO, V., DENARDIN, V., & LOUREIRO, W. (2002). Using Fiscal Instruments to Encourage Conservation: Municipal Responses to the “Ecological” Value-added Tax in Paraná and Minas Gerais, Brazil. In I. P. al., *Selling Forest Environmen.*

MEC - Ministério da Educacão. (2012, Feb). *Ministério da Educacão do Brasil*. Retrieved from Educacão - Prova Brasil: http://portal.mec.gov.br/index.php?option=com_content&view=article&id=210&Itemid=324

MEDEIROS, R., YOUNG, C.E.F., & PAVESE, H. B. (2011). *Contribuição das unidades de conservação brasileiras para a economia nacional: Sumário Executivo.* Brasília: UNEP-WCMC, 44p.

NETO, F. C. (2008). A Construcão dos Mercados de Servicos Ambientais e suas Implicaões para o Desenvolvimento Sustentável do Brasil. UFFRJ.

NINA - Norwegian Institute for Natural Research. (2010). *POLICYMIX.* Oslo.

NINA. (2011). *Review of the Policy Instruments and Their Roles in a Policy Mix*. Retrieved 2010, from POLICYMIX: http://policymix.nina.no/Home.aspx

PARETO, V. (1897). Cours d'Economie Politique, Lausanne.

PEREIRA, M., & GIMENES, M. (2009). Cálculo de Índices Ambientais dos Principais Municípios Paranaenses com Base no ICMS Ecológico. *Simpósio de Pós-Graduacão em Engenharia Urbana.* Maringá: SIMPGEU.

PERMAN, R., MA, Y., Mc GILVRAY, J., & COMMON, M. (1996). *Natural Resoruce and Environmental Economics.* Pearson.

PIMENTEL, D. e. (1997). Economic and Environmental Benefits of Biodiversity. *BioScience, University of California Press and American Institute of Biological Sciences*.

PLOEG, F. V. (2010). Voracious Transformation of a Common Natural Resource into Productive Capital. *International Economic Review*.

RAMALHO, L., & PASSOS, R. (2009). A Eficácia do ICMS Ecológico como Instrumento de Política Ambiental e o Dever do Estado Quanto à sua Efefetivacão.

REIS, M. (2011). ICMS Ecológico como instrumento de protecão ambiental. Universidade de Marília.

RING, I. (2007). A review of some methodological challenges.

RING, I. e. (2009). Rewarding Benefits Through Payments and Markets. In *TEEB - The Economics of Ecosystems and Biodiversity for National and International Policy Makers.* TEEB for Policy Makers Team.

RING, I. e. (2010). Assessing the role of economic instruments in a policy mix for biodiversity conservation and ecosystem services provision: A review of some methodological challenges.

RING, I. e. (2011). Assessing Fiscal Transfers for Conservation Policies. *9th International Conference of the European Society for Ecological Economics.* Istanbul, June 14–17.

ROBBINS, L. (1952). An Essay on the Nature and Significance of Economic Science. London: Macmillan.

SALANIÉ, B. (2003). Ch. 10: Environmental Taxation. In *The Economics of Taxation .*

SEFAZ- MT. (2012, 03). *Secretaria de Estado da Fazenda do Mato Grosso.* Retrieved from Legislacão: http://www.sefaz.mt.gov.br/spl/portalpaginalegislacao#

SEMA-MT. (2011). *Home*. Retrieved from Secretaria de Meio Ambiente do Mato Grosso: http://www.sema.mt.gov.br/

SEMA-PR. (2011). *Home*. Retrieved from Secretaria de Meio Ambiente e Recursos Hídricios do Paraná: http://www.meioambiente.pr.gov.br/

SEN, A. K. (1970). *Collective choice and social welfare.* Holden-Day.

SEN, A. K., & NUSSBAUM, M. (1993). *The quality of life.* Oxford University Press.

SILVA, G. T., FREITAS, A., & WEISS, M. (2009). Energias renováveis e potenciais efeitos para o desenvolvimento regional no Brasil: uma análise geral. *Revista Cadernos de Economia Unochapecó*.

SMA - SP. (2012). *Coordenadoria de Planejamento Ambiental.* Retrieved from Secretaria de Estado do Meio Ambiente – SP: http://www.ambiente.sp.gov.br/

SYDSÆTER, K., STRØM, A., & BERCK, P. (1998). *Economist's Mathematical Manual.* New York: Springer.

The Nature Conservance. (2011). *Home*. Retrieved from ICMS Ecologico.org.br: http://www.icmsecologico.org.br/

VARIAN, H. R. (1992). *Microeconomic Analysis.* Norton.

VIANA, G. (2000, December 10). *LEI COMPLEMENTAR N° 73, DE 07 DE DEZEMBRO DE 2000 – D.O. 07.12.00.* Retrieved from SEMA Secretaria de Meio Ambiente do Estado do Mato Grosso: http://www.sema.mt.gov.br/

VICTOR, D. G. (2008). Climate Accession Deals: New Strategies for Taming Growth of Greenhouse Gases in Developing. *Discussion Paper 2008-18, Cambridge, Mass.:Harvard Project on International Climate Agreements.*

VOSTI, S. A., WITCOVER, J., & CARPENTIER, C. L. (2002). *Agricultural intensification by smallholders in the Western Amazon: from deforestation to sustainable land use.* Washington D.C.: IFPRI Research Report 130.

WATSON, S. (2007). *Introduction to Econometrics.* Pearson .

7- Table of Figures:

8- List of Tables:

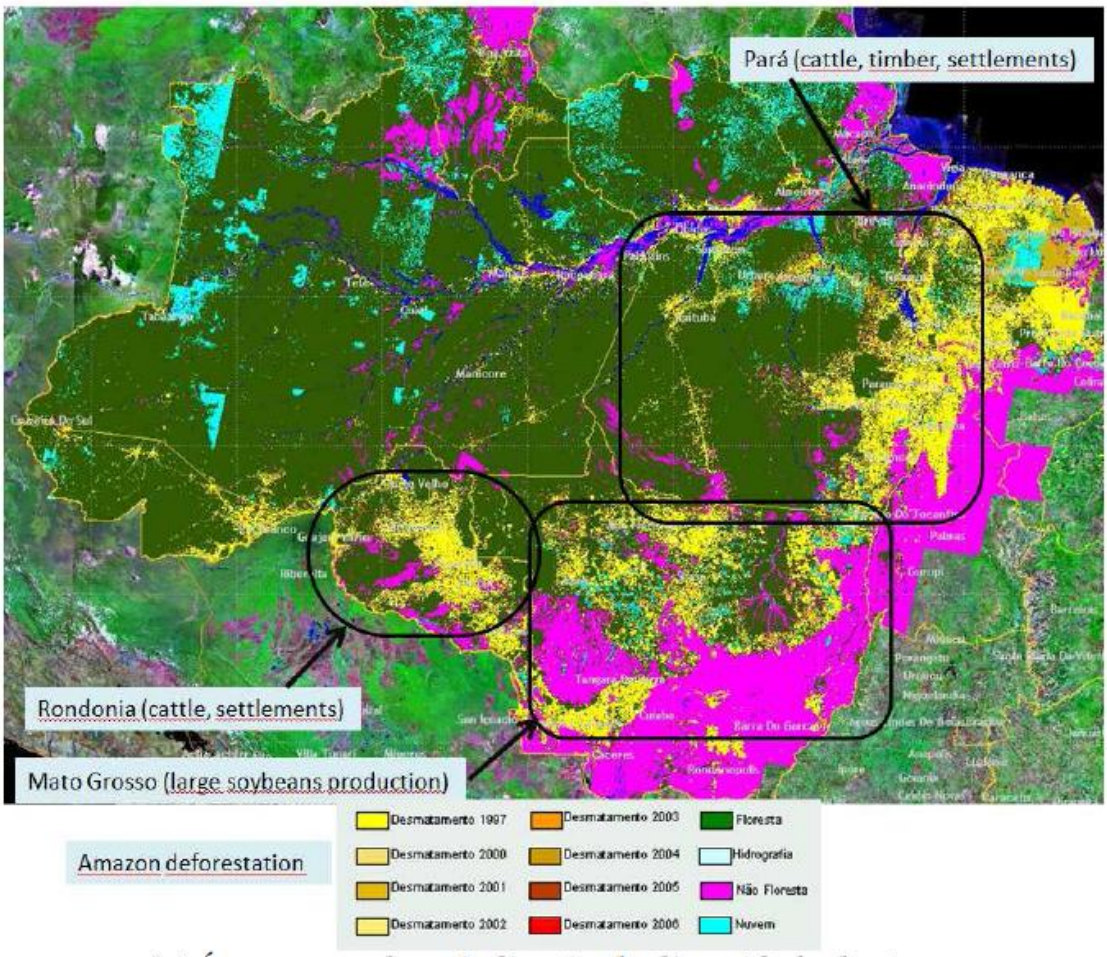
Appendix

Figure 11. The presence of the ecological ICMS in Brazil.

Twelve states in Brazil have introduced the ecological ICMS that redistributes part of their state value-added tax income back to municipalities based on “Conservation Units” system.

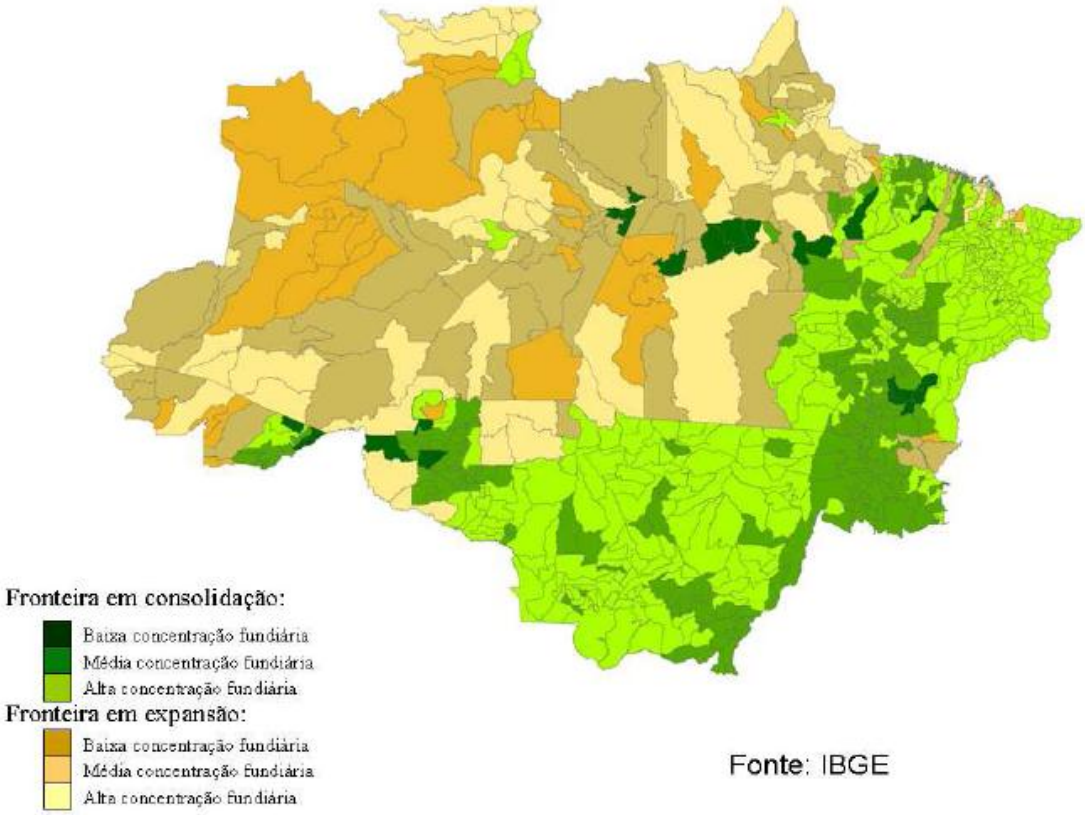
Figure 11

Figure 12: Occupied areas and diversity of actor and activities (IBGE, 2011)**.**

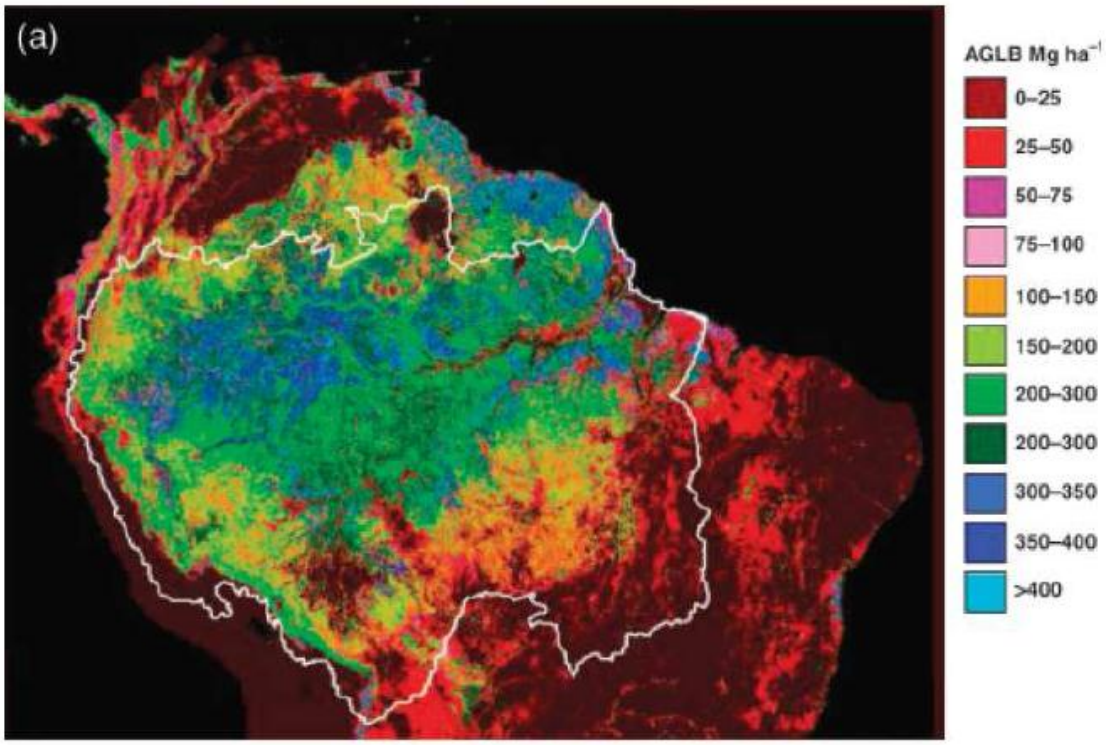


(a) Áreas ocupadas e indicação de diversidade de atores

Figure 12



(b) Estrutura agrária



(c) Biomassa

Figure 13

Figure 14. Illustration of a multi-tiered policy impact assessment framework (NINA - Norwegian Institute for Natural Research, 2010)**.**

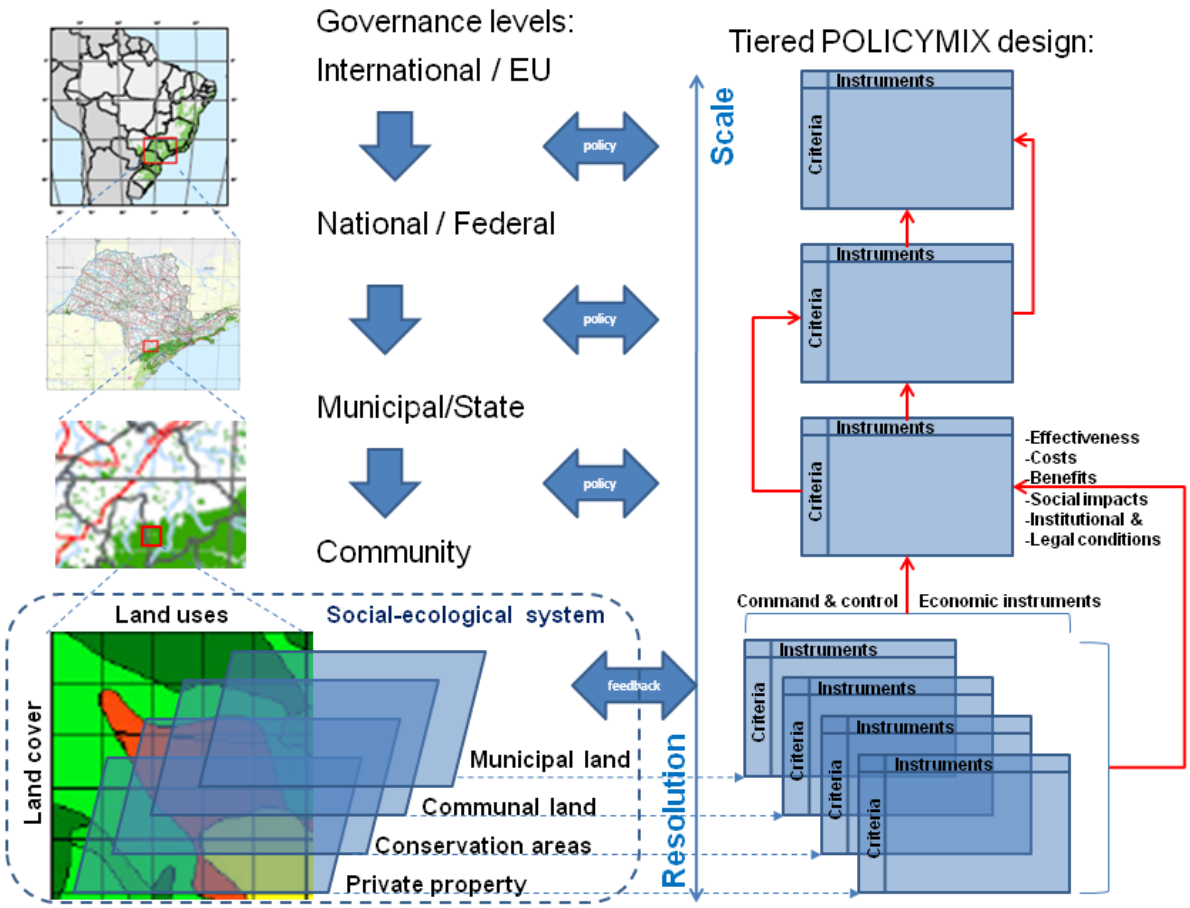


Figure 14

"A multi-tiered policy impact assessment framework needs to address interaction across instruments due to common governance structures of apparently alternative instrument; be robust to correlation across assessment criteria due to spatial interactions (externalities) between land-uses that are subject to policy mixes. Case-based, rather than theory-driven assessment assumes that experiences on the ground determine policy design at higher governance levels".

(RING I. e., Assessing the role of economic instruments in a policy mix for biodiversity conservation and ecosystem services provision: A review of some methodological challenges, 2010)

Figure 15. A multi-tier and multi-scale framework for analysing the impacts of economic instruments in policy mixes on social-ecological systems (RING I. e., Assessing the role of economic instruments in a policy mix for biodiversity conservation and ecosystem services provision: A review of some methodological challenges, 2010)**.**

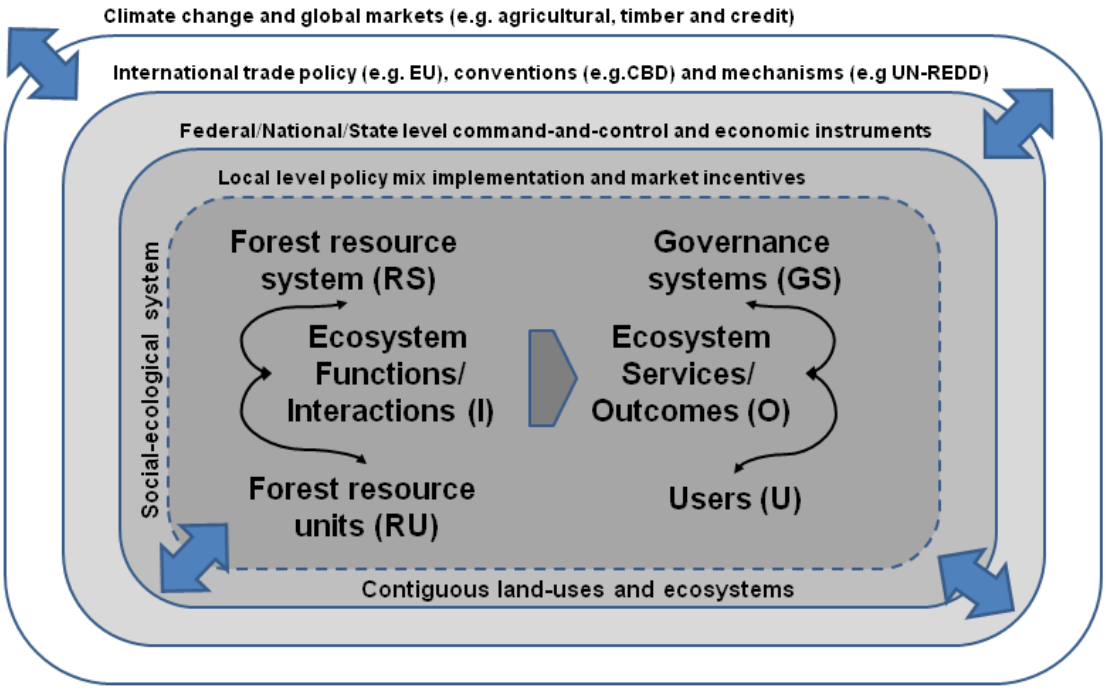


Figure 15

Figure 16. Instruments, administration's jurisdiction and land limits (private and public):

Different economic instruments play different complementary roles across the same landscape, given the configuration of overlapping forest resource, use and governance characteristics. The role of economic valuation is to quantify the externalities (which happens, by definition, across governance interfaces) (POLICIMIX, 2010).

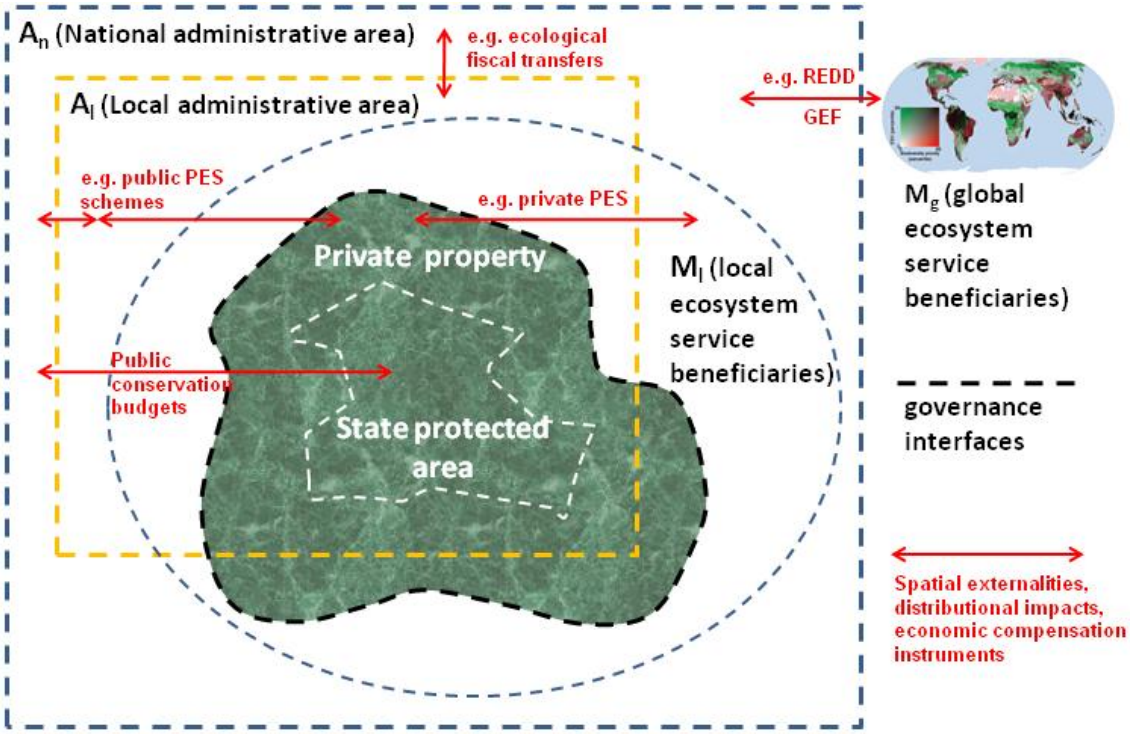


Figure 16

Figure 17. Forest transition stages and policy examples at each stage[26].

"Research has tended to focus on policies causing changes in forest cover. Part of the policy mix in stage 1 and stage 3 is avoiding policy and institutional failure of stage 2". (NINA, 2011)

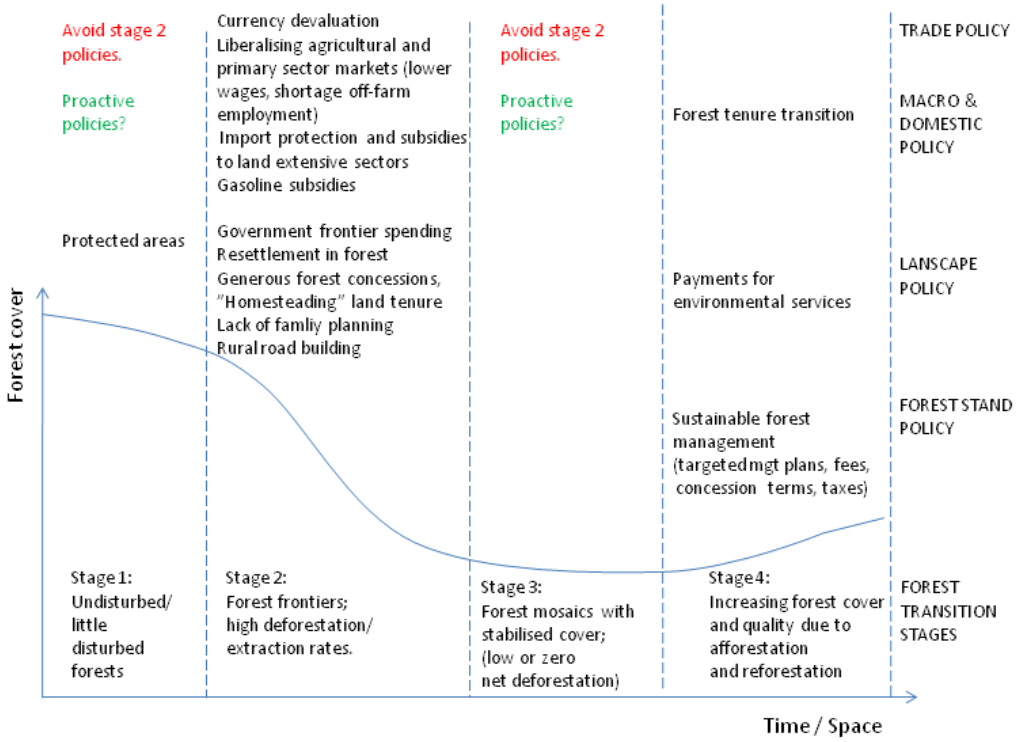


Figure 17

[26] Adapted from Angelsen (2007), Wunder (2003), García-Fernández et al. (2008) and Barbier et al. (2010).

Figure 18: Land Coverage by Biome and Deforestation in Mato Groso: 1999 – 2007

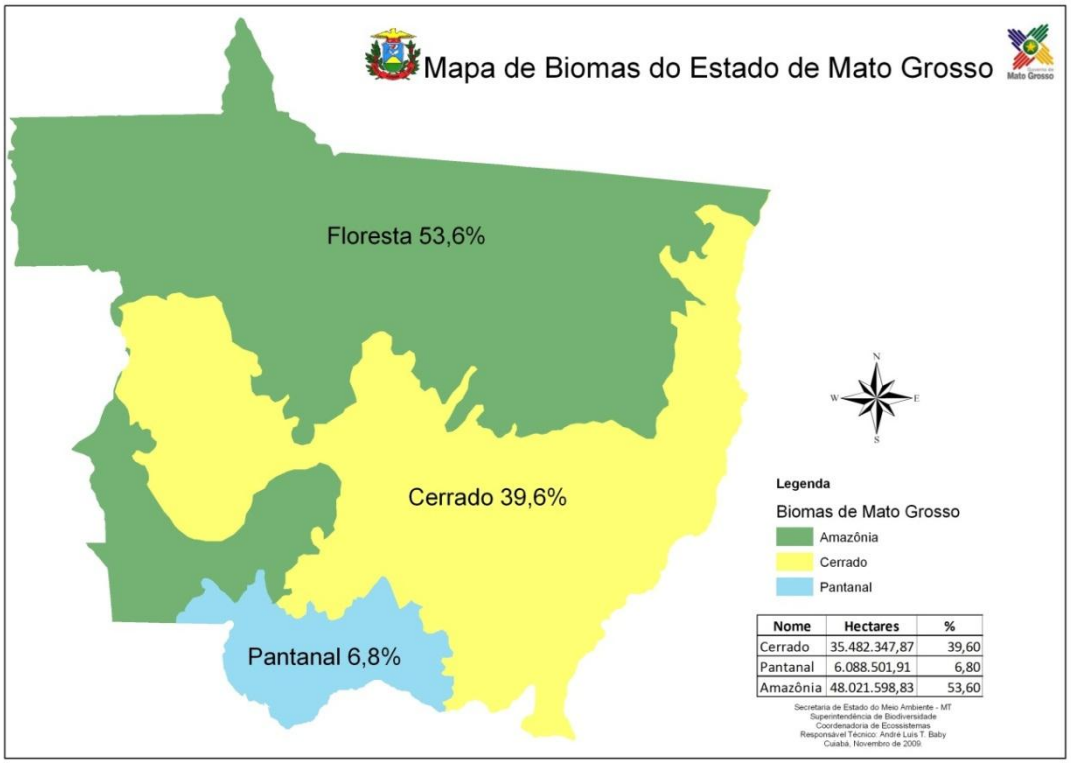
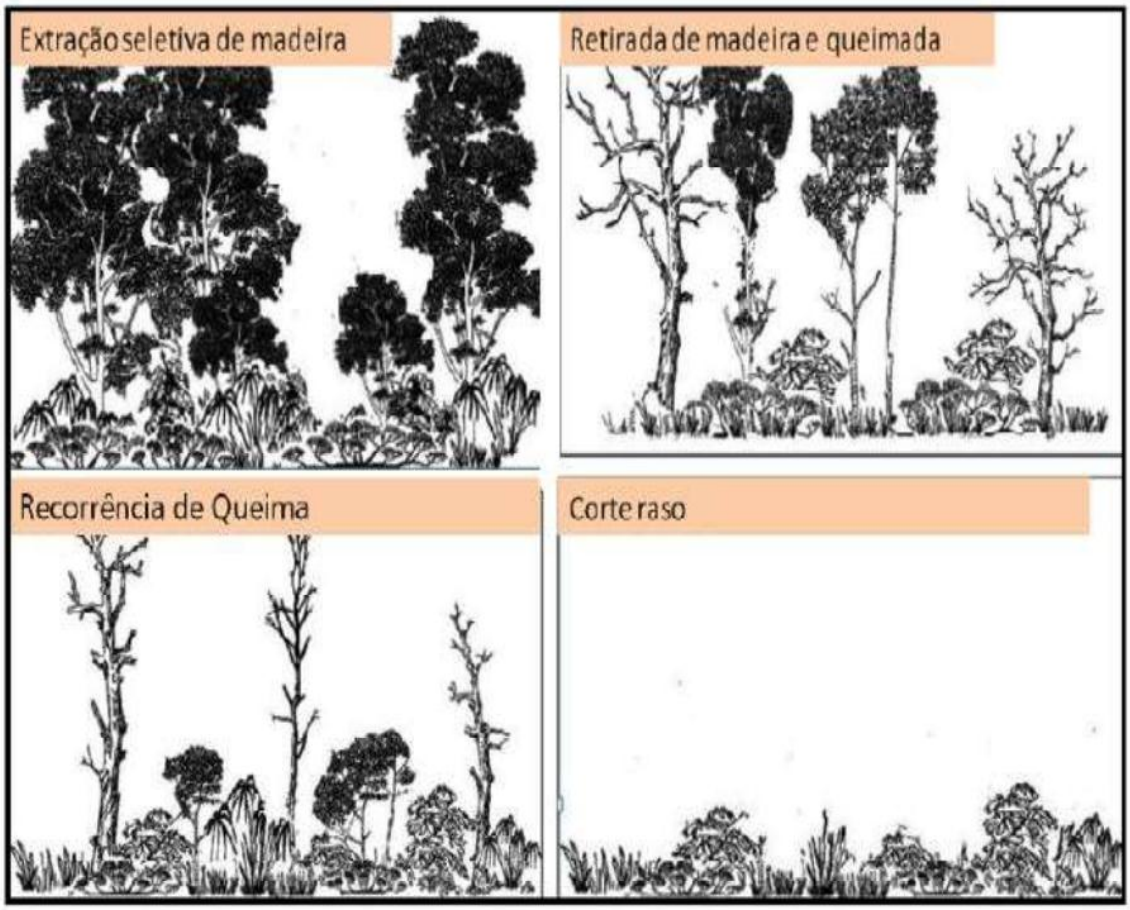


Figure 18

Biome	Area Ha.	Deforest. Ha.	% Def.*
Cerrado	35.484.347,87	16.484.926,17	**46,46%**
Floresta	48.021.598,83	16.398.466,39	**34,15%**
Pantanal	6.088.501,91	1.404.590,89	**23,07%**
	89.594.448,61	**34.287.983,45**	**38,27%**

Source: SEMA-MT and
*own calculations

Figure 19. Classification of selective timber extraction.



Source: INPE (2008:13), based on Barlow & Peres (2008). From left to right: Selective timber extraction; Timber removal and burning; Recurrent burning; Clearcut.

Figure 19

Table 1. Ecological ICMS transferred in 2009 per Federative Stare and contribution by each Conservation Unity criteria indicator.

Table 1

State	Maximun Perct. Allocated to ICMS-E	CU Factor Coefficient	Transfer of ICMS-E in 2009 (Millions of Br R$)	Total Value of the ICMS-E generated by the CU criteria (Million of R$)
Acre	5%	5%		1,5
Amapá	1%	1%	1,0	1
Mato Grosso	5%	5%	55,4	68,4
Mato Grosso do Sul	5%	5%	39,4	39,5
Minas Gerais	1%	1%	45,4	22,7
Paraná	5%	3%	124,1	62,1
Pernambuco	15%	1%		13,5
Rio de Janeiro	3%	1%	37,9	17,1
Rondônia	5%	5%	90,7	90,7
São Paulo	1%	1%	78,2	78,2
Tocantins	13%	4%	29,7	8
		Total	**501,8**	**402,7**

Table 2

Figure13. Ecological ICMS paid to Municipalities, per capta and share in the State Budget, 2009.

State	Population 2009	CU Coefficient	ICMS-E Per Capta	Total Value of the ICMS-E by the CU criteria (Million of R$)*	State Revenue*	ICMS-E CU criteria/ State Budget (%)
Acre	691.132	5%	2,1	1,5	821	0,18%
Amapá	618.807	1%	1,6	1	583	0,17%
Mato Grosso	2.915.428	5%	23,5	68,4	4.464	1,53%
Mato Grosso do Sul	2.354.467	5%	16,8	39,5	4.312	0,92%
Minas Gerais	19.798.130	1%	1,1	22,7	26.836	0,08%
Paraná	10.633.373	3%	5,8	62,1	15.504	0,40%
Pernambuco	8.755.159	1%	1,5	13,5	9.184	0,15%
Rio de Janeiro	15.355.607	1%	1,1	17,1	24.780	0,07%
Rondônia	1.503.928	5%	60,3	90,7	2.088	4,34%
São Paulo	40.935.326	1%	1,9	78,2	77.536	0,10%
Tocantins	1.289.526	4%	6,2	8	1.788	0,45%

Source: SEMA-MT, IPEA, IBGE, INPE and own calculations.

Table- 3. Conservation Unity's Category in Mato Grosso and Correction Factors.

Table 3

ANEXO 3

Categorias de Unidade de Conservação e áreas protegidas, de que trata o artigo 8.º, § 1º e § 4º desta Lei, e seus respectivos fatores de correção:

Fator de correção para categorias de manejo de Unidade de Conservação e outras áreas protegidas.

Categoria de Unidade de Conservação	Fator de Correção
Reserva Biológica	1,0
Estação Ecológica	1,0
Parque Federal, Estadual e Municipal	0,7
Monumento Natural	0,8
Refúgio da Vida Silvestre	0,8
Área de Proteção Ambiental – APA	0,2
Floresta Federal, Estadual e Municipal	0,5
Reserva Extrativista	0,5
Área de Relevante Interesse Ecológico	0,3
Reserva da Fauna	0,4
Reserva de Desenvolvimento Sustentável	0,5
Reserva Particular do Patrimônio Natural	0,2
Estrada Parque	0,3
Terra Indígena	0,7
Área de Proteção Especial	0,5

Source: SEMA-MT

Table 4. ICMS-E in Mato Grosso and Fiscal Allocation Criteria.

Table 4

Critérios	Percentuais por exercício fiscal		
	1º Ano	2º Ano	3º Ano
Receita Própria	8,0%	8,0%	6,0%
População	2,0%	2,0%	2,0%
Área do Município	1,0%	1,0%	1,0%
Cota Igual	9,0%	9,0%	9,0%
Saneamento Ambiental	0,0%	0,0%	2,0%
Unidade de Conservação / Terra Indígena	5,0%	5,0%	5,0%
Soma	25,0%	25,0%	25,0%

Source: SEMA-MT

TABELA 1 - CRITÉRIOS E PERCENTUAIS UTILIZADOS PARA RATEIO DO ICMS A QUE OS MUNICÍPIOS TEM DIREITO NO ESTADO DO MATO GROSSO – 2008

Critérios	Percentuais
Valor Adicionado	75,0%
receita tributária própria	4,0%
População	4,0%
Área do Município	1,0%
Coeficiente social	11,0%
Unidade de Conservação/ Terra Indígena	5,0%
Total	100,0%

Fonte: Lei Estadual nº157/04.

Winners and Losers Analysis – Grieg-Gran (2000)

Conservation Unities in Mato Grosso (Source: SEMA-MT, IPEA, IBGE, INPE and own calculations.)

Table 5

CU Areas

	População	Área	Ecossistema		ICMS-E	2009	2009 Parte do Total Referente							2009
	2007	km2	A	B	S/N	GDP capta	AREA UC	TOTAL ICMS R$	ao ICMS Ecologico	% Receita	IND.UCTI 05%	INDICE FINAL	ICMS-E/ Capita	GDP capta
APIACÁS	7.926	20.364	Amazônia		1	17.760,87	**9.426.941,12**	5072885,78	2702077,60	53,27%	0,255	0,478	340,91	17.760,87
JUINA	38.422	26.251	Cerrado	Amazônia	1	11.344,18	**1.620.673,36**	12018493,13	2373300,36	19,75%	0,224	1,133	61,77	11.344,18
COMODORO	17.939	21.743	Cerrado	Amazônia	1	12.233,70	**1.363.936,00**	7357453,86	2290591,72	31,13%	0,216	0,694	127,69	12.233,70
GAÚCHA DO NORTE	5.816	16.899	Cerrado	Amazônia	1	21.327,30	**814.014,00**	4695357,25	1758982,63	37,46%	0,166	0,443	302,44	21.327,30
QUERÊNCIA	10.682	17.850	Amazônia		1	44.045,53	**728.820,11**	9546088,76	1490929,79	15,62%	0,141	0,900	139,57	44.045,53
ARIPUANÃ	19.100	25.049	Amazônia		1	16.677,67	**655.744,00**	6816703,22	961028,11	14,10%	0,091	0,643	50,32	16.677,67
PEIXOTO DE AZEVEDO	28.987	14.399	Amazônia		1	7.266,32	**643.898,54**	4732496,03	1613184,61	34,09%	0,152	0,446	55,65	7.266,32
TANGARÁ DA SERRA	76.657	11.566	Cerrado	Amazônia	1	16.052,75	**592.173,64**	22051236,28	1867069,11	8,47%	0,176	2,079	24,36	16.052,75
RONDOLÂNDIA	3.348	12.654	Amazônia		1	19.575,28	**589.600,00**	3671695,76	1701450,30	46,34%	0,160	0,346	508,20	19.575,28
FELIZ NATAL	10.279	11.448	Cerrado	Amazônia	1	14.892,07	**526.132,63**	5805067,89	1678204,08	28,91%	0,158	0,547	163,27	14.892,07
SAPEZAL	14.254	13.598	Cerrado		1	90.174,27	**480.829,00**	19361407,46	1291247,62	6,67%	0,122	1,826	90,59	90.174,27
COTRIGUAÇU	13.740	9.124	Amazônia		1	9.035,85	**425.085,00**	3881081,54	1193426,79	30,75%	0,113	0,366	86,86	9.035,85
PARANÁTINGA	20.033	24.178	Cerrado	Amazônia	1	17.828,82	**408.563,00**	8021286,49	615494,91	7,67%	0,058	0,756	30,72	17.828,82
COLNIZA	27.882	27.948	Amazônia		1	9.471,39	**374.333,00**	4985712,42	507578,10	10,18%	0,048	0,470	18,20	9.471,39
COCALINHO	5.841	16.539	Cerrado		1	15.274,24	**296.588,00**	3513277,79	323198,99	9,20%	0,030	0,331	55,33	15.274,24
ROSÁRIO OESTE	18.031	8.802	Cerrado		1	10.997,58	**281.940,77**	3553852,67	334185,81	9,40%	0,032	0,335	18,53	10.997,58
CAMPO NOVO PARECIS	22.322	9.448	Cerrado	Amazônia	1	58.442,03	**277.731,50**	20397699,52	1073367,22	5,26%	0,101	1,923	48,09	58.442,03
CAMPO VERDE	25.924	4.795	Cerrado		1	40.939,17	**277.731,50**	15425550,92	27594,30	0,18%	0,003	1,455	1,06	40.939,17
JUARA	32.023	21.387	Amazônia		1	19.205,99	**261.844,00**	10838598,36	447055,17	4,12%	0,042	1,022	13,96	19.205,99
SÃO FÉLIX DO ARAGUAIA	10.713	16.848	Cerrado		1	14.789,55	**246.611,54**	3389559,47	534493,67	15,77%	0,050	0,320	49,89	14.789,55
	20.496	16.545				23.367	1.014.660	8.756.775	1.239.223	0,19	0,12	0,83	109,37	23.366,73

Winners and Losers Analysis – Grieg-Gran (2000)

Revenue ICMS-E in Mato Grosso (Source: SEMA-MT, IPEA, IBGE, INPE and own calculations.)

Table 6

Revenue ICMS-E

	População	Área	Ecossistema		ICMS-E	2009	2009 Parte do Total Referente							2009
	2007	km2	A	B	S/N	GDP capta	AREA UC	TOTAL ICMS R$	ao ICMS Ecologico	% Receita	IND.UCTI 05%	INDICE FINAL	ICMS-E/ Capita	GDP capta
APIACÁS	7.926	20.364	Amazônia		1	17.760,87	9.426.941,12	5072885,78	**2702077,60**	53,27%	0,255	0,478	340,91	17.760,87
JUINA	38.422	26.251	Cerrado	Amazônia	1	11.344,18	1.620.673,36	12018493,13	**2373300,36**	19,75%	0,224	1,133	61,77	11.344,18
COMODORO	17.939	21.743	Cerrado	Amazônia	1	12.233,70	1.363.936,00	7357453,86	**2290591,72**	31,13%	0,216	0,694	127,69	12.233,70
NOVO SANTO ANTÔNIO	2.110	4.368	Cerrado		1	7.891,89	242.486,45	3001945,52	**2042285,47**	68,03%	0,193	0,283	967,91	7.891,89
ALTO BOA VISTA	5.025	2.242	Cerrado	Amazônia	1	9.690,54	121.393,91	3296351,85	**1977308,43**	59,98%	0,186	0,311	393,49	9.690,54
NOVA NAZARÉ	3.029	4.038	Cerrado		1	9.449,51	218.515,00	3144996,84	**1975696,48**	62,82%	0,186	0,297	652,26	9.449,51
TANGARÁ DA SERRA	76.657	11.566	Cerrado	Amazônia	1	16.052,75	592.173,64	22051236,28	**1867069,11**	8,47%	0,176	2,079	24,36	16.052,75
GAÚCHA DO NORTE	5.816	16.899	Cerrado	Amazônia	1	21.327,30	814.014,00	4695357,25	**1758982,63**	37,46%	0,166	0,443	302,44	21.327,30
CONQUISTA D'OESTE	3.106	2.698	Cerrado	Amazônia	1	11.633,74	128.590,72	3114581,58	**1740391,99**	55,88%	0,164	0,294	560,33	11.633,74
RONDOLÂNDIA	3.348	12.654	Amazônia		1	19.575,28	589.600,00	3671695,76	**1701450,30**	46,34%	0,160	0,346	508,20	19.575,28
FELIZ NATAL	10.279	11.448	Cerrado	Amazônia	1	14.892,07	526.132,63	5805067,89	**1678204,08**	28,91%	0,158	0,547	163,27	14.892,07
PEIXOTO DE AZEVEDO	28.987	14.399	Amazônia		1	7.266,32	643.898,54	4732496,03	**1613184,61**	34,09%	0,152	0,446	55,65	7.266,32
QUERÊNCIA	10.682	17.850	Amazônia		1	44.045,53	728.820,11	9546088,76	**1490929,79**	15,62%	0,141	0,900	139,57	44.045,53
CAMPINÁPOLIS	13.666	5.970	Cerrado		1	7.967,07	232.635,00	4008267,72	**1422813,67**	35,50%	0,134	0,378	104,11	7.967,07
SAPEZAL	14.254	13.598	Cerrado		1	90.174,27	480.829,00	19361407,46	**1291247,62**	6,67%	0,122	1,826	90,59	90.174,27
COTRIGUAÇU	13.740	9.124	Amazônia		1	9.035,85	425.085,00	3881081,54	**1193426,79**	30,75%	0,113	0,366	86,86	9.035,85
CAMPO NOVO PARECIS	22.322	9.448	Cerrado	Amazônia	1	58.442,03	277.731,50	20397699,52	**1073367,22**	5,26%	0,101	1,923	48,09	58.442,03
SANTA CRUZ DO XINGU	2.116	5.625	Amazônia		1	15.283,70	154.564,58	2270240,64	**1003310,36**	44,19%	0,095	0,214	474,15	15.283,70
ARIPUANÃ	19.100	25.049	Amazônia		1	16.677,67	655.744,00	6816703,22	**961028,11**	14,10%	0,091	0,643	50,32	16.677,67
BARRA DO GARÇAS	53.243	9.142	Cerrado		1	13.449,84	246.011,74	13027349,99	**960699,35**	7,37%	0,091	1,228	18,04	13.449,84
	17.588	12.224				20.710	974.489	7.863.570	1.655.868	33,28%	0,16	0,74	258,50	20.709,71

Winners and Losers Analysis – Grieg-Gran (2000)

Deforestation Rate in Mato Grosso (Source: SEMA-MT, IPEA, IBGE, INPE and own calculations.)

Table 7

Aggregated Deforestation 2001-2007

	População	Área	Ecossistema		ICMS-E	2009 Parte do Total Referente							2009		
	2007	km2	A	B	S/N	AREA UC	TOTAL ICMS R$	ao ICMS Ecologico	% Receita	GDP capta	Desm_1999	2001-2007	2001-2007	TOTAL	TOTAL
VERA	9.188	2.951	Cerrado	Amazônia	0		3913172,36	0,00	0,00%	24.656,09	86.605,39	91808,60	**31,1%**	178.413,99	60,46%
ITANHANGÁ	4.703	2.898	Amazônia		0		1981826,16	0,00	0,00%	25.617,57	43.805,69	83223,85	**28,7%**	127.029,54	43,83%
SINOP	105.762	3.194	Amazônia		1	264,00	30088896,93	1505,91	0,01%	15.899,58	148.110,45	79138,41	**24,8%**	227.248,86	71,15%
RESERVA DO CABAÇAL	2.505	371	Cerrado	Amazônia	0		1183998,91	0,00	0,00%	8.979,74	31.072,38	8720,95	**23,5%**	39.793,32	NA
IPIRANGA DO NORTE	4.129	3.467	Cerrado	Amazônia	0		5731076,54	0,00	0,00%	73.987,51	140.784,01	80365,52	**23,2%**	221.149,52	63,79%
JURUENA	8.731	3.190	Amazônia		0		2204160,71	0,00	0,00%	9.532,06	54.711,08	73146,92	**22,9%**	127.858,00	40,08%
CONFRESA	21.361	5.796	Cerrado	Amazônia	1	26.633,00	3567161,96	167782,23	4,70%	11.033,31	208.998,14	132196,99	**22,8%**	341.195,13	58,87%
TABAPORÃ	10.484	8225	Amazônia		0		3572538,72	0,00	0,00%	17.911,16	153.605,86	185275,50	**22,5%**	338.881,35	41,20%
VILA RICA	18.934	7.433	Cerrado	Amazônia	0		4416137,29	0,00	0,00%	13.641,13	250.449,93	153552,53	**20,7%**	404.002,47	54,35%
PARANÁÍTA	11.540	4.830	Amazônia		0		3167574,9	0,00	0,00%	11.546,77	103.444,23	99189,25	**20,5%**	202.633,48	41,95%
NOVO MUNDO	6.725	5.802	Amazônia		1	169.489,60	3379124,13	695414,44	20,58%	13.980,10	134.478,26	117982,19	**20,3%**	252.460,46	43,51%
PORTO DOS GAÚCHOS	6.116	7.012	Amazônia		0		2689606,06	0,00	0,00%	21.103,27	136.561,03	138994,83	**19,8%**	275.555,86	39,30%
SANTA CARMEM	4.319	3.920	Amazônia		0		2743850,85	0,00	0,00%	39.983,14	63.304,88	73760,57	**18,8%**	137.065,46	34,97%
SANTA RITA DO TRIVELATO	2.478	3.345	Cerrado		1	47.770,25	3972815,08	148990,11	3,75%	98.890,75	176.346,14	59994,37	**17,9%**	236.340,51	70,65%
NOVA BANDEIRANTES	12.742	9.531	Amazônia		1	62.640,69	3605615,82	239832,82	6,65%	13.677,21	130.598,89	162445,70	**17,0%**	293.044,58	30,75%
ALTO BOA VISTA	5.025	2.242	Cerrado	Amazônia	1	121.393,91	3296351,85	1977308,43	59,98%	9.690,54	80.238,58	38124,79	**17,0%**	118.363,37	52,79%
VÁRZEA GRANDE	230.307	938	Cerrado	Pantanal	1	4.979,00	49172707,13	55379,48	0,11%	12.498,42	30.454,76	14244,53	**15,2%**	44.699,29	47,65%
SÃO JOSÉ DO RIO CLARO	17.345	5.058	Cerrado	Amazônia	0		6311967,26	0,00	0,00%	14.513,86	144.753,59	76727,74	**15,2%**	221.481,33	NA
CASTANHEIRA	7.808	3.949	Amazônia		0		2356194,47	0,00	0,00%	11.842,22	166.176,78	58904,76	**14,9%**	225.081,55	57,00%
CANABRAVA DO NORTE	5.337	3.450	Cerrado	Amazônia	0		1881640,44	0,00	0,00%	11.016,00	131.769,74	50712,52	**14,7%**	182.482,27	52,89%
	24.777	4.380				61.881	6.961.820,88	164.310,67	4,79%	23.000,02	120.813,49	88.925,53	20,58%	209.739,02	50,29%

Mean by Groups	2009 GDP capta	CU AREA	2009 TOTAL ICMS R$	Ecological ICMS	% Receita	IND.UCTI 05%	Final Index	ICMS-E/ Capita	Commitment Index	2009 GDP capta
Non ICMS-E Mean	18.371,06	0	3655637,605	0	0	0	0,34	0	0	18.371,06
ICMS-E Mean	20.895,08	297.007,95	9.920.676,82	609.484,66	13,53%	0,06	0,94	88,03	1,94%	20.895,08
State Mean	19.928,44	297008	7.521.300,10	376.065,00	8,35%	0,04	0,71	54,32	1,20%	19.928,44

Mean by Groups	Desm_1999	Desm_2001	Desm_2007	2001-2007	Rate of Desf. 2001-2007	Rate of Desf. 2001	Rate of Desf. 2007	TOTAL	Rate of Desf. TOTAL
Non ICMS-E Mean	115.162,87	6472,258	2.408,50	38.577,88	11,32%	0,48%	0,77%	153.740,74	61,33%
ICMS-E Mean	223.044,97	10.916,39	5.018,44	72.711,79	8,57%	0,46%	0,56%	295.756,76	43,19%
State Mean	181.728,42	9.221,86	4.018,89	59.639,23	9,62%	0,47%	0,64%	241.367,65	50,14%

Source: SEMA MT/IBGE/INPE/

*Own Calclulations

Table 8

X-Ray of the ICMS-E: Paraná x Mato Grosso

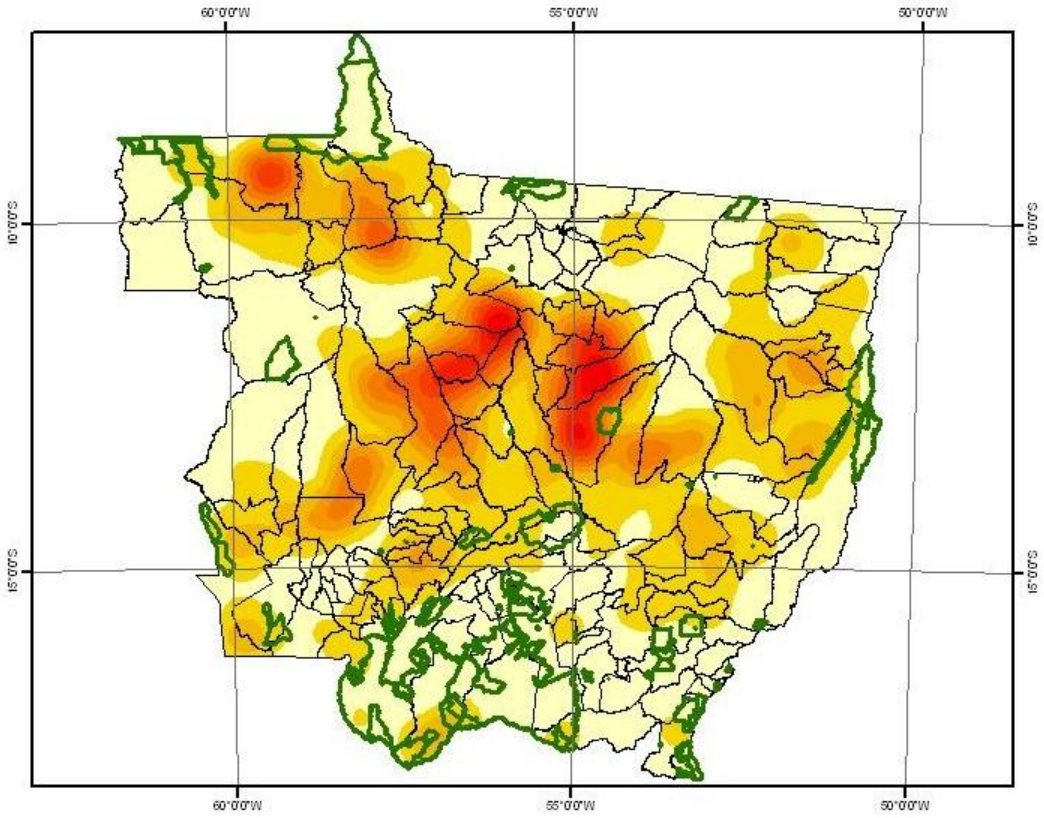
2009	Paraná - PR	Mato Grosso - MT
Area Sq. Km	199.316	903.357
Area Ha.	19.931.600	90.335.700
Average Munic. Area Sq. Km	500	6.407
Average Munic. Area Ha.	49.954	640.679
Population 2010	10.444.526	3.035.122
GDP in Millions R$	189.992	57.294
Per Capta GDP	18.191	18.877
First Year of Programme	1992	2000
Number of Municipalities	399	141
Number of Members	232	85
Percentage of the Total # Munin.	58%	60%
Total ICMS-E Transfer	124.123.771,38	55.427.044,98
Average ICMS-E Transfer	535.016	652.083
ICMS	2.121.367.594	1.060.503.314
Average ICMS-E	5.316.711	7.521.300
Percentage of ICMS-E/ ICMS	5,85%	5,23%
Ratio ICMS-E/ ICMS by Member	11,61%	13,53%
Deforestation in ha. 2007		566.663
Rate of Deforestation 2001-2007		9,60%

Table 9

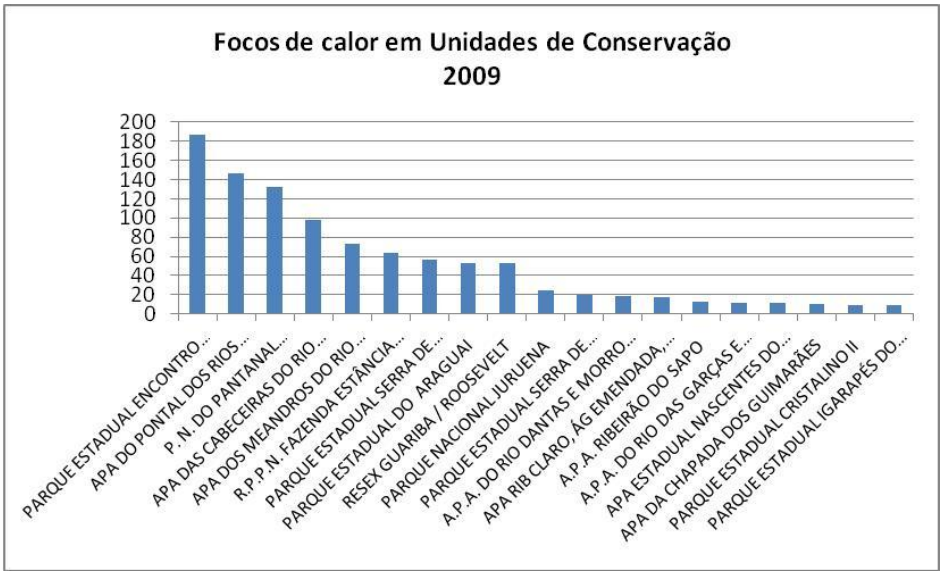
Source: SEMA-MT, IPEA, IBGE, INPE and own calculations.

The Spatial Analysis of Forest Burning Incidences and the Conservation Unities in Mato Grosso - 2009

Figure 20



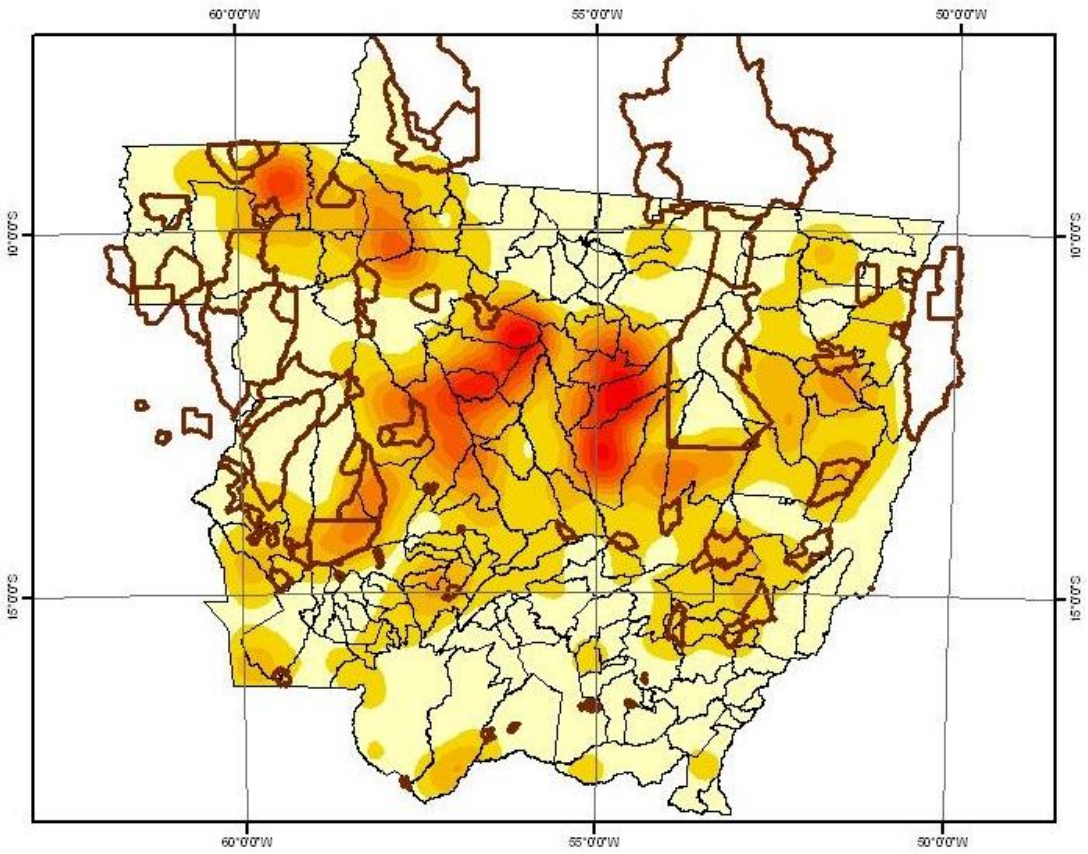
The incidence of forest burning points within Protected Areas' limits, MT - 2009



Source: SEMA-MT

Mato Grosso: Forest Burning – 2008-2009 incidence by hit intensity and Indigenous Land

Figure 21



Source: SEMA-MT

Figure 14. Cattle Slaughter for Meet Production in headcounts.

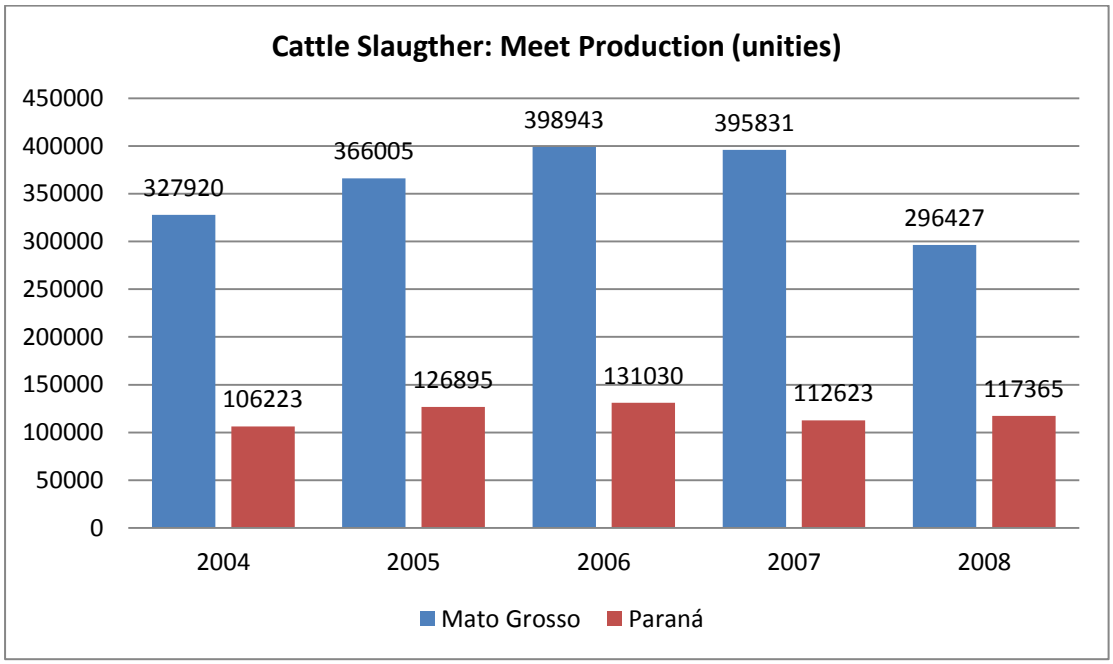


Figure 22

Source: IPEA (Brazilian Applied Statistics Research Institute) and IBGE and own calculations.

Figure 15. ICMS-E and Municipalities' areas in Km^2.

Km²	*Frequency icmsE*	*Frequency no icmsE*
2000	7	26
4000	15	15
6000	22	5
8000	7	5
10000	9	2
12000	6	1
14000	6	0
16000	2	0
18000	5	0
20000	0	0
22000	3	0
24000	0	0
26000	3	0
28000	2	0
30000	0	0
More	0	0

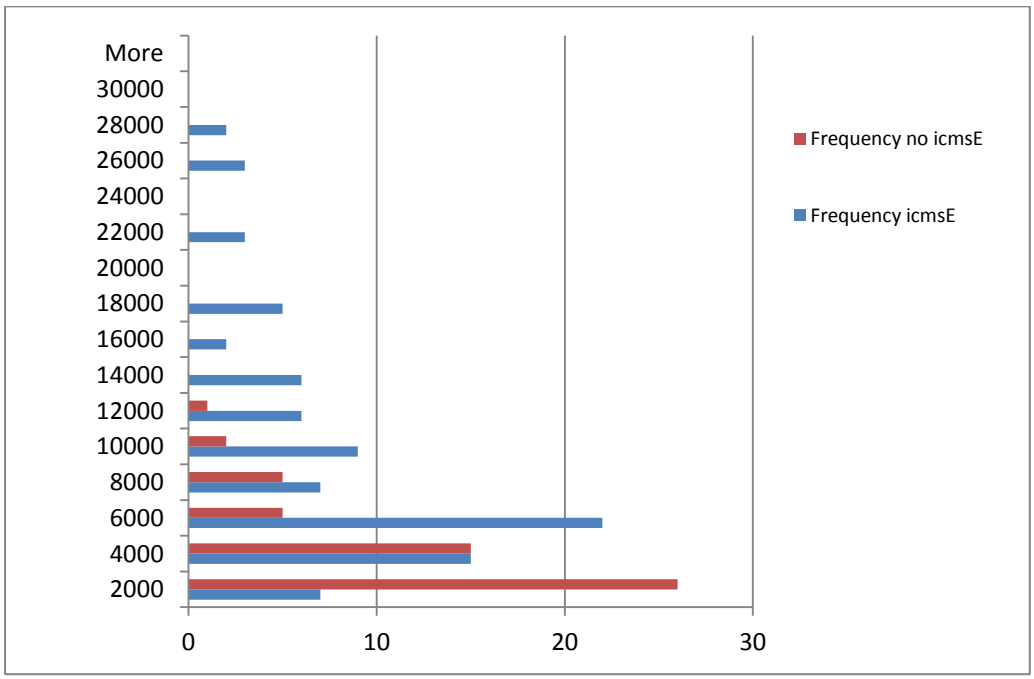


Figure 23

Source: INPE and SEMA-MT

Table10. ICMS Ecológico: Conservation factors for different management categories of protected areas in different Brazilian states. (RING I. e., Assessing Fiscal Transfers for Conservation Policies, 2011)**.**

Table 10

Management categories	Conservation Factors						
	MG	MT	MS	PR	PE	SP**	TO
1. Ecological Station	1.0	1.0	1.0	0.8/1.0*	1.0	1.0	1.0
2. Biological Reserve	1.0	1.0	1.0	0.8/1.0*	1.0	1.0	1.0
3. Parks (National, State, Municipal)	1.0	0.7	0.9	0.7/0.9*	0.9	0.8	0.9
4. Natural Monument	1.0	0.8	0.9		0.7		0.8
5. Wildlife Refuge	1.0	0.8	0.9		0.75		0.8
6. Private Natural Heritage Reserve (RPPN)	1.0	0.2	0.7	0.68	0.8		0.6
7. Forest (National, State, Municipal)	0.3	0.5	0.6	0.64	0.6	0.2	0.5
8. Environmental Protection Area (APA) with management plan	0.1	0.2	0.05		0.1-0.7	0.1	0.1
9. Environmental Protection Area (APA) with no management plan	0.025	0.2	0.05	0.08	0.05	0.1	0.1
10. Area of Relevant Ecological Interest (ARIE)	0.3	0.3	0.08	0.66	0.45		0.4
11. Wildlife Reserve	0.3	0.4	0.6		0.6		0.4
12. Sustainable Development Reserve	0.5	0.5	0.05		0.4		0.2
13. Extractivist Reserve	0.5	0.5	0.4		0.5		0.45
14. Indigenous Reserve	0.5			0.45			0.5
15. Area of Relevant Touristic Interest (ARIT)				0.08			
16. Tourism Destination							
17. Buffer Zone							
18. Wildlife Zone in APA	0.5					0.5	
19. Restricted Use Areas						0.1	
20. Parkway		0.3					
21. Indigenous Territory	0.5	0.7	0.45				
22. Special Protected Area		0.5					
23. Scenic Rivers			0.24				
24. Scenic Roadways			0.08				
25. Natural Resources Reserve			0.8				
26. Ecological Reserve					0.3		
27. Private Land Restoration Area (RPRA)	0.1						
28. Faxinais				0.45			

* *Higher values for locally protected areas, lower values for state and federally protected areas.*
** *Legislation in São Paulo only acknowledges state conservation units for ICMS Ecológico transfers.*

According to the national system of protected areas (SNUC), management categories 1–5 belong to conservation units with so-called integrated protection, involving high land-use restrictions. Management categories 6–13 belong to sustainable use areas, involving lower land-use restrictions. The other management categories included in the table are not classified in federal legislation.

Sources: MG/Minas Gerais: Minas Gerais (2009); MT/Mato Grosso: Mato Grosso (2000); MS/Mato Grosso do Sul: Mato Grosso do Sul (2001); PE/Pernambuco: Pernambuco (2003); PR/Paraná: Loureiro (2002: 168); SP/São Paulo: São Paulo (1993); and TO/Tocantins: Tocantins (2002).