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ECOLOGICAL ICMS *VERSUS* AGRICULTURAL PRODUCTION: APPROACH ON THE OPPORTUNITY COST METHOD

Flávio Amaral Oliveira [I]
Cleci Grzebieluckas [II]
Raimundo Nonato Cunha de França [III]

Abstract: Ecological ICMS (ecological value-added tax on sales and services) lies on the application of environmental criteria at the time to distribute resources collected by Brazilian states. It emerged as innovative instrument capable of developing environmental policy and fiscal justice by financially compensating and encouraging counties hosting environmental conservation areas. The aim of the present study is to compare the public revenue deriving from the ecological ICMS generated by Indigenous Lands to ICMS associated with agricultural production in Tangará da Serra County - MT, based on using the opportunity cost method. This is a descriptive, bibliographical and documentary research, based on quantitative approach and secondary sources. Ecological ICMS is an important environmental policy instrument and source of municipal public revenue. Although it presented better performance than that of agricultural ICMS, it remains insufficient to financially compensate the investigated County for its restricted economic activity.

***Keywords*:** Environmental services; CU/IL; added value; ICMSe; environmental policy.

[I] *Mato Grosso State University, Tangará da Serra County, MT, Brazil.*

[II] *Mato Grosso State University, Tangará da Serra County, MT, Brazil.*

[III] *Mato Grosso State University, Tangará da Serra County, MT, Brazil.*

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1 INTRODUCTION

No one can rationally deny the primitive man-nature connection, i.e., human dependence on the environment. However, it was only in the 1970s that different countries came together to talk about the commitment to environmental preservation. Although Brazil has always participated in these discussions, and although it is also a signatory to United Nations' deliberations, it only came to significantly act in this context in the 1990s. The Brazilian environmental legislation was mainly driven by Rio 92 conference and aimed at developing important mechanisms capable of significantly contributing to environmental preservation and, consequently, to human well-being. These mechanisms enabled instruments capable of setting the link between economic resources and environmental protection, and likely between resources and the environment, itself.

Brazilian environmental policies were set in response to the international environmental movement, which led to the development of environmental legislations, institutions and instruments (MAGRINI, 2001; PECCATIELLO, 2011) that can be summarized in regulatory (prohibition, restriction and punishment) and economic (protector/receiver, polluter/payer and user/payer) instruments.

The so-called protector-receiver principle of the environmental law is a mechanism deriving from the idea of financially compensating and encouraging owners or governments to practice environmental preservation. Protectors/receivers add economic return to environmental protectors; thus, this mechanism has gained prominence in the environmental field, as well as has been applied to it based on tax and credit incentives (HUPFFER *et al*, 2011).

Environmental services (herein understood as synonymous with ecosystem services) can be defined as any benefit, be it tangible or not, people receive from ecosystems – i.e., support for sustainable human well-being (COSTANZA *et al*, 1997; MEA, 2005). These services, which can be of direct or indirect interest to human beings, are provided for free by the environment; among them, one finds: gas regulation, waste treatment, erosion control, clean air, water supply, tourism, climate regulation and many others (SUPERTI; AUBERTIN, 2015). They are essential to maintain life on Earth, as well as to provide support to the economy of different countries worldwide, mainly of those that depend on agricultural and extractive activities. Thus, the total value of environmental services cannot be measured; for example, one cannot say how much the atmosphere is worth, given its importance. However, regardless of whether the valuation of environmental services has incremental or marginal nature, and shows the monetary value of environmental changes, mainly of those caused by humans, it must be considered a necessary practice, and its results must have significant weight in political decision-making, even if it is a hard task to be accomplished (COSTANZA *et al*, 1997; MEA, 2005).

Payment for Ecosystem Services (PES) is the practice of the protective/receiver instrument, since it pays (or rewards) individuals or entities for their efforts in maintaining, conserving or recovering these services. The PES topic has been gaining room in the Brazilian environmental agenda, although it still lacks a broader and deeper discussion to make these forms of economic incentives more environmentally effective and socially

fair (BAKKER; YOUNG, 2015). Notwithstanding, Federal Law n. 14119, from January 13th, 2021, which is called the National Policy on Payment for Ecosystem Services, was recently enacted.

Ecological ICMS (ICMSe - ecological added-value tax on sales and services) is an instrument capable of setting the link between economic resources (collected tax) and a given protector (municipality). This economic instrument of fiscal compensation is an important tool to encourage actions focused on environmental conservation (HEMPEL, 2008). It is the tax that exercises an extra-fiscal function, since it is used to encourage the maintenance and to increase the number of conservation units and, likely, of Indigenous Lands.

Approximately 24% of Mato Grosso State's territory is occupied by 73 Indigenous Lands. Tangará da Serra County hosts four Indigenous Lands belonging to the Paresí ethnic group, which encompass approximately 51% of its territory. All these lands are traditionally occupied and regularized. The territorial area of the aforementioned county covers 1.16 million hectares; approximately 51% of it comprises Conservation Units (CU) or Indigenous Lands (IL). It is a regional trade hub that has the 5th largest population in Mato Grosso State and ranks the 8th position in the state's Gross Domestic Product - GDP (IBGE, 2019).

However, if one puts the socio-cultural factors aside, it is possible seeing that Indigenous Lands are beneficial because they guarantee environmental preservation and public revenue deriving from ICMSe. On the other hand, the developmentalist discourse has recently gained strength: it sees ILs, among other conservation areas, as cost generators and barriers to economic growth - these ideas contradict the development of new conservation areas. Thus, the aim of the current study was to compare the municipal public revenue deriving from ICMSe generated by ILs to ICMS deriving from agricultural production in Tangará da Serra County - MT, based on the opportunity cost method. The specific aim of the current study was to identify the ICMSe generated by conservation units in Mato Grosso State and in Tangará da Serra County (MT).

Although ICMSe was implemented in Mato Grosso State, in 2002, this policy remains unknown to most public managers, a fact that discourages environmental preservation (MATTEI; MEIRELLES NETO, 2015). The present study can help Environmental Conservation Units and Indigenous Lands (CU/IL) to be seen as public revenue and environmental benefit generators for different counties. Thus, it can contribute to encourage new debates and research about this topic, as well as to strengthen environmental and fiscal-justice public policies, mainly the ICMSe.

2 THE ENVIRONMENTAL SERVICE-VALUATION MATTER

Defining the value of air, water and of the atmosphere for humanity is an exercise hard enough to enable understanding the complexity of valuing services provided by the environment, since some of them have infinite value. Costanza *et al* (1997) conducted a meta-analysis of environmental valuation studies and estimated that the global monetary value of these services comprised US$33 trillion a year. Most of the analyzed studies fo-

cused on estimating individuals' "willingness to pay" for environmental services, which is the most adopted evaluation method, to date. The aforementioned study has significantly contributed to improve research focused on valuing environmental services, since then. Costanza *et al* (2014) have reviewed the previous study and updated it with data reported by Groot *et al* (2012) and TEEB (2010), according to whom, the global value of environmental services was estimated at US$145 trillion. Although all these values are underestimated, they significantly contribute to the valuation of environmental services.

Preserving ecosystems may appear to be the most rational decision to be made, since they provide essential environmental services for human well-being. However, this decision faces social and economic issues, such as the pressure to generate employment and income, as well as the need of producing food for humanity's survival. The economic issue is always a factor, although it involves other important issues, such as the cultural, health, aesthetic and moral ones. Relating ecosystems to economic values is a hard and poorly publicized task, although it can be an important tool to raise awareness about the importance of preserving ecosystems (COSTANZA *et al*, 1997; de GROOT *et al*, 2012; COSTANZA *et al*, 2014).

ICMSe is a tool used to value environmental conservation. Somehow, it links environmental to economic resources when it guarantees financial gains to counties hosting conservation areas. It is constituted by law and represents an assessment and decision made by society, which attributes value (albeit under-dimensioned) to environmental services. Like any other service, environmental services generate benefits to, and imply costs for, society. The value attributed to environmental resources means valuing the benefits generated by them and it is often compared to costs with their preservation (CHAGAS; ANDRADE, 2017).

Previous studies have addressed ICMSe as environmental public policy focused on values to be transferred to counties and on the condition of conservation units. According to Young and Medeiros (2018), Brazilian counties received approximately R$ 1.9 billion deriving from ICMSe in 2015 – this value corresponds to 2.2% of the total ICMS received by these counties. In a pioneering manner, the present study aims at contributing to the debate about the economic issue involving environmental preservation, by taking into consideration the ICMSe's opportunity cost, in order to evidence one of the multiple economic relationships involving the decision-making process about environmental preservation and economic activity.

3 METHODOLOGICAL PROCEDURES

3.1 Research type and object of study

The current study is a descriptive, bibliographic and documental research based on the quantitative approach. Descriptive studies focus on investigating, analyzing, recording and classifying facts or phenomena without researchers' interference (RICHARDSON, 2012), whereas quantitative studies focus on quantifying and analyzing data, based on statistical techniques (MALHOTRA, 2005).

The current study was carried out in Tangará da Serra County - MT, which is inserted in the *Cerrado* and Amazon biomes. The local population was estimated at 103,750 inhabitants, in 2019, whereas the local territory covers 11,601.206 km^2: 5,910 km^2 of it belongs to the Paresí ethnic group, which is the object of study in the present research (IBGE, 2020; FUNAI, 2019). Information about ICMS was provided by the Treasury Office and by the Secretariat for the Environment of Mato Grosso State.

The opportunity cost - or alternative cost - was originally used by Frederich Von Wieser (1851-1926) to measure the economic value of production factors; this value represents the net income generated by these factors in their best alternative use (ZAGO; PINTO, 2005). "It represents the cost of choosing one alternative over the other" (NOSSA, 1998, p. 1).

Every conservation process brings along an opportunity cost linked to economic activities that could be developed in the protected area. Opportunity cost refers to economic losses resulting from restrictions on the use of environmental resources. Conservation benefit refers to the environmental resource-use value, which is estimated based on revenue losses when the environmental resources of a certain area are not used in other economic activities (MAIA, 2002).

The term "opportunity cost" can be used at the time to measure the viability or success of a given alternative by comparing it to another alternative. The cost of the first alternative is understood as the opportunity lost due to the non-implementation of the second one. It can be applied to evaluate an alternative economic activity for the potential resources, or even to evaluate the cost of not using these resources, based on using a given parameter for comparison purposes. Thus, opportunity cost can be represented by the income stream that is given up due to the option of not using the land for agricultural production (CHAGAS; ANDRADE, 2017). Therefore, it can be used in the analysis of revenues blocked by environmental restrictions imposed on conservation units and Indigenous Lands, and of revenues that would derive from the agricultural activity if it was developed in the analyzed area.

Indigenous Land (IL) areas generate public revenue deriving from ICMSe for the host county, whereas agricultural activity areas generate added-value ICMS (ICMSav). The ICMSe value generated in one hectare of IL and the ICMSav generated in one hectare of agricultural exploitation (soybean and 'safrinha' corn) in the same region, in 2018, were compared to each other to assess its opportunity cost. The aforementioned analysis took into consideration the portion of the area that is effectively exploitable by agriculture, in compliance with provisions of the Brazilian Forest Code (BRASIL, 2012). After the analysis was completed, an ICMSe scenario was designed by including the value of the environmental services provided by the conserved area, based on Costanza *et al* (1997).

3.2 ICMSav and ICMSe calculation formula

Paresí IL area is fully inserted in the *Cerrado* biome. According to the Brazilian law, 35% of the total area of rural properties inserted in this biome must be covered by

native vegetation, for legal reserve purposes. Thus, the agricultural exploration area can reach, at most, 65% of the rural property area. So, 1 hectare of area corresponds to 0.65 agricultural hectares. In the case of Paresí IL, variables herein taken into consideration comprised:

a) Exploitable area in 1 hectare: 0.65 hectare (Forest Code);

b) Annual agricultural crop: soybean (1st crop) and corn (2nd crop);

c) Local yield per hectare: soybean (54 sacs/ha) and corn (100 sacs/ha);

d) Output value (sale): soybeans (R$61.20/sac – price on 04/30th/2019) and corn (R$21.30/sac - price on 08/01st/2019);

e) Input value = 50% of the output value (LC 157/2004); therefore, soybeans - R$30.60; and corn - R$10.65.

Agricultural activity inclusion in 1 hectare of TI Paresí IL would lead to a new ICMS revenue scenario, since it would increase the ICMSav revenue of Tangará da Serra County. Calculating the incremented added-value ICMS (ICMSad-inc) was fundamental for the development of the current research. This calculation process consisted in estimating direct ICMS value increment based on the added-value criterion, in order to calculate the amount that would be received and to deduce it from the amount received in the previous scenario. In order to do so, it is necessary using the main and the secondary formulas presented below.

$$\textbf{ICMSav-inc} = \textbf{ICMSav-new} - \textbf{ICMSav-pre}$$

Wherein:

ICMSav-pre (Previous added-value ICMS) in the main formula represents the total ICMS received by the county based on added-value criterion, i.e., before the 1-hectare increase in Paresí IL. ICMSav-pre obtainment has followed the same rules used by the State to calculate the amount to be distributed to each county, based on the secondary formula:

$$\textbf{ICMSav-pre} = \textbf{AVpre} / \textbf{AVstate} * \textbf{ICMSav-state}$$

Wherein:

AVpre is the added value of Tangará County before the 1-hectare agricultural exploitation in Paresí IL.

AVstate is the total State added value (sum of counties) before the 1-hectare agricultural exploitation in Paresí IL.

ICMSav-state represents the total tax distributed by the state to its counties, before the 1-hectare agricultural exploitation in Paresí IL.

ICMSav-new (New added-value ICMS) in the main formula represents the total ICMSav Tangará da Serra County would reach if the 1-hectare agricultural exploitation in Paresí IL was in place, i.e., the new ICMSav level. It was calculated through the

secondary formula below:

ICMSav-new = ((AVpre + AVPhec) / (AVstate + AVPhec)) * ICMSav-state

Wherein:

AVPhec is the value added by the 1-hectare agricultural production in Paresí IL. The other items in the formula were presented above. It was necessary using another secondary formula, which was adapted from the one established in State Complementary Law n. 157/2004 (AV = S – A), to find AVPHec:

AVPhec = Vout-hec - (VShec * Iinp)

Wherein:

Vout-hec represents the output values (sales) recorded for corn and soybeans produced in the exploited hectare, whereas *Iinp* is the minimum index of inputs established in LC 157/2004 (50% of the output value). *Vout-hec* must be obtained for soybeans and corn, in separate, and they must be later added to each other – this procedure requires the secondary formula:

Vout-hec = Ar * Iexp * Prod * OUV

Wherein:

Ar represents the size of the agricultural exploitation area (1 hectare).

Iexp is the maximum agricultural exploitation index established by the Brazilian Forest Code for the *Cerrado* biome – i.e., 65% of the property's area.

Prod is the estimated soybean or corn yield in the region.

OUV is the Output Unit Value, i.e., the sales value of one sac of soybeans and one of corn.

4 RESULTS AND DISCUSSION

4.1 ICMSe distribution in Mato Grosso State

From the time the ICMSe Law was enacted in MT until 2018, the State has distributed R$22.733 billion in ICMS to its counties, based on the 6 distribution criteria used by it (added value, own revenue, ecological ICMS, population, area and HDI); R$1.137 billion of this total derived from ICMSe. In 2018, alone, R$128.482 million in ICMSe were distributed to, and benefited, 91 different counties, which corresponded to 64% of the 141 counties in the state. Individual amounts ranged from R$205 thousand to R$5.986 million in that year. Table 1 shows the ICMSe values distributed in 2018, based on CU/IL category; it also informs the number of times (occurrences) each category was used.

Table 1: Distribution of ICMSe in MT, in 2018, expressed in values per CU category

N. of occurrences	CU category	CU/IL area (hectare)	vertical %	ICMSe per category (R$)	vertical %
111	Indigenous Lands	10,809,081	58.30%	77,936,504	60.66%
16	National park	3,887,393	20.97%	21,751,885	16.93%
23	State Park	1,217,344	6.57%	13,156,363	10.24%
37	Environmental preservation area	1,572,170	8.48%	8,695,181	6.77%
12	Ecological station	606,386	3.27%	5,154,727	4.01%
4	Wildlife refuge	122,115	0.66%	902,740	0.70%
3	Extractive reserve	131,959	0.71%	328,176	0.26%
16	Private Natural Heritage Reserve	165,994	0.90%	316,373	0.25%
21	City park	4,072	0.02%	77,747	0.06%
8	Park road	18,590	0.10%	73,128	0.06%
3	Natural monument	509	0.00%	71,439	0.06%
2	Biological reserve	3,588	0.02%	18,399	0.01%
1	Forest garden	11	0.00%	209	0.00%
257	**Total**	**18,539,211**	**100%**	**128,482,870**	**100%**

Source: Research data (2019).

Indigenous Lands (IL) cover 58% of the total CU/IL area in MT (Table 1). This category is the one that mostly generates ICMSe to MT counties and it accounts for almost 61% of the ICMSe distributed in the state.

The number of city parks stood out as negative point (only 21 occurrences). It corresponded to low participation in comparison to the number of counties in MT (141). This policy was expected to encourage the development of these areas in order to help improving the quality of both the environment and the population's life.

Tangará da Serra County has 51% of its territory occupied by Conservation Units (CU) and Indigenous Lands (IL). Together, they have generated R$4.39 million of ICMSe in 2018, which represents 9.25% of the R$47.33 million of the county's ICMS revenue. They comprise 4 Indigenous Lands, 3 urban city parks and 1 Private Natural Heritage Reserve (PNHR). Table 2 shows the total ICMSe and ICMSe values per hectare recorded for each CU/IL in Tangará da Serra County, its position in the ICMSe generation ranking, and its representativeness in MT expressed as total ICMSe percentage, in 2018.

Table 2: ICMSe generated by each CU/IL of Tangará da Serra County, in 2018

CU/IL name	Cu category	CU/IL area in Tangará da Serra County (hectare)	Position in the MT ranking of ICMSe values	CU/IL ICMSe (R$)	% over MT's ICMSe	ICMSe per hectare (R$)
Paresí IL	Regularized IL	563,586.00	3º	4,186,049	3.26%	7.43
Rio Formoso IL	Regularized IL	19,749.00	128º	146,686	0.11%	7.43
Figueiras IL	Regularized IL	5,680.00	169º	42,199	0.03%	7.43
Estivadinho IL	Regularized IL	2,032.00	185º	15,093	0.01%	7.43
Vale do Sepotuba Farm PNHR	PNHR	1,104.54	219º	2,344	0.00%	2.12
Ilto Ferreira Coutinho City Park	City Park	11.77	249º	87	0.00%	7.43
Alto da Boa Vista City Park	City Park	9.34	250º	69	0.00%	7.43
Progresso City Park	City Park	0.97	255º	7	0.00%	7.43
Total		**592,173.62**	**..**	**4,392,535**	**3.42%**	**..**

Source: Research data (2019).

It is possible seeing (Table 2) that ILs account for almost all the ICMSe generated in Tangará da Serra County. Paresí IL (the 7th largest IL in the state) accounts for approximately 563 thousand hectares of the 1.16 million hectares of Tangará County's territory, and it also houses the ethnic group holding this very same name (SEMA, 2017). This IL, alone, generated R$4.18 million of ICMSe in 2018; it accounted for 95% of the ICMSe received by the aforementioned county, as well as for 3.26% of MT State's total ICMSe – in addition, it holds the third position in the state ranking of the highest generated value.

If one proportionally takes into consideration value and occupied area, Paresí IL generates public revenue deriving from ICMSe equivalent to R$7.43 per hectare a year (Table 2), and it benefits Tangará da Serra County. This value represents the opportunity cost when one decides to implement economic activity to the detriment of environmental conservation by taking into consideration the public revenue deriving from ICMSe.

The same happens with ILs such as Rio Formoso, Figueiras and Estivadinho, as well as with City Park such as Ilto Ferreira Coutinho, Alto da Boa Vista and Progresso – they also generate R$7.43 of ICMSe revenue per hectare. However, they are smaller areas, therefore, they account for less than 5% of Tangará da Serra County's ICMSe. The only private CU/IL in this county – i.e., Vale do Sepotuba Farm PNHR - generates R$2.12 per hectare. This value is lower than that of ILs due to the correction factor applied to this management category, a fact that jeopardizes the generation of this public revenue.

Tangará da Serra County recorded the 6th highest ICMSe value among all 141 counties in the state, in 2018, as well as in the previous 6 years. The aforementioned

county recorded the 67th highest value in the national ranking of ICMSe, which comprises 2,161 benefited counties, countrywide. Piraquara County, Paraná State, was the national champion with R$30.7 million.

If one takes into consideration the ranking of the highest value generated in the state, Tangará County's ICMSe generation performed better than the added-value criterion (6th against 12th place). Mato Grosso State has distributed R$1.927 billion of ICMS in 2018, based on AV criterion, in comparison to the R$128 million distributed based on the ICMSe criterion. Tangará County earned R$34.9 million of ICMSav against R$4.39 million of ICMSe.

4.2 ICMSe *versus* ICMSav of Paresí IL in Tangará da Serra County

4.2.1 ICMSav estimate of 1 agricultural hectare in Paresí IL

Table 3 shows the calculation of the incremented annual value of direct ICMSav recorded for soybean (1st crop) and corn (2nd crop) grown in 1 hectare of Paresí IL, Tangará da Serra County, in 2018.

Table 3: Calculation of agricultural ICMSav incremented in 1 hectare of Paresí IL (2018)

Formula		Calculation	Result
Vout-hec =	Ar * Iexp * Prod * OUV (soybean)	1 * 0.65 * 54 * 61.20	2,148.12
Vout-hec =	Ar * Iexp * Prod * OUV (corn)	1 * 0.65 * 100 * 21.30	1,384.50
			∑ 3,532.62
AVPhec =	Vout-hec - (Vout-hec * Iinp)	3,532.62 - (3,532.62 * 0.50)	1,766.31
ICMSav-pre =	$\frac{\text{AVpre}}{\text{AVstate}} * \text{ICMSav-state}$	$\frac{1,641,506,138}{90,381,061,485} * 1,927,243,053$	35,002,701.33
ICMSav-new =	$\frac{\text{AVpre + AVPhec}}{\text{AVstate + AVPhec}} * \text{ICMSav-state}$	$\frac{1,641,506,138 + 1,766,31}{90,381,061,485 + 1,766.31} * 1,927,243,053$	35,002,738.31
ICMSav-inc =	ICMSav-new – ICMSav-pre	35,002,738.31 – 35,002,701.33	36.98

Source: Research data (2019).

The 1-hectare agricultural exploitation of Paresí IL would enable Tangará da Serra County to receive approximately R$36.98 a year of direct ICMS distributed based on the added-value criterion, whereas the ICMSe value received for the same hectare/year is R$ $7.43. This estimate was based on the direct AV increment of R$1,766.31 presented in the table above. This AV increment would increase the county's

participation in ICMS distributed based on this criterion. The aforementioned county has effectively received R$35,002,701.33 as revenue deriving from ICMSav in 2018. On the other hand, the 1-hectare exploitation of Paresí IL would have enabled it to receive R$35,002,738.31 – therefore, R$36.98 more for just 1 hectare. This value represents the opportunity cost of one hectare of CU/IL a year, based on the public ICMS revenue. The current study did not take into consideration the likely indirect revenue increase due to the movement in the county's economy.

It is possible seeing that the public revenue value deriving from direct ICMS incremented by the 1-hectare agricultural exploitation of Paresí IL is approximetely 5 times higher than the ecological ICMS value generated in the same area, if one compares the ICMSav to the ICMSe (R$36.98 *versus* R$7.43) of the same hectare. However, this higher value is explained by the fact that the ICMS percentage allocated by the state to its counties, based on the AV criterion, is 15 times higher than the one allocated based on the environmental criterion (75% *versus* 5%); consequently, its value is also higher. However, the amounts received by Tangará da Serra County do not represent this very same proportion. The ICMSav received by this county is only 7.98 times higher than its ICMSe. In addition, the ICMS incremented by the 1-hectare cultivation in Paresí IL would be only 4.98 times higher than the one generated by the environmental preservation of that very same hectare (36.98 *versus* 7.43), and it denotes ICMSe's best performance in generating municipal revenue.

It is noteworthy that the percentage amount allocated through AV (75%) is constitutional; therefore, states do not have the autonomy to change it. However, states have the autonomy to deliberate over the remainder (25%); therefore, higher percentage of this revenue could be allocated to environmental policies, if the other criteria, except for AV, were reduced.

4.2.2 Adding value of environmental services

The present study does not cover indirect ICMSav, among other economic and social advantages likely resulting from the economic movement triggered by agricultural exploitation in the investigated region. However, the value of environmental services provided by the conserved area must also be highlighted. Costanza *et al* (1997) performed minimum estimates of annual values of environmental services provided per hectare by dividing the planet into 16 different biomes. Given the similarity of features between the African savannah and Brazilian *Cerrado* biomes, the values attributed by Costanza to the savannah can also be attributed to the *Cerrado*, as shown in Table 4.

Table 4: Values of environmental services provided by the savannah biome and attributed to the Brazilian *Cerrado*

	Provided environmental services	Value/annual hectare (U$ on 01/02nd/1995)	Value/annual hectare (R$ price on 01/02nd/1995)
1	Gas regulation	7.00	5.92
2	Climate regulation	0.00	0
3	Disturbance regulation	No information	No information
4	Water regulation	3.00	2.54
5	Water supply	No information	No information
6	Erosion control	29.00	24.51
7	Soil formation	1.00	0.85
8	Nutrient cycling	No information	No information
9	Waste treatment	87.00	73.52
10	Pollination	25.00	21.13
11	Biological control	23.00	19.44
12	Habitat / Refuge	No information	No information
13	Food production	67.00	56.62
14	Raw material	No information	No information
15	Genetic resources	0.00	0
16	Recreation	2.00	1.69
17	Cultural	No information	No information
Total hectare value per year		**244.00**	**206.18**

Source: Adapted from Costanza *et al* (1997).

The aforementioned study has associated African savannah and grasslands due to similarities, such as prevalence of grass and few trees, which are correlated to the Brazilian *Cerrado* biome. Costanza has used data from 1994 and assigned the value of U$244/hectare per year (US dollar) to the environmental services provided by this biome. Based on the US inflation measured through the Consumer Price Index (CPI) of that country from 1995 to 2018, this value would correspond to US$410/hectare per year on 12/31st/2018. If one converts it based on the Brazilian exchange rate on that very same date, it would correspond to **R$1,590/hectare per year** - this value could have been higher, if it was not for lack of information about some services, as shown in Table 4. Although underestimated, the value of services per hectare is much higher than the ICMSe value received by Tangará da Serra County (1,590.00 *versus* 7.43).

The ICMSe value is an effective municipal public revenue, whereas the value of environmental services is an estimate that challenges economic pragmatism. However, both are monetarily measured benefits generated by environmental conservation; thus, they can be added to each other. Therefore, **by adding ICMSe to the updated value of environmental services surveyed by Costanza *et al* (1997), one gets the value of**

R$1,597.43/hectare per year as value of benefits generated by 1 hectare of Paresí IL. Although underestimated, this is the opportunity cost value when one makes the option for having an economic activity to the detriment of environmental conservation, by taking into consideration environmental services. This value is 43 times higher than the direct ICMSav generated by the economic exploitation of the same area (1,597.43 *versus* 36.98).

5 FINAL CONSIDERATIONS

Environmental conservation units and, most of all, indigenous lands, are often seen as barriers to the economic development of their region, mainly in Mato Grosso State. Therefore, it is extremely important comparing public ICMS revenues deriving from environmental conservation to those deriving from the economic activity to enable conservation areas to be also seen as public revenue generators.

The use of taxes in environmental policy is mostly done in the form of benefits to taxpayers, such as tax reductions. On the other hand, ICMSe is a way to benefit counties that have CUs/ILs by distributing a given share of the tax collected by the state to them. As for Mato Grosso State, the higher the CU/IL area:county's area ratio, the greater its share in the ICMSe.

Ecological ICMS is an environmental policy that combines environmental conservation and fiscal justice to economic instruments - a fact that puts into effect the protector/receiver principle – and, at the same time, it is a form of PES. However, it remains poorly known by managers, although it has been in place in MT for 17 years. Moreover, it has benefited 64% of its counties with more than R$1.137 billion of ICMSe in the total investigated period and with R$128.482 million in 2018, alone. Indigenous Lands are by far the biggest ICMSe generators. They also represent the largest proportion of area among CUs/ILs. Tangará da Serra County stands out among the 6 highest ICMSe values in the state, as well as among the 67 highest ones in the country.

Although the present study enabled better understanding the ecological ICMS of Mato Grosso State, it reached its aim when it managed to show the direct ICMS values generated by 1 hectare of area in a CU/IL in Tangará da Serra County - MT – based on the economic criterion called Added Value (AV), in comparison to the environmental criterion called ecological ICMS (ICMSe). Until then, the opportunity cost of environmental conservation was R$36.98, and the opportunity cost of economic exploitation would be R$7.43 per hectare a year. These are public revenue streams that are given up when county managers choose one option over the other. It is possible concluding that although ICMSe works as important fiscal justice policy, it does not fully compensate the counties for the impeded public ICMS revenue, since R$7.43 is not enough to compensate the loss of R$36.98. Nevertheless, ICMSe has highlighted CUs/ILs as important public revenue generators.

Moreover, although the AV criterion has a share 15 times higher than that of ICMSe (75% *versus* 5%), the annual value of this tax directly generated by soybean and

corn cultivation in Paresí IL is only 4.98 times higher than that of ICMSe (36.98 *versus* 7.43). This outcome was more evident in Tangará's performance, since it received the 12th highest ICMSav value in comparison to the 6th highest ICMSe value. Despite this, and under constant conditions, the total ICMSe amount distributed by the state would have to be 8 times higher to fully compensate Tangará da Serra County. These circumstances are the ones making it hard to equalize these two policies.

It is worth emphasizing that the economic activity is the generator of tax collection by the states; in addition, the ICMSav distribution rate follows the constitutional commandment of the country, and it was established to help counties' economic development, which, in its turn, boosts the ICMS collection, itself. On the other hand, it is also worth emphasizing that environmental services provide support to economic activities, mainly to agricultural activity.

However, when the value of environmental services provided per 1 hectare of the same conserved area was taken into consideration, the opportunity cost of agricultural exploitation reached R$1,597.43 per hectare a year. This would be the cost attributed to the economic use of the currently conserved area, if one takes into consideration the public revenue deriving from ICMSe (R$7.43) added to the value of environmental services (R$1,590.00), although the former represents an effective flow of resources and the latter represents an underestimated value of environmental services.

Although the ICMSe of MT is an important environmental policy and fiscal justice instrument, it (alone) is not enough to financially compensate counties in this state for the impeded ICMSav, let alone to compensate the estimated value of environmental services; besides, it does not significantly encourage the creation of new conservation areas. Tangará da Serra County is an example of it, since the number of CUs/ILs in it did not change after this policy was implemented. The ICMSe of MT privileges the size of the areas, a fact that jeopardizes its ability to encourage other counties to create new CUs, mainly because, among the three governmental spheres (federal, state and municipal), counties are the ones facing the worst conditions to create large CU areas. Thus, ILs, as well as national and state parks, are the biggest ICMSe generators. Actually, the valuation of and payment for environmental services to MT's counties would make financial compensation much fairer and more encouraging.

Lack of publicity did not prevent ICMSe from becoming an important environmental policy featured by the protector-receiver principle, based on which the Payment for Environmental Services (PSA) takes place. However, each state does it in its own way. This is how PES public policies in the country are; they lack national or regional coordination, despite the fact that the national environmental policy was legally instituted in 1981.

The Brazilian Forest Code - established through Law n. 12651 - has already given the Federal Government the responsibility for instituting PES programs since 2012. However, the regulation only took place in 2021 through Law n. 14119, which established the National Policy for Payment for Environmental Services (NPPSA) and prioritized services provided by indigenous peoples, among others. Among its guidelines, NPPSA foresees the complementarity of PES programs implemented by different governmental spheres.

Therefore, there would be legal conditions for the Federal Government to establish an agreement to support the states' ICMSe.

Thus, if one considers the ICMSe as state PSA policy, an alternative to equalize the counties' loss of public ICMS revenue (as in the case of Tangará da Serra County) would lie on the Federal Government participation in completing the ICMSe value as payment for environmental services provided by CU/IL. This partnership should also contribute to improve environmental conservation and the living conditions of indigenous peoples.

The opportunity cost method has proved to be an important tool when the challenge lies on bringing ecological and economic aspects closer to each other; in addition, it provided consistency to the herein performed analysis. However, the present research is an original and still incipient study, since it was based on initial estimates that did not cover all the factors, and its application in specific cases requires revising the procedures to be adopted, based on the tax rules of each place. Despite this limitation, it makes a relevant contribution to the debate about environmental policy and public finance. However, other studies should be carried out to investigate non-covered factors, such as the challenge of valuing service categories that were not addressed by Costanza *et al* (1997) - mainly water supply and cultural services - and forms of CU/IL economic exploitation with less environmental impact.

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Flávio Amaral Oliveira
✉ flavioamaral.mt@gmail.com
ORCID: https://orcid.org/0000-0001-9487-0557

Cleci Grzebieluckas
✉ cleci@unemat.br
ORCID: https://orcid.org/0000-0001-9786-9607

Raimundo Nonato Cunha de França
✉ raimundofranca@unemat.br
ORCID: https://orcid.org/0000-0001-9603-0391

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AMBIENTE & SOCIEDADE 25 anos 25 años 25 years

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ICMS ECOLÓGICO *VERSUS* ICMS PRODUÇÃO AGRÍCOLA: UMA ABORDAGEM COM BASE NO MÉTODO CUSTO DE OPORTUNIDADE

Flávio Amaral Oliveira
Cleci Grzebieluckas
Raimundo Nonato Cunha de França

Resumo: O ICMS ecológico é a aplicação de critérios ambientais na distribuição de recursos arrecadados pelos estados brasileiros. Surgiu como instrumento inovador capaz de desenvolver a política ambiental e a justiça fiscal, compensando financeiramente e incentivando municípios com áreas de conservação ambiental. O objetivo do estudo é comparar a receita pública do ICMS ecológico gerado pelas Terras Indígenas com o ICMS da produção agrícola em Tangará da Serra – MT, utilizando o método custo de oportunidade. A pesquisa é de natureza descritiva, bibliográfica e documental, com abordagem quantitativa e fontes secundárias. O ICMS ecológico revelou ser importante instrumento de política ambiental e fonte de receita pública municipal com desempenho melhor que o ICMS agrícola, ainda assim insuficiente para compensar financeiramente o Município pela restrição da atividade econômica.

Palavras-chave: Serviços ambientais; UC/TI; valor adicionado; ICMS-Se; política ambiental.

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ICMS Ecológico *versus* ICMS Producción agrícola: un enfoque basado en el método de costo de oportunidad

Flávio Amaral Oliveira
Cleci Grzebieluckas
Raimundo Nonato Cunha de França

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Resumen: El ICMS ecológico es una aplicación de criterios ambientales en la distribución de los recursos recolectados por los estados brasileños. Surgió como un instrumento innovador capaz de desarrollar la política ambiental y la justicia fiscal, compensando financieramente y fomentando áreas de conservación ambiental con los municipios. El objetivo del estudio es comparar los ingresos públicos del ICMS ecológico generado por las Tierras Indígenas con el ICMS de la producción agrícola en Tangará da Serra - MT, utilizando el costo de oportunidad. La investigación es descriptiva, bibliográfica y documental, con enfoque económico y fuentes secundarias. El ICMS ecológico demostró ser un importante instrumento de política ambiental y una fuente de ingresos públicos municipales con mejor desempeño que el ICMS agropecuario, aún insuficiente para compensar financieramente al Municipio por la restricción de la actividad económica.

***Palabras-clave*:** Servicios ambientales; UC/TI; valor agregado, ICMSe; política de medio ambiente.