ECOLOGICAL ICMS: AN ANALYSIS OF THE SOCIOECONOMIC AND ENVIRONMENTAL REFLEXES IN THE MUNICIPALITIES OF THE RIBEIRA VALLEY IN THE STATE OF SÃO PAULO, BRAZIL

ICMS Ecológico: uma análise dos Reflexos Socioeconômicos e Ambientais nos Municípios do Vale do Ribeira no Estado de São Paulo, Brasil

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ABSTRACT

The Ecological ICMS (ICMS-E) is a Brazilian ecological fiscal transfer mechanism that encourages municipalities to carry out environmental conservation practices. In the state of São Paulo, the municipalities that received the highest value of ICMS-E are located in the Vale do Ribeira region, highlighted by its ecological diversity associated with a precarious socioeconomic condition, verified by the low indicators of Gross Domestic Product (GDP) per municipal capita. This research aimed to analyze the relationship between the environmental and social situation with the collection of ICMS-E in the municipalities of Vale do Ribeira in São Paulo. This is a descriptive, documentary and quantitative research. The sample consisted of municipalities in the Vale do Ribeira region in São Paulo. Descriptive statistics, multiple linear regression and Student's t test were used. The analysis period comprised 2010 and 2020. The results indicated that the increase in ICMS-E transfer did not reflect a considerable increase in the vegetation cover of the municipalities. Regarding the social aspect, there were indications that the increase in the ICMS-E pass-through value, in practice, does not affect the municipal GDP. Such results demonstrate the need to rethink the criteria and effectiveness of ecological fiscal transfers of ICMS-E in the Vale do Ribeira region.

Keywords: Environmental; Conservation; Ribeira Valley; ecological fiscal transfers; Ecological ICMS.

RESUMO

O ICMS Ecológico (ICMS-E) é um mecanismo brasileiro de transferência fiscal ecológica que estimula municípios a realizarem práticas de conservação ambiental. No estado de São Paulo os municípios que receberam maior valor de ICMS-E estão localizados na região do Vale do Ribeira, destacada pela sua diversidade ecológica associada a uma condição socioeconômica precária, verificada pelos baixos indicadores de Produto Interno Bruto (PIB) *per capita* municipal. Esta pesquisa objetivou **analisar a relação entre a situação ambiental e social com a arrecadação do ICMS-E dos municípios do Vale do Ribeira em São Paulo**. Trata-se de uma pesquisa descritiva, documental e quantitativa. A amostra consistiu nos municípios da região do Vale do Ribeira em São Paulo. Utilizou-se de estatísticas descritivas, regressão linear múltipla e o Teste t de Student. O período de análise compreendeu 2010 e 2020. Os resultados indicaram que o aumento de repasse de ICMS-E não refletiu num aumento considerável da cobertura vegetal dos municípios. Em relação ao aspecto social verificou-se indícios de que o aumento do valor de repasse ICMS-E, na prática não afeta o PIB municipal. Tais resultados demonstram a necessidade de repensar os critérios e eficácia das transferências fiscais ecológicas de ICMS-E na região do Vale do Ribeira.

Palavras-chave: Ambiental; Conservação; Vale do Ribeira; Transferências Fiscais Ecológicas; ICMS Ecológico.

1. INTRODUCTION

The environmental advantages of ecosystem conservation benefit on both a local and global scale (BUSCH et al., 2021). However, man's relationship with the environment has changed fearlessly with the emergence of modernity (BEBBINGTON et al., 2021), with conservation not being a priority for

governments and entities, but rather socioeconomic development (RING, 2008). Thus, although the benefits of environmental services extend beyond local boundaries, the economic costs of ecosystem conservation, environmental externalities, and certain constraints regarding economic planning and land use are supported locally (BUSCH et al., 2021; RING, 2008).

Faced with this dilemma, the literature contemplates two main economic instruments to protect ecosystems at the local level: payments for environmental services (PES) (FARLEY; COSTANZA, 2010; WUNDER, 2005) and; ecological fiscal transfers (RING, 2008; RING; BARTON, 2015). The PES aims to encourage and compensate users of private resources for the efforts and certain deprivations to conserve the environment and ensure the continuity of certain environmental services, while the ecological fiscal transfers aim to encourage local governments to carry out management and conservation practices of ecosystem resources (PAULO; PEDROSA; CAMÕES, 2022). In this research, we chose to focus on the mechanism of ecological fiscal transfers.

The ecological fiscal transfers mechanism has developed worldwide in countries such as Portugal (SANTOS et al., 2012, 2015), France (BORIE et al., 2014), China (SUN, 2014; WU et al., 2017) and India (BUSCH; MUKHERJEE, 2018), and in Brazil (BUSCH et al., 2021; RING, 2008; SAUQUET; MARCHAND; FÉRES, 2014). In Brazil, the first mechanism of this type created was the Ecological ICMS (ICMS-E). The ICMS-E is a fiscal transfer of financial resources from the states to the municipalities as a reward for the conservation and maintenance of environmental services, evaluated according to established state criteria (SAUQUET; MARCHAND; FÉRES, 2014).

The first Brazilian state to implement ICMS-E was Paraná, in the 90s (LOUREIRO, 2002; MAY et al., 2002). Currently there are already 16 states that have instituted legislation with ICMS-E measures (OLIVEIRA, 2019). Among the measures adopted in various ways by the states the most common is the protection and creation of Conservation Units (RING, 2008), but other environmental and social policies have been developed such as solid waste management, water conservation, fire control and protection of indigenous lands, used for example in the states of Mato Grosso, Ceará, Rio de Janeiro, Mato Grosso do Sul, Minas Gerais, Pernambuco, Tocantins, Piauí, Goiás (PAULO; PEDROSA; CAMÕES, 2022).

Among the states that adhered to ICMS-E, the state of São Paulo initiated this practice from state legislation nº 8.510 of 1993 (SÃO PAULO, 1993). In the state stands out the region of Ribeira Valley, scope of this research, for being formed by twenty municipalities that directly influence the formation of coastal ecosystems and covers one of the largest remnants of Atlantic Forest in Brazil, entitled in 1999 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as Natural Heritage of Humanity.

Of this area, about 20% of its territory is protected by Integral Protection Conservation Units and another 35% comprises Sustainable Use Conservation Units (GOVERNMENT OF THE STATE OF SÃO PAULO, 2023). In 2022, the state collected R $ 204.6 billion in ICMS, of which the amount of R $ 203 million was passed on as ecological fiscal transfers to the municipalities through ICMS-E. Of these, two municipalities located in the Ribeira Valley received the 2nd and 3rd largest ICMS-E transfers, Barra do Turvo with R$ 7.3 million and Iporanga with R$ 6.8 million (SEMIL, 2023).

Despite the relevance of ICMS-E, the efficacy of this mechanism has not been verified in the literature (RING; SCHRÖTER-SCHLAACK, 2011). Some criticisms are highlighted, such as the way that municipalities use such resources to be applied as they wish, thus, in most of them they are destined for the social, economic functions of the public sector and not necessarily environmental expenditures (CASTRO et al., 2019; GRIEG-GRAN, 2000; RING, 2008), it is also noteworthy the low percentage value of ICMS-E not always sufficient to meet the maintenance needs of the municipality and its conservation unit. Although municipalities with high portions of protected areas tend to benefit considerably from such resources and environmental services, on the other hand they are limited to local economic development (RING, 2008).

In this context, this research aims to analyze the relationship between the environmental situation (native vegetation cover) and social (*municipal GDP per capita*) with the collection of ICMS-E of the municipalities of the Ribeira Valley in the State of São Paulo. Some justifications support the contribution of this research. First, theoretical, because it enables society to understand the evolution of the environmental conservation policy of ICMS-E in environmentally and economically strategic regions such as São Paulo, the most populous state in Brazil (Brazilian Institute of Geography and Statistics - IBGE, 2023).

Secondly, by presenting ecological fiscal transfers as an economic instrument that can foster conservation and environmental preservation practices, minimizing not only local impacts such as quality of life and global warming. Finally, empirical in measuring the socio-environmental reflexes and enabling the effectiveness of the policy to be rethought by local managers, readapted and encouraged other states or countries such as the case of Portugal that was inspired by the Brazilian model, as evidenced by Busch et al. (2021) and Santos et al. (2012, 2015).

2. THEORETICAL REFERENCE

2.1. ECONOMIC INSTRUMENTS OF COMPENSATION FOR ENVIRONMENTAL CONSERVATION

The ecosystem is formed in a complex and dynamic way by plants, animals, microorganisms and non-living environment that together interact in a unique way. Environmental services or ecosystem services can be defined as the benefits that the population receives from the ecosystem (MILLENNIUM ECOSYSTEM ASSESSMENT, 2003, 2005). Many environmental services are available free of charge, without pricing mechanisms and markets, and their effective long-term value is not considered in society's economic estimates (PARRON et al., 2015). In this perspective, in order to manage natural resources, economic instruments are elaborated, such as: Payment for Environmental Services (PES) and ecological fiscal transfers.

Payment for Environmental Services functions as a market mechanism, based on criteria in which a voluntary transaction occurs in which a defined environmental service is purchased by at least one service buyer and at least one environmental service provider, conditioned on the supplier guaranteeing the provision of the service (FARLEY; COSTANZA, 2010; WUNDER, 2005). For Muradian et al. (2010), the PES consists of the transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources.

One of the challenges in designing PES programs is to define who are the buyers who may be the actual users of environmental services or others acting on behalf of users. The possible sellers are actors who are able to guarantee the delivery of the environmental service (BRITO; MARQUES, 2016). Most PES programs are aimed at private owners (BRITO; MARQUES, 2016; PAIVA et al., 2019). Thus, according to the peculiarities and needs (social and environmental) of each region, different institutional arrangements of PES programs can be elaborated.

Ecological fiscal transfers involve the redistribution of public revenues through transfers from national and subnational governments to local governments (RING, 2008). The purpose of ecological fiscal transfers may be to compensate local government for the environmental management of existing natural resources and environmental services, which enable benefits that go beyond the boundaries of local jurisdictions (RING, 2008; SAUQUET; MARCHAND; FÉRES, 2014), and also compensate for the loss of revenue from protected areas (BUSCH et al., 2021).

Various ecological fiscal transfers arrangements can be devised for the purpose of transferring revenue 'vertically' from top-level governments to lower-level governments or 'horizontally' between governments at the same level. They can be 'general purpose' transfers to subnational government budgets that can be spent on any priority of the receiving jurisdictions, whether ecological or non-ecological. Or they may be 'specific purpose' transfers intended for a particular ecological use, e.g. reforestation or water treatment (BUSCH et al., 2021).

While the Payment for Environmental Services instrument usually transfers funds to private landowners, the ecological fiscal transfers instrument is distinguished by transferring funds within a country to local governments. In this article, we chose to focus on the economic instrument to reward municipalities for conservation initiatives, that is, ecological fiscal transfers, based on the experience of the ICMS-E of the municipalities of the Ribeira Valley region located in the state of São Paulo, Brazil.

2.2. ICMS ECOLOGICAL

In Brazil, the Tax on the Circulation of Goods and Services of Interstate Transport and Communication (ICMS), deals with a tax of state collection, provided for in the Federal Constitution (CF) of 1988, instituted through Complementary Law nº 87/1996 and different state legislations (BRASIL, 1988; BRASIL, 1996). Although the tax is state, it is up to the State to transfer 25% of the total revenue collected to the municipalities. Of this redistribution, at least three quarters are defined by the FC, whose criterion is the added value created by each municipality in relation to the occurrence of the generating events and up to a quarter (6.75%) are allocated according to the legislation of each state (BRASIL, 1988).

From this parcel, the Ecological ICMS (ICMS-E) or also called Green ICMS, environmental ICMS or socio-environmental ICMS, instituted through the adequacy of environmental criteria (BRITO; MARQUES, 2016; CASTRO et al, 2019; OLIVEIRA; GRZEBIELUCKAS; FRANÇA ,2022). The ICMS-E is an environmental policy instrument that encourages municipalities to carry out environmental conservation and as compensation, receive through the practice of fiscal transfer of financial resources (TUPIASSU; FADEL; GROS-DÉSORMEAUX, 2019). Thus, municipalities that proportionally have larger conservation areas or better policies receive a larger share of the transfers to the detriment of those with smaller areas or worse policies (OLIVEIRA; GRZEBIELUCKAS; FRANÇA, 2022).

Brazil is formed by 27 federative units, in which the largest source of tax collection is ICMS (SAUQUET; MARCHAND; FÉRES, 2014). The state of Paraná was the pioneer to introduce ecological criteria in the redistribution of ICMS in 1991. (RING, 2008). To carry out the fiscal transfer of ICMS-E between municipalities, the state of Pará uses indicators to evaluate environmental performance (FARLEY; COSTANZA, 2010). In this way, it verifies the quality of protected areas and criteria for the protection of water sources that provide drinking water services (SAUQUET; MARCHAND; FÉRES, 2014).

Based on this experience, ICMS-E legislation was instituted in the states of São Paulo (1993), Mato Grosso do Sul (1994), Minas Gerais (1995), Amapá (1996), Rondônia (1996), Rio Grande do Sul (1997), Mato Grosso (2000), Pernambuco (2000), Tocantins (2002), Acre (2004), Ceará (2007), Rio de Janeiro (2007), Piauí (2008), Goiás (2011) and Pará (2012) (JARDIM; BURSZTYN, 2015; BRITO; MARQUES, 2016;

LIMA; GOMES; FERNANDES, 2020). The state of Paraíba tried to institute ICMS-E through Law No. 9,600/2011, however, the law was declared unconstitutional (OLIVEIRA, 2019).

Among the states that did not adhere to the ICMS-E measure are Alagoas, Amazonas, Bahia, Espírito Santo, Maranhão, Roraima, Rio Grande do Norte, Santa Catarina and Sergipe, located in regions with biomes such as Cerrado, Atlantic Forest and the Amazon Forest, that is, strategic regions that require greater environmental protection (BRITO; MARQUES, 2016; SOUZA; COSTA; MELLO, 2020).

Similar experiences of ecological fiscal transfers can be identified in the international context. As in Portugal that inspired the Brazilian model (BUSCH et al., 2021), in 2007 implemented legislation with the objective of transferring funds from the national budget to more than 300 municipalities in order to compensate these for the loss of revenue arising from protected areas (SANTOS et al., 2012, 2015).

France since 1979 has redistributed central government funds to municipalities with part of the territories under full protection, thus restricted to land use (BORIE et al., 2014). China since 2010 has compensated municipal governments for spending on the conservation of areas with vulnerable biodiversity (SUN, 2014; WU et al., 2017). India in 2015 began compensating states for the low tax revenue collected by virtue of forest cover conservation and for recognizing the prominent ecological benefits of these forests (BUSCH; MUKHERJEE, 2018).

3. METHODOLOGY

The study presents a quantitative approach, which made it possible to characterize and interpret the collected data and analyze them through statistical techniques (MARTINS; THEOPHILO, 2016). Regarding the objectives, the research is characterized as descriptive and exploratory. Thus, it enabled a better understanding and analysis of the relationship between the environmental and social situation and the collection of ICMS-E in the municipalities of Ribeira Valley in the state of São Paulo, whose interval period of the analysis comprises the variation between the years 2010 and 2020.

As research procedures, theoretical methods were used in the analysis of documentary data, such as the reports of Transfer of ICMS-E (SEMIL, 2023), Mapping of the Native Vegetation Cover of the municipalities of the state of São Paulo (IF, 2020), Quantification of the Remaining Native Vegetation for the municipalities of the State of São Paulo 2009/2010 (IF, 2010) and Gross Domestic Product (GDP) per capita municipal (IBGE, 2023) and legislation and regulations issued by the Government of the State of São Paulo, and; Empirical, therefore, the research used the ex post facto technique, since it was verified the management reports in previous years.

As for the population, it includes the 20 municipalities of the Ribeira Valley, however 05 of these cities were excluded for not receiving the transfer of ICMS-E, since they do not have environmental spaces

specially protected by law; and 01 municipality for being characterized as an outlier in the sample, since it has in its territory a mining company, with multinational headquarters, which considerably increases municipal GDP per capita. Given this scope, it is noteworthy that the sample was constituted through stratified selection, creating a subpopulation of municipalities that receive the incentive of ecological fiscal transfers through ICMS-E. Therefore, the final valid sample of the present study covers the 14 municipalities shown in Table 1, according to IBGE (2023).

Table 1 - Valid sample from the Ribeira Valley.

Item	Municipality	Area (ha.)	Population
1	Apiaí (SP)	97.567,00	24.585
2	Barra do Turvo (SP)	100.603,00	6.875
3	Eldorado (SP)	165.079,00	13.069
4	Iporanga (SP)	116.172,00	4.046
5	Itariri (SP)	27.312,00	15.528
6	Jacupiranga (SP)	70.377,00	16.116
7	Juquiá (SP)	81.253,00	17.154
8	Juquitiba (SP)	52.206,00	27.404
9	Miracatu (SP)	100.008,00	18.553
10	Pariquera-Açu (SP)	35.929,00	19.223
11	Pedro de Toledo (SP)	67.099,00	11.281
12	São Lourenço da Serra (SP)	18.701,00	15.984
13	Sete Barras (SP)	106.282,00	12.730
14	Tapiraí (SP)	75.444,00	7.996
		1.114.032,00	210.544

Note. (ha.) = hectare.

Source: Fonte: IBGE (2023).

As for data collection, it was carried out in the period June and July 2023, based on internet searches specifically on the websites of the federal and state government agencies of São Paulo, with a view to obtaining data from reliable sources. Search words/expressions were used such as: “native vegetation cover”, “Ribeira Valley”, “São Paulo ICMS-E transfer”, “São Paulo forest survey”, “biotic thematic map”, “municipal GDP”, “IBGE cities”, among others arising from the developments of the initial surveys with these commands. The collection process also includes contacts made through phone calls, e-mails and WhatsApp messages, with various state agencies of São Paulo and with the secretariats of some municipalities belonging to our sample.

In view of the information collected, it was elaborated the compilation of the same by means of an electronic spreadsheet of Office Excel®, whose data evidenced were: transfer of ICMS-E, vegetation cover and GDP per capita municipal, relative to the periods surveyed. It is reported that the forest inventory that determines the Native Vegetation Cover of the municipalities of the Ribeira Valley was

carried out in 2009, with the publication in 2010, but due to the scarcity of data and a very static change from one year to another, the data were used to compose the analysis of the 2010 period. All other data confer with the year identified.

For data analysis, we used a priori the application of descriptive statistics (mean, standard deviation, minimum value and maximum value) to describe, organize and synthesize the characteristics of the variables collected. The investigation was conducted with the Statistical Package for Social Science (SPSS) software, version 22, and in cases where necessary, a significance level of 0.05 was used.

Subsequently, multiple linear regression was applied to analyze the relationship between the two explanatory variables: municipal vegetation cover (environmental situation) and GDP per capita (social situation) with the dependent variable: transfer of ICMS-E from the municipalities of Ribeira Valley and report the results obtained in the periods verified, in order to achieve the main objective of the research. Furthermore, it was decided to use the parametric Student's t test to compare municipal averages two-by-two from paired data, with a certain theoretical value, to determine significant changes in the analyzed variables for the years 2010 and 2020, highlighting the main inferences and suggestions on the topic addressed.

4. RESULTS AND DISCUSSIONS

4.1. SAMPLE CHARACTERIZATION

The state of São Paulo was the second Brazilian state to adopt ICMS-E as an instrument of ecological fiscal transfers through state law nº. 8.510/1993, which established the redistribution of 1% of the collection of ICMS, of which the percentage of 0.5% to municipalities that have territorial spaces protected by law, such as Conservation Units, and the percentage of 0.5% to those that have water reservoirs for the generation of electricity (SÃO PAULO, 1993). In the state, the Ribeira Valley region has its relevance because its municipalities, as previously noted, directly influence the formation of coastal ecosystems and covers one of the largest remnants of the Atlantic Forest in Brazil (GOVERNMENT OF THE STATE OF SÃO PAULO, 2023). Thus, we chose to focus our research on this region.

The compilation of data from the municipalities of the Ribeira Valley region is detailed in Table 2 and provided a better visualization of the characterization of the sample, as well as preliminary analyses of the study.

Table 2 - Compilation of data for the period 2010 and 2020.

Municipality	ICMS-E (R$)		Vegetation Cover (ha.)		GDP *per capita* (R$)	
	2010	2020	2010	2020	2010	2020
Apiaí	623.259,53	1.012.568,54	58.246,00	64.431,00	16.803,17	29.682,44
Barra do Turvo	3.401.888,42	5.308.306,76	72.029,00	76.767,00	6.766,64	14.303,74
Eldorado	3.851.088,07	4.427.293,62	131.034,00	136.383,00	13.150,86	20.805,58
Iporanga	3.189.776,41	4.949.188,43	104.152,00	105.583,00	5.512,45	15.119,69
Itariri	514.977,77	807.579,09	18.688,00	20.813,00	7.042,82	20.305,21
Jacupiranga	713.219,31	1.024.094,27	40.772,00	49.971,00	15.988,01	29.046,48
Juquiá	1.344.337,57	2.089.526,45	58.235,00	63.948,00	11.218,71	19.297,57
Juquitiba	319.745,52	744.528,03	39.261,00	42.925,00	10.435,20	17.294,82
Miracatu	1.973.380,79	3.146.949,30	76.445,00	80.935,00	16.769,06	21.518,00
Pariquera-Açu	235.891,13	438.139,51	17.975,00	23.207,00	15.344,29	27.070,89
Pedro de Toledo	2.506.875,01	4.224.117,51	59.290,00	60.799,00	9.012,87	14.566,04
São Lourenço da Serra	46.257,92	107.502,40	13.012,00	14.670,00	15.261,27	16.622,93
Sete Barras	2.002.863,67	3.213.715,29	76.661,00	83.515,00	19.025,87	27.506,04
Tapiraí	1.465.693,25	2.166.754,87	65.845,00	66.905,00	9.210,28	23.609,60
Totais	22.189.254,37	33.660.264,07	831.645,00	890.852,00	171.541,50	296.749,03

Note. (R$) = Reais, brazilian currency; (ha.) = hectare.

Source: Data research.

It is initially noticed that while the transfer values of ICMS-E and municipal GDP *per capita increased* respectively by 52% and 73% in this 10-year interval, the percentage of native vegetation cover increased only 7% in the same interval. In a first analysis, the increase in the transfer of ICMS-E did not reflect an increase in the vegetation cover of the municipalities, which denotes the need for analysis of the cost of maintaining the protected environmental spaces and the effectiveness of the objective of the transfer made.

The indicator of increased native vegetation cover can be considered worrying, given its relevance in the urban context, since according to Lacerda et al. (2021) and Vecchiato and Tempesta (2013) the natural environment plays a role that influences the quality of life, by providing people's well-being, contributing to friendship, cooperation and resilience to depression and the stress of life in the city. Unlike the results of this study, the research by Sauquet et al. (2014), highlighted an increase of more than 80% in the volume of Municipal Conservation Units created in the State of Paraná in a decade.

Regarding the native vegetation cover indicator, it is worth highlighting that the municipalities in the sample have high native vegetation coverage compared to the municipal territory, with the municipality with the lowest vegetation coverage in 2020 and 2021 being Pariquera-Açu, as shown in Table 3.

Table 3 - Comparação entre território e cobertura vegetal nativa de 2010 e 2020.

Município	Territorialidade (ha)	Cobertura Vegetal 2010		Cobertura Vegetal 2020	
		(ha)	%	(ha)	%
Apiaí	97.567,00	58.246,00	60%	64.431,00	66%
Barra do Turvo	100.603,00	72.029,00	72%	76.767,00	76%
Eldorado	165.079,00	131.034,00	79%	136.383,00	83%
Iporanga	116.172,00	104.152,00	90%	105.583,00	91%
Itariri	27.312,00	18.688,00	68%	20.813,00	76%
Jacupiranga	70.377,00	40.772,00	58%	49.971,00	71%
Juquiá	81.253,00	58.235,00	72%	63.948,00	79%
Juquitiba	52.206,00	39.261,00	75%	42.925,00	82%
Miracatu	100.008,00	76.445,00	76%	80.935,00	81%
Pariquera-Açu	35.929,00	17.975,00	50%	23.207,00	65%
Pedro de Toledo	67.099.00	59.290,00	88%	60.799,00	91%
São Lourenço da Serra	18.701,00	13.012,00	70%	14.670,00	78%
Sete Barras	106.282,00	76.661,00	72%	83.515,00	79%
Tapiraí	75.444,00	65.845,00	87%	66.905,00	89%
Totais	1.114.032,00	831.645,00		890.852,00	

Source: Data research.

With regard to the São Paulo ICMS-E resource passed on, it should be emphasized that it does not necessarily need to be used for environmental purposes, so many municipal managers use this money to pay off debts, pay administrative expenses or allocate these resources to sectors that they consider to be more useful. The São Paulo legislation has not determined the way this resource is used, so the municipality has the autonomy to use the transfer in the way it deems most appropriate (SOUSA; NAKAJIMA; OLIVEIRA, 2011).

Descriptive statistics were applied via SPSS software in the valid sample, referring to the two periods analyzed, evidencing the mean, standard deviation and minimum and maximum values of the data, which allowed to describe and synthesize the main characteristics of the sample for a better understanding of the indices collected (FÁVERO et al., 2009), as evidenced in Table 4.

Table 4 - Caracterização da Amostra.

Descriptive Statistics	ICMS-E (R$)		Vegetation Cover (ha.)		GDP *per capita* (R$)	
	2010	2020	2010	2020	2010	2020
Average	1.584.946,74	2.404.304,58	59.403,21	63.632,29	12.252,96	21.196,36
Standart Deviation	1.267.268,00	1.796.651,88	33.055,09	33.304,72	4.360,18	5.427,66
Minimum Value	46.257,92	107.502,40	13.012,00	14.670,00	5.512,45	14.303,74
Maximum Value	3.851.088,07	5.308.306,76	131.034,00	136.383,00	19.025,87	29.682,44

Nota. (R$) = Reais, brazilian currency; (ha.) = hectare.

Source: Data research.

Note that the averages obtained reinforce the initial understanding, in which the values of ICMS-E and municipal GDP per capita had a great increase in the decade studied while the average relative to the vegetation cover had a rather timid increase in relation to the other two. It is also noteworthy that the standard deviation of ICMS-E and Vegetation Cover are high, evidencing great variation in relation to the municipalities of the Ribeira Valley that present different realities.

4.2. MULTIPLE LINEAR REGRESSION MODEL

Subsequently, the Shapiro-Wilk test was applied to the 14 observations of each construct in order to verify the distribution of data for the periods analyzed, the results of which are described in Table 5.

Table 5 - Shapiro-Wilk Normality Test

Normality Test	ICMS-E		Vegetation Cover		GDP *per capita*	
	2010	2020	2010	2020	2010	2020
Sig.	0,208	0,156	0,514	0,679	0,404	0,216

Source: Data research.

As described in the table above, all the meanings found were above 0.05, so we did not reject the null hypothesis and concluded that the variables come from populations that follow the normal distribution and meet the assumption for the use of multiple linear regression used to analyze the relationship between variables.

The multiple linear regression test was passed, in which the transfer of ICMS-E consists of the dependent variable, the vegetation cover and the GDP per capita are explanatory variables and the areas of the municipalities were used as the control variable. The regressions for the 2010 and 2020 data were rotated by the insertion method (simultaneous), in which all explanatory variables were included in the model and the results were reported in Table 6.

Table 6 - Multiple Linear Regression Test – 2010 and 2020

Regression Model	R^2	Adjusted R^2	Durbin-Watson	ANOVA
2010	0,850	0,805	1,918	0,000
2020	0,806	0,748	2,585	0,001

Source: Data research.

The first analysis was made through the adjusted R^2, 0.805 (2010) and 0.748 (2020), that is, the set of explanatory variables used in the model explains 80.5% and 75%, respectively, of the variation of ICMS-E, so it is a good model.

The Durbin-Watson indices calculated for 2010 and 2020, through the SPSS, consist of d=1.918 (2010) and d= 2.585 (2020), and the dL= 0.905 and du= 1.551, therefore, it is concluded that the models do not present a problem of autocorrelation of the residues in either of the two years. When continuing the analysis, it was verified that the ANOVA test presented significance = 0.000 (2010) and = 0.001 (2020), both lower than 0.05 indicating that the proposed models present statistical significance, that is, at least one of the explanatory variables included in the models, initially is significant to explain the behavior of ICMS-E in the years 2010 and 2020.

Finally, when analyzing the coefficients of the models for the two periods, the following results were presented in Table 7.

Table 7 - Multiple Linear Regression – Coefficients

Coefficients	Constant		Vegetation Cover		GDP *per capita*	
	2010	2020	2010	2020	2010	2020
Beta	531.454,49	2.698.253,63	28,84	26,75	-76,64	-141,95
t	0,904	2,060	1,195	0,510	-1,664	-2,313
Sig.	0,387	0,066	0,260	0,621	0,127	0,043 *

Note. * = p-value < 0,05.

Source: Data research.

It is reported that only the coefficient of municipal GDP per capita of 2020 presented significance (p-value < 0.05) in the model and a negative relationship with the ICMS-E, therefore, reinforces the evidence that the value of ICMS-E transfer is very low and in practice does not affect the municipal GDP and that the municipalities with greater protected environmental territory, have a minimum compensation that does not impact on the economic and social development of the municipality. Contrary to what several studies point out, when they highlight that the ICMS-E has the role of compensating certain regions in relation to the restrictions regarding economic planning and land use (RING, 2008; BUSCH et al., 2021).

These results can be justified by the fact that among the Brazilian states that have adopted the ICMS-E as an ecological fiscal transfers instrument, the state of São Paulo has the lowest percentage (1%) of ICMS distribution, a percentage that varies according to the state legislation of each state, reaching 20% in the state of Acre (BRITO; MARQUES, 2016).

And also because with regard to the management of Conservation Units, the state of São Paulo is the only one to restrict the transfer of ICMS-E resources to only state areas, other states cover municipal, state, federal and private areas (LIMA; GOMES; FERNANDES, 2020). Thus, the way the criteria for the transfer of the ICMS-E in São Paulo are structured end up discouraging and limiting certain environmental actions of the municipal public management, making the transfer of resources a mere financial compensation.

Possibly, the non-significance of most of the coefficients of the regression model occurred due to the sample size (n=14), so there is no conflict with multicollinearity or autocorrelation of the residuals and presents an adequate R^2, but does not reach significance due to the small number of observations. Therefore, the model cannot be replicated to other regions, that is, the results cannot be generalized to other municipalities only to the Ribeira Valley, despite the indication that the coefficient of GDP per capita 2020 has a significant and negative relationship with the ICMS-E.

The following are the models to be applied only to the municipalities in the sample:

Model 1:

$$ICMS - E_{2010} = 531.454{,}49 + 28{,}84.\,Vegetation\ Cover - 76{,}64.\,GDP + \varepsilon$$

Model 2:

$$ICMS - E_{2020} = 2.698.253{,}63 + 26{,}75.\,Vegetation\ Cover - 141{,}95.\,GDP + \varepsilon$$

In view of the results obtained, it was identified that there is no significant relationship between the environmental (green area) and social (municipal GDP per capita) situation with the collection of ICMS-E of the municipalities of Ribeira Valley in the State of São Paulo, which denotes the lack of mechanisms to measure whether there was/is effective financial compensation for the maintenance of conservation units, casts doubt on whether the ecological fiscal transfers is seen as an instrument to support environmental management, contrary to the conclusions of the research by Sousa, Nakajima e Oliveira, (2011), which points to the ICMS-E as an instrument of strong impact on the conservation and increase of the surfaces of municipal protected areas. However, it corroborates with the same authors in the sense of highlighting the need for the participation of municipal governments for the environmental responsibility that they are responsible for, in order to prevent the ecological fiscal transfers from becoming an isolated tool but rather part of other joint actions of the government.

4.3. STUDENT'S T-TEST FOR ANALYSIS OF PAIRED MEANS

Finally, the hypothesis test was applied through Student's t, suitable for verifying differences or equalities of the means of paired samples (FÁVERO et al., 2014), in order to observe if there was a significant change between the means related to the transfer of ICMS-E, Vegetation Cover and municipal GDP per capita calculated in 2010 and 2020.

Table 8 - Student t-tests

Relation	t	Sig.
ICMS-E 2010 - 2020	-4,913	0,000 *
Vegetation Cover 2010 - 2020	-6,509	0,000 *
GDP *per capita* 2010 - 2020	-8,882	0,000 *

Note. * = p-value < 0,05.

Source: Data research.

With these results from Table 8, it was found that the p-value = 0.000 < 0.05 for each pair analyzed, so the null hypothesis for the three pairs is rejected, denoting that there were significant differences between the paired means of 2010 and 2020 for each construct. showing an increase in averages in 2020.

Thus, it is observed that in the interval of 10 years there was a relevant increase in the values received by the municipalities of ICMS-E, the increase in native vegetation cover and municipal GDP per capita, but in a deeper analysis it can be inferred that these values did not impact on the sufficient compensation of the municipality, these factors analyzed are independent of each other, as insinuated in the characterization of the sample and affirmed in the coefficients of the linear regression, soon there is still much to verify until these ecological fiscal transfers have a really impactful role in municipal life, that the transfers will reach their objective of financial compensation in the face of conservation and environmental maintenance.

Results that corroborate the findings of Azzoni and Isai (1994), who, when elaborating a calculation methodology to estimate values that the government of São Paulo should pass on to municipalities with environmental protection areas, found that protecting would lead to a maximum reduction in GDP state annual revenue, and that the municipalities involved would bear the impact of the reduction in annual revenues. Thus, the authors measured an environmental protection cost between 0.05% and 0.03% of the state's GDP.

5. FINAL CONSIDERATIONS

This research aimed to analyze the relationship between the environmental and social situation with the economic instrument of ecological fiscal transfer the ICMS-E, of the municipalities of the Ribeira Valley region in the state of São Paulo. The results obtained indicated that there is an inverse and significant relationship between GDP per capita 2020 and ICMS-E 2020, but as for the other explanatory variables, they did not present a significant relationship with ICMS-E 2010 or 2020; they also showed that in the last decade the values referring to ICMS-E and municipal GDP per capita had a significant increase, however, in relation to the environmental question, the percentage of native vegetation cover had a great growth shy.

In the environmental context, these findings indicate that the increase in ICMS-E transfer did not reflect a considerable increase in the vegetation cover of the municipalities, which denotes the need to analyze the effectiveness of the objective of the transfer made. In relation to the social aspect, it was possible to verify evidence that despite the growth, the ICMS-E transfer value, in practice, does not affect the municipal GDP per capita.

The results of this research contribute to society by detailing how the ICMS-E policy has behaved over the years in the Ribeira Valley region, an environmentally strategic location in the state of São Paulo. And by recognizing the importance of ICMS-E in fostering socio-environmental development and showing that the main rules of the State, such as having the lowest Brazilian percentage of transfer (1%), not considering in the transfer the municipal, federal and private conservation units, tend to limit certain actions of public management, making the transfer of resources a mere financial compensation.

This research was not exempt from limitations in view of the lack of standardization of the information disclosed by the state and municipalities, in view of a policy in which a relevant prerequisite is the registration and maintenance of information on indicators used to calculate the transfer of ICMS-E. And it was also limited by not effectively verifying the effectiveness of the environmental practices carried out by the municipalities, much less characterizing them with regard to qualitative aspects. In addition, the fact that the study is delimited to the region of Ribeira Valley in the state of São Paulo, without contemplating other municipalities in the most populous state of Brazil.

In this step, it is recommended for future research a detailed investigation of the effectiveness of the environmental actions carried out in the municipalities, as well as the determination of which destinations have received the resources from the ICMS-E, the comparison with other states in order to relate possible obstacles and alternatives of readjustment of the current model, valuation of such areas for the State of São Paulo and globally in case of loss of ecosystems. And also studies that report the impact of the Brazilian tax reform on the ICMS-E policy.

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