



Ecological ICMS, payments for environmental services, and private reserves in the Paraná state (Brazil)

ICMS ecológico, pagamentos por serviços ambientais e as RPPN no estado do Paraná

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ABSTRACT: To protect the essential ecosystem services for the maintenance of society, effective mechanisms of incentive are necessary, acting supplementary to command and control instruments. The *Ecological ICMS of Paraná State*, Brazil, which was the first project of this kind in the country, showed effectiveness as a conservation incentive during its 30 years in operation and has the potential to enhance and increase the safety net of biodiversity in *Paraná* through municipal support to owners of Private Natural Heritage Reserves - *RPPN*. The aim of this study was to analyze the technical and legal feasibility of Payments for Environmental Services – *PSA* from municipalities to *RPPN* owners, using the *Ecological ICMS* as the main financial source. The *Ecological ICMS in Paraná* uses qualitative annual assessments, whose results highly affect the transfer of resources to the municipalities. Therefore, the programs to support *RPPN* owners tend to increase the tributary benefits of the municipalities. The average performance of *RPPNs* in *Paraná* was 27.5% in 2021, indicating an environmental and tributary underutilization of these areas. The *PSA* is the most attractive modality of incentive for *RPPN* owners since it generates financial benefits directly for them. However, because of specific norms, other modalities of municipal incentives are currently predominant, among which the most effective has been the inter-municipal agreements for conservation unit management. We suggest that the *PSA* model used in the *Paraná State* should be adapted to the municipalities using the *Municipal Environment Fund*, with resources from the *Ecological ICMS*. The inflow of resources from the private initiative, to comply with legal requirements and for marketing purposes, should also be observed. We suggest defining priority areas and specific environmental services so that these programs can converge with municipal policies for conservation and sustainable development.

Keywords: conservation incentives; bioeconomy; environmental policies; conservation units; environmental law.

RESUMO:

Para garantir os serviços ecossistêmicos essenciais à manutenção da sociedade, são necessários mecanismos efetivos de incentivo, atuando complementarmente aos instrumentos de comando e controle. O ICMS Ecológico paranaense, primeiro projeto do gênero adotado no Brasil, mostrou-se eficaz como incentivo à conservação ao longo de seus 30 anos de operação e apresenta potencial para fortalecer e ampliar a rede de proteção à biodiversidade no Paraná, através do apoio municipal aos proprietários de Reservas Particulares do Patrimônio Natural – RPPN. O objetivo deste estudo foi analisar a viabilidade técnica e legal dos Pagamentos por Serviços Ambientais – PSA municipais para proprietários de RPPN, tendo o ICMS Ecológico como principal fonte de recursos. O ICMS Ecológico paranaense emprega avaliações anuais qualitativas, de forma que os programas de apoio às RPPN tendem a ampliar os benefícios tributários dos Municípios. O desempenho médio das RPPN paranaenses nas avaliações anuais da qualidade foi de 27,5% em 2021, demonstrando um subaproveitamento ambiental e tributário dessas áreas. O PSA se constitui em uma das mais atrativas modalidades de incentivo às RPPN, pois gera benefícios financeiros diretos aos proprietários. Contudo, devido a normas específicas, atualmente predominam outras modalidades de apoio às RPPN, dentre as quais foram consideradas as mais efetivas os convênios intermunicipais para gestão das Unidades de Conservação. Entende-se que o modelo de PSA adotado pelo Estado do Paraná deva ser adaptado à esfera municipal, com uso dos Fundos Municipais de Meio Ambiente, sendo estes, por sua vez, abastecidos principalmente com recursos do ICMS Ecológico. Deve ser analisado o interesse de empresas privadas em aportar recursos nos programas municipais, diante de possíveis exigências legais e vantagens mercadológicas. Recomenda-se a definição de áreas prioritárias e de serviços ambientais específicos para a convergência desses programas com os objetivos das políticas municipais de conservação e desenvolvimento sustentável.

Palavras-chave: incentivos à conservação; bioeconomia; políticas ambientais; unidades de conservação; legislação ambiental.

1. Introduction

Native ecosystems provide essential services for the survival and quality of people's lives through the conservation of soils, water resources, scenic beauty of natural landscapes, pollinators, molecules of chemical-pharmaceutical interest, climate and microclimate regulation, and water regime of rivers. These, among others, are ecosystem services whose functions have positive impacts on economic, cultural, and social aspects (Bustamante *et al.*, 2019).

Incentives are fundamental to legitimize and, consequently, consolidate the maintenance of significant portions of native ecosystems, in view of the notorious dichotomy between individual economic

interests and nature conservation - which generates diffuse benefits and is of public interest (Rode *et al.*, 2015). Also, the command and control instruments, which in Brazil do not have the appropriate monitoring apparatus and require greater complementation through incentives (Oliveira *et al.*, 2017), have been shown to be limited to containing deforestation and strengthening restoration and protection actions (Strassburg *et al.*, 2012).

Among the instruments of public policies for economic incentives to conservation in Brazil, the mechanisms of ecological tax transfer usually called Ecological ICMS or Green ICMS should be highlighted. Through them, a quota of the resources collected by the States through the ICMS (Tax on

the Circulation of Goods and Services) is distributed among the municipal administrations proportionally to the environmental services provided by them. This is a kind of Payment for Environmental Services (PSA) from the State to Municipalities, currently used in 18 Brazilian states (Busch *et al.*, 2021). In Paraná, the Ecological ICMS is applied to 5% of the share of Municipalities and includes two modalities, Water Supply Watersheds and Conservation Units (UC), with 2.5% allocated to each of these modalities (Paraná, 1991).

PSA is a form of incentive through which “providers” of environmental services are paid by one or more “beneficiaries” of these environmental services. It is a mechanism capable of encouraging conservation behavior in private areas through the receipt of financial resources by their owners (Silva *et al.*, 2016). Environmental services correspond to actions developed by owners of natural areas, in favor of the recovery, maintenance, or expansion of ecosystem services provided by these areas (Salzman *et al.*, 2018).

The Private Natural Heritage Reserves (RPPN) are part of the National System of Conservation Units (SNUC) (Brazil, 2000) and are contemplated by the Ecological ICMS of Paraná (IAP, 1998a). Since these are priority areas for conservation (Tabarelli *et al.*, 2005; Paraná, 2007) created and managed by private initiative, the state legislation provides support to RPPN owners in Paraná through some mechanisms, among which stand out the Ecological ICMS itself, through the support provided by the Municipalities, and the PSA (Paraná, 2007; 2012).

In Brazil, the government is the main responsible for the implementation of the UCs, which is one

of the main strategies for the conservation of natural heritage (Brazil, 2000). Since the implementation and management of public UCs are very costly, support and encouragement to private areas can represent a reduction in Public costs of conserving biodiversity (Mayer & Tikka, 2006). In the case of the municipalities of Paraná, in addition to the environmental benefits, there is an increase in the tax collection resulting from the ecological ICMS by the RPPN.

Therefore, municipal PSA programs using the Ecological ICMS resources are in the interest of Municipalities and RPPN owners (Takenaka *et al.*, 2017), but the lack of a consolidated technical and legal framework often hinders these initiatives (Prado *et al.*, 2019). In this context, the general goal of this work was to analyze the technical and legal landscape of RPPN incentive programs in the State of Paraná, with emphasis on the Ecological ICMS and PSA to propose guidelines for PSA programs at the municipal level.

To this end, the present work contains analyzes on the following subjects:

- (i) Mechanisms of the Ecological ICMS for RPPN in Paraná;
- (ii) The importance of these units for tax collection in Municipalities of Paraná;
- (iii) RPPN support programs using resources from the Ecological ICMS;
- (iv) A description of the operation of the PSA programs to RPPNs;
- (V) The importance of RPPN support and incentive programs;
- (vi) Other forms of support, funding, and income generation for RPPNs.

2. The Mechanism of the Ecological ICMS in Paraná and RPPNs

2.1. The methodology for resource distribution

The Ecological ICMS for UC, also called Ecological ICMS for Biodiversity, remunerates the municipalities of Paraná that have UCs, Indigenous Land Areas (ATI), Faxinal Areas (Special Areas of Regulated Use - ARESUR) or Protective Surroundings of Protected Areas in their territories. The basic criterion of this instrument is the Biodiversity Conservation Coefficient (CCB), which corresponds to the proportion of the municipality occupied by a Protected Area, multiplied by a basic Conservation Factor (FCb) (Equation 1).

$$CCB_{ij} = \frac{AUC}{AM} * FCb \quad \text{Equation (1)}$$

In which: CCB_{ij} = Biodiversity Conservation Coefficient of the Protected Area j in the municipality i ; AUC = Protected Area, in hectares; AM = Municipality Area, in hectares; FCb = basic Conservation Factor, assigned according to the Protected Area classification (IAP, 1998a).

The next step of the calculation is the valuation of the quality of the Protected Area, which is done by meeting a list of criteria based on a Term of Reference. This list of criteria is called an Assessment Table and it is annually applied to all units registered in the Ecological ICMS. The Tables quantify the quality variable (ΔQUC) of these areas, which is included in the calculation of the *Biodiversity Conservation Coefficient by Interface* (CCBI), as described in Equation (2) (IAP, 1998a).

$$CCBI_{ij} = [CCB_{ij} + (CCB_{ij} * \Delta QUC)] * P \quad \text{Equation (2)}$$

In which: $CCBI_{ij}$ = Biodiversity Conservation Coefficient by Protected Area Interface j in the municipality i ; ΔQUC = score, which corresponds to the quality of the Protected Area; P = weighted weight (IAP, 1998a).

The ΔQUC variable, usually called score, is the result of the multiplication of the score obtained from the Assessment Table by the maximum score, which is defined based on the classification of the Protected Area in Annex III of the Administrative Rule of IAP 263/1998 (IAP, 1998a), considering its management category, scope of creation, real estate domain and phytogeographic region. Contrary to what the “ Δ ” symbol suggests, the score is calculated using only the most recent assessment score, without considering previous assessments.

The variable “weighted weight” (P) does not currently have applicability in the calculations of environmental factors by Biodiversity, so the value of 1.0 (one) is always considered, because its function provided for in the State Decree 2.791/1996 (Paraná, 1996) was replaced by the systematic classification of Protected Areas established by the Administrative Rule of IAP 263/1998 (IAP, 1998a), in which the municipal Protected Areas receive an FCb and, most importantly, *higher maximum scores* than the state and federal Protected Areas, among other specific details established by the regulation.

The relative values of the CCBI constitute the reference indexes for the distribution of Ecological ICMS resources. The percentage of each municipality in the Ecological ICMS by Biodiversity is attributed based on a variable called *Biodiversity Conservation Coefficient by Municipality* (CCBM),

which corresponds to the sum of the CCBI of all Protected Areas in the municipality. The reference indexes for the distribution of the Ecological ICMS in Paraná are called *Environmental Factors*, and they make up the *Municipality Participation Indexes (IPM)*. These, in turn, represent the total percentages of each municipality in the ICMS of Paraná (Paraná, 1991; 1996; IAP, 1998a).

$$FM2_i = \frac{0,5 * CCBM_i}{\sum CCBM_i} * 100 \quad \text{Equação (3)}$$

In which: *FM2_i* = Municipal Factor 2 of the municipality *i*, also called Environmental Factor by Conservation Units, Environmental Factor by Protected Areas or Environmental Factor by Biodiversity; *CCBM_i* = Coefficient of Biodiversity Conservation in the Municipality *i*; $\sum CCBM_i$ = Sum of the Biodiversity Conservation Coefficients of all the municipalities that make up CEUC (IAP, 1998a).

2.2. Annual quality assessments

The Assessment Tables contain questions focused on the planning and management of Protected Areas; the characteristics of the natural and socioeconomic environment; the support provided by the municipalities; the infrastructure and organizational resources available for the unit; public use, research, and environmental education; and threats and aggressions. The indicators that make up the Tables all have an equivalent weight. In the case of RPPN, there are 32 indicators (IAT, 2019), each with a 3.125% impact on the score, as shown in Table 1. There are different models of Assessment Tables for each management category, also varying in relation to the sphere of creation of the Protected Area.

TABLE 1 – Model of Assessment Table for the Ecological ICMS of Paraná for federal, state, or municipal RPPNs.

Group	Indicator
Planning and Management	Management Plan approved by an environmental agency
	Implementation of the Management Plan
	Update of the Management Plan
Natural and socioeconomic environment	Presence of rare or threatened species
	The municipality discloses the UC and its social value, regarding environmental and tax aspects
	Secretariat or Department of Environment in the Municipality
	There are commitments to environmental investments by the Municipality (through terms of commitment, covenants, etc.)
	Relationship of rural and real estate with Sisleg and/or CAR
Organizational resources – infrastructure	Fenced or identified property lines
	UC access and location signs
	Access roads to the UC
	Infrastructure to welcome visitors at the UC
	Public use paths (interpretive)
	UC internal fire breaks and paths (management/inspection)
	UC guidance signs (internal)

	Duly identified areas for stopping, sightseeing and meeting
	Restrooms and drinking fountains
	Waste collection containers with separation
	Destination of waste (generated or collected)
Organizational resources – equipment	Environmental education support equipment
Organizational resources – personnel	Employees working in management and inspection
	Environmental educators (guide, monitor, intern, volunteer)
	Identification of personnel (uniform, badge, etc.)
Public, Scientific, and Environmental Education Use	Research in the Conservation Unit
	Support and opportunities for researchers/volunteers, etc. by the Municipality
	Publicity and environmental education material
	Publicity and educational actions in the community
	Visitors to the Conservation Unit in the previous year
Threats and Aggressions	Environmental fines received in the previous year in the Municipality
	Third-party pressure on the UC
	Municipality pressure on the UC
	Control and eradication of exotic species (fauna and flora)
-	TOTAL

SOURCE: IAT (2019).

2.3. The formation of a virtuous circle

In the case of a state or municipal RPPN, the scores can reach the maximum values of 5.0 to 6.0, depending on the phytogeographic region in which the area is located. This means that the impact of the quality assessment can represent up to 85.7% of the Ecological ICMS reallocation, as illustrated in Figure 1, where we can see that a 100.00 ha RPPN in the region of the Floresta Estacional Semidecidual (FES), with half of its area (50.00 ha) superimposed with the property’s Legal Reserve, in a hypothetical municipality with an area of 40,500 ha, would generate, in gross values, a reallocation of R\$ 29,207.62/year with the minimum score in

the Table and a reallocation of R\$ 175,119.43/year with the maximum score, using as a reference the State Register of Conservation Units and Specially Protected Areas (CEUC) in force in 2021 (IAT, 2021) and the annual collection of ICMS by the State of Paraná in 2020 (SEFA, 2020).

Thus, the application of Assessment Tables generates a very interesting effect as an incentive. The high impact of annual quality assessments leads to an increase in the interest of Municipalities in establishing support programs in order to expand the financial benefits of the project. This is a virtuous circle, in which the Municipality that supports the RPPN obtains greater reallocations, as shown in Figure 2.

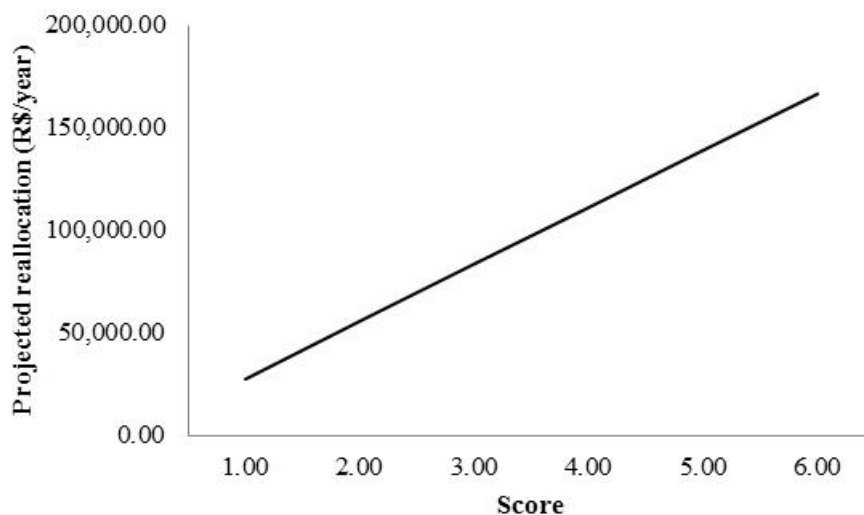


FIGURE 1 – Simulation of the impact of the quality variable in the reallocation of the Ecological ICMS by a State or Municipal RPPN in the State of Paraná.

SOURCE: Authors (2021).

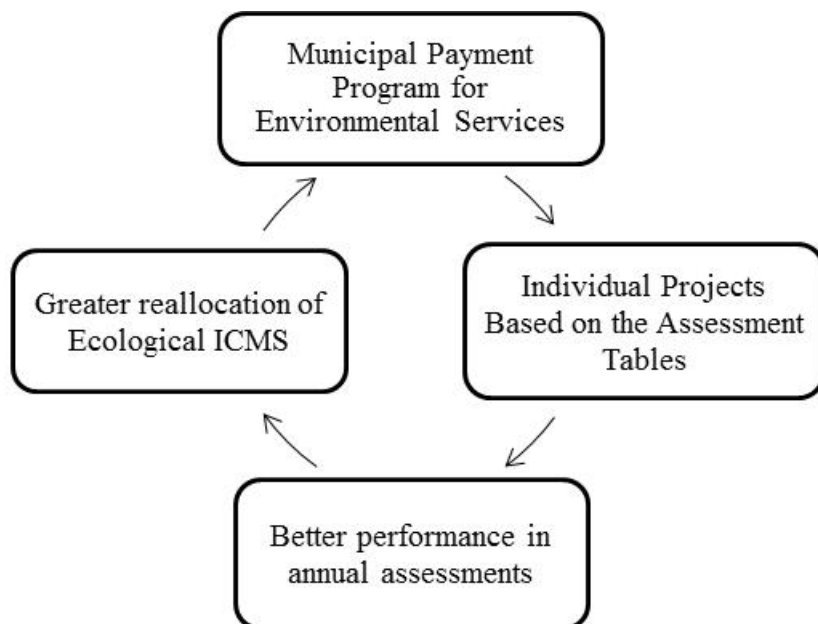


FIGURE 2 – Illustration of the virtuous circle generated by the Municipality's support to the RPPNs, resulting from the potential to expand the benefits from the ecological ICMS.

SOURCE: Authors (2021).

In this way, municipalities that intend to expand their reallocations of the Ecological ICMS should develop actions to improve the criteria assessed by the Tables and encourage the creation of new units. Still, improvements in quality assessment, especially when not very expressive, do not always result in greater allocations because this also depends on the collection of ICMS by the State and the performance of other Municipalities.

Annually, new Protected Areas are registered in the Ecological ICMS, which reduces the availability of resources for the units already registered, causing a “dilution” effect on reallocations. The same is true if many Municipalities receive better assessments from one year to the next. As a result of this continuous inflation of the Conservation Coefficient, the Municipalities that do not present gains in quantity (area) or quality tend to receive smaller reallocations.

2.4. Other details of the Ecological ICMS mechanism for the RPPNs

The IAP Administrative Rule 232/1998 (IAP, 1998b) provides that RPPN owners can request the IAT to suspend the reallocation of the Ecological ICMS from their areas if the Municipalities fail to support the management of the unit. Faced with the lack of support from many Municipalities, some owners have unregistered their RPPNs after a formal request to IAT. This is a very interesting mechanism, which, if well used, keeps the Municipalities obliged to provide support to the owners.

Surplus portions to the Legal Reserves and Permanent Preservation Areas (APPS) in the RPPNs generate reallocations 40% higher to Municipalities

(Paraná, 2012). The idea behind this mechanism is to encourage increases in the protected area since the Legal Reserves and APPs are already legally protected. However, this mechanism may inhibit the setoff of the Legal Reserve in the RPPNs, which consists of an opportunity to generate income for the owners and is a mechanism provided for in article 40 of the State Decree 1.529/2007 (Paraná, 2007).

Although the offset of Legal Reserves does not represent gains in the protected area, which is one of the most important objectives of conservation policies, it is part of the national policy and is duly regulated in Paraná (Paraná, 2007; Brazil, 2012; SEDEST, 2020). On the one hand, it is important to encourage the increase in protected areas, on the other, it is important to financially enable the management of RPPNs. So what would be the ideal role of the Ecological ICMS in this regard?

Many owners have created their RPPNs hoping to obtain economic advantages from the Ecological ICMS, which has rarely occurred. Thus, there was a movement of disinterest and even revolt by owners regarding this system (Schacht & Rocha, 2019). One of the solutions found by some of these owners was the “sale” of their areas to the Municipalities, resulting in their immediate re-classification as UCs of integral protection and public domain, which does not hinder conservation.

However, the public resources required to re-classify a UC in an area that is already fully legally protected are usually unjustified. RPPNs, although of private domain, are of public interest and are perpetually registered in the property title (Brazil, 2000). Although RPPNs are among the UCs of the sustainable use group, their restrictions are equivalent to those attributed to the integral protection group (Leuzinger *et al.*, 2020).

In this context, it is much more interesting for the Municipality to support UC management, preferably through PSA, and invest the resources available in the creation of UCs in areas that are not fully protected. It is necessary to note that RPPN owners have made a commitment to preserve these areas and are, therefore, directly responsible for any damage to them.

3. RPPNs in the Ecological ICMS of Paraná

The Ecological ICMS of Paraná distributed 192.87 million reais in 2020 (IAT, 2020). The 257 RPPNs registered in 2021, covering 51,349.51 ha of total area and 49,004.68 ha of area considered satisfactory based on the project criteria, will

receive 14.4% of the resources of the Ecological ICMS for that same year, as illustrated by Figure 3 (IAT, 2021).

Figure 4 shows that reallocations by RPPNs can be quite attractive and, in some Municipalities, are one of the main sources of tax revenue, representing up to 55.9% of the total ICMS reallocations from the State to the Municipalities.

According to articles 212 and 77 of the CF/88 (Brazil, 1988), of the gross ICMS values destined to the municipalities, 25% must be applied in Education and 15% must be applied in Health. Thus, 40% of the resources of the Quota Share of Municipalities in the ICMS have to be invested in health and education, while the municipalities are free to use the other 60% as they see fit.

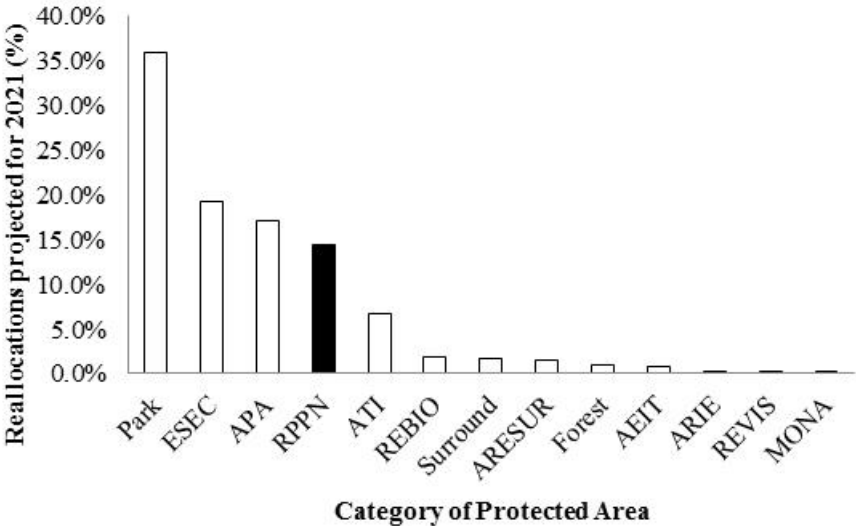


FIGURE 3 – Distribution of Ecological ICMS resources in 2021 by classification of Protected Area (IAT, 2021).

LEGEND: Park = fully protected management category; ESEC = Ecological Station; APA = Fully Protected Area; RPPN = Private Natural Heritage Reserve; ATI = Indigenous Land Area; REBIO = Biological Reserve; Surround = Protective Surroundings of Protected Areas; ARESUR = Special Area for Regulated Use, used for the recognition of Faxinal Areas; Forest = sustainable use management category; AEIT = Special Tourist Interest Area; ARIE = Area of Relevant Ecological Interest; REVIS = Wildlife Refuge; MONA = Natural Monument

SOURCE: IAP, 1998a; Brazil, 2000.

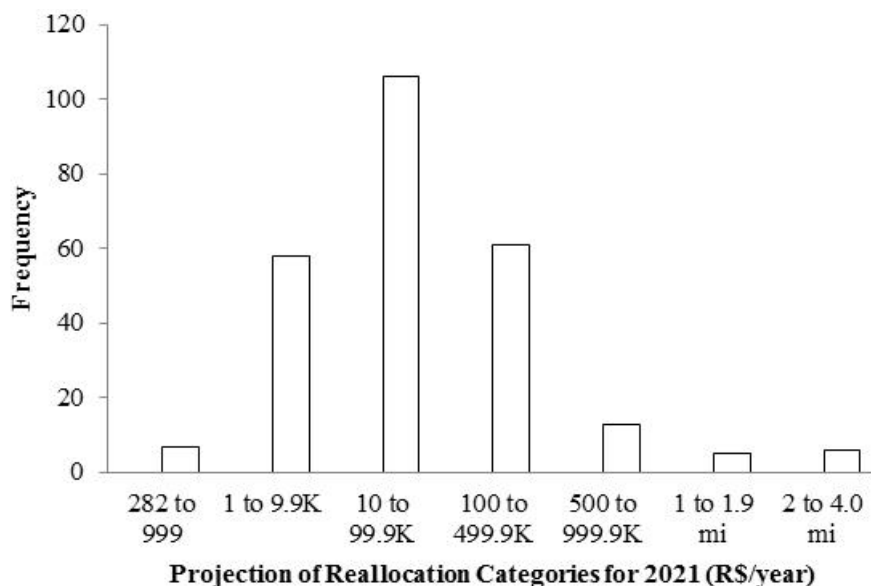


FIGURE 4 – Frequency distribution of reallocations of Ecological ICMS to the Municipalities of Paraná, according to a forecast for 2021, by the RPPNs in their territories, in gross values, based on the collection of ICMS by Paraná in 2020.

SOURCE: SEFA, 2020; IAT, 2021.

Understanding the environmental and financial importance of the RPPNs, some municipalities of Paraná have established commitments to support these units by allocating part of the resources from the Ecological ICMS or other sources to their management. In addition to the direct benefits of the Ecological ICMS, the structuring of Protected Areas tends to enhance tourism use, which can be an important activity for income generation with low environmental impact (Vincent & Thompson, 2002).

4. Analysis of current legislation

State Decree 1.529/2007 (Paraná, 2007), in its articles 9, 11, 42, and 47, establishes the formation of a Support Network for RPPN owners, in which

government authorities must articulate support for conservation actions in these areas with technical, financial, advertising and other resources, valuing their owners for the ecosystem services they provide. With regard to the role of Municipalities, art. 12 of the Decree establishes the following:

Art. 12. The Municipality where the RPPN is located, immediately after the publication of the Recognition Ordinance, after hearing the owner, regardless of other actions, must:

- I - Identify the UC by placing signs and other indicators, as defined by the IAP;
- II - Visit the RPPN, proposing joint activities and partnerships;
- III - Divulge the creation of the RPPN to the community and local and regional segments, seeking plans, programs, and projects of sustainable development that generate jobs and income, in addition to other

benefits that can be generated from the Conservation Unit.

The investment of Ecological ICMS resources by Municipalities in RPPNs is the most important type of support for these conservation units in Paraná (Cegana *et al.*, 2007). Many RPPNs in the State have difficulty structuring and, therefore, support programs are fundamental for the recovery, maintenance, or improvement of the ecosystem services provided by these areas (Schacht & Rocha, 2019).

Regarding the municipal support to RPPNs using Ecological ICMS resources, the Decree establishes in its Subsection I - Municipality Support to the owner of RPPNs and the Ecological ICMS, whose pertinent excerpt we present below, a model in which it is necessary to have a non-profit entity intermediating support actions, formal reporting of the resources received and audits.

Art. 29. The municipal actions to support the conservation of biodiversity in private reserves will include, among others, the following procedures:

(...)

III - A covenant between the Municipality and a non-profit entity, owner or representing the owner, as instructed by the State Audit Court; (...)

V - Reporting of the resources received;

VI - Audits.

(...)

The need for a non-profit entity to work as an intermediary is a factor that can hinder RPPN support initiatives using Ecological ICMS resources in Paraná. There is a trend of reduction of the project's financial attractiveness as a result of the administration fees charged by the entities, and the reallocations by the RPPNs are not always so significant, particularly in the smaller areas, as shown in Figure 5.

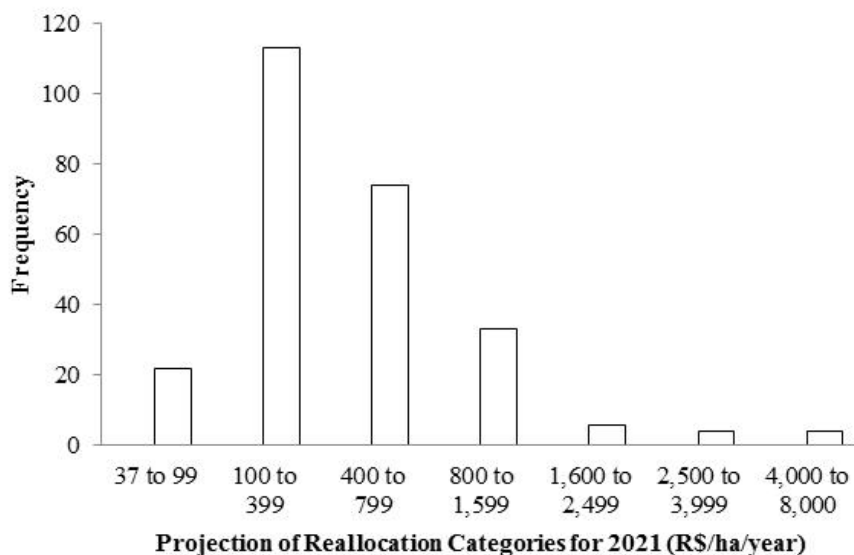


FIGURE 5 – Frequency distribution of reallocations of Ecological ICMS, per area unit, by the RPPNs in Paraná in 2021, in gross values, based on the collection of ICMS by Paraná in 2020.

SOURCE: SEFA, 2020; IAT, 2021.

In addition to inhibiting investments in smaller RPPNs, which generate less significant reallocations, the model established in the State Decree 1.529/2007 (Paraná, 2007) does not include the PSA using Ecological ICMS resources. The PSA is the most attractive incentive modality, both for RPPN owners, who are directly remunerated for environmental services provided, and for Municipalities, who will have greater environmental and tax benefits for the creation and improvement of RPPNs.

The use of Ecological ICMS resources in municipal PSA programs in RPPNs is natural since these units generate reallocations to Municipalities. However, it is important that the municipalities that are interested in that have the necessary institutional and technical framework to properly conduct these programs, such as the Municipal Department of Environment (SMMA), Municipal Environment Fund (FMMA), Municipal Environment Council (CMMA), and trained technicians (Soneghet & Siman, 2014; Aguirre *et al.*, 2016).

Also, to have greater legal safety, it is interesting that the municipal PSA legislation does not link the payments amounts directly to the resources of the Ecological ICMS, it should do so indirectly, using the FMMA, which can be supplied directly with the resources of the Ecological ICMS. The financial resources allocated to the state PSA/RPPN were allocated in a specific sub-account of the project at the State Environment Fund (FEMA), a model that can be adapted to the municipal sphere, using the FMMA (Soneghet & Siman, 2014; SEMA, 2018).

5. Municipal RPPN support programs in Paraná

Intermunicipal covenants and associations are interesting alternatives for strengthening the management of natural heritage in small Municipalities. As in other models of associations, there is an optimization in the use of resources. The same technical team can meet the demands of several small municipalities so that each one does not have to pay the costs of maintaining specialized personnel as city hall employees nor has to hire temporary contractors for each new service (Ávila & Malheiros, 2012).

These models of inter-municipal management have as their main source of resources the Ecological ICMS received by the municipalities that compose them. Since there is an institution intermediating the RPPN support actions, the model is suitable under article 29 of State Decree 1.529/2007 (Paraná, 2007).

The Intermunicipal Covenants and Associations manage and divulge the UC, including the RPPNs, as well as provide actions in environmental education and other issues related to these areas. Among these entities, we highlight the Peroba-Rosa Association (Region of Jacarezinho/PR); Intermunicipal Covenant of Federal APA of Northwest of Paraná - COMAFEN (Northwest Region of Paraná); and the Intermunicipal Covenant for the Conservation of the Remaining Paraná River and Influence Areas - CORIPA (Northwest Region of Paraná).

According to Schacht & Rocha (2019), institutional support is decisive in the quality of RPPNs, so that the areas managed by legal entities and/or with the support of incentive programs have a significantly better structure. Although this support is reverted in larger reallocations, the same authors point out that the owners of 80.3% of the 132 RPPNs of Paraná covered by their study were not benefited in any way by the Ecological ICMS generated by their areas.

In the registry in force in 2021 (IAT, 2021) the average quality of the RPPNs was 27.5%, and most of these areas met between 1.1% and 39% of

the criteria in the Assessment Tables, and only 22 presented quality equal to or greater than 60%, as shown in Figure 6.

Of the 257 RPPN registered in the ecological ICMS of Paraná, 29 (11.3%) have approved management plans, 40 (15.6%) have more than 10 rare or threatened species, 66 (25.7%) are in Municipalities that divulge the environmental and tax benefits provided by these areas, 95 (37.0%) have Municipal Environmental Councils (CMMA) in their Municipalities, and 44 (17.1%) receive some type of support from the Municipalities.

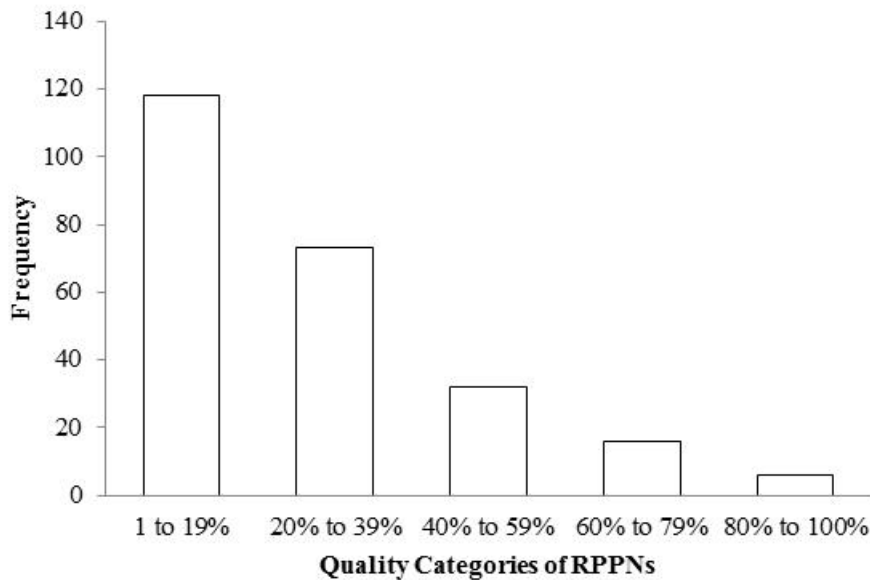


FIGURE 6 – Frequency distribution of RPPN quality indexes in the registry of Ecological ICMS of Paraná in 2021.
SOURCE: IAT, 2021.

Among the well-evaluated RPPNs in the current registry of Ecological ICMS of 2021 (IAT, 2021), with quality indexes above 70%, are some of those managed by environmental entities, such as the Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental (SPVS)¹ and the Fundação Grupo Boticário², or managed with the support of Municipalities³ and/or COMAFEN⁴ and with the support of private companies⁵.

It is known that some municipalities of Paraná have Municipal Legislation to support RPPNs, but there are cases in which they have never been put into practice (Schacht & Rocha, 2019). The use of public resources in private areas raises concerns about possible questions by supervisory bodies,

especially the State Audit Court – TCE. Therefore, once a municipal PSA framework is established, it might be interesting to divulge it to the other State municipalities (Aguirre *et al.*, 2016).

There is a positive relationship between the creation of RPPNs and the creation of specific legislation on the subject. There was an explosion in the number of RPPNs in Paraná in 1998 when this category was included in the Ecological ICMS through the IAP Administrative Rule 263/1998 (IAP, 1998a), as illustrated in Figure 7. Many Municipalities saw the possibility of obtaining financial benefits and began to contact possible stakeholders for the creation of private reserves (Schacht & Rocha, 2019).

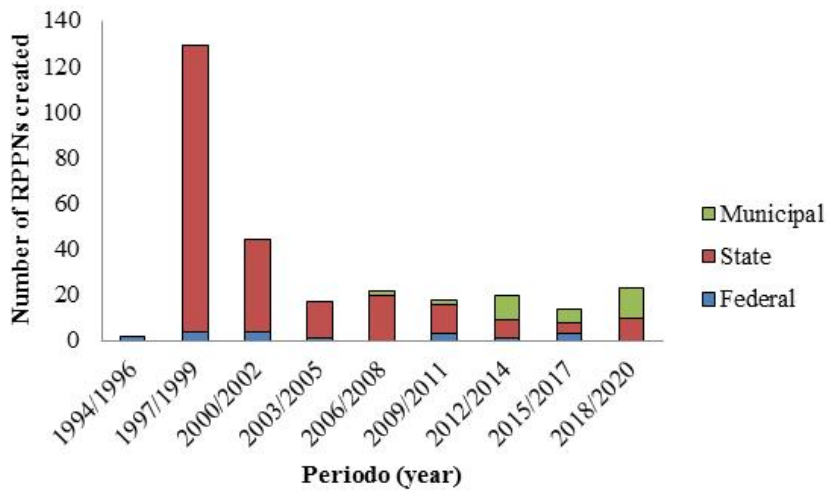


FIGURE 7 – Establishment of RPPNs in Paraná by period and by government authority level in which the unit was created.
SOURCE: IAT, 2021.

¹ RPPN Águas Belas, Morro da Mina, Rio Cachoeira and Faz. Santa Maria, in Antonina/PR (IAT, 2012).
² RPPN Salto Morato, in Guaraqueçaba/PR (Fundação Grupo Boticário, 2011).
³ RPPN Monte Sinai, in Mauá da Serra, and RPPN Faz. Barbacena, in São Pedro do Ivaí (Schacht & Rocha, 2019; Instituto Monte Sinai, 2013).
⁴ RPPN Faz. of Mata, Faz. Sta. Fé and Mata Sta. Francisca, in Querência do Norte/PR (COMAFEN, 2020).
⁵ RPPN Mata do Uru, Lapa/PR (ICMBio, 2014).

The growth in response to the Ecological ICMS occurred at the state level because the legislation until then did not include municipal RPPNs. As for the federal ones, the criteria established by the IAP Administrative Rule 263/1998 (IAP, 1998a) are less attractive than those for state RPPNs in terms of reallocations of Ecological ICMS. However, given the fact that few municipalities have implemented programs to support the RPPNs already established, the effect of the Ecological ICMS as an incentive for the creation of RPPNs was significantly reduced in the following years, as shown in Figure 7.

In the case of Municipal RPPNs, there is also a positive relationship between the increase in the number of units and the creation of specific legislation by the Municipality of Curitiba (where all 34 municipal RPPNs of Paraná are located) in 2011 and 2012. This legislation of Curitiba provides for the creation of municipal RPPNs and grants IPTU exemption and constructive potential to the owners of these units (Curitiba, 2011; 2012).

Regarding the structuring of the RPPNs, which is what consolidates the provision of ecosystem services by these areas, it is noted that support programs played a fundamental role in Paraná. This situation has already been described by Schacht & Rocha (2019), with emphasis on municipal support programs using Ecological ICMS resources.

6. PSA programs for RPPNs

In order to receive the benefits of a PSA program, owners must first meet the program criteria. Each program has specific criteria, depending on its objectives and context. PSA programs can be

directed to specific locations, such as a watershed or a certain phytophysiology, or to certain types of areas, such as to rural owners in Environmental Protection Areas (APA) or RPPN owners (Salzman *et al.*, 2018).

In the case of the state PSA/RPPN - Notice 001/2018 (SEMA, 2018), any RPPN owner in the State could participate if their area had a Management Plan and they or the RPPN had no environmental liabilities. However, the areas in the region of the Mixed Ombrophilic Forest (FOM) were given priority, with the justification that this phytophysiology requires greater protection. The Ecological ICMS, in turn, remunerates more the areas located in the FES region, because this is the most degraded phytophysiology in the State (IAP, 1998a).

Interested owners who meet the established criteria can be selected for the PSA program; in order to do so, they must commit to the paying agent through a legal act (contract, commitment term, etc.) containing the actions (obligations) that make up the environmental services that will be provided. It should be noted that environmental services are those that aim to recover, protect or expand ecosystem services, which are derived from nature itself (Silva *et al.*, 2016).

It is known through information obtained from the IAT, the agency responsible for the management of the PSA/RPPN State, that the main environmental services contracted from the owners participating in the project were: fencing of RPPNs, ecological restoration, control of invasive alien species, maintenance of paths, placement of information and interpretive signs, measures against unauthorized entry of domestic animals and third-parties, removal

of garbage, maintenance of fire breaks, and purchase of fire prevention and fighting equipment.

Considering the convergence between the actions contracted in the state PSA/RPPN and the indicators that make up the Ecological ICMS Assessment Tables, it is noted that their use as a reference in the definition of the environmental services of municipal PSA/RPPN programs tends to be effective both for nature conservation and for the expansion of tax reallocations. The fact that all RPPNs that participated in the State PSA/RPPN presented scores above the average in the annual quality assessments speaks for itself; they all had performances of 40.0% to 96.7% in the Assessment Tables in force in 2021 (IAT, 2021).

PSA programs can also direct commitments to certain types of actions, depending on their objectives, such as ecological restoration, soil and water resource conservation, and public use development, among others. These are the actions that will be established through the commitments between the owner of the area and the entity that will make the payments (Engel *et al.*, 2008).

PSA programs are generally classified into four main groups: PSA biodiversity, PSA Protected Areas (or Conservation Units), PSA restoration (or recovery of degraded areas), and PSA water (Salzman *et al.*, 2018). PSA biodiversity is intended for natural areas, regardless of having special legal protection, and the other categories correspond respectively to programs that specifically cover: Protected Areas, such as UCs and Indigenous Land; areas legally intended for restoration or recovery; areas located in watersheds considered strategic. The State PSA Policy (Paraná, 2012), also adopts these categories.

Regarding the institutional framework, the state PSA/RPPN (SEMA, 2018), a small-scale project so far, has brought achievements of great importance. Resources were transferred directly to the owners and reporting was provided only regarding the fulfillment of the actions determined in the terms of commitment, without ties to the use of the resources received. This de-bureaucratization made the program attractive since complex reporting processes for the use of public resources can hinder the participation of RPPN owners (Bremer *et al.*, 2014).

Another important point for PSA programs is that payments to owners should be equivalent to or higher than the cost estimates of the actions established in the commitment, but such a model would go against State Decree 1.529/2007 (Paraná, 2007, art. 31), which states that “the entirety of the public resources made available to the RPPN should be applied in its conservation” if it was applied at the municipal level with the resources of the Ecological ICMS.

The actions defined in the commitment, which correspond to the environmental services provided by the owners of the RPPN, should be established based on individual projects of the RPPN, considering the natural and socioeconomic contexts specific to each area. For each of these actions, objective indicators should be established to enable proof of its completion. The monitoring of these indicators should occur periodically, and the continuity of resource provision should be linked to the completion of the predefined actions (SEMA, 2018).

With regard to individual projects and environmental service indicators, the state PSA/RPPN followed a model suitable to article 29 of State Decree 1.529/2007 (Paraná, 2007), except for the

fact that there was no link between the resources received and the execution of the actions determined in the terms of commitment.

Art. 29. The municipal actions to support the conservation of biodiversity in private reserves will include, among others, the following procedures:

(...)

V - Approval of a Specific Project with its respective Application Plan for the resources to be received, whether financial, material, or human resources, with objective indicators of results and effectiveness.

Regarding the State PSA Policy, the RPPNs are considered priority areas, which is defined in article 7 of State Law 17.134/2012 (Paraná, 2012). The remuneration of RPPN owners for ecosystem services provided was also established in art. 9 of the National Payments Policy for Environmental Services – National Law 14.119/2021 (Brazil, 2021). Thus, it is noted that the model of State Decree 1.529/2007 (Paraná, 2007) for the support of RPPNs using Ecological ICMS resources is not in line with the guidelines of the State and National PSA Laws.

An important merit of the PSA is its longevity. This usually stems from the use of a stable source of resources. In this sense, the Ecological ICMS consists of a very adequate source of resources, as it is continuous and reasonably predictable. This characteristic tends to generate better results than those observed in programs based on less secure resource sources (Young & Bakker, 2014).

The program Desmatamento Evitado, by the Non-Governmental Organization (NGO) SPVS, has also presented important results in the creation and structuring of some RPPNs in Paraná, providing

technical and financial support to rural owners using resources from private companies for five years (Tagliari *et al.*, 2019). In addition, RPPNs managed by legal entities, as well as those with institutional support, tend to present better management conditions (Schacht & Rocha, 2019).

7. Municipal PSA/RPPN via Ecological ICMS

The most appropriate tool for the management of municipal resources for environmental public policies is the FMMA. Thus, the resources from the Ecological ICMS that will be destined for conservation must be first allocated in the FMMA and then used for their specific purposes, such as the PSA. The allocation of part of the Ecological ICMS to the FMMA is common and occurs through Municipal Law (Soneghet & SIMAN, 2014).

Considering that the Municipality must maintain a technician or a specific technical team for the program, it may be interesting, in some cases, to have this done through inter-municipal agreements, which can bring reductions in costs, particularly for municipalities that do not have qualified technical staff. Currently, most municipalities have one or two RPPNs (IAT, 2021), so one technician is usually enough to manage the programs, but there may be a large increase in the number of these UCs due to the operationalization of incentive programs, especially the PSA.

Regarding the payment valuation criteria, the calculation methodology may vary according to the specific objectives of the municipal programs (Silva *et al.*, 2008). In some cases, it may be interesting for

the Municipality to adopt PSA calculation formulas that are not correlated with the reallocations and criteria of the Ecological ICMS. In others, the use of correlated formulas can strengthen the bond of mutual benefit between owners and Municipalities.

The simplest and most direct valuation methodology for the municipal PSA/RPPN when the Ecological ICMS is the main source of resources consists of the use of quota of the Ecological ICMS reallocation as a PSA value. The State PSA/RPPN used the Oasis formula as a valuation methodology, which, as the ecological ICMS, has quantitative and qualitative variables to measure the environmental and ecosystem services provided by the Protected Area (Young & Baker, 2014; SEMA, 2018).

Andrade *et al.* (2012) also present an interesting and easy-to-understand valuation methodology, in which, for properties located in strategic conservation areas, each land use class corresponds to a PSA value per hectare. This model can be interesting for projects in strategic areas that cover a large number of properties, such as APA, because it requires less effort with qualitative evaluations, in comparison with the state PSA/RPPN, in which three on-site surveys were carried out per year in each participating RPPN.

In Andrade *et al.* (2012), the highest PSA values were attributed to water bodies, because this is a project for the protection of water resources. The values for each land use in a possible adaptation of this valuation methodology, as well as of the other methodologies mentioned, should be defined based on the direct and indirect costs and benefits associated with nature conservation in each region and project (Coelho *et al.*, 2021).

The costs and benefits of conservation can be represented, for example, by the following reference values: agricultural land price; cost of conservation management; reallocation of Ecological ICMS; reductions of public expenses with water treatment; financial movement by public use, environmental education and tourism related to Protected Areas; value of agricultural production; and other inferences of the opportunity cost of maintaining surpluses of native vegetation in rural or urban properties (Coelho *et al.*, 2021).

The establishment of minimum and maximum PSA values should be considered in order to avoid, on the one hand, the loss of attractiveness of conservation in small or so-far poorly structured areas (in ecological or management terms), and, on the other, disproportionately high gains that may affect the availability of project resources. The values of Ecological ICMS reallocations per RPPN in Paraná, for example, can reach from R\$ 49.00/year to R\$ 2.75 mi/year (IAT, 2021), thus illustrating the importance of minimum and maximum values in PSA programs whose valuation methodology is based on the Ecological ICMS.

Municipal PSA/RPPN programs can also have specific Assessment Tables related to those used in the Ecological ICMS in order to ensure the expansion of the tax use by the project, but also contemplating the specific objectives of the municipal policies of sustainable development, which tends to provide better environmental and socioeconomic results (Aguirre *et al.*, 2016).

The Ecological ICMS Assessment Tables have a predominance of indicators aimed at assessing the management and infrastructure of Protected Areas,

also considering the support by municipal administrations, while the State PSA/RPPN Assessment Table contains a higher proportion of indicators focused on the environmental relevance of RPPNs, although it also focuses greatly on management aspects (SEMA, 2018).

Municipalities may also establish priority areas for their incentive programs, as well as for other conservation investments and actions. These areas should correspond to those where there is special interest in the creation of Protected Areas, such as water supply watersheds, areas of high ecological value, prone to soil loss, surroundings of UC of public domain and/or fully protected, and areas located in APA, among others.

The PSA can be exclusively directed to priority areas or, which is most recommended, more attractive values can be directed to properties in these locations. As with the Ecological ICMS, differences can be established in PSA values between phytophysionomies (IAP, 1998a). In the case of the state PSA/RPPN, the RPPNs located in the phytogeographic region of the FOM were prioritized when selecting the participating owners (SEMA, 2018).

The definition of the objectives of the PSA programs should be in compliance with regional vocations and demands, in convergence with the objectives of the municipal conservation policies, also considering the profile of the population and aiming, whenever possible, for the financial sustainability of the RPPNs (Muradian *et al.*, 2013). In this sense, the actions established through the commitments between Municipalities and owners can transcend the criteria of the Assessment Tables of the Ecological ICMS in order to encourage ac-

tions in line with the objectives of the municipal PSA program.

In regions with an interest in tourism, for example, it is important that the actions established in the commitments are defined in order to divulge and structure the RPPNs, locally and regionally, for public use. In the case of heavily agricultural regions, where there was more intense fragmentation of natural areas, the main objective may be the creation of ecological corridors, emphasizing, through advertising campaigns, the importance of RPPN for agriculture due to the conservation of soils, water resources, and pollinators, as well as market advantages resulting from ecological marketing.

Although RPPNs are priority areas and generate allocations of ecological ICMS (IAP, 1998a; Parana, 2007), the National PSA Policy (Brazil, 2021) establishes several categories of areas that can be covered by these programs, including Legal Reserves and APP. Therefore, the Municipality can address in projects of municipal PSA laws the possibility of including in these programs natural areas without special legal protection (PSA biodiversity) or conventional rural properties with the purpose of environmental regularization (PSA restoration), soil and water resource conservation (PSA water), and others.

8. Beyond the Ecological ICMS

The use of resources from the private initiative should also be considered in payments for environmental services and in other types of conservation incentives (Murdian *et al.*, 2013). There are compa-

nies with potential interest in investing in Protected Areas due to environmental compensation needs, certification program requirements, and ecological marketing (Tagliari *et al.*, 2019).

Analyzing from an economic point of view, incentives to RPPNs tend to be more sustainable if they are established within market interests. For example, in order to obtain private initiative certifications, some companies invest in RPPNs as a way to offset their impacts on biodiversity (Reale *et al.*, 2019). The Desmatamento Evitado program is also an example of the use of resources from partner companies in rural properties aimed at environmental compensation and ecological marketing (Tagliari *et al.*, 2019).

The economic sustainability of conservation actions is a key factor for the maintenance and

expansion of ecosystem services. In the same way that the source of perennial resources constituted by the Ecological ICMS allowed good results in municipal RPPN support programs in Paraná (Schacht & Rocha, 2019), the generation of income in these units through market mechanisms can be decisive to ensure the conservation of biodiversity in the long term (Muradian *et al.*, 2013).

In this sense, it is also important to note that, in a broader approach, there are several possibilities of revenue inflows for the management of RPPNs or other areas whose main objective is conservation (Bugge *et al.*, 2016) as shown in Figure 8. These sources should be explored when developing public incentive policies, at a municipal level and at other levels of public power, as well as sought by the owners concerned.

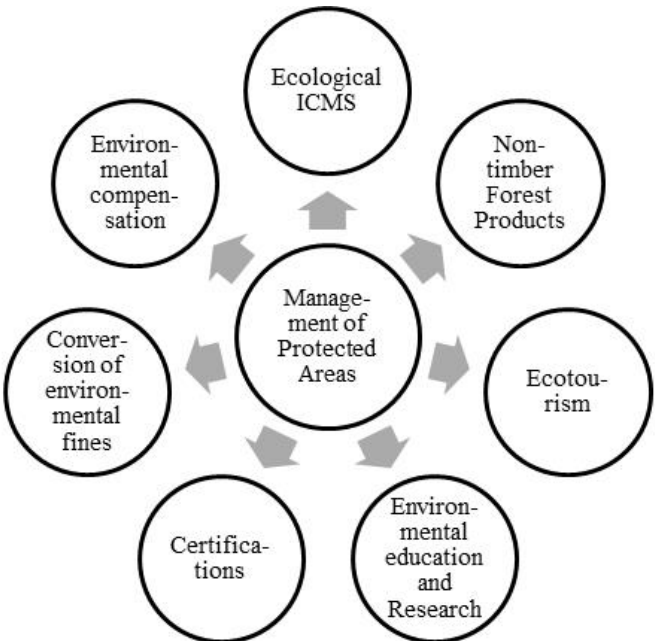


FIGURE 8 – Illustration of sources of resources that can be explored in the management of protected areas.
SOURCE: Authors (2021).

RPPN investments from private entities can be stimulated through:

(i) environmental fine conversion programs, in which environmental offenders may receive discounts for converting their fines into investments in RPPNs;

(ii) environmental licensing processes, using investments in RPPNs as a condition for obtaining licenses;

(iii) environmental certifications that have as requirements the compensation of environmental impacts through investments in Protected Areas.

RPPN owners can also, if their areas have the required attractive characteristics, develop paid ecotourism activities, scientific research, and environmental education activities, as well as, outside the scope of RPPN, exploit Non-Timber Forest Products (PFNM).

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