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# Municipal Payment for Environmental Service - proposition of a monetary valuation method

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**SUMMARY**
The way in which resources for human survival are obtained, processed, distributed, and disposed defines the economic model. The capitalist economic model predominates worldwide. One of the major challenges of this model remains maintaining the possibilities of obtaining natural resources and the destination of the waste generated, since, until recently, the finitude of resources and the limitations of the natural decomposition of waste were disregarded. There are several initiatives to address these issues, and, in this sense, environmental services have proven to be a relevant alternative to contribute positively to the solution of economic challenges, with environmental and social benefits. Environmental services, despite not being defined this way and having relatively low levels of environmental effectiveness and efficiency, have been long provided by individuals and organizations. For the individuals, sometimes the objective is not the environmental benefit, but their own survival. When provided by organizations, the interests are institutional, such as profit, market positioning, and advertising, among others interesses. Remuneration is given under market conditions, disregarding social and environmental aspects. In January 2021, Federal Law No. 14,119 was enacted in Brazil, which provides for payment for environmental services, clarifies that parties establish in common agreement, both the amount and the payment method for the environmental service. The objective of this work is to propose a method of monetary valuation for payment for environmental services when provided by the individual, which should encourage the provision of environmental services by citizens, favoring monetarily effectiveness and efficiency aspects. For this purpose, through an applied, deductive, bibliographic study, with a qualitative and quantitative approach, comparative nature, of an experimental nature, it focused on investigating monetary valuation for payment for environmental services that met the issues presented. As a result, the work proposed that a reference cost, discounting costs and indirect expenses, is calibrated through effectiveness and efficiency indices. Additionally, the result makes it possible to encourage unstructured, individual, and diffuse economic chains to provide environmental services and social and economic development.

**KEYWORDS:** Economy. Environment. PES. ESG. Sustainability.

## 1 I NTRODUCTION

The traditional capitalist model disregards the interactions between the environment and the welfare of society. It is understood that there is a closed cycle involving money, producers, companies, and consumers (OLIVEIRA, 2017), favoring the extractive production model and social inequalities. However, human development based on this economic model is also limited by the sustainable use of natural resources. The scarcity of these resources directly interferes with socioeconomic evolution, which may lead to an increase in conflicts and displacement of populations. This would generate long-term negative impacts on human development. (ZAPATA; GUEDES, 2017)

There are at least two ways to protect or recover natural resources, advocating development based on social, economic, and environmental aspects, one through punitive measures, such as the environmental penalties described in Brazilian legislation (FERRARI; LIMA, 2018), the other through incentive measures, through remuneration for sustainable actions in relation to natural resources, for example, the carbon credit market.

More recently in Brazil, another form of incentive for the sustainable use of natural resources was created, which is the payment for environmental services, sanctioned in Federal Law No. 14,119/2021, which established the National Policy of Payment for Environmental Services (BRASIL, 2021). Among its objectives is to recognize individual initiatives through monetary retribution and to foster sustainable development (BRASIL, 2021).

Even if there is no objective evidence or directly related statistical studies, it can be noticed, in empirical experiences, that the issue of payment for environmental services is

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widespread in Brazil, primarily, to a qualified public such as financial investors, agricultural or industrial producers, or students and other academics.

An example is the Brazilian stock market for the creation of the Corporate Sustainability Index, to group companies that approach the environmental issue with greater maturity and reliability (ISEB3, 2019). These initiatives represent a step forward in terms of access to participation in the provision of environmental services, however, with little coverage for ordinary citizens, those who do not present themselves through any legal entity, social organization, or any other way that mischaracterizes them as an individual.

Payment for environmental services could be more effective if there were a municipal reach, closer to the citizen, not only advocating major economic markets but also with the possibility of remunerating community or individual actions at the local level. It is possible to find in the formal communication media of public authorities, some programs for Payment for Environmental Services, such as the State of São Paulo, the Programa Nascentes, and in Minas Gerais, the Projeto Águas de Ubá.

Government programs, in general, pay for environmental services directly through public resources or incentives to the private sector, with a reduction in taxes or debts, to provide resources that are destined to providers of environmental services.

But the main obstacle to this large-scale application is the absence of a legal framework that covers the individual, as well as the definition of an objective and easy-to-apply methodology to monetarily value the municipal payments for environmental services.

## 2 OBJECTIVES

The general objective of this work is to propose a monetary valuation method for Municipal Payment for Environmental Services (MPES).

The specific objectives are:

- Identify the duties to demand an environmental service;
- Establish criteria for measuring the effectiveness and efficiency of an environmental service;
- Encourage individual participation in the provision of environmental services.

## 3 ANALYSIS METHOD

The applied, deductive, bibliographic study, with a qualitative and quantitative approach, comparative and experimental nature, was focused on investigating the monetary valuation of payments for environmental services.

The bibliographic survey started the research activities, followed by the collection and analysis of data from specialized publications, books, periodicals, and scientific articles. Data on themes related to ecosystem services and their valuation and applicability were collected, described, and analyzed.

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All information was systematically checked with the selected bibliographic material, similarities were drawn with the specific technical bibliography and others related to the approached themes, mainly those described and related to the Federal Law No. 14,119/2021 which instituted the National Policy of Payment for Environmental Services.

In the current context resulting from the analyses, an attempt was made to understand the participation of the individual as a provider, proposing a specific methodology to be applied, initially, at the municipal level.

**4 RESULTS**

The materials accessed and studied brought a direction for the Federal Law No. 14,119/2021, associated with the conceptual content prepared by the Natural Capital and WWF Brazil, and adapted to the context of this proposal.

The Federal Law No 14,119/2021 defines Ecosystem Services and Environmental Services.

> Ecosystem services: relevant benefits to society generated by ecosystems, in terms of maintenance, recovery, or improvement of environmental conditions [...]
> Environmental services: individual or collective activities that favor the maintenance, recovery, or improvement of ecosystem services (Brasil, 2021).

The Law also describes the components of ecosystem services, organized in Table 1 presented later in due time.

The numerous relationships of ecosystems and their components manifest themselves directly or indirectly; instantly or timelessly; in local or distant places, or even with influences on other ecosystems. Therefore, it is unaffordable to state that an environmental service only predictably influences a limited set of ecosystem services.

An example of individual participation in providing environmental services is the activity of collectors of recyclable material. The study "'Não Tinha Trabalho, mas Tinha Reciclagem': Sentidos do Trabalho de Catadores de Materiais Recicláveis" explains that the collector provides the environmental service as a way of survival, not with the intention of environmental benefit, he understands it as unemployment, a condition of material and social vulnerability (BRAGA; LIMA; MACIEL, 2015).

Environmental services, when structured with a primarily economic view, can generate impacts along with ecosystem services on several aspects, which would represent a low effectiveness to provide benefit for the ecosystem service. In the long-term, these impacts can be provision of food, availability of water for different purposes, nutrient cycling, soil maintenance, fertility, and control of synanthropic animals, in addition to immaterial damage, such as in cultural ecosystem services - landscapes, spaces for coexistence, spirituality, and sports.

When environmental services, even if socially and environmentally conceived in an adequate manner, are performed without concern for the choice of inputs, the establishment of processes, and the destination of products and by-products, the efficiency of providing the environmental service is deprived, representing less efficiency in the ecosystem benefit.

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Therefore, the applicant, legitimately knowledgeable about the environmental service in question and the ecosystem needs, must specify the environmental service as a whole, such as the inputs used, the processes, the products and by-products involved, as well as their origins and destinations.

Thus, it is expected that, in addition to the possibility of defining a more socially fair monetary value, such actions would mitigate potential negative impacts and achieve greater levels of effectiveness and efficiency.

Therefore, the present work proposes that the Municipal Payment for Environmental Service (MPES) be calculated by the product between a Reference Cost (RefC), and an Adjustment Factor (AF), according to equation 1.

$$\mathrm{MPES} = \mathrm{RefC} \cdot \mathrm{FA} \qquad \text{Equation 1}$$

The reference cost will be determined based on the discretionary criteria of the applicant for the environmental service, which, by assumption, depends on the detailed specification of the service and available data.

The specification should contain as much relevant information as possible, including ecosystem aspects, inputs, processes, products, and by-products of the environmental service. During this specification, the applicant must identify the components of the ecosystem services that will be part of the scope of the environmental service specified in the aforementioned Law 14,119/2021, as well as to describe the anticipated needs and influences, in addition to other relevant observations for the following stages, according to Table 1 - Scope of Ecosystem Services influenced by the Environmental Service.

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Table 1 - Scope of Ecosystem Services influenced by the Environmental Service

| Nature of service | Components | Is it scope? (yes/no) | Expected influences | Other observations |
|---|---|---|---|---|
| Provision | Water<br>Foods Alimentos<br>Wood<br>Fibers<br>Extracts<br>Other | | | |
| Support | Nutrient cycling<br>Waste decomposition<br>Soil production<br>Soil maintenance<br>Soil renewal<br>Soil fertility<br>Pollination<br>Seed dispersal<br>Management of potential pest populations<br>Control of potential vectors of human disease<br>Protection against ultraviolet solar radiation<br>Maintenance of biodiversity and Genetic ancestry | | | |
| Regulation | Carbon sequestration<br>Air purification<br>Moderation of extreme weather events<br>Maintenance of the hydrological cycle balance<br>Minimizing floods and droughts<br>Control of critical processes of erosion and landslide | | | |
| Cultural | Recreation<br>Tourism<br>Cultural identity<br>Spiritual experiences<br>Aesthetics (landscapes)<br>Intellectual development | | | |

Source: The authors.

Therefore, the applicant can define a Basal Cost (BC) that will be given by the most situational-appropriate method, such as historical values, bids, market research, cost calculation involving hours worked, tools, and inputs, among others. Legal aspects must be observed when establishing the baseline cost if specific monetary laws govern the requesting entity.

Also, to establish the reference cost and for economic and social justice, any Indirect Benefits and Expenses (BDI) that are incorporated into the baseline cost, must be taken from the baseline cost, "budget element that is added to the cost of a work or service to obtain its selling price" (CARDOSO, 2018, p. 04).

The withdrawal of benefits and indirect expenses is relevant in this proposal in order that the monetary value to be paid calculation enables the provision of the service by the diffuse public, the individual. Indirect benefits and expenses include amounts, such as taxes,

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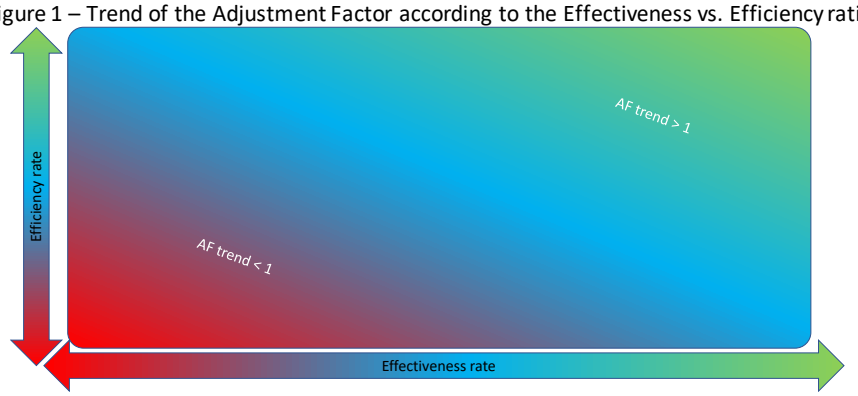
administrative charges, profits, and other costs not related to the core activity. Keeping them in the calculation could generate a monetary value so that companies and other organizations not related to environmental services are also encouraged to participate in calls for the provision of Environmental Services, which, besides generating unfair competition, would not meet the purpose of this work, the Law, and environmental and social needs. Indirect benefits and expenses must be represented in percentages and are defined on a case-by-case basis, as they may vary depending on local, seasonal, market peculiarities, and other situational aspects. This calculation is defined by Equation 2.

$$\mathrm{RefC} = \mathrm{BC} \cdot (1 - \mathrm{BDI}) \qquad \text{Equation 2}$$

The Adjustment Factor (AF) is the element that will weigh the reference cost through effectiveness and efficiency indices. Effectiveness concerns aspects related to the context and achievement of the objectives of a particular action. Efficiency, in turn, relates to aspects related to the way of carrying out a certain action, contemplating procedural aspects, and the ratio of how much a certain result consumes resources (ALMEIDA; ALMEIDA, 2014, p. 04 and 05).

This combination should establish a factor that reduces the reference costs of environmental services with unfavorable effectiveness and efficiency ratios; that does not significantly change reference values of environmental services with low influences, and; increases monetary values of benchmark costs of environmental services with favorable effectiveness and efficiency ratios (Figure 1).

Figure 1 – Trend of the Adjustment Factor according to the Effectiveness vs. Efficiency ratio




Source: The authors

For the adjustment factor, values ranging from 0.8 to 1.2 were established according to the Cartesian combination of efficacy and efficiency indices. These values proved to be appropriate in the simulations carried out, however, they can be calibrated according to the specificities of each situation. Its rationale is that values below 1 (one) are applied to stimulate the development of methods, tools, products, or by-products of the environmental service, as they present unfavorable relationships in the effectiveness and efficiency indices. The environmental services that show relative neutrality between the effectiveness and efficiency indices have values closer to 1 (one) for the adjustment factor. Environmental services that

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provide benefits to ecosystem services with a positive relationship between effectiveness and efficiency indices must have adjustment factors higher than 1 (one).

The effectiveness index is determined by the combination between demand for a particular ecosystem service and how much that ecosystem service impacts upon the perception of the value of that location before and after the provision of the environmental service.

Both the demand for the ecosystem service and the perceived value of the location are quantified by the demanding entity in the components of the ecosystem services listed in the environmental service specification during the understanding of its scope (Table 1).

The Ecosystem Demand (ED) is perceived on a scale suitable to the objectives of this work. It is very low, low, moderate, high, or very high according to Table 2.

Table 2 - Ecosystem Demand (ED)

| Demand for Ecosystem Service | ED Values |
|---|---|
| Very high | 1.0 |
| High | 0.8 |
| Moderate | 0.6 |
| Low | 0.4 |
| Very low | 0.2 |

Source: The authors.

The perception of value is quantified by the Variation in the value of Natural Capital (VCN) also on a scale suitable for the purposes of this work. References for defining this perception are made through the guidelines of the Natural Capital Protocol. The aim is not to measure the value of Natural Capital itself but rather to understand whether a particular environmental service contributes positively or negatively to this value or whether it is neutral.

The guidelines of the Natural Capital Protocol (Natural Capital Coalition, 2016) advise that the process for measuring Natural Capital must be done by identifying the reasons that lead to a certain study.

For the purposes of this work, the reasons are identifying the need for recovery, and the maintenance or reinforcement of an Ecosystem Service through an anthropic action, and provision of an Environmental Service.

The Protocol calls for reflection on the objectives. In this regard, it is important to highlight the differences between motivators and objectives, the objectives should guide actions for the future situation, while the motivators identify past causes.

Thus, the scope of work and which components must be analyzed in providing the Environmental Service are established. Once the scope is defined, the dependencies between them in that context are identified, if possible, in the ecosystem in which this context is inserted, the impacts, and other influences.

Therefore, as the Protocol directs, measurements and estimates are made, for this work, in terms of effectiveness, it is appropriate to consider whether the influence of the environmental service provision is positive, neutral, or negative, valuing them numerically according to Table 3.

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Table 3 – Variation of the Natural Capital (VNC)

| Natural Capital Variation | VNC Values |
|---|---|
| Negative | -1.0 |
| Neutral | 0.0 |
| Positive | +1.0 |

Source: The authors.

For the calculation of the Effectiveness Index (IEx), in the components of the ecosystem services identified as the scope of the environmental service concerned (Table 1), the respective values are registered in Table 4, as indicated in Tables 2 and 3 for the Ecosystem Demand (ED) and Variation of Natural Capital (VNC), respectively.

Table 4 - Calculation of the Effectiveness Index (IEx)

| Nature of service | Components | ED | VNC | Sum |
|---|---|---|---|---|
| | | 0;0.2;0.4;0.6;0.8;1.0 | +1;0;-1 | EVI= ED+VNC |
| Provision | Water<br>Foods Alimentos<br>Wood<br>Fibers<br>Extracts<br>Other | | | |
| Support | Nutrient cycling<br>Waste decomposition<br>Soil production<br>Soil maintenance<br>Soil renewal<br>Soil fertility<br>Pollination<br>Seed dispersal<br>Management of potential pest populations<br>Control of potential vectors of human disease<br>Protection against ultraviolet solar radiation<br>Maintenance of biodiversity and Genetic ancestry | | | |
| Regulation | Carbon sequestration<br>Air purification<br>Moderation of extreme weather events<br>Maintenance of the hydrological cycle balance<br>Minimizing floods and droughts<br>Control of critical processes of erosion and landslide | | | |
| Cultural | Recreation<br>Tourism<br>Cultural identity<br>Spiritual experiences<br>Aesthetics (landscapes)<br>Intellectual development | | | |
| **Arithmetic mean (MEx)** | | | | |

Source: The authors.

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The EDs, and VNC are added component by component, thus establishing the Environmental Valuation Index (EVI) for each component. The arithmetic mean of the EVIs will define the Effectiveness Factor (MEx). The Effectiveness Index (IEx) will be obtained by applying the correlation shown in Table 5.

Table 5 - Effectiveness Index (IEx)

| Arithmetic mean dos EVI - MEx | IEx Values |
|---|---|
| -1.0 >= MEx > -0.5 | D - depreciates |
| -0.5 >= MEx > -0.0 | SD - slight depreciation |
| 0.0 >= MEx > +0.5 | NC - not change |
| +0.5 >= MEx > +1.0 | SV - slight valuation |
| +1.0 >= MEx > +2.0 | V - valuation |

Source: The authors.

Efficiency is estimated using WWF Brazil guidelines (2003) that suggest a perception of planet consumption according to a particular pattern of resource consumption.

It is measurement is made in Ecological Footprints. Larger Ecological Footprints have a negative impact, creating less favorable conditions for the maintenance, recovery, or strengthening of ecosystem services, while smaller footprints can favor these conditions.

The number that will qualify and quantify the efficiency index is established through the rationale defined for the Ecological Footprint calculation in the scope of this work.

Likewise Natural Capital, the proposal is not to measure the Ecological Footprint itself, but rather to have a technically based perspective on the impact or favoring the recovery of the ecosystem service through anthropic action and to understand how efficient a particular environmental service is.

The Ecological Footprint measure considers several aspects, such as changes in the soil and seas, including habitat fragmentation, exploitation of environmental resources, climate changes generated by anthropic actions, pollution, and insertion of exotic species in habitats, it is, therefore, an appropriate reference for the measure of efficiency in providing the environmental service.

For the determination of the Efficiency Index (IEy) (Table 6), each component of the scope of the environmental service defined in Table 1 must be completed in relation to inputs, processes, products, and by-products, according to the perception that the service will provide to the ecosystem in terms of Ecological Footprint.

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Table 6 - Ecological Footprint

| Nature of service | Components | Inputs | Processes | Products and waste | Sum |
|---|---|---|---|---|---|
| Provision | Water<br>Foods Alimentos<br>Wood<br>Fibers<br>Extracts<br>Other | | | | |
| Support | Nutrient cycling<br>Waste decomposition<br>Soil production<br>Soil maintenance<br>Soil renewal<br>Soil fertility<br>Pollination<br>Seed dispersal<br>Management of potential pest populations<br>Control of potential vectors of human disease<br>Protection against ultraviolet solar radiation<br>Maintenance of biodiversity and Genetic ancestry | | | | |
| Regulation | Carbon sequestration<br>Air purification<br>Moderation of extreme weather events<br>Maintenance of the hydrological cycle balance<br>Minimizing floods and droughts<br>Control of critical processes of erosion and landslide | | | | |
| Cultural | Recreation<br>Tourism<br>Cultural identity<br>Spiritual experiences<br>Aesthetics (landscapes)<br>Intellectual development | | | | |
| | | | | **Arithmetic mean (MEy)** | |

Source: The authors.

The Ecological Footprint Score (EFS) must be given according to the correlation presented in Table 7.

Table 7 - The Ecological Footprint Score (EFS)

| Perception of the Ecological Footprint | Values |
|---|---|
| Negative | -1.0 |
| Neutral | 0.0 |
| Positive | +1.0 |

Source: The authors.

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The sum of the EFSs in each component must be recorded in the respective column. The Efficiency Factor (MEy) will be obtained by the arithmetic mean of the sum of the EFSs, component by component. The definition of the Efficiency Index will be given by applying the correlation shown in Table 8.

Table 8 - Efficiency Index (IEy)

| Arithmetic mean of EFSs - MEy | IEy Values |
|---|---|
| -3.0 >= MEy > -1.5 | D - depreciates |
| -1.5 >= MEy > -0.0 | SD - slight depreciation |
| 0.0 >= MEy > +1.0 | NC - not change |
| +1.0 >= MEy > +2.0 | SV - slight valuation |
| +2. 0 >= MEy > +3.0 | V - valuation |

Source: The authors.

By making the relationship between the IEx and IEy (Tables 5 and 8), respectively, the value of the adjustment factor for a given situation is obtained, according to Table 9.

Table 9 - Adjustment Factor Values (AF)

| IEy | IEx | | | | |
|---|---|---|---|---|---|
| | D | SD | NC | SV | V |
| V | 1.00 | 0.95 | 1.05 | 1.15 | 1.20 |
| SV | 0.95 | 1.00 | 1.05 | 1.10 | 1.15 |
| NC | 0.90 | 0.95 | 1.00 | 1.05 | 1.10 |
| SD | 0.85 | 0.90 | 0.95 | 1.00 | 1.05 |
| D | 0.80 | 0.85 | 0.90 | 1.00 | 1.00 |

Source: The authors.

Having all the variables in Equation 1, the monetary calculation of the amount to be paid by the municipality for the provision of an environmental service is made.

The scope of the environmental service, the influences on ecosystem services and their components, demand assessments, estimates of Variation in the Natural Capital, and Ecological Footprint Scores must be identified, qualified, and quantified by specific environmental technical methods depending on each particularity, not objects of this work.

Although the method suggests a monetary value for payment for environmental service, depending on the form of public call, market conditions, new practices, and technologies, among other factors, the viable and effectively paid amount to the Environmental Service provider may vary compared to the proposed.

## 5 CONCLUSIONS

The method makes it possible to determine the monetary value of Municipal Payment for Environmental Service, based on Law No. 14,119/2021, regarding the encouragement of individual and community participation in the provision of Environmental Services. The method contemplates the different natures of environmental services, allowing it to be applied to the remuneration of different environmental projects or programs in the municipalities.

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On the one hand, the provision of environmental services was already carried out even before Law No. 14,119/2021 but was not defined or treated as such. When understood this way, it places the environmental service provider in a vulnerable position in the economic chain, remunerating them with marketing rules that historically have proven not suitable for environment preservation and recovery. The provider does so as an alternative to generating or supplementing income. The definition established in the referred Law favors the environmental balance and the stimulation of the environmental provision, both for the existing objectives, and additionally for the objectives set forth therein.

On the other hand, the proposed method maintains the economic balance now established in terms of monetary movement but directs capital to more efficient and effective supply chains in environmental preservation and recovery.

Therefore, the intention is that this methodology establishes a step towards the conservation and recovery of ecosystem services, in favor of sustainable human development.

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