



Academic year 2017 - 2018

Evaluation of integrated PES schemes with focus on sustainability and resilience enhancement: the case of Brazil

Ana Claudia Ferreira Aza

Promotor: Prof. PhD Francesco Di Iacovo

Thesis submitted in partial fulfilment of the requirements

for the joint academic degree of International Master of Science in Rural Development from Ghent University (Belgium), Agrocampus Ouest (France), Humboldt University of Berlin (Germany), Slovak University of Agriculture in Nitra (Slovakia), University of Pisa (Italy) and University of Córdoba (Spain) in collaboration with Can Tho University (Vietnam), China Agricultural University (China), Escuela Superior Politécnica del Litoral (Ecuador), Nanjing Agricultural University (China), University of Agricultural Science Bengaluru (India), University of Pretoria (South-Africa) and University of Arkansas (United States of America)



Co-funded by the
Erasmus+ Programme
of the European Union





This thesis was elaborated and defended at University of Pisa within the framework of the European Erasmus Mundus Joint Master Degree “International Master of Science in Rural Development ” (Course N° 2015 - 1700 / 001 - 001)

Certification

This is an unpublished M.Sc. thesis and is not prepared for further distribution. The author and the promoter give the permission to use this thesis for consultation and to copy parts of it for personal use. Every other use is subject to the copyright laws, more specifically the source must be extensively specified when using results from this thesis.

The Promoter(s)
Prof. PhD Francesco Di Iacovo

The Author
Ana Claudia Ferreira Aza

Thesis online access release

I hereby authorize the IMRD secretariat to make this thesis available on line on the IMRD website

The Author
Ana Claudia Ferreira Aza



Co-funded by the
Erasmus+ Programme
of the European Union



Acknowledgements

I would like to thank all the people that have supported me on this journey called career changing, which I have started even before the admission on the IMRD programme. I am grateful to all my friends and family who did not let me forget that “doubts kill more dreams than failures do.”

Thanks to the IMRD colleagues from all over the world, who shared their knowledge with me during these two years, and were my foreign family in Gent, Nanjing, and Pisa.

An especial thanks to my thesis promoter, Prof PhD Francesco Di Iacovo who, unknowingly, helped me find the path to be followed in the next phases of this journey. Thank you for your tireless patience and dedication in guiding me through the most challenging part of this thesis: the theoretical framework.

My gratitude to Bernardete Neves, who helped me not only to find a case study but also warmly received and guided me during my internship at the FAO.

My special thanks to the Rio Rural team: Helga Hissa, Marcelo Costa, Sergio Siciliano, Duarte, Claudio, Leonardo and Jorge who supported me during the fieldwork in Brazil. As a student, I am grateful for the opportunity to have learned from you. As a Brazilian, I am happy to know that people are working earnestly to change the rural scene of our country.

Finally, I would like to thank all the farmers who opened the doors of their properties to receive me (often with a delicious coffee and cake) and who dedicated an hour of their days to teach me so much about rural development. It was certainly the best class in the entire master's program.

Abstract

This study analyses nine combinations of Payment for Environmental Services schemes (PES) and a Rural Development (RD) project in three regions of Rio de Janeiro – Brazil. The primary objective is to evaluate the outcomes provided by the integrated packages of incentives (PES + RD schemes) comparing to the ones supplied by single systems, analysing which one is superior regarding impacts on the sustainability of the ecosystem service and resilience enhancement of the benefitted community. Desk research and field interviews were conducted to obtain the necessary information to analyse the costs and benefits of the schemes using the MCDA methodology for consolidation. The results confirmed an excellent performance of the integrated projects in all regions, being the PAF + RR scheme considered the best one. The fifteen criteria considered in the model were analysed for the PAF + RR arrangement and some opportunities to optimise the socio-economic and environmental outputs of the scheme were raised. The study has contributed to verify the feasibility of investing in integrated approaches rather than stand-alone policies to solve complex environmental problems.

Acronyms

AGEVAP	Pro-Water Management Association of the Paraíba do Sul River Watershed
APN	RPPN Owners Association of Rio de Janeiro
APP	Areas of Permanente Protection
APROSA	Association of Small Rural Producers of <i>Saquarema</i>
BIRD	International Bank for Reconstruction and Development
CAP	Common Agriculture Policy
CBD	Convention on Biological Diversity
CBH	Watershed Committee
CCIR	Rural Property Registration Certificate
CITES	Convention on Trade in Endangered Species of Wild Fauna and Flora
COGEM	Micro Watershed Management Committee
CPRR	Common Property Rights Regime
CTPEM	Permanent Technical Chamber of Micro Watersheds
EMATER	Brazilian Company for Technical Assistance and Rural Extension
EMBRAPA	Brazilian Agricultural Research Corporation
ETAO	Technical Support Office of the CBH
FAO	Food and Agriculture Organization
FIRJAM	Federation of Industries of the State of Rio de Janeiro
FUNASA	National Health Foundation
FUNBOAS	Fund for Good Socio-Environmental Practices in micro-watersheds
FUNDRHI	State Fund for Water Resources
GDP	Gross domestic product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
HDI	Human Development Index
ICDP	Integrated Conservation and Development Projects
ICMS	Tax on Operations related to the Circulation of Goods and on Services of Interstate and Intermunicipal Transportation and Communication
IFDM	The FIRJAM Municipal Development Index
INCRA	National Institute of Colonization and Agrarian Reform
INEA	State Environmental Institute
IPTU	Municipal Property Tax

IQM-Verde	Green Quality Index of Municipalities
IQUS	Land Use Quality Indicator (part of the IQM-Verde)
ITPA	Earth Institute for Environmental Preservation
ITR	Rural Property Tax
IUCN	International Union for Conservation of Nature and Natural Resources
MA	Millennium Ecosystem Assessment
MCA	Multicriteria Analysis
MCDA	Multicriteria Decision Analysis
MDA	Ministry of Agrarian Development
MES	Market for Ecosystem Services
MWS	Micro Watershed
NCU	Nature Conservation Units
NGO	Non-Governmental Organisation
PAF	Water and Forest Producers
PDC	Collective Development Plans
PDI	Individual Development Plan
PEM	Executive Plan of the Micro Watershed
PES	Payments for Environmental / Ecosystem Services
PESAGRO	Agricultural Company of the State of Rio de Janeiro
RD	Rural Development
REDD+	Reduce Emissions from Deforestation and forest Degradation in developing countries
RPPN	Private Reserve of Natural Heritage
RR	Rio Rural programme
SDG	Sustainable Development Goals
SDS	Superintendence of Sustainable Development
SEAPEC	Secretariat of Agriculture and Livestock of the State of Rio de Janeiro
TNC	The Nature Conservancy
UGP	Project Management Unit
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wildlife Fund

List of figures

Figure 1 - The evolution of the economic schools and the emergence of PES.	16
Figure 2 - The logic of payments for ecosystem services.....	17
Figure 3 - Relation among (i) importance of the economic incentives; (ii) degree of commodification and; (iii) directness of the transfer.	20
Figure 4 - Stakeholders and possible arrangements of PES schemes.....	29
Figure 5 - Common features of environment and agriculture when acting separately and together.....	38
Figure 6 - Correlation among environmental conservation, multifunctional agriculture and resilience.....	40
Figure 7 - PES approaches as environmental policies instruments.	44
Figure 8 - possible interactions among elements when formulating a policy	46
Figure 9 - Framework for answering the research questions of this study.....	60
Figure 10 - Sample framing procedure.....	64
Figure 11 - Regions of Rio de Janeiro State and selected municipalities for the case study...	66
Figure 12 - Flow of resources within the ICMS Ecológico scheme.....	75
Figure 13 - The main steps demanded to apply MCDA.....	88
Figure 14 - ICMS Ecológico incentives flow.....	94
Figure 15 - PAF incentives flow.	96
Figure 16 - FUNBOAS incentives flow.	97
Figure 17 - MCDA decision tree.	102
Figure 18 - Contribution of benefits and costs for the final scores.	104
Figure 19 - Benefits contribution scores.....	104
Figure 20 - Benefits criteria contribution scores.	105
Figure 21 - Sorts comparing the ICMS + RR and the PAF + RR schemes.....	106
Figure 22 - Costs contribution scores.....	107
Figure 23 - Costs criteria contribution scores.....	107
Figure 24 - Costs and benefits map.	108
Figure 25 - Sensitivity down analysis.....	109
Figure 26 - Benefits sensitivity up analysis.....	110
Figure 27 - Opportunities for improvements in the PAF + RR scheme.....	117

List of tables

Table 1 - Type of PES according to the degree of commodification and the importance of the economic incentives	20
Table 2 - List of potential buyers of PES schemes by service provided.....	23
Table 3 - Forms of influence in policy instrument integration	50
Table 4 - Number of interviews by the group of stakeholders.	63
Table 5 - The main problem and its causes in each of the studied regions	71
Table 6 - Decision options for MCDA	87
Table 7 - A classification of the evaluated PES schemes	91
Table 8 - Main stakeholders of the evaluated projects	92
Table 9 - Issues and barriers of the evaluated schemes	99
Table 10 - Description of the MCDA criteria.....	103
Table 11 - Desired conditions to render feasible the replication of the PAF + RR scheme..	114

Table of contents

1. Theoretical debate	12
1.1. History	12
1.2. Genuine-PES (Environmental Economics)	16
1.3. PES-like (Ecological Economics).....	19
1.4. Other classifications for PES schemes	22
1.4.1. Funding source	22
1.4.2. Services provided	24
1.4.3. Purpose of the PES scheme	24
1.4.4. Type of incentive	25
1.4.5. Criterium of payment	26
1.5. Some important items to notice on PES schemes.....	26
1.5.1. Stakeholders identification	26
1.5.2. Institutional framework	27
1.5.3. Legal, political and social barriers.....	30
1.5.4. The role of PES in resilience enhancement.....	31
2. Drivers of ecosystem services payments.....	32
2.2. Environmental conservation	33
2.3. Agricultural and agroecological systems activities.....	35
2.4. Resilience enhancement.....	38
3. How environmental policies are thought	41
4. Problems of applicability	44
4.1. When formulating policies and tools	44
4.2. When designing and implementing PES	47
5. Integration	49
5.1. Livelihood diversification.....	51

5.2.	Expansion of ecosystem services to other activities	52
5.3.	Greater government support	52
5.4.	Participation of more stakeholders	53
5.5.	More fund options	54
5.6.	Double dividend payoffs.....	54
5.7.	Institutional collaboration.....	55
5.8.	Lower transaction costs	56
6.	Research questions and objectives	57
7.	Theoretical framework.....	58
8.	Methodology	61
8.1.	Methodological approach	61
8.1.1.	Interviews	62
8.1.2.	Sample frame.....	63
8.2.	Description of the case study	65
8.2.1.	The Atlantic Forest in Rio de Janeiro.....	65
8.2.2.	General information about the region.....	67
8.2.2.1.	Varre Sai region.....	67
8.2.2.2.	Guandu region	67
8.2.2.3.	Lagos region	68
8.1.	General information about the problem.....	70
8.2.	Description of the PES projects and the RD scheme.....	72
8.2.1.	The Payment for Environmental Services (PES) schemes.....	73
8.2.1.1.	ICMS Ecológico	73
8.2.1.2.	PAF.....	76
8.2.1.3.	FUNBOAS.....	79
8.2.2.	The RD scheme - Rio Rural	80
8.3.	Methods	84

8.4. Methodological limitations.....	89
9. Results.....	90
9.1. PES classification	90
9.2. Stakeholders identification and institutional framework.....	92
9.2.1. Rio Rural	93
9.2.2. ICMS Ecológico	94
9.2.3. PAF.....	95
9.2.4. FUNBOAS	97
9.2.5. Institutional framework	98
9.3. Issues and barriers.....	98
9.4. MCDA	101
9.5. Conditions that render feasible the replication of the scheme.....	113
9.6. Opportunities for improvements.....	117
10. Conclusions	120
11. Bibliography.....	124
ANNEX I.....	138
Criteria description.....	138
Scores	140
Weights.....	145

1. Theoretical debate

1.1. History

It is known that population growth for a long time has been responsible for the depredation of the environment. Compensations for this problem have been studied by economists over the years, and Payments for Environmental Services (PES) is undoubtedly the most popular tool to address this topic.

From the economic point of view, PES consists in a voluntary transaction between a buyer and a supplier, where a well-defined ecosystem service is bought conditioned to the secure provision of it (Wunder, 2005).

The idea behind PES is that the beneficiaries of service provision (buyers) compensate the suppliers for preserving the demanded goods or services. Nowadays, the primary services commercialised are carbon sequestration, provision of habitat for endangered species, protection of landscapes and several hydrological functions (Wunder, 2005).

Both terms “Ecosystem Services” and “Environmental Services”, will appear in this document, and it is useful to understand the difference between them. Muradian, Corbera, Pascual, Kosoy, & May (2010), define the former one as a subcategory of the later, referring to the benefits humans can have from the ecosystem. The definition of Environmental Services though, include the benefits associated with the management of other ecosystems such as sustainable agricultural practices and rural landscapes. Another critical concept to notice is the difference between ecosystem services and ecosystem goods (Gretchen C. Daily, 1997):

- Ecosystem goods are tangible materials which result from ecosystem processes,
- Ecosystem services are improvements of these goods or other valuable things.

One example to illustrate this logic consists of the purification (ecosystem service) of water (ecosystem good) produced by a spring (ecosystem function). Goods are usually tangible, while services are more difficult to perceive. However, to simplify it, Costanza et al. (1997) and later the Millennium Ecosystem Assessment (2003), adopted the term ‘Ecosystem

Services' for both services and goods. In this document the simplification suggested by Costanza will be utilised.

Four categories of ecosystem services are recognised by the Millennium Ecosystem Assessment, named (Millennium Ecosystem Assessment, 2005):

- a) provisioning (food, water, timber, genetic resources, etc.);
- b) regulating services (climate regulation, flood and waste treatment, etc.);
- c) supporting services (soil formation, pollination, nutrient cycling, etc.) and;
- d) culture services (the non-material benefits that people obtain such as spiritual enrichment, recreation, landscape appreciation, etc.)

The history of ecosystem services started back in the 1970s with studies to quantify absorption of air pollution by soil/plants and radiation balance (Westman, 1977). In 1980, with the publication of the World Conservation Strategy by the International Union for Conservation of Nature and Natural Resources (IUCN), great emphasis was placed on the need for conservation of ecosystems and its services (de Groot, 1987). However, the mainstreaming of the concept shifted focus to the market potentialities of it when the economic value of ecosystem services calculated by Costanza et al. (1997) was broadly accepted by economists of that time (Peterson, Hall, Feldpausch-parker, & Peterson, 2010).

The overview provided below, and Figure 1 - The evolution of the economic schools and the emergence of helps to understand how the ecosystem services evolved and were incorporated into the market. The main phases of this process are: a) classical economics; b) neoclassical economics; c) environmental economics, and; d) ecological economics.

- a) *Classical economics (19th C.):* based on three necessary inputs (land, labour and capital), where land was the representation of the natural environment or space to allocate the economic production activities, with the advantage that the services provided by land were costless (Hubacek & Van Den Bergh, 2006). Together with labour, the land was not included in the production function, maintaining an essential position in the classical economic analysis, even though it is not clear how the intangible benefits were considered (Gómez-Baggethun, de Groot, Lomas, & Montes, 2010). Later on, some economists realised that economic processes also depended on the stock of goods, considering capital as a distinguishing factor of production

(Schumpeter, 1981, p. 560) mentioned by (Hubacek & Van Den Bergh, 2006). Besides that, over the years the industrial development promoted changes in the classical economics, and the importance of labour became greater than land, which consequently lost its distinct status earlier acknowledged (Gómez-Baggethun et al., 2010).

- b) *Neoclassical Economics (20th C.)*: the industrialisation process reduced people's interest in land leading to a new economic model where capital was the primary factor together with labour. Also, the analysis changed the emphasis from the physical to the monetary point of view (Hubacek & Van Den Bergh, 2006). The focus on use-values (how a commodity satisfies a social need) were then switched to exchange-values (ratio in which one good exchanges for another) being the non-market services left out (Naredo, 2004). This school was based on the premise of substitutability of human-made and natural capital, initiating the commoditization process of the ecosystems and neglecting its unique services provided (Hubacek & Van Den Bergh, 2006).
- c) *Environmental Economics (1960)*: consist of an expansion of the neoclassical economics, where environmental problems were analysed and incorporated into the decision-making process using economic evaluation tools to justify it (Naredo, 2004). The financial contribution of nature, so far ignored by the neoclassic school received a new approach. The non-marketable services (that were excluded of the analysis) were considered as externalities that could contribute to solving the undervaluation problematic of the environmental dimension (Gómez-Baggethun et al., 2010). This new method aimed to correct market failures, opening the door to the development of several procedures to value external costs and benefits related to ecosystems (Gómez-Baggethun et al., 2010). However, no attention was given to the spatial location of the ecosystems and its services (Hubacek & Van Den Bergh, 2006).
- d) *Ecological Economics (1980)*: it derivates from the Environmental Economics school. Although some techniques remained the same, Gómez-Baggethun et al., (2010) highlight three main differences comparing to the previous school. The Environmental Economics maintain the basic concepts of the Neoclassical school, while Ecological Economics break some of them and incorporate issues such as equity and scale (Daly, 1992). Another difference between both schools is related to the “strong versus weak

sustainability debate”. The Environmental economics consider that natural and manufactured capital can be substitutable (*weak sustainability*), while the Ecological economics defends the *strong sustainability*, where natural and manufactured capitals are complementary and not substitutable (Costanza & Daly, 1992; Pearce et al., (1989) mentioned by Neumayer, 1999). Finally, the Ecological Economics stands for a multi-criterion evaluation of ecosystem services rather than a cost-benefit one, due to the incommensurability criterium, which means that different types of values may not be expressed in a single unit (Martínez-Alier, 1987 mentioned by Gómez-Baggethun et al., 2010). Hubacek & Van Den Bergh (2006) mention that, the definition of sustainable social and environmental scales that respects the ecosystem's capacity, distinguish the ecological economics from the previous economic schools.

With the inclusion of ecosystem services into the economic analysis, and the evolution of the monetary value of that, the interest was so great, that ecosystem functions were commoditised, and market logics in nature conservation were created (Nicolás Kosoy & Corbera, 2010). The most common ones are the Market for Ecosystem Services (MES) and Payment for Environmental Services (PES). The first PES was officially created in 1997 in Costa Rica (Figure 1). However, there are registers that its preparation started back in the 1970s (Pagiola, 2008). In the last three decades, a considerable number of ecosystem services were priced and made available in the mentioned markets (Landell-mills & Porras, 2002; Wunder, 2005). In this document, we will focus on PES only.

Both Environmental and Ecological schools have influenced the design of different PES schemes. The most common definitions of PES, like the one suggested by Wunder (2005) at the beginning of this chapter, is based on the Coase theorem and considers the Environmental Economics perspective, even though some economists of this school have divergent opinions concerning the Coasean approach. On the other hand, Ecological economists acknowledge the complexity that a multi-criterium evaluation of ecosystem services can create (Spash, 2008), and that's why they support a different model. It is common to find in the literature two classifications:

- the ‘genuine-PES’ (which meet the Coase theorem requirements – Environmental Economics)

- the ‘PES-like’ (which fails in accomplish one or more of the requirements and so assume different formats – Ecological Economics).

This sorting will be adopted to analyse the main differences among the most common PES schemes.

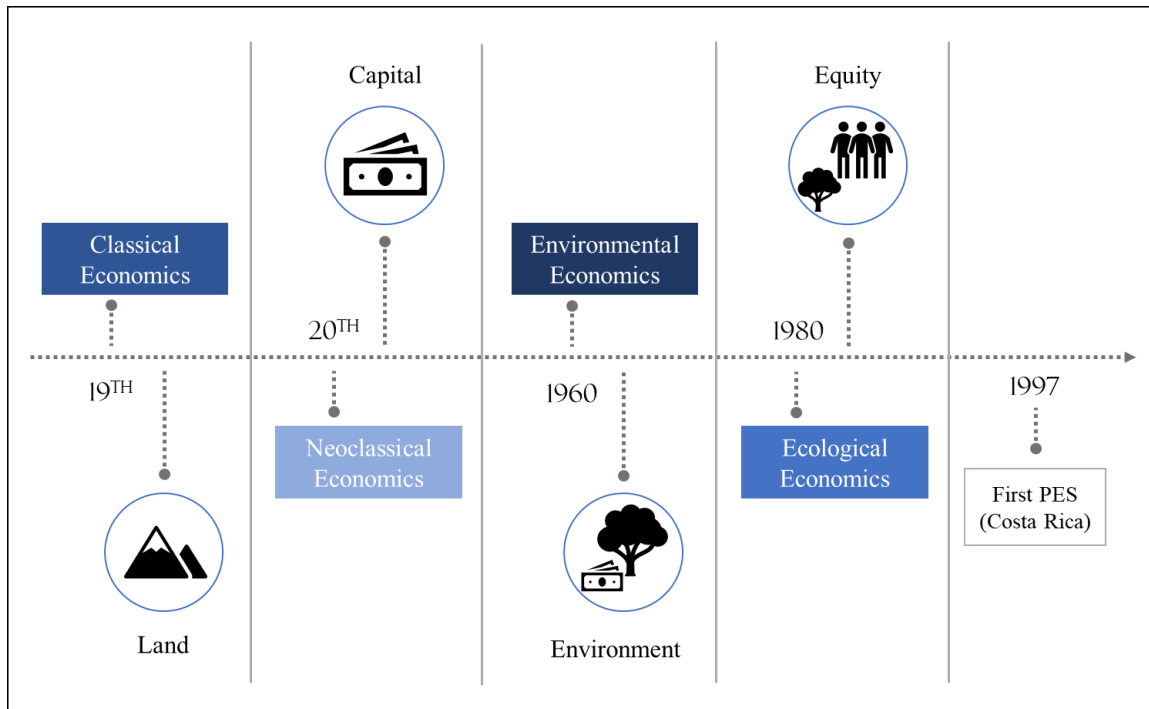


Figure 1 - The evolution of the economic schools and the emergence of PES. Source: Author's own elaboration.

1.2. Genuine-PES (Environmental Economics)

The Environmental Economics approach of PES gives priority to economic efficiency, fitting the ecosystem services into a market model (Engel, Pagiola, & Wunder, 2008). To better understand the implications of genuine-PES schemes, it is first necessary to have a look at the definition of Coase Theorem (on which they are based). It states that: in a competitive market, with sufficiently low transaction costs and in the presence of clear property rights, bargaining will lead to a Pareto efficient outcome (Coase, 1960).

The conditions mentioned above are hardly met in the complex environment where ecosystem services are produced (Clements et al., 2010). The main criticism is related to transaction costs, which are the expenses of getting information about the supplier, finding buyers,

transferring and registering titles, etc. (Coase, 1960). To reduce transaction costs it is necessary to reduce the number of suppliers and increase the scale of them, besides limiting the number of services delivered (Engel et al., 2008). Also, clear property rights (that can be understood as both ownership and land use rights) are demanded to avoid extra transaction costs with the registration of it and to ensure the capacity of the supplier in taking the necessary actions to deliver the traded service. According to Coase (1960), all these requirements aim to increase the value to be paid for the services.

To understand how the value of the ecosystem service is determined and what are the implications of that, it is necessary to analyse the interests from different points of view: the suppliers and the buyers. For the land managers (suppliers) it is worth to enter in this scheme when the money they can receive from PES is, at least, equal to the opportunity cost of the alternative land use, known as the willingness to accept (WTA). From the buyers' point of view, however, the maximum value to be paid cannot exceed the total cost of damage incurred when the land is converted to alternative land use (WTP). It means that PES become feasible when the benefits of preserving an ecosystem are more substantial than the opportunity cost of turning the land into an alternative use (OECD, 2010).

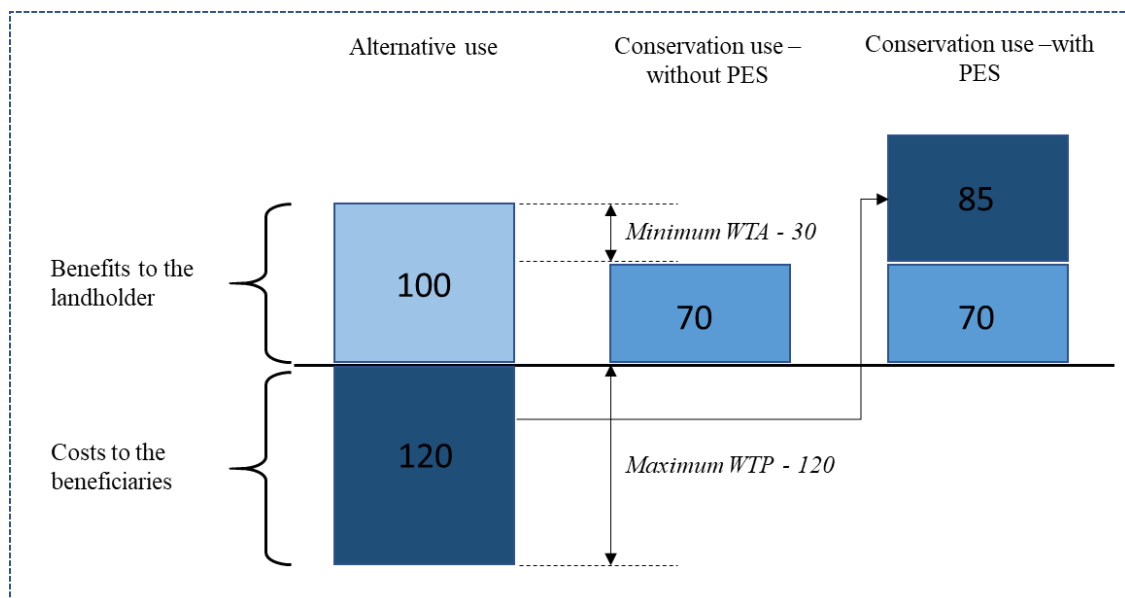


Figure 2 - The logic of payments for ecosystem services. Source: adapted from Engel et al.(2008)

Figure 2 illustrates a hypothetical example where the PES is worth for both supplier and buyer. For a more competitive market, the efficiency can be addressed through inverse auctions, for instance. After the establishment of the PES budget, the landlords with best ratio environmental additionality or lowest WTA, are admitted into the scheme, based purely on a competitiveness criterium (Roldan Muradian et al., 2010). When there are no close substitutes for the ecosystem service negotiated, the WTA can be much higher than the WTP. Also, the WTA can be hard to measure, making WTP a more appropriate and used measure in this case (Brown, Bergstrom, & Loomis, 2007), bringing advantages for the buyers.

In resume, genuine-PES take place in a very competitive market and require a comprehensive development, context-specific and socio-ecological research. The reality though shows that is expensive to reach this level of cohesion, making this sort of scheme impracticable particularly in developing countries and poor areas (Roldan Muradian et al., 2010).

Another feature of genuine-PES is that they are considered a tool that must be used to promote environmental preservation and not poverty alleviation. The concept does identify poverty reduction as a positive aspect. However, this criterion is only considered in the selection as long as all the other requirements are equality met by all of the suppliers (Pagiola, Arcenas, & Platais, 2005). OECD (2012) recognises that attempts to valorise ecosystem services, for instance, through PES, are likely to exclude the poor, and affirms that hard work is demanded to improve governance regimes and markets, to make this process fairer. The same institution points out that for the equity principle of PES to be correctly addressed it is necessary to motivate potential buyers from developed countries to invest in developing nations and settle new institutional and economic arrangements to ensure the involvement of more ecosystem services suppliers.

Genuine-PES are often criticised by the effect they can cause on the environment dynamics. Usually, the pressure for market efficiency leads to an 'over exploration' of the ecosystem services, and the tendency is an increase of the demand in the next years due to the population growth (Palmer et al., 2005).

Economists have been trying to figure out if the cost of producing substitutes for the destroyed natural services is cheaper than the cost of protecting the original ones (Brown et al., 2007). These analyses, which are typical from genuine-PES, often disregard the multiplicity of services and goods produced, focusing on one single service and generating thus biased

results. Nicolás Kosoy & Corbera (2010) mention that the monetisation of the service does not consider social and ecological aspects embedded in its production.

It is a fact the focus on monetary evaluation and cash-payments for ecosystem services were essential to bring attention and political support to conservation issues. However, it generated spillover effects such as the simplification of the systems (Gómez-Baggethun et al., 2010).

1.3. PES-like (Ecological Economics)

The PES-like schemes consist of alternative frameworks to promote the inclusion of suppliers that cannot meet the market requirements supported by the genuine model. The scheme supported by ecological economists is focused on multiple goals and take into account social issues (Farley & Costanza, 2010).

The system below, proposed by Muradian et al. (2010), helps to understand the different PES schemes that may arise from a combination of three factors, which are: the importance of the economic incentive; the directness of the payment; and the degree of the commodification of the ecosystem service. It is worth to mention that some of these combinations can result in schemes which fit in the genuine-PES scheme, however, for organisational reasons they were kept in this section, duly identified.

- a) *Importance of the economic incentive*: it relates to the capacity of the transfer in promoting the desirable land use change. It is known that other factors, rather than cash payments, influence the willingness to preserve the environment. Nevertheless, some patterns can be associated with the type of payment promoted.
- b) *The directness of the payment*: it refers to the flow of payments between the buyer and the supplier. In most of the cases, other actors are intermediating the process, like Non-Governmental Organisations (NGOs), individual intermediaries, the State, etc. Also, the payments can take place in the form of investments in public goods or other non-cash options.

c) *The degree of the commodification*: refers to the precision with which the traded ecosystem service is defined. For instance, the amount of carbon sequestered can be easily measurable, so it has a high degree of commodification. Services such as landscapes, for example, are hard to be quantified, so the ‘monitoring’ consist of the analysis of the land use change, and consequently the payments are based on that.

Table 1 - Type of PES according to the degree of commodification and the importance of the economic incentives

Degree of commodification \ Importance of economic incentives	Low	High
Low	1) Community based PES	2) Community based with external commitment/evaluation
High	3) Community specialisation in quasi genuine-PES	4) Genuine specialised PES

Source: author’s own elaboration

Quite a lot of combinations of these three factors can happen. Each one demands a different structure of PES to better assess the benefits, and therefore deliver a fair reward for the suppliers. The Figure 3 illustrates the relation among these factors:

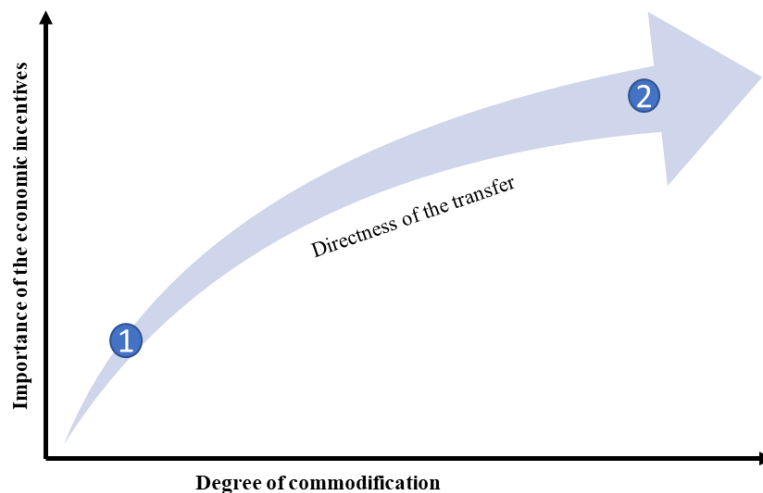


Figure 3 - Relation among (i) importance of the economic incentives; (ii) degree of commodification and; (iii) directness of the transfer. Source: adapted from Muradian et al. (2010)

Let's consider two situations to better understand this figure. First, an indigenous community that preserves forest and in turn receive investments in infrastructure through an NGO. In this situation, the community is likely to protect the forest anyway (since they depend on it to survive). The resources flow, from the buyer to the tribe rely on intermediaries. Also, the preservation activities provide several ecosystem services such as wood, food, biodiversity conservation, carbon sequestration, etc. This scenario is an example of a Common Property Rights Regime (CPRR), based on a PES scheme indicated by the number "1" in the figure.

Second, the owner of a large farm decides to reforest an area to apply for incentives of the REDD+ program (Reduce Emissions from Deforestation and forest Degradation in developing countries) for carbon sequestration. In this case, the economic incentives are important (since the farmer's interest is to receive the payments), the service delivery has a high level of commoditization (carbon sequestration), and the number of actors involved is relatively small. The scenario fits well into the Coasean definition, and thus the PES scheme would take place at the point "2" in the figure.

The examples above are also useful to illustrate Table 1. The indigenous tribe contemplated with an "reward" for protecting a national forest over the years could be an example for case 1. In this case, several ecosystem services were provided, and the tribe would probably protect the forest anyway, with or without any reward. If the same indigenous community decides to direct the investments to protect a specific bird of that region, the scheme will shift to a high degree of commodification and low importance of economic incentives (case 2 of the table). To exemplify case 3 let's imagine that the indigenous community reduce their attitudes related to self-consumption and expand their activities towards diversified ecosystem services, reducing the traditional crops used for the internal needs. In this case, the importance of the economic incentive is clearly high, while degree of specialization remains low. Finally, the large farm joining the REDD+ programme is the best example to illustrate a situation with high degree of commodification and high importance of the economic incentives (case 4).

PES-like are not only based on market transactions but also incorporates social issues. Analysing PES for biodiversity conservation in Cambodia, Clements et al. (2010) found that for schemes engaged in collective actions, different combinations of cash and non-cash incentives are embedded in social relations rather than economic interests only. This approach is supported by the review of Bowles & Polanía-reyes (2012) which list several motivations

for commercial transactions that besides the extrinsic ones. The authors found that intrinsic motives, such as interest in doing right things, sense of fairness and concern about self-image, also play a role in defining the involvement of individuals and communities in PES schemes.

The context in which PES-like schemes operate is favourable to join NGOs, government agencies and other institutions involved in mixed projects, such as environmental protection and poverty alleviation or environment protection and resilience promotion (Roldan Muradian et al., 2010). While genuine-PES schemes claim not to prioritise equity issues in its framework (Pagiola et al., 2005), PES-like schemes believe both equity and efficiency can be connected in practice. It does not mean that the project will be somehow harmed. If well designed, both goals can be jointly achieved, and the effects of a purely efficient PES scheme can be neutralised (Roldan Muradian et al., 2010). Since one of the primary Sustainable Development Goals is poverty reduction, all PES schemes should be at least neutral regarding issues like equity (van Noordwijk & Leimona, 2010). Otherwise, it shows that international policies are entirely disconnected.

1.4. Other classifications for PES schemes

1.4.1. Funding source

PES schemes are based on the beneficiary-pays rather than the polluter-pays principle¹. Several can be the actors funding PES schemes, from local beneficiaries (watershed services) to global beneficiaries (climate regulation). Table 22 lists potential buyers for PES schemes, according to the types of ecosystem service being provided:

¹ Even though polluters can also act as beneficiaries when sponsoring a PES schemes.

Table 2 - List of potential buyers of PES schemes by service provided.

Service provided	Potential buyers
Carbon offsetting	<ul style="list-style-type: none"> • Government and industries demanded to reduce emissions to comply with regulations • Agencies or municipalities seeking to improve air quality • Companies and individuals acting voluntarily • NGOs / International Funds
Biodiversity conservation	<ul style="list-style-type: none"> • Conservation agencies and organisations working in private land • Tourism industries (especially where there endangered species that attract tourists) • Land developers (purchasing offsets for damage or development) • Farmers and agricultural industry (to protect pollinators, sources of wild products, etc) • NGOs / International Funds
Watershed services	<ul style="list-style-type: none"> • Governments acting on behalf of beneficiaries • Industrial, agricultural water users • Municipal water utilities, consumers • Hydroelectric power generators • NGOs / International Funds
Landscape services	<ul style="list-style-type: none"> • Tourism industries • Government acting on behalf of beneficiaries • NGOs / International Funds

Source: adapted from Morrison & Wendelin (2010)

These buyers are aggregated into two groups, which are: a) private schemes, and; b) public schemes.

a) *Private scheme*: buyers are the ones that pay and benefit from the service. These mechanisms are likely to be efficient, since the actors (individuals, companies, government, etc.) that pursue most information about the ecosystem are directly involved in the scheme. Also, there is a clear incentive to ensure the service provision, the results are easily observable and the negotiations are easier to happen (Pagiola & Platais, 2007). The “private” scheme, which name was suggested by Wunder (2005) is also known as “Coasean” scheme (Pagiola & Platais, 2007) and “user-financed” scheme (Engel et al., 2008).

b) *Public scheme*: in the case the buyers are intermediaries acting on behalf of the beneficiaries. The intermediaries can be a government agency, an international financial institution, a conservation institution, a NGO, etc. These schemes are a bit more complex since the buyer have limited access to information and cannot directly check if the services are being provided or not. However, these schemes can be more

cost-effective since they work with economy of scale, lowering the transaction costs. This type of scheme is also known by “government-financed” (Engel et al., 2008).

1.4.2. Services provided

A basic rule to ensure an effective PES scheme is a clear definition of the service (s) provided and the way it contributes to human well-being (Arriagada & Perrings, 2009). It should be one of the first steps in the design of a PES programme, to assure that buyers and providers agree and are aware of the main outcome to be obtained from the programme (Krupnick & Siikamäki, 2007). The activities and all the mechanism involved in the programme is shaped to achieve this outcome. The providers may be reward by a single or multiple service, according to the interest of the buyer. In integrated approaches it is important to specify which services each one of buyers are interested in obtaining.

1.4.3. Purpose of the PES scheme

PES can reward land managers for two different types of commitments incumbent upon the provider: ‘use-restricting’ and ‘asset-building’.

- a) *‘Use-restricting’*: when providers receive money to stop any activity going on, or avoid a hazardous activity that could be settled in an ecosystem rich area (Wunder, 2005). Use-restricting schemes can become expensive in a long-term (continued payments). This type of scheme is likely to result in faster short-term outcomes, but with a high risk of leakage effects (Pirard, Billé, & Sembrés, 2010).
- b) *‘Asset-building’*: it relates to providers that receive incentives (not always cash-payments) conditional to developing alternative actions that can lead to the enhancement of the ecosystem services (e.g., agroforestry, capacity building, infrastructure, etc.) (Pirard et al., 2010; Wunder, 2005). Asset-building schemes have a higher probability of eliminating the payments in a long-term and maintaining the provision of the ecosystem services. Pirard et al. (2010) however, believe that it is a

hard outcome to achieve, since many land managers do not acknowledge sustainable practices as a perfect substitute for the conventional ones.

Chee (2004), suggests that in well-preserved and resilient ecosystems, PES should invest in use-restricting schemes, while in altered and less resilient systems, the asset-building would be the best choice to keep the level of services far from the thresholds.

1.4.4. Type of incentive

Cash or in-kind incentives are embedded in social relations rather than economic interests only. The choice is highly context-dependent.

- a) *Cash*: some economists have a clear preference for cash payments due to its flexibility and higher potential in alleviating poverty than in-kind incentives or development projects (Wunder, 2005). This topic, however, divide researchers' opinions. Clements et al. (2010) point out that cash payments in exchange of ecosystem services may affect inherent motivations to preserve ecosystems. Vatn (2005) mentioned by Gómez-Baggethun et al., (2010) believes that direct transfers of cash may induce the suppliers to do the best individually, instead of choosing the most suitable option for the whole community. Also, cash transfers to rural communities are not always employed to create sustained local welfare, since it may be used with “myopic spending” (Wunder, 2005, p. 15).
- b) *In-kind*: some examples are facilities for the community, land tenure rights, access to loans, access to equipment, infrastructure, capacity building, etc. (Morrison & Wendelin, 2010). Some researchers believe that land managers really committed to environmental preservation are also likely to accept in-kind incentives to comply with social codes for land use (Clements, 2014). This type of incentive can be more effective when the value to be paid in cash is not significant. Some providers are more likely to understand in-kind incentives as a fair exchange currency for the services delivered (Heyman & Ariely, 2004).

- c) *Mixed*: consist on combinations of cash and in-kind incentives. This type of incentive is likely to work better in keeping the motivation of the actors, especially when the providers are groups or communities. Specially in countries where land tenure is not well defined, support on property rights regularization is a great initial reward, that can turn in the future into another incentive (Clements et al., 2010).

1.4.5. Criterium of payment

A further design consideration is whether to pay for the service itself or for some proxy for the service. If ecosystem services can be easily measured, and if cause-and-effect linkages are straightforward, payments will be most effective if made directly for output of the services delivered. In other cases, payments may be linked to observable land-use changes that correlate with provision of the desired ecosystem service. In the clear majority of PES payments have been associated with land-use changes rather than with service provision directly, and the buyers have borne the risk of inadequate service provision. So long as the farmers manage their property in accordance with the terms of the contract, they are paid whether the service is provided or not (Arriagada & Perrings, 2009).

1.5. Some important items to notice on PES schemes

1.5.1. Stakeholders identification

The effectiveness of any scheme is largely shaped by the context in which it takes place, and by the interests of the different stakeholders involved in these initiatives (Rosa, Barry, Kandel, & Dimas, 2004).

According to Pirard et al. (2010) the two main stakeholders in a PES scheme are the buyer and provider of a given ecosystem service. In addition, intermediary stakeholders usually exist to bridge the gap between the main actors.

- a) *Buyers*: choosing the correct buyers is an important step towards an effective PES scheme (Sommerville, Jones, & Milner-Gulland, 2009). Buyers are the ones that will

compensate the providers for preserving the demanded services (Gómez-Baggethun et al., 2010). Payments for Environmental Services can be funded by several sources, being private corporations, government, donor agencies, financial investors and NGOs the main sources (OECD, 2012a). Depending on the services provided more than one buyer might be involved in the PES scheme.

- b) *Providers*: they are the actors whose actions alter the quantity or quality of ecosystem services available to the buyers (Swallow et al., 2009). Providers might be private land managers (individual, family, group, community) and public land managers (government bodies). The selection of providers to meet the requirements of the PES scheme is a crucial phase.
- c) *Intermediaries*: they are the entities that directly or indirectly outline interactions among buyers, providers, and the ecosystem itself (Swallow et al., 2009). Intermediaries usually are responsible for a range of tasks such as selecting the providers, monitoring and evaluating contracts, negotiating agreements, providing a forum for negotiations, enforcing regulations and contracts, offsetting transaction costs, assisting providers in the application process, finding new buyers, etc. (Swallow et al., 2009). In general terms they are responsible for all the practical issues related to the programme functioning (Gorman, Mannion, Kinsella, & Bogue, 2001).

1.5.2. Institutional framework

The institutional framework is responsible for the following tasks, according to Morrison & Wendelin (2010):

- Develop and implement a mechanism to collect and distribute the incentives from the buyers to the providers;
- Negotiation and contracting of service providers;
- Monitoring activities;
- Establishment of a procedure for making decisions and resolving disagreements.

The mentioned activities can be played directly by the provider and buyer when the PES is small and simple. It happens, for example, in the field of landscapes services, where the communities (providers) offer direct services such as guides, accommodation and food for

tourists (buyers) (Morrison & Wendelin, 2010). Complex PES schemes though, involving multiple buyers and providers, require intermediary institution (s) with a clear governance and organisational structure to coordinate the mechanism. Three types of institutions are probable to be part of this structure:

- a) *Local (community) organisations*: in this study, any group of *providers* that arrange themselves in form of a trade union, municipal association, and others are considered as local organisations. Some authors mention the importance of having a community organisation as part of the PES scheme. Gong, Bull, & Baylis (2010) highlight that community organisations can strengthening collaborations with non-local bodies and potential buyers, besides supporting participants to overwhelm the uncertainties about the programme and assisting applicants to meet the entry requirements (Bremer et al., 2014). The community organisation problem has been pointed for a long time by Ostrom (1990) as a critical factor to increase efficiency of any project. The author argues that “organising is a process; an organisation is a result of that process” (p. 39). She believes the organisation can bring better results than the ones the providers would have obtained if remained “unorganised” (Ostrom, 1990).
- b) *Non-local organisations*: this group comprehends NGOs, committees, groups with regional influence and others, that are *non-providers* of services. Jack, Kousky, & Sims (2008) mention that NGOs can help the programme to be more effective in areas where they complement government institutions, which may be weak. They can offer valuable help with monitoring and enforcement capacity, besides having a closer relationship to the providers providing faster and good quality assistance. NGOs can also play a number of roles as intermediaries acting as ‘project coordinators’, or initial designers of a scheme (Morrison & Wendelin, 2010).
- c) *Government agencies*: in most of the cases government agencies are also involved in the process due to its relation to the providers of service (during the animation phase) or during the payment process (if the scheme involves for example water charge, the return of a fee collected by the government, etc.).

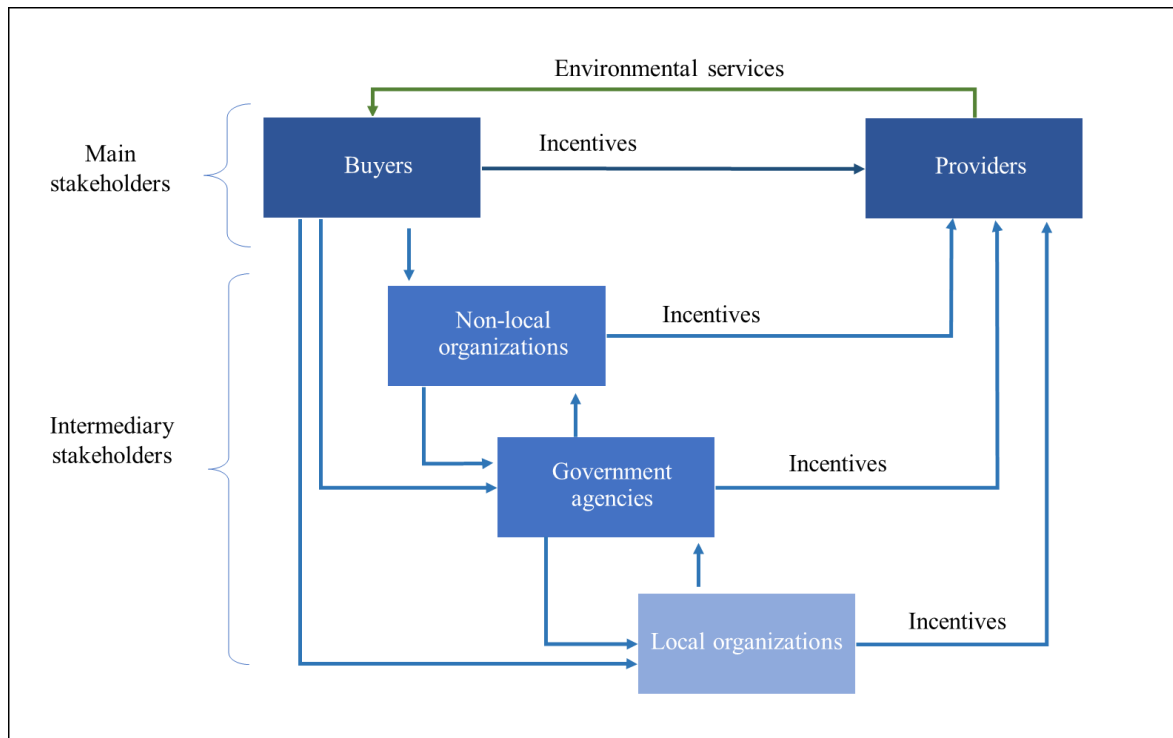


Figure 4 - Stakeholders and possible arrangements of PES schemes. Source: author's own elaboration

Figure 4 above illustrate some possible arrangements of PES scheme involving the main stakeholders discussed. The demand for non-local organisations, as well as the scale of it, will depend on the complexity of the mechanism, the number of actors involved, the government involvement, the administrative capacity of the actors, etc. (Morrison & Wendelin, 2010). Just as the size of the organisation depends on the mechanism complexity, the potential size of the mechanism will depend on the administrative capacity of the organisation.

The government involvement with the PES scheme will depend on the scale of it. Porras, Greig-Gran, & Neves (2008), argue that local schemes can run with a little, or perhaps without government involvement, while national or regional schemes are likely to rely on the government's willingness to intervene and adequate the legislation, if necessary. Wunder (2005) points out that global problems like climate change mitigation should be address by large programmes, where government and PES work together.

1.5.3. Legal, political and social barriers

- a) *Legal barriers*: some legal issues might be observed to ensure the legitimacy and the efficiency of the PES scheme. The main aspects are described below:
- *Land tenure*: as previously mentioned, property rights are not required for all PES schemes, but for most of them, providers need to have the right and authority to manage the ecosystems and benefit from the incentives. Engel et al. (2008) explain that land ‘without a legal owner’ tend to be neglected and susceptible to disputes, which can lead to the interruption of the activities.
 - *Customary use rights*: the implementation of a PES scheme can interfere on customary use rights, impacting local livelihoods and inducing social conflict (Bulte & Engel, 2007). Bishop (2010), mention the examples of forest products collection and grazing systems, in which individual might hold the rights to develop these activities in public lands of developing countries. If a synchrony is not possible, it is necessary to verify if the impacts of stopping the customary use rights can bring a larger negative impact than the positive ones caused by the scheme (Primer, 2008).
 - *Areas protected by law*: areas already protected by law might be ineligible for some PES schemes. For instance, if a forest is already securely protected by law, it cannot be entitled for a PES programme, since the additionally criterion won’t be met. However, ecosystems protected by law where there are clear evidenced threats (lack of government capacity to enforce the area), might be eligible to PES-schemes as an extra source of safety (Morrison & Wendelin, 2010).
- b) *Political barriers*: one of the basic requirements for a PES scheme to work well is a level of political stability, mainly for regional or national schemes involving government actors. The programme consists in a long-term strategy where situations like strong and ongoing conflict may lead to the interruption of the programme due to the unsteadiness of the activities and the lack of security of the providers (Morrison & Wendelin, 2010). Also, PES schemes are more likely to succeed in countries where the government impose effective laws, conservation policies, land use planning and zoning, etc. (ten Kate et al., 2004).

- c) *Social barriers*: unless the PES is based on a very simple mechanism, with few actors involved, some level of social capacity is demanded to implement a scheme like this in rural areas (Bishop, 2010). Trainings and workshops are usually part of the implementation phase of a PES, and community leaders must be able to engage in these activities. In broader terms, any programme is more probable to succeed in a long-term if it meets the community needs and priorities. To reach this level and optimise the environmental benefits, a deep understanding of the social context and especially how ecosystem services support local well-being is fundamental (Morrison & Wendelin, 2010). Schemes that invest in participatory process have a great chance to improve governance at community-level and be sustainable, even if it means investing in training, negotiation, sensitisation and other techniques that, might be considered wasted transaction costs by ones (Wunder, 2008).

1.5.4. The role of PES in resilience enhancement

The impacts of PES schemes are accessed through monitoring and more complex evaluations at the end of the programme. A highly efficient scheme though, should consider the impact of its actions on the ecosystem services' and providers' resilience enhancement. Several are the ways to address this topic through PES schemes.

- a) *Community organisation*: In Cambodia, for instance, Clements et al. (2010) found that in-kind incentives that demanded governance building had a greater long-term effectiveness than direct cash payments to providers. The authors add that cash payments did not promote institution building, which could bring more benefits than PES scheme itself (Kerr, Vardhan, & Jindal, 2014).
- b) *Income stability*: Scherr (1999), emphasises the importance of creating longer-term livelihood opportunities for the poor in environmental management projects, ensuring that these actors won't need to adopt non-sustainable practices again.
- c) *Livelihood diversification*: according to Nicolas Kosoy, Corbera, & Brown (2008) PES must help to consolidate new kinds of collaboration among actors in order to create different livelihood strategies and alleviate poverty. It is especially important in areas

with legal restrictions on land use, biophysical constraints (such as topography, soil fertility, elevation, and inaccessibility) in which land managers have limited livelihood alternatives (Bremer et al., 2014). An important remark made by Rosa et al. (2004) is that the existing production strategies must be the base for livelihood diversification, while ensuring the conservation of ecosystem services.

- d) *Social inclusion*: it is a bit difficult to consider all social factors when defining the targeting procedure of PES schemes, however, some areas offer a great opportunity for it. Including marginalised groups in the programme might strength social relations, which are essential to promote resilience at community level.
- e) *Adoption of environmental friendly practices*: in France, Perrot-Maître (2006) found that through external assistance and technical support, farmers were encouraged to modify their agricultural practices in order to eliminate the risk of nitrate contamination, while maintaining the same level of income even with the end of the PES incentives.

It might be not easy to convince some stakeholders that designs focusing in long-term impacts are better, since “individuals attribute less value to benefits that they expect to receive in the distant future, and more value to those expected in the immediate future” (Ostrom, 1990, p. 34). However, this topic need to be addressed as soon as possible in PES schemes and partner projects to ensure the sustainability of the impacts once the project is over.

2. Drivers of ecosystem services payments

PES schemes are voluntary, so the land managers and farmers need a motivation to apply for that (OECD, 2010). It could be only environmental preservation, however ecosystem services are usually taken for granted by the beneficiaries, since they are free (J. Salzman, 2005). Despite these complicators there is a significant potential for such schemes, and several are the motivations driving the change from both the supply and demand side, as will be exemplified below.

For organisation issues, the drivers will be analysed by categories, which primary interests are related to environmental conservation, agricultural activities and resilience enhancement.

2.2. Environmental conservation

In the past years, there has been an increasing acknowledgement of the role played by biodiversity in maintaining the well-functioning of ecosystems, while these last give back habitat for different forms of biodiversity, providing all the necessary conditions to allow their survival (Newcome et al., 2005). Biodiversity also works as a "savings account" to recover from unexpected shocks (Landell-mills & Porras, 2002). All these factors were better understood and acknowledged due to the Convention on Biological diversity organised by the United Nations in 1992, which focused on the implementation of strategies for the maintenance and sustainable use of the biological resources (OECD, 1996).

The mentioned convention also highlighted the importance of multi-stakeholders initiatives, including actions at national level, conducted by the governments (OECD, 1996). Indeed, the payments for biodiversity preservation are increasing mainly due to government conservation targets, which often does not involve charges on beneficiaries, but the imposition of goals to be achieved through policy tools (mainly in developed countries) and market tools (in developing countries). The last alternative is usually preferred by the recipients since it creates the possibility of looking for a more cost-effective initiative for each case creating a high demand for PES designed to protect biodiversity and thus all its benefits (Landell-mills & Porras, 2002). Positive incentives, such PES, can help on the acceptance of biodiversity conservation by the population in general. It is essential that people recognise the importance of biological resources since its loss is diffuse and comprises several sectors (OECD, 1996).

The world's concern about global warming is another critical driver for PES focusing on carbon sequestration. Actions in this area are demanded by international/national agreements, by the pressure of environmental NGOs and by the private market such as insurance companies, which could be beneficiated by emission reductions (Landell-mills & Porras, 2002). International commitments such as the Paris Agreement signed in 2015, states that countries collectively shall limiting the global average surface temperature increase to well

below 2°C, being the desired goal 1.5°C above pre-industrial levels, while strengthening the capacity to adapt to the impacts of climate change (United Nations, 2015a). Among several initiatives, the carbon offset has a high potential, and PES schemes such as REDD+ were created with this specific focus.

In addition, there is a crescent demand by private companies in investing in carbon offset mechanisms to have positive publicity towards environmental awareness. NGOs play an essential role in this aspect, promoting campaigns and raising people's consciousness towards this topic. The private sector is increasingly sensitive to public opinion and is seeking for ways to reduce their greenhouse gas (GHG) emissions or compensate it in another way, for example, PES mechanisms. Other actors from the private sector are also interested in sponsor initiatives to promote carbon offset since global warming impact on their business. The most known case is the insurance industry, which is being threatened by the high number of natural disasters and climate change events over the past years (Landell-mills & Porras, 2002).

Carbon sequestration can happen at any ecosystem where plants are growing up: agriculture, wetlands, forests, etc. In 2015 30,8% of the world's land surface was covered by forests (FAO, 2018), constituting one of the leading carbon pools. Despite its importance, forests have been rapidly degraded and deforested resulting in the emission of carbon dioxide to the atmosphere (Charlie Parker, Andrew Mitchell, Mandar Trivedi, 2009). Forests are continually being pressed by agricultural, livestock activities, infrastructure development, etc. The Secretariat of the Convention on Biological Diversity (2001) states that subsidies for agriculture, illegal and preferential logging concessions, and construction of roads for logging access, encourage deforestation in developing countries.

PES can act as a tool to avoid it as, once the contract is firm, the land manager is responsible for ensuring the integrity of the area. Kremen et al. (2000) examined the opportunity cost of forest conservation and pointed the alternative uses as more profitable. However, when added the incentive from PES, the conservation benefits became greater. Ickowitz, Sills, & Sassi (2017) however, affirm the cost per tonne of avoided carbon emission (often expressed by tCO₂e) can broadly vary by spatial location, employed methodology and income group. In many cases, joining a PES is probable to be advantageous for the poor under the economic point of view, comparing to the regular activities he/she would rather develop in the same area. The situation becomes more complex when big investors and companies are

interested in a specific region. In this case they are willing to pay a high price to have access to it, and the remuneration given by PES is certainly not enough to match the offer. Kremen et al. (2000) mentioned that in a similar situation in a national park managed by small farmers in Madagascar, the conservation and diplomatic community played an essential role in persuading the government to reject the logging companies' proposals. The arguments were based on the analysis of externalities and political interests. This situation, nevertheless, may not be the same in other areas, since in many cases the government has a lot of interest in the proposed business, and the community is not strong enough to make their voice being heard.

Other ecosystem services that deserves attention is the water production and purification. The United Nations Development Programme formulated a proposal (SDG6) to ensure the achievement of the Sustainable Development Goal (SDG) number six: ensure access to water and sanitation for all of providing safe drinking water for all (United Nations, 2015b). The proposal contains a mix of strategies, such as protecting and restoring water-related ecosystems, which can be reached through PES initiatives. In a national level, the demand for water management schemes comes primarily from governments and then is complemented by market approaches which aim to increase the efficiency of the management practices, besides reducing costs (Landell-mills & Porras, 2002).

2.3. Agricultural and agroecological systems activities

Agrarian lands account for a significant share of global land use and thus represent a priority in strategies that seek for slowing or reversing the degradation of ecosystem services (Kroeger & Casey, 2007). The primary driver of humanity's impact on ecosystem services has been the conversion of nature in agricultural areas and application of new technologies (Millennium Ecosystem Assessment, 2005). Parallel to it, during the green revolution between the 1940s and 2000s, countries have prioritised the productivity of the land, generating severe environmental consequences. After this phase, there was increased concern about the sustainability of intensive cultivation, changing the focus to more sustainable practices (Evenson & Gollin, 2003).

Nowadays, agriculture is valued by its multifunctional character, which can be divided in the production of commodities and non-commodities. The production of commodities is remunerated by the market; however, other categories must find other means of remuneration.

Non-commodities can be distinct in positive and negative externalities (Van Huylenbroeck & Durand, 2003). Over the years, with the specialisation of agriculture, the rural environment was altered in a way not appreciated by the consumers, diminishing their welfare (negative externalities), like nutrient runoff, carbon and other emissions, pesticide poisoning, loss of wildlife habitat, etc. Also, agriculture demands a high volume of water for irrigation (Stevens, 2011), which results in a negative impact on water availability. These negative externalities can harm biodiversity and negatively affect other ecosystem services, and thus are considered a threat to conservation (Power, 2010).

On the other hand, people started recognising the other functions of the land such as recreation, an area for leisure activities, etc., which contributed to increase the intolerance to the negative externalities mentioned before (Van Huylenbroeck & DURAND, 2003). This situation though, is reversible through appropriate techniques to suppress the adverse effects and stimulate the positive externalities, compensating for the disservices previously produced, and maintaining the provision of services (Swinton, Lupi, Robertson, & Hamilton, 2007). The authors remark that an agricultural area is an ecosystem directly managed by humans to meet their needs and therefore plays a unique role in supplying and demanding services.

The provision of services is not linear and positively correlated. It means that the production or consumption of services will impact the availability or quality of the other (Millennium Ecosystem Assessment, 2005). Nevertheless, Pretty et al. (2006) affirm that it is possible to co-produce different services if the areas are well-managed.

It is worth to remember that agriculture is affected by external factors such as climate change, which represents a threat for the agricultural sector, which is currently being forced to adapt itself due to the increases in global temperature and weather unpredictability, including the precipitation regime. Differences in the snowpack melt and timing of rainfall may lead to floods and droughts, affecting crop production. At the same time, the agricultural sector has a high capacity to contribute to carbon sequestration (through crop cultivation or soil capture) and help to offset the emissions of farming activities by solving the problem in a micro-level. By the adoption of agro-ecological systems, these effects can be potentialized (Stevens, 2011).

Power (2010) points out that unmanaged or sustainably managed agriculture will always be highly dependent on services provided by natural areas. It has been known for a long time that the conversion of the natural ecosystem into agricultural regions reduce the flow of specific services and thus shall be avoided to the maximum (Matson, Parton, Power, & Swift, 1997). If no other option is possible, land managers must consider agroecosystem schemes to minimise the impacts on ecosystem services and perhaps produce new ones.

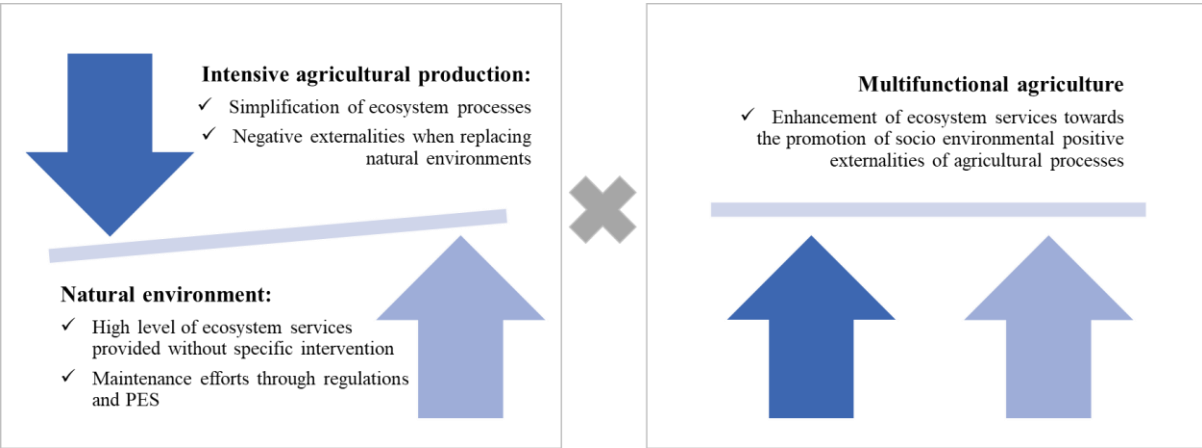
This axis of agriculture is still little explored, and PES can act as a valuable tool to incentive sustainable agricultural practices. The transfers can assist land managers, farmers and communities to invest in land use activities that will potentialize the delivery of ecosystem services (Nicolás Kosoy & Corbera, 2010). Investment in PES within the agricultural sector has two main advantages when comparing to other areas, according to (Wossink & Swinton, 2007): a) already established market involvement, and; b) co-production possibility of ecosystem services and agricultural products.

Considering the population growth and the increasing demand for food, investments in sustainable agriculture can bring excellent results especially in developing countries, where the access to commercial inputs is restricted and perhaps expensive. Developing countries are highly dependent on natural resources and ecosystem services as a source of income, besides agricultural activities (Newcome et al., 2005). Farmers and local communities are often aware of the benefits received. However, they cannot take any action to preserve it due to the lack of money, of uncertainty about the land property (Scherr, 1999). Besides that, these less-resilient agricultural areas (which are located in the tropics) are expected to face even drier seasons, resulting in high production variability which may affect food security (Stevens, 2011).

Paddy rice systems are especially important in countries like Vietnam, China and other big producers of rice. These areas receive little attention and economic incentives, even though this crop is part of the diet of 3 billion people around the world (Schuyt & Brander, 2004) and provide valuable ecosystem services. On the other hand, in Europe, the scenario is very different. Agricultural areas, like wood-pastures, have a high aesthetic value attributed and the land managers receive incentives from the Common Agriculture Policy (CAP) to preserve these areas, which provide landscape beauty (Plieninger et al., 2015). The policies of subsidies to farmers for the provision of ecosystem services is well-established in developed countries, being the CAP one of the most acknowledged mechanisms. However, in developing countries,

there is still a gap to be filled and a high potential for the delivery of ecosystem services through sustainable agricultural practices.

Figure 5 below synthetises conditions generated by the disbalance of the natural environment and intensive agriculture when acting separately, as well the equilibrium achieved when working under a sustainable framework.



*Figure 5 - Common features of environment and agriculture when acting separately and together.
Source: author’s own elaboration*

2.4. Resilience enhancement

Resilience was first defined by (Holling, 1973) as “a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables”. Later on, Biggs et al., (2012, p. 3) applied this concept to the environmental services context and interpreted it as “the capacity of the socio-ecological systems to sustain the desired set of ecosystem services in the face of disturbance and ongoing changes”.

Ecosystem goods provide a range of benefits essential for the survival of rural communities, such as food, water, animal fodder, forage, medicinal plants and energy (Palomo, Felipe-Lucia, Bennett, Martín-López, & Pascual, 2016). In Sub-Saharan Africa, it is widespread for poor farmers to sell fuelwood as a complementary source of income (Arnold, Köhlin, Persson, &

Shepherd, 2003). In other forested areas, communities rely on timber as building material for their houses (small-scale exploration) besides other non-wooden materials such as bamboo and palm leaves for construction, fruits, nuts, medicinal plants, etc. (Newcome et al., 2005).

A large parcel of rural poor relies on small-scale agriculture and harvesting of products provided by different ecosystems. In these areas, the landlords have limited access to other sources of income and no alternative land-use due to legal restrictions (environmental regulations) or biophysical constraints (elevation, inaccessibility, soil fertility, etc.) (Bremer, Farley, & Lopez-Carr, 2014). Rosa, Barry, Kandel, & Dimas (2004) state that it is necessary to provide more flexible arrangements that allow farmers to conciliate preservation with some productive land uses.

In areas exposed to natural disasters and climate change effects, ecosystem services such as mitigation of floods, erosion control, regulation of rainfall provided by different types of vegetations contribute for resilience enhancement reducing the risk of extreme events. They constitute an essential ally for rural communities that in general are vulnerable to the dangers of natural disasters, or either lack resources to invest in insurance of their crop production (FAO, 2001).

Investing in the conservation of ecosystems is the same of investing in environmental hazard protection. Nevertheless, it is usually cheaper and more effective (Palomo et al., 2016). PES schemes fit well in these areas with low opportunity cost, providing an alternative source of income, and preserving regions which indeed are responsible for the provision of valuable ecosystem services (Bremer et al., 2014).

Another type of services provided by ecosystems is related is the 'cultural' category. It comprises the scenic beauty, recreation and tourism functions. Several natural components provide cultural benefits for local populations. Benefits such as a sense of belonging, well-being and place-attachment are strictly related to resilience enhancement, and should then be preserved. Hegney et al. (2008) mention in their work that the connection with nature enhances personal and community resilience, often by providing people with an additional sense of meaning and purpose in their everyday lives.

The landscape beauty market is still small compared to other services financed by PES schemes. Perhaps it may be considered superfluous by some people that rely on the free access

to the resources. However, the mainstreaming of ecotourism has changed this scenario diversifying the sources of income (Landell-mills & Porrás, 2002). A resilient local economy is based on several businesses and employment opportunities, so that community welfare does not rely on the performance of one single area (Hegney et al., 2008). Participants of a PES scheme in the Páramo region – Ecuador, agree that the possibility of having an alternative livelihood source is desirable and played an essential role on the decision of joining the scheme (Bremer et al., 2014).

PES schemes can also cooperate with enhancement of resilience when it comes to land security and community organisation (Kosoy, Corbera, & Brown, 2008). With PES some landlords expect to protect the margins from political and economic threatens and to prevent strangers from depredating the protected area when enrolling in such programmes (Bremer et al., 2014). It is especially true in Latin America, where property rights constitute a big issue. On the other hand, less informed landlords are afraid of land expropriation by the government when enrolled in PES schemes (Southgate & Wunder, 2009), confirming the demand for informative actions as the first step towards more substantial participation in conservation schemes. The current problem of property rights can become an opportunity to attract more suppliers if the PES schemes manage to help with financial and juridical assistance to farmers/communities that want to join the program but are limited by land tenure issues.



Figure 6 - Correlation among environmental conservation, multifunctional agriculture and resilience. Source: author's own elaboration

Figure 66 illustrates the correlation among the three drivers discussed above. The willingness to promote environmental conservation leads to the establishment (or conversion) of multifunctional agriculture and agroecological systems. Together, both environments (natural and agriculture) create conditions that foster the resilience of the communities engaged in the programme.

3. How environmental policies are thought

The twenty-first century has been noticeable by the crescent importance given to the sustainability of the world we live in. Together, scientists, policymakers and communities have been studying and implementing uncountable policies that aim to create better-living conditions for all of us. By “policies” this study refers to a statement of intent, implemented as a procedure or protocol. They can be understood as political, managerial, juridical, financial, and administrative mechanisms arranged to reach explicit goals.

Policies can have its origin in studies like the Millennium Ecosystem Assessment (MA) approved in 2005 to understand the dynamics of ecosystems and its relation to human well-being. According to Carpenter et al. (2009), the MA sought to analyse how ecosystem services can benefit people, and how human actions may in return, impact ecosystems and their services.

The MA, however, was not the first attempt of call attention to ecosystems. Everard et al. (2014), remember us that this topic has been addressed through protocols for almost half century. The Convention on Wetlands (or Ramsar Convention) took place in 1971 and is considered the pioneer of ecosystems protocols. Other important conventions related to the theme are the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD). The common fact among all these protocols is the attempt of safeguarding important ecosystems and their services.

Although the decisions taken during the conventions seem to be far away from the reality of the practitioners and providers of ecosystem services, clear instructions are, sometimes,

produced, as the case of the Ecosystem Approach adopted in 2000 as result of the CBD. The Ecosystem Approach consists of 12 principles that serve as a framework to resolve ecosystem issues and understand how they connect (or fail to connect) within broader geographical and socio-economic contexts (Everard et al., 2014).

Besides the immediate results generated by the conventions, which consists of the participants' commitment to do something, a range of subsequent actions take place in different forms, depending on the country's approach to the theme and its interest in complying to the agreement. Everard et al. (2014) mention legislation, market-based instruments and other tools as fragmented policies instruments developed by countries to reach conservation goals. It is worth to remark that the boundaries between all these tools are not fixed, with the possibility of transforming one measure into another.

The different approaches implemented within a given geographical area create a mosaic of landscapes and organisational processes, with individual characteristics. This condition can, to some extent, offer flexibility and resilience in ecosystem services provision, but underproduce social benefits. To create a more effective scenario, more significant development of socio-environmental levers is required to increase the coherence of ecosystem services in all its levels (Everard et al., 2014).

The Payments for Ecosystem Services discussed in this thesis, is one of the most common market-based instruments for ecosystems conservation. PES schemes are expected to fill the gaps where other tools cannot reach or do not work. Their attractiveness can be attributed to the interest of different stakeholders in finding new ways of promoting ecosystem conservation while supporting the development of rural populations (Corbera, González, & Brown, 2008). PES can assume three different approaches, which are described below and illustrated in Figure 77.

- A. *Win-win approach*: aims to address several problems at the same time. This configuration very much attracts the attention of politics, government agencies and some NGOs, especially in developing countries. The reason is the promise of meeting two or more goals from different policy areas at the same time by the same project (e.g., ecosystem protection and poverty alleviation) (Roldan Muradian et al., 2010). Several are the criticisms of this approach, though. Some authors believe this type of solution is too simple to solve complex policy problems (R Muradian et al., 2013).

Others argue that initiatives aiming to reduce poverty and improve living conditions work better when addressed as primary goals (Tacconi, 2012). Indeed it is a hard task for PES schemes to balance additionality and financial efficiency together with equity at the same time (Wunder, 2007). Win-win projects can work, although not typical. Unfortunately, the scarce information does not reveal the practices that led to the success of this approach (Carpenter et al., 2009).

- B. *Stand-alone approach*: in this case, PES schemes are implemented alone, with no other incentives or parallel projects to complement the outcomes of the PES scheme, or perhaps address other issues faced by providers. It often happens when the stakeholders have different priorities and choose to create separate development worlds, each one with its objectives (Politics, 2017).
- C. *Integrated approach*: refers to a partnership between a PES scheme and at least one more project with similar or different objectives that somehow complement each other in a broader policy scenario². It is also referred as an 'integrated package of incentives'. When PES are part of a well-structured programme, they may be more efficient in its purpose, and even incorporate the best-practices design that can better off the livelihood of both participants and non-participants (Tacconi, 2012). This topic will be further discussed in the next chapters.

² It is worth to mention that "*bundling*" of environmental services within the PES scheme is not considered a type of integrated program since it can be done (and it is highly recommended) within any approach.

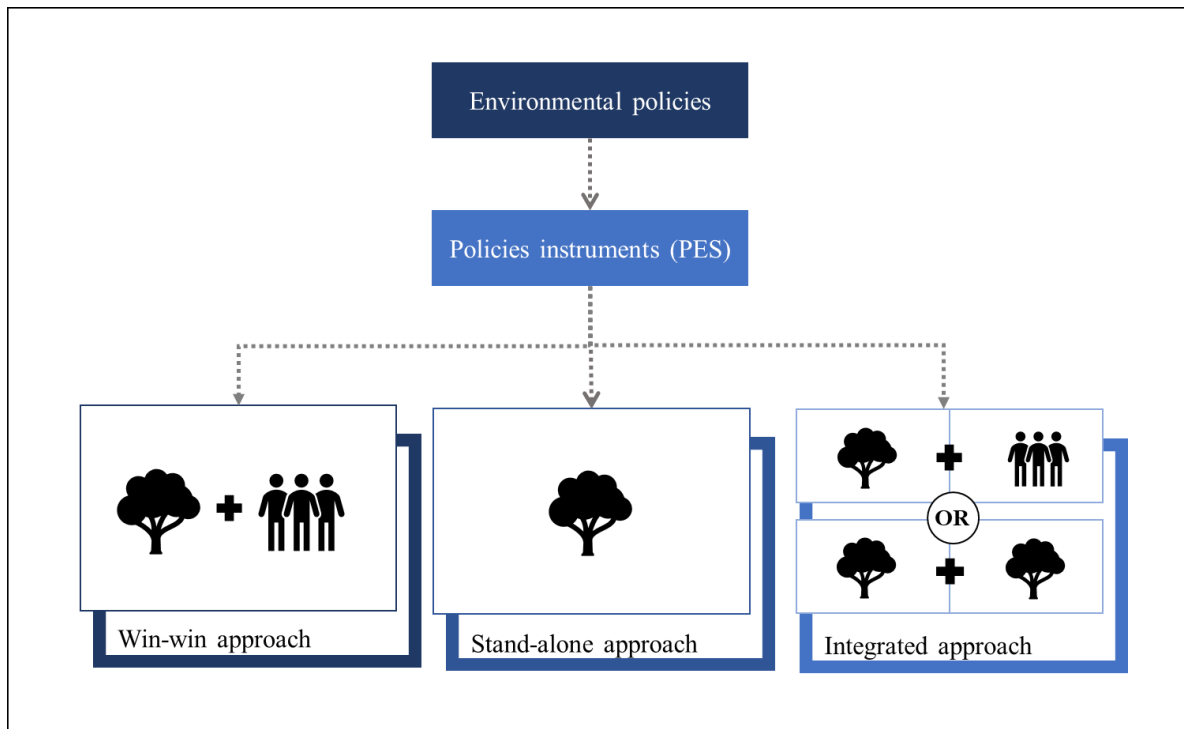


Figure 7 - PES approaches as environmental policies instruments. Source: author's own elaboration.

4. Problems of applicability

4.1. When formulating policies and tools

From the conception of environmental policies to the development of instruments and generation of outcomes, uncountable are the choices that must be made, and the factors influencing these choices. Some decisions will be crucial to ensure the effectiveness of the PES, while others might lead to its failure.

There is a high heterogeneity, by policymakers, in the perception and importance given to ecosystem services and the benefits they can provide (Martín-López, Montes, Ramírez, & Benayas, 2009). Policymakers are usually focused in their areas of expertise and naturally will try to adopt the best solution to meet their goals, which may not be the best approach to address global problems.

It is essential to accept that difficult choices will be demanded while designing PES, involving winners and losers. For example, biodiversity can be threatened if forests are cut down to

expand agricultural production aiming the increase of food security. In another scenario, food security could be jeopardised if the government decide to invest in biofuel production for energy security in areas where food was previously produced. Or perhaps water security can be threatened by the intensification of agriculture, etc. (Chandran & Ivanovic, 2016). Each one of these scenarios has opposing stakeholders' interests attached to them, which can lead to a conflict of interests. The decisions taken inevitably will expose governance weaknesses, especially when it comes to complex problems.

The perception that environmental problems are secondary leads to little interest in its mainstreaming, resulting in difficulties in the implementation of solutions and marginalisation of people affected by ecosystems degradation (UNDP, 2009). Also, the lack of interest can arise from insufficient capacity to evaluate risks and opportunities of environmental policies and instruments.

Policymakers are likely to address a problem when three principles are met: 1) the problem must be perceived as significant enough to claim action; 2) solutions must be seen as politically and bureaucratically practicable, and; 3) a policymaker must be willing to engage in the change process (UNDP, 2009, p. 3). The first condition is essential to create effective policies and instruments. It demands though, identification of individuals with power and interest to promote environmental conservation. The support of a dedicated person with empirical knowledge that can motivate others to adopt new ideas might be a determinant factor to ensure the approval and success, or not, of the policy and its tools (UNDP, 2009).

It is important to notice some aspects that, if considered in the formulation of environmental policies, can compromise their effectiveness and makes their failure inevitable. Laitos (2017) suggest two policy flaws, which are: 1) treat humans as being separate from nature, and; 2) address ecosystems as a stationary system.

The first premise considers that human actions can be "isolated" or "controlled", with limited impact on ecosystems (Laitos, 2017). This disconnection, for instance, can be observed when a policy or any other legal instrument allows a company to burn fossil fuels and, in turn, plant new forests in another country to sequester carbon. Even though the quantity of carbon emitted/ sequestered may be similar, other ecosystem services such as microclimate regulation will not be taken advantage of by community surrounding the company. If policymakers

considered the co-dependency and interconnection among human and natural components when elaborating policies, better results would undoubtedly be achieved.

The second aspect argues that environmental policies focus on preserving natural spaces in some unrealistic form, rather than allowing ecosystems to adapt and evolve (Laitos, 2017). This type of flaw happens, for example, when a law does not allow rural communities to access forests and other ecosystems in search of provisioning services for their subsistence. Policies that support adaptive capacity of ecosystems need to be developed, rather than focusing in “untouchable” kind of policies that are easier to put into practice but does not address the real needs of the society. Unfortunately, Laitos (2017) correctly points out that no environmental policy or instrument offers a bullet-proof solution to stop ecosystem degradation.

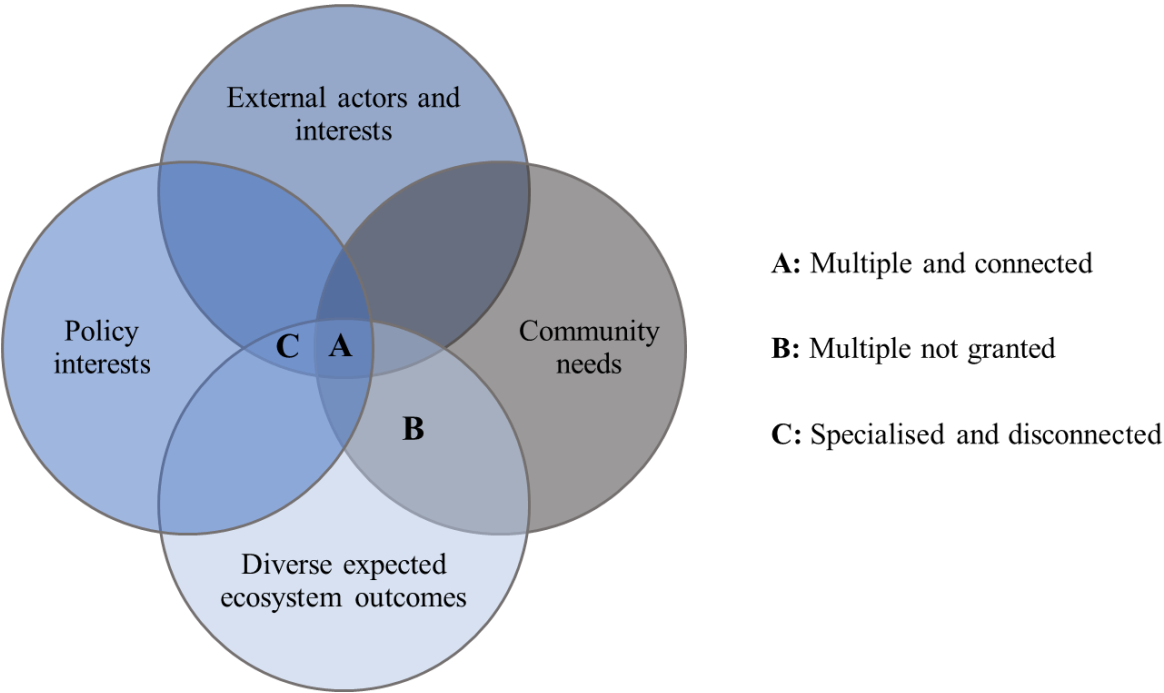


Figure 8 - possible interactions among elements when formulating a policy Source: author’s own elaboration

Figure 8 above illustrates the possible interactions among elements when formulating an environmental policy. The focus is to achieve the area market with “A” (multiple and connected), which would represent a perfect policy where all the interests are met. The reality

though, is that there are a lot of ecosystem services falling into the area “B” (Multiple not granted). They are developed by traditional communities who provide the service and usually does not receive any official grant for it. Still, it is possible to find policies indicated by the area “C” (specialised and disconnected), where the community needs are completely set aside and only the interest of external actors is considered.

4.2. When designing and implementing PES

Once the policies are formulated and approved, the next step consists of the design and implementation of its instruments, such as PES schemes, which can assume several forms.

The central actors involved in this phase are usually the intermediaries’ organisations, which are charged with several tasks and responsibilities. Problems arise when there is weak organisational capacity (UNDP, 2009) and inability to connect with institutes responsible for the management of different environmental disciplines involved in the PES implementation (Baldwin et al., 2009). When these problems exist, they can become constraints, limiting opportunities for PES mainstreaming.

In developing countries, issues such as the abovementioned weak institutions, besides market failures, low awareness of linkages in between policies, and lack of alternative livelihoods (UNDP, 2009), are the leading causes of PES schemes’ failure. The effectiveness of environmental instruments become even lower when the interest for private profit competes with the benefit of public wealth (UNDP, 2009).

The low awareness of possible linkages in between policies and instruments is a chronic problem. Most of the PES schemes are developed to address specific sectors (e.g., agriculture, water supply, marine fisheries, etc.) or, sometimes, particular intersections (e.g., biodiversity and land use change) (Carpenter et al., 2009). A reason that, perhaps, may discourage the adoption of joint management of landscapes (provision of multiples services) is the difficulty in obtaining a consistent economic valuation of several ‘potential services’. In many cases the information for translating services into a monetary value is inexistent (as in the case of cultural services), limiting the interest of investors (Carpenter et al., 2009).

Far from being a sign of consistency, a PES that plays to specific audiences is likely to become disconnected from one another and even fail to involve appropriately with their original goals (Politics, 2017). The SDG suggests many possible co-benefits among goals, where addressing one helps address others at the same time (Chandran & Ivanovic, 2016).

Even though there is the possibility of addressing multiple topics through well-structured PES (an alternative still little explored by the policymakers), it is essential to define a clear strategy to ensure the incentives will be spent efficiently. It firstly consists of the definition of priorities, which might cause conflicts, since the urgencies in the national ranking may not be the same ones of the international or the investors ranking. The lack of prioritisation combined with the lack of planning, create disconnected strategies. Lots of policies and instruments fail in this phase since no attention is paid to the order in which the problems are addressed. Instead of first solving questions that will assist in the resolution of the following issues, decision-makers use any arbitrary criteria to define the arrangement to be followed, lowering the effectiveness of the environmental policy instruments.

The most effective PES involves many different stakeholders operating at diverse scales, from national governments to private companies, local and international NGOs, small community organisations, and many other possible partnerships (Chandran & Ivanovic, 2016). Connections are essential to solve the problem of insufficient inputs since the budget restriction is usually a matter to be overcome by PES practitioners. It is crucial to keep in mind that a large number of stakeholders might solve the budget problem, but also increase the chance of conflict and shock of interest, demanding transparent and robust governance by the coordinating actors. Achieving a well-structured strategy for a PES scheme will require national governments, private sector, NGOs, and communities to make tough decisions based on sincere and genuine commitment to it (Chandran & Ivanovic, 2016).

Two other risks associated with the design phase might take a PES to failure. First, if the cycle of the programme is not well defined, it might not have enough time to embed the changes into the local community and local government structures, i.e., it may not be sustainable. Second, if the type of incentive provided is not wisely chosen, the PES can create a culture of dependency by which the maintenance of the benefits in a long-term will be conditioned to the presence of incentives.

A crucial final challenge to ensure the effectiveness of a PES consists of the monitoring of the programme's progress. It is necessary to measure both inputs as well as outcomes, and feeding this information back into the policy arena to hold responsible stakeholders in the programme. Chandran & Ivanovic (2016) question how will the stakeholders make sure the PES is being implemented and working correctly if these sorts of 'feedback loops' are not created to show them the results of their investments?

Converting ambitions into fully integrated operational practice across various geopolitical scales remains challenging (Everard et al., 2014). Some factors that lead to the failures mentioned above can be controlled; however, others are far away from our realities and cannot be changed.

5. Integration



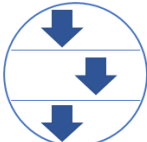
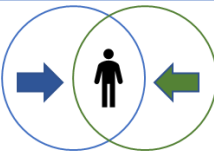
Over the first four chapters, it was discussed the origin, the drivers, the way how environmental policies are thought, and the problems faced when implementing PES. As one can notice, there are lots of divergences about what would be the perfect scheme. Although some sources of inefficiencies cannot be controlled, the implementation of PES schemes following the integrated approach can increase its effectiveness and offer solutions for some of the mentioned disconnections.

Researchers from either Environmental and Ecological Economics school agree that PES can achieve better outcomes when part of a policy mix or a broader programme. OECD (2010) classify PES as a mechanism that can be used alone, or preferentially together with other tools as part of a policy mix. PES, according to Muradian et al. (2013), should be threatened as a complement to a broader policy mix or hybrid governance structure. In another article Muradian suggest PES as part of a more comprehensive policy for rural development in developing countries (Muradian et al., 2010). Bremer et al. (2014) and Rosa et al. (2004) defend PES as an approach to sustainable development, rather than a stand-alone tool. Rowcroft & White (2013) recommend PES in association with other instruments within environmental policies, including additional market-based mechanisms. Regardless of the political arena with which the PES can integrate, the important is structuring the programme

in a context-specific framing, with a broad set of tools that jointly seek to solve socioenvironmental challenges (Muradian et al., 2013). Funds and international organisations, such as the World Bank and United Nations, have been recently prioritising projects that implement PES as part of integrated approaches, rather than a stand-alone model (Pagiola & Platais, 2007).

An approach is integrated when a set of policies and projects are associated to achieve synergies between them (Di Gregorio et al., 2017). The integration is not restricted only to multi-sectoral services (environmental, development, poverty reduction, etc.), but can also involve different stakeholders (non-governmental organisations, multilateral financial institutions, regional associations, private sectors, government agencies, community organisations, individuals, etc.) (Conway, 2003). With so many possible actors involved, the challenge lies in coordinating the efforts to make them complementary, and not contradictory. It does not mean that different projects might be coordinated by the same institution. A great level of coordination can be reached even with two completely separated governances.

Table 3- Forms of influence in policy instrument integration

Form		Strategy
<ul style="list-style-type: none"> Multiple instruments of a policy targeting a specific actor or group of actors 		<ul style="list-style-type: none"> Increased intensity of policy intervention
<ul style="list-style-type: none"> Multiple instruments of a policy targeting different actors / group involved in the same process 		<ul style="list-style-type: none"> Integration of multiple instruments into one interactive process between government and target groups
<ul style="list-style-type: none"> Interactions between instruments and action taken at different levels of multi-level governance (same policy) 		<ul style="list-style-type: none"> Involvement of different levels of governance working for the same topic
<ul style="list-style-type: none"> Interactions across policy areas/domains 		<ul style="list-style-type: none"> Competition and co-operation between different but interdependent policy fields

Source: Flanagan, Uyarra, & Laranja (2011, p. 707) based on Bressers, H.A., O’Toole (2005)

Several are the possibilities to promote integration of policies and instruments. Table 33 above, an adaptation of Bressers, H.A., O'Toole (2005), provides some forms and the strategy behind the alternative proposed. More than one form can happen within an integrated programme.

But what are the advantages of creating integrated and more complex programmes? Some of the possible answers are provided below.

5.1. Livelihood diversification

There are two ways in which integrated schemes can contribute to livelihood diversification. In areas where agricultural projects already exist and support farmers, the integration with PES will contribute to the conservation of natural resources and its services. It can be important in providing livelihood security in times of seasonal scarcity (such as drought, crop failure, market failure, etc.) for any community or individual living near ecosystems, independently of their primary economic activity. A well-maintained ecosystem can be a source of alternative foods, fuel, wood and other resources (Conway, 2003).

Also, the incentives provided by the PES programmes can act as an extra source of income, used as a complement to already existing activities rather than as substitutes (Engel et al., 2008). Campbell (2009) mentions the example of the carbon market, where incentives (usually cash) mean extra revenue for the providers, which maintain others economic activities as a primary source of income. PES schemes can be particularly important in communities with limited sources of income and non-linear pay, such as regions highly dependent on small areas of cash crops. If the PES scheme is well administered, the regular payments can turn to be a stable source of household income (James Salzman, 2009).

Integrated schemes that seek to promote livelihood diversification through PES encourage providers to pursue a productive activity while reducing their impact on the environment and its services (Pirard et al., 2010). PES schemes can establish a partnership with projects that provide technical assistance, investments, consultancy and other incentives to ensure the improvement of the primary activity.

5.2. Expansion of ecosystem services to other activities

Ecosystem services are naturally associated with protected areas such as forests, basins, wetlands, etc. However, services can be produced in any type of ecosystem, including agricultural areas, as mentioned in item 2.3 of this study.

The Integrated Conservation and Development Projects (ICDPs) proposed by the World Wildlife Fund (WWF) in the middle 1980s aimed to integrate biodiversity conservation projects with rural development components (Hughes & Flintan, 2001). The idea was to encourage rural communities to provide ecosystem services by eco-friendly activities, without interrupting the operations (mostly agriculture) that would lead to rural development (Wells, Michael; Guggenheim, Scott; Khan, Asmeen; Wardojo, Wahjudi; Jepson, 1999).

The type of agricultural production using methods compatible with ecosystem preservation and maintenance of the countryside is known as Green Growth (OECD, 2012b). In this model, incentives are provided for farmers to broader agriculture production using compatible practices to environmental maintenance (Gorman et al., 2001). Besides the sustainable practices on agriculture, "green farmers" can go even further and implement other activities compatible with PES incentives, such as reforestation, watershed protection, biodiversity conservation, etc. In Brazil, farmers engaged in a Green Growth programme promoted the reforestation of springs and riparian areas to improve water for downstream irrigation (Kongsager, Locatelli, & Chazarin, 2016). This example illustrates sustainable practices where PES, integrated to other initiatives, produce outcomes that will beneficiate both ways round and contribute to the resolution of local problems.

5.3. Greater government support

Landell-Mills and Porras (2002) mention that PES and other market-based mechanisms are often seen as tools that will solve the conservation problem faced by several governments, especially in developing countries. The true reflection though, "is not whether we should promote markets instead of government intervention, but what is the optimal combination of

market, hierarchical and cooperative systems for governing forest sector utilisation and management?" (Landell-mills & Porras, 2002, p. 3).

Linking PES schemes to high priority national policies, such as economic growth, rural development or poverty reduction can be a smart strategy of integration. Associating PES schemes to these high-level policy objectives increases the probability of inserting this instrument in the national development plans and the policy sphere, gathering more government support (UNDP, 2009).

To fully take advantage of the partnership with government agencies, it is vital that the proposed programme is adapted to the country's needs and the government participates in each phase of the work, to ensure their interests will also be met. In counterpart, PES shall negotiate all demanded assistance that can be provided by the government, to reduce bureaucracy and increase the effectiveness of the programme (UNDP, 2009).

5.4. Participation of more stakeholders

PES schemes, when associated with land-use programmes from the national governments, can make viable the involvement of the poor, which would be more difficult if the project was running without external support. Brown et al. (2007) mention that PES may be more expensive and bureaucratic to establish when it aims to beneficiate the poor, however with government's support it can become feasible.

Rosa et al. (2004) suggest that PES schemes integrated with agricultural activities through partnerships, such as agroforestry projects, are more likely to attract marginalised rural farmers who depend on their land for subsistence. If these farmers had to convert their properties into a conservation area, they would probably not join the PES scheme.

Another opportunity to expand ecosystem preservation is through the association of PES schemes to climate change adaptation programmes. People working on adaptation measures are already suffering from climate change effects and are more open to adopting practices that aim to promote mitigation in addition to adaptation. This predisposition can be advantageous

to integrate the two climate change objectives, which can serve as a way to avoid incoherence in policy design and lead to more effective outcomes (Di Gregorio et al., 2017).

5.5. More fund options

Several are the advantages of an integrated approach when it comes to funding options. The insertion of PES on a broader policy framework maintain the essential features of this type of market-based instruments, such as conditionality, additionality and voluntary transaction, and complement it with additional finances and capacity building efforts from other actors (Van de Sand, Mwangi, & Namirembe, 2014).

Ashia, Akansina, Boy, & Frimpong (2008) points out that some projects such as watershed management are likely to be financed by national or regional government funds, while projects related to the SDGs (poverty reduction, gender equality, food security, etc.) receive more attention from international funds. Van de Sand et al. (2014) mention that international donors are increasingly attracted by integrated projects, which means more funds available for projects that fit into this model. Projects that aim to promote tourism, in turn, are frequently financed by private companies willing to establish themselves in the region. In a well-designed PES scheme, different projects can be reward by various funds.

The integration of PES with programmes financed by private companies that further environmental, social, and governance goals can be a very profitable partnership for both parts, since PES depend on funds to operate, and private investors need an institutional framework to provide the service they want to buy. In this case, it is important to adequate the programme to the size of the investment, so that the money is spent as best as possible.

5.6. Double dividend payoffs

Before entering the subject, it is necessary to clarify the differences between double dividend payoffs and win-win approach. The later one addresses distinct objectives with equal significance by one scheme. The double dividend payoff occurs when different schemes are

integrated but each initiative works focused on achieving its own goals. In this case, the partnership aims to create synergies in between them, resulting in outcomes that will beneficiate directly or indirectly both objectives.

Fisher, Kulindwa, Mwanyoka, Turner, & Burgess, (2010, p. 1253) indicate the potential for "double dividend" payoffs in programmes that integrate biodiversity conservation and poverty reduction, and a mutual-positive scenario in programmes for biodiversity protection and livelihood improvements. Kongsager et al., (2016) suggest this partnership for PES schemes integrated with climate change adaptation projects, since ecosystems provide both mitigation (carbon) and adaptation services (watershed protection, forest products for livelihood diversification, microclimate regulation in agricultural fields).

It is important to keep in mind that, even though PES can have substantial positive secondary benefits (for instance, livelihoods) they cannot by themselves solve complex problems like lifting poor people out of poverty (Conway, 2003). For that, parallel economic and social development needs to be promoted through an integrated package of incentives, involving a different set of stakeholders. In this way, the potential risk of overfilling PES with various objectives instead of focusing on its primary goal of ecosystem service provision is minimised without affecting the final result (Van de Sand et al., 2014).

5.7. Institutional collaboration

Effectively integrated schemes share collective expectations for the future, as well as the means to achieve it. At the same time, the initiatives are adequately diverse in their stakeholders and networking to ensure a variety of resources and knowledge. These capacities are known by bridging and bonding social capital and are wisely employed by effective partnerships. Bonding social capital consists of the consolidation of internal organisation and its ability to take collective action. Bridging social capital involves the link among local groups to resources and external allies with similar objectives (Ashwill, Flora, & Flora, 2011).

In Kenia, a programme that aimed to combine PES with adaptation measures to climate change found that institutional structures of the PES scheme could be useful for conducting

additional training and promoting capacity building for adaptation (Van de Sand et al., 2014). It is a clear example of bonding social capital.

Kowalski & Jenkins (2015), state that bridging organisations can improve ecosystems management outcomes by linking actors from different sectors and promote group decision-making. Once the interaction among actors is facilitated, the transaction costs tend to lower. NGOs acting as intermediaries in integrated schemes might be great bridging organisations within the natural resource governance arena.

5.8. Lower transaction costs

The transaction costs involved in a PES scheme consist on the value of attracting potential buyers, finding possible providers, updating and gathering project partners and several other activities to ensure that all stakeholders accomplished their responsibilities (Arriagada & Perrings, 2009). Usually, transaction costs are highest when: 1) numerous PES actors are involved; 2) when institutions and property rights are fragile, and; 3) when is expensive monitoring land use (Wunder, 2007).

The problem of high transaction costs is that it diminishes the money available for the payments, consequently reducing the number of services that a given budget can pay for. Nobody wants to pay for these costs. If transaction costs are incorporated into the unit cost of the service, this can reduce its demand. On the other hand, if the service provider pays transaction costs, the willingness to participate in the scheme will reduce (United Nations Economic and Social Commission for Asia and the Pacific, 2009). The best solution is to look for alternatives to reduce transaction costs and keep the interest of the stakeholders in the scheme.

A creative way to solve this problem consists of the reorganisation of programmes in such a way as to reduce administrative costs (Primer, 2008). Integrate the scheme on already existing community development projects in the area might be the best solution. Already existing programmes have an infrastructure for handling the costly tasks of monitoring and managing a project ready to go. The integration also offers the possibilities of:

- a) *Creating cost-sharing mechanisms*: dividing common costs among all buyers and other funders from the projects involved, etc.;
- b) *Scaling up the programme*: looking for more funds, new providers, new partnerships, renewing the cycle of the programme, etc.

6. Research questions and objectives

With the mainstreaming of the PES, several studies are publicised annually about the effectiveness of these schemes. Although researchers and policymakers are increasingly suggesting the adoption of a PES scheme in association with other policy instruments, there is a very limited bibliography discussing this topic.

This study aims to analyse PES and Rural Development (RD) projects implemented in an integrated package of incentives and stand-alone, comparing a range of items associated to scheme's strategy. The central research question that arises is:

- a) *Are the integrated packages of incentives superior to the single systems when it comes to impacts on the sustainability of the ecosystem services and resilience enhancement of the benefited community? What are the causes of it?*

Two other complementary research questions are also proposed:

- b) *What are the conditions that render feasible to replicate the best scheme to other areas and why?*
- c) *How could the best scheme make the socio-economic and environmental benefits associated to the program even higher?*

To answer the research questions, the primary objective of this thesis is:

- a) *to evaluate the outcomes provided by the integrated packages of incentives (PES + RD schemes) comparing to the ones supplied by single systems, analysing if the first is*

superior regarding impacts on the sustainability of the ecosystem service and resilience enhancement of the benefitted community, and the causes of this superiority

The secondary objectives are:

- b) isolate the conditions that render feasible to replicate the best scheme to other areas*
- c) identify which issues need to be addressed to maximise the environmental and socio-economic benefits of the best scheme*

7. Theoretical framework

To answer the proposed research questions, a range of items were analysed and discussed. The theoretical framework illustrated in Figure 9 proposes three groups of factors whose interaction leads to the outcomes. The groups consist on: a) the instruments to promote the changes and its associated costs; b) the description of areas benefited by the schemes; and c) other items that may interfere on the scheme's results, such as context, stakeholders, governance and mechanism. The outcomes, originated from the interaction of all these items, were then used to assess the level of achievement of the desired impact.

Starting from the analysed policy instruments, two types were selected: PES and RD schemes, which were implemented in single and integrated approaches. Even though this study does not intend to perform a detailed costs analysis of these projects, monetary and non-monetary costs were associated to the schemes, having some impact on the decision of which configuration of projects better met the desired impacts.

Regarding the scenarios considered for the evaluation of the schemes, two types of areas were carefully chosen. The first one consists on regions with Intensive Agriculture, that demand a high quantity of ecosystem services, while the conditions are not favourable for their production. These areas are being converted into properties with Sustainable Agricultural Practices, where farming activities were still developed using less aggressive techniques from an environmental conservation perspective. In this case, the balance between demand and production of ecosystem services is undoubtedly different from the first situation. The second

type of area comprises Natural Environments, without any significant intervention in its standard processes, or areas under restoration where the services can be optimised to the maximum.

The sustainable development policies aim to promote the increase of the areas of protected natural environments and sustainable agriculture. The instruments abovementioned play an important role to support this process. Land managers willing to migrate from an intensive agriculture model to a sustainable one, can receive the incentives provided by the RD or PES scheme, or both at the same time. On the other hand, land managers that hold an area of natural landscape can also receive incentives to keep preserving the forests, water and other environmental goods essential for the sustainable development process.

Finally, this study also analysed other factors interfering on the process, such as context (see item 1.5.3.), the stakeholders involved (see item 1.5.1.), the governance and institutional framework (see item 1.5.2.) and the mechanism behind the process (see item 1.4.). The interaction of all these factors and the above-mentioned ones generated different outcomes, varying from situation to situation.

Since the number of outcomes produced can be massive, to answer the main research question, focus was given to the ones considered important to ensure the sustainability of ecosystem services while enhancing the resilience of the community receiving the incentives.

The concept of sustainability provided by Edenhofer, Pichs-Madruga, & Sokona, (2014, p. 332) suggest a definition based on the “Current evolution of capacities”. This definition mention basic principles supporting the sustainability that can also enhance resilience, if adequately managed:

"Preserving the resources transmitted to the future generation is a key step in guaranteeing a sustainable path. It is useful to think of the capacities underlying the functioning of the three spheres: economic, social, environmental. The economic sphere needs various forms of productive capital and raw materials, infrastructures, and a favourable environment, but also human capital, institutions, governance, and knowledge. The social sphere needs various forms of institutions and resources for sharing goods and connecting people, which involve certain patterns of distribution of economic resources, transmission of knowledge, and forms of interaction,

coordination, and cooperation. The environmental sphere needs to keep the bases of its health, including habitat, climate, and biological integrity.”

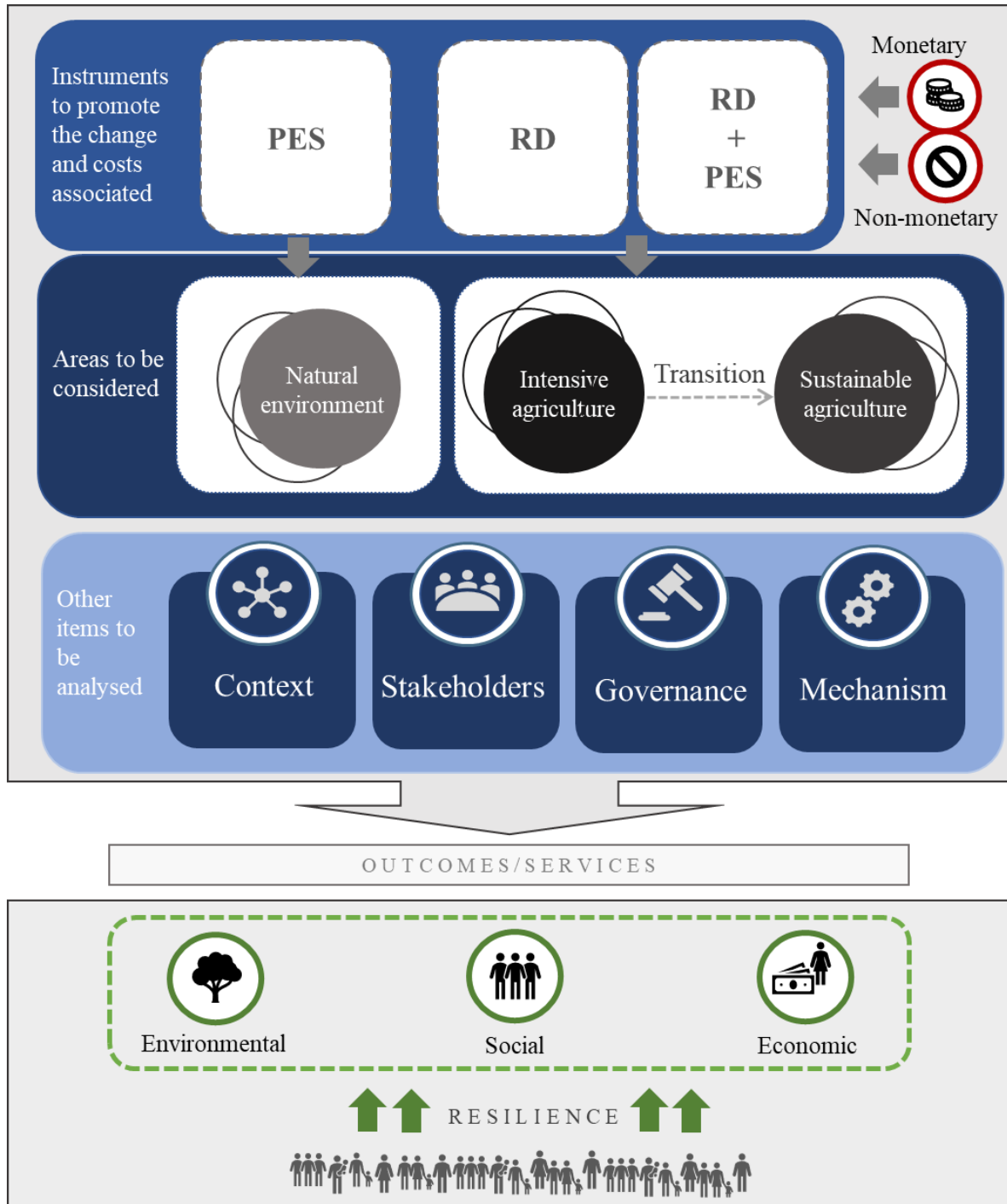


Figure 9 - Framework for answering the research questions of this study. Source: author’s own elaboration.

Following this rationale, the same “pillars” were used to organise the outcomes of the projects: environmental, social and economic. The analysis also considered the costs of the schemes, here divided in monetary and non-monetary costs. The best scheme was further explored, comparing its findings to the experiences available on the literature.

As this study aims to serve as support tool to multiply good practices, a range of relevant factors attributed to the success of the best scheme were identified and discussed. This phase was useful to answer the second research question and to provide more information for the reader to understand how those outcomes were achieved.

Finally, the research question number three applies to the whole context, focusing on the optimisation of the scheme’s outcomes.

8. Methodology

8.1. Methodological approach

The study was divided into two phases to answer the research questions:

- a) *Desk research*: the desk research was essential to understand the context embedding the projects, such as political tools, culture, environment, socio-economic background, and others. The institutional framework, and the mechanism behind each one of the evaluated projects was also clarified by the desk research. By this detailing, it was possible to identify potential outcomes to answer the main research question. After the desk research the field interviews (that were previously formulated) were reviewed to better assess the demanded information.
- b) *Interviews*: face-to-face interviews were conducted with different groups of stakeholders. The interviews aimed to assess new data about the schemes, besides double checking the accuracy of the information previously collected by desk research. This step was also important to better understand the operational phase of the processes, and to assess the beneficiaries’ perception about the projects and its different phases, besides capturing external opinions about the schemes.

8.1.1. Interviews

The interview technique is an effective way to gather qualitative information of persons involved in or affected by a project, its implementation and results. This technique is also useful to provide feedback on all aspects of a programme inputs, activities, outputs, outcomes and impact (European Commission, 2013). It works as a double check to verify if the strategy initially proposed is being met and to fine-tune the project.

Another advantage of using interview is that it consists in a reliable source of information to evaluate projects that aim to produce changes in actor's behaviour and perceptions, as the present study (European Commission, 2013). In this case, harder outputs would not truly capture the desired change, which can be better assessed through conversation techniques.

Different methods of interviews were used for each one of the groups mentioned at Table 4 below. The farmers were interviewed using a semi-structured model, while the method used for other stakeholders was a narrative interview based on pre-selected topics to be discussed.

For all stakeholders, individual interviews rather than collective ones or focus groups were preferred, since the RD project consists on practices that differ according to the profile of the participant and the property benefited, as further explained. Each farmer received a package of incentives specially formulated for him/her, thus generating different effects and perceptions from farmer to farmer. In this case, groups dynamics would not allow capturing how the experiences varied from person to person. Another reason for choosing interviews is that most of the farmers have a low level of schooling and would, probably, face difficulties in filling forms or questionnaires, for instance.

Individual interviews are also relevant when the stakeholders involved in the project are few (European Commission, 2013), which is the case of this project. Even though there are many land managers participating in the RD project in the State of Rio de Janeiro, the filters applied to define the sample units limited the number of available individuals, thus making feasible the one-to-one interview method.

Table 4 - Number of interviews by the group of stakeholders.

	Group of stakeholders	Number of interviews				Total
		Rio Rural	ICMS Ecológico	PAF	FUNBOAS	
1	Project's coordinators	2	1	1	2	6
2	Technicians responsible for the operational part of the project	7	1	1	1	10
3	Partner organisations (NGOs, government institutions and others)	5	2	1	0	8
4	Local association representatives	8	0	0	0	8
5	Farmers participating in one project	23	6	5	5	39
6	Farmers participating in both projects	-	5	4	4	13
	Total	45	15	12	12	84

Source: author's own elaboration

In total, 84 interviews were performed, with 73 people. When authorised the interviews were recorded. The semi-structured interviews were parallelly uploaded in an offline form created with the software Open Foris Collect – Version 3.21.14, licenced by the Food and Agriculture Organization (FAO). The Open Foris Collect is a free online/offline platform where forms can be created, and feed with data collected in field-based research. Once completed, the forms were exported to Excel for compilation and analysis.

8.1.2. Sample frame

The interviews conducted with groups 1, 2 and 3 of Table 4 above, were based on the availability of key informants. The interviewees of groups 4, 5 and 6 were randomly selected after applying the following procedure, illustrated in Figure 10:

- A. For each one of the PES schemes desk research was conducted to identify the land managers that have received (or are still receiving) the incentives provided by the scheme acting in that region;
- B. Within the same region previous selected, the land managers receiving the incentives of the RD scheme were listed;

- C. Of possession of these two lists, the information was crossed, and three groups were designed:
- i. farmers participating in the PES (black);
 - ii. farmers participating in the PES and RD (green), and;
 - iii. farmers participating in the RD scheme (blue);
- D. Finally, there was the exclusion of the farmers who received the incentives in the last 12 months³;
- E. The remaining individuals were considered eligible to participate in the interviews.

From this universe, five individuals of each group were randomly selected for the interview. When possible, more than five farmers were interviewed. It is worth to mention that some of these individuals are part of the Micro Watershed Management Committee (COGEM in the Portuguese acronym) and thus, were also interviewed as part of the group 4 (local association representatives).

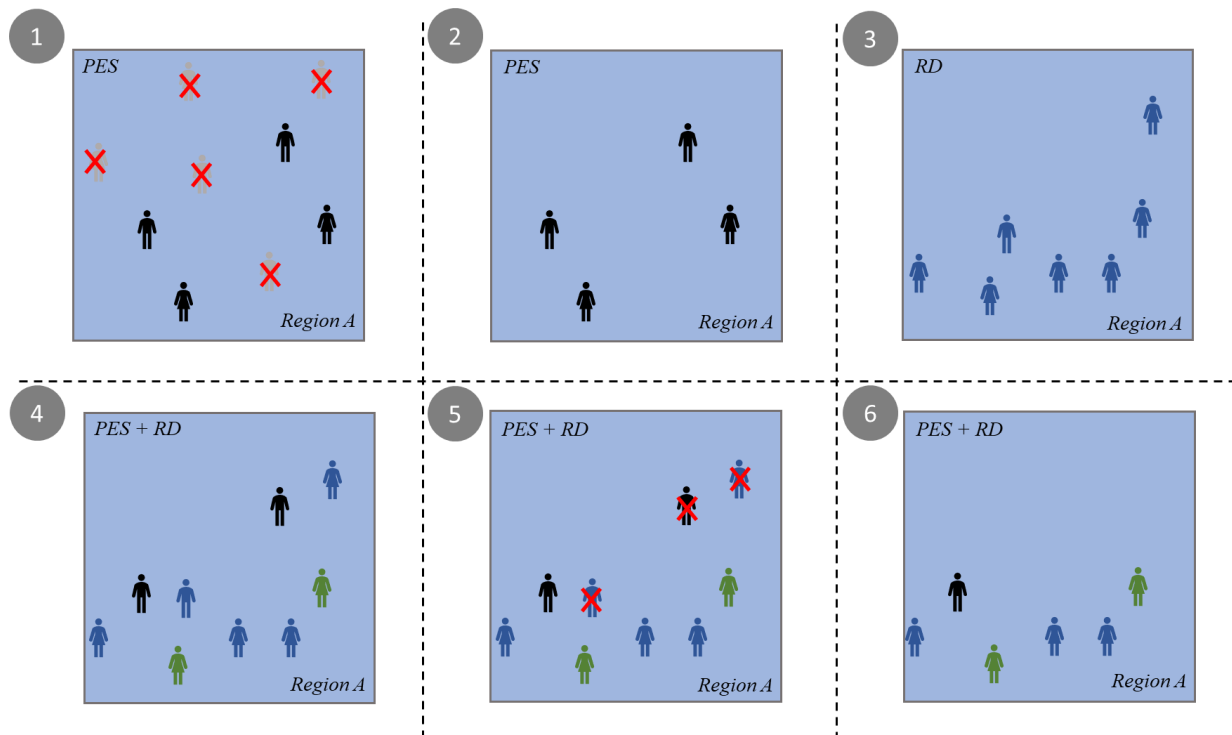


Figure 10 - Sample framing procedure. Source: author's own elaboration

³ This filter aimed to select farmers who could have a better perception of the project and the changes embedded into the local community

8.2. Description of the case study

8.2.1. The Atlantic Forest in Rio de Janeiro

The Atlantic Forest is a region consisting of a set of forest formations and other types of vegetation, which initially covered an area equivalent to 1,296,446 km², by the territory occupied by 17 Brazilian states. Today, the remaining area occupies 22% of the original area, where approximately 123 million people live, equivalent to 67% of Brazil's population (Guedes & Seehusen, 2011; MMA, 2013). The SOS Mata Atlântica (2015), estimates the Rio de Janeiro State, has only 30,7% of its original Atlantic Forest, which was originally 97% of the State's area.

The Atlantic Forest is recognised as National Patrimony by the 1988 Federal Constitution (BRASIL, 1988), and as a Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Despite the extinction of an already substantial quantity of its species, the Atlantic Forest still hosts one of the most considerable biodiversity in the world, with a high incidence of endemic species and is therefore classified as one of the five priority areas of the planet (MMA, 2013).

Parallel to this, the Atlantic Forest offers valuable ecosystem services, ensuring the water supply of the largest Brazilian cities, regulating the flow of water sources to ensure soil fertility, controlling climate balance and protecting escarpments and slopes, as well as preserving historic and cultural heritage. These are vital ecosystem services for approximately 123 million of Brazilians living in this region (Guedes & Seehusen, 2011).

Beyond of being one of the wealthiest regions in the world in biodiversity, and an essential provider of water services, the Atlantic forest is also a carbon sink of significance for the climate, as its remaining forest formations represent essential carbon pools. Due to its potential for forest restoration, estimated at 17 million hectares, the different forest formations of the Atlantic Forest could capture even more carbon. For this reason, the Atlantic Forest is considered a carbon sink of global relevance (Guedes & Seehusen, 2011; MMA, 2013).

Even though the remaining forest is spread all over the State, only three regions were chosen for this case study, as shown in Figure 11. They are the municipality of Varre Sai, located in the "Noroeste" region of the state; the municipality of Rio Claro, located in the "Medio

Paraíba" region and the municipalities of Saquarema, Silva Jardim and Casimiro de Abreu, located in the "Baixadas Litorâneas" region. The mentioned regions are the official nomenclatures of the state. In this study, from now on, the well-known names of the regions will be adopted, as done by the projects' coordinators and the locals. These names are:

- *Varre Sai region*: municipality of Varre Sai
- *Guandu region*: municipality of Rio Claro
- *Lagos region*: municipalities of Saquarema, Silva Jardim and Casimiro de Abreu.

Each one of these regions, although some similarities, have some peculiarities, follow described.



Figure 11 - Regions of Rio de Janeiro State and selected municipalities for the case study. Source: Rio Rural website <<<http://www.microbacias.rj.gov.br/pt/microbacias>>>

8.2.2. General information about the region

8.2.2.1. Varre Sai region

The municipality of Varre Sai, because of its cold climate and high altitude, stands out as the largest coffee producer of the State of Rio de Janeiro. The Ribeirão Varre Sai Micro Watershed (MWS) where the data was collected, contemplates 6,281 hectares located southwest of the municipality of the same name. It is the primary water source of the urban centre. There are still essential remnants of Atlantic Forest and some connectivity between different fragments. Besides the forest, there are still some areas with native pasture.

The distribution of land is very homogeneous, with only three properties with an area greater than 50.00 ha. About 80% of the properties have less than 20.00 ha and occupy 67% of the total area of the MWS. The family income, due to agricultural activities, is reasonable, despite the almost monoculture of coffee, which practically boosts the economy of the municipality. The FIRJAM⁴ Municipal Development Index (IFDM in the Portuguese acronym) measured in 2016 for Varre Sai was 0,6346 which is considered moderated (FIRJAN, 2018).

The MWS still has abundant resources, but it is necessary to create mechanisms to stop the conversion of forest into agriculture uses, which has been slowly happening throughout the years. The community counts with a COGEM composed of representatives from groups of coffee producers, employees, livestock producers, women producers, and young producers.

8.2.2.2. Guandu region

Within the Guandu region, the data was collected in two MWSs: "Rio das Pedras" and "Rio Claro". The Rio das Pedras MWS is located in the Serra do Mar, municipality of Rio Claro, on the border with Cunhambebe State Park. It occupies an area of 1,500 ha and has the Piraf

⁴ The IFDM is a study of the FIRJAN System that annually monitors the socioeconomic development of all of the 5,000 Brazilian municipalities in three areas of work: Employment & Income, Education and Health. Created in 2008 it is exclusively based on official public statistics made available by the Ministries of Labour, Education and Health. It has four categories, which are: a) High development: results higher than 0.8 points; b) Moderate development: results between 6 and 0.8 point; c) Regular

River as the main watercourse. The Rio Claro MWS consists of an adjacent and larger area, with similar characteristics.

The main economic activities developed by the farmers of the region are milk, bananas and vegetables. Maize, beans and cassava are also cultivated in small scale and restricted for the consumption of families. This region also has business in rural tourism and a few agroindustries. It is possible to notice a significant number of people who live in the rural communities and work in the city of Rio Claro, Lídice and, in many cases, in other larger cities like Angra dos Reis and Mangaratiba. The remaining population obtain its living through family farming. The IFDM measured in 2016 for Rio Claro was 0,6662 which is considered moderated (FIRJAN, 2018).

Illiteracy is predominant among the elderly population, and there is a lack of training (computer science, plant and animal production) among the rest of the population. In general, there is no paid work for women. The community does not have a local hospital and has to travel to the city when someone needs it. They also face a lack of collective transportation, a sewage network, selective collection and recreational areas.

The Rio das Pedras community counts with some local associations such as the Association of Residents of Rio das Pedras, the Association of Residents of Várzea do Inhame and the Association of Quilombolas of Alto da Serra, and the local COGEM. However, currently, only the Association of Quilombolas and the COGEM is more active. In Rio Claro there are no quilombolas living in that area, and the only local association active is the COGEM.

8.2.2.3. Lagos region

The selected municipalities at Lagos region contemplates three MWS: Roncador, Cambucaes and Rio Lontra. These MWSs belong to a greater hydrological system, composed by the São João watershed and two big Lakes: Araruama and Saquarema. The water resources of these ecosystems are used for public supply, irrigation, small industries, mining, salt production,

development: results between 0.4 and 0.6 points; and d) Low development: results lower than 0.4 points.

recreation and leisure, small navigation and habitats for thousands of animals, plants and native micro-organisms.

The stream of Cambucaes river is in the Municipality of Silva Jardim, located upstream of the Juturnaíba Reservoir, the most significant source of water supply in the watershed. The river lends its name to the MWS, located in a rural community occupied by landless settlements. The Lontra River is located in Casimiro de Abreu. It flows out into the São João river (an essential river for the region's water supply). The Roncador MWS, another important area is located at the municipality of Saquarema.

The region is characterized by small properties. In the Cambucaes MWS approximately 1,500 hectares were randomly subdivided among landless farmers in 105 lots (Kobata, 2006). The lots are divided in area for agricultural use and area with forest vegetation of the Atlantic Forest (Ramos, Doracy Pessoa, Manzatto, Celso Vainer, Hissa & Shinzato, 1999).

The farmers of this region obtain their living through family farming. The main activities consist of milk production, raising chickens, egg production, vegetable production and mainly livestock activities. Most of the rural community is low income and low schooling. The industrialisation, however, has been slowly reaching districts of rural characteristics and changing the landscapes.

The IFDM measured in 2016 for Silva Jardim was 0,6741, for Casimiro de Abreu the index was 0,6829 and in Saquarema was 0,6727. All of them are considered moderated and indicate similar levels of development for the three cities (FIRJAN, 2018).

Even though there are a range of local organisations in the Lagos region, most of them are directed to farmers with different characteristics from the ones participating into the project. The local organisations acting in the MWSs are the COGEMs and the Association of Small Rural Producers of Saquarema (APROSA in the Portuguese acronym).

It is worth to mention that within the Lagos region, Casimiro de Abreu (the Municipality in which the Lontra MWS belongs) has one of the highest rates of forest conservation, with 31% remaining of Atlantic Forest. The same can be observed in the Roncador MWS, which has many springs and conserve good plots of Atlantic Forest in the mountains, besides a valuable sample of the forest that belongs to Ecological Reserves.

8.1. General information about the problem

The ecosystems of the Atlantic Forest have been profoundly devastated in the past and are still under severe deforestation pressure. The isolation of well-conserved fragments of native vegetation and the ongoing process of degradation are critical and jeopardise the long-term sustainability of their biodiversity, implying severe consequences for their ability to provide ecosystem services for the society (MMA, 2013). Both rural populations, traditional communities, and the urban population depend on the ecosystem services provided by the Atlantic Forest. Also, the maintenance of the native vegetation offers the ecosystem services also to the communities, in the regional and global scopes (Guedes & Seehusen, 2011).

Varre Sai is a municipality stuck in the middle of coffee plantations. The regime of rains, though, has changed a lot in the past years. The coffee production is historically the primary asset of local farmers. For almost two centuries, the coffee cycle and the arrival of cattle for milk production were the pillars of deforestation in the region. This process happened together with burnings and illegal extractive activities. Over the years, rural producers removed native vegetation to establish agricultural environments or pasture.

The anthropogenic interference in the Varre Sai MWS is visible. This area, which was dominated by the Atlantic Forest for decades, currently has only a small portion of the original vegetation. Instead of the natural forest, there are eucalyptus plantations, coffee cultivation, pasture and meadows.

In the Guandu region, the Guandu watershed is responsible for about 80% of the water supply and 25% of the electricity generated for the Metropolitan Region of Rio de Janeiro, benefiting approximately seven million people (Filho, Antunes, & Vettorazzi, 2012). The region is historically characterised by the exploitation of its natural resources, with the predominance of unsustainable modes of production such as low productivity dairy farming. This activity resulted in a scenario of progressive environmental degradation (deforestation, soil deterioration and silting, among others) (Filho et al., 2012).

In the Lagos region the ecosystems are continuously threatened, either by deforestation, the occupation of hillsides, waterproofing of the soils or by the contamination of springs, among others (Consórcio Intermunicipal Lagos São João, 2013). The changes in land use and occupation in the region, resulted mainly from very accelerated urban growth in recent

decades, coupled with extensive areas with pasture without soil conservation management. The result is a scenario of severe environmental degradation of natural resources, especially water resources due to a reduction in rivers flow and erosion processes.

The Roncador MWS has undergone intense deforestation in recent years. There was a replacement of forest cover by crops such as banana and coconut. These forms of occupation, along with the existing pasture areas, are responsible for the erosive erosion process. Mass movements can be readily observed, carrying their sediments to the lowland areas and end up causing the silting of the lagoons, which further aggravates the imbalance of the ecosystem (Borges, 2009). Projects acting in the region identified some points of water contamination due to the precarious rural sanitation systems, besides inadequate systems of water supply.

At the Cambucaes MWS, another specific situation has caused several conflicts. The settlers had their economic and social problems aggravated due to the restriction to produce appropriately (presence of forest vegetation, heavily sloping reliefs and excessive humidity in most of the plots located in low flat areas). This situation resulted in conflicts not only with local authorities but also within the community itself, lacking the leadership and technical knowledge to solve the problem (Ramos, Doracy Pessoa; Manzatto, Celso Vainer; Hissa & Shinzato, 1999).

Table 55 below provides a resume of the main problems discussed above for each one of the analysed regions.

Table 5 - The main problem and its causes in each of the studied regions

Region	Problems faced	Main causes
Varre Sai	<ul style="list-style-type: none"> Deforestation of Atlantic Forest 	<ul style="list-style-type: none"> Expansion of agricultural areas, especially coffee plantations
Guandu	<ul style="list-style-type: none"> Deforestation of riparian areas; Soil deterioration and silting 	<ul style="list-style-type: none"> Increasing of low productive dairy farming and banana plantations
Lagos	<ul style="list-style-type: none"> Deforestation of riparian areas; Contamination of water flows by human or animal waste 	<ul style="list-style-type: none"> Low productive dairy farming, small area suitable for cultivation on properties

Source: author's own elaboration

8.2. Description of the PES projects and the RD scheme

Rio de Janeiro is the Brazilian state with the highest percentage of Atlantic Forest in relation to its territory, 27,84% (SOS Mata Atlântica, 2015). Although its dimensions represent only 10% of the national territory, Rio de Janeiro has the second largest population of the country, reaching the mark of 16,718,956 million inhabitants (IBGE, 2017), with more than 80% concentrated in the metropolitan region.

The potential for agricultural production in the State of Rio de Janeiro is indisputable since it aims to supply the second largest consumer market in the country. Currently, a significant parcel of Rio de Janeiro's food production comes from family farming, which demonstrates the importance of this sector.

Given the mentioned context, the question that arises is: how to preserve Atlantic Forest, whose ecosystems are so valuable, ensure the agricultural production, and at the same time provide better living conditions for the rural population, often lacking in development? The challenge is to harmonise, on the one hand, the requirements of preservation and conservation and, on the other, the need to improve the levels of income generated in rural properties. For this purpose, it is fundamental to consider the diversities and specificities of the socio-productive elements of the rural environment. Among the different rural social realities, it is worth mentioning the convergence between the poverty status of most small farmers and the decapitalization that is affecting many medium and large landowners due to the recent crisis faced by the country.

One of the policy instruments chosen by the government agencies and NGOs of Rio de Janeiro, is the PES. The payment for ecosystem services developed in the Rio de Janeiro State presents itself as a promising instrument for successful environmental management that at the same time generates new sources of income to advance in the protection of the environment (Guedes & Seehusen, 2011).

On the other hand, there was the development of a RD project. The idea behind the initiative is to reduce threats to biodiversity, increase carbon stocks in the agricultural landscape, reverse the process of land degradation in critical ecosystems, promote sustainable productive chains to increase the empowerment of local communities and actors, improve the

competitiveness of family agriculture and improve the implementation of multisector public policies for sustainable rural development.

In this study, three PES schemes were selected for analysis. They were implemented to help solve the problems mentioned in Table 55, in those regions. From these three schemes, two are still active (ICMS Ecológico and PAF), while the FUNBOAS (which consists of a PES scheme based on investments made in 2009/2010) is no longer active. Parallel to it, the RD scheme (Rio Rural) was also analysed in the same areas, since most of the environmental problems faced by the regions have a strict correlation to the development of agricultural / livestock production.

8.2.1. The Payment for Environmental Services (PES) schemes

8.2.1.1. ICMS Ecológico

The Tax on Operations related to the Circulation of Goods and on Services of Interstate and Intermunicipal Transportation and Communication (ICMS in the Portuguese acronym), is a state tax, which constitutes about 90% of the State's tax revenue and one of the primary sources of income for municipalities. In the European context, it could be translated as the "Brazilian state value-added tax".

The Article 158 of the Federal Constitution establishes that 75% of the resources collected by the ICMS remain within the State, while 25% are transferred to the municipalities. From this 25%, three quarters are distributed according to the Federal Constitution, and the remaining quarter is allocated according to the state legislation (BRASIL, 1988).

In the case of Rio de Janeiro State, the law regulating this one quarter was first created in 1996 (Law N° 2,664 / 1996), later amended to the Law N° 5,100 / 2007, and finally complemented by the Decree N° 41,844 / 2009. These legislations establish the ecological criterion (equivalent to 2.5% of the funds collected by ICMS) as one of the six indexes considered for the calculation of the transfer. To qualify, though, the municipality must organise its municipal environmental system, composed at least by an environmental policy enforcement agency, a council and an environment fund, as well as an environmental guard.

Also, the law determines a set of environmental measures, used to qualify the percentage that each municipality is entitled to receive from the total transfer of the ICMS, known as ICMS Ecológico (or Ecological ICMS in English). The transfers are proportional to the goals achieved in five criteria. The better the indicators, the more resources the municipalities receive. The criteria are⁵:

- Sewage treatment (20%)
- Water supply sources (10%)
- Waste disposal (20%)
- Remediation of dumps (5%)
- Nature conservation units (45%)

From the list above, we can note that Nature Conservation Units (NCU) have a considerable weight in the calculation (45%). Among the several options of NCU available, one specific type was prioritised by the Varre Sai municipality to increase the transfer of ICMS Ecológico: The Private Reserve of Natural Heritage (RPPN in the Portuguese acronym). The RPPN is a protected natural area (rural or urban), established in a private area, by the owner's deliberate intention, recorded in perpetuity, with the objective of preserving biological diversity (Article 21 of Law N° 9.985 / 2000).

Although the RPPNs could contribute to increasing the budget of the municipality, there was no guarantee of any return to the owner of it, and few were the benefits for those deciding to set up an RPPN. The municipality that receives the resource, by the law, is not required by the Federal Constitution to reinvest in environmental expenditure. Therefore, it is an indirect incentive for the municipality to apply this resource to environmental conservation since it can increase the transfer of funds.

To change this scenario, the Varre Sai City Hall, supported by the RPPN Owners Association of Rio de Janeiro (APN in the Portuguese acronym) approved the Law N° 570 / 2010, which allowed the recognition of RPPNs at the municipal level, and the Law N° 572 / 2010, which

⁵ All the details about the criteria, and the calculations can be found in the document <http://www.icmsecologico.org.br/site/images/legislacao/leg031.pdf> (in Portuguese).

determined the transfer of up to 60%⁶ of the ICMS Ecológico to owners of private reserves. The approval of the law, together with the incentive program for the RPPNs of the Atlantic Forest (which began to operate in 2009) sponsored by the NGOs SOS Mata Atlântica and Conservation International, resulted in a significant number of RPPNs in Varre Sai.

To transfer the resources to the owners, the City Hall has signed a cooperation agreement with the APN, which receives the amount in a private bank account and distributes it to the owners, according to the area of each RPPN. The transfer happens twice a year and the APN is responsible for submitting the accountability to the City Hall. The following transfer is always subject to the approval of the accountability of the previous transfer. The municipal laws do not mention how the owners shall spend the resources received through the ICMS Ecológico. However, it is their responsibility to keep the RPPN in excellent condition. Figure 12 below illustrates the ICMS Ecológico mechanism.

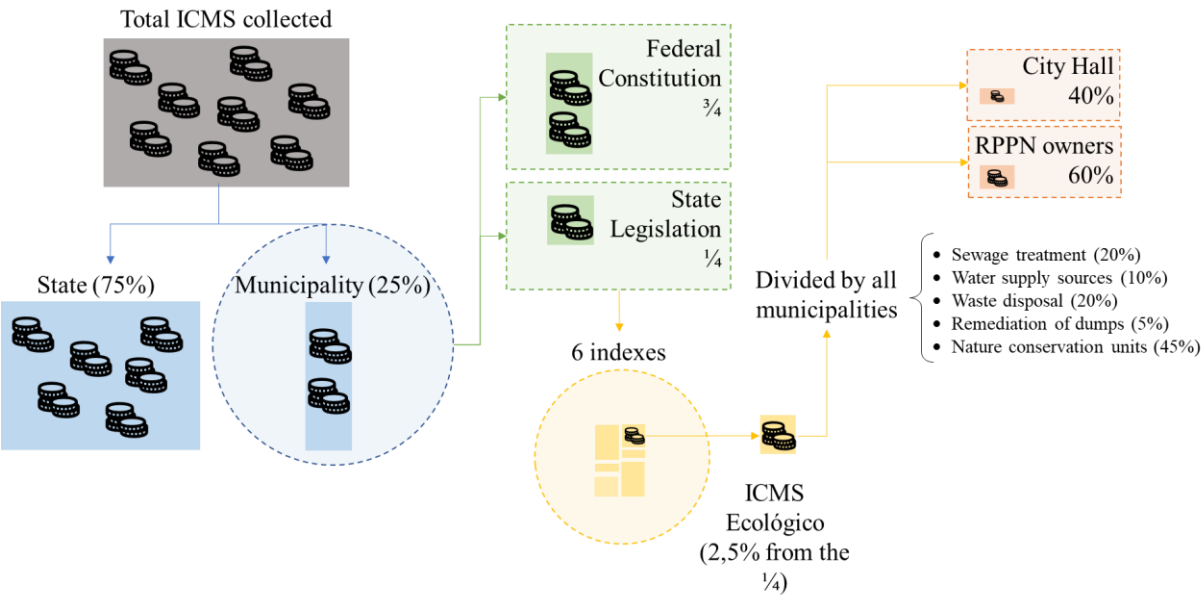


Figure 12 - Flow of resources within the ICMS Ecológico scheme. Source: author's own elaboration

⁶ The Law N° 572 / 2010 is currently under revision, and one of the proposed items is to change the term "transfer of up to 60% of the funds to the owners" to "transfer of 60% of the funds to the owners", to avoid the reversal of any right already acquired.

8.2.1.2. PAF

The Water and Forest Producer (PAF in the Portuguese acronym) originated in 2007 when The Nature Conservancy (TNC) started the first moves to create a PES scheme in the State of Rio de Janeiro. The TNC and the State agencies were looking for a region where the provision of different services could be integrated, and both forest and water resources could be protected. While the watershed is the best unit for water management, a biodiversity corridor would be the best territory to plan large-scale conservation measures.

After some studies, they found an area containing all the desired characteristics: the intersection between the Guandu River Watershed and the Tinguá – Bocaina Ecologic Corridor, located in the municipality of Rio Claro. The financing of the project happens with resources collected by the charge for the use of water in the Guandu watershed. The primary objective is to encourage, through financial compensation, rural producers and land managers to protect and recovery water sources and forests, helping to protect threatened ecosystem services (Ruiz, 2015).

The project was structured in 2009, supported by the Law N° 5,234 / 2008 which determines that 90% of the resources collected by water-use charges has to be reinvested in the watershed that raises the fund. The Resolution N° 42 / 2009, regulated the application of the financial resources (90% as mentioned) collected through the Guandu River Watershed Committee account (CBH Guandu, in the Portuguese acronym), within the State Fund for Water Resources (FUNDRHI in the Portuguese acronym), to a PES scheme. These resources were later ratified by the State Council of Water Resources in the Resolution N° 43 / 2010, guaranteeing its applicability to the PAF.

Once the resource was already regulated, the Rio Claro City Hall published the Municipal Law N° 514 / 2010, officially creating the PAF. In 2011, this law was regulated and had other measures added through the Decree N°. 931 / 2011.

A working group, known as the Project Management Unit (UGP in the Portuguese acronym), was formed between members of the State Environmental Secretariat, the State Environmental Institute (INEA in the Portuguese acronym), the CBH Guandu, the Rio Claro City Hall, TNC and the Earth Institute for Environmental Preservation (ITPA in the

Portuguese acronym). The UGP enables the implementation and shared management of this project between public agencies, deliberative body and organised civil society (Ruiz, 2015).

The PAF project is intended for owners, holders of rural properties or responsible for the use and management of the soil in the headwaters of the contributing basins of the Guandu River Watershed. The following cases can submit proposals: a) Individual entities owning rural properties, proven their legal relationship with the property; b) Non-profit legal entities of traditional communities (quilombolas, natives and others); and c) Municipalities that have approved legislation on PES, representing rural landowners (Filho et al., 2012).

The call for proposals takes place through a public call issued by the municipality, following a resource transfer contract signed between the Pro-Water Management Association of the Paraíba do Sul River Watershed (AGEVAP in the Portuguese acronym) and the City Hall. The criteria used to choose the participating owners are (Filho et al., 2012):

- a) conservation or restoration intentions;
- b) quantity of priority areas for water production within the property;
- c) conservation status of forest fragments located within the property; and
- d) location in the project's area of coverage.

Priority will be given to proposals submitted by a family farmer or rural family entrepreneur. To join the project, the proponents must submit a proposal describing the actions and goals of forest conservation and restoration for the contracted property. The minimum condition for joining the project is to make available for restoration at least 25% of the priority areas (riverbanks, springs and moisture interceptor areas) without vegetation (when joining the scheme). The ranking of proposals only occurs in case of resource constraints in relation to the demand for proposals.

The amounts destined for the PAF project are determined by the CBH Guandu, through the resolutions that deal with its budget and the allocation of resources available for investments in spontaneous or induced actions in the watershed. The valuation of the ecosystem service provided, though, is based on the area (in hectares) contracted and on the proposed restoration

percentage, whose calculation uses the local opportunity cost (R\$ per ha/year) as a base, associated to four parameters⁷:

- a) conservation and restoration areas (ha);
- b) priority level to produce water (riverbanks, springs and moisture interceptor areas);
- c) successional stage of conservation remnants (advanced, medium or initial); and
- d) proximity or inclusion in Conservation Units (CUs).

The conservation goals are determined through the identification of areas of interest. This action is usually performed in conjunction with the owners during the allocation of potential areas on field visits by the ITPA. After the execution of the contract, areas allocated for conservation of forest remnants and restoration are isolated. The project negotiates restoration techniques such as total planting, regeneration, enrichment or agroforestry systems, with the owners. That is the work plan.

The contract signed with the rural producer establishes treaties and takes care of the actions to be developed in compliance with the work plan, with technical and financial assistance of the partners of the project (ITPA) for its achievement (Ruiz, 2015).

The payments are conditional on the evaluation of the activities carried out on their properties to meet the contracted goals. This process, carried out by the AGEVAP, takes place through the analysis of periodic reports and field survey to check the general condition and the care with the implemented actions. If the farmer meets the goals, the payments happen through three routes: a) direct contracting through the AGEVAP; b) through the City Hall, or c) through a non-governmental organisation. Although all these paths are possible, in Rio Claro only the second option was implemented (Filho et al., 2012).

It is worth to mention that the transfer of the resource between the Rio Claro City Hall and the rural land managers (the model currently adopted by the PAF) is only possible due to the existence of a Municipal Law. It creates the necessary legal framework at the municipal level, which allows both the transfer of resources and exemption of taxes.

⁷ The criteria and values for each condition are available on page 279 of Filho et al. (2012).

8.2.1.3. FUNBOAS

The Fund for Good Socio-Environmental Practices in micro-watersheds (FUNBOAS in the Portuguese acronym) is an incentive mechanism for those who directly or indirectly conserve natural resources and more specifically water bodies. Its primary goals are to improve the environmental conditions of the watershed, the community and its properties, and to awaken the commitment of rural producers, managers and other social actors with conservation and sustainability policies.

The FUNBOAS, was created through the Resolution N° 13 / 2007 and regulated by Resolution N° 23 / 2009 and N° 38 / 2011 of the Lagos São João Watershed Committee⁸. The Permanent Technical Chamber of Micro Watersheds (CTPEM in the Portuguese acronym) is responsible for its management and by the decisions on the resources application within the watershed. The resources come from the water-use-charges in the São João River Basin, which is responsible for 75% of the water supply in the region. Up to 50% of the water-use charges can be directed to the FUNBOAS.

The project was created in line with the State Micro-Watershed Program, using the same selection criteria to prioritise the participants MWSs:

- a) biodiversity;
- b) water supply for human consumption;
- c) community organisation; and
- d) the number of family farmers.

The Committee's view is that properties should not be considered in isolation since it is not the property, but the watershed that produces water. A good project should finance small and medium-sized farmers, for them to become ecologically correct without losing its production capacity and increase their income. The Committee recognises that, although farmers do not own the water (which by the laws is of state or federal domain), their livelihood depends on the management of the landscape in the MWS. Following the mentioned logic, the programme developed two types of investments: the collective and the individual ones.

⁸ The Committee, in turn, was created and regulated by the Federal Law N° 9,433 / 1997, the State Law N° 3,239 / 1999 and the State Decree N° 36,733 / 2004.

Firstly, to order the assistance of the selected beneficiaries within the MWS, the Executive Plan of the Micro Watershed (PEM in the Portuguese acronym) was used to define the priority areas for intervention, combining environmental and social information. This instrument was used to point out the collective projects necessary to the MWS and the resident community.

Later, the project also developed some Individual Development Plans (PDI in the Portuguese acronym), indicating practices and providing information for long-term integral property planning. However, this instrument will not be evaluated in this study due to the limited number of beneficiaries and the impossibility to find them. Besides that, it would be difficult to distinguish the effects of this project from the Rio Rural project, which has a very similar structure. Given these conditions, only the collective projects will be analysed.

Since the areas participating into the project were considered strategic for the conservation of natural resources, especially water resources, the collective project was focused in rural sanitation. It consisted on the installation of septic tanks, grease trap and adequacy of water collection systems. The chosen model⁹ was the one proposed by the Brazilian Agricultural Research Corporation (EMBRAPA in the Portuguese acronym), which allows the use of the final effluent in the fertilization of perennial crops.

8.2.2. The RD scheme - Rio Rural

The project Integrated Management of Agroecosystems in Micro Watersheds, or Rio Rural as it popularly known, was first created in 2006 to meet new patterns of consumption of agricultural products imposed by the markets and society. It was coordinated by the Secretariat of Agriculture and Livestock of the State of Rio de Janeiro (SEAPEC in the Portuguese acronym), through the Superintendence of Sustainable Development (SDS in the Portuguese acronym). and had its focus on the North and Northwest regions of the Rio de Janeiro state.

⁹ For further details about the model developed by EMBRAPA, please access (in Portuguese): <https://www.embrapa.br/gado-de-leite/busca-de-publicacoes/-/publicacao/1004077/como-montar-e-usar-a-fossa-septica-modelo-embrapa-cartilhas-adaptadas-ao-letramento-do-produtor>

This first cycle, financed by the Global Environmental Facility (GEF), took place from 2006 to 2011. In 2010 the Government of the State of Rio de Janeiro negotiated with the International Bank for Reconstruction and Development (BIRD in the Portuguese acronym) a financing to expand the area of coverage and complement the interventions of the first cycle with new strategies to promote the transformation necessary to effectively achieve the sustainable development of the rural population. The Rio Rural BIRD (as the second cycle is known) took place from 2010 to 2016. Finally, an additional fund for the period 2012 to 2018 was negotiated, and the programme was again restructured, scaling up its scope and developing a more structured permanence in the face of the effects of the climatic changes and adaptation force to the global climate change.

The Rio Rural focus on sustainable development, with the primary objective of empowering family farmers, raising awareness about environmental issues and promoting their social and productive inclusion. More than a single intervention, the project promotes a bunch of actions in different spheres, which when put together endorse the desired change. There are three pillars that organise these actions, according to Bassi (2014):

- a) *Support for productivity and competitiveness of family farming*: it aims to support the territorial planning regarding the federal policy of the Ministry of Agrarian Development (MDA) and based on the micro-watershed methodology;
- b) *Institutional Framework*: (i) engagement of local institutions in the discussions and negotiations of priorities for implementation of multisector public policies; (ii) support for the implementation of public policies for the development of the rural sector; (iii) engagement of partnerships and co-funding (public and private sector) as elements of sustainability;
- c) *Project Coordination and Management of Information*: (i) improvement of governance through co-shared management; (ii) use of participatory monitoring approach in all benefited MWSs; (iii) development a marketing system in all spheres of activity and promote the dissemination of the Programme and its results

Together, these actions aim to integrate income generation, increase food security and promote governance strategies with management practices that can deliver more ecosystem services: soil conservation, water protection and carbon sequestration.

One might be asking how the environmental issues integrate the context of this project. The answer is: the Rio Rural provides financial incentives and technical assistance to improve productivity, and in return, farmers agree to implement conservation and restoration projects in part of their lands, contributing to the sustainability of the Atlantic Forest. Some of the practices are spring protection, recovery of riparian vegetation and protection of water recharge areas, sanitation, rural roads rehabilitation, green and organic manure, among other actions with direct impact on natural resources (Bassi, 2014). The practices adopted varies from farmer to farmer, according to its PDI, which will be later detailed.

Since the project is present all over the Rio de Janeiro state, some criteria were established to prioritise the municipalities receiving the investments. These criteria are:

- a) Number of family farmers
- b) Low-income households
- c) Municipal Human Development Index (HDI)
- d) The concentration of rural population (%)
- e) Participation of the agricultural sector in the composition of municipal GDP (%)
- f) Green Quality Index of Municipalities¹⁰ (IQM-Verde in the Portuguese acronym)

Once the municipalities are defined, the micro-watershed methodological approach is applied. It focuses on relevant stakeholders, engaging and empowering rural communities in a democratic, bottom-up decision-making process to identify priorities and to promote sustainable development more efficiently. The main phases are described below:

- a) *Motivation phase*: (i) presentation of the project; (ii) mapping of the MWSs; (iii) the selection process of the MWSs; (iv) community engagement and acceptance;
- b) *Planning phase*: (i) participatory rural diagnosis; (ii) development of the PEM; (iii) draw of beneficiaries; (iv) development of the Individual / Collective Development Plans (PDI /PDC in the Portuguese acronym);
- c) *Implementation phase*: (i) preparation of the executive subproject; (ii) implementation of the subprojects;
- d) *Monitoring phase*: (i) complete monitoring system; (ii) participatory monitoring

During the motivation phase, it is necessary to prioritise MWSs to receive the support. This process goes through another prioritisation procedure. The criteria applied were established based on the social, economic and environmental aspects proposed by Rio Rural. They are:

- a) *Biodiversity*: areas with remnants of native vegetation to be preserved, reducing threats to biodiversity with the implementation of production systems that allow the conservation of natural resources around these fragments;
- b) *Water for Human Supply*: MWSs drained by watercourses that supply the most substantial number of inhabitants;
- c) *Community organisation*: existence of some form of organisation have priority;
- d) *The concentration of family farmers*: small and family farmers are the target group.

It is worth to mention that all the prioritisations happen transparently and openly. Since the project has no resources to meet all the demands, this process is necessary to ensure the participation of the most demanding areas. It also allows the community to access to information and control the investments, avoiding any political interests that may arise.

Another crucial phase to the understanding of Rio Rural is the development of the Individual / Collective Development Plans. It consists of a farm action plan to guide the farmer in the transition of productive systems towards agroecological, biodiversity-friendly and climate-smart agriculture systems. The development of the PDI aims to improve the production processes, through the adoption of good production practices and sustainable management practices, which will at the same time increase productivity, products, environmental adequacy of property and conservation of natural resources. The farmer and the Executor Technicians jointly develop them. The PDIs are unique, since each one of the properties has different characteristics, thus demanding distinct investments.

Another possibility is the Collective Development Plan, which supports the strengthening of community organisations through the sustainable self-management of natural resources. The Rio Rural support the formation of rural associative enterprises based on sustainable businesses, which can access a higher value to invest in activities that are common to a group of farmers. To join a PDC, the participants should also create their PDI, be committed to

¹⁰ The IQM-Verde is a detailed survey of the vegetation cover of the State of Rio de Janeiro, displaying a Land Use Quality Indicator (IQUS in the Portuguese acronym) for the municipalities of Rio de Janeiro. The CIDE / FAPERJ periodically issue it.

sustainable agriculture, environmental conservation and link their production with the collective project. The PDC has the format of a simplified business plan, and the farmers should demonstrate its economic feasibility, the rules of operation and the maintenance of the proposed enterprise.

Finally, it is necessary to mention the role of the COGEM within this process. It consists of a group of at least nine members, comprising all the diversity of actors and representatives of the inhabitants of the upper, middle and lower courses of the main course of the MWS. Each COGEM has a model of internal functioning regulation, defining its attributions and responsibilities, guaranteeing the representativeness of the community. They are appropriately prepared to stimulate the identification and democratic participation of different groups in the search for joint and consensual solutions for local development.

The COGEM (named Pré-COGEM at this moment) assist on the Participatory Rural Diagnosis together with the executing technician, thinking about their optics the development of the MWS. They also play an essential role in the development of the PEM, besides indicating the farmers for participating in the project. It is worth to mention that the rules of indication of the beneficiaries are established in the MWS itself, considering the participation and attendance at meetings, residence in or in a rural settlement near the MWS, and attendance of the requirements for being a Rio Rural beneficiary.

8.3. Methods

To answer the proposed research questions, it was necessary to go beyond of interrogations like "yes or no" and "how many". It was essential to understand "how" and "why" things happened as they did. Qualitative methods can give further confidence we need to understand complex scenarios.

The data collected through desk research and interviews (field and office) provided us with qualitative data to illustrate the theory behind the project, and people's lived experiences. However, it was necessary to organise and explore the data, to describe critical aspects of interest, to compile them, and finally to conclude it.

The context, stakeholders, governance and mechanisms behind each project was exposed through tables, figures and narratives aiming to explain the details of it. Other qualitative descriptive methods were used to help the reader to understand the main aspects of the projects. According to Miles et al., (2014, p. 149) “..it is hard to explain the “hows” and “whys” of something satisfactorily until you understand what that something is”.

To compile the information a Multicriteria Analysis (MCA) was applied. Usually, MCA applies to ex-ante evaluations of public projects. However, some methods can also be used in intermediate or ex-post evaluations of programs, especially the ones within the socio-economic development framework (European Commission, 2013). This technique allows the integration of several criteria to decide about a complicated situation, helping human decision-makers to solve difficulties when consistently dealing with a significant amount of complex information. Besides that, MCA is an open and explicit method, which can be easily audited (Department for Communities and Local Government: London, 2009).

Among several methods based on the MCA concept, the Multicriteria Decision Analysis (MCDA) was chosen for this study. It is both a method and a set of techniques, which aims to ordering options, from the most to the least preferred option. It was first proposed by Keeney & Raiffa (1976). The MCDA fits well into complex problem analysis, due to its possibility of disaggregating the problem into small pieces, facilitating its judgement, and then reassembling these pieces to an overall representation to the decision makers (Department for Communities and Local Government: London, 2009).

There are several computer programs able to assist the technical aspects of MCDA. The one chosen was the HIVIEW Version 3.2.0.9, marketed by Catalyze Ltd. This software can solve complex MCDA problems, by structuring a value tree which can be easily created and edited (Department for Communities and Local Government: London, 2009).

The MCDA model was constructed based on a root node, and then nodes representing trade-offs, nodes representing objectives, and finally the criteria. The root node is the focus for the final decision. All the criteria were processed and the best (and worst) combination of them were identified on the root node. In this study, the root node correspond the impact expected to be achieved through the implementation of one or more schemes, i.e., the sustainability of the ecosystem services being protected and the resilience enhancement of the community receiving the incentives.

The next level of nodes, consist on trade-off parameters facing the decision makers. This study used “benefits” and “costs” as balances. However, it is not one more regular cost-benefit analysis of PES scheme, as criticised by the Ecological Economics researches. It is only a way to include more decision variables in the model. As the main objective of the study is finding the scheme that offers more positive results, the weights attributed to the “costs” and “benefits” were very different¹¹. The objectives nodes, consisted on groups of environmental, social and economic benefits and, on the other hand, monetary and non-monetary costs. Some of the fifteen criteria associated to these objectives were previously chosen, and others were chosen after gaining a better understand of the theory of change proposed by the projects. The information to feed the criteria was partially obtained by desk research and partially by field research. They are further described in the results section.

After establishing the criteria, it was necessary to define their scale. There are several scale possibilities. In this study two types were used: the relative and the fixed scale. In the relative scale input scores are automatically transformed to scales extending from 0 to 100. It works well when the qualitative data can be converted into percentages, for instance. In the fixed scale the user defines what input values are to be associated with values of 0 and 100. It is useful when the criteria are given by qualitative data that cannot be converted into numbers or percentages. Relative and fixed scales can be defined as inverse, which is useful for scoring costs criteria, where the lowest score is preferable. Also, it is possible to define linear value functions, where the scores input for a criterion are normalised across the 0-100 scale proportionally to their values. A list of the scales for each of the criteria is present in Annex I.

Another important component of MCDA are the decision options, which in the study context, are the schemes and combination of schemes whose performance is evaluated regarding each one of the abovementioned criteria. The decision options were elaborated based on the region, and the type (s) of scheme (s) implemented, as shown in Table 6 below.

¹¹ The idea is to identify which scheme offer the most benefits towards the desired impact. As some of the decision options can have very similar benefits, the cost was used as a parameter to assist on the differentiation of these options. The costs analysis also revealed some aspects that should be considered on the decision-making process, even though they were not outcomes.

Table 6 - Decision options for MCDA

Decision options	Description
ICMS	<ul style="list-style-type: none">• PES scheme ICMS Ecológico from Varre Sai region
ICMS + RR	<ul style="list-style-type: none">• PES scheme ICMS Ecológico and RD project Rio Rural from Varre Sai region
RR VSR	<ul style="list-style-type: none">• RD project Rio Rural from Varre Sai region
PAF	<ul style="list-style-type: none">• PES scheme Produtores de Água e Floresta (PAF) from Guandu region
PAF + RR	<ul style="list-style-type: none">• PES scheme Produtores de Água e Floresta (PAF) and RD project Rio Rural from Guandu region
RR GR	<ul style="list-style-type: none">• RD project Rio Rural from Guandu region
FUNBOAS	<ul style="list-style-type: none">• PES scheme FUNBOAS from Lagos region
FUNBOAS + RR	<ul style="list-style-type: none">• PES scheme FUNBOAS and RD project Rio Rural from Lagos region
RR LR	<ul style="list-style-type: none">• RD project Rio Rural from Lagos region

Source: author's own elaboration

The weighting process is how the MCDA compare criteria with different measurement units. Catalyze (2016, p. 21), didactly illustrates it by saying that “*rather than comparing "apples" with "oranges", MCDA compares the value of a change in the number of apples with the value of a change in the number of oranges*”. This process can happen in several ways. The bottom-up approach, where all the criteria are judged by their importance, followed by calibration of the upper nodes, was selected. This process consists in multiplying an option’s score on a criterion by the importance weight of that criterion. After doing that for all the criteria, the overall preference score for that option is given by the sum of those products. This process is made by the software and repeated in different node levels. The weights employed are result from the authors opinion and calibrated by two specialists in PES schemes that are not involved in the projects. The final weights are shown in the Annex I.

After performing the mentioned activities, the model was analysed by using a range of graphs and tools available on HIVIEW. The MCDA software ranked the schemes, but other analysis was done before the final decision. Some of the divergences in the weighting process were tested through a sensitivity analysis, which highlighted areas in the model that influenced the overall preference ordering. After checking the sensitive cases, a final decision was taken.

The main steps involved in this methodology and the preparation phase are described below, in Figure 133.

- 1. Establish the decision context.**
 - 1.1 Establish aims of the MCDA, and identify decision makers and other key players.
 - 1.2 Design the socio-technical system for conducting the MCDA.
 - 1.3 Consider the context of the appraisal.
- 2. Identify the options to be appraised.**
- 3. Identify objectives and criteria.**
 - 3.1 Identify criteria for assessing the consequences of each option.
 - 3.2 Organise the criteria by clustering them under high-level and lower-level objectives in a hierarchy.
- 4. 'Scoring'. Assess the expected performance of each option against the criteria. Then assess the value associated with the consequences of each option for each criterion.**
 - 4.1 Describe the consequences of the options.
 - 4.2 Score the options on the criteria.
 - 4.3 Check the consistency of the scores on each criterion.
- 5. 'Weighting'. Assign weights for each of the criterion to reflect their relative importance to the decision.**
- 6. Combine the weights and scores for each option to derive an overall value.**
 - 6.1 Calculate overall weighted scores at each level in the hierarchy.
 - 6.2 Calculate overall weighted scores.
- 7. Examine the results.**
- 8. Sensitivity analysis.**
 - 8.1 Conduct a sensitivity analysis: do other preferences or weights affect the overall ordering of the options?
 - 8.2 Look at the advantage and disadvantages of selected options, and compare pairs of options.
 - 8.3 Create possible new options that might be better than those originally considered.
 - 8.4 Repeat the above steps until a 'requisite' model is obtained.

Figure 13 - The main steps demanded to apply MCDA. Source: author's own elaboration

Once the best scheme was identified, a range of relevant factors attributed to the success of the best scheme were identified, discussed and exposed in a table, to help answering the second research question.

Finally, observations collected throughout the desk research and field work were compiled with recommendations from the literature, and consolidated in an "opportunity chart", indicating adjustments that could optimise the environmental, social and economic outcomes of the scheme.

8.4. Methodological limitations

The following constraints and gaps in the study should be noted:

- Although the five individuals belonging to each one of the study groups (PES, PES + RD and RD) were randomly chosen, the actual interview could not happen with some of them. It is because some farmers were not at home during the visits, or it was not possible to reach the property due to the roads' condition. In these cases, due to time and fuel constraints, the farmer was replaced by the nearest neighbour belonging to the same group;
- For the FUNBOAS, the desk research has pointed out a wide range of benefits and partnerships established during the project cycle. However, the farmers interviewed affirm not to have received several of these benefits (or claim not to remember having received it). Given this situation, only the collective projects, which were acknowledged by all the farmers, were considered in this study.
- The primary general challenge, however, is to extract the farmers' views on the effects already achieved so far, especially when the project faces problems in the payment of incentives. In these cases, there is a tendency for respondents to focus on missing incentives instead of answering about the benefits already achieved. This challenge was faced when interviewing farmers enrolled in the ICMS Ecológico project, which had its payments blocked since 2015 due to auditing problems in the NGO responsible for the distribution of benefits. In this case, the interviewees were asked to answer the questions, such as the impact of the benefit on their income, considering the period when receiving the benefit. The problem of the non-payment was, however, approached in other questions. The Rio Rural project has also been affected after economic crises faced by the Rio de Janeiro state, which implied in the reduction of the value made available by the State and consequently by the World Bank (shared the values by both Rio de Janeiro State and World Bank). Due to this problem, some of the farmers have not received all the parcels so far, expressing this discontent in the interviews.
- Although the use of a standard group of indicators for each project facilitates comparison across schemes, not all cases had the same level of information available.

- As well as in many others PES schemes, the monitoring information that quantify the ecosystem services (carbon sequestering, water quality information, biodiversity levels and others) were not available for the three regions contemplated in the study.

9. Results

9.1. PES classification

The four schemes evaluated in this study were classified based on the criteria discussed in item **Error! Reference source not found.** of this study to give a broad idea of their mechanism.

Table 77 shows that all the schemes support at least one ecosystem service. Three of the payments do not aim to remunerate for one specific service, but for many of them. The ICMS Ecológico project consists of an NCU, which, if adequately managed, can receive tourists providing landscape services in addition to the other benefits. The PAF, even though provide multiple services, has its focus directed to the watershed services, since the resources to remunerate the providers come from the water-use-charges. The FUNBOAS, within the scope analysed in this study, provides incentives to improve watershed services, more precisely water quality.

When it comes to the funding source, the Rio Rural and the ICMS Ecológico are classified as a public scheme, since the State partially finances the first and the second is a national project¹² financed with resources originated from taxes. The PAF and the FUNBOAS schemes, in turn, do not rely on public budget and were created in a regional scale, obtaining its financial resources from the water-use-charge collect by the grantor, according to the local policies.

Table 7 - A classification of the evaluated PES schemes

Item	Rio Rural ¹³	ICMS Ecológico	PAF	FUNBOAS
Main ecosystem services being provided	Watershed services, biodiversity conservation and carbon offsetting	Watershed services, biodiversity conservation, carbon offsetting and landscape services	Watershed services, biodiversity conservation and carbon offsetting	Watershed services
Funding source	Public scheme	Public scheme	Private scheme	Private scheme
Purpose of the scheme	Use-restricting and asset-building	Use-restricting	Use-restricting	Asset-building
Type of incentive	In-kind	Implementation: In-kind Project cycle: Cash	Implementation: In-kind Project cycle: Cash	In-kind
Criterion of payment	One-time investment	Monitoring of land-use change	Monitoring of land-use change	One-time investment

Source: author's elaboration

Regarding the purpose of the schemes, both ICMS Ecológico and PAF are based on use-restricting practices, since they pay the providers not to access the area, avoiding its conversion to unsustainable practices, and therefore keeping it preserved. The FUNBOAS, in turn, does not establish any restriction of access, obtaining environmental preservation by adopting practices to make them more environmentally friendly. The Rio Rural has incentives for both purposes, protecting springs and riparian areas, but also providing incentives for more sustainable production practices.

The type of incentives provided by the Rio Rural project is in-kind. Even though the land manager receives the resource in cash, the money must be spent with the incentives agreed in the PDI. The ICMS Ecológico and PAF work in the same way. It starts with in-kind incentives, providing material to fence springs and riparian areas, besides seedlings for the

¹² There is a federal law regulating the distribution of the ICMS according to green practices. However, its implementation in the local level depends on the State and Municipal laws.

restoration of deforested areas. Once the area is adequate, the providers receive cash incentives as a reward for keeping the area well-maintained and refunding any costs the farmer may have to ensure the protection and improvement of the area. In the case of FUNBOAS, only in-kind incentives are provided in the form of investments in septic tanks and seedlings for the implementation of agroforestry systems.

Finally, the criterium for payment is based on the monitoring of land-use change for the ICMS Ecológico and PAF, while the Rio Rural and FUNBOAS gives a one-time investment. Even though all schemes (claims to) contemplate environmental indicators, this information is used to assess the project effectiveness when demanded, but not to weight the payment of the incentives.

9.2. Stakeholders identification and institutional framework

There are different stakeholders involved in the three PES schemes and the RD project. The participation of these stakeholders might be, sometimes, restricted to a specific area. The actors who directly participate in the project's activities in the areas where the study took place are described below:

Table 8 - Main stakeholders of the evaluated projects

Group	Rio Rural	ICMS Ecológico	PAF	FUNBOAS
Buyers	BIRD / Rio de Janeiro State	Rio de Janeiro State	CBH Guandu	CBH Lago São João
Intermediaries	SEAPEC-SDS/ EMATER / PESAGRO-RIO / EMBRAPA / INEA / City Halls	Varre Sai City Hall / APN / SOS Mata Atlântica	AGEVAP / Rio Claro City Hall / INEA- FUNDRHI / TNC / ITPA	INEA-FUNDRHI / CTPEM / ETAO / FUNASA / EMATER / EMBRAPA / City

¹³ Even though the Rio Rural project is not a PES scheme, it was also included in this table to make easier the comparison among the structure of the projects.

				Halls of the Lago São João region
Providers	Rural producers indicated by the COGEM within each MWS	Any rural producer that meet the requirements to create an RPPN	Rural producers whose work plan is approved by City Hall and AGEVAP	Rural producers meeting the criteria of the CBH and located in the priority areas for intervention according to the PEM

Source: author's elaboration

9.2.1. Rio Rural

Table 88 shows that the buyers of this current cycle of Rio Rural are the BIRD and the State Government, which share the costs of the project.

There are many intermediaries since the Rio Rural area of operation encompasses the entire Rio de Janeiro State. The SEAPEC, through the SDS, executes and coordinates the project. The Brazilian Company assists the SDS for Technical Assistance and Rural Extension (EMATER in the Portuguese acronym) and the Agricultural Company of the State of Rio de Janeiro (PESAGRO in the Portuguese acronym), which are linked to the SEAPEC. These institutions provide technical assistance for the territorial planning, subprojects structuring, training of technicians, relevant actors and beneficiaries, socioeconomic and participatory monitoring, impact assessment and participatory research.

The EMBRAPA and the INEA are responsible for supporting water and soil monitoring activities. Finally, the City Halls are also involved in several processes, such as the motivation phase, supporting training in environmental education and others. Besides the abovementioned institutions, there is a range of Federal and State agencies that support the project in administrative tasks, capacitation and other activities that do not reach the provider directly but are essential for the well-functioning of the Rio Rural.

The providers of services are the rural producers receiving the incentives to shift their activities towards more sustainable practices. The providers are indicated by the COGEM's

members, which select the farmers based on the criteria described in the item "**Error! Reference source not found.**". The Rio Rural contemplates not all farmers since the project limits the number of MWS within the municipality and the number of farmers within the MWS. This practice aims to distribute the resources available all over the state in a fair way according to the demands.

9.2.2. ICMS Ecológico

Regarding the ICMS Ecológico project, the primary buyer of the ecosystem services is the State Government, which has created the law and is the responsible for transferring the resource to the participating municipalities.

The intermediaries acting in this project are only three, as mentioned in Table 88. The City Hall is responsible for calculating the payment of the farmers and transferring the money for the APN to pay the farmers since, by the law, the City Hall cannot perform this task. The money flow is demonstrated in Figure 144 through a scheme. The City Hall supports the animation phase and organises events to increase environmental awareness and attract more providers. The APN, in turn, is responsible for the payment of the resources to the farmers, for demanding the accountability from the farmers, and for its submission to the City Hall.

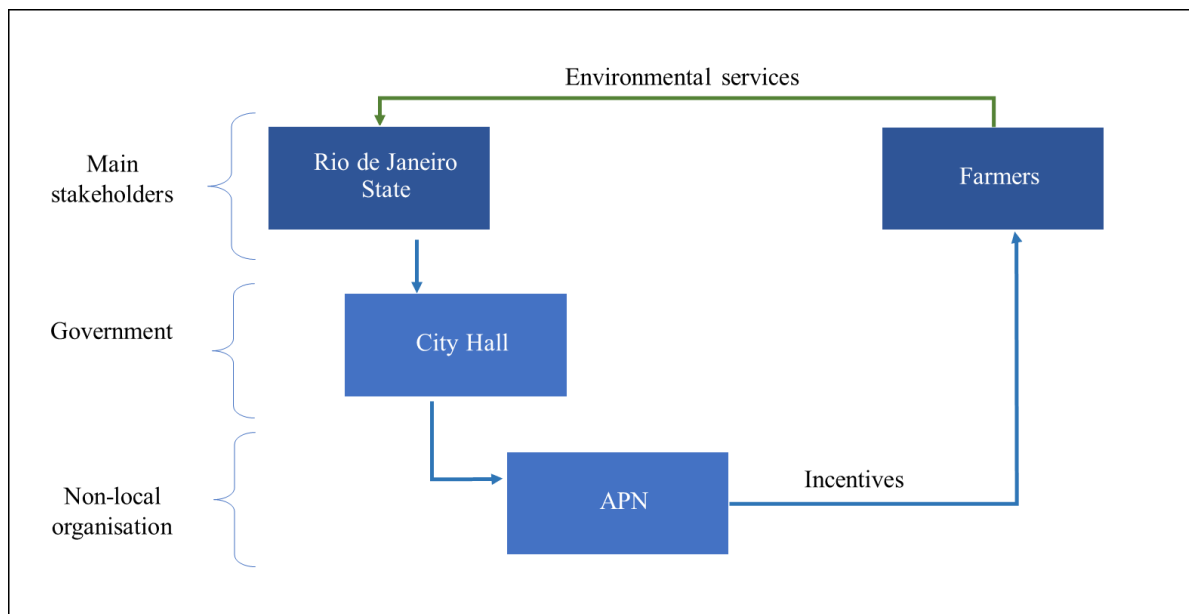


Figure 14- ICMS Ecológico incentives flow. Source: author's elaboration

The SOS Mata Atlântica is an NGO with an active presence in several Brazilian municipalities located in the region first occupied by the Atlantic Forest. They are well-known by Brazilians and helped the project during the animation phase, and by helping with topographical survey and fencing off areas to be protected. The first providers to subscribe in the ICMS Ecológico have got this support from the SOS Mata Atlântica. The City Hall assisted the following ones, and the last ones did it by themselves¹⁴. Nowadays the SOS Mata Atlântica is not participating in the ICMS Ecológico project anymore.

Finally, the providers of the ICMS Ecológico can be any land manager that meet the criteria¹⁵ to create an RPPN within the States that already have laws regulating the transfer of this resource.

¹⁴ Nowadays neither the SOS Mata Atlântica and the City Hall are assisting farmers with topographical survey and fencing of APPs anymore. This process, however, has been done by the farmers anyway, since it is mandatory to obtain the CCIR. The CCIR is indispensable to legalise the transfer, lease, mortgage, dismemberment, remembrance and the sharing of any rural property. It is also essential for the granting of agricultural credit as banks and financial agents require it. This initiative is coordinated by the INCRA and aims to know the land structure and the occupation of the Brazilian rural environment to ensure the planning of public policies. The

¹⁵. It is not the focus of this study to discuss the creation of RPPNs. However, the reader can find more information about it by accessing: <http://www.icmbio.gov.br/portal/criesuareseerva/criacao-de-rppn>

9.2.3. PAF

The buyer of the PAF scheme is the CBH Guandu, responsible for deciding and authorising how the money of the FUNDRHI will be spent (including the values directed to the PAF).

Since the committee is not an institution dedicated only to run the project, the CBH Guandu maintains a management contract with a Delegate Agency (currently AGEVAP), to serve as Executive Secretary and financial instrument for contracting services or products authorised by the plenary of CBH Guandu.

The Rio Claro City Hall receives the money from the AGEVAP in a specific account, and the values to be paid for each farmer. The payment is carried out directly by the local municipality, due to specific legislation, that allows the payment to the rural owners (Figure 155). In this model, the Rio Claro City Hall is also responsible for the monitoring of PSA contracts with the rural land managers and for submitting the accountability back to the AGEVAP.

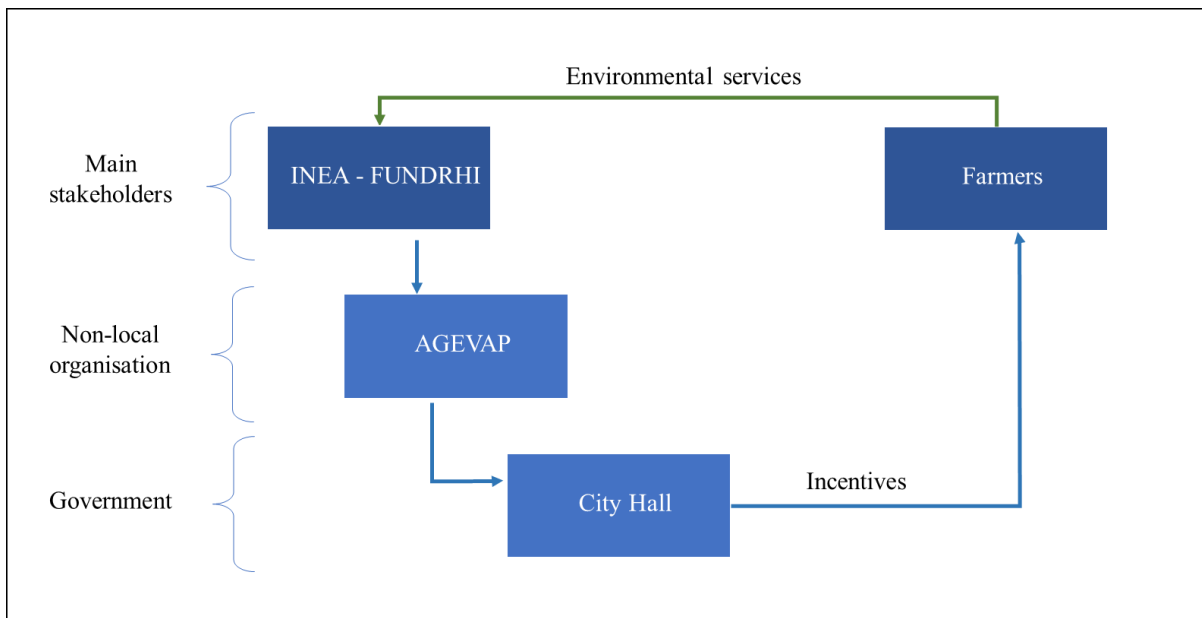


Figure 15 - PAF incentives flow. Source: author's elaboration

The INEA is the institution responsible for the management of the FUNDRHI, the fund receiving the money collected from water-use-charges, even though they do not directly administrate it.

The TNC played an essential role at the beginning of the project by providing technical support and initially financing administration and monitoring costs. Nowadays they are no longer involved in the project. The ITPA was the institution responsible for performing the administration and operation services to the farmers. They were also the representatives of the Executive Secretariat of the project in contracts with rural land managers. Nowadays they are being replaced by another institution.

Lastly, as exposed in Table 88, the providers of services are rural producers whose work plan were approved by the City Hall and AGEVAP.

9.2.4. FUNBOAS

As well as the PAF scheme, the FUNBOAS is financed by CBH (in this case the Lago São João CBH) with resources prevenient from water-use-charges. The CBH Lago São João defines the rules to regulate the project and the value to be transferred.

The CTPEM does the executive coordination of the project. The implementation of project expenditure, in turn, is the responsibility of the Technical Support Office (ETAO in the Portuguese acronym).

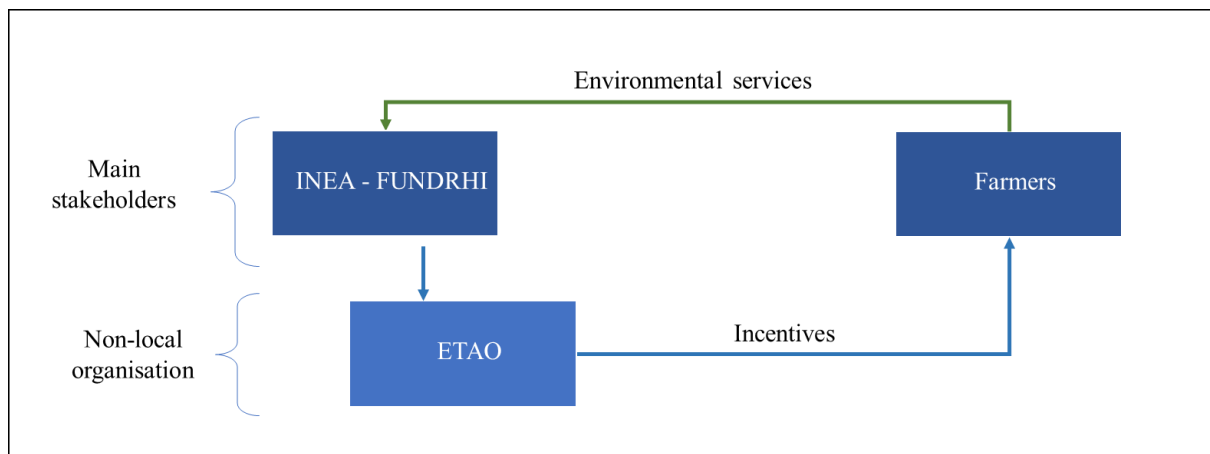


Figure 16 - FUNBOAS incentives flow. Source: author's elaboration

The INEA, as well as in the PAF scheme, is the institution responsible for the management of the FUNDRHI. The National Health Foundation (FUNASA), participated at the beginning of the project by providing sanitation agents for field work, guiding the adequacy of sanitary facilities installed by the project. The septic tanks provided were proposed by EMBRAPA, another partner of the project. The role of City Halls consisted in logistical and operational support on the implementation of facilities, and assistance in identifying the farmers. While the committee participated donating the septic tanks, the City Hall was responsible for the installation of it.

The providers of ecosystem services, in this case, consisted of a limited number of rural producers, due to budget restrictions. The selected farmers were the ones meeting the criteria of the CBH and located in the priority areas for intervention according to the PEM.

9.2.5. Institutional framework

There is a lack of institutional framework integrating the studied schemes. Even though they are implemented in the same region as an integrated package of incentives, their governances and mechanisms operate entirely separated from each other. However, a high level of coordination was observed in some partnerships, even with distinct governances.

First, it is worth to remark that the only institution common to both RD and PES schemes are the City Halls. However, they play different roles in both schemes and are not able to integrate the initiatives.

In the Varre Sai region, the EMATER played an essential role in integrating both schemes. The technicians of the region use to offer also the ICMS Ecológico scheme for the farmers interested in applying for the Rio Rural project. In the Lagos region, the FUNBOAS and the Rio Rural firmed a partnership to build up a nursery to produce seedlings for the individual plans of the FUNBOAS, which were not considered in this study. The schemes of the Guandu Region, however, seems to operate more independently than the other regions, with no signs of a relationship between the PAF and the Rio Rural governances.

9.3. Issues and barriers

Land tenure has always been a big problem to operationalise PES schemes in several countries. This issue, however, does not seem to be a big issue in Brazil, since the country is working to legalise rural properties through the Rural Property Registration Certificate (CCIR in the Portuguese acronym). Three schemes, out of the four contemplated by this study, demand a certain level of land tenure. In the case of ICMS Ecológico, it is necessary to create an RPPN to apply for the benefit, which in turn, demands the CCIR. The official tenure of the land is demanded due to the perpetuity of the NCU. This type of scheme cannot take place in areas under lease agreements, for instance.

The PAF scheme requires only the demonstration of ownership the of rural property whose area is the subject of the program. Ruiz (2015) clarifies that it does not need to be through the CCIR, but rather by:

- a) Up-to-date certificate issued by the competent Real Estate Registry Office, or supporting documents of the domicile situation, such as purchase and sale receipts (formalized in a notary's office); proof of payment of Territorial Tax (ITR or IPTU), rental or lease agreements (provided they contemplate the term of the ecosystem service proposal), etc.
- b) Document of proof of possession, including possession of property in an area expropriated by the Public Entity, with proof by means of a "temporary impoundment of imprisonment", mandatorily granted by a judge; donation not yet completed, but that has a donation law published in Official Gazette; copy of the contract of free use,

irreversible and irrevocable use, for a minimum period of twenty years, counted from the date of signature of the contract, and updated certificate of real estate registration demonstrating the assignment of use, and others.

Table 9 - Issues and barriers of the evaluated schemes

Issues	Detailing	Rio Rural	ICMS Ecológico	PAF	FUNBOAS
Legal issues	Demand land tenure	Yes, informally	Yes, formally	Yes, informally	-
	Interfere in customary use rights	Yes	Yes	Yes	-
	Incompatible with areas protected by law	-	-	-	-
Political issues	The existence of political stability	Yes	Yes	Yes	Yes
	Demand supporting laws	Yes	Yes	Yes	Yes
Social issues	Demand community engagement	Yes	-	-	Yes

Source: author's elaboration

The Rio Rural also demands proof of authorisation for land use, since the incentives will be applied to the land. Since this project focuses on small farmers and family farming, which are considered the stakeholders with the highest probability of not having clear land tenure, any of the proofs abovementioned by PAF are also accepted in this case. Owners, renters, partners, settled and commodore can apply for the resource if their contract has a period that varies from three to five years (according to the incentive to be received).

The FUNBOAS scheme, in turn, did not require any proof of land tenure. Most of the farmers that have received the incentives were settled, and since the project had a partnership arrangement with the National Institute for Colonization and Agrarian Reform (INCRA in the Portuguese acronym), it was not a problem. Also, the project was focused on collective actions directed at rural sanitation, which do not demand a legal land tenure.

Regarding the project's interference in customary use rights, both Rio Rural and PAF partially restrict the access to the protected areas (springs, riparian areas and others) to avoid the access of livestock, prevent wood exploration, and allow the restoration or conservation of the area. This restriction is endless according to the rules of Rio Rural, even though there is no legal mechanism to ensure this perpetuity. The PAF restricts the access to the protected area during the period of the project, conditioning the payment of the benefit to compliance with the rule, even though the area can be accessed with the approval of a management plan. In the case of the ICMS Ecológico, the area consists in an RPPN, which by the law cannot be reconverted into a productive area in its endlessness, demanding no additional regulation by the PES scheme. Management plans can also allow low impact activities in the RPPN, such as tourism. The FUNBOAS has no restriction of access.

When it comes to incompatibility with areas protected by the law, all the schemes have no restriction. As mentioned before, the ICMS Ecológico is a scheme to reward farmers that decide to convert their areas in RPPN, which is an NCU protected by law in its perpetuity. The Rio Rural and PAF provide incentives for the farmers to protect zones that often fall into the Areas of Permanente Protection (APP in the Portuguese acronym), which are secured by the law, but in practice are not respected by some land managers. The FUNBOAS scheme, in turn, was implemented in rural properties next to the houses where families were living, and productive areas. These types of land-use usually do not fall into a protected area; however, due to its environmentally friendly aspects, it would not be a problem to implement the project in areas secured by law.

Political stability is a pre-condition for implementing all the analysed projects. There are several government agencies, including the City Halls, that actively participate in the schemes and are essential to their well-functioning. Without the laws and decrees, it would not be possible to implement any of the schemes. These instruments are necessary to regulate the

project, the conditions in which it works, the role of the actors, the values to be transferred, and other essential processes for the correct functioning of the mechanism behind the scheme.

Among the projects considered by this study, the Rio Rural and FUNBOAS are based on the Micro Watershed methodology to define their work unit. This procedure seeks community self-management through sustainable management practices, and that is why they demand a certain level of community organisation. It does not mean, however, the necessary existence of local organisations to join the project. The Rio Rural scheme, besides demanding such organisation aim to qualify potential multipliers trained concerning the criteria and procedures adopted, besides strengthening the process of community engagement. On the other hand, the ICMS Ecológico and PAF do not consider this criterium when selecting potential providers. The contracts are signed individually, and the schemes have no specific actions aiming to reinforce community ties.

9.4. MCDA

After analysing the stakeholders involved in each one of the schemes, the governance process, the issues and barriers associated to the projects, and a general idea about the mechanisms behind the initiatives, it is possible to proceed to the next phase of the study: the MCDA.

The decision tree with all the criteria and nodes levels considered in the analysis are shown below in Figure 177. The model aims to find out the scheme that provides more favourable conditions to reach the sustainability of the ecosystem services protected and the resilience enhancement of the community participating in the projects. Two prominent groups were created in a trade-off arrangement: the benefits and costs. After evaluating the importance of each criterion for the achievement of the mentioned impact, the software's result was calibrated, indicating 27% of the model's weight for the costs, and 73% for the benefits. As mentioned, the unbalanced distribution was intentional, since the objective of this work is to focus on the positive aspects created by the projects. The adverse features, however, could not be neglected.

Following the theoretical framework, five classes of objectives were established, and the criteria belonging to each one of them were decided after the desk research phase. It is worth

to recall that several outcomes and parameters could be considered as criteria. However, the focus was given to the ones meeting the “ROARS” requirements, which are: Relevant, Objective, Available, Realistic and Specific.

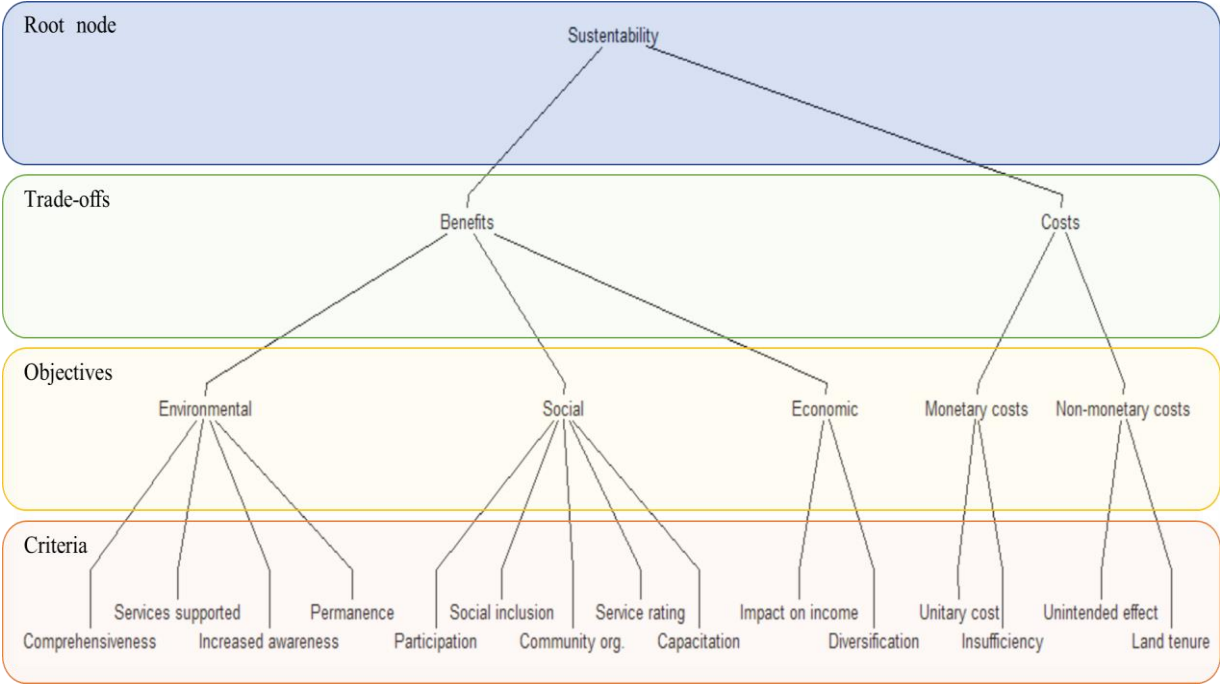


Figure 17 - MCDA decision tree. Source: author's elaboration

A brief description of the criteria, as well as the origin of the data feeding it, are given in Table 10 below:

Table 10- Description of the MCDA criteria. Source: author's elaboration.

Criteria	Description	Criteria's origin
Comprehensiveness	Type of sustainable practice covered by the project and its importance to produce ecosystem services	Desk research
Services supported	Number of (or group of) ecosystem services supported by the project	Desk research

Increased awareness	% of farmers that reported an increase in the environmental awareness obtained through the projects' initiatives (lectures/events) or by information provided by the projects' technicians	Field research
Permanence	% of farmers that intend to maintain the sustainable practices implemented by the projects after the end of it	Field research
Participation	% of farmers that reported active participation in the definition of projects	Field research
Social inclusion	Presence or absence of criteria to prioritise the selection of less favoured groups	Desk research
Community organisation	Presence or absence of incentives to create and strengthen community organisations	Desk research
Service rating	% of satisfaction regarding the services provided by the projects (accorded incentives and activities). It is calculated by the weighted average of the completely satisfied, partially satisfied and not satisfied levels	Field research
Capacitation	% of farmers that reported capacitation to make the best out of the incentives provided by the projects	Field research
Impact on income	% of farmers that reported income increase or income stabilisation due to the incentives provided by the project	Field research
Diversification	% of farmers that reported diversification of income sources due to the incentives provided by the projects	Field research
Unitary cost (R\$/ha/year)	The cost of the project, expressed by R\$/ha/year. Calculated through the division: the total amount of money demanded by the project / total area assisted	Desk research
Insufficiency	% of farmers that reported to have spent their own money to operationalise the activities in their properties	Field research
Unintended effects	% of farmers that reported unintended effects after the projects' activities	Field research
Land tenure	Demand for different types of land tenure	Desk research

After computing the scores and weights mentioned in Annex I, the general results of the model are observed in Figure 18 below. The green bars (benefits) represents a significant portion of the composition of the final result, which is expected since its weight is way higher than the costs. The graph shows that the PAF + RR scheme obtained the highest score (82), while the FUNBOAS scheme got the lowest one (27). In general, we can affirm that for all the regions evaluated, the integrated approach obtained good scores, followed by the stand-

alone RD scheme and then the stand-alone PES scheme. In the Lagos region, the PES scheme got a deficient grade, impacting the score of the integrated scheme in that region.

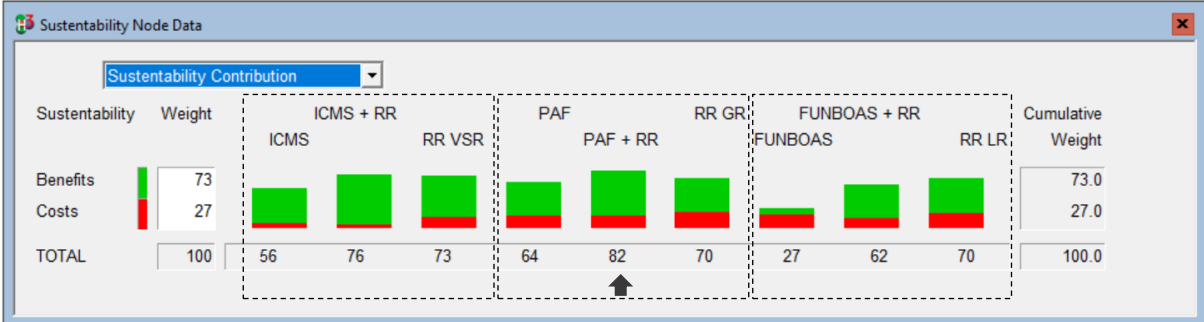


Figure 18 - Contribution of benefits and costs for the final scores. Source: edited from HIVIEW software, model elaborated by the author.

To better understand the results, it is useful to divide them into benefits and costs. Figure 19 displays the scores obtained only for the benefits’ criteria. In this graph, they are consolidated in objectives (environmental, social and economic). It is interesting to notice that the ICMS + RR has a higher score (97) than the PAF + RR (88) when analysing only the benefits.

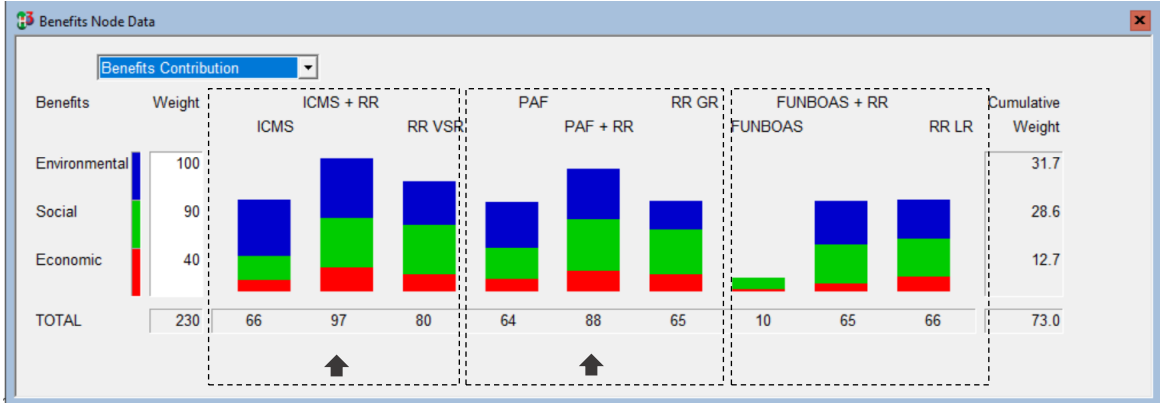


Figure 19 - Benefits contribution scores. Source: edited from HIVIEW software, model elaborated by the author.

The contribution of each criterion to build up the benefit node is demonstrated in Figure 20. It is possible to notice that both schemes scored for all the principles, however some differences in criteria with high cumulative weight were responsible for the better performance of the “ICMS + RR” scheme.

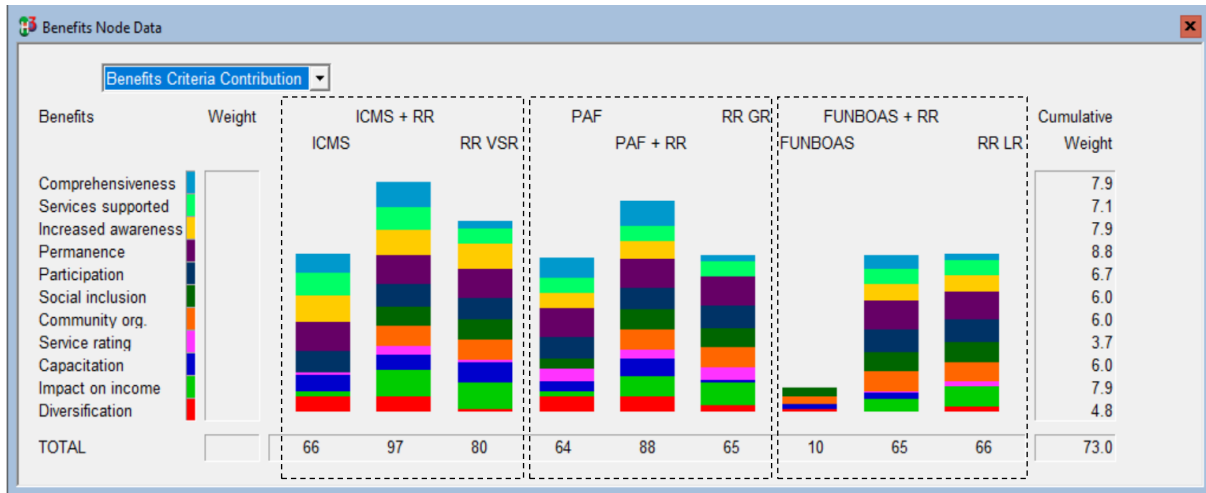


Figure 20 - Benefits criteria contribution scores. Source: edited from HIVIEW software, model elaborated by the author.

The difference lays on three criteria: services supported, increased awareness and impact on income. Figure 21 displays the weight of each criterion, the differences between the actual score, and the weighted difference. The green bars mean that ICMS + RR scored higher than the PAF + RR. Since the RD scheme works similarly for both schemes, we will focus on the analysis of the PES scheme. The difference is because the ICMS + RR scheme supports landscape services, besides all the others that are also supported by the PAF + RR. When creating an RPPN (pre-condition to join the scheme) the owner has the possibility of cooperation and financing with several public and private entities to assist in the management of the area and carrying out leisure, education or research activities. Also, the scheme from the Varre Sai region had a higher score regarding "Increased awareness", and the combination of two factors can explain it. The region has been supported for a long time by the NGO SOS Mata Atlântica, which develops environmental education projects and closely monitors forest conservation. The Guandu region, where the PAF + RR scheme is located, was supported by the ITPA, which performed excellent work on the implementation of the PAF scheme but does not have the same organisational capacity and influence as the SOS Mata Atlântica. Finally, the impact on income was more significant in the ICMS + RR scheme due to the better price paid by the project to its beneficiaries, which represents a substantial parcel on the total income for several of the interviewed land owners/managers.

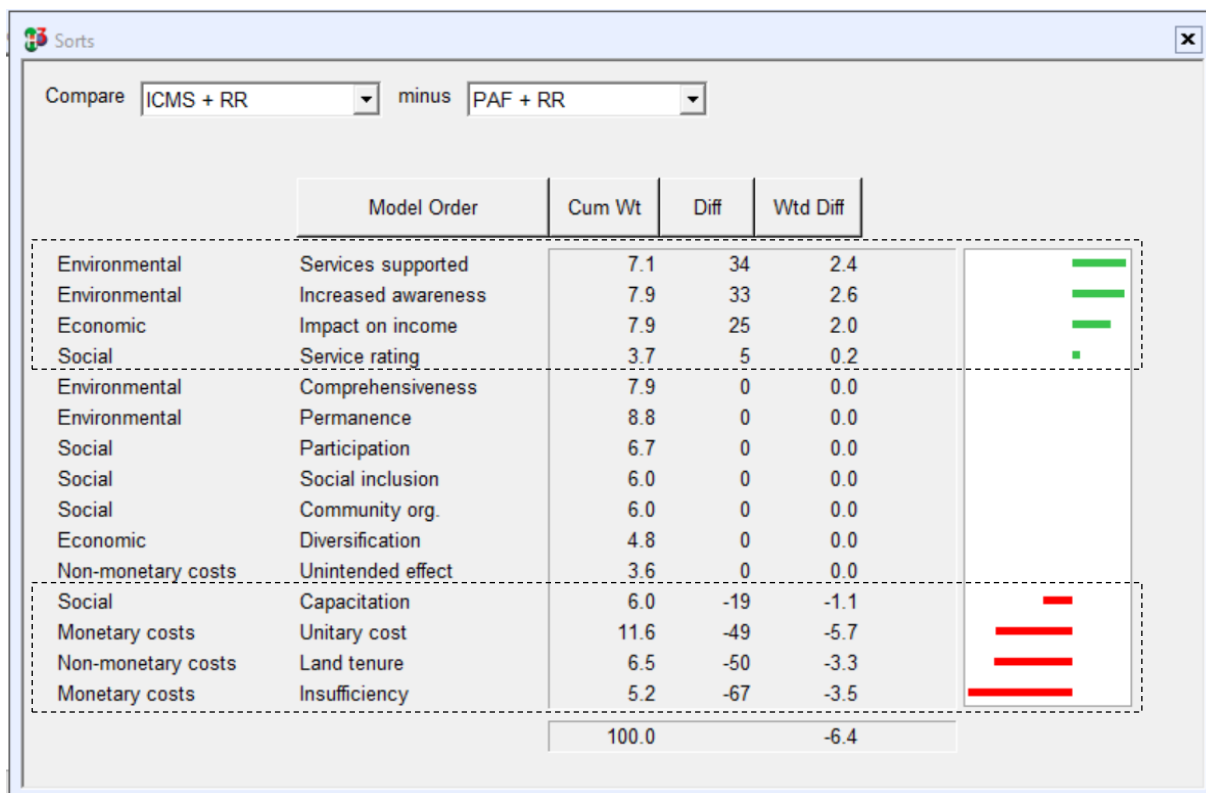


Figure 21 - Categories comparing the ICMS + RR and the PAF + RR schemes. Source: edited from HIVIEW software, model elaborated by the author.

One might be thinking why the ICMS + RR scheme is not the number one in the software ranking since its benefits are more significant than all the other ones. The answer is shown in Figure 22. When it comes to the costs, the contribution of the ICMS + RR to the final result is the lowest one. Figure 23 shows us that the reason for that is the highest cost of the integrated scheme (R\$323.6/ha/year) among all options, which is incorporated by the unitary cost criterion. Besides that, the ICMS Ecológico scheme is the only one that requires customary land tenure of the property, implying in other monetary costs to the farmer willing to apply.

Comparing both schemes back in Figure 21, we can notice that the PAF + RR got better scores when it comes to unitary cost, land tenure and insufficiency. The last criterion means that fewer people participating in the scheme from the Guandu region reported having spent their own money to operationalise the proposed activities.

Notice that even though the RR GR got a high score in costs, the benefits were not high enough to keep this project in the top positions of the ranking.

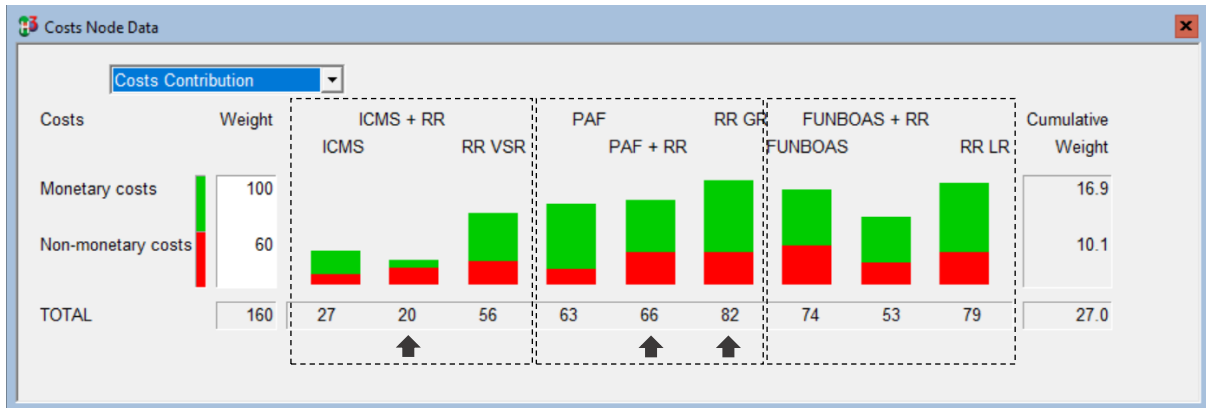


Figure 22 - Costs contribution scores. Source: edited from HIVIEW software, model elaborated by the author.

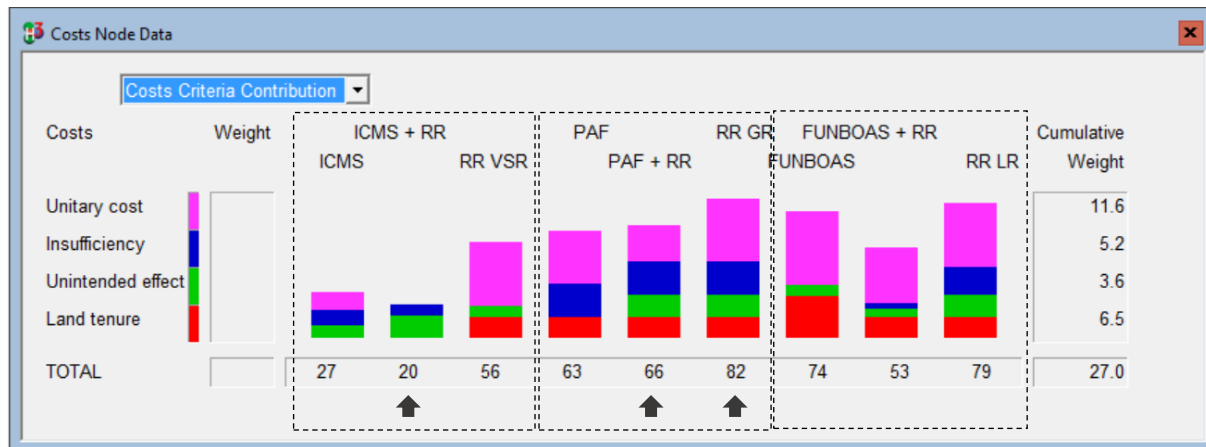


Figure 23 - Costs criteria contribution scores. Source: edited from HIVIEW software, model elaborated by the author.

Another perspective of the overall result can be obtained by observing the Costs vs Benefits Map shown in Figure 24. Again, the ICMS + RR scheme appears on the top of the benefits axis, but with a bad position on the costs axis. The PAF + RR, on the other hand, is well positioned in both axes, being considered the best scheme among the nine examples evaluated in this study. It is worth to have a look at the Rio Rural scheme in the Guandu and Lagos regions (RR GR and RR LR). Both schemes scored precisely 70 points; however the criteria's contribution in each case is different. Looking back in Figure 20 we can notice the criterion "increased awareness" did not score in the RR GR scheme, while the "capacitation" did not score in the RR LR scheme. From this example, we can state that similar projects can generate distinct outcomes, which are influenced by other factors such as the political context, the level of governance, the location where the scheme takes place, and several other factors.

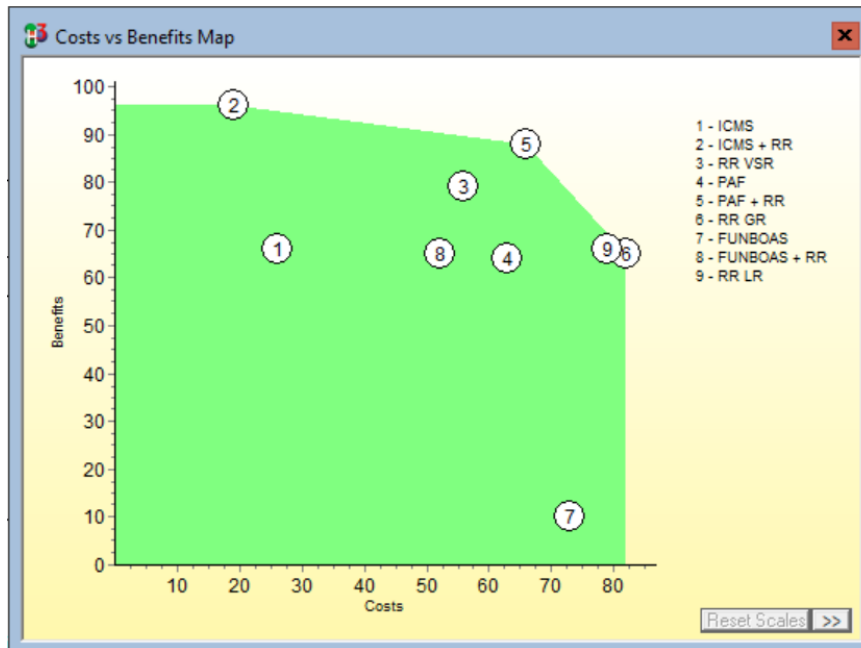


Figure 24 - Costs and benefits map. Source: HIVIEW software, model elaborated by the author.

Although the MCDA exists to help decision-makers develop coherent preferences, some doubts may arise when creating the model. In this study, the major doubt was related to the weights of the benefits and costs nodes and some specific criteria. The literature does not provide any parameter to quantify the importance of these items when creating a PES / RD scheme that aims to promote the ecosystem services' and providers' resilience enhancement. That is why a sensitivity analysis was performed to check the consistency of the model.

First, the so-called sensitivity down analysis was performed by the software. Instead of manually change weights of criteria to test for sensitivity, the sensitivity down function calculates which criteria weights are sensitive. The results are shown in Figure 25. A criterion with red bar means the weight is very sensitive, while a yellow bar is less sensitive, and a green bar would require a substantial weight change to change the most preferred option. For instance, if the "services supported" increases its cumulative weight in 5~15 points, the ICMS + RR would be the most preferred option rather than the PAF + RR. However, this is not feasible, since the number of services supported is not the most critical criterion in this study. The green bars would require more than 15 points in the cumulative weight to shift the results towards the scheme of the right column, which is also infeasible. This checking, therefore, indicates a very consistent model, as well as the choice for the most preferred option.

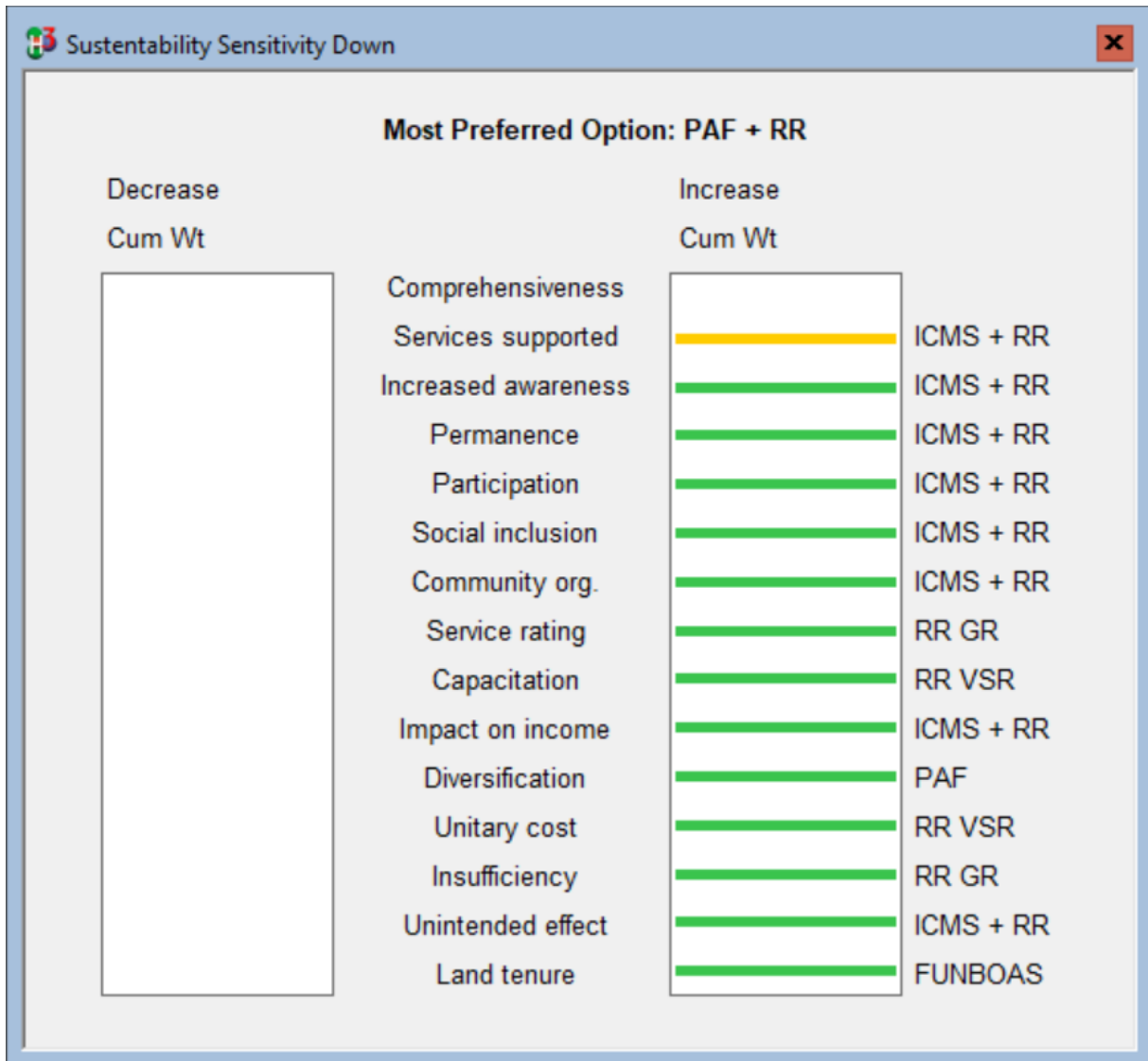


Figure 25 - Sensitivity down analysis. Source: HIVIEW software, model elaborated by the author.

Second, the weights of the trade-offs (benefits and costs) were analysed by simulating an equalisation. It means that instead of 73% and 27% respectively, we analysed the results considering their weights at 50% and 50%. Figure 26 simulates the overall score of each scheme from weights that goes from 0% to 100% for the benefits node. As we would like to simulate the result considering 50% weight for each benefit and costs, a red ticker bar was inserted on the appropriate scale to point out the new overall score. Even though the overall score is a bit lower in this new simulation, the PAF + RR scheme is still the best option.

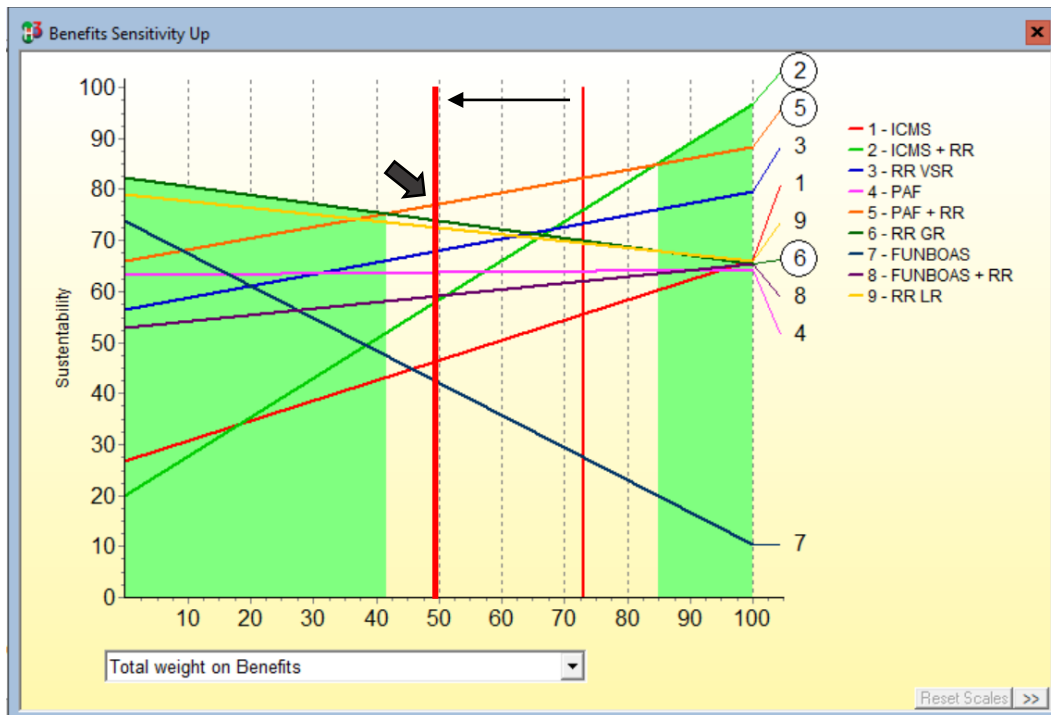


Figure 26 - Benefits sensitivity up analysis.Source: edited from HIVIEW software, model elaborated by the author.

Since the PAF + RR scheme was indicated as the best scheme to reach the desired impacts, let's analyse how it is ensuring the sustainability of the environmental resources and promoting the change towards a more resilient community.

The integrated scheme has a broader comprehensiveness compared to single schemes. The PAF project acts on the restoration and conversation of forested areas, which usually are located in areas of permanent protection. The Rio Rural project though promotes improved land practices in production areas (usually occupied by agriculture). The combination of these two schemes allows greater comprehensiveness of sustainable practices.

When it comes to services supported, both schemes focus on watershed services, biodiversity conversation and carbon sequestering. The advantage of the integrated approach is that the quantity of services being produced increases when a larger area is preserved. An opportunity could be inserting incentives for landscape services. There are several green areas supported by the PAF nearby the Rio Claro city, and it could serve as a leisure area for the inhabitants, or even a local for environmental education. The multi-services support provided by the PAF indicates a new approach for PES schemes, which are no longer specialised as stated by Carpenter et al., (2009).

Increasing environmental awareness is an essential point to promote resilience enhancement and ensure a harmonious coexistence with the environment. Even though the PAF + RR scheme had a regular score in this regard, most of the interviewees reported the ITPA played an essential role in promoting events and explaining the importance of environmental preservation.

One of the most important criterion is the “permanence”. It measures the willingness of the farmers to keep preserving the protected areas and developing the sustainable activities proposed by the Rio Rural in a long-term. 100% of the farmers confirmed the intention to continue this process. Some of the farmers want to register other areas to the PAF scheme, while others give continuous maintenance on the fences and equipment provided by the Rio Rural project.

The participation of the farmers when deciding the terms of the project was essential to create a sustainable environment. This criterion has shown a close relationship with the criterion of permanence, i.e., when farmers were involved in the definition of the activities, the probability of its maintenance is way higher. All the interviewed farmers of the Guandu Region reported an active contribution in this process. This result confirms the findings of Wunder (2007), which affirms that the participatory process has a great chance to improve governance at community-level and be sustainable.

Regarding social inclusion, the PAF + RR scheme is firmly committed to it. The PAF scheme gives priority to proposals submitted by a family farmer or rural family entrepreneur, as well as the Rio Rural project which still includes other conditions such as priority for low-income farmers and municipal HDI in its prioritisation criteria. Both schemes are also available for indigenous people, quilombolas and landless settlements. As well as mentioned by Brown et al. (2007) the government's support was essential to become the social inclusion feasible.

Although the Rio Rural project contemplates some benefits such as the "laying hen kit", which are highly demanded by the women households, few are the concrete examples of investments directed explicitly to rural women. On the other hand, young farmers had most of their interests met by the Rio Rural, such as tractors, milk storage tank, and others. It has been contributing to fixing the rural population to their lands, whereas investing in sustainable practices for the ones that represent the future of the agricultural production.

The merit for the community organisation, which is essential to ensure the continuity of the activities after the end of the project, entirely belongs to the Rio Rural project. The Rio Rural provides all the necessary support to ensure the functioning of the COGEM and the leadership development of its members. This action aims to build up resilient communities with leaders that will assist in the continuous development of the region.

The perception of the farmers about the projects is also relevant for the final result. If they do not trust the mechanism, it is likely that they will not keep it. Most of the farmers said they have received the agreed benefits and affirm to be satisfied with the project in general. The success of this criterion worth a remark regarding the institutions supporting the projects at the operational level, like the EMATER. If the potential participants do not trust or do not know the projects' facilitators, probably they will not agree on enrolling in the scheme.

Learning from experiences and capacitation can build resilience by increasing personal and group capacity to cope with life challenges (Hegney et al., 2008). More than providing new incentives, the projects must teach how the farmers can make the best use out of it. The PAF + RR scheme did it well. A significant parcel of the farmers reported having received sufficient information and instructions to manage the incentives from the Rio Rural project. Also, they are aware of their rights and duties regarding the preservation areas of the PAF schemes. Like in the other schemes, the demand for assistance increased in proportion to the growth in farmers' knowledge. This process needs to be continuous to ensure the effectivity of the scheme in the long-term.

Regarding the impact on income, the PAF + RR scheme was not the first in the ranking but still got a suitable placement. Some farmers reported the value paid by the PAF scheme is not a significant part of the income, but it keeps them motivated to keep preserving the forests and rivers. The Rio Rural, however, promoted a significant change concerning income and created opportunities to stabilise it. It is a real proof that it is possible to generate income whereas protecting the ecosystem services, as suggested by Rosa et al. (2004).

Finally, the resilience is also boosted by the existence of a diverse economy, so that economic cycles in different sectors can compensate for one another. The PAF + RR project had an enormous impact in this regard, since the cash payments of the PES scheme constituted a new source of income for all farmers, as mentioned by Engel et al. (2008) even though the value is not very significant for most of them. The Rio Rural, on the other hand, has a high potential to

optimise this principle, since it offers a wide range of incentives for the farmers to choose from. The problem is that most of the farmers go for the safest way and choose incentives related to activities they already pursue. It may not be considered a negative point, as stated by Rosa et al. (2004) since they are investing in activities that bring them a certain level of safety. However, there is an opportunity to encourage farmers to move out of their comfort zone and experiment with new activities.

When it comes to the costs, the PAF + RR scheme has a regular unitary cost, which can be optimised as further suggested. There were no cases of insufficiency, which means that the incentives offered by the schemes were well-dimensioned. The land managers reported no unintended effect. To finish, the land tenure required by both schemes consist of an unofficial proof, which does not imply further costs to the participant willing to join the project.

9.5. Conditions that render feasible the replication of the scheme

It is always a risk to generalise findings, especially when it comes to qualitative researches. The outcomes of any scheme depend on several factors, which often cannot be controlled. This part of the study aims to provide more information to the reader about the conditions that render possible the replication of the most preferred scheme, the PAF + RR. Of possession of this information, it will be easier to identify potential areas and verify the existence (or the possibility of creation) of certain conditions required to generate results as good as the ones obtained in the experience in Rio Claro - Brazil, when implementing a similar scheme.

Table 11 - *Desired conditions to render feasible the replication of the PAF + RR scheme.*

The condition is related to:	The scheme can be replicated when:	Brief explanation
Stakeholders	There is a reliable funding source. Preferably one big donor or a constant source of money, such as water-use charges or tax on carbon emission.	Even though the value paid isn't significant for some farmers, it works as a motivation to keep the preservation. Late payments compromise the confidence in the project

Stakeholders	The potential area is composed of small/medium farmers	The value paid by the PAF is not significant for big farmers. Also, big farmers are not interested in joining an RD scheme, where the incentives available for investments is not compatible with their needs and interests
Stakeholders	It is possible to establish a partnership with a trustworthy extension company or any other organisation with expertise and credibility with the target audience of the project	A significant parcel of the participants does not understand the purpose of the projects at first. However, they join the projects merely because they trust the technicians. Of course, after that, the project must invest in events and other ways to increase awareness and capacitation of the participants.
Stakeholders	There is a range of potential partners, preferentially institutions that are not related to public administration (City Halls, State government, etc.) acting in the area	Most farmers rated the participation of several partners as positive. According to them, this increases the channels of communication and the opportunities to acquire knowledge. This opinion is shared by Chandran & Ivanovic (2016). However, they do not rely on the institutions related to public administration, mainly the City Halls.
Context	There is a willingness to create specific laws regulating the process. Ex.: 1. creation of Watershed Committees 2. drafting of Watershed plans 3. structuring of granting and charging systems for the use of water	If the money is coming from water-use charges or tax on carbon emission, for instance, it is necessary to create laws to regulate the process. The laws serve to ensure a well-structured system with a defined territory, democratic management bodies, financing sources and an instrument of control and planning.
Context	The potential participants live in the rural areas and obtain their primary source of income from agriculture/livestock or retirement	The Rio Rural scheme promotes a more significant change when the participants obtain their income from the farm. In this case, the willingness to comply with the environmental measures is higher, since it is a condition to obtain the economic benefit. Also, the farmers themselves can perceive the results and thus help in the dissemination of the project
Context	There are many disconnected forest fragments	Usually, the PAF scheme contracts a larger area than the Rio Rural. However, the environmental value can be optimised if these large fragments are connected. It happens by connecting the farms through the corridors formed by the small conservation areas of the properties participating in the Rio Rural project

Context	The potential participants can provide at least an informal land tenure such as the purchase receipt, property deed, definitive title, lease agreement, etc.	A minimum level of proof of land tenure is required for the PAF since the payment is conditioned to the protection and integrity of the area. However, since the project is aimed at small landholders/managers, demand for an official document could discourage the participation of several potential farmers.
Governance	There is the possibility of creating distinct funds (depending on their origin)	The two schemes partially overlap when it comes to the environmental preservation measures. However, other objectives are not similar. According to the projects' coordinators the money from water-use charges, for example, should not be spent with rural development activities. If the donor is the Government or an International fund, it would not be a problem.
Governance	There is the possibility of creating distinct governance structures	Both schemes demand a significant volume of administrative work. However, they deal with different agencies, and not much work overlaps. Also, different capacitation is demanded by the technicians. The study indicated that an excellent level of coordination could be reached even with two wholly separated governances.
Governance	The primary stakeholders agree in creating a Project Management Unit involving coordinators and representatives of all the institutions involved, mainly public bodies	The biggest challenge faced by both schemes to make the project viable, is the bureaucracy, as mentioned by UNDP (2009). Periodic meetings with the presence of top government leaders can be a highly effective way of solving complex problems.
Mechanism	The specialised monitoring can be carried out by partner institutions and by the farmers themselves, remaining the land-use monitoring for the projects' technicians	The specialised monitoring can be executed, for instance, by the water company. The participatory monitoring proposed by the Rio Rural scheme is also a handy way to stimulate local communities to observe the changes occasioned by the more sustainable management of natural resources. This tool also values the perception and holistic understanding of the farmers for better decision making. The presence of technicians on the field is though appreciated and demanded by the farmers, which claim feedbacks from their areas.
Mechanism	The economic benefits can be conditioned to compliance with environmental measures	All the interviewed farmers assumed to have subscribed to the projects due to the presence of economic incentives, although some of them also mentioned the desire to preserve the ecosystems. If economic incentives are

		not conditional on compliance with environmental measures, the latter is unlikely to happen spontaneously. Integrated schemes can help in solving this problem as suggested by (Pirard et al., 2010).
Mechanism	Several types of economic incentives and environmental incentives can be offered for the RD scheme	Farmers need to be part of the decision process, and letting them choose what they want to do, within a range of options, is a simple, effective way of doing that. It directly reflects on the permanence of the activities
Mechanism	The payments are based on negotiation with farmers, rather than other techniques (for the PES scheme)	The amount to be paid should not be established based on the complete economic valuation of ecosystem services, nor an analysis of the financial returns of alternative land uses. It can be useful in the negotiation process of the price to be paid. However, any price that is negotiated between the parties can be right if they are satisfied with the value and if there is sufficient funding to keep the PES system operating
Mechanism	There are potential partners with experience in promoting environmental education for people of low schooling	Only the incentives (cash and in-kind) are not enough to ensure the perpetuity of the benefits obtained through the projects. It is necessary to invest in environmental awareness among the farmers and the rest of the community. It can be a hard task when the schooling level is low; thus a certain level of preparation is required

Source: author's elaboration

The more items of Table 111 are possible to be found or implemented, the better will be the results and the higher the chances of success of the scheme.

9.6. Opportunities for improvements

A variety of opportunities to improve the benefits of the schemes is listed in Figure 27 and followed explained.

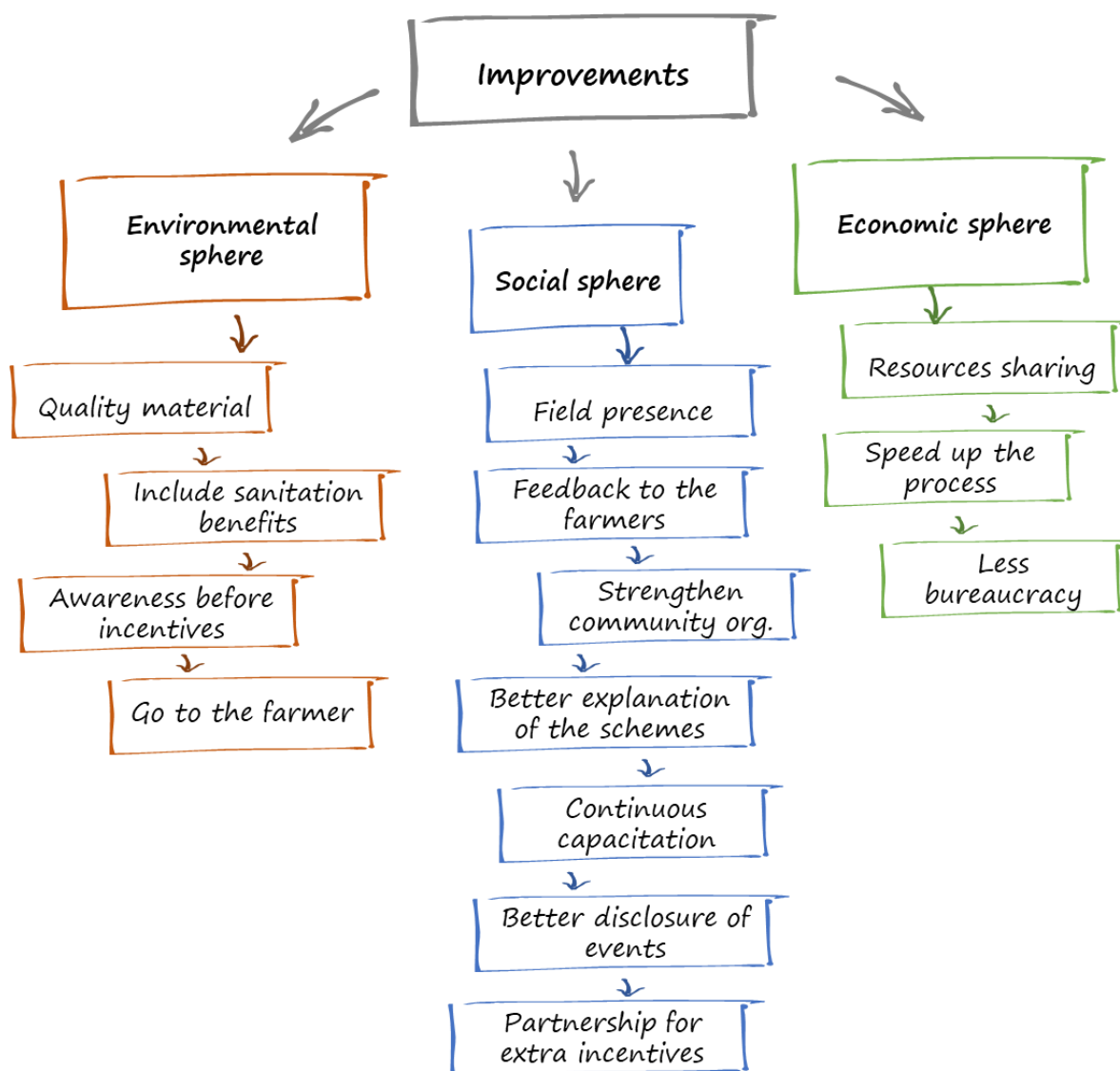


Figure 27 - Opportunities for improvements in the PAF + RR scheme. Source: author's elaboration

Starting from the social benefits, during the interviews many farmers complained the projects' practitioners have only visited their properties during the implementation phase, never coming back to give feedback about the developed activities. Periodic visits to the participants contribute to increase the credibility of the projects and work as a communication channel between buyers/ intermediaries/providers of ecosystem services. It is also essential to deliver feedbacks about the general results of the project, and not only about the situation of a single property. Farmers are also stakeholders and might be aware of the positive or negative outcomes. It increases the sense of belonging to the project. Some marketing material written in simple language may be an effective way of keeping the rural producers informed.

There is a big room for strengthening community organisation in the PAF + RR scheme. The interviews have shown that word of mouth is a very effective way of disseminating the project, so why not taking advantage of it and stimulating this practice? The COGEM's members and potential new participants could participate in field visits to "model farms" in other MWS to check themselves concrete examples of the benefits created by the project. It could be an excellent opportunity for networking, exchanging of experience, etc.

The field interviews also revealed that some rural producers are not aware of rights and duties regarding the area subscribed to the projects. Farmers not taking part in the schemes reported the concern regarding land tenure as the main reason for their non-participation, a common reason that also impacted the scheme studied by Southgate & Wunder (2009). It is understandable since there is a distrust on the part of the rural land managers towards the environmental agencies, nourished by a history of action focused on the environmental control and repression. This situation though can change through a new approach, where all the information is made clear to the land manager, and his/her freedom of choice is accepted.

Continuous capacitation is an incentive that must be provided parallel to the environmental awareness. The interviews have shown that farmers with a higher level of environmental consciousness are seeking information about new sustainable production techniques. It is excellent evidence that the project may generate the expected impacts; however, to ensure the achievement of it, this cycle cannot be broken. Not only farmers but also practitioners must be continuously trained. Also, the training and events for capacitation should be disclosed by using other ways that not only a personal invitation, like radio or telephone contact. Some farmers reported they did not participate in the events because they did not know about it.

The PAF scheme has a good relationship with relevant partners, such as the Rio Claro City Hall. This partnership could be better explored to optimise the benefits provided to the farmers. The City Hall, in the current design, is only responsible for the payments to the farmers. To better integrate this institution into the project, other social benefits could be negotiated, such as support to legalise the properties (topography, juridical orientation, etc.).

Regarding the environmental sphere, the interviews indicated that some of the materials provided by the projects did not have a good quality. There were complaints about the seedlings (inappropriate species), the quality of the fence and others. Environmental impacts

are often not seeing in the short-term; thus it is essential to ensure the permanence of the benefits in the long-term with right quality materials.

Some farmers live in a very precarious condition and do not have sanitation tanks in their houses. The Rio Rural project, in the past, used to offer sanitation tanks as a possible benefit; however, it is no longer offered. This decision could be reconsidered, at least for the impoverished farmers. Instead of creating a project focused on it (FUNBOAS), the incentive could be incorporated into the Rio Rural scope, taking advantage of the structure offered by the project.

In all the schemes evaluated it was possible to observe excellent and regular examples of implementation of the project's benefits. It was possible, though, to associate the good examples to farmers who have a reasonable level of environmental awareness. An opportunity to increase the number of well-succeeded cases could be investing in creating awareness before the money release.

Another strategy is the use of technology to search for potential areas to participate in the scheme. Several farmers, who participate in only one of the studied schemes, reported in the interviews that they are not participating in the other project only because they do not have time, or they are “lazy” to look for information about it. If the projects’ team can invest some energy in identifying principal farmers and visiting them to explain the scheme, instead of waiting for the farmer to come to them, the conservation and restoration goals can be faster achieved.

When it comes to the economic sphere, the resources sharing is an excellent opportunity to explore. Even though the governance of the projects is not joint, some resources like training for environmental awareness, maps and information of the properties, logistical resources, monitoring information, etc. can indeed be shared. These savings can be converted into higher payments.

Some interviewees reported the incentives from the Rio Rural project took a long time to be released. In this meantime, there was the increase in incentives’ price to be acquired. The farmer, therefore, had to complete the missing value. To eliminate the problem, it is necessary to speed up the release of the resource so that there is no lag in the price of the materials to be acquired. Some changes could also be implemented in the PAF scheme, eliminating additional

phases of the process like two intermediate agencies. The cash flow should be redesigned aiming for more agility, less bureaucracy, and less risk of corruption.

10. Conclusions

In the past years, increasing importance has been given to the sustainability of the world we live in. Top-down policies are being discussed among the countries' leaders, who are testing the most diverse policy instruments to reach their environmental goals. One of the most popular tools to address this topic is the PES schemes. These instruments are expected to fill the gaps other tools cannot reach or do not work.

There are two main groups of PES denominated “genuine-PES” and “PES-like” schemes. The first group gives priority to economic efficiency, fitting the ecosystem services into a market model. The PES-like schemes though, consist of alternative frameworks to promote the inclusion of suppliers that cannot meet the market requirements supported by the genuine-PES schemes. There is no consensus about which group is the best one. However, several researchers (Bremer et al., 2014; Muradian et al., 2010; OECD, 2010; Pagiola & Platais, 2007; Rosa et al., 2004; Rowcroft & White, 2013) support the idea of having an integrated approach when implementing a PES scheme, i.e., applying the PES within a basket of policies, which can be rural development projects, social initiatives, other environmental instruments, etc.

To further investigate this topic, nine PES and Rural Development schemes were studied in Rio de Janeiro – Brazil. They are located in three different regions surrounded by the Atlantic Forest, where a significant parcel of the population relies on farming activities for their subsistence. The intensive coffee production, livestock activity and banana production have caused the deforestation of the forest, and sedimentation/contamination of essential rivers for the population's water supply. The primary objective of the study is to verify which arrangement offers the best outcomes aiming the ecosystem services' and providers' resilience enhancement.

Desk research and field interviews were performed with the most diverse stakeholders. The outcomes and other pertinent parameters to drawn a conclusion were compiled and analysed through an MCDA. The model indicated an excellent performance of the integrated schemes

compared to the stand-alone projects within the same region. Among the nine schemes, the PAF + RR project obtained the highest score. Even though its benefits are not the greatest ones among the schemes, its costs are attractive. When balanced in an alternative model of cost-benefit analysis, the PAF + RR offers the best cost-benefit ratio.

This integrated scheme offers a great comprehensiveness and number of ecosystem services supported by its incentives. The farmers participating in the scheme have good environmental awareness and are willing to preserve the nature, giving continuity to the activities of the project in a long-term. When it comes to the social sphere, both schemes consider social inclusion as a priority factor in the selection of the participants. The Rural scheme develops a great work on stimulating and developing community organisation within the MWSs. The participants also reported active participation in the decision-making process of the projects, besides having received excellent capacitation to make better use of the incentives provided. All these factors printed out an excellent overall perception of the scheme on the farmers. The economic benefits were also analysed through the impact on the farmers' income, which increased mainly due to the incentives of the Rio Rural project. The PAF scheme, on the other hand, contributed to diversifying the sources of income, through a regular cash payment to its participants. The cost of the scheme is considered intermediate among the options available, and all the farmers evaluated as sufficient the value provided to acquire the necessary materials to operationalise the activities. Also, there were no unintended effects originated from the scheme and only an unofficial document is required to prove the land tenure of the participants, eliminating further costs to the farmers.

The mentioned outcomes have a high potential to ensure the sustainability of the ecosystems services produced within that area. Also, the community has been well-prepared to think about solutions to improve their living conditions while experiencing the rural development of the region. The Rio Rural project is expected to finish its activities in the Guandu region in 2018; however its legacy will continue with the community leaders who have the task to use the knowledge and resources obtained to move forward. The PAF project has no date to finish its activities, as well as the participants, have no intention to stop preserving the area.

The transferability of the project is something hard to determine. Several factors are influencing the outcomes of a project and changing the situation will imply changes in the outcomes. Some items, however, were enumerated to give the readers a better idea of the

conditions necessary to implement a similar scheme to the PAF + RR. Among the recommendations, it is advisable to implement the scheme in areas composed of small/medium farmers which obtain their income from farming activities/retirement and live in areas where there are many disconnected forest fragments. It is also essential to look for a trustworthy extension company with expertise and credibility with the target audience of the project. Willingness to create specific laws regulating the process is a mandatory condition, and bureaucratic issues can be more easily solved through a Project Management Unit. Both economic and environmental incentives must be offered; however the payment of the first group must be conditioned to compliance with environmental measures.

Although the several positive aspects of the scheme, the study has also identified opportunities for improvements. Among the suggestions, the idea of investing in environmental awareness before the releasing the incentives might contribute to creating even better outcomes. Visits to the farmers in their properties can be a good tactic to bring strategic areas to the project. Continuous capacitation is demanded to ensure the development of the sustainable practices. Marketing material and field visits to provide feedback about the project is a straightforward action which can help to fill a gap regarding communication with one of the most important stakeholders of the project: the providers. To optimise the economic benefits, resources sharing could be encouraged, besides a revision of the mechanism to speed up the processes and save some money.

This study has contributed to verify the feasibility of investing in integrated approaches rather than stand-alone policies to solve complex environmental problems. The case studies reflect the reality of several developing countries facing the same challenge of developing while maintaining the natural resources that generate benefits. By applying a new logic in forest conservation projects integrated with economic development, it presupposes new ways of acting and thinking. Further investigation of the costs of these projects as well as the quantification of the services provided will be useful to consolidate the results presented here.

11. Bibliography

- Arnold, M., Köhlin, G., Persson, R., & Shepherd, G. (2003). *Fuelwood revisited: what has changed in the last decade?* Center for International Forestry Research (CIFOR).
<https://doi.org/10.17528/cifor/001197>
- Arriagada, R., & Perrings, C. (2009). Making Payments for Ecosystem Services Work. *Environment*, (August).
- Ashia, S., Akansina, M. A., Boy, J., & Frimpong, K. (2008). *Payments for Environmental Services (PES) as innovative financing mechanism for adaptation to climate change in Ghana. Area*. Retrieved from www.berlinseminar.de
- Ashwill, M., Flora, C., & Flora, J. (2011). Building Community Resilience to Climate Change: Testing the Adaptation Coalition Framework in Latin America. *International Bank for Reconstruction and Development / The World Bank*. Retrieved from http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1232059926563/5747581-1239131985528/Adaptation-Coalition-Framework-Latin-America_web.pdf
- Bassi, L. (2014). *Participatory micro-watershed management and strategies for long term sustainable rural development : Rio Rural Experience*.
- Biggs, R., Schlüter, M., Biggs, D., Bohensky, E. L., BurnSilver, S., Cundill, G., ... West, P. C. (2012). Toward Principles for Enhancing the Resilience of Ecosystem Services. *Annual Review of Environment and Resources*, 37(1), 421–448.
<https://doi.org/10.1146/annurev-environ-051211-123836>
- Bishop, J. (2010). The economics of ecosystems and biodiversity: TEEB for business. *Initiatives*, 27. Retrieved from http://www.teebweb.org/LinkClick.aspx?fileticket=bYhDohL_TuM=&tabid=1278&mid=2357
- Borges, R. (2009). CARACTERIZAÇÃO SÓCIO-AMBIENTAL E ORDENAMENTO TERRITORIAL PARA A BACIA DO RIO MATO GROSSO, SAQUAREMA - RJ.

Caminhos de Geografia, 10(30), 142–152.

Bowles, S., & Polanía-reyes, S. (2012). Economic Incentives and Social Preferences: Substitutes or Complements? *Journal of Economic Literature*, 50(2), 368–425.

BRASIL. (1988). Constituição da República Federativa do Brasil. *Constituição da República Federativa do Brasi*. Brasília, DF, BRASIL: Senado Federal: Centro Gráfico, 1988. 292 p.

Bremer, L. L., Farley, K. A., & Lopez-Carr, D. (2014). What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador's SocioPáramo program. *Land Use Policy*, 36, 122–133.
<https://doi.org/10.1016/j.landusepol.2013.08.002>

Bressers, H.A., & O'Toole, L. . (2005). *Designing Government: From Instruments to Governance*. McGill-Queen's University Press. McGill-Queen's University Press.
Retrieved from <http://www.jstor.org/stable/j.cttq938d>

Brown, T. C., Bergstrom, J. C., & Loomis, J. B. (2007). Defining, valuing and providing ecosystem goods and services. *Natural Resources Journal*, 47, 329–376.
<https://doi.org/10.1525/sp.2007.54.1.23>.

Bulte, E., & Engel, S. (2007). *Conservation of Tropical Forests: Addressing Market Failure*.

Campbell, B. M. (2009). Beyond Copenhagen: REDD+, agriculture, adaptation strategies and poverty. *Global Environmental Change*, 19(4), 397–399.
<https://doi.org/10.1016/j.gloenvcha.2009.07.010>

Carpenter, S. R., Mooney, H. A., Agard, J., Capistrano, D., Defries, R. S., Díaz, S., ... Reid, W. V. (2009). Science for managing ecosystem services : Beyond the Millennium Ecosystem Assessment, 106(5), 1305–1312.

Catalyze. (2016). Hiview3: Starter Guide, 4121233–4121235.
<https://doi.org/10.1002/ejoc.201200111>

Chandran, R., & Ivanovic, A. (2016). Managing major risks to sustainable development : Conflict , disaster , the SDGs and the United Nations, (December 2015).

- Charlie Parker, Andrew Mitchell, Mandar Trivedi, N. M. (2009). *The little REDD+ Book* (Vol. 12). <https://doi.org/10.1038/sj.ebd.6400789>
- Chee, Y. E. (2004). An ecological perspective on the valuation of ecosystem services. *Biological Conservation*, 120(4), 549–565. <https://doi.org/10.1016/j.biocon.2004.03.028>
- Clements, T. (2014). Impact of payments for environmental services and protected areas on local livelihoods and forest conservation in northern Cambodia, 29(1), 78–87. <https://doi.org/10.1111/cobi.12423>
- Clements, T., John, A., Nielsen, K., An, D., Tan, S., & Milner-Gulland, E. J. (2010). Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia. *Ecological Economics*, 69(6), 1283–1291. <https://doi.org/10.1016/j.ecolecon.2009.11.010>
- Coase, R. (1960). The Problem of Social Cost. *Law and Economics*, 3(1), 1–44. <https://doi.org/10.1086/466560>
- Consórcio Intermunicipal Lagos São João. (2013). *Relatório De Situação Ano III (2012 - 2013) Região Hidrográfica IV - Lagos São João*.
- Conway, G. (2003). The Paradoxes of Integrated Development. *An Integrated Approach to Rural Development : Dialogues at the Economic and Social Council*, 18–22.
- Corbera, E., González, C., & Brown, K. (2008). Institutional dimensions of Payments for Ecosystem Services : An analysis of Mexico ' s carbon forestry programme, 8. <https://doi.org/10.1016/j.ecolecon.2008.06.008>
- Costanza, R., Arge, R., Groot, R. De, Farberk, S., Grasso, M., Hannon, B., ... van den Belt, M. (1997). The value of the world ' s ecosystem services and natural capital. *Nature*, 387(May), 253–260. <https://doi.org/10.1038/387253a0>
- Costanza, R., & Daly, H. E. (1992). Natural Capital and Sustainable Development. *Conservation Biology*, 6(1), 37–46.
- Daly, H. E. (1992). Allocation, distribution, and scale: towards an economics that is efficient, just, and sustainable. *Ecological Economics*, 6(3), 185–193.

[https://doi.org/10.1016/0921-8009\(92\)90024-M](https://doi.org/10.1016/0921-8009(92)90024-M)

de Groot, R. (1987). Environmental Functions as a Unifying Concept for Ecology and Economics. *The Environmentalist*, 7(2), 105–109.

Department for Communities and Local Government: London. (2009). *Multi-criteria analysis: a manual*. Crown. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7612/1132618.pdf

Di Gregorio, M., Nurrochmat, D. R., Paavola, J., Sari, I. M., Fatorelli, L., Pramova, E., ... Kusumadewi, S. D. (2017). Climate policy integration in the land use sector: Mitigation, adaptation and sustainable development linkages. *Environmental Science and Policy*, 67, 35–43. <https://doi.org/10.1016/j.envsci.2016.11.004>

Edenhofer, O., Pichs-Madruga, R., & Sokona, Y. (2014). *Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on. Ippc*. [https://doi.org/using statistical](https://doi.org/using%20statistical)

Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, 65(4), 663–674. <https://doi.org/10.1016/j.ecolecon.2008.03.011>

European Commission. (2013). *Evalsed Sourcebook: method and techniques*.

Evenson, R. E., & Gollin, D. (2003). Assessing the impact of the Green Revolution, 1960 to 2000. *Science*, 300(5620), 758–762. <https://doi.org/10.1126/science.1078710>

Everard, M., Dick, J., Kendall, H., Smith, R., Slee, B., Couldrick, L., ... Mcdonald, C. (2014). Improving coherence of ecosystem service provision between scales. *Ecosystem Services*, 1–9. <https://doi.org/10.1016/j.ecoser.2014.04.006>

FAO. (2001). *Report of the Fao Asia-Pacific Conference on Early Warning , Prevention , Preparedness and Management of Disasters*.

- FAO. (2018, 03 27). *Forest area (% of land area)*. Opgehaald van The World Bank: <https://data.worldbank.org/indicator/AG.LND.FRST.ZS?end=2015&start=1990&view=chart>
- Farley, J., & Costanza, R. (2010). Payments for ecosystem services: From local to global. *Ecological Economics*, 69(11), 2060–2068. <https://doi.org/10.1016/j.ecolecon.2010.06.010>
- Filho, D. T., Antunes, J. C. O., & Vettorazzi, J. S. (2012). *Bacia Hidrográfica dos Rios Guandu, da Guarda e Guandu-Mirim: Experiências para a gestão dos recursos hídricos*. (Comitê da Bacia Hidrográfica Guandu (RJ), Ed.), *Bacia Hidrográfica dos Rios Guandu, da Guarda e Guandu-Mirim - Experiências para a gestão dos recursos hídricos* (INEA Insti). <https://doi.org/10.13140/2.1.3021.5367>
- FIRJAN. (2018, 07 10). *Índice FIRJAN de desenvolvimento municipal*. Opgehaald van FIRJAN: <http://www.firjan.com.br/ifdm/consulta-ao-indice/>
- Fisher, B., Kulindwa, K., Mwanyoka, I., Turner, R. K., & Burgess, N. D. (2010). Common pool resource management and PES: Lessons and constraints for water PES in Tanzania. *Ecological Economics*, 69(6), 1253–1261. <https://doi.org/10.1016/j.ecolecon.2009.11.008>
- Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the ‘policy mix’ for innovation. *Research Policy*, 40(5), 702–713. <https://doi.org/10.1016/j.respol.2011.02.005>
- Gómez-Baggethun, E., de Groot, R., Lomas, P. L., & Montes, C. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics*, 69(6), 1209–1218. <https://doi.org/10.1016/j.ecolecon.2009.11.007>
- Gong, Y., Bull, G., & Baylis, K. (2010). Participation in the world’s first clean development mechanism forest project: The role of property rights, social capital and contractual rules. *Ecological Economics*, 69(6), 1292–1302. <https://doi.org/10.1016/j.ecolecon.2009.11.017>

- Gorman, M., Mannion, J. O. E., Kinsella, J. I. M., & Bogue, P. A. T. (2001). Connecting Environmental Management and Farm Household Livelihoods : The Rural Environment Protection Scheme in Ireland, *147*(March), 137–147.
- Guedes, F. B., & Seehusen, S. E. (2011). *Pagamentos por Serviços Ambientais na Mata Atlântica: lições aprendidas e desafio. Pagamento por Serviços Ambientais na Mata Atlântica: Lições aprendidas e desafios* (MMA). MMA. [https://doi.org/CDU\(2ed\)33:504](https://doi.org/CDU(2ed)33:504)
- Hegney, D., Ross, H., Baker, P., Rogers- Clark, C., King, C., Buikstra, E., ... Stallard, L. (2008). Building Resilience in Rural Communities Toolkit. *The University of Queensland and University of Southern Queensland*. Retrieved from <http://www.usq.edu.au/resources/resilienceorderloforweb.pdf>
- Heyman, J., & Ariely, D. (2004). Effort for payment - A tale of two markets. *Psychological Science*, *15*(11), 787–793. <https://doi.org/10.1111/j.0956-7976.2004.00757.x>
- Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, *4*(1), 1–23. <https://doi.org/10.1146/annurev.es.04.110173.000245>
- Hubacek, K., & Van Den Bergh, J. C. J. M. (2006). Changing concepts of ‘land’ in economic theory: From single to multi-disciplinary approaches. *Ecological Economics*, *56*(1), 5–27. <https://doi.org/10.1016/j.ecolecon.2005.03.033>
- Hughes, R., & Flintan, F. (2001). Integrating Conservation and Development Experience : a Review and Bibliography of the ICDP Literature. *International Institute for Environment and Development*, *3*(3), 24 p. Retrieved from <http://iodeweb1.vliz.be/odin/handle/1834/805?language=en>
- IBGE. (2017, 07 13). *Portal Brasil em Síntese*. Opgehaald van IBGE: <https://cidades.ibge.gov.br/brasil/rj/panorama>
- Ickowitz, A. M. Y., Sills, E., & Sassi, C. D. E. (2017). Estimating Smallholder Opportunity Costs of REDD + : A Pantropical Analysis from Households to Carbon and Back. *World Development*, *95*, 15–26. <https://doi.org/10.1016/j.worlddev.2017.02.022>
- Jack, B. K., Kousky, C., & Sims, K. R. E. (2008). Designing payments for ecosystem services:

- Lessons from previous experience with incentive-based mechanisms. *Proceedings of the National Academy of Sciences*, 105(28), 9465–9470.
<https://doi.org/10.1073/pnas.0705503104>
- Kerr, J. M., Vardhan, M., & Jindal, R. (2014). Incentives, conditionality and collective action in payment for environmental services. *International Journal of the Commons*, 8(2), 595–616. <https://doi.org/10.18352/ijc.438>
- Kobata, C. (2006). *A EDUCAÇÃO AMBIENTAL COMO FERRAMENTA DA GESTÃO PARTICIPATIVA NA MICROBACIA DO RIO CAMBUCAES, SILVA JARDIM, RJ*. Universidade Federal Fluminense.
- Kongsager, R., Locatelli, B., & Chazarin, F. (2016). Addressing Climate Change Mitigation and Adaptation Together: A Global Assessment of Agriculture and Forestry Projects. *Environmental Management*, 57(2), 271–282. <https://doi.org/10.1007/s00267-015-0605-y>
- Kosoy, N., & Corbera, E. (2010). Payments for ecosystem services as commodity fetishism. *Ecological Economics*, 69(6), 1228–1236.
<https://doi.org/10.1016/j.ecolecon.2009.11.002>
- Kosoy, N., Corbera, E., & Brown, K. (2008). Participation in payments for ecosystem services: Case studies from the Lacandon rainforest, Mexico. *Geoforum*, 39(6), 2073–2083. <https://doi.org/10.1016/j.geoforum.2008.08.007>
- Kowalski, A. A., & Jenkins, L. D. (2015). The role of bridging organizations in environmental management: Examining social networks in working groups. *Ecology and Society*, 20(2).
<https://doi.org/10.5751/ES-07541-200216>
- Kremen JO; Dalton, MG; Daily, GC; Ehrlich, PR; Fay, JP; Guillery, RP, C. N. (2000). Economic incentives for rain forest conservation across scales. *Science*, 288(June), 1828–1831.
- Kroeger, T., & Casey, F. (2007). An assessment of market-based approaches to providing ecosystem services on agricultural lands. *Ecological Economics*, 64(2), 321–332.
<https://doi.org/10.1016/j.ecolecon.2007.07.021>

- Krupnick, A. J., & Siikamäki, J. (2007). Resources for the Future. *Resources for the Future*, (165), 14–16. Retrieved from <http://ideas.repec.org/s/rff/dpaper.html>
- Laitos, J. (2017). *Why Environmental Policies Fail*. Cambridge University Press.
<https://doi.org/10.1017/9781316343326>
- Landell-mills, N., & Porras, I. T. (2002). Silver bullet or fools' gold ? *A Research Report Prepared by the International Institute for Environment and Development*, 100(March), 272. Retrieved from <http://cbd.int/doc/external/iied/iied-silver-report-2002-en.pdf>
- Martín-López, B., Montes, C., Ramírez, L., & Benayas, J. (2009). What drives policy decision-making related to species conservation? *Biological Conservation*, 142(7), 1370–1380. <https://doi.org/10.1016/j.biocon.2009.01.030>
- Matson, P. A., Parton, W. J., Power, A. G., & Swift, M. J. (1997). Agricultural intensification and ecosystem properties. *Science*, 277(5325), 504–509.
<https://doi.org/10.1126/science.277.5325.504>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative Data Analysis. A methods sourcebook* (3rd ed.).
- Millennium Ecosystem Assessment. (2003). *Millennium Ecosystem Assessment (MA): Strengthening Capacity to Manage Ecosystems Sustainably for Human Well-Being*. World Resources Institute.
- Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being: Synthesis*. World Resources Institute. (Vol. 1). Washington, DC.: Island Press.
<https://doi.org/10.1196/annals.1439.003>
- MMA. (2013). *Lições aprendidas na conservação e recuperação da Mata Atlântica: Sistematização de desafios e melhores práticas dos projetos-pilotos de Pagamentos por Serviços Ambientais* (Série Biod). Brasília.
- Morrison, A., & Wendelin, A. (2010). Payments for Ecosystem Services Literature Review A review of lessons learned, and a framework for assessing PES feasibility. *BioClimate Research and Development*. WWF Available on: <Http://Www.Planvivo.Org/Tools-and-Resources/Reference-Materials/Last Access>, 25(January), 2012.

- Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., ... Rica, C. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions, 274–279. <https://doi.org/10.1111/j.1755-263X.2012.00309.x>
- Muradian, R., Corbera, E., Pascual, U., Kosoy, N., & May, P. H. (2010). Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*, 69(6), 1202–1208. <https://doi.org/10.1016/j.ecolecon.2009.11.006>
- Naredo, J. M. (2004). La economía en evolución : invento y configuración de la economía en los siglos XVIII y XIX y sus consecuencias actuales. *Manuscripts*, 22, 83–117. <https://doi.org/10.1016/j.procs.2014.08.154>
- Neumayer, E. (1999). Global warming: Discounting is not the issue, but substitutability is. *Energy Policy*, 27(1), 33–43. [https://doi.org/10.1016/S0301-4215\(98\)00063-9](https://doi.org/10.1016/S0301-4215(98)00063-9)
- Newcome, J., Provins, A., Johns, H., Ozdemiroglu, E., Ghazoul, J., Burgess, D., & Turner, D. (2005). The Economic, Social and Ecological Value of Ecosystem Services: A Literature Review. *Final Report for the Department for Environment, Food and Rural Affairs*, (January 2005), 47. <https://doi.org/10.1196/annals.1439.003>
- OECD. (1996). Saving Biological Diversity: Economic Incentives. *Paris*, 156. Retrieved from <http://www.oecd.org/env/resources/2089495.pdf>
- OECD. (2010). *Paying for Biodiversity Enhancing the cost-effectiveness of payments for ecosystem services*. OECD Publishing. <https://doi.org/10.1787/9789264090279-en>
- OECD. (2012a). Green Growth and Developing Countries: A Summary for Policy Makers. *Oecd*, (June 2012), 1–28. <https://doi.org/10.1787/9789264111318-en>
- OECD. (2012b). Green Growth and Developing Countries Consultation Draft. *Oecd, CONSULTATI*(June), 145.
- Ostrom, E. (1990). Governing the Commons. *The Evolution of Institutions for Collective Action*, 302. <https://doi.org/10.1017/CBO9780511807763>
- Pagiola, S. (2008). Payments for environmental services in Costa Rica. *Ecological*

Economics, 65(4), 712–724. <https://doi.org/10.1016/j.econ.2007.07.033>

Pagiola, S., Arcenas, A., & Platais, G. (2005). Can Payments for Environmental Services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World Development*, 33(2 SPEC. ISS.), 237–253.

<https://doi.org/10.1016/j.worlddev.2004.07.011>

Pagiola, S., & Platais, G. (2007). Payments for Environmental Services. *Environment Strategy*, (3), 4.

Palmer, M. A., Bernhardt, E. S., Chornesky, E. A., Collins, S. L., Dobson, A. P., Duke, S., ... Turner, M. G. (2005). Ecological science and sustainability for the 21st century. *Front Ecol Envir*, 3(1), 4–11.

Palomo, I., Felipe-Lucia, M. R., Bennett, E. M., Martín-López, B., & Pascual, U. (2016). Disentangling the Pathways and Effects of Ecosystem Service Co-Production. In *Advances in Ecological Research* (1st ed., Vol. 54, pp. 245–283). Elsevier Ltd. <https://doi.org/10.1016/bs.aecr.2015.09.003>

Perrot-Maître, D. (2006). The Vittel Payments for Ecosystem Services: A “Perfect” PES Case? *Environment*, (September), 24.

Peterson, M. J., Hall, D. M., Feldpausch-parker, A. M., & Peterson, T. R. A. I. (2010). Obscuring Ecosystem Function with Application of the Ecosystem Services Concept, 24(1), 113–119. <https://doi.org/10.1111/j.1523-1739.2009.01305.x>

Pirard, R., Billé, R., & Sembrés, T. (2010). Upscaling Payments for Environmental Services (PES): Critical issues, 3(3), 249–261.

Plieninger, T., Hartel, T., Martín-López, B., Beaufoy, G., Bergmeier, E., Kirby, K., ... Van Uytvanck, J. (2015). Wood-pastures of Europe: Geographic coverage, social-ecological values, conservation management, and policy implications. *Biological Conservation*, 190, 70–79. <https://doi.org/10.1016/j.biocon.2015.05.014>

Politics, L. (2017). 9 . Disconnected Development Worlds : Responsibility towards Local Communities in Papua New Guinea.

- Porras, I., Greig-Gran, M., & Neves, N. (2008). *All that glitters: a review of payments for watershed services in developing countries*. International Institute for Environment and Development. <https://doi.org/10.1119/1.2341716>
- Power, A. G. (2010). Ecosystem services and agriculture: tradeoffs and synergies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 2959–2971. <https://doi.org/10.1098/rstb.2010.0143>
- Pretty, J. N., Noble, A. D., Bossio, D., Dixon, J., Hine, R. E., De Vries, F. W. T. P., & Morison, J. I. L. (2006). Resource-conserving agriculture increases yields in developing countries. *Environmental Science and Technology*, 40(4), 1114–1119. <https://doi.org/10.1021/es051670d>
- Primer, A. (2008). *Payments for Ecosystem Services : Getting Started*.
- Ramos, Doracy Pessoa; Manzatto, Celso Vainer ; Hissa, H. R., & Shinzato, E. (1999). Bases metodológicas para a reorganização da ocupação das terras do assentamento Cambucaes, Silva Jardim, RJ. Rio de Janeiro: Embrapa Solos.
- Rosa, H., Barry, D., Kandel, S., & Dimas, L. (2004). *Compensation for Environmental Services and Rural Communities: Lessons from the Americas*.
- Rowcroft, P., & White, C. (2013). The Role of Payments for Ecosystem Services in Climate Change Adaptation, (August).
- Ruiz, M. (2015). *Pagamento por Servicos Ambientais: Da Teoria à Pratica*.
- Salzman, J. (2005). The promise and perils of payments for ecosystem services. *International Journal of Innovation and Sustainable Development*, 1(1), 5–20. <https://doi.org/10.1504/IJISD.2005.008079>
- Salzman, J. (2009). A Policy Maker’s Guide to Designing Payments for Ecosystem Services. *SSRN ELibrary*. Retrieved from [http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1498629%5Cn/Users/Scott/Library/Application Support/Zotero/Profiles/o2w6fm8m.default/zotero/storage/RUDWRZXU/papers.html](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1498629%5Cn/Users/Scott/Library/Application%20Support/Zotero/Profiles/o2w6fm8m.default/zotero/storage/RUDWRZXU/papers.html)

- Scherr, S. J. (1999). Poverty-Environment interactions in agriculture: Key factors and policy implications. In *Workshop on Poverty and the Environment* (p. 36).
- Schuylt, K., & Brander, L. (2004). *Living Waters: Conserving the Source of Life – The Economic Values of the World's Wetlands*. WWF. WWF.
- Secretariat of the Convention on Biological Diversity. (2001). *The Value of Forest Ecosystems*. CBD Technical Series no.4. [https://doi.org/retrieved at: http://www.cbd.int/doc/publications/cbd-ts-04.pdf](https://doi.org/retrieved%20at%3A%20http%3A%2F%2Fwww.cbd.int%2Fdoc%2Fpublications%2Fcbd-ts-04.pdf)
- Sommerville, M. M., Jones, J. P. G., & Milner-Gulland, E. J. (2009). A Revised Conceptual Framework for Payments for Environmental Services. *Ecology and Society*, 14(2), 34-. <https://doi.org/34>
- SOS Mata Atlântica. (2015, 05 15). *Fundação divulga mapeamento inédito da Mata Atlântica do Rio*. Opgehaald van SOS Mata Atlântica: <https://www.sosma.org.br/102355/levantamento-inedito-mata-atlantica-rio/>
- Southgate, D., & Wunder, S. (2009). Paying for watershed services in Latin America: A review of current initiatives. *Journal of Sustainable Forestry*, 28(3–5), 497–524. <https://doi.org/10.1080/10549810902794493>
- Spash, C. L. (2008). Deliberative Monetary Valuation and the Evidence for a New Value Theory Deliberative Monetary Valuation and the Evidence for a New Value Theory. *Source: Land Economics*, 84(3), 469–488. <https://doi.org/10.3368/le.84.3.469>
- Stevens, C. (2011). 'Agriculture and Green Growth,' contribution to OECD (2012), Food and Agriculture, OECD Green Growth Studies. Retrieved 15 December 2017, from <http://www.oecd.org/greengrowth/sustainable-agriculture/48224529.pdf>
- Swallow, B. M., Kallesoe, M. F., Iftikhar, U. A., Noordwijk, M. van, Bracer, C., Scherr, S. J., ... ABSTRACT. (2009). Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison. *Ecology and Society*, 14(2). <https://doi.org/26>
- Swinton, S. M., Lupi, F., Robertson, G. P., & Hamilton, S. K. (2007). Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits. *Ecological*

- Economics*, 64(2), 245–252. <https://doi.org/10.1016/j.ecolecon.2007.09.020>
- Tacconi, L. (2012). Redefining payments for environmental services, 73, 29–36. <https://doi.org/10.1016/j.ecolecon.2011.09.028>
- ten Kate, K., Bishop, J., Bayon, R., ten Tate, K., Bishop, J., & Bayon, R. (2004). *Biodiversity offsets: Views, experience, and the business case*. Diversity. <https://doi.org/ISBN:2-8317-0854-0>
- UNDP. (2009). What drives institutions to adopt integrated development approaches? Discussion Paper, 19. Retrieved from http://www.undp.org/content/undp/en/home/librarypage/environment-energy/integrating_environmentintodevelopment/discussion-paper--what-drives-institutions-to-adopt-integrated-d.html
- United Nations. (2015a). Paris agreement. In *Paris Agreement* (p. 25). United Nations.
- United Nations. (2015b). Transforming our world: the 2030 Agenda for Sustainable Development. *General Assembly 70 Session, 16301*(October), 1–35. <https://doi.org/10.1007/s13398-014-0173-7.2>
- United Nations Economic and Social Commission for Asia and the Pacific. (2009). Payments for ecosystem services Greening of Economic, 1–32.
- Van de Sand, I., Mwangi, J. K., & Namirembe, S. (2014). Can payments for ecosystem services contribute to adaptation to climate change? Insights from a watershed in Kenya. *Ecology and Society*, 19(1). <https://doi.org/10.5751/ES-06199-190147>
- Van Huylenbroeck, G., & DURAND, G. (2003). Multifunctional Agriculture: a new paradigm for European agriculture and rural development. In G. & Van Huylenbroeck, *Multifunctionality and rural development: a general framework*. (pp. (pp. 1–16)). Ghent: Ashgate Publishing.
- van Noordwijk, M., & Leimona, B. (2010). Principles for fairness and efficiency in enhancing environmental services in asia: Payments, compensation, or co-investment? *Ecology and Society*, 15(4). <https://doi.org/10.5751/ES-03664-150417>

- Wells, Michael; Guggenheim, Scott; Khan, Asmeen; Wardojo, Wahjudi; Jepson, P. (1999). *Investing in biodiversity : a review of Indonesia's integrated conservation and development projects*. <https://doi.org/Export> Date 19 June 2014
- Westman, W. E. (1977). How Much Are Nature's Services Worth?, 4(1969).
- Wossink, A., & Swinton, S. M. (2007). Jointness in production and farmers' willingness to supply non-marketed ecosystem services. *Ecological Economics*, 64(2), 297–304. <https://doi.org/10.1016/j.ecolecon.2007.07.003>
- Wunder, S. (2005). Payments for environmental services: some nuts and bolts. *CIFOR Occasional Paper No. 42*, (42), 1–25. <https://doi.org/10.1111/j.1523-1739.2006.00559.x>
- Wunder, S. (2007). The efficiency of payments for environmental services in tropical conservation: Essays. *Conservation Biology*, 21(1), 48–58. <https://doi.org/10.1111/j.1523-1739.2006.00559.x>

ANNEX I

Criteria description

Short Name	Description	Scale Type	Fixed Upper	Fixed Lower	Units	Value Function
Comprehensiveness	Type of sustainable practice covered by the project and its importance to produce ecosystem services	Fixed	100.0	0.0	Data	Discrete
Services supported	Number of (or group of) ecosystem services supported by the project	Fixed	100	0	Data	Discrete
Increased awareness	% of farmers that reported an increase in the environmental awareness obtained through the projects' initiatives (lectures/events) or by information provided by the projects' technicians	Relative	100	0	Data	Linear
Permanence	% of farmers that intend to maintain the sustainable practices implemented by the projects after the end of it	Relative	100	40	Data	Linear
Participation	% of farmers that reported active participation in the definition of projects	Relative	100	40	Data	Linear
Social inclusion	Presence or absence of criteria to prioritize the selection of less favoured groups	Fixed	100	0		Discrete
Community org.	Presence or absence of incentives to create and strengthen community	Fixed	100	0	Data	Discrete

	organisations					
Service rating	% of satisfaction regarding the services provided by the projects (accorded incentives and activities). It is calculated by the weighted average of the completely satisfied, partially satisfied and not satisfied levels	Relative	100	60	Data	Linear
Capacitation	% of farmers that reported capacitation to make the best out of the incentives provided by the projects	Relative	80	0	Data	Linear
Impact on income	% of farmers that reported income increase or income stabilisation due to the incentives provided by the project	Relative	100	0	Data	Linear
Diversification	% of farmers that reported diversification of income sources due to the incentives provided by the projects	Relative	100	0	Data	Linear
Unitary Cost	Unitary cost of the project, expressed by R\$/ha. Calculated through the division: total amount of money demanded by the project / total area assisted	Relative	323.6	33.0	Data	Linear
Insufficiency	% of farmers that reported to have spent their own money to operationalise the activities in their properties	Relative	60	0	Data	Linear
Unintended effect	% of farmers that reported unintended effects after the projects' activities	Relative	40	0	Data	Linear
Land tenure	Demand for different types of land tenure	Fixed	100	0	Data	Discrete

Scores

Short Name	Option	Input Score	Preference Score	Weighted Score
Comprehensiveness	ICMS	2. Conservation, restoration	75.00	5.95
Comprehensiveness	ICMS + RR	1. Conservation, restoration, improved land practices	100.00	7.93
Comprehensiveness	RR VSR	4. improved land practices, little conservation	25.00	1.98
Comprehensiveness	PAF	2. Conservation, restoration	75.00	5.95
Comprehensiveness	PAF + RR	1. Conservation, restoration, improved land practices	100.00	7.93
Comprehensiveness	RR GR	4. improved land practices, little conservation	25.00	1.98
Comprehensiveness	FUNBOAS	5. Sanitation	0.00	0.00
Comprehensiveness	FUNBOAS + RR	3. Improved land practices, little conservation, sanitation	50.00	3.97
Comprehensiveness	RR LR	4. improved land practices, little conservation	25.00	1.98
Services supported	ICMS	4 services	100.00	7.05
Services supported	ICMS + RR	4 services	100.00	7.05
Services supported	RR VSR	3 services	66.00	4.66
Services supported	PAF	3 services	66.00	4.66
Services supported	PAF + RR	3 services	66.00	4.66
Services supported	RR GR	3 services	66.00	4.66
Services supported	FUNBOAS	1 service	0.00	0.00
Services supported	FUNBOAS + RR	3 services	66.00	4.66
Services supported	RR LR	3 services	66.00	4.66
Increased awareness	ICMS	100	100.00	7.93
Increased awareness	ICMS + RR	100	100.00	7.93
Increased awareness	RR VSR	100	100.00	7.93
Increased	PAF	60	60.00	4.76

awareness				
Increased awareness	PAF + RR	67	67.00	5.32
Increased awareness	RR GR	0	0.00	0.00
Increased awareness	FUNBOAS	0	0.00	0.00
Increased awareness	FUNBOAS + RR	67	67.00	5.32
Increased awareness	RR LR	60	60.00	4.76
Permanence	ICMS	100	100.00	8.82
Permanence	ICMS + RR	100	100.00	8.82
Permanence	RR VSR	100	100.00	8.82
Permanence	PAF	100	100.00	8.82
Permanence	PAF + RR	100	100.00	8.82
Permanence	RR GR	100	100.00	8.82
Permanence	FUNBOAS	40	-0.00	-0.00
Permanence	FUNBOAS + RR	100	100.00	8.82
Permanence	RR LR	100	100.00	8.82
Participation	ICMS	100	100.00	6.72
Participation	ICMS + RR	100	100.00	6.72
Participation	RR VSR	100	100.00	6.72
Participation	PAF	100	100.00	6.72
Participation	PAF + RR	100	100.00	6.72
Participation	RR GR	100	100.00	6.72
Participation	FUNBOAS	40	-0.00	-0.00
Participation	FUNBOAS + RR	100	100.00	6.72
Participation	RR LR	100	100.00	6.72
Social inclusion	ICMS	no commitment	0.00	0.00
Social inclusion	ICMS + RR	strong commitment	100.00	6.05
Social inclusion	RR VSR	strong commitment	100.00	6.05
Social inclusion	PAF	partial commitment	50.00	3.02
Social inclusion	PAF + RR	strong commitment	100.00	6.05

Social inclusion	RR GR	strong commitment	100.00	6.05
Social inclusion	FUNBOAS	partial commitment	50.00	3.02
Social inclusion	FUNBOAS + RR	strong commitment	100.00	6.05
Social inclusion	RR LR	strong commitment	100.00	6.05
Community org.	ICMS	Does not demand neither strengthen	0.00	0.00
Community org.	ICMS + RR	Demand and strengthen	100.00	6.05
Community org.	RR VSR	Demand and strengthen	100.00	6.05
Community org.	PAF	Does not demand neither strengthen	0.00	0.00
Community org.	PAF + RR	Demand and strengthen	100.00	6.05
Community org.	RR GR	Demand and strengthen	100.00	6.05
Community org.	FUNBOAS	Demand but does not strengthen	33.00	2.00
Community org.	FUNBOAS + RR	Demand and strengthen	100.00	6.05
Community org.	RR LR	Demand and strengthen	100.00	6.05
Service rating	ICMS	67	17.50	0.65
Service rating	ICMS + RR	90	75.00	2.77
Service rating	RR VSR	70	25.00	0.92
Service rating	PAF	100	100.00	3.70
Service rating	PAF + RR	88	70.00	2.59
Service rating	RR GR	100	100.00	3.70
Service rating	FUNBOAS	60	0.00	0.00
Service rating	FUNBOAS + RR	63	7.50	0.28
Service rating	RR LR	75	37.50	1.39
Capacitation	ICMS	67	83.75	5.07
Capacitation	ICMS + RR	60	75.00	4.54
Capacitation	RR VSR	80	100.00	6.05
Capacitation	PAF	40	50.00	3.02
Capacitation	PAF + RR	75	93.75	5.67
Capacitation	RR GR	13	16.25	0.98
Capacitation	FUNBOAS	20	25.00	1.51

Capacitation	FUNBOAS + RR	25	31.25	1.89
Capacitation	RR LR	0	0.00	0.00
Impact on income	ICMS	17	17.00	1.35
Impact on income	ICMS + RR	100	100.00	7.93
Impact on income	RR VSR	100	100.00	7.93
Impact on income	PAF	20	20.00	1.59
Impact on income	PAF + RR	75	75.00	5.95
Impact on income	RR GR	88	88.00	6.98
Impact on income	FUNBOAS	0	0.00	0.00
Impact on income	FUNBOAS + RR	50	50.00	3.97
Impact on income	RR LR	80	80.00	6.35
Diversification	ICMS	100	100.00	4.76
Diversification	ICMS + RR	100	100.00	4.76
Diversification	RR VSR	20	20.00	0.95
Diversification	PAF	100	100.00	4.76
Diversification	PAF + RR	100	100.00	4.76
Diversification	RR GR	38	38.00	1.81
Diversification	FUNBOAS	20	20.00	0.95
Diversification	FUNBOAS + RR	0	0.00	0.00
Diversification	RR LR	30	30.00	1.43
Unitary cost	ICMS	253.3	24.19	2.82
Unitary cost	ICMS + RR	323.6	0.00	0.00
Unitary cost	RR VSR	70.3	87.16	10.14
Unitary cost	PAF	110.0	73.50	8.55
Unitary cost	PAF + RR	180.3	49.31	5.74
Unitary cost	RR GR	70.3	87.16	10.14
Unitary cost	FUNBOAS	33.0	100.00	11.64
Unitary cost	FUNBOAS + RR	103.3	75.81	8.82
Unitary cost	RR LR	70.3	87.16	10.14
Insufficiency	ICMS	33	45.00	2.36
Insufficiency	ICMS + RR	40	33.33	1.75

Insufficiency	RR VSR	60	-0.00	-0.00
Insufficiency	PAF	0	100.00	5.24
Insufficiency	PAF + RR	0	100.00	5.24
Insufficiency	RR GR	0	100.00	5.24
Insufficiency	FUNBOAS	60	-0.00	-0.00
Insufficiency	FUNBOAS + RR	50	16.67	0.87
Insufficiency	RR LR	10	83.33	4.36
Unintended effect	ICMS	17	57.50	2.07
Unintended effect	ICMS + RR	0	100.00	3.59
Unintended effect	RR VSR	20	50.00	1.80
Unintended effect	PAF	40	0.00	0.00
Unintended effect	PAF + RR	0	100.00	3.59
Unintended effect	RR GR	0	100.00	3.59
Unintended effect	FUNBOAS	20	50.00	1.80
Unintended effect	FUNBOAS + RR	25	37.50	1.35
Unintended effect	RR LR	0	100.00	3.59
Land tenure	ICMS	Formal land tenure	0.00	0.00
Land tenure	ICMS + RR	Formal land tenure	0.00	0.00
Land tenure	RR VSR	Informal land tenure	50.00	3.27
Land tenure	PAF	Informal land tenure	50.00	3.27
Land tenure	PAF + RR	Informal land tenure	50.00	3.27
Land tenure	RR GR	Informal land tenure	50.00	3.27
Land tenure	FUNBOAS	No land tenure	100.00	6.53
Land tenure	FUNBOAS + RR	Informal land tenure	50.00	3.27
Land tenure	RR LR	Informal land tenure	50.00	3.27

Weights

Short Name	Scale Bottom	Scale Top	Relative Weight
Comprehensiveness	5. Sanitation	1. Conservation, restoration, improved land practices	90
Services supported	1 service	4 services	80
Increased awareness	RR GR	ICMS	90
Permanence	FUNBOAS	ICMS	100
Participation	FUNBOAS	ICMS	100
Social inclusion	no commitment	strong commitment	90
Community org.	Does not demand neither strengthen	Demand and strengthen	90
Service rating	FUNBOAS	PAF	55
Capacitation	RR LR	RR VSR	90
Impact on income	FUNBOAS	ICMS + RR	100
Diversification	FUNBOAS + RR	ICMS	60
Unitary cost	ICMS + RR	FUNBOAS	100
Insufficiency	RR VSR	PAF	45
Unintended effect	PAF	ICMS + RR	55
Land tenure	Formal land tenure	No land tenure	100