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Building a Methodology for the Design of an Environmental Services Payment Programme for the Mangroves of Mexico

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Abstract

Environmental Services Payment Programmes are not entirely new and they are more flexible than the usual command-and-control type of regulation. In the 1990s for example, an Environmental Services Payment programme was introduced to cope with the forestry system and pay benefits to farmers for the good that their forests would produce. This review examines the possibility of using Environmental Services Payment programmes for Mexican mangroves as they are an important resource against natural disasters, and reducing greenhouse gases in the Earth's atmosphere, for example, and they are constantly invaded by the human race which impacts on their destruction. The review aims at constructing a methodology that can be applied to the implementation of Environmental Services Payment programmes. The value of this study is in aiming a straight arrow at the environmental problems outlined in this paper, problems that have not been fully resolved to date, especially in Mexico where it is not officially recognised that mangroves play an important role in the mitigation of greenhouse gases. Furthermore, Environmental Services Payment Programmes in Mexico have not pinpointed specific types of area. We conclude this paper with elaborating on our ten-point strategy for implementing Environmental Services Payment programmes which includes, in brief: 1) Fully accepting the importance of the mitigation of greenhouse gases via mangroves; 2) designing a Environmental/Ecosystem Services Payment Programme with particular emphasis on Mexican mangroves; 3) identifying specific environmental services and their level from local to international; 4) formation and implementation of a system of "whoever benefits must pay"; 5) building of a knowledge base of owners and others who benefit from environmental services; 6) hypothetical models of particular Environmental Services Payment programmes must be constructed; 7) clarifying who must pay; 8) grouping all sectors that must pay; 9) inspiring all actors to cooperate via 10) the impact of a Citizens' Council, for example.

Keywords

Mangroves, Mexico, Environmental Services, Payment Programme

1. Introduction

In recent years, the need to value the services provided by the mangroves of Mexico has been strongly emphasised as a vitally important strategy to promote the conservation of those mangroves. It is noteworthy that Mexico is one of the four countries in the world with the largest mangrove area. The mangroves of Mexico represent 5% of the world total mangrove area and place the country only below Indonesia, Brazil and Australia [1]. Mangroves, globally, are subject to enormous pressure and the lost surface of this ecosystem is estimated to have reached 20% during the last two decades [2].

Mangroves are constantly threatened because coastal areas are especially attractive to human populations, both for housing and tourism. The economic value of coastal areas is usually high and, therefore, decision making between conservation and development is not always appropriate. Some mangrove species are currently within the species that are protected by national legislation because they are listed as endangered species [3]. There are also mangroves that are within protected natural areas, which entail a particularly strict protection regime and, sometimes, there are also some mangrove areas that are protected by the Ramsar Convention (*i.e.*, the Convention on Wetlands) [4] because they are important wetlands of international importance. Furthermore, in Mexico the Federal Penal Code considers an environmental crime as very serious: "A fine of two to ten years in prison and a fine of three hundred to three thousand days shall be imposed on anyone who illicitly damages, drains or fills wetlands, mangroves, lagoons, estuaries or swamps" [5].

In spite of all the aforementioned details, whereby it might seem that this set of legal provisions would be sufficient to guarantee an adequate conservation of the mangroves in Mexico, they are in a vulnerable situation. In many cases, the pollution levels facing the mangroves are a serious issue, and actions are necessary to ensure the protection and restoration of these ecosystems.

From an economic point of view, it is necessary that incentives exist for the conservation of these areas and these incentives should directly benefit those involved and those responsible for the protection of mangroves.

In this paper, we make a methodological proposal for the design of an Environmental Services Payment (ESP) Programme for the mangroves of Mexico. These Programmes aim to pay the owners or holders of ecosystems which provide services to a society in order to conserve them instead of using them in other ways. The main objective of these Programs is to help ecosystem conservations by paying the services they provide.

2. Mangroves and Their Environmental Services

2.1. Legal Bases for Payment of Atmospheric Environmental Services in Mexico

A wetland is a transition zone, or coastal intertidal zone, between aquatic and terrestrial systems and within wetlands there are mangroves which are forest areas with both trees and shrubs that provide many goods and services. According to the Mexican Ministry of Environment and Natural Resources (SEMARNAT), the environmental services that are provided by wetlands are the following:

- "flood control;
- soil stabilisation in the coastal zone;
- filtration and protection of fresh water from rivers, lakes and coastal streams;
- transport of people and materials;
- recreational and water sport activities;
- dilution of contaminants and protection of water quality, bird habitats and wildlife;
- soil fertilisation;
- increase in property value
- cultural, ethical, emotional and aesthetic values". [6]

Sanjurjo and Welsh describe the value of environmental goods and services in mangroves, emphasising that "to capture the totality of the values that make up a forest ecosystem, such as the mangrove forest, requires the concept of Total Economic Value (VET)" which, according to these authors, "consists of two types of value" [7]:

- Active use values;
- Passive use values [7].

Within the passive use values the authors distinguish between inheritance values and existence values and, as regards the active use values, these would involve the following:

- Present use values;
- Future use values.

Also, within the present use values there would be:

- direct use values;
- indirect use values.

Finally, within the indirect use values there would be:

- environmental values;
- ecosystem values.

Regarding services related to carbon sequestration, as indicated by UNEP [8], about 20% of the carbon released into the atmosphere comes from deforested ecosystems (*i.e.*, burning and clearing). Therefore, conserving these ecosystems could significantly reduce greenhouse gases in the Earth's atmosphere. Forests, wetlands and woodlands are the main systems that function as carbon sinks, in addition to providing material goods and protection services.

In addition, it is necessary to take into account that mangroves release less

carbon than other forest ecosystems. This is due, in large part, to the fact that in mangrove soils the rates of decomposition are low and, therefore, the carbon storage in the soil may be higher than in freshwater forest systems [9]. Hence, the conservation of mangroves and even their recovery can constitute a very effective strategy within public policies to combat climate change, specifically within those strategies that are aimed at mitigating carbon emissions.

It is necessary, therefore, that the conservation of mangroves be encouraged, not only from a normative strategist but also through the use of economic instruments that promote the internalisation of environmental externalities in terms of protection of the atmosphere. Notwithstanding, as some authors note , "currently a fully formed carbon capture market cannot be recognised, given that the greater number of transactions have been made as direct arrangements between governments or non-governmental organisations and the environmental service providers" [10].

Additionally, in the case of mangroves, in many cases they are within protected natural areas, which make it difficult to identify who favours or makes possible the service provision. It is also difficult to find the link between the holders of those ecosystems that provide environmental services and those who make possible, or are in charge of, the conservation of the mangrove in question and those who are directly benefited by those services.

The Stern Review on the Economics of Climate Change was issued by the UK Government [11] and notes that "Economists describe human-induced climate change as an 'externality' and the global climate as a 'public good' and, unlike other externalities, it is global in character, because of its causes and its consequences".

It is possible, then, to consider that mangroves provide global environmental services, in the same way as forests, and should be considered when accounting for emissions of greenhouse gases (GHG). Furthermore, at a national level, it is possible and desirable to design economic instruments that pay for the environmental services that mangroves provide.

2.2. Legal Bases for Payment of Atmospheric Environmental Services in Mexico

In Mexico, the National Development Plan 2013-2018 [10] includes a strategy for strengthening the National Climate Change Policy and care for the environment in order "to move towards a competitive, sustainable, resilient and low carbon economy". For its part, the Mexican National Climate Change Strategy (ENCC) [10] states, in relation to economic instruments:

"… in our country there are fiscal, financial and economic schemes that still persist and that generate an inefficient use of natural resources; additionally, they accentuate the economic differences of the population. Moving towards better practices requires rethinking such schemes and creating new statistics, instruments, regulations, policies and programmes for a more responsible management of resources, which will result in better living conditions for the general

population.

Some examples of better practices are: the conservation of ecosystems and the species that inhabit them, the sustainable use of forests and wildlife; the establishment of effective control over protected natural areas; the generation of an economic value for environmental services; a sliding of gasoline prices; and finally to the implementation of new tariff schemes for some of the sectors that consume more water and electricity. However, all of the above would be insufficient, given the multiple needs in terms of climate change and sustainable development as a general vision within the country".

On the other hand, the General Law on Climate Change (LGCC) [12] states that it is within the power of the Mexican Federation "To design and promote, for the agencies and competent entities, the establishment and application of economic, fiscal, financial and market instruments linked to the actions concerning the subject of climate change".

Regarding the powers of the member states, we highlight the power that refers to:

Formulation, regulation, direction and implement of mitigating actions with respect to, and adaptation to, climate change, in accordance with the National Strategy and the National Programme, among others, in the following matters of:

Preservation, restoration, management and sustainable use of the ecosystems and water resources of under their authority.

The municipalities have the power to:

"Formulate and implement policies and actions in order to face climate change in accordance with the National Development Plan, the National Strategy, the Programme, the State Programme on climate change and the applicable laws, among others, in the following areas: Natural resources and the environmental protection of their competence; additionally, they can participate in the design and application of incentives that promote actions for the fulfilment of the object of the LGCC".

The General Law of Climate Change [12] of 2012, when referring to the principles that must be observed in the formulation of the National Climate Change Policy also reaffirms that: "The use of economic instruments in the mitigation, adaptation and reduction of vulnerability to change climatic gives incentive for the protection, preservation and restoration of the environment; the sustainable use of natural resources, as well as generating economic benefits for those who implement them".

There are, in short, the legal bases within each of the three levels of government for the design of a payment system for atmospheric services provided by the mangroves, which are contained, in many cases, within the fringe of the Federal Terrestrial Maritime Zone (*i.e.*, on the Gulf of Mexico coast) in accordance with the provisions of the Regulation for the use and exploitation of the territorial sea, navigable waterways, beaches, federal maritime land area and land reclaimed from the sea [13] and, therefore, its regulation is a federal responsibil-

ity. However, the states and municipalities, in which these areas are located, have a large number of responsibilities related to the management of these important environmental resources and they could be involved in some of the aspects of the design of this economic instrument.

Mangroves play an important role in the mitigation of greenhouse gases, a role that has not yet been recognized in Mexican environmental policy, and these ecosystems are in a very vulnerable situation. Hence, we propose the design of payment instruments for the atmospheric services that the mangroves provide, based on the principle of "whoever benefits must pay".

The traditional "polluter-pays" principle, according to which the potential polluter is the one who must bear all of the economic costs of preventing and controlling pollution, is not the only principle for the distribution of costs, since the "whoever benefits must pay" principle also makes sense. According to the "whoever benefits must pay" principle, those who receive or expect to receive benefits for pollution control activities or conservation actions should pay for that said benefit. This payment can be orchestrated in many different ways. Next, we expose the steps to follow for the design of this type of instrument.

3. Methodology for Preparation of the ESP Programme

The proposed steps for the design of an Environmental Services Payment (ESP) Programme for the mangroves of Mexico (and they are steps that are considered to be easily replicable for any coastal zone in which this type of ecosystem exists) are described in the subsections that follow. **Figure 1** shows a Flow Chart for designing a PES Programme.

3.1. Delimitation of the Area or Ecosystem Where Influence Is Desired

Firstly, it is necessary to clearly delimit the area where the influence is desired via the Environmental Services Payment (ESP) Programme. It is important to highlight the importance of using, whenever possible, some pre-existing territorial delimitation, which will facilitate the obtaining of information and data to be used throughout the design of the programme, taking into account the shortcomings that usually exist in this regard throughout Mexico.

As aforementioned, in many cases the mangrove areas are within a protected natural area or within a Ramsar Convention area. In these cases, it is very convenient that our delimitation takes those previous delimitations as a reference, since data and information will exist that will prove to be very useful for the programme. In order to delimit the physical space over which our Environmental Services Payment (ESP) Programme will operate, it is important to distinguish between the conservation/restoration zone and the application zone of the programme, which are discussed in the following two subsections.

3.1.1. Conservation and Restoration Zone

The aim is to determine the space over which the most intense conservation

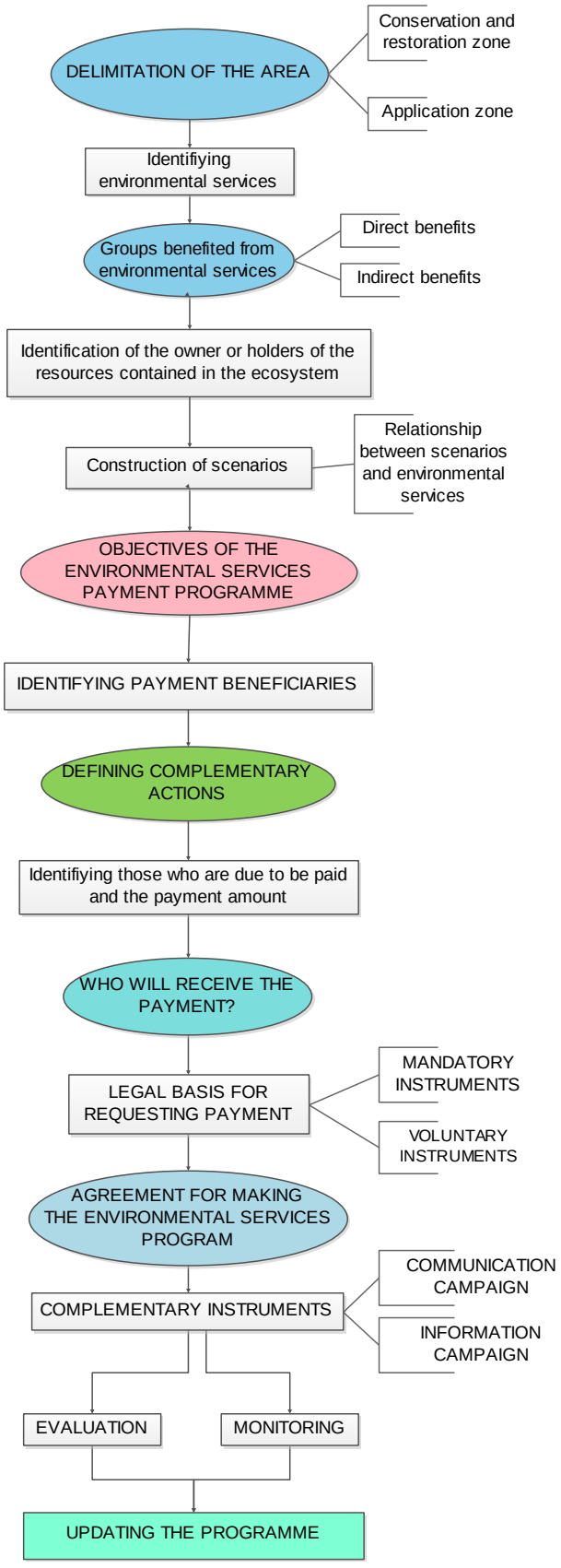

Figure 1. Flow chart for designing a PES programme.

and/or restoration actions are necessary (*i.e.*, the target area or zone for which the programme is designed). In this area, the most vulnerable resources will be determined, as well as those resources that provide the greatest number of environmental services. In short, it is the ecosystem that justifies the design of the payment program for environmental services, due to its ecological value or importance. Based on this space, most of the beneficiaries of this programme will be identified according to their level of participation in the conservation of resources.

3.1.2. Application Zone of the Programme

Ordinarily, this area can, and will be, much wider than that described in the previous subsection. This area can include, for example, the entire basin in which the conservation zone is located or can simply go beyond the ecosystem to be protected, and include the political demarcations related to the ecosystem. The area of application of the programme would be the economic, political, environmental and social units that are directly related to the mangroves to be protected.

3.2. Identifying Environmental Services

It is then necessary to identify the specific environmental services that are provided by the ecosystem. These services must be ordered according to their levels of importance and value and they should also be classified. There are different ways to classify these services, and they can be distinguished between:

- intermediate services,
- final services [14].

They can also be distinguished between:

- existing ecosystem service,
- potential ecosystem service [14].

The most widespread distinction classifies them as:

- provision services,
- regulation and maintenance services,
- cultural services [15].

3.3. Groups that Benefit from Environmental Services

The next step is to make a list of the groups that benefit from the environmental services provided by the ecosystem which is the focus of attention. We must not lose sight of the fact that the fundamental objective of the programme to be designed is to make the cost of its conservation fall on the beneficiaries of environmental services, according to aforementioned principle of "whoever benefits must pay".

The correct delimitation of those beneficiaries, according to the list of environmental services provided by the mangroves, is fundamental for the construction of the proposal, since these groups will be those that pay according to the principle of common but differentiated responsibilities (CBDR) in the United

Nations Framework Convention on Climate Change (UNFCCC) that was formalised at the Earth Summit in Rio de Janeiro, Brazil in 1992. According to this principle, we are all responsible for the care and protection of the environment, "but not all of us have the same level or degree of responsibility, since the principle depends upon different factors. At the national level, the principle does not present many complications *a priori* since for any legal system it is usual to differentiate between different obligations, depending on the subject in question that is to be regulated. However, in the area of Public International Law, its consideration does merit further study…" [16].

At this stage of the process of designing the Environmental Services Payment Programme, it is important to distinguish the level of framing of beneficiaries, such as the municipal, state, national and international or global levels, since the payment strategy will depend to a large extent upon those levels, which will also dictate the necessary legal bases for the design of this instrument. The legal bases, which will be discussed later in this paper, will be related to the particular level of those will benefit from the payment.

Likewise, it is fundamental to associate each specific environmental service with those who benefit from it. An example of the above-mentioned argument can be seen in the following **Table 1** [17].

Sometimes, the beneficiaries are very diffuse, especially as the scale or scope increases and, therefore, it is normal that the smaller scale will involve the associated environmental services.

Direct vs. Indirect Benefits

It is also important to distinguish between direct and indirect benefits at this stage, since it is desirable that environmental services be paid for, at least initially, by direct beneficiaries, although there are others who benefit indirectly from these services. As these types of schemes permeate throughout a society, it would be desirable for all beneficiaries (either directly or indirectly) to be paid for an environmental service, although logically, this would be based on the aforementioned principle of common but differentiated responsibilities (CBDR).

3.4. Identification of the Owners or Holders of the Resources Contained in the Ecosystem

It is necessary to determine who are the owners or holders of resources providing environmental services. It is also necessary to take into account that, in the case of mangroves, the usual modus operandi is to find ourselves with different regimes of "land tenure". It is common to have both public and private lands, ejidatarios (holders of the rights to communal lands), owners, possessors, concessionaires, in addition to applying to the same mangrove. Furthermore, some spaces are often within the federal maritime land area and other spaces are outside of such land, and consequently there are differences in the applicable legal regimes. This delimitation of owners or possessors must serve to identify those who will be benefited by the programme, that is, those who will be paid to carry

Table 1. Scope of the environmental services of the Alvarado Lagoon System (ALS) in the Gulf of Mexico.

Environmental Service	Scope			
	Local	State	National	International
Tidal protection and flood control	130,277 Municipal inhabitants* (Direct)			
Sediment accumulation and soil formation	130,277 Municipal inhabitants* (Direct)			
Area for breeding, shelter and feeding of species	Total number of employed staff. Sector 11: Fishing and aquaculture. 2739 Municipal inhabitants* (INEGI, 2010) (Direct)			
Scenic beauty	130,277 Municipal inhabitants* (Indirect) Tourism companies (Direct)	Tourists from the state of Veracruz (Direct)	Tourists from around the country (Direct)	Tourists from around the world (Direct)
Food production	130,277 Municipal inhabitants* (Direct)	State inhabitants who acquire food from fishing on the site (Indirect)	Inhabitants of other states where there is a trade in food species (Indirect)	
Habitat for human populations	96 people in the mangrove area (Direct)			
Pollution control and improvement of water quality	130,277 Municipal inhabitants*			
Oxygen production and carbon dioxide capture	130,277 Municipal inhabitants*	Although there is no specific number of people who benefit, this service has an international scope		

*Municipalities: Alvarado, tlalixcoyan, ignacio de la llave, acula, tlacotalpan and ixmatlahuacan.

out or prohibit the carrying out of actions with respect to the conservation of mangroves, thus guaranteeing the provision of environmental services.

We should also include groups involved in the use of the mangrove, for example groups of fishermen who have traditionally carried out activities to use the resource and which the programme may propose to modify or limit.

3.5. Construction of Conservation Scenarios and Their Relationship with Environmental Services

For a proposal of this type, this subsection focuses on the construction of hypothetical scenarios for conservation of the resources of an area. These scenarios will serve, subsequently, to establish the objectives of the programme, which will be the basis for the payment contract for the Environmental Services Agreement between the beneficiaries and those who pay for the environmental services.

These projections can be established in the medium or long term. However, it is advisable to undertake them in the medium term of 20 or 30 years, a time period that is considered adequate in order to observe changes in an ecosystem with an adequate conservation policy.

Here, the construction of three scenarios is proposed, in a general sense:

The first scenario, which we describe as "pessimistic", would take as a basis a period of approximately 30 years up until today, normally characterised (especially in the first half of that period) by inaction and, therefore, a considerable loss of mangrove has ensued.

The second scenario, which we describe as "intermediate" could be constructed based on the levels of mangrove loss over the last five years (for which there are existing data), so that the projection would reflect the current trend.

The third scenario, which we describe as "optimistic", proposes an improvement in the level of conservation, the result of the Environmental Services Payment Programme and, therefore, it would be the scenario that would help the ecosystem to continue providing these services and even to expand them.

3.6. Objectives of the Environmental Services Payment Programme

After having constructed these hypothetical scenarios and in order to achieve the most optimistic of them, the objectives of the Environmental Services Payment Programme should be considered. Each objective must be associated with a specific environmental service. It will be necessary to distinguish between conservation and restoration objectives and to associate deadlines with them. The objectives must involve a series of actions and must identify and associate a group or several separate individuals to each of the actions. In **Table 2** there is an example of the above [17].

3.7. Identifying Payment Beneficiaries

The next stage in the design of the Environmental Services Payment Programme focuses on clearly identifying who should benefit from the payment, that is, to whom it should be paid and also why it should be paid. Beneficiaries of the payment are those who should carry out the preventative actions, any conservation and/or restoration deemed necessary in order to achieve the objectives of the programme. In this case, the beneficiaries have been grouped, and they are ordered by their importance, and priority is given to those in a more vulnerable situation, that is, those who have been considered as cases where it is necessary to give a priority payment. **Table 3** provides an example of how to organise or divide the groups who benefit from the payment [17].

3.8. Defining Complementary Actions

At the same time, the complementary actions that should be carried out by a group or sector should be included, even if they receive no remuneration for it.

Table 2. Environmental services-objectives to fulfill. Those who perform the actions for which they receive a payment and those who perform complementary actions.

Environmental Service*	Objectives	Who must perform the actions and then receive a payment for them	Complementary actions
Tidal protection and flood control	- Reforestation of areas that have suffered excessive cutting. - Protection in areas with preserved mangroves.	- Ejidatarios and land co-owners. - Possessors. - Private owners.	Concessionaires
Sediment accumulation and soil formation	- Reforestation of areas that have suffered excessive cutting. - Protection in areas with preserved mangroves.	- Ejidatarios and land co-owners. - Possessors. - Private owners.	Concessionaires
Area for breeding, shelter and feeding of species	- Establish strict closure periods. - Organise a surveillance group. - Restrict the fishing of species where the number of examples is compromised.	Working team of owners, ejidos, communities, and possessors	Municipal governments
Scenic beauty	- Residental collection of rubbish within the mangroves, on the banks of lagoons and within lagoons.	Fishermen	- Municipal - Governments. - Municipal inhabitants.
Food production	- Establish strict closure periods. - Organise a surveillance group. - Restrict the fishing of species where the number of examples is compromised.	Working team of owners, ejidos, communities, and possessors	Municipal governments
Habitat for human populations	- Establish mangrove use and maintenance rules.	This is a service that does not have to be paid; the establishment of rules of use and maintenance of the mangrove has to be respected by all and does not represent a cost.	
Pollution control and improvement of water quality	- Reduce the emission of pollutants coming from upstream. - Periodic analysis of water quality in the Lagoon System.	- Ejidatarios and land co-owners. - Possessors. - Private owners.	Companies and industries. Veracruzana University, Veracruz, Mexico or research institutions.
Oxygen production and carbon dioxide capture	- Reforestation of areas that have suffered excessive cutting. - Protection in areas with preserved mangroves.	- Ejidatarios and land co-owners. - Possessors. - Private owners.	Concessionaires

Key: Ejidatarios, ejidos or ejidos management: holders of the rights to communal lands.

For example, the government or municipal governments could assume the surveillance or coordination duties of a commission, which is made up of different sectors, for the dissemination of the programme. For instance, fishermen could take responsibility for certain cleaning tasks, etc.

3.9. Identifying Those Who Are Due to Be Paid and the Payment Amount

The next step is to determine who should pay for environmental services (according to the relative information of the beneficiaries, as previously revealed)

Table 3. Beneficiaries of the environmental services payment in the Alvarado Lagoon System (ALS) in the Gulf of Mexico.

Group 1	Group 2	Group 3
People with mangrove lands: Ejidos and communities: - Alvarado: 19 - Tlalixcoyan: 56 - Ignacio de la Llave: 30 - Acula: 9 - Tlacotalpan: 19 - Ixmatlahuacan: 8 Possession-holders: - Alvarado: 764 - Tlalixcoyan: 874 - Ignacio de la Llave: 572 - Acula: 140 - Tlacotalpan: 51 - Ixmatlahuacan: 61 Private owners	Working team of the owners, ejidos, communities and owners for the protection of the area with respect to breeding, refuge and feeding of species, which in turn will ensure the food production.	Fishermen

Key: Ejidatarios, ejidos or ejidos management: holders of the rights to communal lands.

and how much they should pay. This latter aspect is perhaps the most complicated in a proposal of this kind, since it is not easy to give natural resources an economic value. There already are multiple methodologies that aim at valuing some of the environmental services pertaining to mangroves, which can be used for a proposal of this type. According to the calculation that results from each of the services and those directly benefited by these services, we can obtain the amount to be paid.

It is usual, based on these methodologies, that results are obtained that are too high to make a realistic payment proposal and also according to the level of income in the area. Hence, one must choose to divide the programme into stages of application, so that in the first stage it is chosen to pay only some of the environmental services that are provided by the ecosystem and in subsequent stages others be paid, depending on the impact that the programme has had on the conservation of natural resources. According to some authors "it is necessary to assess only those services that are directly consumed by the human being to avoid overestimating their value". [7]

Table 4 exemplifies the discussion in the above [17].

Who Shall Receive the Payment?

It is convenient to group the sectors into those we believe the payment should fall. These sectors will have to separate themselves from the beneficiaries of the environmental services provided by the ecosystem and it is suggested that they be sorted or consolidated according to the benefits or services received for the conservation of the mangroves, taking into account whether they are directly or indirectly benefited and according to their economic capacity. For example: inhabitants of the municipality or municipalities where the mangroves are located; tourists who visit the area; private companies that are in some way related to the

Table 4. Environmental services: who makes the payment, who receives the payment, and what is the payment amount?

Environmental service	Acciones complementarias	Who receives the payment?	Who makes the payment?	How much is to be paid?
Tidal protection and flood control	Concessionaires	Ejidatarios, land co-owners, possessors, and private owners.	Inhabitants of the 6 municipalities	US$1,743,620.01 (13.33%)
Sediment accumulation and soil formation	Concessionaires	Ejidatarios, land co-owners, possessors, and private owners.		
Area for breeding, shelter and feeding of species	Gobiernos municipales	Working team of the owners, ejidos, communities and owners		US$1,635,052.52 (12.5%)
Scenic beauty	Gobierno municipal y habitantes de los municipios.	Fishermen	Tourists	US$4,578,147.06 (35%)
Food production	Gobiernos municipales	Working team of the owners, ejidos, communities and owners		US$1,635,052.52 (12.5%)
Habitat for human populations	-			
Pollution control and improvement of water quality	Companies and industries	Ejidatarios, land co-owners, possessors, and private owners.	Companies: brewery, paper mill and sugar mill.	US1,743,620.01 (13.33%)
Oxygen production and carbon dioxide capture	Concessionaires	Ejidatarios and land co-owners, possessors, and private owners.	Carbon market	US$1,743,620.01 (13.33%)

Key: Ejidatarios, ejidos or ejidos management: holders of the rights to communal lands.

ecosystem.

During recent years, different initiatives that are related to the development of different carbon markets have been developed and it is very convenient to aim at attracting or incorporating buyers of this carbon capture service through the sale of credits or certificates. Hence, it is important to determine the amount of carbon that the area captures. There are several methodologies for calculating the capture capacity of mangroves.

3.10. Legal Basis for Requesting Payment: Mandatory Instruments vs. Voluntary Instruments

The legal bases that the programme will rely on for its implementation will be, of necessity, related to the level of those bodies to which the payment will go. For example: if we consider that the inhabitants of the municipalities where the ecosystem is located must pay for the flood control service, then, for the payment of that service, the legal bases should be sought in municipal law. It is also important to take into account that payments can be required on a compulsory basis,

for example, via a levy or voluntarily and through contribution amounts that have already been established.

To effect payments from those who are obliged to pay towards the fund from which the payments to the beneficiaries will be made later, there are several options. Firstly, it is necessary to set up a public, private or mixed (public/private) economic fund. The most convenient situation, in our opinion, would be the constitution of a mixed fund that can draw on both public and private contributions.

Environmental funds are financial mechanisms that facilitate the implementation of policies and actions to protect the environment. They act "complementing governmental actions and encouraging the participation of civil society in the conservation of natural resources, reconciling global environmental demands with national priorities and realities" Most commonly, these types of funds are established as private foundations or trusts, as non-governmental organisations, or as non-profit limited liability companies and they are usually administered by a board of directors consisting of members of the public and private sectors [18].

3.11. Agreement for Making the Environmental Services Payment

The conclusion of a payment of environmental services contract is absolutely necessary between the beneficiaries and the institution that manages the resources. The intention of this contract is to clearly establish the obligations borne by those who will receive payments and to stipulate that the total, or any partial, breach of these obligations will entail the suspension of payments and even the termination of the contractual relationship.

3.12. Communication and Information Campaigns as Complementary Instruments

A communication and information campaign is fundamental to the success of the programme. This campaign should be directed to all of the sectors involved in the programme, both the beneficiaries of the payment and those who are obligated to make the payment, the authorities and society in general. It is a necessity that the society is informed of the assessment of the environmental services of the area and also what the assessment is for and why it was made. A communication campaign is essential in the event that part of the programme is financed through voluntary contributions (from tourists, for example).

3.13. Evaluation and Monitoring

The monitoring of the programme can be carried out through a Councils' Council that would be created for this purpose, and through which the relevance and utility of the programme would also be evaluated periodically. For the evaluation, it is useful to have brigades of volunteers that review the fulfilment of the objectives that have been agreed upon and accepted by all parties.

3.14. Updating the Programme

The payment for environmental services programme should be evaluated periodically. The duration of each stage can be biannual and, after this period, it will be necessary to rethink the objectives and the resources that are intended for the payments.

4. Conclusions

1) Mangroves play an important role in the mitigation of greenhouse gases, which is an important function that has not yet been recognised in Mexican environmental policy, and these ecosystems are in a very vulnerable situation. The conservation of mangroves can be encouraged, not only from a normative strategy but also through the use of economic instruments that promote the internalisation of environmental externalities in terms of protection of the atmosphere.

There are also the legal bases within each of the three levels of government for the design of an Environmental Services Payment (PSA) Programme for mangrove atmosphere. In many cases the mangroves are located within the fringe of the Federal Terrestrial Maritime Zone according to the provisions of the Regulation for the use and exploitation of the territorial sea, navigable waterways, beaches, federal maritime land area and land reclaimed from the sea and, therefore, their regulation is a matter of federal competence. However, the states and municipalities in which the mangroves are located have a large number of competencies related to the management of these important environmental resources and they could be involved in some of the aspects of the design of this economic instrument.

2) In order to design a payment programme for ecosystem or environmental services in mangroves it is necessary, firstly, to clearly delimit the area over which the influence is desired through the Environmental Services Payment (PSA) Programme, and distinguishing between the following:

- Conservation and restoration zone.

The objective zone or zone for which the programme is designed is the space over which the most intense conservation and/or restoration actions are necessary. In this area, the most vulnerable resources will be found, as well as those resources that provide the greatest number of environmental services. In this space, most of the beneficiaries of this programme will be identified according to their level of participation in the conservation of resources.

- Application area of the programme.

This area can and will usually be much wider than the conservation and restoration zone. It can include, for example, the entire basin in which the conservation zone is located or simply go beyond the ecosystem to be protected, including the political demarcations at are related to the ecosystem. The area of application of the programme would be the economic, political, environmental and social units that are directly related to the mangroves that are in need of protection.

3) It is necessary to identify the specific environmental services that are provided by the ecosystem. These services must be ordered according to their importance and value and they should also be classified. It is necessary to list the groups that benefit from the environmental services provided by the target ecosystem. It is also important to distinguish between the levels that these beneficiaries fit into: municipal, state, national and international or global, since the payment strategy will depend to a large extent on those levels, which will also provide the legal bases that are necessary for the design of this instrument.

4) The traditional "polluter-pays" principle, according to which the potential polluter must bear all of the economic costs incurred in preventing and controlling pollution, is not the only principle for the distribution of costs, since the principle of "whoever benefits must pay", according to which those who receive or expect to receive benefits for pollution control activities or conservation actions should pay for those benefits.

5) It is necessary to determine the identities of the owners or holders of the resources providing environmental services. It is necessary to take into account that, in the case of mangroves, it is usually the case that there are different regimes of land tenure. It is common to have both public and private lands, ejidatarios (holders of the rights to communal lands), owners, possessors, and concessionaires. Additionally, the same mangrove can and often is located on spaces that are, sometimes, within the Federal Terrestrial Maritime Zone and, in other cases, that same mangrove can be outside of that zone, consequently, with differences in the applicable legal regimes.

6) It is necessary for a proposal of this type to focus on the construction of hypothetical scenarios for the conservation of the resources of the area. These scenarios will serve, subsequently, to establish the objectives of the programme, which will be the basis for the payment contract for the Environmental Services Agreement between the beneficiaries and those who pay for the services. After having constructed these hypothetical scenarios, and in order to achieve the most optimistic of them, the objectives of the Environmental Services Payment (PSA) Programme should be considered. Each objective must be associated with a specific environmental service.

7) The next stage in the design of the Environmental Services Payment (PSA) Programme has a focus on clearly identifying who should benefit from the payment, that is, to whom should the payment be made and why should it be made. The beneficiaries of the payment are those who should carry out the prevention, conservation and/or restoration actions that are necessary to achieve the objectives of the programme.

8) The next step is to determine who should pay for environmental services and how much they should pay. This aspect is perhaps the most complicated in a proposal of this type, since it is not easy to provide an economic value of natural and environmental resources, although there are different methodologies in this regard. It is convenient to group the sectors to which the payment should be

made. These sectors will have to rid themselves of the beneficiaries of the environmental services provided by the ecosystem. Those beneficiaries and can be sorted or consolidated according to the benefits or services received for the conservation of the mangroves, taking into account whether they are directly or indirectly benefited and also their economic capacity.

9) It is necessary to design a communication and information campaign that is targeted at all actors that are involved in the programme. The campaign would permit the imaginative contribution of the groups of interest, prevent social conflicts and provide transparency to the programme.

10) The monitoring of the programme can be undertaken through a Citizens' Council that would be created for this purpose, and in which the relevance and utility of the programme would also be periodically evaluated.

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