Tropentag 2019, Kassel, Germany
September 18-20, 2019

Conference on International Research on Food Security, Natural Resource Management and Rural Development
organised by the Universities of Kassel and Goettingen, Germany

Ecosystem Services Valuation in Puerto Vallarta, Mexico for a Concurrent PES Scheme to Foster Adaptation to Climate Change

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Mexico introduced a nation-wide payment for ecosystem services (PES) scheme in 2003 as an economic incentive for forest owners to compensate them for conservation costs and expenditures incurred in while carrying out good land use practices. Due to budgetary constraints the Mexican government migrated from a purely public to public-private funding, called concurrent funds. To implement such scheme the National Forestry Commission (CONAFOR) requires information of the value of the ecosystem services and the land use opportunity cost. The National Institute of Ecology and Climate Change (INECC) developed such information for the watersheds that feed Puerto Vallarta in the state of Jalisco, Mexico. The location was chosen given its ecological and touristic importance and because it has been subject of the project "Conservation of Coastal Basins in the Context of Climate Change" to foster ecosystem-based adaptation (EbA) actions. The research intended to showcase the importance and value that upstream ecosystem services provide to tourism, the potential to implement EbA in the region and also to provide economic incentives to landowners to conserve forests and implement low-impact agricultural practices. To achieve these objectives a literary review was conducted to understand the environmental, social and economic dynamics in the area and to identify the priority ecosystem services, then the willingness to pay and accept (WTP and WTA) was estimated via a contingent valuation to consider the rural/urban and consumers/producers perspectives. The study focused on water provision, scenic beauty and carbon sequestration by the upstream forest in the region. During this contingent valuation, economic data regarding forestry and agriculture activities was also captured to calculate the opportunity cost to conserve the forest. The results showed that tourist and residents would be willing to pay $3,161 million pesos per year and farmers would be willing to accept $1,524.6 million pesos. This shows the great existing potential and feasibility to implement a concurrent PES scheme. A payment of $2,070 pesos per hectare would be a sufficient incentive to allow conserving 51.7% of the forest areas of the watersheds. This research evidence the great potential to implement concurrent PES schemes in Mexico to conserve large forest areas while contributing to its Nationally Determined Contributions under the Paris Agreement.

Introduction

Mexico is a particularly vulnerable to the impacts of climate change due to its geographical location, topography and socioeconomic characteristics (INECC-SEMARNAT, 2018), which differentially affect population groups, as well as productive activities and natural systems with for example water availability decrease, loss of agricultural yields, vector transmitted diseases,

floods, loss of biodiversity and ecosystem services, to name a few (DOF, 2014). Given this scenario, it is important to promote adaptation to climate change as a way to address these impacts and reduce the vulnerability of natural and social systems.

For the last 25 year Mexico's economy has transition to a services focused one, from 1993 the services sector has increased from 56 per cent of the Gross Domestic Product (GDP) to 64 per cent (INEGI, 2019). Within the sector one of the most important activities is tourism, it has contributed to an average 4 per cent of the Mexican GDP for the last 6 years (INEGI, 2019). In 2018 Mexico was the seventh tourism most visited destination worldwide and the sixteenth in foreign exchange earnings due from tourist (SECTUR, 2019).

In this regard, Puerto Vallarta, in the Pacific coast of Mexico, is the sixth touristic destination in Mexico and in 2017 it attracted an expenditure of almost 800 million dollars, 4 per cent of Mexico's tourism activity (SECTUR, 2018; SECTURJAL, 2018). Puerto Vallarta presents an important amount of attractions based mainly on natural resources. In addition to its beaches, it has other natural spaces, as well as a huge green area of mangroves and marshes in the urban area. Unfortunately, there have been deficiencies in the implementation of plans, programs and regulations in the conservation and sustainable use of the natural areas of the municipality, which jeopardizes their preservation, sustainable development and livelihood of its inhabitants (SECTUR/Gobierno de Jalisco, 2014). The unsustainable development of Puerto Vallarta and its augmented vulnerability to climate change are boosted by steep slopes to the east of the municipality and by increasingly land use change for urbanization and agriculture in the higher regions of the mountain range. The attention to these issues is complexed by the progressively increasing incidence of extreme hydrometeorological events and their adverse effects.

In the last 20 years, the number of tropical cyclones has increased 32 per cent and almost half of the last 344 cyclones have achieved the hurricane category. Moreover, the frequency of hurricanes category 1, 3 and 4 has also increased and the tendency indicates it will only worsen in the near future (Figure 1). This increased cyclone activity can be attributed to climate change.

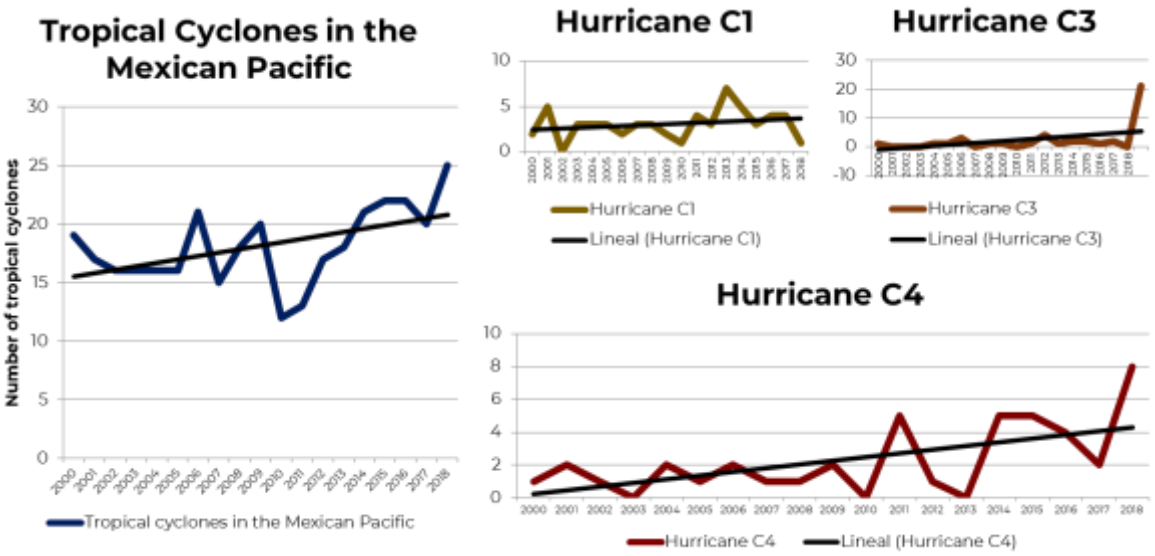


Figure 1. Incidence and tendency of tropical cyclones in the Mexican Pacific.
Source: own elaboration with information of (CONAGUA, 2018).

There is emerging evidence that allowed (T. Knutson, 2019) that at the global scale and in the northwest Pacific Basin, a future increase in tropical cyclone precipitation rates is likely; an

increase in tropical cyclone intensity is likely; an increase in very intense (category 4 and 5) tropical cyclones is more likely than not; and there is medium confidence in a decrease in the frequency of weaker tropical cyclones (NOAA, 2019). This would imply an even larger percentage increase in the destructive potential per storm. Existing studies suggest a tropical cyclone windspeed increase of about 1-10% and a tropical cyclone precipitation rate increase of about 10-15% for a moderate (2 degree Celsius) global warming scenario (T. Knutson, 2019).

Given the combined evidence of more frequent hydrometereological extreme events that will hit Mexican Pacific coast, the importance of tourism, increasingly land use change in the mountain range and the deficiencies in the implementation of plans to foster its sustainability, the exposure of Puerto Vallarta to adverse effects of climate change will likely increase its ecosystems and population vulnerability.

In order to prevent these two consequences it was necessary to propose projects and policy to preserve and use Puerto Vallarta's natural assets sustainably through the development of adaptation to climate change measures.

In the context of the project "Construction of adaptation monitoring and evaluation schemes in Mexico for the formulation of evidence-based public policies" between the National Institute of Ecology and Climate Change (INECC, for its acronym in Spanish) and the National Council of Science and Technology (CONACYT, for its acronym in Spanish). There were developed a set of essential criteria (recommendations and basic elements) to be considered during the life cycle of an adaptation to climate change measure. Within the proposed criteria, economic feasibility has been identified as a key one. It refers to the economic attributes of the measure itself and as well as the context in which it is promoted. That is to say, the success of an adaptation measure depends, in part, on the funds availability to be designed, carried out and sustained in the long run.

Currently Mexico is reallocating its public expenditure to attend country-wide social needs therefore funds for adaptation measures are limited. As a way to finance them, it was considered to rely on a concurrent funds scheme, as the one used by the national Payment for Environmental Services program, where resources are partially provided by the government and by the local population and private sector.

Material and Methods

To estimate the potentially collectible funds in Puerto Vallarta, an economic valuation of its environmental services was conducted. A biophysical and socio-economic characterization of the place of study was conducted. Based on this characterization, the main ecosystem services provided by the area were identified, as well as their providers and consumers. A contingent valuation exercise was carried out to estimate the willingness to pay (WTP) of the consumers or users of selected ecosystem services. To estimate WTP, a choice experiment was designed, which allows calculating the willingness to pay for different attributes of an ecosystem. A field survey was applied to a total of 551 people with two user profiles: tourists (nationals and foreigners) and residents.

In addition, a survey aimed to estimate the willingness to accept a compensatory payment (WTA) of the providers (farmers and foresters) of ecosystem services provided in Puerto Vallarta was carried out, also using a choice experiment. In particular, the area to be protected or preserved and the payment per hectare were considered as the attributes of the ecosystems. A survey was applied in situ to a total of 232 people. This survey also collected information necessary to

conduct a cost-benefit assessment to estimate the opportunity cost of shifting from purely productivities to adaptation measures.

Based on the estimation of the WTP and WTA, the supply and demand curves of providers and consumers of ecosystem services were approximated. For this, these curves were specified in the PxQ space, where P represents the monetary expression of the ecosystem services and Q the number of hectares of the study area. The amount of hectares (Q) ranges from 0 to 304,000 hectares, the latter being the estimated forest area in the study area. For its part, the monetary value ranges from 0 to the maximum potential amount that could be collected to finance the adaptation measures and ecosystem conservation.

The supply curve was estimated from the percentiles of the opportunity costs of the different types of rural producers. On the other hand, the demand curve was calculated considering the maximum WTP for the different profiles of respondents. To express these WTPs in terms of hectares, the respective WTP was multiplied by the total number of visitors per year in Puerto Vallarta or by the total number of households and this result was divided by the total number of hectares in the study area. This operation results in a DAP per hectare. Only the percentage of people who are willing to pay according to the results of the latent class model was also considered.

Results and Discussion

Based on the methodology presented in the previous section, the WTP, WTA and opportunity costs were estimated (Table 1). As the table shows, the average opportunity cost amounts to 1,683 pesos per hectare per year and the WTP by tourists amounts to 2,074 pesos per hectare per year, which indicates that there is a collectable margin to establish a concurrent fund scheme.

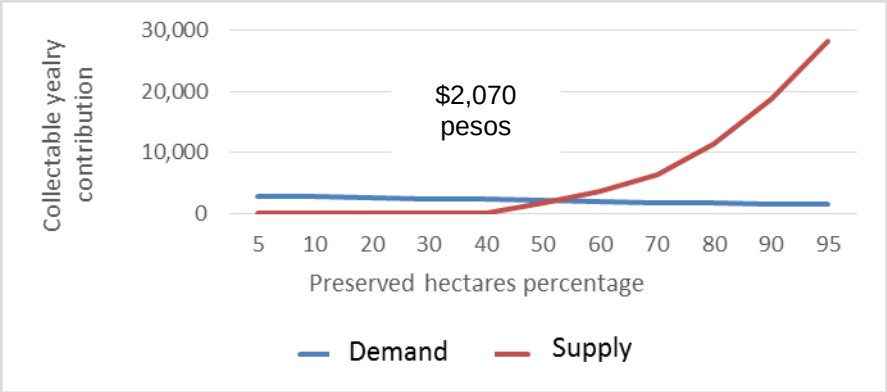
Table 1. WTP, WTA and opportunity costs (pesos per hectare per year)

Profile	Parameter	Mean	Minimum	Maximum
Tourists	WTP	2,074	1,397	2,751
Local inhabitants	WTP	22	14	30
Small enterprises	WTA	2,557	184	4,930
Community leaders	WTA	4,880	61	9,700
Agriculture (A)	Opportunity cost	2,631	0	29,886
Husbandry (H)	Opportunity cost	1,276	0	14,633
Forestry (F)	Opportunity cost	0	0	8,715
A + H + F	Opportunity cost	1,683	0	28,396

Source: Own preparation

Figure 1 shows supply and demand of ecosystem services curves in the study area. This figure was constructed based on the confidence intervals of the WTP and the opportunity costs of the 3 rural activities. From this figure the intersection between supply and demand was estimated; the intersection value amounts to 2,070 pesos (approx.. 100 USD) per hectare per year and is in the 51.7 percentile of the number of hectares. That is, if tourists and inhabitants contribute with 2,070 pesos per hectare per year, it is feasible to implement adaptation and conservation projects to preserve 51.7% of the forested hectares of the study area, which amount to 157 thousand hectares.

Figure 1. Supply and demand of ecosystem services



Thus, the main finding of this study is that there is a high economic feasibility for the implementation of adaptation measures based on the WTP, WTA and opportunity cost estimated. If the estimated maximum WTP would be collected, approximately 75 million dollars per year, there would be enough financial resources to cover the entire municipality and preserve 100 percent of its forests. Per hectare, this would amount to 10 times what the national PES scheme grants or 100 times more than the voluntary carbon market.

Conclusions and Outlook

This case study points out the local willingness to preserve and protect ecosystems and the services they provide to reduce the hazards brought by climate change. Economic instruments and approaches can provide feasible answers to questions or problems that might reach an impasse viewed from an ecological or agronomical approach. It is paramount to regard land use and land use change with a transdisciplinary perspective to achieve holistic solutions and gap financial issues.

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