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Zones with Potential for the Payment of Environmental Services in the Valle del Mezquital, Hidalgo

Genaro Aguilar-Sánchez
g_aguila@correo.chapingo.mx https://orcid.org/0000-0003-1518-0801
Reynol González-Vizcarra
canas_X@hotmail.com https://orcid.org/0000-0002-4983-3164
Universidad Autónoma Chapingo (México)
Carretera México-Texcoco, Km 38.5, Chapingo, municipio de Texcoco, Estado de México, México. 56230

KEYWORDS

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Facets

INTRODUCTION

According to the General Law of Sustainable Forestry Development of Mexico, environmental services are defined as those provided by forest ecosystems in a natural way or through the sustainable management of forest resources, such as: the provision of water in quality and quantity ; the capture of carbon, contaminants and natural components; the generation of oxygen; the damping of the impact of natural phenomena; climate modulation or regulation; the protection of biodiversity, ecosystems and ways of life; the protection and recovery of soils; landscape and recreation, among others (DOF, 2009).

In Mexico, environmental services have received increasing attention, such is the case of payment schemes for their protection. As a result of this, since 2003, the Payment for Environmental Services (PSA) program has been implemented, which works within a national scheme that provides financing for that purpose. In the case of Mexico, the governing body responsible for carrying out the direction and execution of this is the National Forestry Commission (Official Gazette of the Federation 2009).

The objective of the present work is to carry out an identification, at a regional level, of those potential payment zones for environmental services in the Mezquital Valley, Hidalgo State (Mexico).

The Forest Management Unit (UMAFOR) "1304-Valle del Mezquital", which by territorial extension occupies the first place within the state of Hidalgo relative to the other four management units that comprise it, has a total area of 642,654 hectares. It is located southwest of the state of Hidalgo, between the extreme coordinates 20º 42'19,98" 'and 19º 4' 09.81" north latitude, and 99º 51' 06" and 98º 46' 44,48" west longitude

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Correspondencia autores: g_aguila@correo.chapingo.mx (Genaro Aguilar-Sánchez).

METHODOLOGY

In the present work it is considered that the use of combined methodologies derived from simple observation and the help of the Geographic Information Systems (GIS) help to better define the important areas, for PES, of the semi-arid and arid regions. Ancira (2015) and Valdez (2011) support the veracity of the results by using satellite images combined with GIS.

The identification of eligible or priority areas for the PSA was based to a large extent on the combination of the methodology used by Imbach, I., (2005) and Chuvieco E. (2000). In which it is explained through the use of a Geographic Information System (GIS) and the Multicriteria proposed by Malczewski, J. (1999) for the analysis of proposals. This methodology was also used by Paneque (2006) and Paegelow, M., et al (2003) in studies on water governance and landscape modeling.

The methodology consists of two main components whose integration makes it possible to prioritize the PES; this refers to the fact that a map of the provision of ecosystem services is combined with a map of the threat or risk of losing these services. In this methodology, the different eligible activities are prioritized under the current CONAFOR environmental services schemes (which would be forest conservation and Forest Environmental Services, but each one is evaluated differently (González, B., 2011).

SPOT XS sensor satellite images were used, each covering an area of 3,600 km2 with 3 bands of the electromagnetic spectrum. The images cover 100% of the area covered by UMAFOR 1304, which corresponds to the Mezquital Valley region. Digital thematic cartography is obtained to attend the different variables, it is processed through the use of Geographic Information Systems (GIS) ArcGis © 9.2. The identification of the areas, of the Mezquital Valley, was carried out through geoprocessing and spatial analysis of the cartographic coverage.

In the present study, the "record-range procedure" was used. For equitable criteria and indicators, Equation 1 was used, while Equation 2 was used for the criteria and cost indicators (Bechhofer, E. 1954) and (Einot, I., and Gabriel, R. 1975).

The interpretation of these equations is that when the criterion or beneficial indicator is the highest, the value is more attractive and the criterion has to be maximized; and when the criterion or cost indicator is higher, the value is less attractive and the criterion has to be minimized (González, B., 2011). Thus, the criteria, which were used to evaluate the areas with priority for their importance for the provision of environmental services, their demand and the risk or threat of losing them, were chosen according to the literature consulted and the information available for the area of study.

Equation 1:

$$x'_{ij} = \left(\frac{X_{ij} - X_{jmin}}{X_{jmax} - X_{jmin}} \right) * 100$$

Equation 2:

$$x'_{ij} = \left(\frac{X_{jmax} - X_{ij}}{X_{jmax} - X_{jmin}} \right) * 100$$

where:

X'_{ij} = Value of the standardized pixel Xij = Value of all the pixels on the map

X_{ij} = Value of all the pixels on the map

X_{jmax} = Maximum value of the pixel on the map Xjmin = Minimum value of the pixel on the map

X_{jmin} = Minimum value of the pixel on the map

In the case of qualitative and categorical variables, Equation 3 was used, by means of which a value with equivalent rank (ascending or descending) is assigned to each class or category.

Equation 3:

$$Valor = \left(\frac{X_{ijmax}}{n} \right)$$

where:

V= value

X_{jmax} = Maximum value of the pixel on the map n = Number of classes or category

RESULTS AND DISCUSSION

Delineation of Earth Systems and Facets

Given the climatic conditions of the Management Unit, it was determined that polygons generated by temperate and semi-dry climate types, which converge in UMAFOR 1304, were used as Terrestrial Systems, due to the fact that by default the biological characteristics of flora and fauna they are affected by the climate factor. In such a way that for the present work they were located according to the climate vector layer of the Regional Forestry Study with scale 1: 250,000, nine polygons with own climatic characteristics, which gives us a total of nine Earth Systems to be described. It should be mentioned that according to the data obtained in terms of natural habitats in which the faunal species that will be mentioned below are developed, only a description of the vegetation type of each of the 9 terrestrial systems is made. We also obtained 20 facets in the entire IMAFOR 1304 area.

Importance for the conservation of ecosystems in the Region

In accordance with the map of land use and vegetation of the state of Hidalgo which is derived from the State Forestry Inventory scale 1: 50000, 23 categories or coverage were reported, of which 19 are of forest importance, because the forest units of abies, oak forest and low deciduous forest, you do not have high percentages.

Also, it can be highlighted that the MDM has a value of 100, the BMM with a value of 94, BQ with 87, Mixed B with a value of 74 and SBC with 59, the other types of vegetation have values under 50. The importance and value of studies on endemic species is mentioned by: León, B., Pitman, N., And Roque, J., (2006) where they make a study of endemic plants in Peru, which is influenced by the Cordillera de los Andes. Andes, with its variations in altitude and as a consequence of climate.

Surface loss at the regional level.

Using the equation 1 proposed above, the ecosystems with the greatest loss of surface are those with the highest value, for this case the highest value is assigned according to the scale used by the methodology, that is, 100 and this value is the reference to define the lower values, which will be in proportion to the surface loss and will be lower

As a result of the proposed methodology, the eligible zones for the Payment for Environmental Services within the UMAFOR 1304 were identified. The value range of 0-100, highlighting values of 1, 36, and 40, is significant. Higher values correspond to areas that have more value for their conservation. Eligible areas to be proposed for the PSA of higher priority, demand and risk of losing SEs were identified. The results show that only 911 ha of the entire surface in the UMAFOR are areas of high to very high priority due to the supply and risk of losing SE derived from the conservation of biodiversity.

CONCLUSIONS

Eligible areas to be proposed for the PSA of higher priority, demand and risk of losing SEs were identified. The results show that only 911 ha of the entire surface in the UMAFOR are areas of high to very high priority due to the supply and risk of losing SE derived from the conservation of biodiversity.

The different methodologies and procedures that we use in this work can be implemented by the state management of CONAFOR, with the objective that decision-making on the choice of priority areas for the PSA be carried out in a decentralized manner and that all the owners of land located in important areas for the PSA, have the same opportunities to participate and be elected.

Studies on the environmental services provided by forests are relatively recent, Domínguez, O., Betancourt, Y. and Rodríguez, G, (2007) indicate that in Cuba, in 2004, institutions and the people in general are unaware of the importance of SA, which provides in forest and, which have been provided spontaneously. They also mention that there are no works on their economic valuation. Therefore, what is done in Mexico is relevant. But in order not to lose SEs, it is necessary that the PSA is greater than what is authorized by CONAFOR, as indicated by Sánchez A., García R M., and Palma A. (2007). Since both the PSA, and the PSAH, are important to conserve and preserve the ecosystems of Mexico.