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Role of forest conservation in lessening land degradation in a temperate region: The Monarch Butterfly Biosphere Reserve, Mexico

Lilia Manzo-Delgado*, José López-García, Irasema Alcántara-Ayala

Instituto de Geografía, Universidad Nacional Autónoma de México, Ciudad Universitaria, México City, D.F., Mexico

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ABSTRACT

With international concern about the rates of deforestation worldwide, particular attention has been paid to Latin America. Forest conservation programmes in Mexico include Payment for Environmental Services (PES), a scheme that has been successfully introduced in the Monarch Butterfly Biosphere Reserve. To seek further evidence of the role of PES in lessening land degradation processes in a temperate region, the conservation state of the Cerro Prieto *ejido* within the Reserve was assessed by an analysis of changes in vegetation cover and land-use between 1971 and 2013. There were no changes in the total forest surface area, but the relative proportions of the different classes of cover density had changed. In 1971, closed and semi-closed forest occupied 247.81 ha and 5.38 ha, 82.33% and 1.79% of the total area of the *ejido*, respectively. By 2013, closed forest had decreased to 230.38 ha (76.54% of the *ejido*), and semi-closed cover was 17.23 ha (5.72% of the *ejido*), suggesting that some semi-closed forest had achieved closed status. The final balance between forest losses and recovery was: 29.63 ha were lost, whereas 13.72 ha were recovered. Losses were mainly linked to a sanitation harvest programme to control the bark beetle *Scolytus mundus*. Ecotourism associated with forest conservation in the Cerro Prieto *ejido* has been considered by inhabitants as a focal alternative for economic development. Consequently, it is essential to develop a well-planned and solidly structured approach based on social cohesion to foster a community-led sustainable development at local level.

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1. Introduction

1.1. Environment and development: the international agenda

Sustainability has been defined as 'a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional changes are made consistent with future as well as present needs' (Brundtland Commission (1987)). At the first Earth Summit on Sustainable Development in 1992, Agenda 21 called for the integration of environment and development. Of particular interest was the necessity of team work based on an integrated approach for planning and management of land resources, in addition to combating deforestation (United Nations Conference on Environment and Development, 1992), since global figures were already disconcerting (Table 1). Twenty years after, the main outcome of the Earth Summit Conference Rio+20 on Sustainable Development was the document *The future we want*, which renewed the commitment to

sustainable development and to promotion of an economically, socially and environmentally sustainable future for the planet and for present and future generations (United Nations, 2012).

Global figures indicate that deforestation rates decreased from 16 million ha/y⁻¹ during 1990–2000 to 13 million ha/y⁻¹ during 2000–2010; similarly, the area of other wooded land decreased by ~3.1 million ha/y⁻¹ during 1990–2000, but by ~1.9 million ha/y⁻¹ during 2000–2010 (FAO, 2010). At the global level, the creation of protected areas has played an important role in restricting deforestation and in supplying environmental services such as (1) Carbon sequestration and storage, (2) Biodiversity protection, (3) Watershed protection, and (4) Landscape beauty (Wunder, 2005). Each requires preservation of the environment. The philosophy behind linking economic incentives to environmental services has been interpreted in two contrasting ways when conservation and rural development are separate aims: Conservation of the environment will accompany any improvement of socio-economic conditions; and environmental protection will lead to land dispossession and loss of root culture (Karsenty, 2004; Karsenty and Nasi, 2004; Romero and Andrade, 2004). The latter interpretation is strongly related to the poverty levels at which marginalised groups live; they must depend upon scarce resources,

* Corresponding author. Tel.: +52 55 5622 4334/5623 0222x45501.

E-mail address: lmanzo@igg.unam.mx (L. Manzo-Delgado).

Table 1
Forest Resources Assessment 1990 – Global synthesis (FAO).

	Forest & other wooded land			Total 1000 ha	Forest		Biomass million tons	Other wooded land 1000 ha
	Total 1000 ha	Annual change 1000 ha	%		% Of land	Per cap. ha		
Developed Countries	2,063,565	–78.6	0.01	1,432,457	27	1.07	112,598	631,108
Developing Countries	3,056,663	–9874.1	0.43	2,009,912	26	0.50	327,882	1,046,751
Total	5,120,227	–9952.7	0.20	3,442,369	27	0.64	440,479	1,677,859

withstand economic crises and food shortages, and adapt to commercial practices established by outsiders or to new socio-economic perspectives based on culture.

In 2011, the International Union for Conservation of Nature (IUCN) registered 157,897 protected areas, encompassing more than 24 million Km² and representing 16.2% of the surface of the Earth (IUCN, 2012). These numbers confirm the interest in conserving not only biodiversity but also the forest cover (Chape et al., 2008). However, protected areas are subject to significant deterioration through resource extraction, land use change and ecotourism (Carey et al., 2000), caused by socio-economic conflicts in combination with ecosystem vulnerability associated with extreme meteorological events, the topography and the types of vegetation (Goodman, 2003; Figueroa et al., 2011).

Ecotourism seems to be one of the most attractive options for rural communities, particularly those living in poverty. However, one of the major challenges facing ecotourism in both developed and developing countries is to maintain a balance between environmental stresses and conservation. In the Monarch Butterfly Biosphere Reserve (MBBR), Payment for Environmental Services (PES) programmes have reduced deforestation; this has contributed to the conservation of the environment and to the preservation of a unique physiographic setting in Mexico where the monarch butterfly hibernates, and activities associated with tourism have been developed.

Traditional knowledge and practices of indigenous peoples and local communities are key ingredients for conservation and sustainable use of biodiversity. Nonetheless, adequate strategies to improve social well-being and to implement sustainable livelihoods for those groups have not been properly addressed, particularly in mountain areas. Marginalization, poverty, food insecurity and malnutrition, social exclusion and environmental degradation are still major elements in these areas (United Nations Development Programme, 2012).

In the framework of the world-wide scenarios for the period 2000–2050, included in the IAASTD Global Report (Rosegrant et al., 2009), it was pointed out that the impacts of changes in agriculture and demand for biofuels cause land-use changes. Total land use for the world's population is estimated to have increased by 4 million km² by 2050, with the rising demand for bioenergy being one of the most significant causes. Moreover, natural forest areas are decreasing in all regions, but in developing regions such as Latin America and the Caribbean, and South-East Asia and the Pacific, this decline is even greater.

Biodiversity has been decreasing for several centuries, most significantly in temperate and tropical grasslands and forests. Future scenarios suggest that this tendency will be maintained with an accelerating further loss of biodiversity, and that the rate of reduction of biomass for the period 2000–2050 will be greater than in the period 1970–2000 (Rosegrant et al., 2009).

During the past 20 years, considerable areas of forest have been converted in Amazonia, South-East Asia, and Central and West Africa. Around 40% of the global land surface is occupied by agriculture; nonetheless, there has been no incentive to establish new

technologies that could increase productivity in regions such as Latin America (Thornton and Herrero, 2010).

Interpretation of scenarios for forest conservation raises diverse questions, particularly in terms of assessing the severity of degradation and the associated environmental, social and economic impacts. Sources of uncertainty in those models are also of concern and as future conservation of forest remains uncertain, the only practical action that can be undertaken involves the development of strategies for environmental protection at regional and local level.

1.2. Environmental conservation in Mexico

In Mexico, temperate forest provides a large range of environmental services including groundwater recharge, carbon capture, biodiversity protection and scenic beauty. However, these environmental services are affected by deforestation, illegal logging, land-use changes and forest-fires, which favour global warming, biodiversity loss, floods and hillslope instability. In the context of economic need, land tenure has played an important role in the exploitation of natural resources in opposition to forest conservation.

Annual loss of forest amounted to 354,000 ha in the 1990s, 235,000 ha during 2000–2005, and 155,000 ha during 2005–2010, representing an annual deforestation rate of 0.5%, 0.4% and 1.2%, respectively (FRA 2010). In the past decade, Mexico was one of the very few countries in which the rate of deforestation followed a downward trend. The decrease is attributable to the development of new conservation policies to promote the sustainable use of natural resources by application of various programmes, most notably of PES (Muñoz-Piña et al., 2008) and the national reforestation programme.

The establishment of Natural Protected Areas (NPAs) has contributed significantly to forest conservation (Figueroa and Sánchez-Cordero, 2008; Figueroa et al., 2009). At present, there are over 25 million ha of NPAs, equivalent to 13% of the surface of Mexico. However, this designation *per se* does not guarantee protection and conservation. At the beginning of 2000, a PES programme was created with the aim of providing economic incentives to land owners to refrain from logging in areas situated within a NPA (Honey-Rosés et al., 2009).

PES is a voluntary, negotiated framework that does not involve command-and-control measures but has a well defined and measurable environmental service that is being bought by a buyer from a provider who secures its continuous provision, although in some cases the service needs to be intermittent and fulfilment must be monitored (Wunder, 2005).

The number of implemented PES schemes has increased in recent years, as have the benefits. Sub-programmes include hydrological services, carbon capture, non-forest use and conservation services. As a result, PES programmes in Mexico have helped to decrease deforestation and illegal logging in NPAs (Alix-García et al., 2010).

The concept of PES is accepted in principle, but some investigations have addressed the efficiency of these programmes

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