

## Trends of Conservation and Development in Mexican Biosphere Reserves: Spatial Analysis and Linear Mixed Model

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**Abstract :** Biosphere reserves (BR) are considered as the main strategy for biodiversity and ecosystems conservation. Mexican BR are mainly inhabited by rural communities who strongly depend on forests and their resources. Even though the dual objective of conservation and development has been sought in BR, land cover change is a common process in these areas, while most rural communities are highly marginalized, partly as a result of restrictions imposed by conservation to the access and use of resources. Achieving ecosystems conservation and social development face serious challenges. Factors such as financial support for development projects (public/private), environmental conditions, infrastructure and regional economic conditions might influence both land use change and wellbeing. Examining the temporal trends of conservation and development in BR is central for the evaluation of outcomes for these conservation strategies. In this study, we analyzed changes in primary vegetation cover (as a proxy for conservation) and the index of marginalization (as a proxy for development) in Mexican BR (2000-2015); we also explore the influence of various factors affecting these trends, such as conservation-development projects financial support (public or private), geographical distribution in ecoregions (as a proxy for shared environmental conditions) and in economic zones (as a proxy for regional economic conditions). We developed a spatial analysis at the municipal scale (2,458 municipalities nationwide) in ArcGIS, to obtain road densities, geographical distribution in ecoregions and economic zones, the financial support received, and the percent of municipality area under protection by protected areas and, particularly, by BR. Those municipalities with less than 25% of area under protection were regarded as part of the protected area. We obtained marginalization indexes for all municipalities and, using MODIS in Google Earth Engine, the number of pixels covered by primary vegetation. We used a linear mixed model in RStudio for the analysis. We found a positive correlation between the marginalization index and the percent of primary vegetation cover per year ( $r=0.49-0.5$ ); i.e., municipalities with higher marginalization also show higher percent of primary vegetation cover. Also, those municipalities with higher area under protection have more development projects ( $r=0.46$ ) and some environmental conditions were relevant for percent of vegetation cover. Time, economic zones and marginalization index were all important. Time was particularly, in 2005, when both marginalization and deforestation decreased. Road densities and financial support for conservation-development projects were irrelevant as factors in the general correlation. Marginalization is still being affected by the conservation strategies applied in BR, even though that this management category considers both conservation and development of local communities as its objectives. Our results suggest that roads densities and support for conservation-development projects have not been a factor of poverty alleviation. As better conservation is being attained in the most impoverished areas, we face the dilemma of how to improve wellbeing in rural communities under conservation, since current strategies have not been able to leave behind the conservation-development contraposition.

**Keywords :** deforestation, local development, marginalization, protected areas

**Conference Title :** ICFRD 2019 : International Conference on Forestry and Rural Development

**Conference Location :** New York, United States

**Conference Dates :** January 30-31, 2019