

EVALUATION OF NATURAL POTENTIALS IN THE TERRITORIAL ECOLOGICAL PLANNING: NORTHWEST OF THE STATE OF CHIAPAS, MEXICO

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From the perspective of sustainable development, programs of ecological land-use planning and environmental territorial regulation are tools for the definition of organized spatial patterns of human activities according to the land's potential uses and compatibility with the historical utilization of the territory. In this context, the evaluation of the natural land suitability of the study area aims at providing concrete criteria for the economically efficient and environmentally adequate use of present natural assets, based on the quantitative and qualitative availability of natural resources, the available data of the environmental attributes of land, and the potential for diverse socioeconomic and conservational goals.

Under this scenario, the evaluation of land suitability provides the needed information for knowing the true natural aptitude of the diverse units of the physical-geographical landscape considered as spatial units in a geographical analysis. Based on this assessment, it is possible to assign a prioritized selection of uses for a given territory in such a way that environmental conflicts among the involved stakeholders are minimized.

In the present work, several criteria are presented for the definition of natural potential categories (high, medium and low) for five basic land uses (agriculture, cacao grove, grazing, forestry and conservation) in the particular geographical setting of the northwestern region of the state of Chiapas, Mexico. In this assessment, the innovative criterion of adopting the natural landscape units as the spatial units was introduced.

The study was made in the northwestern territory of the state of Chiapas, located between the geographic coordinates 17° 59' 00" and 17° 17' 00", Northern Latitude, and 93° 33' 00" and 93° 00' 00", Western Longitude. The total extension of the studied territory is of approximately 2 456.88 km², including the municipalities of Reforma, Pichucalco, Juárez, Ostuacán and Sunuapa. According with Ortega-Gutiérrez *et al.* (1992), the zone belongs to the geological provinces of the *Cuenca Deltaica de Tabasco* (Tabasco Deltaic Basin) and the *Cinturón Chiapaneco de Pliegues y Fallas* (Chiapas Fold and Fault Belt). The relief in the territory features a spectrum of orographic steps in its central portion,

going from low mountains and pre-mountains to hills, and in its central-northern part, a system of hilly and undulated dissected plains and of flat plains. The dominant soil groups are Acrisols, with lesser extensions of Gleysols, Cambisols, Leptosols, Fluvisols, Luvisols, Andosols, Regosols and Vertisols. The natural vegetation includes tropical evergreen forest, medium-height tropical evergreen forest of Canacoite [*Bravaisia integerrima* (Spreng.) Standl], and freshwater wetlands, mainly of popal, that have been replaced by crops, cacao groves and extensive grazing. Five basic land uses are predominant: agriculture (banana, *Musa paradisiacal* L.), cacao (*Theobroma cacao* L.), grazing (bovines), forestry and conservation.

Previous to the process of evaluation of the natural potential of the territory, the physical-geographical landscape units were classified using the criteria of Sochava (1972, 1978) and Mateo *et al.* (1994), establishing the taxonomic units of Landlocality (*Localidad*), Landarea (*Comarca*) and Landplace (*Subcomarca*). However, for the evaluation of the territorial natural potential only the units of Landlocality and Landarea were used, given that the Landplaces are related to markedly punctual aspects, both linearly as locally. In the mapping of the physical-geographical landscapes of northwestern Chiapas at a 1: 100 000 scale, five Landlocalities, 11 Landareas and 43 Landplaces were delimited (Bollo and Hernández-Santana, 2008). For the geomatic process, the GIS software Arc.Gis version 9 was used.

In turn, some available basic attributes were considered for the evaluation of the natural potential of the territory using the land assessment methodology (FAO, 1976). This methodology is based on the definition of the requirements of each type of land use being considered, the description and valuation of the natural qualities and/or attributes of the territory, the definition of the spatial units for evaluation (in this case, the physical-geographical landscapes), and in the comparison of the land qualities within the physical-geographical landscapes with the inputs required by each activity (in the present study, agriculture, cacao grove, grazing, forestry and conservation). The evaluation of the landscapes for each productive or conservation activity and its cartographical representation are based on the totalized weighted ranking of each of the natural attributes of the landscape involved in each activity, and the definition of a numerical standardization of the resulting values, in order to assess a degree of potential optimization.

To establish the natural potential of landscapes for agriculture the following indicators were evaluated: soil fertility, slope, stoniness, susceptibility to erosive processes, susceptibility to flooding and soil acidity; while in the case of cacao groves the evaluated indicators were: soil fertility, slope, elevation above sea level, susceptibility to flooding and soil acidity. The indicators evaluated for determining the potential for grazing activities were: soil fertility, slope, vertical dissection of the relief, susceptibility to erosion, and soil acidity. The natural suitability for forestry was estimated based on the quantity and quality of timber, while the suitability for conservation was based on the evaluation of: singularity, endemism and biodiversity parameters, degree of modification of the landscape and percentage of natural and semi-natural surface in each landscape unit.

It was concluded that the classification of the physical-geographical landscapes had a significant relevance in the evaluation of the natural suitability for agriculture, cacao grove, grazing, forestry and conservation uses in the territory of northwestern Chiapas; first, as synthesizing natural and cartographic units for diagnostic evaluation, and second,

as management units of the assignment model within the ecological land-use planning. Likewise, the implementation of a GIS using Arc.Gis, version 9, as a tool for the spatial analysis of the gathered geographical information, contributed to the precision of the geomatic process of evaluation of the natural potentialities and constraints for the promotion of the considered productive activities.

In addition, the implementation of the land assessment methodology (FAO, 1976), based on the natural inputs for each productive activity that are spatially displayed by the physical-geographical landscapes, allowed to valuate and ponder the intrinsic properties of the natural attributes of each Landarea, as well as to identify the better suited landscapes for each of the activities: always under the premise of optimizing the management of the territory of northwestern Chiapas.

The physical-geographical landscapes located on low and flat to undulate plains showed a high potential for agriculture and grazing, while hilly and very hilly landscapes revealed a medium suitability, and the landscapes set upon hills, pre-mountains and low mountains reported a low to null suitability for these same activities. As to the promotion of cacao groves, the landscapes with hilly and very hilly plains and hills showed the best natural suitability for this activity.

The highest natural aptitude for forestry activities concentrated in the landscapes with hills and mountains, as in the Canacoite forest areas in the low plains of the Pichucalco River Valley; while the remaining flat and hilly Landareas displayed very low suitabilities for forestry. Finally, the higher potential for conservation activities was determined to be located in the low pre-mountains and mountains.

