Conceptual proposal of the landscape as an environmental indicator for the spatial and temporal study of the territory

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ABSTRACT
Objective: To propose the landscape as an environmental indicator that spatially and temporally, describes, analyzes, and evaluates territory, by changing some natural, social, economic, and cultural components.
Approach: Different methodological concepts of the landscape and environmental indicators were reviewed, as well as their characteristics to describe and evaluate the environment.
Results: It was found that the landscape is a comprehensive analysis method for the study of the environment, by selecting the parameters that describe and represent each landscape, through shapes, size, colors, textures, shadows, patterns, situations, associated features, and structures arranged under a spatial and temporal order which, when perceived by humans, present a given form of organization or disorganization in the environment.
Implications: The environmental indicator allows to analyze and evaluate the changes in space and time, with updated qualitative and quantitative research. These changes play an important role in building the perception of environmental problems through the landscape.
Conclusion: Landscape is an integral component that describes the biotic and abiotic elements of a given space. While, as an environmental indicator, it analyzes and evaluates changes in the composition and configuration of the environment, both spatially and temporally.

Keywords: ecosystem, natural resources, territory.

INTRODUCTION

Landscape is the image that humans perceive of their environment; as well, it is a natural resource able to be used (Rodríguez *et al.*, 2013), which describes the integration of the spatial and temporal characteristics of the elements of nature (Allan *et al.*, 2015; Jiménez *et al.*, 2019). While an environmental indicator is the key instrument for planning natural resources that assesses the environmental, social, economic (He *et al.*, 2011; Walz, 2015) and even cultural aspects, that determine the current condition of a particular ecosystem.

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The importance of the information obtained from the landscape is since any change in the composition and configuration of the environment may be used as an environmental indicator (Alphan, 2017), through qualitative (Delphi method, interviews, etc.) and quantitative (biodiversity models, regression, indices, etc.) techniques (Matovnikov and Matovnikova, 2016; Jiménez *et al.*, 2019). Changes in landscapes are solid environmental indicators about mainly anthropogenic disturbances that should be monitored for decision-making. Thus, explaining the conditions and interactions of physical changes and social aspects of each element forming a place in a given time (Ginzarly *et al.*, 2019). Therefore, a space-temporal environmental indicator studies, understands and evaluates the condition of the territory (Jiménez *et al.*, 2019).

Based on the above, the objective was to propose the concept of landscape as an environmental indicator for the spatial and temporal study of territory. By the diversity of characteristics, it presents to describe, analyze, and evaluate the composition and configuration of an ecosystem. This is an analytical and comprehensively methodological process.

Conceptual analysis of landscape and environmental indicator

Landscape. It is a set of natural and cultural phenomena that describe the extension of a territory and provide information (Cruz-Medoza, 2018). They are complex systems, subject to rapid and extensive changes due to human activities affecting the environment (Alphan, 2017; Ginzarly *et al.*, 2019).

Recent studies (He *et al.*, 2011; Zhang *et al.*, 2019) conceptualized landscape as the environmental factor linked to the subjective experience of analysis of a place that is characterized by positive and negative elements. Other authors (Walz, 2015; Cruz-Mendoza, 2018) consider the landscape as the integral and visual external expression of an ecosystem. This perception is produced on the environmental system, in a subjective and variable way through all senses of direct and indirect appreciation, which operate in the observer, for example: sight, hearing, smell, touch, among others. And, based on perceptual experience of the individual classification and valuation of each landscape is determined by relating a person with their space, which sets out the role of the landscape as an environmental indicator (Schindler *et al.*, 2014; Ginzarly *et al.*, 2019).

Landscape is a real, complex, and dynamic fact that exists in the earth's surface, the nature and characteristics are independent of the meaning attributed to it by human beings, through shapes, sizes, colors, textures, shadows, patterns, situations, associated features, and structures arranged under a spatial and temporal order. Which, perceived by a human present a given form of organization or disorganization in the environment (Matovnikov and Matovnikova, 2016; Cruz-Mendoza, 2018).

Consequently, human activity and the scenery of social life in each landscape is interpreted by the interactions between the biotic and abiotic elements of the natural environment (Alphan, 2017). Reason why landscapes are the consequence of natural and social evolution through time (Walz, 2015).

Environmental indicator. It is a parameter that provides information, data, comparisons, and it evaluates situations of a place at a given time (Shul'kin *et al.*, 2017), evidencing the impact of human beings on the biophysical and socioeconomic environment. For this reason, they are fundamental at the international, national, regional, and local levels, to describe and evaluate the consequences of human development (Rodríguez *et al.*, 2013).

Environmental indicators provide useful information for planning and environmental assessment (Alphan, 2017; Gao *et al.*, 2017; Luo *et al.*, 2017), constitute a basic tool of information and monitoring of the processes occurring in the environment, in social and economic aspects. It explains the status and trends of natural resources in order to manage and formulate policies for programs aiming at the conservation and sustainable use of natural resources (Asumadu and Asantewaa, 2017), providing information in a simple and easy way to understand (Walz, 2015). In summary, they are useful for communicating scientific and technical information for the environmental management and to the general public (Schindler *et al.*, 2014).

The use of environmental indicators has been of great relevance to science (Burkhard *et al.*, 2015), because they allow to build the perception of the environmental problems, providing qualitative or quantitative information, as well as, evaluating decision alternatives and solutions (Schindler *et al.*, 2014). These are fundamental instruments to generate and to analyze relevant information from environmental, social, economic, and even cultural aspects (Delgado *et al.*, 2011; Rodríguez *et al.*, 2013).

The landscape on environmental study

The landscape is a spatial unit of environmental analysis, which describes the structure forming a visual or surface image (He *et al.*, 2011). It studies dynamic and functional aspects covering all the environmental components, and the influence of human beings (Ginzarly *et al.*, 2019).

Landscape is a complex and deep concept which involves environmental, social, economic, and cultural aspects that determine the characteristics of a place. These must be taken to get to know the functioning of the territory (Rodríguez *et al.*, 2013).

From a more general perspective, the landscape integrates configurations perceptible through sight and images. It reflects the state or condition of the nature it occupies, and the form of participation of each environmental component, determined by space and time of each process, which are key to the functioning of the environment (Gao *et al.*, 2017; Jiménez *et al.*, 2019). Within this context, the configuration of the landscape is complex and sensitive, subordinate to any change that affects its structure and environmental components (Walz, 2015).

The potential of the landscape depends on both the relationships between its components, as those relations with neighboring landscapes. Thus, it is conditioned not only by local characteristics, but also includes regional influence. This potential changes over time due to the levels of development of the society, and their needs (Delgado *et al.*, 2011; Allan *et al.*, 2015).

Importance of the environmental indicator on the composition and configuration of the territory

Currently, human beings have made great modifications to their environment, that is, changes in the composition and configuration of nature, which is evident through an environmental indicator (Walz, 2015). This shows the situation of the environment in different analysis systems and determines the current diagnosis of the ecosystem (Bredemeier *et al.*, 2015; Dyer *et al.*, 2017).

Environmental indicators explain conditions and interactions with each element forming the place (space) at a given time (temporary) (Ginzarly *et al.*, 2019; Jiménez *et al.*, 2019). They expose those environmental problems caused by socioeconomic activities involving human beings for their development and growth (Asumadu and Asantewaa, 2017). They analyze and evaluate environmental conditions likely to improve through environmental management and the scope on the ecosystem (He *et al.*, 2011; Gao *et al.*, 2017). Those which can be described by different definitions, specifications, guidelines, statistics and classifying categories; they should be practical and realistic, as statistical, social, demographic and economic systems that allow us to observe changing trends, predictive situations, and they provide signs of possible future scenarios (Rodríguez *et al.*, 2013; Walz, 2015).

Analysis and approach of the landscape as environmental indicator

The landscape as an environmental indicator describes, analyzes and evaluates environmental problems affecting ecosystems due to human intervention (Alpha, 2017). Conceptually, landscape is dynamic, because it analyzes the environment in a consistent relationship within a theoretical and practical context, to show a comprehensive environmental assessment from different perspectives (environmental, social, economic, and cultural) of each landscape (Rodriguez *et al.*, 2013; Asumadu and Asantewaa, 2017).

A landscape represents the external condition of the environment in which some biotic and abiotic components are evaluated, on the use and extraction of natural resources. It also shows, the degree of social development and the quality of environmental management (Ginzarly *et al.*, 2019). It considers limitations on the stability conditions of an ecosystem, based on a spatially and temporally related study of the landscape (Jiménez *et al.*, 2019); those conditions are due to environmental and social characteristics (Delgado *et al.*, 2011; Walz, 2015).

Any change in the configuration of landscape can be used as an environmental indicator (Jimenez *et al.*, 2019), which describes (qualitatively) and generates quantitative information to analyze and assess the condition of that landscape.

The landscape as an environmental indicator aims to be an effective tool in the (spatial) study of the territory, in a conceptual and methodological way, because it involves (temporarily) those environmental, social, economic and cultural disturbances occurring at a specific moment (Alphan, 2017; Jiménez *et al.*, 2019). An environmental indicator is one of the most important components of the landscape, because of its spatial, temporal and comprehensive aspects, integrated from different (environmental, social, economic and cultural) perspectives of evaluation. Such analysis must be planned and assessed, aiming to offer major contributions to knowledge, intending to explain

different components of the environment for the benefit of nature and human beings (Cruz-Mendoza, 2018).

The aforementioned defines the landscape as an environmental indicator that describes, analyzes and evaluates ecosystems, and thus it can be used with applications on management and environmental analysis (Burkhard *et al.*, 2015; Luo *et al.*, 2017). It shows the ecological fragility and the degree of conservation, identifying the most sensitive elements of the environment, as well as the risks of breaking the environmental balance and moreover, the ecological behavior (Rodríguez *et al.*, 2013).

Landscape as an environmental indicator is not a static and passive depiction, but images full of dynamic meanings, composed of biotic and abiotic components showing developments and imbalances, most of them caused by human activities on ecosystems (Cruz-Mendoza, 2018). Landscape explains the situation of the environmental components, and shows through scenarios perceived by people, complex images in which it is possible to detect the nature of the environmental components participating in the ecosystem (Ginzarly *et al.*, 2019). Likewise, its comprehensive character allows those elements forming the landscape to appear not in a disaggregated manner but integrated into complex systems that bring us closer to the real understanding of nature (He *et al.*, 2011).

For example, a landscape seen as an environmental indicator describes the climate, flora, fauna, soil types, as well as the consequences of human activities on the ecosystem and the magnitude of environmental impacts. It shows and evaluates the need for protection in the face of certain natural events caused by humans, which are dangerous for the very survival of the landscape, and which threaten the integrity of the ecosystem (Alphan, 2017; Jiménez *et al.*, 2019).

The landscape is a fundamental component of the ecosystem and its character as a globalizing environmental indicator from an integral perspective, establishes direct contact between human beings and their environment in which he is immersed and of which he is a part (Ginzarly *et al.*, 2019). In other words, it shows the consequences of human perception and assessments, becoming a useful instrument as an environmental indicator for environmental management (Rodríguez *et al.*, 2013). In addition to this, an adequate understanding of the characteristics of the landscape shows the causes of environmental problems, and the consequences of the human impact on ecosystems (Alphan, 2017).

CONCLUSIONS

The landscape as an environmental indicator is an effective tool to describe, analyze and evaluate changes in the configuration of the territory. It provides analytical and methodological direction, spatially and temporally comprehensive to incorporate different perspectives of study (environmental, social, economic, and cultural), and it is essential for management and planning.

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