Evaluating the Potential of Landscape Metrics in Supporting Landscape Planning in Atlantic Forest:
Rio de Janeiro, Brazil

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ABSTRACT

The landscapes are highly dependent on the dynamics of local land use and land cover, which directly affects landscape structure and determines the spatial patterns of forest patches, as well as to the major land uses within a specific region. The calculation of landscape metrics can support the understanding of such spatial distribution. In this study, 16 landscape metrics were analyzed in a drainage watershed in a high relief region in the Rio de Janeiro state, Southeastern Brazil, with the aim to evaluate the use of landscape metrics as indicators for agricultural management. Metrics calculation was followed by a Principal Component Analysis, which indicated the metrics that were most effective in evidencing the landscape structure in analysis. The results showed that the late-succession forest is the dominant component in the landscape. This class also presented the highest MPS metric value, related to the mean patch size by class. Some PCA results suggest that the metrics association was less effective in clustering the overgrown pasture, clean pasture, and annual crops classes, but this could result from the intrinsic association among those classes, by crop rotation, meaning the abandon of a site formerly occupied by an annual crop. Some metrics better suggested an interaction among land use classes and have potential to be use in the analyses of agricultural landscapes in high relief sites.

Keywords: Agricultural Landscapes, Atlantic Forest, Landscape Metrics, Landscape Planning, Principal Component Analysis

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1. INTRODUCTION

Since its origins, the scientific stand view of landscape is a physiognomic, correct notion, involving everything visible, as well as not immediately visible subjects which are anyway related to visible elements and their apparent spatial relations (Tricart, 1977).

Landscape is also considered a heterogeneous land of area composed of a cluster of interacting ecosystems that is repeated in a similar form (Forman & Godron, 1986), which allows landscape to be measured and defined according to the patterns of repeatability and ecosystems interaction.

Studies on Landscape Ecology are based on three aspects of the landscape (Forman & Godron, 1986): *Structure*, characterized by the spatial relation among the distinct landscape components; *Function*, represented by the interaction among those components, and *Dynamics*, represented by the changes on both structure and function of the landscape mosaic over time.

Landscape Ecology can be also defined as the study on how landscape patterns affect ecological processes (Turner, 1988), quantifying spatial heterogeneity on landscape is necessary to understand the relationship between ecological processes and spatial patterns (Turner, 1990; Turner et al., 2003). This approach is closely related to the study on landscape structure based on the calculation of landscape metrics.

Investigations based on landscape metrics have received considerable attention since the early 1980s, when the development and use of specific techniques has begun (Leitão & Ahern, 2002). Several of landscape metrics have derived from mathematic theories, as percolation theory, fractal geometry, and theory of information, similarly to the events, which led to the development of diversity indices (Lian Li, 2000). As spatial data have become more available, especially over the last twenty years, the development, tests and use of landscape metrics have also increased (Turner et al., 2001).

There is a large amount of metrics that can be calculated. Few softwares area widely used for this aim as FRAGSTATS (McGarigal & Marks, 1995; McGarigal et al., 2002) and modules developed and integrated with Geographical Information Systems (GIS), as Patch Analyst (Rempel et al., 1999) in ArcGIS (ESRI, Inc., Redlands, CA). However, it is useful to know which metrics are more related with the specific goals of each study in landscape ecology. Ritters et al. (1995) showed that a lot of metrics are strongly correlated to each other. The authors demonstrated the statistical independence of 55 metrics and concluded that the information contained in these metrics could be summarized in only six metrics, including dominance, contagion, fractal dimension from perimeter/area, average patch perimeter/area ratio, average patch perimeter/area ratio orthogonally adjusted to a number of classes.

Landscape structure indicators is widely used in scientific environment because they show to be good indicators of ecological sustainability, since they are related to ecological characteristics of landscapes, as naturalness and biodiversity (Peterseil et al., 2004). Nevertheless, the potential of a quantitative landscape analysis has to be explored. In this context, it is necessary the development of studies to evaluate the potential of using landscape metrics as indicator for land use impacts in agricultural landscapes, which supposes the selection of the most sensitive ones. It would be interesting for the decision makers have a set of selected metrics to analyze and apply to contribute for territorial planning.

This study aimed to evaluate the use of landscape metrics as indicators for agricultural management, as well as its potential on the landscape conservation in a watershed located on a steep relief region of Rio de Janeiro State, Southeastern Brazil. Goals include selected a set of metrics that could be used to describe the landscape in terms of structure and contributes for decision for territorial planning.

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