Environmental Characterization of Coffee in the Environmental Protection Area of Coqueiral, Southern Region of the State of Minas Gerais, Brazil

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SUMMARY

This study aimed to characterize the environment of existing coffee plantations in the Environmental Protection Area (APA) Coqueiral using geotechnologies. To survey the use and occupation of the land, satellite images from SPOT were used, a SPOTMAPS product, with a spatial resolution of 2.5 m. Topographic data from the IBGE and the SRTM radar were used to generate information on the topography and altimetry. The software SPRING was used to evaluate the spatial distribution of coffee in the landscape. The coffee in the APA occupies almost 12 % of the total area. A little over 83% of the coffee plantations are at altitudes ranging from 800 to 950 meters. About 10% of the coffee is at altitudes ranging from 950 to 1000 meters. At altitudes above 1000 meters only 1 % was occupied. As for terrain, 64.08% of the coffee crops were planted on steep hills (slope of 8-20%) and 23.05% on gentle hills (3-8% slope). It is found that the distribution of crops by soil classes occurs predominantly in Ultisols and Cambisols, accounting for about 85% of the total area, followed by Gleysols/Organosols with a little over 8% occupied by coffee plantations. The monitoring of the coffee plantations in this region is important, since this information provides the subsidies needed to maintain a competitive and sustainable coffee sector.

INTRODUCTION

Coffee makes up one of the most important sources of income for the Brazilian economy, as it plays an important role on the country's exports. The state of Minas Gerais stands out on the national scene as a major coffee producer in Brazil, with a market share of 50.99% of the total production of the country. Because it is an important crop of Minas Gerais, coffee has been historically influential in the use and occupation of the State. Despite being a perennial crop, coffee is dynamic, with cycles that rise and fall which influence, among other things, their relationship with the environment. The Brazilian coffee is currently going through a favourable time for both the national and the international scene, which has led the sector to seek improvements in production systems. These improvements are without question environmental issues, sustainability and competitiveness.

The areas occupied by coffee plantations in recent years have gone through changes with new planting, replanting and as well as abandonments and eradications, complicating the assessment of the current situation of the coffee plantations in Minas Gerais. The survey of these areas and the establishment of methodologies enabling the monitoring of this culture,

with periodic updating of this information, have become important for managing this agribusiness. Rational planning of any agricultural activity requires, first of all, knowledge of the environment in which this activity is inserted. For this, geographic information systems together with remote sensing tools are indispensable in assisting in the representation and in detailing the territorial space and can provide information for the conservation and sustainable management of land use and occupation.

Planning for sustainable use of natural resources requires knowledge and organization of updated information about the environment, and the basis of any environmental study is the characterization of the physiographic region of interest. The integrated analysis of the characteristics of the physical and socioeconomic aspects of the areas occupied by coffee plantations enables the rational planning of agricultural activities to be used there, but for this to happen, it is first necessary to have knowledge on the environment in which this activity is embedded.

In that sense, this study aimed to characterize the environment of existing coffee plantations in the Environmental Protection Area (APA) of Coqueiral by using geotechnologies.

MATERIALS AND METHODS

Study Area

The study area is located in the municipality of Coqueiral in the south of Minas Gerais, Brazil. It has an area of 6836.21 ha, located at the geographic coordinates 45° 19'37.5" and 45°26'16.3" W and 21°03'52.7" and 21°09'30.8" S. The microregion is situated in a terrain ranging from rolling to mountainous hills. The predominant soils in the area are shallow, with Ultisols and Inceptisols being the principle classes.The vegetation types are cerrado and semi deciduous forests, which are located in the Atlantic Forest biome.

Mapping and environmental characterization of coffee

The data relating to land use were extracted from SPOT 5 satellite image, with 2.5 m spatial resolution. The image was acquired with preprocessing radiometric and geometric patterns which were then orthorectified (SPOTMAP to form the basis for the realization of mapping occupation and land use). Only coffee areas were used for checking the spatial distribution of the culture in the APA.

The characterization of the terrain (altitude and slope) was generated from the digital elevation model (MNE) obtained from SRTM data. The model was interpolated from 90 to 30 meters, using the algorithm of bi-cubic interpolation from SPRING 5.1.5. The soil map of the area was prepared by the Department of Soil Science, Universidade Federal de Lavras. The slope classes and their gradients were: Nearly Level: 0 - 3%, Gently Sloping: 3 - 8%, Strongly Sloping: 8 - 20%, Moderately Steep: 20 - 45%, Steep: 45 - 75%, and Very Steep: > 75 %.
The thematic maps of the environmental characterization obtained where overlapped with the land use/land cover map. The procedure was performed using the software SPRING and the language program LEGAL.

RESULTS AND DISCUSSION

Through the interpretation of satellite imagery, it was possible to classify the area into nine types of land use, but the study in question used only the coffee area. The coffee in the APA makes up for about 12% of the total environmental protection area.

Environmental characterization of the coffee lands

From the results obtained it was observed that the land use class coffee is distributed in all classes of altitude, soil and slope observed in the study area.

Most of its surface (about 80%) is found at altitudes between 734-900 meters above sea level. Classes of higher elevations (900 to 1040m) account for about 20% of the area.

Slightly more than 83% of the coffee plantations are at altitudes ranging from 800 to 950 meters (Table 1), whereas, the majority are found at altitudes between 900-950 meters. About 10% of the coffee is at altitudes ranging from 950 to 1000 meters. At altitudes above 1000 meters, with the highest potential for production of quality coffee, only 1% was occupied.

Table 1. Distribution of coffee plantations by classes of altitude and slope.

Altitude	Area (%)	Class of terrain	Area (%)
<800	6,34	Nearly Level	3,71
800-850	26,43	Gently Sloping	23,24
850-900	24,87	Strongly Sloping	64,08
900-950	31,90	Moderately Steep	8,96
950-1000	10,15	Steep	0,09
>1000	0,31	Very Steep	0,00

In regards to terrain, 64.08% of the coffee plantations are in rolling areas and 23.05% in gently rolling terrain (Table 1). The agricultural areas with very steep slopes are limited, since in most cases the control of erosion is costly and may be uneconomical, althought with coffee the risk of erosion becomes smaller since it is a perennial crop. The terrain of the area is mostly composed by slopes of 8 to 20%, with over 50% of the total APA. These areas may be used for farming since an efficient management and control of soil erosion is undertaken. The APA does not have areas with steep slopes.

Regarding the distribution of crops by soil classes there is a predominance of occurrence of the classes Ultisol and Cambisols with about 85% of the total area, followed by the class Gleysol/Organosol with a little over 8% occupancy by coffee (Table 2).

Table 2. Distribution of coffee plantations by soil classes.

Soil Class	Area (%)
Rocky outcrop	0,20
Ultisol/Cambisol	43,34
Cambisols	40,11
Gleysol / Organosol	8,43
Fluvic	2,87
Udorthent	5,05

The geotechnology allowed the characterization of the coffee plantations of the APA, quantifying the occupation of coffee in the environmental units of altitude, topography and soil, showing that they are important and efficient tools, both in terms of time savings and resources.

The monitoring of the coffee plantations in this region is important, since these subsidies provide information needed to maintain a competitive and sustainable coffee sector. The environmental characterization can be considered essential to initiate the development of a sustainable management plan for the area.

ACKNOWLEGMENTS

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