CHARACTERIZATION OF SITES WITH MONODOMINANCE OF AROEIRA (*MYRACRODRUON URUNDEUVA ALL.*) IN TUMIRITINGA, MG

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ABSTRACT:

The forest species *Myracrodruon urundeuva* Fr. All. is scientifically recognized by the set of ecological features and utilities that characterize "noble" species of the Brazilian flora. Although the species is present in the list of flora species threatened by extinction, it is monodominant in some regions of the state of Minas Gerais, especially in the area of the middle Doce River. The conflicts generated by the Aroeira monodominance increase pressure on local ecosystems, making management studies urgent. This study aimed to describe patterns of spatial distribution of forest fragments monodominated by Aroeira in the municipality of Tumiritinga, MG, correlating the occurrence of the species monodominance with the terrain slope and aspect, using RapdEye satellite images for mapping Aroeira occurrence.

1. INTRODUCTION

The framework of advanced environmental degradation in the region of the Middle Doce River is attributed by several authors to the practice of cattle raising, in addition to edaphic, climatic, geomorphological and anthropogenic interactions. Vieira (2008) and Valente (2005) draw attention to the expansion of the monodominance of Aroeira tree species (Br Myracrodruon urundeuva All.) aggravating the degradation in the region. In the late 80s years, Hart et al. (1989) spread coined the term "monodominant" to describe forests that have more than 50% of the number of individuals in the community belonging to a single specie.

Oliveira (2011) reports that in the areas with monodominance of Aroeira, soil remains uncovered and ceases to be used for crops and pasture establishment. Since livestock is the main activity in the region, (BARUQUI, 1982; OLIVEIRA, 2011) local residents complain that the damage caused by monodominance of Aroeira is recurrent within the communities. The fragments monodominated by Aroeira occupy about 22% of Tumiritinga (OLIVEIRA, 2011). According to testimonies of local residents, they have expanded over the past 20 years, occupying pastures throughout the region.

Researchers who study the behavior of monodominant forest species often turn to soil properties and characteristics to explain the mechanisms that favor the establishment of a species, and reduce the species diversity in these environments. However, according to Valente (2005), the monodominance of Aroeira, on many occasions, occupies the entire toposequence of certain sites, and apparently the phenomenon is related more to the type of land use and management than to the soil types present there. The areas in which monodominance of Aroeira occur are usually related to soil erosion. Because of this, it represents an obstacle to regional productive agroecosystems, contribiting with economic and social conflicts (CTI Rio Doce, 2009).

The technological advances in recent decades have favored the development of satellites that assist in land monitoring through images provided by highly sensitive sensors. The qualitative and quantitative data of the surface from these satellites is shown to measure indexes such as: environmental degradation, pollution levels of water and atmosphere, climate change, bushfires, expansion of forest species, monitoring of culture, agriculture, soil moisture, occurrences of droughts, and others (LIU, 2006). Through these indexes it is possible to monitor and plan human interventions in the environment.

The mapping of the patterns of land use and soil cover helps to study the dynamics of the landscape and to evaluate the interaction between temporal and spatial phenomena in a given region (Soares Filho, 1998). It is also possible through these mappings to get a picture of human activities and their impacts on the environment. In this work, the remote sensing was the main tool of assistance in understanding the processes of expansion in the region of Aroeira.

The present paper aims to describe patterns of spatial distribution of forest fragments monodominated by Aroeira in Tumiritinga, MG.

2. METHODOLOGY

The study was conducted in the municipality of Tumiritinga, MG (Figure 1), which occupies an area of 489Km², with a population of 6169 inhabitants and is inserted in the middle region of Doce River Valley, MG. The original vegetation in the region is the semideciduous forest (Veloso et al., 1991), included in the Atlantic Forest biome. Due to the removal of forests for alternative land uses, especially for cattle, currently the land is dominated by degraded pastures (BARUQUI, 1982). According to data from the IBGE sense of 2006 the area of native forest occupies about 2% of the municipal territory.

The following soils occur in the studied area: of red, eutrophic Ultisols on the lower third of the slopes, eutrophic Fluvents in the lower areas and dystrophic Oxisols on the flat uppermost part of the landscape. The geomorphic units are formed by fluvial dissection and are predominantly active in the granite-gneissic rocks of the crystalline basement (BARUQUI, 1982). According to the classification of Köppen, the climate prevailing in the region is Aw (tropical wet - mega thermal), characterized by high temperatures and rainfall concentrated in summer, with the lowest monthly precipitation being less than 60 mm. The water balance of the region shows strong water deficit (Valente, 2005).

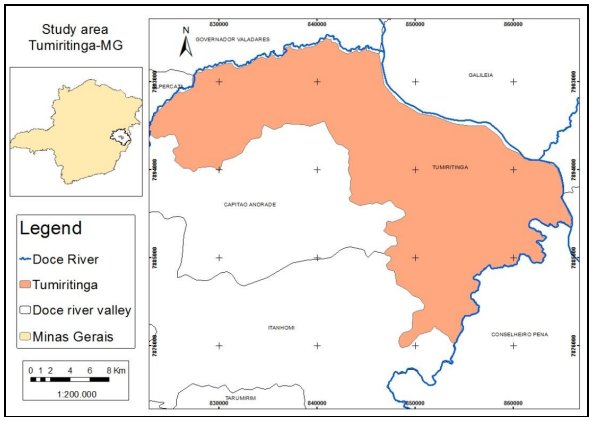

Figure 1: Study area

The Aroeira specie (*Myracrodruonurundeuva All. Br*) (Figure 2), belongs to the family Anacardiaceae, classified as late secondary, and is present in different vegetation types, such as: the Brazilian Forest semideciduous, deciduous seasonal forest, lower montane formations, Cerrado and in the Pantanal biome (CARVALHO, 2003). The Aroeira occur naturally from Mexico to Paraguay, being considered in Brazil to native forest species widely distributed in the Northeast, Southeast and Midwest (SILVAet al., 2006).

Figure 2: Aroeira monodominance in Tumiritinga-MG

For this work, we used maps in the municipality produced by OLIVEIRA (2011). The map was made though supervised classification of RapidEye images acquired on 02/13/2010, with the radiometric and geometric corrections, covering 100% of the studied area. The sensor achieves a spatial resolution of 5m, using the algorithm maximum likelihood in ArcGis 10. In order for the classification to obtain similar results to those observed in field, 19 combination of bands of the image were tested. The best result was obtained using the total composition, and its bands are Red, Green, Blue, infrared and near infrared. The classification obtained 80 as Global Kappa and 90 as conditional Kappa for the Aroeira class, the focus of this study, and is considered an excellent result according to the literature (Landis and Koch, 1977). Since the goal is to study the spatial distribution of the occurrence of Aroeira, the result of supervised classification was re-grouped into two classes using the Reclassify tool in Spatial Analyst tools in ArcGIS 10. The two new classes created are Aroeira, composed only by this specie, and other classes, consisting of the differing classes of land uses (Figure 3).

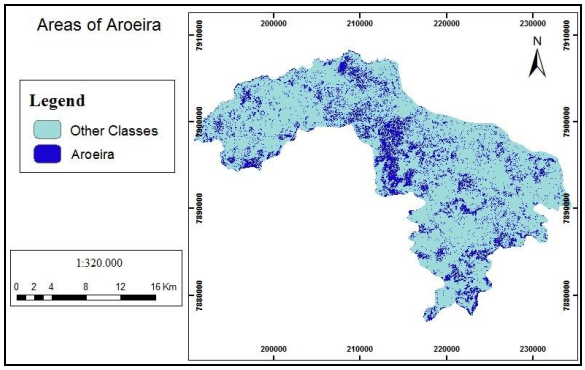

Figure 3: Image Reclassification

The ArcGIS software 10 was used to generate a digital elevation model from SRTM images (NASA, 2006). Based on this model terrain slope and exposure to sunlight were modeled. The errors of the digital elevation model, caused by a lack of data in smaller regions, were eliminated by applying an average filter locally. Values of slope classes were reclassified (0 to 3%, 3 to 8%, 8 to 20%, 20 to 45%, 45 to 75% and more than 75%) according to EMBRAPA (1999). Likewise, the value of face exposure were reclassified and simplified in the 5 directions of the cardinal points plus the plane.

Using the Tabulate Area tool, implemented in ArcGis 10.0 (ENSRI, 2010), cross-tabulation was made from the attributes of the terrain, slope and solar radiation exposure, along with the location of the fragments of Aroeira in monodominance. The resulting matrix of cross-tabulation shows the area classified in each class of land use (Aroeira and other uses), distributed among the classes of slope and face exposure. The matrix calculated the percentage distribution of Aroeira of each slope class: flat, smooth, soft-wavy, wavy, strongly undulated, hilly and steep; and on each side of solar radiation (plane: north, south, east, west).

To evaluate if the occurrence of fragments monodominated by Aroeira in Tumiritinga follows standard random spatial distribution for the parameters of Slope of Land and Solar Radiation, it must be applied a nonparametric chi-square nominal scale, given by equation 1.

$$\chi^2 = \sum \frac{(O-E)^2}{E} \quad (1)$$

Where: O = Observed occurrence of Aroeira in slope classes and radiation.
E = Occurrence overall slope classes and radiation in the study area.

The test involves the independent variables Occurrence of Aroeira, and Solar Radiation / Slope of land, aimed at testing the hypothesis Ho that among the variables there is no degree of association. If χ^2 cal> χ^2 tab rejects the null hypothesis. The test was applied to the significance level α of 10%, 5% and 1%.

3. RESULTS AND DISCUSSION

The results presented in Figure 4 show that Aroeira in monodominance in the municipality of Tumiritinga occurs prominently in areas of steep slopes, especially in the features "steep hills" relief (50%) and "hills" (34%), which together account for 84% of the total catchment area of "Aroeirais" in the municipality. According to BARUQUI (1982) in these areas, Ultisols are the main soil class and favors the development of Aroeira. The low frequency of Aroeira in "flat" regions (1%) and "gentle hills" (10%) may be linked to anthropogenic factors such as preference for using these areas for annual crops and pastures. The occurrence of these fragments monodominated by aroeira in these geonenvironments can be controlled by cutting and handling of the farmers in the region

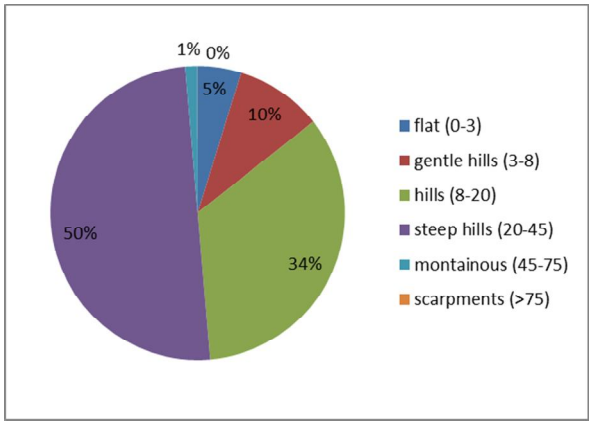

Figure 4: Percentage of areas classified as Aroeira in each slope class (degrees)

Figure 5 shows the distribution of slope classes in Tumiritinga, MG. Note that the "mountainous" and "scarpment" classes occur with low frequency, summing 1.5% of the municipal territory. Together, the classes "flat" (10%) and " gentle hills " (13%), representing 23% of the total area of the municipality, provide the most appropriate areas for agrosilvopastorals systems. The classes "hills" (37%) and "steep hills" (39%) together account for 76% of the municipal area.

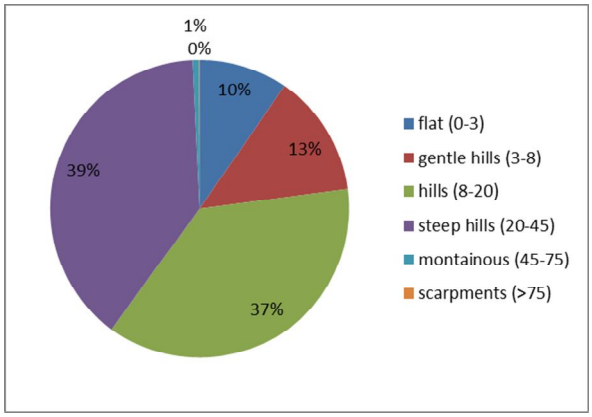

Figure 5: Percentage of each class of slope (degree) relief in Tumiritinga -MG

To evaluate the degree of independence between slope classes and the occurrence of Aroeira, chi-square test of independence for these variables was applied. The contingency table or two-way table (Table 1) was used for the test considered the frequency observed as the percentage distribution of fragments by monodominated Aroeira per class relief in Tumiritinga. The expected frequency was considered as the percentage distribution of relief classes in the municipality. The null hypothesis tested was that Ho between the "class relief" and "occurrence of Aroeira" there is no degree of association.

The null hypothesis was rejected at significance level α of 20% and 5 degrees of freedom, could conclude that there is a strong conditioning to the occurrence of Aroeira dictated by geomorphological features of relief.

Table 1: Contingency table of observed and expected frequencies for variables Class Relief and Aroeira monodominant.

Classe	Aroeira (%)	Município (%)	χ^2_{calc}
Plano	4.80	9.62	2.4192
Suave Ondulado	9.59	13.29	1.0305
Ondulado	34.26	37.17	0.2274
Forte Ondulado	50.00	39.23	2.9584
Montanhoso	1.35	0.69	0.6327
Escarpado	0.02	0.06	0.0334
Total	100.0	100.0	**7.3017**

Figure 6 shows the sides of the relief exposure, where the greatest amount of aroeira is facing north (30%) and west (27%), more regions that are known to receive solar radiation. The presence of illumination for a long period of the day causes higher evapotranspiration occurs from both the soil and the plant, which is aggravated by the slope of the relief, which provides less accumulation of water, has added to soil degradation and erosion laminar, which increases the water deficit in place. This fact may show an evolutionary advantage

of the species that survives noticeably well in hot environments, and water deficit.

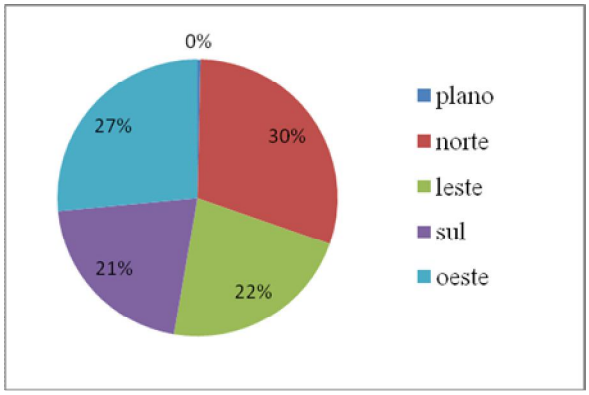

Figure 6: Percentage of areas classified as Aroeira for each face of exposure to the sun

To evaluate the degree of independence between faces exposure to solar radiation and the occurrence of Aroeiratest was applied chi-square test of independence for these variables. The contingency table or two-way table (Table 2) used for the test considered the frequency observed as the percentage distribution of fragments by monodominados Aroeira per side exposure in Tumiritinga. The expected frequency was considered as the percentage distribution of the faces of exposure to solar radiation in the municipality. The null hypothesis tested was that Ho between the "face of exposure to solar radiation" and "occurrence of Aroeira" there is no degree of association. The null hypothesis was rejected only the significance level α of 84% and 4 degrees of freedom, could conclude that the face of exposure to solar radiation is not related to the occurrence of aroeira, or that the aforementioned variables are independent.

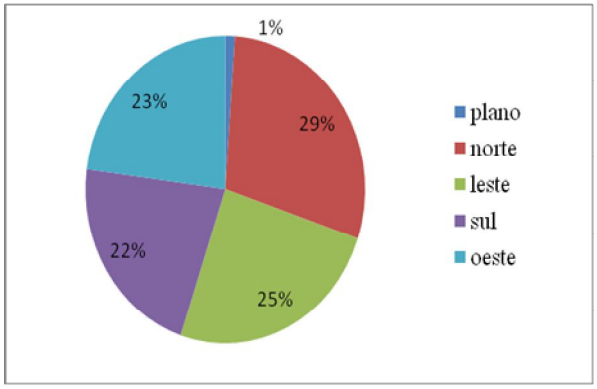

Figura 7: Faces exposure to the sun relief in the Tumiritinga-MG

Tabela 2: Contingency table of observed and expected frequencies for variables and Aroeira monodominant Solar Radiation.

Classe	Aroeira (%)	Município (%)	χ^2_{calc}
Plano	0.36	1.09	0.4946
Norte	30.02	29.09	0.0298
Leste	22.31	24.98	0.2847
Sul	20.81	21.91	0.0550
Oeste	26.49	22.92	0.5558
Total	100.0	100.0	**1.4199**

4. CONCLUSION

The generated mapping data extracted from the classification of satellite image added to the field observations confirm the marked development of Aroeira in regions of steepest slope and insolation in the region of Tumiritinga-MG. The Aroeira monodominance has been an environmental problem since the removal of other forest species in the region parallel to the ecological and social imbalance. This is because the use of the timber and other components is restricted by law, therefore local residents have limited use of soil. The study of the expansion over time in regions occupied by Aroeira, added to the study presented in this paper, is intended for better understanding the environmental and social problems caused by the municipality of Aroeira Tumiritinga, and to assist in planning long-term use of available land in the municipality.

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