LAND USE EVALUATION: CASE STUDY IN BRAZIL

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ABSTRACT:

This work presents an analysis of the land use and land cover in the region of Paraiba Valley and North coast area of São Paulo State. Visual interpretation of Landsat and SPOT imageries at scale 1:100,000 was used to detect land use/land cover changes during the period of 1977/1988. In addition, maps of land use suitability and current land use/land cover categories were compared. Identification of inappropriate land use in the region were made.

KEY WORDS: Land use, Satellite image, Multitemporal analysis, Land use discrepancy.

1. INTRODUCTION

Land use Survey and mapping of one area provides subsidiaries for regional land use planning. It shows how the region has been used.

The multitemporal analysis of land use indicates the dynamics of land cover/land use and also gives subsidiaries for the analysis of the human occupation tendency.

The comparison of land use/land cover maps with land use suitability maps allows the evaluation of land use categories adjustment to the physical characteristics of one area.

The objective of this study was to update the land use information of the Paraiba Valley and North Coast region of São Paulo State (approximately 18,000 square kilometres) through the visual interpretation of Landsat and SPOT satellite imageries at scale 1:100,000 obtained in 1988. This information was one of the basic data for the regional land use planning study called "Macrozoning of the Paraiba Valley region and North Coast of São Paulo state" performed in 1991 to help the decision making process, described in Kurkdjian et al. (1992).

A final land use map at scale 1:250,000 was made.

2. PROCEDURE

The land use/land cover survey was done using Landsat and SPOT satellite data at scale 1:100,000. This data was selected according to absence of cloud cover, contrast between land use classes and the crop calendar of the area.

The band combination selection was based on Seevers et al. (1985).

The image analysis was carried out using the conventional criteria of photointerpretation such as: tone, colour, texture, shape, pattern and related aspects. It was considered the spatial and spectral proprieties of different targets which compose the land use classes. Information contained in Pereira et al. (1988) was also used.

The land use survey and analysis included the following steps:

a) visual interpretation of satellite imageries. Through the use of band 4 drainage networks, humid areas associated to the irrigated crops and different relief units were mapped.

In the next step to discriminate natural vegetation from artificial construction related to the man's activities on land, color composite 3,4 and 5 (blue, green and red color sequence) was used.

Furthermore the utilization of the same color composite reversing the color sequence of bands 4 and 5 allowed the discrimination between dense and dispersed natural vegetation, crop areas and reforest areas.

To improve the discrimination between urban areas (settlement) and crop fields band 3 of TM and multispectral image of SPOT-1 were used.

b) Checking of the visual Interpretation Results: ground truth.

To verify the areas which presented interpretation problem an aerial survey was performed.

Vertical aerial photos at scale 1:10,000 for those sampling areas were obtained.

c) Land use map.

The ground truth information was added to

the results of imageries visual interpretation and a final land use map was obtained. The land use map was reduced to scale 1:250,000.

d) Determination of occupied area (km^2) by different land use categories.

The determination of the land use area was achieved using a grid (4mm x 4mm) corresponding one square kilometre in the field. The occupied area was obtained by counting numbers of intercepting points belonging each analysed class.

e) Multitemporal analysis of the data.

The multitemporal analysis was performed through the comparation between the land use/land cover map obtained using orbital remote sensing data (1988) with the land use chart (1977) obtained from visual interpretation of aerial photos.

The changes of land use categories were evaluated by comparative analysis of these two maps.

f) Comparation between land use map and land use suitability map.

The comparison between the two maps allowed the detection of areas which presents inappropriate land use according to their suitability.

3. RESULTS

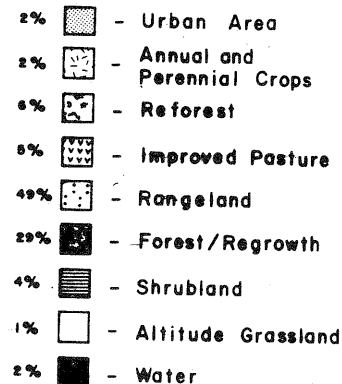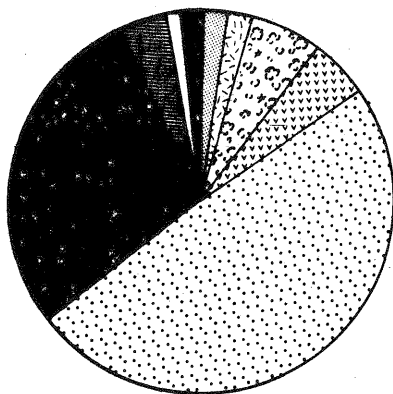Figure 1 shows the results of the satellite imageries visual interpretation.

2%	— Urban Area
2%	— Annual and Perennial Crops
6%	— Reforest
5%	— Improved Posture
49%	— Rangeland
29%	— Forest/Regrowth
4%	— Shrubland
1%	— Altitude Grassland
2%	— Water

Figure I - Land Use Frequency (%)

From the analysis of that figure it is possible to verify that the category rangeland is dominante in the region with 49% occurrence. By adding the improved pasture category to that class it is observed that this activity takes up more than half of the analysed area (54%).

The second class in occupied area is forest/regrowth (approximately 29%). This class occurs predominantely in very steep areas related to the undulated relief.

Having a smaller percentage of occurrence the following classes are observed: reforest (6%), improved pasture (5%), shrubland (4%), annual and perennial crops/horticulture (2%), urban area (2%) and altitude grassland.

Figure 2 shows the frequency of occurence (%) of land use categories during the years 1977 and 1988 and the land use changes for that period.

Comparison between the two dates shows that rangeland was the dominant land use class for the two periods analysed. In relation to the land use with less occurence it was observed a difference between the two dates. For the year 1977 the urban area and altitude grassland categories presented less occurrence (1%); in 1988 only the altitude grassland category had (1%). The urban area at that time had an expressive growth rate. This growth took place mainly in the area of gentle sloping relief located along the Paraiba river floodplain and along the coast.

The annual and perennial crops/horticulture category decreased in area from 3% to 2%. This retraction ocurred mainly in the Paraiba river floodplain. This land use category turned into improved pasture, rangeland and urban areas. In many cases there was misuse of the area which presents alluvial soil and flat relief suitable for agricultural practices.

The reforest category had an increase of 50% from 1977 to 1988 mainly with eucaliptus species (occuping 6% of the area). This category replaced rangeland areas.

In relation to the category forest/regrowth, the comparative analysis between the two dates show that this category decreased (from 32% to 29%). This fact occured mainly in the eastern part of the area.

The decrease of this category is serious environmental problem considering that this area is suffuring from a great devastation and same of it is preservation area as well.

The altitude grassland category remained the same in the two years analysed.

Table 1 shows the discrepancy between the current land use categories and the suitability land use categories.
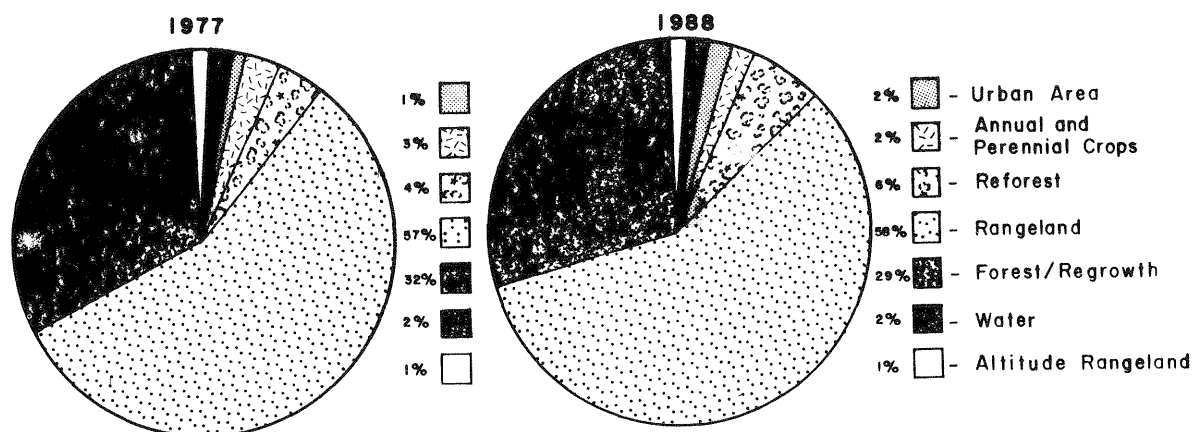
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Figure 2 - Land Use Change (1977-1988)

TABLE 1 - EVALUATION OF THE DISCREPANCY BETWEEN LAND USE CATEGORIES AND LAND USE SUITABILITY CATEGORIES

Groups of land use suitability	Area (km^2)	Discrepancy (%)	Land use discrepancy (%)				
			Reforest	Improved Pasture	Crops	Shrubland	Rangeland
Crops	2,079.95	54,00	15,00	11,00	-	-	74,00
Improved pasture	6,881.53	55,00	9,00	-	2,00	-	89,00
Rangeland and reforest	6,209.59	3,00	-	97,00	3,00	-	-
Unsuitable land	2,939.58	3,00	10,00	13,00	0,60	76,40	-
Total	18,110.65	29,00	10,00	6,00	2,00	1,00	81,00

Analysing Table 1 it was verified that 29% of the study area is inadequately occupied. The pasture category is responsable for 81% of that discrepancy followed by the reforest category.

Among the suitable areas for annual and perennial crops it was verified that 74% was misuse by natural pasture. This situation leads to a decrease in agricultural production and soil degradation risks. These changes have become more serious specially considering that the region presents low percentage of suitable agricultural area.

Approximately 55% of the suitable area for improved pasture is not properly occupied. The greatest discrepancy is associated with the rangeland category (89%). This aspect causes a low cattle breeding profit considering the area great potencial for this activity.

The areas suitable for rangeland and reforest misuse represent 3% of the study area. In a regional context these areas present severe restrictions due to declivity. These areas are occupied by improved pasture that could cause soil degradation risks.

The unsuitable land category has areas which have been suffering from anthropogenic interference. About 76% of those areas is now occupied by regrowth category; 13% by improved pasture and 10% by reforest.

The comparison between the analysed data shows that the study area is potentially subject to environmental disruption due to poor use of the natural resources.

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