APLICATION OF REMOTE SENSING AND GIS TO COMPILE AND UPDATE SOIL MAPS AT THE ENVIRONMENTAL PROTECTION AREA - APA OF GUARATUBA - PR - BRAZIL

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Abstract

This work has in view the analysis, updating and compilation of soil information and agricultural aptitude studies using the remote sensing allied to geoprocessing techniques and geographical information systems. The studies are based mainly on the following works: 1) Geomorphology Survey with emphasis in Soil at South of "Serra do Mar" (ROCHA, et al, UFPR/ IAP, 1992); 2) Agricultural use potential at meadow areas of Parana State (IAPAR, 1994); 3) Recognition soil survey of Parana State littoral (1977). The studies covered the existing bibliography and cartographic materials. The results demonstrated the real possibility of update and adequate adjustment of mapping units, employing digital processing techniques and geoprocessing associated to convencional interpretation.

1. INTRODUCTION

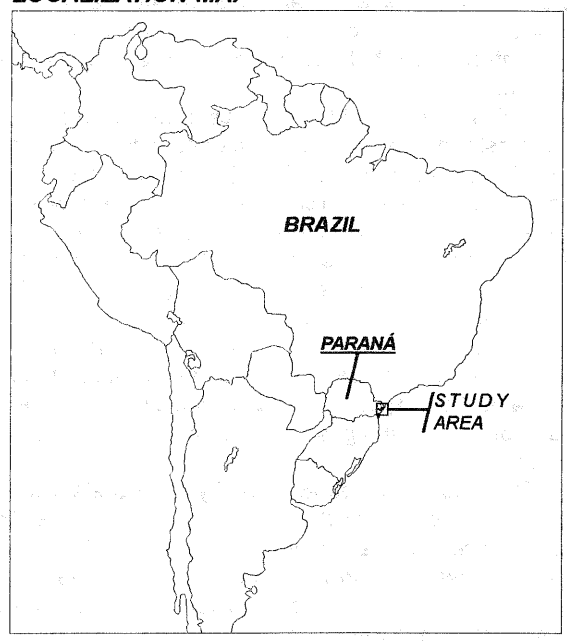
The Atlantic Forest, in the area of the "Serra do Mar", Parana State (south Brasilian), have about 500.000 ha, since 1993 it is included in the international net of Biosphere Reserves (UNESCO). This net is composed of protected areas that represent the most important ecosystems of the world, and have two objectives: nature conservation and the development of cientific researchs to benefit the man.

The Atlantic Forest at this region still conserves some primitive characteristics and protects many specimen of the local flora and fauna, what determine the high biodiversity of the ecosystem. This study has been made in all "Environmental Protection Area" (APA) of Guaratuba, amounting 200.000 ha, about 90% of this area is covered with the Atlantic Forest. To realize the zoning of the Environmental Protection Areas (APA), is necessary a good knowledge of the environment characteristics and aspects that allow the execution of a sustainable management plan and the delimitation of permanent preservation areas.

In this way, the studies of the physical environmental characteristics, specialy the soil survey are essential instruments to the adequate zoning of the Environmental Protection Areas (APA). The objective of this work was the updating and compilation of soil maps and agricultural aptitude studies through remote sensing techniques together with geoprocessing. The next steps were the restore of the legends, digitalization of ancilary information, adjustment and definition of mapping units based on the satellite images interpretation and the adjustment of the agricultural aptitude map to the new products obtained in the process. The studied area is geomorphologycaly divided in two big portions: 1) the coastal plain (25%), formed by plain areas that begin at the end of Serra do Mar extending till the Atlantic Ocean; 2) the Serra do Mar portion, with a very diversified landscape, which formation is related to different endogenous and exogenous process.

The geology of the Serra do Mar area is composed of the following units: 1) metamorphic rocks, quartzits, anfibolits and schist; 2) granitic rocks; 3) volcanic deposits; 4) diabasic dikes; 5) alluvial deposits.

LOCALIZATION MAP



At the coastal plain the soils are derived from recent alluvial sediments. In the area occur various classes of soils, standing out at Serra do Mar the Litolicos soils (HAPLUMBREPT and HAPLUDOLL) and Cambissolos (HAPLUMBREPT). In more restricted areas occur the Latossolos (ACROHUMOX). At the coastal plain predominate the Glei and Alluvial soils.

2. MATERIALS

The materials used in this work envolved the following works : Geomorphology Survey with emphasis in Soil at South of "Serra do Mar" (ROCHA, et al, UFPR/IAP, 1992); Agricultural use potential at meadow areas of Parana State (IAPAR, 1994) and Recognition soil survey of Parana State littoral (1977). The database was created with the help of topographic maps at the scale 1:50.000 and thematic maps in the same scale. Also were used geology, geomorpholy,

climate, vegetation, fisiographic and contour lines maps in this work. On the field work was used various equipments including GPS, information from the database and maps.

The softwares used in the process was the SGI (geographic information system) and SITIM (image treatment system) both development by INPE (National Institute of Space Research); EASI PACE - PCI.

3. METODOLOGY

The first phase of this work was the digitalization and integration of the thematic information and contour lines in a GIS.

At the Easi Pace-PCi (image treatment system) was done the geometric correction of the satellite image. The produced image from the digital elevation model (DEM) was transported to the SITIM as a new band. This procedure facilitate the integration of the DEM with the satellite image.

The 3, 4, 5 and 7 bands of Landsat TM5 satellite were used to the reinterpretaton of the mapping units. Various color compositions generated from the digital image processing proceedings were employed, with emphasis in principal component analysis and IHS transformation. These proceedings were used to enhance the images and integrate information that assist the analysis and interpretation process.

In this way, one of the most used techniques was the IHS transformation, looking for the integration of the relief, in digital elevation model (DEM) form, with the Landsat images. In the geographical information system were created a project delimiting the studied area, where the digital elevation model was obtained from the digitalization of contour lines. Other informations were digitalized in different layers: drainage pattern, vegetation, geology, geomorfology, access and limits. The mapping units were digitalized and superposed on the color compositions of Landsat images generated from digital processing techniques. The reinterpretation of the images was made directly from video screen.

The field work was assisted by GPS system to warrant the localization of the observation points. The digital image processing was done by the software SITIM (image treatment system) and the geographical information system used was the SGI, both developed by INPE - National Institute of Space Research.

The reinterpretation process also involved the analysis of spectral characteristics of the mapping units. These data were used to help the detection of casual heterogeneity between mapping units and to assist the field work.

The Methodology schematic diagram shows how the database was created by compiling the information taken from maps thus being analised and modified by the Geographical Information System (GIS). On the same ilustration is shown the IHS transformation process which consists on generating a Digital Elevation Model which is combined with the Landsat image resulting in a RGB image which colors represent the altitude.

Again the results were stored in the database and trough interpretation to create a adjusted and corrected map. On this map were compiled all the legends of soil maps (and others) to create a unique legend resulting in a final map which acompanied by the report generated the agricultural aptitude.

4. RESULTS

The images obtained through IHS transformation were very efficient. The utilization of the grey levels, at the 3, 4, 5 e 7 bands, to verify the mapping units at office, was very efficient, it allowed the election of the most representative places, where the field prospections were done. The usage of images also facilitated the organization of the field works because the access to the area is very difficult.

Finally, the present work demonstrated that it is possible to obtain the update and adequate adjustment of mapping units using remote sensing, digital processing, geoprocessing and field work together.

All the data obtained by the processes described before, resulted in a huge database that is fundamental for preserving the environmental protection area of Guaratuba and to develop a sustainable management plan.

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Please regard the colour page at the end of the volume.