

ANALYSIS OF DEFORESTATION IN MATO GROSSO USING MULTI-TEMPORAL LANDSAT TM IMAGERIES

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1. INTRODUCTION

Mato Grosso (MT), one of the nine Amazonian States of Brazil, suffered heavy conversion recently. In Brazil, soybeans are one of the principal agricultural products for export. Of the total area of Brazil, soybean plantation larger than 1000 ha is 43%, and farms smaller than 10 ha is less than 2,7% (IBGE, 2009). Many cities were created along the main roads of Amazonia for soybean plantation in the last twenty years. They are Nova Mutum, Lucas do Rio Verde and Sorriso, among others, built by the Highway BR 163 in Mato Grosso. Sorriso, the city built 742 km North from Cuiabá, the capital city of MT, has the biggest plantation area of soybeans of the world (Fig. 1), with 578 thousand hectares (IMEA – Instituto Mato-Grossense de Economia Agropecuária, 2005).

BR 163 is a 1765 km long highway linking Cuiabá to Santarém (a big fluvial connection port of the Amazon River in Pará State, northeastern Amazon), known as Soy Road. This highway is still under construction and it is paved: 98 km between Santarém and Rurópolis in Pará State, and 714 km between Guarantã do Norte and Cuiabá in Mato Grosso State (IMEA, 2005). The present study focuses on the deforestation being carried out along the Highway BR 163, which passes the cities of Nova Mutum, Lucas do Rio Verde, and Sorriso. This study proves the fact that in Amazonia, 80% of the deforestation occurs within 30 km from the main roads [1] [2]. In this present paper, unsupervised classification and NDVI analysis were performed to determine vegetation cover changes [3] between August 1991 and July 2009.

2. DATA AND METHODS

Two Landsat TM (Thematic Mapper) data were downloaded from INPE – CDSR and used for analysis: Landsat 5 TM scenes Path 227 Row 69 dated August 28, 1991 (Fig. 1) and July 28, 2009 (Fig. 2). NDVI (Normalized Difference Vegetation Index) was used for comparing the alteration of vegetation cover, where

$NDVI = (\text{infra-red} - \text{red}) / (\text{infra-red} + \text{red})$.

Before performing unsupervised classification (ISODATA method), the 1991 scene was resampled doing polynomial rectification. For that purpose, 20 GCPs (Ground Control Points) were picked up in both imageries

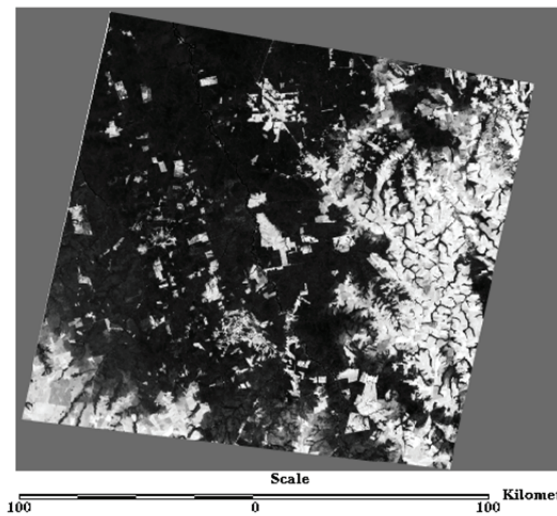


Fig. 1 Landsat 5 TM 19910828
 NDVI imagery Path 227 Row 69
 INPE – CDSR

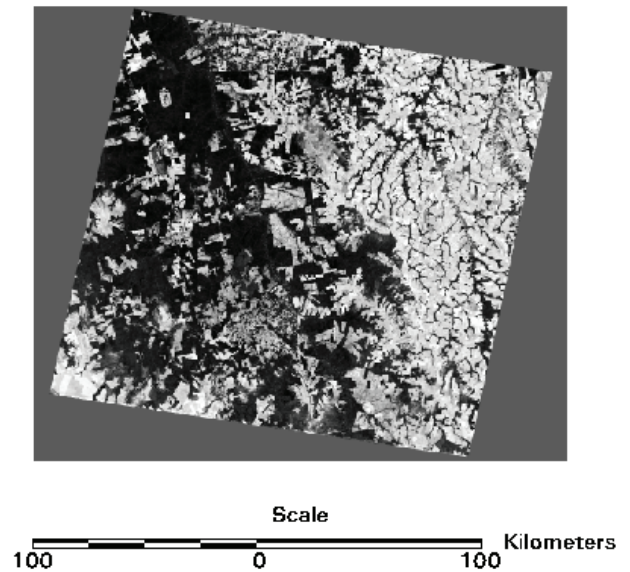


Fig. 2 Landsat 5 TM 20090728
 NDVI imagery Path 227 Row 69
 INPE - CDSR

and taking the 2009 imagery as reference. Categorization was used for determining water, forest, croplands, roads and urban areas. Also, deforested areas were obtained based on the summation of the cultivated areas, i.e., geometric polygons within the scenes. Each Landsat scenes were subset in 16 sub-scenes and for each of them was used measurement tool to obtain more accurate anthropogenic influences within the forests, taking as reference, the classification imagery.

3. RESULTS AND DISCUSSION

From the above mentioned calculation, forest cover in 1991 was 76%, whereas in 2009, it was 13% of the full scene. Soybean plantation was expanding mainly along the Highway BR 163. Compared to the 1991 scene, croplands were growing without leaving space for forests nearby the Highway in 2009, as we can see in Fig. 3. Also, within natural forest of Landsat TM scene of 2009, we could find many clear geometric division lines, showing the future cultivation area of some hundreds to some thousands hectares each, which was not included in the calculation of the present study. If clearing takes place following those lines in the years to come, deforestation rate in that region will increase much more than presented in this study.



Fig. 3 NDVI image of Sorriso, MT with BR 163 highway passing through the city in the low left of the image to northeast, bound for Santarém, PA. (Landsat 5 TM 227/69 20090728 INPE – CDSR)

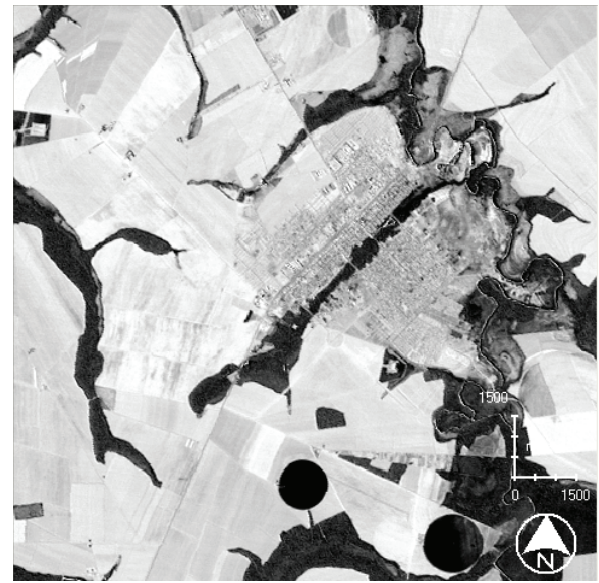


Fig. 4 NDVI image of Lucas do Rio Verde, MT with BR163 highway passing through the city in the middle of the image to northeast, to Sorriso. (Landsat 5 TM 227/69 20090728 INPE – CDSR)

4. CONCLUSION

The result visually shows us that the Amazonian forest does not exist anymore along paved Highway BR 163, even far beyond a 30 km diameter from the road, as we can see in Fig. 4. Soybean plantation in Brazil expanded 88.8% in ten years (1995-2006). In Mato Grosso State, the yield between 2009 -10 is expected to be 17.6 million tones (30% of national yield of Brazil), according to IMEA, 2009). However, in November, 2009, the Brazilian government announced that clearing of Amazon was the lowest in 20 years, since the government started monitoring deforestation in 1988. Further studies are needed to understand if it is the result of enforcement measures for promotion of sustainability of forests or it is simply the consequence of world economical recession.

5. REFERENCES

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