Using imagery satellite to assess the Land Use Change (LUC) from natural and grazing areas to crop farming in Central Brazil

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Introduction

At the same time agriculture is a major source of economic resources for Brazil, it also plays a major role on national greenhouse gases emissions. Brazil has being adopting responsible measures not only to reduce emissions from agriculture, but also to turn it into a sink. The first step to develop sustainable policies in the subject is to have a systematic overview of land use change (LUC) dynamics in major and representative agricultural areas of the country. In this sense, Literature might offer different figures for GHG emissions from the different land uses. However, for reliable estimates, a sound basis of LUC assessment is essential.

In this regard, intending to support estimates of Greenhouse Gases (GHG) emissions from LUC this work has carried out a LUC assessment through analysis of satellite imagery for the regions of Dourados in Mato Grasso do Sul State, Alto Teles Pires and Sinop in Mato Grosso State. These two areas were chosen for their relevance on soybeans farming and the different characteristics of their clearing for cultivation. The LUC analysis covered the period between 1993 and 2013 with temporal scale of 10 years (1993, 2003 and 2013).

Material and Methods

Initially crop farming areas were identified in Landsat satellite images of the last year of the study period (2013) and then compared to the images from the middle (2003) and initial year (1993). Images were a combination of three bands available from Landsat, yielding images with false-color composition, with spectral information outside the sensitive range of the human eye (Piroli et al., 2002), which support identification and differentiation of land use classes to be studied. Applying the methodology described in Esteves et al. (2016), areas were classified as: natural areas (savannah and forest) and agricultural areas (soybean and pasture), following color and texture patterns characteristic for each of these classes.

Figure 1 illustrates the image processing method, showing the main characteristics of each class analyzed: i.e, ***crop farming*** with uniform color and smooth texture in each batch; ***sown pasture*** with non-uniform color and smooth texture in each batch; ***rain forest*** with red color due to intense photosynthetic activity and wrinkled texture caused by tree shading and finally ***savannah*** with red and green color and little wrinkled texture.

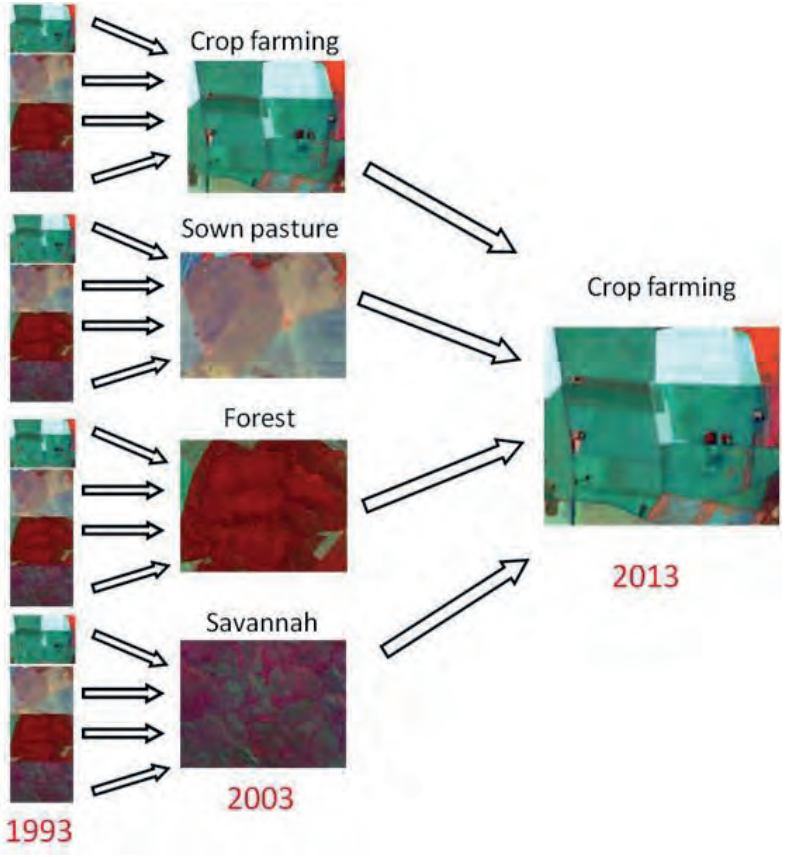

Figure 1: Methodology of analyzed classes

Results

The method for satellite imagery analysis for a larger time horizon proved effective and allowed rather good mapping for comparison with images from recent years. Results evidence substantial difference on LUC patterns in the two regions studied. This might be linked to the time when agricultural expansion reached these zones, being influenced by differences like in infrastructure and environmental regulations as well as by the kind of land cover itself.

Figure 2 shows LUC for the periods between 2003 and 2013 and from 1993 to 2013, in the State of Mato Grosso do Sul State. Regarding the 20 years period, it can be observed that LUC was essentially through conversion of sown pastures to crop farming, mostly soybeans. Higher proportions of pastures being converted to crop farming indicate intensification of cattle ranching in the area, since beef production in the area has been constant with even some increase in the last years (Bungenstab et al, 2014).

In the period between 2003 and 2013, a reduction on LUC can be noticed as well as a substantial reduction of LUC as a whole and especially on converting natural areas, especially savannah into crop farming. This can be explained by the fact that in Mato Grosso do Sul, agricultural expansion, converting natural areas to sown pastures occurred prior 1993 whose areas of more fertile soils were converted to crop farming, essentially soybeans.

In the other hand, in the State of Mato Grosso, were agricultural expansion occurred later, LUC converting natural areas (savannah and rain forest) directly to crop farming were more than 70% of the total LUC in the period between 1993 to 2013, showing a rather different pattern of agricultural expansion. However, in the last decade, clearing natural areas was

substantially reduced showing 32% conversion of natural areas and 59% of no LUC. It can be speculated that this is due to improvements on environmental law enforcement and land tenure issues, as well as some change of farmers focus, aiming at better yields instead of larger low fertility areas.

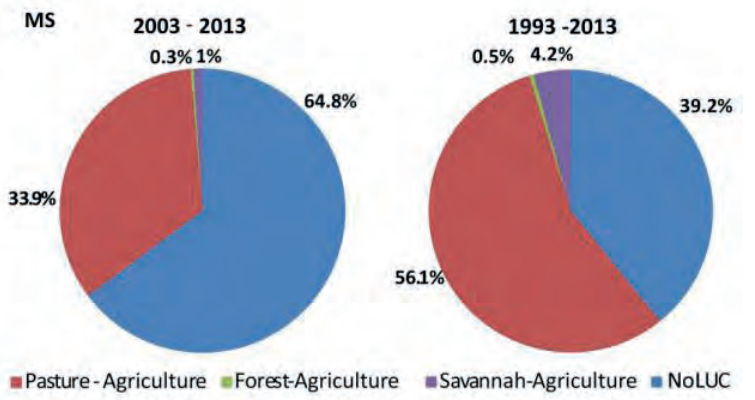

Figure 2: Land Use Change between 1993 and 2013 for Mato Grosso do Sul State, Brazil.

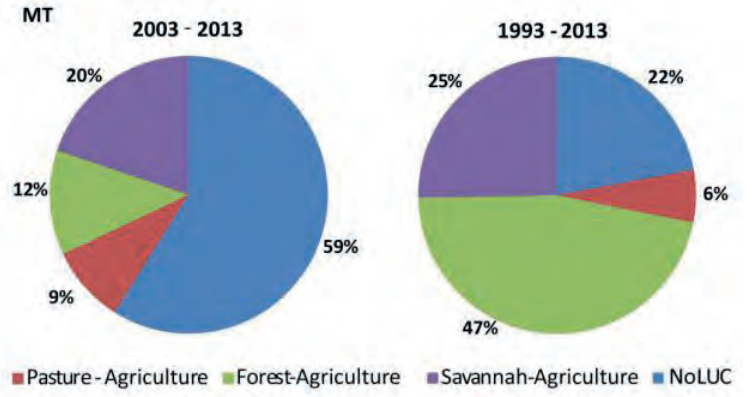

Figure 3: Land Use Change between 1993 and 2013 for Mato Grosso State, Brazil.

Conclusions

Therefore, this work proves that, when estimating GHG emissions from LUC in Brazil, scientists must have a close look on time scales and regional characteristics, segmenting assessments by small regions and avoiding generalizations in order not to go into miscalculations that would lead to wrong conclusions and poor orientation for policy making in both, national and international levels.

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