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Brazil shows the way in use of GIS for sustainable agriculture

Brazil, one of the world's main agricultural powers, utilises geotechnologies to integrate datasets from several sources for sustainable agribusiness



Embrapa Satellite Monitoring facility in Campinas, Brazil

The Brazilian Agricultural Research Corporation (Embrapa) aims to provide feasible solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer. One of its many research centres is Embrapa Satellite Monitoring Centre, a thematic unit focused on geotechnologies, which houses qualified staff, monitoring agricultural expansion, land use change, and their implications on environmental and economic sustainability of agribusiness.

The Centre has provided support in many research fields such as land use and cover dynamics in the Amazon region and its relation to socio-economic drivers, land-use zoning based on biophysical and human characteristics for distinct Brazilian states, land-use

and cover change studies on agricultural frontiers, carbon storage estimates in forest and agricultural systems, among others. The Centre also conducts studies for the identification and monitoring of degraded pastures in Brazilian biomes, the control of animal diseases on the country's borders, improving the knowledge of how agricultural activities affect the environmental quality such as greenhouse gas emissions, sustainable use of water resources, and dynamic mapping.

Increasing agricultural production

Brazil is blessed with favourable biophysical conditions, which places it among the world's main agricultural powers. Since 2004, the Amazon deforestation rate has dropped 80% and the agricultural production has increased consistently year after year. Different productive chains are responsible for 27% of the country's GDP, 36% of the exports, and 39% of the jobs. Recent assessments based on satellite imagery have shown that more than 60% of the country is still covered by its pristine land cover, approximately 5 million sq km or 10 times the size of France.

The use of geotechnologies has fostered great innovations in rural areas in Brazil. Rural planning, infrastructure and logistic issues, environmental impacts, crop forecast, expansion and intensification of agricultural systems, and even cattle traceability systems can make use of geospatial information.

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Geospatial knowledge is the basis for promoting a new development model in order to minimise the negative environmental and social impacts resulting from human activity. Organising and integrating census variables and remote sensing information in one geospatial database in order to enable studies and analysis for the characterisation and monitoring of agricultural activities, the preservation of natural resources, and the production of maps and zones is essential.

In this context, Embrapa Satellite Monitoring Centre developed the System for Agriculture Observation and Monitoring (SOMABRASIL), which integrates geographic databases from several sources and allows the performance of interactive queries based on different access levels.

SOMABRASIL organises, integrates and makes geospatial databases available on the Web by means of tools for spatially explicit analysis and dynamic visualisation, thus contributing to the understanding of land use and land cover changes. The WebGIS interface allows the user perform basic and advanced queries and generate useful information for land zonings, agricultural monitoring and for detecting priorities for research and policy making.

The system is entirely based on open source software (i.e., PostgreSQL, PostGIS, and GeoServer) and has been used by several organisations as a valuable tool for the dissemination of products and results obtained through geospatial analysis. The system has thousands of registered users, ranging from government agencies, universities, research institutes, banks, agricultural private companies, and the civil society in general.

SOMABRASIL is a WebGIS that includes tools for access, display, and manipulation of geospatial information. The user can display several layers and control their transparency, besides selecting different types of background

information, such as Google, Virtual Earth and Yahoo. The system structure is divided in three sections:

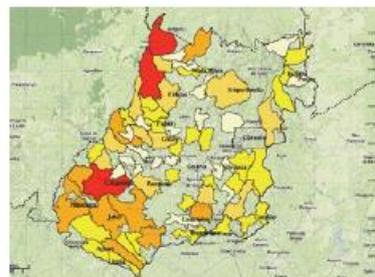
» **Thematic maps:** In this, geospatial data include administrative boundaries for states, meso-regions, micro-regions, and municipalities; cartographic indices; path and row for different satellites providing free data; physical layers (topography, hydrography, basins, biomes, soils, and agricultural aptitude); protected areas (conservation units of sustainable use, integral protection, and indigenous lands); logistics (waterways, railroads, and roads); and climate.

» **Diagnostics:** This includes land-use and land cover satellite-derived information from the 'Project of Deforestation Monitoring of Brazilian Biomes' (PMDDBS) and 'Project for Deforestation Monitoring of the Brazilian Amazon.' There are also layers generated by users from queries to the official statistics on Municipal Agricultural Production and Animal Production. Depending on the user access level, other advanced databases and queries are available, using the SQL syntax.

» **Monitoring:** Dynamic information derived from satellite data is available, such as vegetation indices and large scale agriculture mapping for the entire country. Examples are the maps indicating areas of severe drought or precipitation, polygons of agriculture based on one or two crops per year, and maps showing pasture degradation levels, all produced using MODIS (Moderate Resolution Imaging Spectroradiometer) and SPOT Vegetation time series.

SOMABRASIL is updated regularly with new information layers and databases generated by Embrapa Satellite Monitoring or other organisations, creating new possibilities for the observation and monitoring of the Brazilian agriculture. ☺

Mateus Battistella,
Embrapa Satellite Monitoring



SOMABRASIL WebGIS interface showing a query example for municipalities with cattle herds larger than 100,000 heads in 2011 (above) and levels of pasture degradation (below) in the state of Goiás, central Brazil

SOMABRASIL organises, integrates and makes geospatial databases available on the Web for spatially explicit analysis and dynamic visualisation, thus contributing to the understanding of land use and land cover changes