

Use of Geo-informational Systems for the Russian Agriculture Census

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Abstract

The paper discusses the difficulties in introducing geo-informational system technologies in agriculture in the Russian Federation. Monitoring of farmlands based on remote sensing data taken from space satellites is reviewed as a tool to estimate and forecast the impact of weather and climate conditions on crops performance. This approach has been confirmed by long-term positive practical experience of using remote sensing in the United States and other countries. These technologies were used to prepare and carry out the Agricultural Census in Russia in 2006 as well as to publish the census data. The paper describes the results of the work aimed at GIS introduction and adaptation to the farming industry carried out by the Main Computing Center of the Russian Ministry of Agriculture in 2003-2007.

1. Introduction

Starting from the year 2005, the Russian Federation domestic policy has been strongly focused at implementing the priority national projects in the four key areas of healthcare, education, housing, and agriculture development. The initiative of the Russian President and the Russian Government speaks for encouraging the accelerated livestock development, facilitating various types of land management and providing young specialists working in rural areas with housing.

Informational and analytical support based on the integrated empirical data and statistics should facilitate our progress in achieving two critical medium-term goals for the Russian agriculture. These goals are successful implementation of the National "Agriculture Development" Project and Russia's accession to the World Trade Organization (WTO) on conditions acceptable for the agricultural producers. Agricultural data collection, integration and distribution should reduce the costs associated with insufficient data support in the course of implementing this and other objectives.

2. Russian Agriculture

Agricultural production in Russia today has a significant potential for development having extensive opportunities for using the key production resource, i.e. lands fit for crops and livestock.

It is a well-known fact that farm production develops dynamically only if there is a high-performance farming system. These days we simply cannot farm effectively unless we introduce high end technologies for farm data collection and processing to

resolve numerous issues related to planning, forecasting, analysis, modeling and so on.

Over 400 ml. hectares of the RF territory is farmland including 221 ml. hectares of arable land. Arable land in Russia is located in 49 administrative territories of the Russian Federation. This land with 22 ml. people farming here is the main production tool for the Russian agriculture.

Availability of agricultural statistics is critical given the important strategic role of the farm industry, its involvement in speeding up the social and economic development of our country.

All-Russian Agricultural Census in 2006 became one of the ways to address this challenge.

3. Introduction of GIS in Russian Agriculture

The Russian Ministry of Agriculture initiated the work focused at introducing GIS in the Russian agriculture in 1999. Beginning from 2002, issues related to GIS applications have been considered within the concepts of development of automated informational systems for the industry. Since 2003 the Main Computing Center was commissioned by the Russian Ministry of Agriculture to carry out this work on permanent basis. We have created a general working model for the Federal GIS. It includes two major units consisting of farmland satellite monitoring and the geo-informational system.

Since 2003 the Main Computing Center of the Russian Ministry of Agriculture jointly with the Space Research Institute of the Russian Academy of Science, the Soil Institute of the Russian Academy of Science, the All-Russian Agricultural Meteorology Research are working on a number of projects aimed at introduction of remote sensing techniques in the Russian agri-industrial complex.

Remote sensing data analysis, farmland and crop monitoring are done in accordance with the general layout of the industry's GIS model and are represented as a separate unit.

Currently, you can get access to the satellite monitoring data on our web site <http://www.agrocosmos.gvc.ru/> that covers almost every Russian region -- major crop producers located from West to East, from St-Petersburg to Vladivostok.

NDVI averaged by oblasts is updated every 16 days for 61 administrative territories of the RF.

The satellite monitoring web site offers yield forecasts for 14 crops based on NDVI of the analogue year.

Visual data demonstration by analogue years reflecting yields, production and prices, and cross-referencing those parameters between themselves and against those available for 2006 enables agricultural producers and officials to address various administrative and operational challenges.

GIS technologies in the farm industry will allow to address the majority of complex objectives in the agricultural production:

- farmland monitoring;
- crop growth dynamics;
- yield forecasting;
- evaluation of damage incurred through emergencies and natural disasters;
- natural resources conservation and reproduction in the interest of improving efficiency of farm operations.

GIS technologies combined with informational capabilities of the farmland remote sensing increases significantly the efficiency of making an evaluation of the bio-climatic potential of certain regions.

The GIS database was used during the All-Russian Agricultural Census and will be used to analyze the results.

4. All Russian Agriculture Census

The All-Russian Agricultural Census – first ever in the history of New Russia -- was successfully completed on July 25, 2006. About 100 million people were involved in this national event.

Overall, the following numbers were collected in Russia:

- 59,200 agricultural organizations and enterprises including households;
- 253,400 private farms;
- 31,800 individual entrepreneurs;
- 17,900,000 people's households or other individual people's farms;
- 80,300 horticultural, gardening, livestock and dacha non-commercial people's associations.

4.1 Maps

One of the most important work activities in preparation to the Census was to provide enumerators with the GIS based maps. It required building digital maps with the use of geo-informational technologies. A number of Russian agencies and organizations with special expertise were invited to accomplish this task.

In accordance with the Russian legislation, having such large scale project in mind, a tender was announced. The Main Computing Center of the Russian Ministry of Agriculture with its technological and informational resources fitting the Census needs became the winner. The Federal Non-Movable Assets Land Register Agency and the Russian Space Research Center laboratories were invited as subcontractors.

4.2 Use of Maps at Rayon Level

Index maps for 2,000 administrative rayons of the Russian Federation territories were developed in the course of preparations to the census to carry out the census zoning and enumerator route planning. The index maps included data layers of cadastral division of territories, hydrography, road network, names of settlements, and numbers of census targets, their graphic and semantic personal data put together with the help of geo-informational technologies using digital maps and satellite images. Total number of those index maps counted 4,200 copies.

The objective of providing the statistics offices with such detailed maps in digital and paper format was to advance the efficiency of censuses and reliability of data received.

Cartographic materials were developed and distributed to the regional statistics offices as two types of maps (map 1 and map 2).

Digital index maps 1 show the number of plots with large and small agricultural census targets linked to administrative rayons and cadastral areas. Maps 1 were developed for approximately 2,200 administrative rayons of the Russian Federation in the raster format.

Digital index maps 2 show the boundaries of administrative rayons and large agricultural census targets in the raster format for almost 2,000 administrative rayons of the Russian Federation with the additional layer of high resolution satellite imagery that includes areas where farmland is being used.

The work was based on the data obtained through the farmland monitoring system of the Ministry of Agriculture of the Russian Federation developed by the subordinate organizations of the Ministry, the Federal Non-Movable Assets Land Register Agency, the Federal Statistics Service, the Russian Academy of Sciences, the Russian Academy of Agricultural Sciences, and the Russian Space Research Institute.

The following inputs were required to develop the maps for the Census:

- digital base material;
- cadaster maps and farmland plans by territories of the administrative rayons of the Russian Federation linked to the census targets;
- library maps and/or land regulation layouts;
- agricultural census lists with addresses;
- satellite data (remote sensing data).

4.3 Census Database

The final census database will be transferred to the Ministry of Agriculture. It will serve as a basis for a powerful analytical system supported by GIS technologies capable of running multidimensional analysis (using OLAP-cube technology) and visualizing the industry profile looking at operations down to a rayon level.

Official publication of the summary census results will provide all interested citizens and organizations with the information on the Russian agriculture.

Extensive access to the informational resources by the Ministry of Agriculture experts, analysts and men of science will effort an opportunity to receive reports on the agricultural outputs, industrial makeup of agriculture, its economic potential. It is essential to develop high quality forecasts for perspective agriculture development and to draft economic policies aimed at advancing farm production efficiency.

4.4 Russian Agriculture Census Results

Currently, the work is underway to develop an Internet portal based on ESRI server geo-informational technologies that allows to update on-line the aggregated results of the All-Russian 2006 Ag Census on base material, which will create a basis for generating secondary analytical reports.

In addition, work is in progress to publish a printed version of the “Atlas of Russia” publication that includes thematic index maps with the key data from the agriculture census superimposed on the base material by territories, administrative rayons and municipalities of the Russian Federation.

Index maps with the census results will display aggregated data for crops, livestock and farmlands to visualize agricultural commodity distribution and regional specialization in Russia.

Geo-informational systems are the most effective tools available today. With their help many challenges are being addressed in the world farm industry including land and crop monitoring with the use of remote sensing data, crop growth dynamics, and yield forecasts.

4.5 Use of Satellite Monitoring

The use of statistical or other methods of obtaining unbiased and independent information from various sources supported by the unified base material for municipalities will address issues not only related to monitoring, data cross-referencing and analysis, but visualization and recipient oriented data representation.

Once the digital maps are verified there will be a better way to plan sample surveys of agricultural producers on the basis of information related to the farmland use.

As soon as we clarify the data on arable land composition and determine owners of the “unaccounted” arable lands we’ll be able to discover the numbers “escaping” statistical reports, and to improve the quality of the final census results.

Data received and economic forecasts typical for food market development may serve as the basis for the government to develop strategic policies. The results may also be used to draft new federal regulations for agricultural markets.

The federal informational resources updated on regular basis, displayed on electronic media and delivered to organizations on their requests and individuals via communication channels, represent a new direction in the informational security of production and management in the Russian Agri-Industrial Complex. These resources are available to any interested federal agencies, services and organizations.

All-Russian Agricultural Census has already made a revolution not only in the people’s minds but it also made a breakthrough in the country’s economy.

5. Conclusion

Development of the agrarian sector of the Russian federal statistics is now more than ever essential in order to draft and support the farm policy, general strategy and tactics of the agri-industrial complex development for medium- and long-term perspective, to increase the competitiveness of the Russian farm produce. It is especially important in connection with Russia’s accession to the UN Food and Agriculture Organization (FAO) and forthcoming accession to the World Trade Organization (WTO) that require their members to be open and transparent.