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CONTROL AND MONITORING SYSTEMS IN AGRICULTURAL ENTERPRISES

U.Nasritdinova - PhD, Z.Abddurakhmonov - assistant
S.Khikmatullaev - assistant, O.Abdisamatov - independent researcher
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

One of these innovations is the use of geo-information technologies in agriculture, equipping agricultural machinery with satellite navigation systems, and automation of production processes. It is the dynamic development of agricultural production that requires the introduction of a highly efficient farming system, modern technologies for collecting and processing information necessary to solve numerous production and management problems using modern technologies, including geographic information systems (GIS). At the moment, the bulk of agricultural enterprises in the region are experiencing financial difficulties, and each manager is trying to reduce costs, use working hours more rationally, more efficiently use the resource of equipment in order to achieve a lower cost of the final product. It is no longer possible to improve the work of the enterprise in the "old fashioned way", therefore, a fundamentally different approach to the management mechanisms of the enterprise and all technological processes is required, completely autonomous and at the same time disciplining workers. As follows from the tasks facing agriculture, the introduction of geoinformation technologies in an agricultural enterprise and computer monitoring of its activities is the most promising direction in the development of the agro-industrial complex. This will increase the efficiency of technological processes of an agricultural enterprise, more rational use of agricultural land, agricultural machinery and working hours and, as a result, increase the profitability of agricultural enterprises in the region.

Key words: GLONASS/GPS, AgroControl, AutoGRAPH, Navigator-Agro, SCOUT.

Introduction. Satellite monitoring allows improving the quality and reliability of agricultural statistics by increasing the accuracy, objectivity and monitoring frequency in agricultural production. As for our country, the attempts to introduce such technologies encounter a number of difficulties. First of all, there are no tools to collect accurate information on land use and control of technical means of production, especially in large farms. Even the heads of large farms often do not have information about the exact size of their own agricultural land. Large areas of land require reliable software that will provide quality control and convenient work with information on all fields and crops. The implementation of such programs gives a very tangible economic effect.

Currently, satellite monitoring systems are mainly used to control and monitor automobile transport - to track unplanned movements and detect fuel discharge. There are very few fleet management systems in agriculture. Attempts are being made to introduce automobile monitoring systems into agricultural production. However, the tasks that the enterprises put forward may not always be satisfied with the ready-made functional systems designed for another industry. The land, though immovable, also has variability: crops are changing, as well as their cultivation technologies, field boundaries are transformed over time, which leads to a change in areas. All this also needs to be monitored in real time and stored for several years in order to ensure the continuity of information and to minimize problems that arise due to a change in the personnel of farms.

Materials and methods. In general, it should be noted that the introduction of such systems takes farm management to a qualitatively new level, reduces operating costs, limits the inappropriate use of the fleet, thereby increasing the productivity. In addition, using these systems, large farms may manage with a minimum of personnel and the time control of all agro technical stages will undoubtedly result in an increase in the yield of the main crops.

At an expanded meeting of the Government of the Ryazan Region in April 2012, the Minister of Agriculture and Food of the region reported that the cultivated area that year increased by 6 thousand hectares and amounted to 774.5 thousand hectares. The region is fully provided with seeds of spring grain crops and potatoes. The introduction of mineral fertilizers is planned at the level of the previous year. The readiness of the main types of agricultural machinery is 85%. By the beginning of spring field work, all farms were fully provided with reduced-price fuel. Governor Oleg Kovalev instructed to revise the volume of fertilizers applied, as well as to exclude the possibility of using substandard seeds during sowing. The head of the region paid special attention to the gasification of grain dryers, which he demanded to check before the start of harvesting. He also instructed to consider the possibility of a centralized fuel delivery to agricultural enterprises.

The issue of registration of unclaimed land shares, the area of which currently exceeds 400 thousand hectares in the region, was also discussed. According to the governor, it is necessary to accelerate their allocation to efficient owners in order to put them into agricultural circulation. The funds received from this should go to the local budgets for targeted use. The Minister noted that "today, in the context of an increase in milk production in the Ryazan region (in the first quarter, there was a 10% increase compared to the previous year) and expecting the season of large milk volume, the general task of the ministry, producers and processors was to take measures to ensure that in summer period fewer problems would

rise for those who produce milk and who process it.

To date, the structural units of the Ministry of Agriculture of the Russian Federation have identified the main directions for implementing global positioning systems in agriculture, organized the supply of GLONASS/GPS equipment to centers and stations of the agrochemical service of the Ministry of Agriculture of Russia. In addition, a number of agricultural universities have developed the methods for contact mapping of fields by soil fertility (humus content) using satellite navigation systems. A comprehensive development of technologies is underway, including the adaptation of navigation equipment to domestic technology. In particular, the Center for Precision Agriculture for the introduction of navigation technologies in agriculture was created at the Moscow Agricultural Academy named after K. Timiryazev.

Control and monitoring systems are hardware and software systems consisting of sets of equipment installed on vehicles or mechanisms (from seeders and combines to automotive and tractor equipment) subject to control and specialized software that process, analyze and visualize data received from the vehicle with subsequent reporting. A GPS/GLONASS receiver is installed in the vehicle; it determines the exact position of the vehicle, its speed, motion direction, etc. Then, using a GSM modem over the mobile networks, these data are transmitted in real time to a special server, and then via the Internet to the system users. The system is able to control a large number of technical parameters, both primary and secondary, beginning from the presence of a driver at the steering wheel and the fuel level in the tanks to fuel consumption and the duration of parking. If a controlled tool equipped with sensors is for any reason out of the GSM network coverage area, all data on its movement are stored in a database (up to several months of continuous operation) and come in the form of reports to the customer when communication is resumed.

Paste in picture: customer's working place Server platform; radio transmitter medium; navigation signal; GPS satellites; objects of monitoring; user equipment; file transfer.

The user has access to maps on which the object under observation is displayed, and to a database that contains all the information received, the information is displayed both on the maps and in the event log.

The examples of such systems are:

• AgroControl - a specialized system for transport and land plots monitoring and control. The navigation equipment installed on a moving object provides the collection of necessary information and transmission to the central server of the system. This information is accessible to the chief mechanic, head of garage, engineer, agronomist or manager who makes decisions. Data transmission is carried out both via an electronic drive (flash memory), and in real time using cellular networks.

• AutoGRAF equipment monitoring system - a flexible and cost-effective monitoring system operating on domestic devices.

• "Navigator-Agro" allows checking the work of agronomists, machine operators and combiners, it assesses the quality of work and prevents the theft of seeds, marketable grain, fertilizers, plant protection products and fuel and lubricants.

• "SCOUT" or Satellite Control of Transport and Fuel - a system for transport monitoring and control. Thanks to this system, it is possible to track the location and

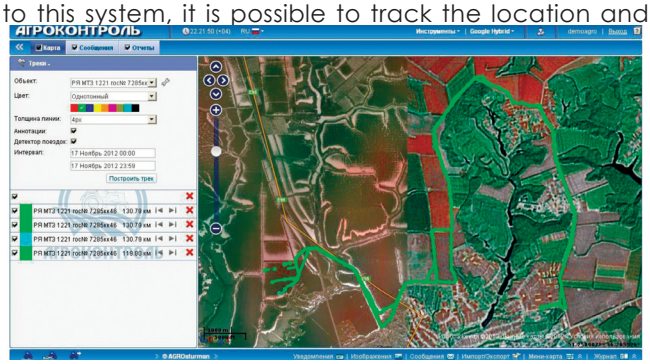

Fig. 2. An example of the interface of the AgroControl monitoring and control system

condition of any vehicle on which it is installed.

Figure 3 shows the stages of SCOUT system installation on a self-propelled car FGBOU VPO RGATU.

control of the main parameters of a combine - idle schedule, ignition, speed chart, schedule for filling and unloading the hopper, field motion control, switching on the additional devices, etc.

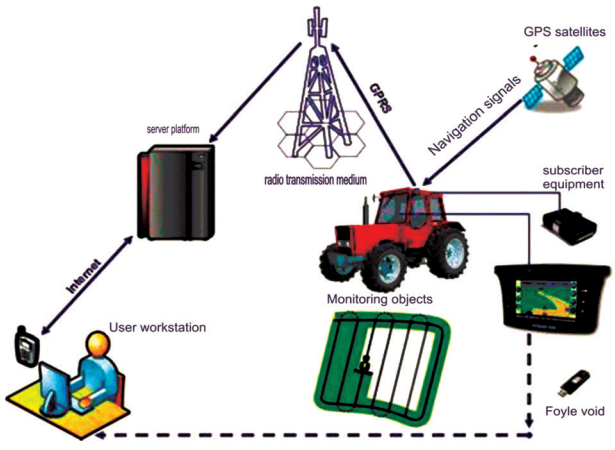

Fig. 1. The principle of operation of the control and monitoring system

Figure 3. Installing the SCOUT system on a self-propelled vehicle FGBOU VPO RGATU

Fig. 4. An example of an interface of a SCOUT control and monitoring system: track superposition on photographs taken from space

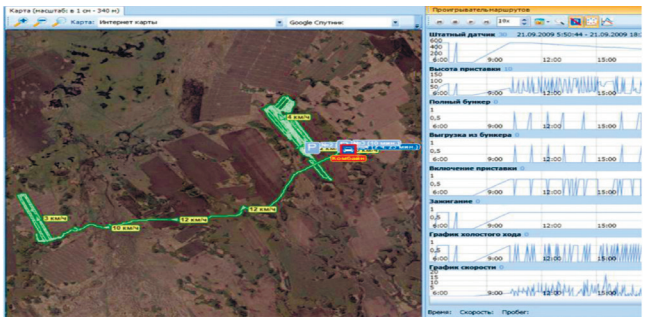

Fig.5. An example of an interface of a SCOUT control and monitoring system

In general, such systems allow solving the following range of problems:

- determination of geographical location, direction and speed of agricultural vehicles;
- control of loading, transportation and unloading of agricultural goods;
- control of fuel consumption, as well as its unauthorized discharge;
- account of farm land cultivated by agricultural machinery;
- control of the start and end time of work;
- monitoring the compliance with speed limits when performing agricultural work;
- control the location of the object within the designated area (field) with entry/exit time control;
- monitoring the compliance with the route and detection of the facts of its violation;
- control of fuel consumption according to the distance traveled.

Conclusions. The dynamic development of agricultural production requires the introduction to a highly efficient farming system, modern technologies for collecting and processing information necessary to solve numerous production and management tasks using modern technologies, including geographic information systems (GIS). The use of space and information technologies allow us to give the process of managing the agriculture of country such properties as global, systematic, responsive, continuous. In recent years, some progress has been not in the use of space activities in agriculture. But GISs in the agro-industrial complex are accompanied by the following implementation problems:

1. Lack of information about the benefits, the tendency towards agricultural managers to "traditional" methods of management.
2. The time spent on development, the need for advanced training as/in/for specialists.
3. Lack of robotic agricultural machinery of the domestic market equipment, including Russian-made.
4. Lack of domestic software.
5. Low profitability of agricultural enterprises, reducing the likelihood of GIS implementation. To overcome the existing difficulties, the authors propose the following activities to be implemented by students studying this manual in the near future:
1. Creation of a federal integrated GIS specialized in agricultural purposes of appropriate space resources.
2. Development of unified software.
3. The creation of regional centers of information technology for precision farming on the basis of agricultural universities in all regions of the Russian Federation with the active support of the state.

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