GEOGRAPHIC INFORMATION SYSTEMS AS THE BASICS FOR AGRISHARING

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ABSTRACT

The study substantiates the need for joint development of higher education, science and agribusiness to ensure their harmonious development - "agrisharing" based on the Geographic Information System (GIS) platform. Problems of development the corresponding branches separately are defined. It is proved that their joint development in modern conditions of introduction the information and communication technologies is possible on condition of existence the platform which would combine as information on joint material, technical and intellectual resources, so give the chance of economic development and profit from such collaboration. Given the presence of the agricultural sector in this interaction and land as the basis of the relevant production, the use of geographic information system for researching purposes is determined by a single and optimal solution. "Agrisharing" is defined by the authors as the joint consumption of goods, natural resources, material and technical base and intellectual capital in the system of higher education, business and science interaction in the agricultural sector. The directions, functions, tasks and advantages of using the GIS platform in agrisharing system are given. Such systems for agricultural entrepreneurs, educational institutions and research institutions allow to develop the following areas: information support for decision-making; planning of agricultural operations; monitoring of agrotechnical operations and dynamics of land use; crop yield forecasting and loss estimation; planning, monitoring and analysis of the technology use, intellectual resources and scientific potential development; territorial distribution of the possibility of providing consulting services and educational facilities; optimization of joint resource usage.

Keywords: GIS PLATFORM, AGRISHARING, AGRICULTURAL ENTREPRENEURS, EDUCATIONAL INSTITUTIONS, RESEARCH INSTITUTIONS, JOINT DEVELOPMENT.

INTRODUCTION

The problem of depletion of land resources and the need to optimize their use for food and agricultural production has become extremely relevant in a constantly growing population of the globe and the need to provide them with food. The ability of global agricultural markets to correct supply disruptions and stabilize commodity prices is linked to the continued operation and depletion of land resources. Thus, for agriculture in general and agricultural producers personally, it is important to provide scientific support and staffing of the industry with innovative approaches to solving problems and agribusiness management.

Among the problems of the scientific sphere it is worth noting the main ones - insufficient funding, aging of staff and the gradual extinction of classical applied science. An impetus is needed to catalyze the development of science. This impetus can be both the state and private enterprises. Higher education, in turn, can revive human resources and interest in science among young people.

The problems of agricultural enterprises are the lack of a strategic approach to solving the problem of making a profit. Without scientific support, the use of own resources is unsystematic. Also, agricultural enterprises are constantly faced with the problem of lack of qualified personnel and the need to improve the skills of existing personnel, taking into account the constant development of new technologies in the agricultural sector.

Important problems of higher education are outdated material and technical base, lack of close ties with agricultural producers (and as a consequence - the inability to form the required specialist after obtaining the document on higher education), low interest of young people in research and problems of further employment of graduates.

The solution of the above problems is possible under the condition of joint development of three branches - science, higher education and agricultural producers as the main stakeholders in the development of the agro-industrial sector of our country.

Appropriate joint consumption and development is possible by implementing basics of the sharing economy.

Authors propose the definition of "agrisharing" as a joint consumption of goods, natural resources, material and technical base and intellectual capital in the system of interaction of higher education, business and science in the agricultural sector.

As mentioned above, each of the industries has a number of its own problems that negatively affect the economic aspect of the development of the respective areas separately. Joint development in the current conditions of introduction the information and communication technologies is possible with a platform that would combine information about common material, technical and intellectual resources, and also at the same time provide an opportunity for economic development and profit from such collaboration. Given the presence of the agricultural sector in the relevant interaction and land as the basis of the relevant production, the use of geographic information system for appropriate purposes is the only and optimal solution.

The aim of the study is to justify the advantages, features and directions of applying the GIS platform as the basis of the agrisharing system.

RESULTS AND DISCUSSION

In the 60s of the twentieth century, the pioneers of information systems for the first time put forward ideas and projects for the creation of GIS. The Harvard Computer Graphics and Spatial Analysis Laboratory has had a major impact on the development of GIS. In the 1980s, it was determined that any GIS is characterized by four functions:

1) collecting information about the territory, i.e. obtaining coordinate and semantic information about the studied objects of this territory;
2) generalization of the collected information in the form of a thematic map, plan, scheme - conditional visualization of the location and properties of objects on a cartographic basis;
3) processing and analysis of generalized information about the territory;
4) making a decision (or conclusions) based on the results of the analysis [1].

In the modern world due to integration with global IT trends - artificial intelligence, big data, VR, drones and robots - geoinformation technologies are moving away from the classical understanding of the map and turning into multipurpose solutions, covering almost all spheres of human activity: from development to the entertainment industry. High-precision 3D models of territories and VR technologies are actively used by architects, designers and game developers.

The ecosystem of geospatial technologies is a complex object with many interactive components. These technologies have evolved over the years and are broadly divided into four categories: GNSS and positioning, GIS and spatial analytics, Earth observation and 3D scanning. These four segments span various other technologies and are key components of the geospatial technology ecosystem.

GNSS and positioning. The constellation of satellites, the Global Navigation Satellite System (GNSS), transmits signals from space to users with a compatible device to determine their location, speed and time. The GNSS industry, used in many applications, is a mixture of the emerging and following GNSS markets, the surveying market, and the fastest growing indoor positioning market [2].

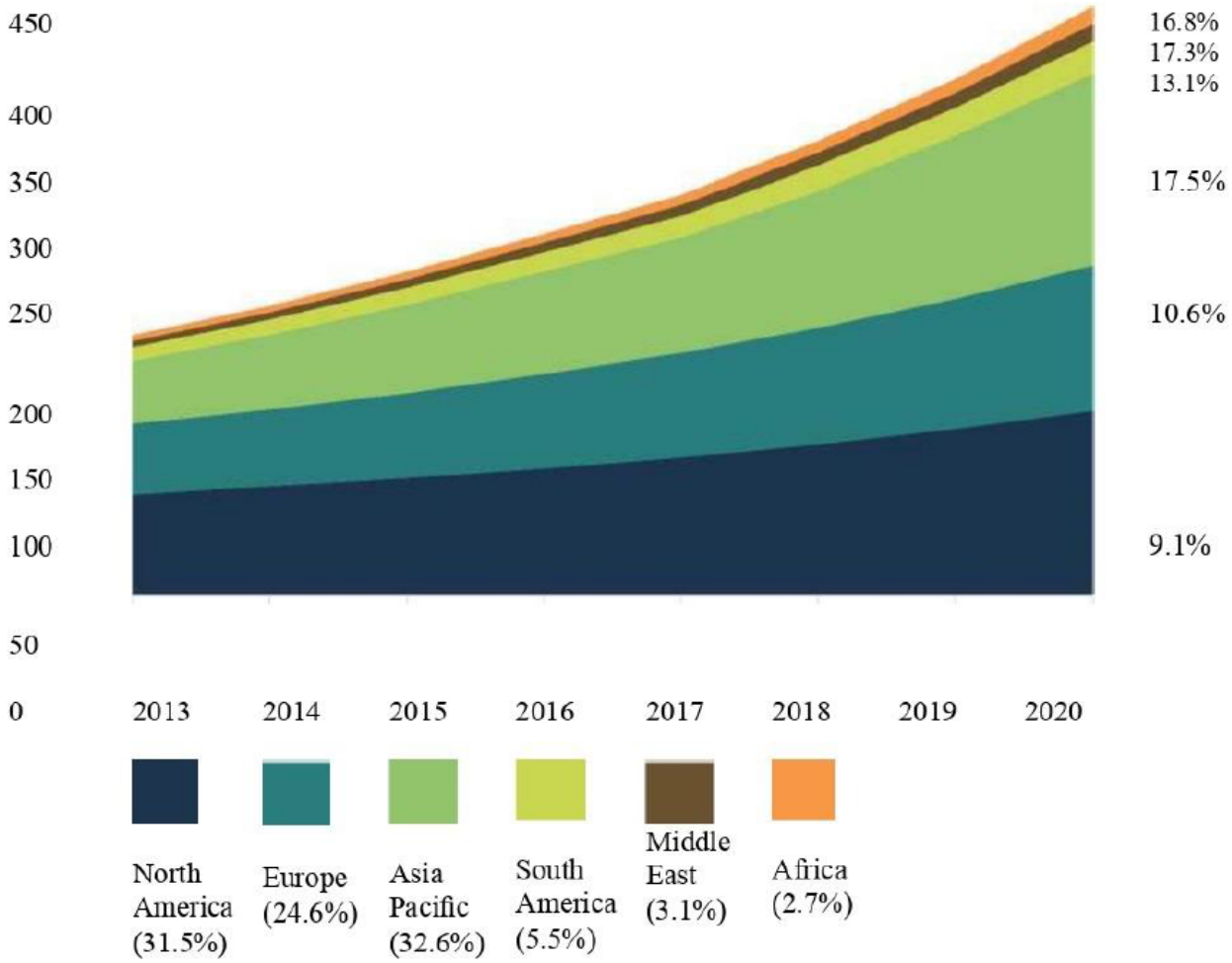
GIS and spatial analytics. Geographic information systems is a system that is designed to collect, store, manage, analyze and interpret data relationships, patterns and trends. Available to consumers in the form of software, GIS is subdivided into three types: desktop GIS running on a personal computer; Web / Cloud GIS, which allows the user to use the software in the cloud; Mobile GIS, which allows the user to use the GIS on a smartphone or tablet.

Earth Observation is a technology used to map the surface or earth from above or from space. This includes remote sensing satellites and aerial photography.

3D scanning. The scanning technology segment is currently the fastest growing segment, including LiDAR, radar and laser technology. These technologies are used to digitally capture the realm of physical objects and the environment by creating "point clouds" of data from the object's surface or environmental data.

Globally, the geospatial industry continues to gain relevance and maturity, and the overall market is expected to grow faster over the forecast period, according to the Geospatial Industry Outlook and Readiness Index [3]. However, industry growth is unevenly distributed across different regions (Figure 1). Emerging market regions are expected to grow significantly faster than regions with relatively mature markets.

Figure 1. Dynamics of development the geospatial industry in the world [3]



The cumulative geospatial industry was estimated at US $ 299.2 billion in 2017 and is projected to reach US $ 439.2 billion over 5 years, with a CAGR of 13.6%. This acceleration in growth can be attributed to continuous technological advances in the industry, democratization of geospatial information based on integration with advanced digital technologies and, as a result, innovative business models. The market size of the second largest segment of geospatial technologies - GIS / spatial analytics - is expected to grow at a CAGR of 12.4% as it finds increasing use in urban planning, utility management, e-government, applications, retail and logistics, disaster management and various other applications [3]. More and more business data integration with location information across enterprise level functions, engineering-construction-infrastructure sectors graduating to using spatial analytics, deepening integration of Big Data with GIS, the Spatial Analytics industry is poised for greater growth by the demand for adding location context to data.

Accordingly, GIS is a rapidly developing technology around the world, which, in conjunction with GNSS, earth Observation and 3D scanning, provide society with the sustainable development of geospatial technologies. These technologies should become the basis for the development of agrisharing, taking into account the need for an appropriate system in the constant monitoring of the state of land resources, spatial analytics, mapping and forecasting.

After all, the peculiarity of the use of information technologies in agriculture is that almost all the data used have a spatial (geographic) reference. And if we want, for example, to analyze the distribution of soil moisture together with yield, then both data must be in the same coordinate system and have the required coordinate accuracy. Only programs specialized in working with spatial information, namely, GIS, can process such data. The peculiarity of these systems is that they allow to integrate, maintain and jointly analyze a variety of types of spatially distributed indicators and descriptive data.

Such systems for agricultural entrepreneurs, educational structures and scientific institutions allow developing the following areas:

• information support for decision making;
• planning of agricultural operations;
• monitoring of agrotechnical operations and dynamics of land use;
• forecasting crop yields and assessing losses;
• planning, monitoring and analysis of the use of technology, intellectual resources and scientific potential;
• territorial distribution of the possibility to provide consulting services and the provision of an educational base;
• optimization of resource sharing.

Information support for decision making. To provide managers with a complex of information necessary for making management decisions, a database is created on the GIS platform containing:

• digital terrain model;
• information about remote sensing;
• information on the properties and characteristics of soils, crop maps by year, history of field cultivation, etc.
• a database of administrators of educational institutions who provide support for filling the platform;
• a base of scientific institutions providing advisory support to agricultural producers

Information support for decision making. For more efficient use, the GIS should contain a multilayer electronic map of agricultural fields, educational structures and scientific institutions, as well as an attributive database of the history of fields with information about all agricultural activities, scientific achievements and educational services. Be sure to include relief layers, information about the steepness of slopes and their exposure, microclimate, groundwater level, humus content in the soil, etc.

Thus, creation of an information support system for decision-making processes based on GIS technologies allows increasing overall efficiency by providing relevant analytical information on the entire range of necessary parameters for making optimal and timely management decisions.

Agricultural planning. Information management systems based on geoinformation technologies play an important role in planning agrotechnical operations.

Based on the attributive data of agrotechnical measures, tasks for workers can be drawn up, as well as recommendations of scientific institutions and educational structures to optimize production processes and, if necessary, make changes to them.

Planning based on GIS data allows you to reduce (or completely eliminate) downtime, optimize agricultural operations and improve agricultural performance.

Monitoring of agrotechnical operations and dynamics of land use. In the course of solving **this** problem, registration of all agrotechnical operations is carried out, scientifically reasoned recommendations for their optimization, the costs of their implementation, expert assessments of agronomists and data of remote sensing of the Earth are registered and entered into the database.

Forecasting crop yields and assessing losses. The yield forecasting system is based on the methods of monitoring the state of crops, taking into account the influence of natural and climatic conditions. This technology allows to track the dynamics of the development of agricultural crops, growing conditions, determine the timing of their ripening and the optimal timing of the harvesting beginning, conduct economic analysis at the minimum and maximum yield levels that are consistently possible for specific conditions.

As a result of forecasting crop yields and assessing losses, educational and research organizations can predict for private entrepreneurs the optimal price for equipment and materials that the enterprise will need in the future, and determine the purchase prices for agricultural products.

Planning, monitoring and analysis of the use of technology, intellectual resources and scientific potential. The technical subsystem of agricultural enterprises in the GIS system includes graphs, analytical data of attributive tables for all movements of equipment, calculation of mileage and cultivated areas, depreciation costs, determination of optimal travel routes, and the like. Also, the attributive data of educational institutions will provide analytical data on the development of various areas of service provision, scientific - scientific support.

The territorial distribution of the possibility of advisory services and the provision of an educational base will provide an opportunity to take into account the presence of an educational institution (and its capabilities in attribute tables) and research centers on the corresponding territory, and form a base of services and opportunities provided by them.

Optimization of resource sharing. In the aggregate, the use of the GIS platform and its filling jointly with agricultural enterprises, scientific structures and educational institutions will ensure the availability of constantly updated spatial and analytical information for harmonious development.

The following main functions of the agrisharing platform can be distinguished:

• maintaining an information base of the state and development of institutions and organizations involved in the system;
• accounting of agricultural land with data in connection to the map;
• conducting agrochemical monitoring of agricultural land;
• organization of rational use of land, optimization of the structure and placement of crops;
• processing the navigation data and control of equipment movements;
• planning and accounting of actual work;
• forecasting activities;
• planning of works, services and development of the sharing system;
• calculating the needs and capabilities of participants in the agricultural sharing system;
• exchange of information with external systems.

Agrisharing GIS platform allows to solve the following tasks:

• create an digital workspace for the development of the education system, scientific structures and agricultural producers;
• develop conservation and precision farming systems;
• support the operational decision-making;
• create and expand information databases of agricultural producers, educational structures and scientific organizations for their purpose and content, with the binding of information to a specific territorial location;
• fill the information platform with constantly updated attributive information;
• ensure reliable storage and keeping up to date of information databases;
• provide analytical reports on the development of the industry with visualization;
• provide the necessary information to specialists in related industries;
• work with information through personal computers, laptops, navigators, mobile phones, etc.
• use Internet technologies (WEB-portal, geoportal, geoserver) for data exchange, transmission and control [4].

The authors propose the content of GIS platforms for agricultural sharing, shown in Figure 2.

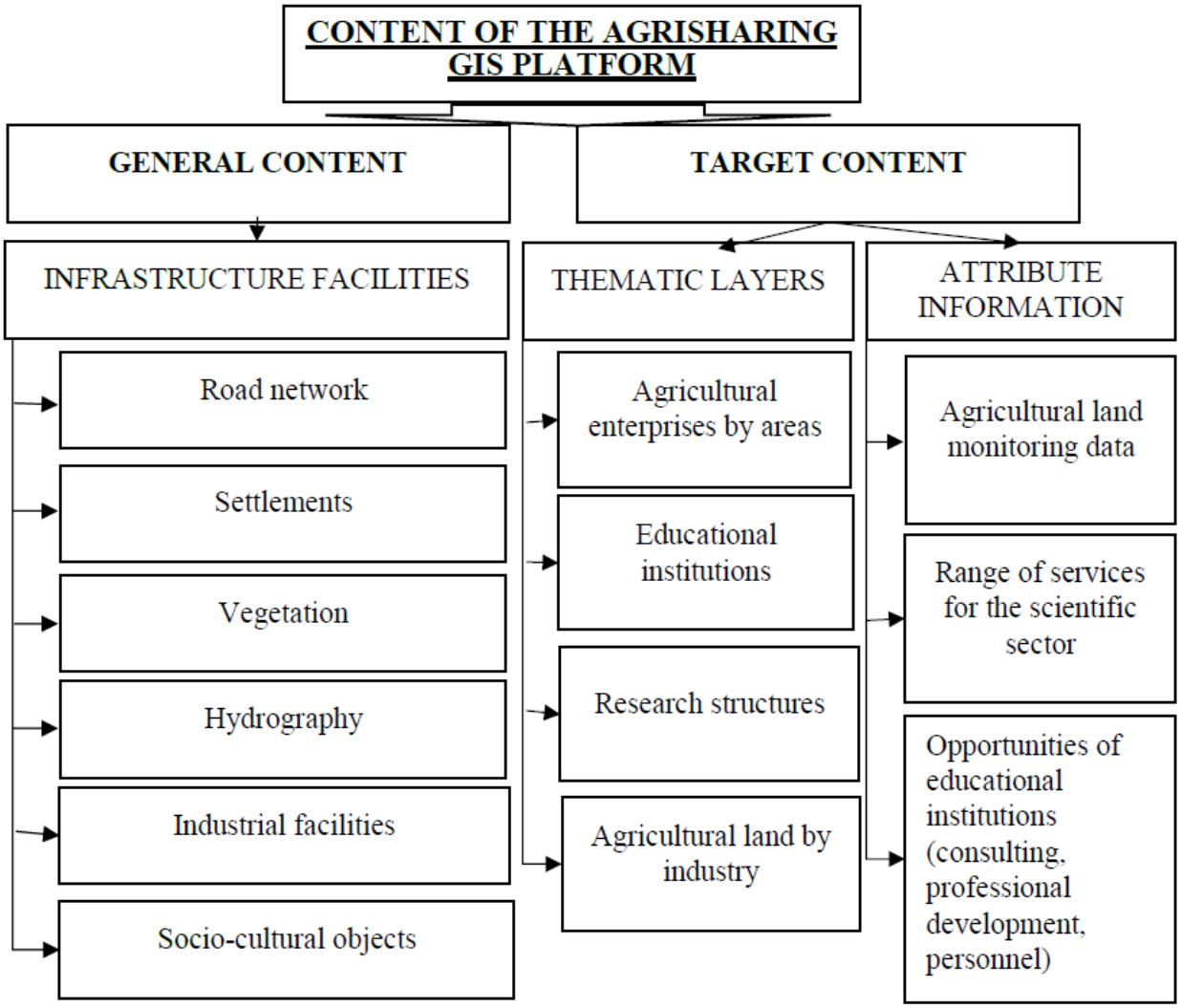


Figure 2. Content of the Agrisharing GIS platform

CONCLUSIONS

As a result of research, the use of the GIS platform as the basis of the Agrisharing system is justified. The directions of development, tasks and functions of the corresponding GIS platform, which is a tool for collecting, storing, analyzing and graphical visualization of spatial data and related information about the objects of the system "Education-Science-Production" are determined. The advantages of using GIS as the basis of agricultural sharing are: the correspondence of the volume and quality of the joint filling of the platform for the cardinal improvement of information support and services for agricultural organizations, the development of the education and science system; providing uninterrupted access to a complete database of analytical information on resources and territories; availability of online advisory support anywhere in the world; advanced training of personnel, taking into account territories of a certain agrarian entrepreneur by teachers from any university remotely at any time; providing access to domestic and world information resources; introduction of IT in the agricultural sector, which will increase the attractiveness of the sector, contributing to the retention of personnel; reduction of risks from low-quality design solutions in the field of land management, increased responsiveness to hazardous environmental situations; stabilization of the financial condition of agricultural producers, reduction of the unprofitable results risk for their economic activities through scientific support of doing business in real time.

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