

Automation of Land Use Planning Based on Geoinformation Modeling

S N Zudilin¹, Yu S Iralieva²

¹doctor of agricultural Sciences, Professor, Head of Department of Land management, soil science and agricultural chemistry, FSBEI HE Samara state agricultural Academy. 446442, Russia, Samara region, Kinel, p. G. T. Ust-kinelsky, ul. Uchebnaya, 2, 89272622382

¹Cand. of agricultural Sciences, associate Professor of Department of Land management, soil science and agricultural chemistry, FSBEI HE Samara state agricultural Academy. 446442, Russia, Samara region, Kinel, p. G. T. Ust-kinelsky, ul. Uchebnaya, 2, 89277590018

E-mail: zudilin_sn@mail.ru, crop, iralieva@rambler.ru

Abstract. The relevance of the presented research stems from the need to develop new methods of automation of on-farm land management using modern geoinformation technologies. The aim of the study is to develop and implement new methods of geoinformation technologies to automate the process of land management in agricultural enterprises. The object of the research is new methods of geoinformation technologies, which allow automating the process of performing a cameral stage of work on land management design and organizing an information base for agroecological monitoring of the territory of agricultural enterprises. To achieve the goal of the study, we developed a geographic information model for creating land management projects to provide an ecological and economic justification for land use. For land management projects with the aim of designing crop rotations, the main initial data are: relief; agro-industrial soil groups; agricultural plots; ecological and technological groups of arable land. This model was tested on the example of SPK im. Kuibyshev, Kinelsky district, Samara region. In the work, the influence of the conditional working length of the field on the productivity of the equipment was studied and analyzed, an equation was obtained for the dependence of the time losses for idle turns and arrivals on the length of the run (average conditional length of the field). The application of the obtained formula in the automated system of economic substantiation of options for the organization of the territory of crop rotation in the preparation of projects for on-farm land management.

1. Introduction

The task of intra-farm land management is to create an appropriate combination of natural and economic factors that ensure the minimum costs of production of a product by the proper placement of land and means of production. The effect of these factors should be such that environmental conditions are observed on an equal basis with economic ones. Successful solution of the problem is impossible without geoinformation modeling.



According to scientists, the bulk of the information that people receive in the life of the -, has a clear territorial orientation. That is why so led-to the value of geographic information systems that can most accurately provide a reference to the area of almost any object

The scope of GIS is very extensive. They include various areas from demography and medicine to management, security and real estate trading.

GIS is very variable and can be used for monitoring of a limited space, for example, a trading hall or a casino, and for exploring more areas (city, region or even country).

GIS systems, using up-to-date and regularly updated information on the road situation, allow to build the best route for a single vehicle and for the entire logistics chain.

Thanks to the creation and implementation of GIS, environmental monitoring of the area is greatly facilitated and the record-keeping of natural resources becomes orderly. On the basis of modeling functions can be used to detect problem areas and pre-ventive prevent them from increasing in the future. Geographic information systems allow to determine the relationship of the parameters of interest (for example, climate and soil) and to draw a conclusion about the state of the area.

GIS take into account in detail the location and area of objects. The complex analysis carried out by the system simultaneously on the basis of several factors allows to obtain the most accurate and objective assessment of the territory from the position of the given parameters.

In addition, geographic information systems are very effective in determining the location of the site, helping to resolve territorial disputes and can provide real assistance in coordinating the activities of operational services during emergencies. The requested information is provided in the form of detailed maps with additional detail in the form of texts, diagrams, graphics and diagrams.

2. Methodology of research and materials

This research work is devoted to the development and implementation of new methods of geoinformation technologies for the automation of the process of land management design.

The object of research in this work is the new methods of geo-information technologies that allow to automate the process of completion of the Desk stage of work on land management design and organization of information basis of agro-ecological monitoring of the territory of agricultural enterprises.

The relevance of the research follows from the need to develop new methods of automated execution of land management Pro-design using modern geographic information technologies. Relevant is the development of methodological and al-aritmetikoa ensure information technology application of geo-information systems (GIS) to address a number of practical problems that arise when creating projects farm land.

The developed technology is based on the use of a complex of modern geographic information systems, improved methods of collection and preparation of information, as well as a number of developed and implemented methods of creating land management projects and design plans and maps with the use of special applications. Thus, the task of development and implementation of geoinformation modeling in the territory of agricultural enterprises is relevant.

The aim of the research is to develop and implement new methods of geoinformation technologies for automation of the process of intra-agricultural land management

The goal is to solve the following tasks:

- 1) analysis of the problem and ways to solve it;
- 2) development and testing of the technological scheme of creation of the geoinformation basis on the territory of the agricultural enterprise;
- 3) development of methods of processing of agroecological information for agricultural lands.

3. Discussions and results

The first step in assessing the quality of agricultural land is local monitoring. Local monitoring (at the level of individual land uses) uses remote sensing data, cartographic materials and satellite data.

1. The calculation of the anthropogenic load on landscapes. The carried out assessment of the territory by the method [2, 4] SEC im. Kuibyshev showed that the level of load is significant, as the anthropogenic impact on the territory exceeds its natural capabilities. Ecosystem stability is lost

2. Assessment of soil fertility economy. According to the latest survey data, the average weighted content of humus was 3.2%, mobile phosphorus 128 mg/kg of soil, potassium exchange 124 mg/kg [1, 3].

Soils with very low humus content were 23.4 % (1601 ha), low – 58.1% (3972 ha) and medium – 18.5% (1264 ha). The farm is dominated by soils with high and high phosphorus content, and 33.5 % (2291 ha) of soils have high potassium content.

Analysis of the dynamics of soil fertility economy showed that there was a reduction in the area of low-humus soils by 23.1% and an increase in low-humus soils by 22.9%.

One of the modern methods of control over the state of natural resources is the method of mapping the state of fertility of land at a certain time. The cartograms made according to the data of the soil survey are shown in figure 2. They provide comparable and systematic information on the state and use of agricultural land and the extent of its degradation. This information is necessary to identify the dynamics of the basic properties of soils, the state cadastral evaluation of land, decision-making related to the protection of land resources and their rational use, monitoring of land.

3. Estimation of erosion danger lands of the farm. In the process of drawing up and studying maps of erosion risk of the economy, we can draw the following conclusions: most of the land is subject to water erosion of a weak degree of manifestation; land farms are in the II category of erosion risk of land; washout from the entire area is 13.0 t / ha.

4. The work studied and calculated the effect of the field length on the performance of the technique. The length of the field determines the frequency of turns, the size of the pens during plowing and harvesting and the time for their breakdown, the area of headlands and cuttings, the length of split furrows during plowing and the underutilization of the working width at the end of work on the pens. The length of the fields, working areas should be such as to ensure the most productive use of agricultural machinery in specific conditions, to reduce the relative amount of losses for idle drives and turns [3].

With a run length of 100 m, the time spent on turns and arrivals will be 41%, with a length of 2000 m - 3.8%. The loss of time for turns and arrivals when harvesting with a field length of 100 m is 42%, 1000 m - 8.6%, 2000 m - 4.1% of the total time. The graphs of the dependence of the time losses for turns and arrivals on the length of the run are shown in the figure. The resulting dependencies can be used to determine the productivity of technology, the norms of production of time for planning and production management.

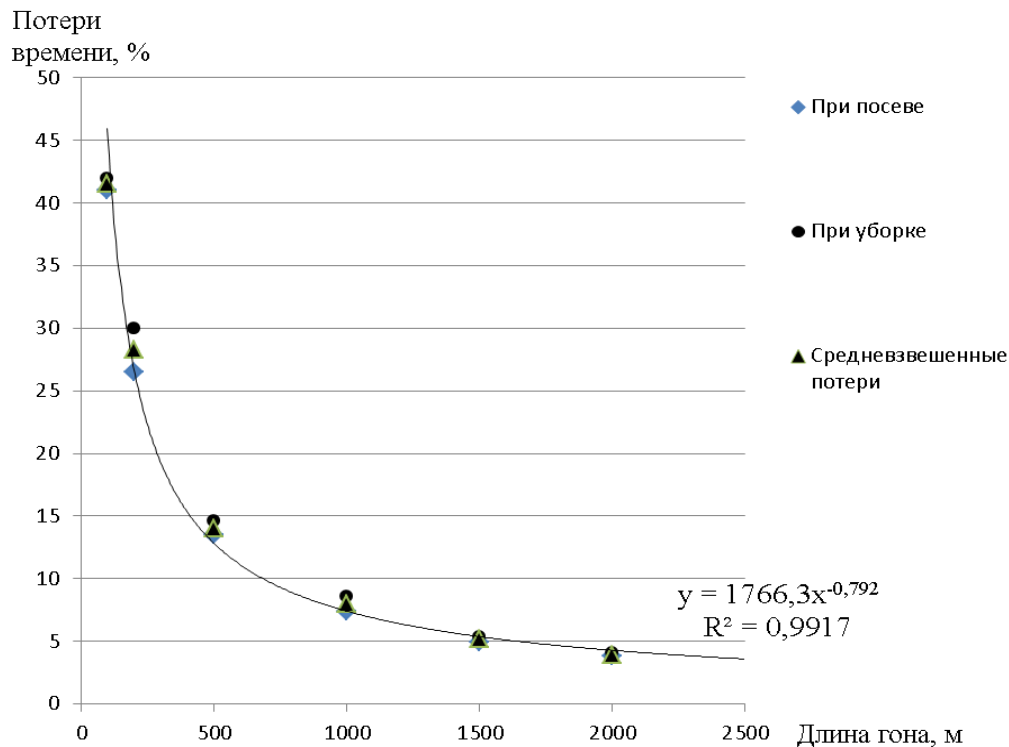


Figure 1. Dependence of time losses for turns and arrivals on the length of the run.

On average, the loss of time depending on the length of the rut (average conditional length of the field) is described by the equation

$$y = 1766,3x^{-0,798},$$

the value of the approximation reliability $R^2=0,99$. Thus, we propose to use the equation $y = 1766,3x^{-0,798}$ to determine the cost of annual losses on idle turns when calculating the weighted average percentage of losses for idle turns and arrivals depending on the length of the rut when justifying the options for arranging the territory of crop rotation. It is also possible to use this dependence in the automated system of economic feasibility of projects.

5. Agroecological classification of land for suitability for crops. We carried out an agro-ecological grouping of arable land for its suitability for cultivation of zoned crops on the basis of qualitative characteristics of arable land, taking into account soil types, topography, degree and types of erosion (Fig. 2). 10 agro-production groups were singled out. Recommended anti-erosion measures and recommended crops are indicated for each group.

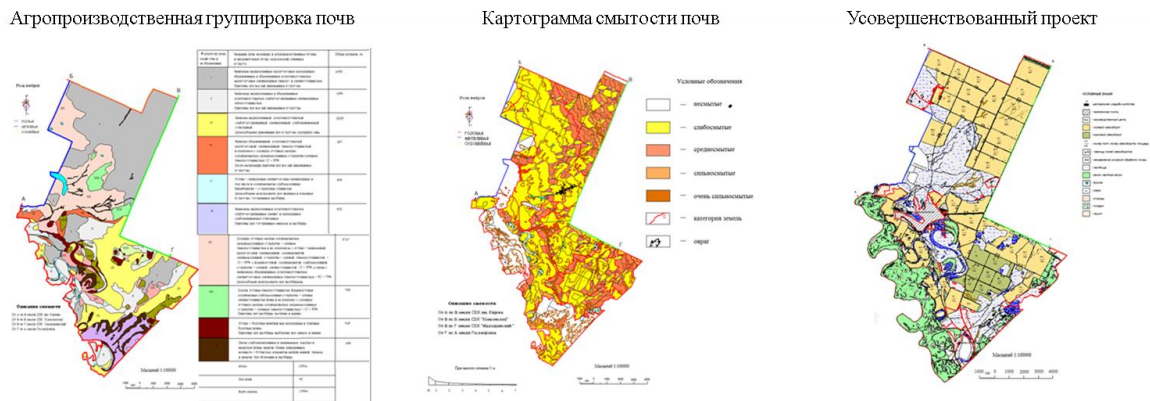


Figure 2. Improvement of land management system of SEC im. Kuibyshev Kinelsky district of Samara region.

In our work, GIS technology with the use of computer technology was used in the mapping of the territory and mapping of soil fertility. On a space image of the territory of land use digitization of the land plots of agricultural purpose of SEC by it was carried out. Kuibyshev.

After the agroecological monitoring of arable land, the construction of a map of the content of humus, mobile forms of phosphorus and potassium, digital models of the area with the use of geostatistics methods, the project of on-farm land management of the enterprise was improved.

4. Conclusions and proposals

Designing a GIS model involves defining data, geoprocessing tools, and the relationships between them, namely:

- source data-existing data added to the model; for the model to work correctly, the source data must be consistent and meet the necessary criteria;
- intermediate data that are generated in the process model and serve only to further conversion, largely unnecessary, and have the "si-Rui" information;
- result data-new data created by GIS models "on output»;
- geoprocessing tools - model elements that perform data transformation; in addition to built-in tools, scripts and other models can be used;
- links connect data to tools and indicate the direction of the information flow.

For land management projects for the purpose of crop rotation design, the main input and output geospatial data are :

- relief;
- agricultural soil groups;
- agricultural land (farmland));
- environmental engineering group arable land (take into account potential ing the danger of erosion processes and intensity of se-stranded).

All other data is intermediate. Their standardization can be disregarded because they are less important.

All feature classes can be optionally supplemented with the necessary attributes.

To achieve the goal of the study, we have developed a geoinformation model for the creation of land management projects to ensure the ecological and economic justification of crop rotation and land management (Fig.3).

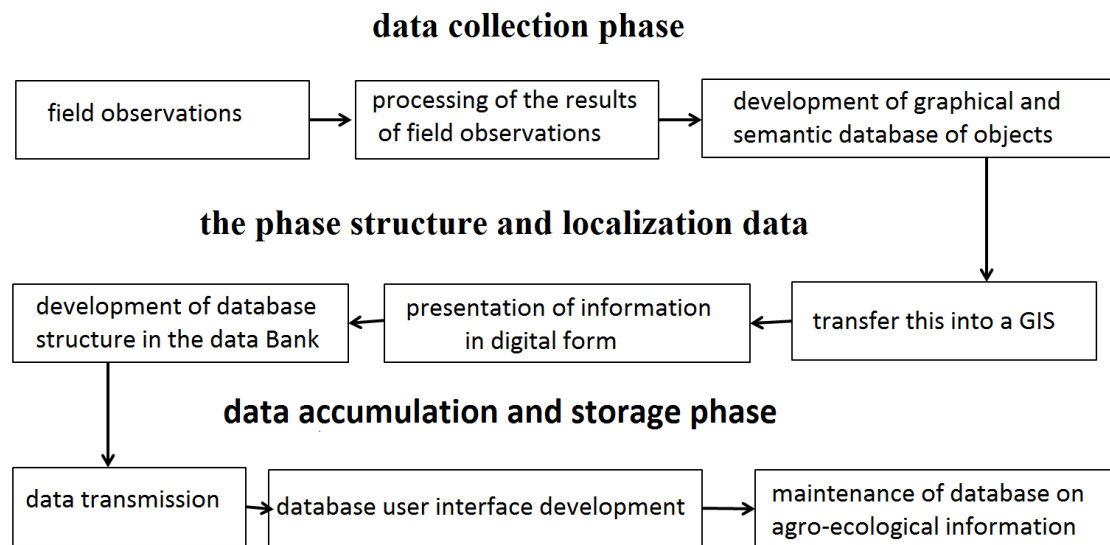


Figure 3. Technological scheme of creation of a data Bank for accounting of complex agroecological information.

The optimal solution to the problem of automated land management design and the task of developing projects of on-farm land management is possible with the use of GIS technologies.

The economic effect of the introduction of an improved project of on-farm land management, taking into account the results of agro-ecological monitoring of land SEC. Kuibyshev will be 1 740 500 rubles.

The proposed technology is complex in nature, as it combines not only the methodology of work on on-farm land management, but also the technical component of the work, which is the most time-consuming and expensive. The algorithms of production operations for the collection, processing and subsequent use of cadastral data in the preparation of the project of agricultural land management are shown. Also, the applied software tools, which are based on the geographic information system MapInfo, are considered.

5. References

- [1] Bochkarev E, Iralieva Y 2014 the Use of GIS-technologies in land management (Samara) scientific works of scientific-practical conference "advances in science agro-industrial complex" pp 38-40
- [2] Zudilin S, Kirichenko V 2010 Methodology of scientific research in land management *RITS sgsha* (Samara) 212 p
- [3] Zudilin S, Iralieva Y 2018 Automation of land management design based on geoinformation modeling *Bulletin of the Samara Scientific Center of the Russian Academy of Sciences* vol 20 **2(3)** (Samara: Publishing House of the Samara Scientific center of RAS) pp 570-577
- [4] Iralieva Y 2016 on-farm land management, taking into account the results of agroecological monitoring of arable land Kinel scientific papers of the conference "Actual problems of agricultural science and ways of their solution" pp 28-32

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.