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MPHTI 36.33**Zh. K. Shaimardanov¹, B. Kh. Shaimardanova², M.M. Toguzova³, M.E Rakhymberdina⁴,
A.O. Oralbekova⁵, A.K. Abdygalieva⁶, B. Apshykur⁷, N.A. Beysekenov⁸**

D. Serikbayev East Kazakhstan technical university, Ust-Kamenogorsk, Kazakhstan

¹E-mail: ZhShaymardanov@ektu.kz²E-mail: bshaimardanova55@gmail.com³E-mail: marzhan123@mail.ru*⁴E-mail: MRakhymberdina@ektu.kz⁵E-mail: ainuroralbekova@mail.ru⁶E-mail: alma-abdygalieva@mail.ru⁷E-mail: bake.ab@mail.ru⁸E-mail: BNail@ektu.kz**АУЫЛ ШАРУАШЫЛЫҒЫН БАСҚАРУДА «ФЕРМЕР ПЛАНШЕТІН»
ӘЗІРЛЕУ: АРТЫҚШЫЛЫҚТАРЫ МЕН БОЛАШАҒЫ****РАЗРАБОТКА «ПЛАНШЕТА ФЕРМЕРА» ДЛЯ УПРАВЛЕНИЯ СЕЛЬСКИМ
ХОЗЯЙСТВОМ: ПРЕИМУЩЕСТВА И ПЕРСПЕКТИВЫ****DEVELOPMENT OF A "FARMER'S TABLET" FOR AGRICULTURAL MANAGEMENT:
ADVANTAGES AND PROSPECTS**

Abstract. Currently, geoinformation technologies are actively used in agriculture, and the use of various applications, especially mobile ones, has become a useful tool in the precision farming system due to their mobility and affordable cost. Their computing power allows us to solve various practical problems that arise when implementing precision farming systems.

The article provides a comparative analysis of both domestic and foreign applications for farmers, identifying their main functionality and advantages. On the basis of scientific developments, taking into account existing analogues, a group of university scientists is developing an application "Farmer's Tablet", which allows for the rapid collection, accumulation and transmission of data on the progress of field work, to analyze the available cartographic, archival and reference material, to monitor the use of labor and material resources for operational, effective control and management of agricultural production.

Keywords. Precision farming; agriculture; IT-technologies; electronic cards.

Аңдатпа. Қазіргі уақытта геоақпараттық технологиялар ауыл шаруашылығында белсенді түрде қолданылып келеді және әртүрлі қосымшаларды, әсіресе мобильді қосымшаларды қолдану олардың ұтқырлығы мен қол жетімді құны арқасында дәлме-дәл егіншілік жүйесінде пайдалы құралға айналды. Олардың есептеу қуаты нақты егіншілік жүйелерін енгізу кезінде туындайтын түрлі тәжірибелік міндеттерді шешуге мүмкіндік береді.

Мақалада фермерлерге арналған отандық, сондай-ақ шетелдік қосымшаларға салыстырмалы талдау жүргізілді, олардың негізгі функционалдық мүмкіндіктері мен артықшылықтары анықталды. Дала жұмыстарының барысы туралы деректерді жедел жинауды, жинақтауды және беруді қамтамасыз етуге, қолда бар картографиялық, мұрағаттық және анықтамалық

материалдарды талдауды орындауға, ауыл шаруашылығы өндірісін жедел, тиімді бақылау және басқару үшін еңбек және материалдық ресурстардың пайдаланылуын бақылауды жүргізуге мүмкіндік беретін ғылыми әзірлемелер, қолда бар аналогтарды есепке алу негізінде университет ғалымдарының тобы «Фермер планшеті» қосымшасын әзірлеуде.

Кілттік сөздер. Дәлме-дәл егіншілік; ауыл шаруашылығы; IT-технологиялар; электрондық карталар.

Аннотация. В настоящее время геоинформационные технологии активно вошли и используются в сельском хозяйстве, а применение различных приложений, особенно мобильных стали полезным инструментом в системе точного земледелия благодаря их мобильности и доступной стоимости. Их вычислительная мощность позволяет решать различные практические задачи, возникающие при внедрении систем точного земледелия.

В статье проведен сравнительный анализ как отечественных, так и зарубежных приложений для фермеров, выявлены основные их функциональные возможности и преимущества. На основе научных разработок, учета имеющихся аналогов группой ученых университета разрабатывается приложение «Планшет фермера», позволяющего обеспечивать оперативный сбор, накопление и передачу данных о ходе полевых работ, выполнять анализ имеющегося картографического, архивного и справочного материала, вести контроль за использованием трудовых и материальных ресурсов для оперативного, эффективного контроля и управления сельскохозяйственным производством.

Ключевые слова. Точное земледелие, сельское хозяйство, IT-технологии, электронные карты

Introduction. The era of globalization dictates its own conditions to the modern market. Digitalization of agriculture occupies one of the leading positions in this issue, because the economic stability of the state largely depends on the degree of development of the agricultural sector in the country. Agriculture in the world is turning from a traditional to a high-tech industry that is able to create new markets for innovative solutions and developments.

Digital technology in Kazakhstan is considered as the main way to increase the economic benefits of investment in the national economy, its reorientation from the raw material to the industrial-service model [1].

The main technologies that are primarily being implemented as part of the digitalization of agriculture in Kazakhstan are GPS navigation of agricultural machinery, parallel driving, automation of the weighing room, electronic field maps and, of course, unmanned aerial vehicles. Modern technologies are gradually penetrating the agricultural sector, offering more effective solutions to agricultural problems. A new stage in the development of IT-agronomy can be called the precision farming system, which is an innovative technology of the future. The advantage of precision farming is that it allows agricultural producers to conduct agricultural production on an environmentally friendly basis, focused on saving fertilizers, reducing risks, obtaining programmed yields and protecting the environment from pollution. To implement this approach, geoinformation systems of precision agriculture are used, which are decision-making assistance systems based on electronic maps, the input data for which are remote sensing data, weather data and data on the current state of the soil for each of the studied locations. In addition to increasing yields and reducing raw material costs, precision farming systems also reduce fuel costs for equipment used in the fields, since they allow the most accurate determination of the route of machines using high-precision systems [2].

Materials and methods of research. For the present, it can be stated that the scale of the introduction of digital technologies in agriculture in our country is not uniform. Large agricultural organizations have been implementing and adapting digital technologies for a long time. The main factor is that precision farming technologies are effective if they are used in combination with other agricultural complexes. Thus, the introduction of a precision farming

system is especially effective in large and developed farms that have finances and qualified specialists. Precision farming technologies are complex in nature, their application requires a lot of knowledge and experience, and their implementation requires a lot of money. Small and medium-sized farmers rarely or do not have permanent access to precision farming technologies and practically do not use them.

The experience of a number of countries shows that farmers use digital applications intermittently, but each time such an application is effective [3].

Through the mobile application, you can check the weather forecast, make notes about the state of fields, make payments and transfer funds, as well as make a complex crop forecast or use mapping tools. However, in comparison with the number of publications on individual agricultural technologies, the topic of using mobile applications for agriculture is not covered in such detail [4-6]. Thus, the main conclusions of the research can be summarized as follows: there is a positive correlation between the benefits of using mobile applications and material well-being, and the level of education of farmers. As in the case of the introduction of specific technologies (for example, the use of high-yielding seeds), the use of mobile applications is likely to bring great benefits to farmers with a higher level of education and better material wealth. To solve this problem, it is necessary to provide state support for small and medium-sized agricultural producers, which will allow the largest number of farmers to be involved in the use of digital technologies in agriculture.

Digital applications can eliminate the problems associated with the introduction of a separate agricultural technology. For example, they provide constant mobile access to consulting services or to information about agricultural technology. While the appeal to the consulting agricultural services, in most cases, is a one-time and solves only a separate problem. As a result, with the appearance of new developments, changes in existing regulations, and the appearance of new varieties, farmers who use mobile technologies to obtain information may find themselves in a more favorable position than farmers who seek advice from employees of traditional agricultural knowledge dissemination services (Aker 2011).

Open data remains the main obstacle to the rapid spread of digital technologies in the agricultural sector. In particular, the quality, protection, methods of data collection, management and analysis require further development and the creation of a scientific arsenal for working with data [7].

The use of a regulatory mechanism will be crucial for the creation and expansion of the use of digital technologies in agriculture. In order to analyze both domestic and foreign existing applications for farmers in the field of agriculture, 9 applications were considered and analyzed in terms of functionality, convenience, simplicity of actions and services offered: OneSoil, GIS panorama AGRO, Soft.Farm, Mobile workplace of an agronomist, Exactfarming, FarmLogs, Diary of an agronomist, AgroBasis, Egistic [8-16].

The results of the analysis of the comparative characteristics of the considered applications are summarized in Table 1.

Table 1. Comparative characteristics of applications

№	Application	specifications	provision of meteorological indicators
1.	Diary of an agronomist https://agroserver.ru	- clear and user-friendly interface; - electronic field maps and the ability to	does not display weather indicators

	Country of origin- Russian Federation Year of development- 2015	edit; - calculation of the amount of work performed and materials consumed; - NDVI monitoring ; - visual display of the structure of sown areas (the actual placement of crops on any date), adding photos with a link; - import of electronic field maps from specialized GIS programs via the KML format; - GPS / GLONASS navigation on fields and roads of the farm; - availability of the free version; - offline work without the internet; - availability of reference information; - availability of training materials; - availability of the mobile version; - availability of Russian and English languages.	
2.	Exactfarming https://exactfarming.com/ Russian Federation 2014	- clear and user-friendly interface; - electronic field maps; - maintaining a crop rotation log, a field work diary; - meteorological indicators; - cost and inventory accounting; - designer of technological maps; - availability of the free version; - offline work without the internet; - availability of reference information; - availability of training materials; - availability of the mobile version; - availability of Russian, English, German (trial version), Portuguese (trial version), Spanish (trial version) languages.	the weather forecast and the history of weather data is carried out from the Storm Glass provider. Currently, the Sokol-M, Pessl, Kaipos and Meteo Bot weather stations are available for connection
3.	AgroBasis https://www.agrobasis.com/ Russian Federation 2014	- clear and user-friendly interface; - electronic field maps; - analysis of NDVI images; - creation of technological maps; - procurement and sales management; - availability of the free version; - offline work without the internet; - availability of reference information; - availability of training materials; - availability of the mobile version; - availability of Russian and English languages.	weather data, data on the temperature of the soil surface are provided online. Daily data of the UV index is available, which characterizes the level of ultraviolet radiation in a specific location

4.	FarmLogs https://farmlogs.com/lite USA 2012	<ul style="list-style-type: none"> - clear and user-friendly interface; - display of fields; - climate indicators; - soil maps; - futures prices; - availability of the free version; - offline work without the internet; - availability of reference information; - availability of training materials; - availability of the mobile version; - availability of Russian and English languages. 	the history of precipitation is tracked and a comparison with previous seasons is given. Daily or weekly report on climate indicators
5.	OneSoil https://onesoil.ai/ru/ Belarus 2018	<ul style="list-style-type: none"> - clear and user-friendly interface; - display of fields; - measurement of soil and air temperature. - availability of remote monitoring using a web application; - analysis of NDVI images; - availability of free installation, free use; - availability of training materials; - availability of 10 languages, including Russian, English, French and Spanish. 	Recognition of shadows, snow, clouds. Definition of cloudy and sunny days. The ability to connect a weather station, which can be purchased from the company.
6.	GIS panorama AGRO https://gisinfo.ru/products/panagro.htm Russian Federation 1996	<ul style="list-style-type: none"> - clear and user-friendly interface; - maintaining field passports with reference to the year of harvest; - linking to the map of land; - linking to the enterprise infrastructure map; - electronic card management; - creating and editing an electronic map; - availability of training materials; - availability of Russian, English, Ukrainian and Vietnamese languages. 	does not display weather indicators
7.	Soft.Farm https://www.soft.farm.ru/site/cost Ukraine2017	<ul style="list-style-type: none"> - clear and user-friendly interface; - land bank; - agricultural technology; - GPS - monitoring of equipment; - satellite images, NDVI index; - availability of training materials; - availability of Russian, English and Ukrainian languages. 	Data on temperature, air humidity and soil
8.	Mobile workplace of an agronomist https://globalcio.ru/live/projects/515/ Russian Federation	<ul style="list-style-type: none"> - clear and user-friendly interface; - contains all the necessary reference information; - the entire production cycle is covered: - from preparing the soil for sowing, to qual- 	Temperature and air humidity, wind speed and direction, the amount of precipitation, at-

	2018	ity control of harvesting; - a basic tool for creating an industrial agricultural GIS; - the survey route is planned based on NDVI indices (obtained from satellites); - monitoring of the condition of fields and crops; - availability of training materials; - availability of Russian and English languages.	mospheric pressure, soil and leaf humidity, the level of solar ultraviolet radiation.
9.	Egistic https://egistic.kz Kazakhstan 2019	- clear and user-friendly interface; - determination of the NDVI index from satellite images; - monitoring of the condition of fields and crops, including remote; - GPS monitoring of equipment; - agro-escort, reference book of plant diseases; - interpretation of agrochemical soil analysis; - availability of training materials; -availability of Russian and English languages.	weather forecast for 9 days ahead within a radius of 20 km from the field..

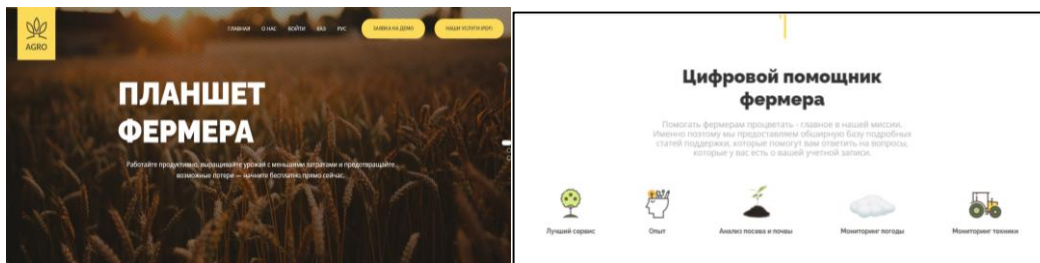
Results and discussion. A comparative analysis of the presented applications used in agriculture showed that the main task of the applications for the farmer is the procedure for collecting and analyzing information about the agricultural field in accordance with the specified parameters and its further use for monitoring the state of crops. Inspections of the field allow not only to determine the stages of plant development, the state of the soil, the presence of diseases, the centers of the spread of weeds or pests, but also to monitor the quality of work performed on the field, as well as to form recommendations for its further processing.

Based on the analysis of world analogues and methods of their application, similar in terms of application goals and technical capabilities, work is underway on the development of the Farmer's Tablet software on the basis of the VERITAS Center of Excellence at the D. Serikbayev East Kazakhstan technical university. The main purpose of the "Farmer's Tablet" is a platform that allows participants to effectively manage agribusiness, make timely decisions and reduce risks, significantly increase the transparency of interaction both for a specific client and between platform participants. The "Farmer's Tablet" application is a universal application that is designed to work both indoors and in the field. It allows you to use the advantages of portable electronics in agricultural work. The availability of archives (field history, content maps N, P, K, etc., important documents), reference books, actual indicators, etc. significantly simplifies and speeds up the decision-making process of an agronomist. The application is being developed precisely as a handy tool for agricultural production workers who need to keep records of various voluminous information accumulated in the process of work. To combine all this information into a single whole product suitable for use in Kazakhstan's natural and climatic conditions, the application "Farmer's Tablet" was developed.

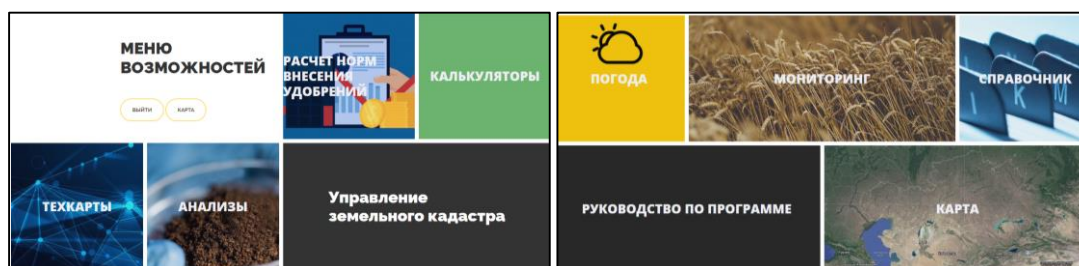
The main task of the developed application is the automation of the farming system,

including the collection, systematization, data processing, that is, the formation of a database for the user about the state of agricultural fields, the result of which is to provide relevant recommendations on further planning of field work, allowing to increase production efficiency at the lowest cost..

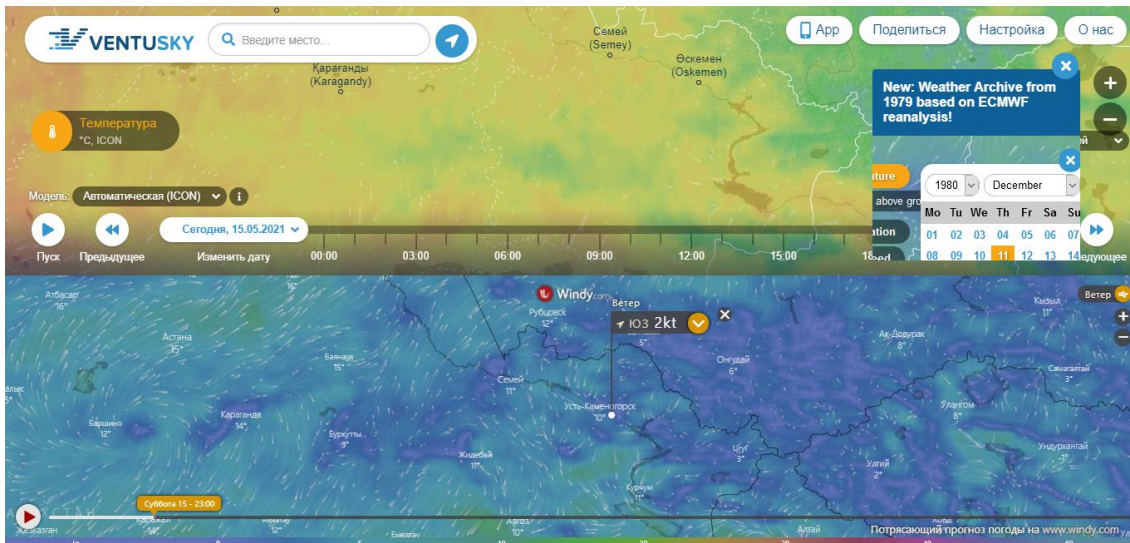
Focus on the main functionality of this application. The main page of the tablet is shown in picture 1.



Pic. 1 The main page of the Farmer's Tablet application To review acquainted with the functionality of the tablet, a demo version is provided, which allows users to get acquainted with the main functions of the tablet, enter data about their land plot, get information on request and get recommendations in an abbreviated version. The interface language is Russian and Kazakh. The main functions of the farmer's tablet are presented in the features menu (Pic. 2).



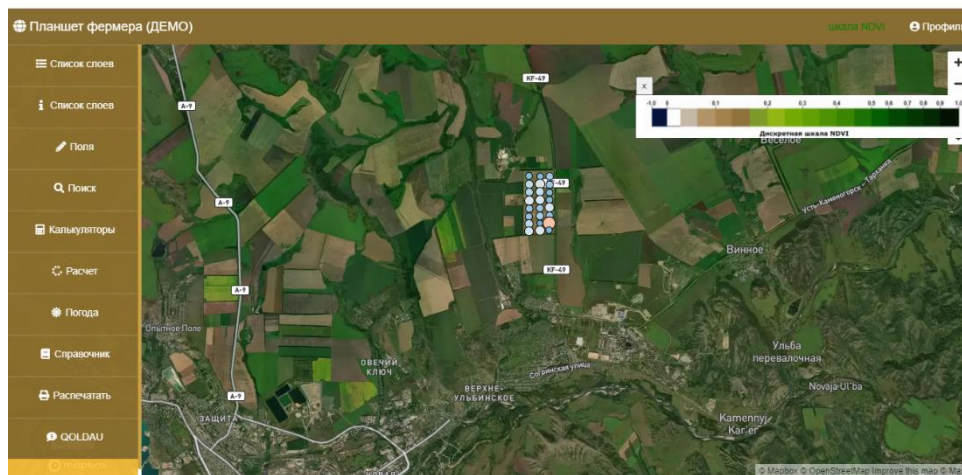
Pic. 2 The menu of features of the farmer's tablet For effective agricultural activity, it is necessary to have reliable meteorological information about the territory in a specific area. Even the most insignificant discrepancies in the assessment of weather conditions can be critical when planning and conducting field work. The temperature and humidity of the air, the speed and direction of the wind, the amount of precipitation, atmospheric pressure, soil and leaf moisture, the level of solar ultraviolet radiation, etc. Without possession of this information, the crop production process will not be able to be made economical and profitable. Data of meteorological indicators that are reflected in the tab "Weather" «Farmer's tablet» (Pic. 3).



Pic. 3 The "Weather" tab with the provision of information for a given territory

This tab allows users to get the full range of meteorological indicators, which are provided both from special applications and from local weather stations. Data can be provided for the past years, online and as a forecast for the future.

Taking into account meteorological indicators will allow users to plan work in the field season, determine the optimal timing of work, the choice of crops, as well as perform a vegetation assessment of crops for a certain season. The use of most of the modern technologies in the field of precision agriculture is impossible without electronic field maps. With the use of electronic field maps, the agrochemical service can, in a user-friendly form, collect, classify and use information on crop rotation, yield, soil types, diseases, fertilizers and plant protection products (Pic.4).

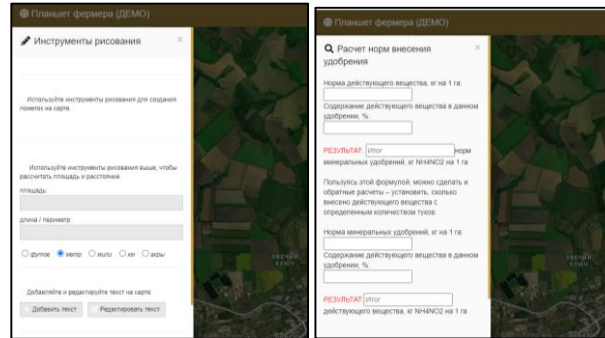


Pic. 4 The "Maps" tab

Electronic field maps contain information:

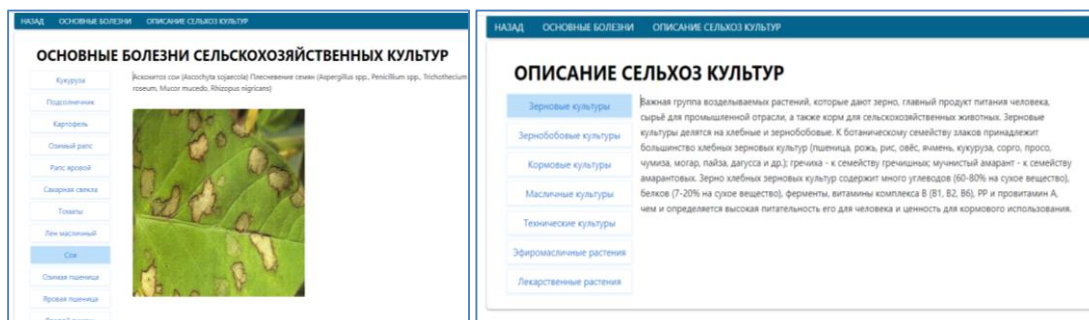
- makes it possible to keep strict records and control of all agricultural operations, since it is based on accurate knowledge: the area of fields, the length of roads, information about fields, etc.;

- helps to conduct a more complete analysis of the conditions affecting plant growth in this particular field;- serves to optimize production in order to obtain maximum profit, as well as the rational use of all resources involved in production.



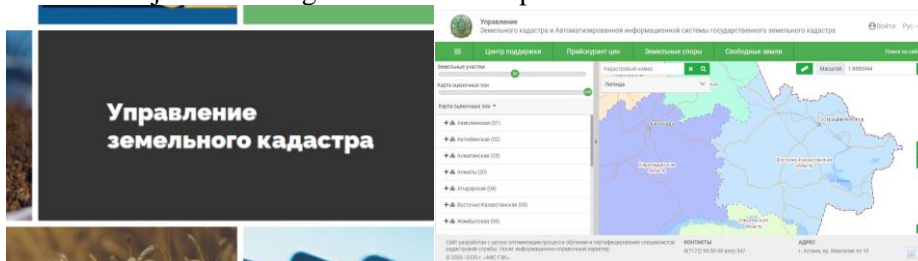
Pic. 5 Tabs "Drawing tools" and "Calculation of fertilizer application rates"

The "Reference books" tab allows users to get the necessary theoretical information about the main agricultural crops, the main diseases of crops (Pic. 6).



Pic. 6 The "Directory" tab

One of the advantages of the "Farmer's Tablet" over other analogues is integration with the AIS SLC website and the Qolday KZ platform (Pic. 7). This tab will allow users to receive additional information about land plots: cadastral and other thematic maps, information about the quality condition of the plot, estimated cost, information about subsidies and other information for the subjects of the agro-industrial complex.



Pic. 7 "Land Cadastre Management" tab A significant advantage of the developed application

in relation to analog applications was the sharpness of its application for the natural and climatic conditions of Kazakhstan. Also, the functions of the tablet include the ability for users to make notes, receive information online and offline, order services for agrochemical soil analysis, NDVI maps and other thematic maps, receive recommendations on the effective use of their resources. Today, there are a sufficient number of different applications on the service market that offer a variety of services, so when developing the "Farmer's Tablet", the task was to supplement it with those advantages that have no analogues yet. These advantages include:

- storing the database in one interface on the personal server of the university, which will allow you to maintain the confidentiality and reliability of storing the data of application users;
- the content of the tablet is close to the Kazakh conditions: technological maps, climate, soils;

- the ability to connect local weather stations to monitor weather conditions;
- monitoring and control of economic indicators of agricultural production;
- compatibility with information platforms of the Republic of Kazakhstan: the digital platform "Qolday", AIS SLC.

Today, the main tasks facing the development of the "Farmer's Tablet" have been achieved, but work on it continues. In the future, it is planned to significantly expand the functionality of the application: automatic detection of diseases and pests (image recognition), linking the GPS tracker to agricultural machinery, auto-loading and documenting all changes in the data structure of the device for monitoring changes in data file, etc. These developments are classified as long-term. They imply the participation of specialists in specific fields of knowledge, additional long-term development and appropriate funding.

Conclusions. Accordingly, increasing the efficiency of agricultural enterprise management through digitalization technologies contributes to maintaining competitiveness in the market. To work without digitalization means to lose in the global competition. Today, modern applications are an effective assistant to an agronomist, engineer, zootechnician or farm manager, helping to increase the efficiency and profitability of agricultural production. The developed "Farmer's Tablet" is aimed at improving the efficiency of agricultural production and will contribute to increasing labor productivity, making effective management decisions while increasing the level of sustainability and competitiveness of agribusiness.

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