Introduction of innovative technologies for the effective use of permanent plants in the conditions of the chuy region

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Annotation. In this article, we analyze the possibilities and prospects for digitalization of farms in the Chui region in perennial plantations, using the example of intensive gardening that has become popular in recent years using MS Access programs suitable for gardeners. We will discuss the combination of this topical topic and, also often discussed, an innovative direction in the agricultural sector, intensive horticulture: the digitalization of intensive horticulture and its prospects in our country. In the process of studying the problem, theoretical methods of scientific research were used. It is abstract and generalized. The main result of the study is the process of creating and planning a database for the MS Access program that facilitates the activities of gardeners in perennial plantations in the Chui region. Conclusions and main scientific novelties – analysis of the MS Access database, creation and schematic analysis of databases to facilitate the work of gardeners in the peasant farm "Islambek" of the Sokuluk district of the Chui region.

Keywords. Innovative technologies, MS Access, perennial planting design, horticulture, programming language, database.

1 Introduction

Innovative technologies penetrate deeper and deeper into all spheres of our life. The idea of software products for automating calculations and calculations in horticulture [1, 2]. The term "digitalization" is increasingly common both at economic conferences, forums and round tables, as well as in Internet resources. Let's take a look at the definitions that have been discussed and adopted in such forums. Alexander Tarasov, Managing Partner of DIS Group: “Digital transformation (digitization, digitalization) is a change in the form of business in a digital reality based on data [1]. Konstantin Yan, co-founder, CTO of CloudPayments: “Digitalization is the process of transferring documents (text, photos, videos, voice messages, maps, music) into an electronic format and then exchanging these data through electronic communication channels. Digitization is the solution of business

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problems with the help of digital technologies.” [1] Konstantin Anisimov, CEO Rusonyx: “Digitalization can be considered a natural process that accompanies the transition to an information society. This involves the transformation of methods and ways of transmitting information: the replacement of analog instruments with digital ones.” [1] Based on the definitions given above by leading top managers and businessmen in the IT field, let's try to give our own definition of such a popular term. Digitalization is the collection and systematization of statistical and other data for analysis, effective business management and building its future strategy. The financial sector, the media, trade and some manufacturing sectors have been actively digitizing for quite some time. Recently, they have been discussed, and in some farms in Russia and Kazakhstan, digital methods in agriculture are already being introduced. For the first time, the topic of digitalization of the agricultural sector of the Kyrgyz Republic began to be discussed since last year, and in 2019 the President of the Kyrgyz Republic Jeenbekov S.Sh. was declared the “Year of Regional Development and Digitalization of the Country”, also this year there was the “Digital Kyrgyzstan Digital Transformation Concept – 2019-2023”, which lays down strategic goals and first steps in this direction. The decision taken by the president will undoubtedly become a big impetus to increase the speed and coverage of the Internet in rural areas, the introduction of new directions and innovative technologies in the educational system of the country. [2] Let's discuss the combination of this topical topic and the often discussed innovative direction in the agricultural sector, intensive horticulture: digitalization of intensive horticulture and its prospects in our country. [3] Let's analyze the possibility of applying digitalization along the value chain, starting from the process of planting apple orchards and ending with the sale to the final target consumer: what digital information is needed to collect and store for further analysis.

I. Planting and growing a garden.

a) Soil. There are certain requirements for the content of trace elements in the soil, with their shortage, the type of necessary fertilizers for its enrichment is determined. Information is required from the Research Institute of Agriculture of the Ministry of Agriculture, Food Industry and Melioration of the Kyrgyz Republic on the available soil maps by region; laboratory sample results ordered privately; other scientific research for public access. Also, a database on prices, types and suppliers of fertilizers, their doses could significantly reduce the time and financial costs of farmers.

b) Seedlings. Also, data on suppliers, and statistics on the survival rate and yield of each variety by region – for further planning.

c) Irrigation system. Statistical information on the effectiveness of the drip (or other) irrigation system of various manufacturers – to optimize the selection of the best option.

d) Weather. Calculation of the likelihood of adverse climatic conditions – to determine the need for protective installations from hail and heavy rains during the flowering period.

e) Other information. For example, a calendar of watering, spraying, tree pruning, indications of meteorological stations – for accurate planning, if necessary, taking emergency measures to prevent losses in the event of a threat, forecasting production costs and possible yields [1].

II. Harvesting.

a) Vehicles (at all stages of the production chain). Their presence and territorial location online – for searching and renting the necessary equipment or attachments.

b) Fixing the time of fruit ripening by region – to predict cash flows for the payment of seasonal workers, the purchase of containers and other expenses for their collection.

c) Productivity of varieties by regions and years – for planning sales volumes.

III. Storage and sale of fruits.

a) Consolidated information on the availability of goods ready for shipment by volume, grade and location – for stable and timely deliveries to customers.
b) Spatial data on prices and sales volumes – to forecast sales revenue, reduce price risks.

c) Database on transport companies, transportation costs, delivery time to customers.

d) Other information. For example, for purchasing firms – for pricing flexibility for regular and reliable customers or for determining risks when selling to new customers. Let's consider the prospects for digitalization of intensive gardening in four key positions: digital base, analytics and “big data”, digitalization of production and sales. [2]

- Digital database for decision support systems in agricultural business: digitization of maps on soil composition, yield, air temperature and humidity, irrigation.
- Analytics and “big data”: yield forecasting, climate risks.
- Digitalization of production: robotization and control of "smart" equipment associated with sensors installed around the perimeter; remote control of the irrigation system; automatic fertilizer dispenser; drone filming and/or installation of sensors – for inventory and monitoring of orchards; [2]
- Digitalization of sales: electronic exchanges for the sale of products, online tracking of the transportation route.

Digitalization of the agricultural sector will reduce risks, increase yields, more accurately and timely plan the process of production and sale of goods, shorten the supply chain, reduce costs, shortage of skilled labor, provide reliable information to all stakeholders. And all of the above will lead to an increase in the competitiveness of Kyrgyz fruits in the world market.

An analysis of the activities to create a MS Access database of perennial plantations showed the following:

- in calculations at all stages (from the preparation of calculations to summary estimates), preference is given to the use of manual methods of calculation with a minimum introduction of automation systems;
- the necessary literature (reference books of prices and correction factors, for the most part, are stored on paper in limited copies);
- Functional responsibilities for each specialist are clearly defined, obliging him to have maximum competence in the area of responsibility assigned to him.

The consequence of the above conditions of activity is:

- a large number of errors in calculations at different stages, requiring repeated manual verification and adjustment, and, as a result, a significant increase in the time costs for the project;
- the overall complexity of the process of forming design and estimate documentation
- the formation of a complete package of documents takes up to 50 hours of working time;
- the lack of digitized reference books and the literature used in the calculations also affects the accuracy of the calculations, since the employee reading information from the media requires maximum care, which is not always possible, referring to the human factor, and as a result lowering the overall quality of the input data;
- the absence of a universal employee, equally competent at all stages of the development of project documentation, sometimes makes it impossible to work on a project without a certain specialist who is absent for some reason.

Based on the foregoing, there is an obvious need to modernize the methods for compiling project documentation, which prompted us to develop software that can solve the problem of reducing errors in calculations and optimize the time resources spent [21, 22].

First of all, it was necessary to improve the existing and develop new calculation algorithms, to provide for their conversion into a logical sequence for further use in the
program code. The work was successfully done within one quarter – the logical chains for
the program and the algorithms were ready for testing in the software environment (Fig. 1).

![Diagram of algorithm](image)

**Fig. 1.** General algorithm of the developed software product.

The next step was to create a software prototype, but the transition to it was hampered
by the absence in a digitized form of the parameters necessary for calculating – prices,
correction factors and types of work. Priorities shifted towards digitizing the data and
building a single database that was ready for use in computing and incorporation into code
as early as the end of the second quarter of development. To write a prototype of the
executable code and its further practical testing, the programming language Visual Basic for
Application (VBA) and software from Microsoft – MS Excel 2013 [3] were chosen. The
choice is due to a large number of advantages that simplify the development of
development, the following should be highlighted separately:

- code that does not require compilation, providing the ability to quickly debug and
  identify errors;
- the language refers to object-oriented programming, which is most suitable for
  solving the chosen task;
- integrated designer allows you to develop a graphical interface without changing
  the development environment and in a short time.

The database management system, digitization and entry into the databases of the
collected data, methodological tools should be used to optimize the parameters of the
functional stability of reproduction processes according to the criteria of environmental
management and resource saving, containing analytical, design and statistical bases,
software packages of application programs for information processing. Paramount when
creating a software product is the development of its system clustering, since how well the
program is organized largely depends on how it will work.

In parallel with the development of the program prototype, a graphical interface was
created, which was supposed to solve one of the key problems – improving the quality of
input data and the speed of their input. The main criterion, which was emphasized during
the development, was the solution of the following tasks: intuitive navigation between the stages, designed to ensure the comfortable work of a specialist; the ability to easily move between stages and edit the source data; options for saving projects, options for loading projects that other specialists have worked on, and uploading; optimized initial data entry system – lists with ready-made options, switches for the necessary options and other interface elements similar in purpose.

Based on the basic requirements for the program by its users, it is required to identify the main blocks of which the prototype of the developed software should consist, namely:

- database of varieties;
- database of agroecological zones of cultivation;
- database of planting areas of varieties (with data on their yield and quality harvest);
- DBMS (database management system);
- modules for selecting varieties according to specified criteria;
- calculation of basic technologies, operational technologies;
- assessment of the effectiveness of plantings (using self-learning systems),
- forecasting outbreaks of diseases and pests;
- assessment of the natural potential of agro-ecological territories of the Chui region (using GIS methods).

The maximum digitalization and automation of all processes in agriculture, as a recognized necessity, is included in the development strategies of the largest agro-industrial and engineering companies in the world. Huge amounts of collected information and advanced data management systems (data science and data management) make it possible to accelerate the growth of agricultural productivity, ensure a stable result of innovation and increase the competitiveness of enterprises on a local and global scale. In addition, with the help of automated agricultural management systems, it is possible to control 2/3 of the factors leading to crop losses [5]. Until recently, for large producers of horticultural products, potential users of software, the most important thing was to stabilize their position in the market and increase the economic efficiency of production. In turn, more developed countries such as the USA, Canada, India, Germany, China, and Israel have long been using such programs for the agricultural industry, which provides a huge reduction in time costs and increases the accuracy of calculations [3, 4]. The issue of automation of agro-industrial processes becomes more and more relevant every year and attracts more and more investments. The long value chain of agro-industrial products and the large number of unsolved problems in the industry that can be solved with the help of IT and automation is one of the main arguments in favor of the investment attractiveness of the industry [5].

Information that these users would like to receive:

- economically valuable characteristics of varieties (physical and chemical composition, ripening time, fruiting stability and ripening period.
- to select an assortment that guarantees the expediency, stability and economic success of perennial plantations, ensuring a uniform flow of products to trade and processing enterprises (i.e. a varietal conveyor).
- characteristics of cultivation areas (soil and climatic characteristics, terrain);
- to identify the most suitable for perennial plantings, climatic characteristics;
- to select the assortment that is most suitable for a given area, as well as the culture of reference, etc.);
- planting areas of various varieties of perennial plantations and their yield indicators (quantitative and qualitative);
to identify the most favorable cultivation zones for specific varieties, to exclude an overabundance of specific varieties in the assortment of a region (or region), to identify missing varieties to create a region's variety conveyor;

- basic technologies for the cultivation of perennial plantations;

- a list of recommendations, including optimization of the placement of varieties, selection of rootstocks, formation and maintenance of bushes, soil maintenance and cultivation, mineral nutrition regimes, systems for protecting perennial plantations from harmful organisms;

- to identify the reasons for the low or insufficiently high level of productivity and quality of the resulting crop, to build ways to solve this problem;

- forecasting outbreaks of foci of diseases and pests of perennial plantations for the long and short term;

2 Materials and Methods

In the process of studying the problem, theoretical and practical methods of scientific research were used. It is abstract and generalized. Thanks to them, the actual materials were organized. The following methods were used: theory, work with literary sources, analysis of the collected information and extraction of results and give recommendations. The theoretical and methodological basis of the study was conceptual judgments, conclusions and recommendations made and substantiated fundamental and applied research by foreign scientists in the field of the theory of agricultural development, as well as in the work of leading scientists in the field of innovative development and strategic management. The methodological basis of the study is research using methods of analysis, extrapolation, conclusions and comparisons. During the research, the procedure and methodology for calculating the necessary sections of design and estimate documentation, standards, etc. were established.

3 Results

The main hypothesis can be put forward the assumption that the policy of modernization of the agricultural sector should be formed taking into account the specifics of the functioning of the industry, the epistemological roots and impulses of its development. The modernization of the sphere of functioning of the agricultural sector should be carried out in stages and with the right target orientation. It is proposed to use a comprehensive, systematic approach to the innovative modernization of production relations and productive forces of the agricultural sector of Kyrgyzstan. The article deals with the digitalization of peasant farms in the Chui region. In some peasant farms, special programs have been created to facilitate their work. In the Chui region, some farms did not pay much attention to digitalization. As a result of the study, we created a database using the MS Access program to simplify and improve the work of the Islambek farm in the village of Novoye, Sokuluk district, Chui region.

There are many database management systems in the world. Despite the fact that they can work with different objects in different ways and provide the user with different functions and tools, most DBMSs rely on a single, well-established set of basic concepts. As such an object, we will choose the Microsoft Access DBMS included in the Microsoft Office package. Databases (DB) currently form the basis of computer support for information processes that are included in almost all areas of human activity. Indeed, information processing processes are of a general nature and are based on a description of
fragments of reality, expressed as a set of interrelated data. Databases are an efficient means of representing and manipulating data structures. The concept of databases involves the use of integrated information storage facilities that allow centralized data management and service for many users. In this case, the database must be supported in the computer environment by a single software called a database management system (DBMS). The tasks of the DBMS include the following:

✔ Formation and maintenance of the database;
✔ Information processing;
✔ Receiving requests;
✔ Providing information to users;
✔ Ensuring the integrity and reorganization of the database values;
✔ Organization of joint work of users.

Benefits that the user receives when using the database as a paperless technology:

- compactness (information is stored in a database, there is no need to store multi-volume paper file cabinets);
- speed (the speed of information processing by a computer is much higher than manual processing);
- low labor costs (no need for tedious manual work on data);
- reduction of data redundancy due to the use of a single database;
- elimination of inconsistencies (changes made by one user are available to all);
- data sharing;
- ability to comply with standards;
- the possibility of introducing restrictions to ensure security;
- Ensuring data integrity (absence of contradictions).

Fig. 2. MS Access database schema.
A database is a program that allows you to receive and store large amounts of related information. It consists of tables containing information. At the stage of its creation, it is necessary to determine which tables need to be created and what relationships will exist between the information in the tables, i.e. develop a database project. A good database design will ensure data integrity and ease of maintenance. The main tasks of database design:

- ensuring the storage of all necessary information in the database;
- Ensuring the possibility of obtaining data on all necessary requests; — reduction of data redundancy and duplication;
- Ensuring the integrity of the database [5].

The development of an effective database consists of several stages:

- the process of developing a database begins with an analysis of requirements, that is, it is necessary to determine: what data elements should be stored in the database, who will access them and how;
- the logical structure of the database is created, that is, it is determined how the data will be grouped logically;
- The logical structure of the database is transformed into a physical one, taking into account performance aspects. Data elements at this stage receive attributes and are defined as columns in the tables of the DBMS selected for the implementation of the database [6]. The main difficulty in designing a database is that it is necessary to come up with a representation for real objects and their relationships in terms of tables, fields, attributes, records, that is, in terms of abstractions of the relational data model.

List of entities and their attributes required to implement the task:

1. Product.
   Product code – unique identifier, key attribute
The creation of a database of valuable traits of varieties took place in three stages.

Stage 1. Analysis of requirements. The general technique for determining database requirements is to compile a data dictionary. The data dictionary enumerates and defines the individual data elements that must be stored in the database. An important part of requirements analysis is to anticipate the needs of users, i.e. the data dictionary should contain information that describes the varieties as completely and in detail as possible [7]. At the stage of creating a dictionary, you can already determine the data type for each element (later – column), this will save design time. In addition to storing data, it will be necessary to extract them from the database, use them in technology calculation algorithms, therefore it is advisable to replace the text elements of the table with numeric ones, since it is more convenient for the program code to process numbers rather than text. Therefore, when compiling a dictionary, it is thought out which textual characteristics can be replaced by numerical ones.

81 characteristics were chosen as the parameters that most fully describe the economically valuable traits of varieties, this distinguishes the development from world analogues (varieties are described by 7-20 parameters), as it allows the user to obtain a more detailed characteristic of the variety. The breakdown of one parameter into several unified ones (for example, the description of a berry is divided into 5 characteristics: shape, size, weight, color, presence of seeds) makes it possible to quickly search and select
varieties (instead of searching the text for the meaning of the word "seedless", you can simply filter varieties by cell "presence of seeds"). To determine all the necessary characteristics, the varieties were analyzed according to the requirements of various users for the system being developed, as a result of which all data describing the variety were divided into functional groups. The main parameter for describing a grape variety is its name (Variety) – this is a unique name. There are no two varieties with the same name. The data type is text, the string length is 50 characters[8].

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Stage 2. Logical structure

This stage provides a description of the organization of data in tables and the definition of the relationship between these tables. The result should be presented in the form of an entity-relationship diagram. Before constructing such a diagram, you need to determine the primary keys for all the designed tables. Due to the fact that numeric keys are more convenient and the DBMS processes them faster, by analogy with the database of varieties, code fields have been added to all tables:

- the "Information about areas" table – the ID_AREA attribute has been added;
- table "Information about soils" – ID_Soils;
- table "Information about farms" – FARM_ID.

Keys consisting of a single attribute – are called simple. However, it is not possible to define simple keys for all tables. For example, for the Productivity and Quality table, the key will consist of two attributes:

ID_Varieties and FARM_ID, since the same variety can be cultivated in several farms, similarly, several varieties can be cultivated in the farm. Therefore, only the coupling of these two attributes gives a unique row in the table. Such a key is called a composite key. To link soils with cultivation areas and farms, tables consisting of two key attributes are used:

- table "Soils of regions" – region_id, Soil ID_ID;
- The table "Farm soils" – Farm ID, Soil ID: At this stage, a data schema has been constructed that clearly represents the relationships between the tables (Fig).

Stage 3. Physical structure.

Physical database design – creating a database schema for a specific DBMS, creating a DBMS description. The specifics of a particular DBMS may include restrictions on naming database objects, restrictions on supported data types, etc. When creating a database table, it is necessary to determine the data type for each column (it was done at the first stage). In addition to the data types, the RDBMS allows you to limit the data that can be entered. For
example, limit the length or force to indicate the uniqueness of the value of the records in this column. These restrictions give control over the integrity of the data and prevent:

- entering text in the field where the number should be;
- entering too large or small a number;
- creating varieties with the same name.

The result of the research is the development of a database structure of economically valuable characteristics of grape varieties. The information contained in the database most fully describes the variety and does not contain unnecessary (unimportant) information. In addition, after designing the data dictionary and dividing the characteristics of varieties into functional groups, layouts of forms for displaying data on varieties were developed, indicated on the "Main page" of the interface developed in section 3 [9].

4 Discussion

The American scientist Hemil Pearsall emphasized the need for long-term plantings to be included in the Google world map using GIS technology. In addition, he noted that for a complete collection of all information, improving their activities with the help of economic and information technologies, every farmer should create a database and enter it into the global Google map. Some scientists already believed that the basis of peasant farms should be digitalization. In the article we will discuss the analysis of scientists who, on the basis of a scientometric database, considered work with perennial plantings necessary and outlined steps for the development of perennial plantings. In addition, we discussed the criteria for the development of perennial plantings based on information technology in the conditions of the Chui region of Kyrgyzstan. We were able to create a technological base of the farm "Islambek", which was supposed to improve and facilitate the activities of this farm. Therefore, many peasant farms working with perennial plantings could improve and facilitate their activities by creating a technological database for their plantations. To do this, many peasant farms working with perennial plantings must jointly create a large-scale GIS technology. Every head of a peasant farm must learn how to properly place a crop in a plantation. After each peasant farm creates its own technological base, it is possible to place GIS technologies on the world map and distribute them on the Internet, there is no doubt that it will make its work a little easier.

5 Conclusion

Thus, the MS Access database, a retrospective study and analysis of the design and survey work available in archival materials and special documents for planting perennial fruit plantations carried out according to the above indicators over a number of years, identification of reserves for improvement of the pre-project stage of development and adoption of technological solutions of design solutions and the definition of tasks to improve the efficiency of this stage for economic feasibility.

Over the years, the growth trend of the area of perennial plantings laid by small agricultural enterprises that play an important role in the market economy has been determined, which largely determines the further and features of their current work. Improving the efficiency of MS Access is closely related to the systematization of materials before any project by creating electronic databases.

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