Approaches to Digitalization of Glass-Grown Vegetable Production

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Abstract

Technological development assumes that the modern world cannot be imagined without the application and introduction of digital technologies in various sectors of society. Human use of digital economy has brought certain features that have led to changes in human life, which has provided the greatest opportunities, improving the quality of life. Against the background of institutional changes and ongoing transformations through the development of digital communications and the emergence of definitely new digital infrastructures, various innovative and information technologies are increasingly being used in the production process, including in

agriculture. Such trends bring changes in the economic and socio-political life of society, which today cannot do without all the above mentioned technologies, which in turn forms a continuous consumer demand and allows to provide and form the industrial digital economy. The article presents the prospects for the digitalization of vegetable production and provides a list of indicators calculated in the analysis of innovative processes.

Keywords: economy; digitalization; agriculture; industry; glass-grown vegetable production.

Introduction

One of the most important and basic components of modern society at the present stage is the economy, which gives certain vectors of its development and acts as a guarantor of national security. The economy defines a choice of the most optimum and effective directions of development of a society as a whole in the conditions of multivariability that in turn, is connected with all processes proceeding in world space. Innovativeness of production, industrialization and informatization of society, interactivity of communications together form a new type of economy and are the most perspective global and strategic trends of recent years, generating the emergence and formation of fundamental theoretical categories: information economy (informationeconomy/knowledgeeconomy); digital economy (web, Internet economy, electronic economy); network economy; innovation economy (knowledge economy, intellectual economy), etc.. From the point of view of institutionalism the mentioned type variety of economics or neo-economics is interpreted as a post-industrial stage of development of economic system.

Methods

The paper uses theoretical and empirical research methods; retrospective, systematic and general scientific approaches; methods of theoretical and empirical cognition; induction and deduction, analysis and synthesis; dialectical approach to the study of processes and phenomena, monographic.

Primary Data Analysis

More and more industries are beginning to use different types of digitalization. Thus, from the point of view of research on approaches to digitalization of greenhouse vegetable production, the scientific category "digital economy" is the defining one. Describing the transformation shifts in the world economy, we note that the category of digital economy is the electronic economy.

In 1995, American computer scientist Nicholas Negroponte first introduced the concept of "electronic economy" (Negroponte, 1995). With the further development of informatization

processes, the concept of "electronic economy" was already transformed into two concepts such as "Internet economy" and "digital economy". If the first concept includes the environment for conducting e-business, the second one reflects the very production, exchange, distribution and consumption of "electronic goods", where calculations are made by means of electronic money.

One of the most authoritative experts in the field of business strategies, Donald Tapscott, in 1995 for the first time defined the term "digital economy", which has already contributed to its separation as a separate direction in the economy based on digital technologies. However, the formulation of the concept of digital economy, which defines it as "the transition from atomic processing to bit processing", still belongs to the founder of media laboratory of Massachusetts Institute of Technology Nicholas Negroponte, mentioned above (Negroponte, 1995).

Let us consider the opinion of the scientific community on the conceptual interpretation of the digital economy. Thus, Yudina (2016) characterizes digital technology as the dominant technical, economic and economic paradigm of the economy, which in turn cannot but affect all spheres of economic activity.

In turn, Vasilenko (2017) defines digital economy through three basic components: infrastructure, software, etc.; electronic business operations and e-commerce, significantly deepening and expanding its application.

Experts from McKinsey & Company (2017) note that the use of the digital economy in all spheres of human society has a certain positive impact on increasing productivity and accelerating economic growth.

Sudarushkina and Stefanova (2018) not only identify and define the Internet technologies that have come into life everywhere, but also point to the importance of digital economy as a social function of modern society.

The common opinion of various authors is that the digital economy not only affects the aspects of the economic life of society, but also its social component, gradually replacing the personal contacts and interactions of people, which from the point of view of production activity allows to solve the necessary issues much faster. In particular, in the field of economic processes.

The process of formation of digital economy as a developing direction of modern society has the following features:

1. The material and technical base has changed radically due to the introduction of automation and other information resources, which contributed to the emergence of new production resources.

2. The introduction of information technologies in the sphere of production, trade and services, as well as the development of computer network Internet is determined through the digital economy, which is the main base of network enterprises and network intelligence.
3. A new type of activity emerged as a form of employment characterized by remoteness, which ensured a change in the nature of labor in the digital economy. In particular, this point is reinforced by current trends against the background of the worldwide coronavirus pandemic COVID-19, which significantly stimulated and became the basis for the widespread use of online labor.

Despite the introduction and establishment of certain regulations in the development of the digital economy, there are a number of factors that have a certain impact on it, including:

- low level of introduction and use of the newest digital and information technologies in all educational processes as compared to foreign developed countries;
- under the existing unique domestic information products, interesting innovations in various areas of Internet technologies and robotization in Russia there is a situation of restraining restrictions on the introduction of scientific achievements at the world level, including due to the underdeveloped institutional environment and relevant infrastructure.

In the Russian business community strategic planning documents within the framework of goal setting, forecasting, planning and programming of production activity prospects were actively disseminated. This approach provides for the development of certain measures aimed at stimulation and development, including on the basis of digital technologies, as well as their use in various areas of activity.

At the federal level, the Strategic Program "Digital Economy of the Russian Federation", focused on the development of the information society in the state for 2017-2030, was adopted and approved. It includes the main global digital technologies, where close interaction between the state, business and science is required (Strategy for the development of the information society in the Russian Federation for 2017-2030).

The digitalization of greenhouse vegetable production is based on the emergence of certain needs that determine the state of the industry, namely, round-the-clock cultivation of plants in various conditions of a regulated microclimate; the use of technologies for the light cultivation of vegetables; transition to new technologies and extension of the growing cycle through interplantation, etc. These features predetermined the problems in this industry, which ensured the

development of technical solutions that contribute to: reduction of all costs necessary to maintain a certain microenvironment; development and improvement of lighting equipment; depending on environmental conditions - automated control of cultivation mode, as well as climate parameters and the general condition of plants (Marcela Rodriguez-Soto, Bejarano Martinez, Dario Arellano-Ramirez, 2019; Nemmaoui, Aguilar, Fernando Aguilar, Manuel, 2019; Nissen, Machts, 2018; Gruda, Bisbis, Tanny, 2019; Montero, Antón, Lorenzo, 2018; Katircioglu, 2020). Complex of technical modulations and information field serve as a basis for providing and maintaining the current state of digitalization of greenhouse vegetable production (Figure 1).

Figure 1. Composition of elements for assessing the current state of digitalization of glass-grown vegetable production

Transition of the branch to the protected ground, on new modern level with application of digital technologies by means of formation of the general uniform information space for protection of plants and at the expense of use of the data in a digital format, used as the basic factor in the given manufacture, allow to assume the decision of the given problem.

Formation of a common unified databank on creation of information platforms for exchange of scientific research results, services of increase of global scientific productivity and codification of knowledge are included into the main elements of digital transformation, which are necessary for determination of the main unified digital space, providing certain interconnection with new production technologies.

Regardless of how quickly innovative digital solutions are introduced into production activity, it is necessary to rationally define target directions for increasing efficiency and correctly identify opportunities for value-oriented transformation of business and information technologies (Neganova, Dudnik, 2019).

Ubiquitous distribution in hothouse vegetable growing of the computerized control system of business processes, transition to remote control of microclimate and plant growing assumes reception of a constant stream of data - the operative information on a condition of plants by means of phytomonitoring and vegetative diagnostics. All this is additionally accompanied by visual observation with the use of digital video cameras, as well as the analysis of photo-absorbing system of plant leaf apparatus, which further offers corrective measures that require the development of the process (Barrett, Alexander, Robinson, Bragg, 2016; Nemmaoui et al., 2019; Assumpcio, Torrellas, Raya, Montero, 2014).

The current state of greenhouse vegetable production in close cooperation with the digital space implies a permanent access to the Internet telecommunication network and creation of own Internet resources. This trend forms the need of business structures to apply marketing approaches to promote products not only on wholesale but also on retail markets, through which active advertising activities are conducted. For example, in the conditions of the worldwide pandemic of coronavirus COVID-19 according to the data of the Russian market leader e-grocery LLC "Novy Impulse-50" (brand "Utkonos") the increase in demand for greenhouse products (vegetables, fruits and berries, greens, mushrooms) was +50.7% (Pertseva, 2020).

The marked tendencies predetermined the appearance of the system of three components, which together form the prospects for the digitalization of greenhouse vegetable production: the formation of a common common information field (space) of all business processes in the industry, automatic data transmission through the communication environment streaming data, providing data to authorized users of the operative requested information (Figure 2).

Figure 2. Components of systems for the future development of digitalization of greenhouse vegetable production

In order to implement these directions in the development of digitalization of greenhouse vegetable production it is necessary to take into account the energy information approach, which involves the use of operational data in digital form, associated with the costs of crop production.

As a result of placement of digital data in a single information field, business processes are generated:

- a list of certain indicators that determine the efficiency of the use of provided resources for the cultivation of plants in protected soil is formed;
- all necessary data are analyzed when coming from digital information sources when certain parameters are formed;
- different requirements to the integrity and volume of data, as well as to their protection, transmission, etc., are determined.

Results

The growing importance of research and development (R&D) in greenhouse vegetable production in the process of digitalization is due to the energy intensity of the production process.

The approximate list of technological and energy (energy intensity of vegetable production) indicators of cultivation of an agricultural crop depending on a mode of cultivation is presented in the table.

The table is an approximate list of necessary indicators, applied at performance of research and development works (R&D) in greenhouse vegetable growing (Basarygina, Shershnev, 2018).

Table 1. The approximate list of necessary indicators, applied at performance of research and development works (R&D) in greenhouse vegetable growing

№	Indices	Variants	
		experiment	control
Technological indicators of cultivation of an agricultural crop			
1	Agrotechnology	photoculture	
2	Agricultural crop	Parthenocarpical greenhouse cucumber Demarrage F1	
3	Substrate Method of plant protection	rock wool	
4	Creation of microclimate parameters in air and rooted environments	computerized	
5	Method of plant protection	biological, entomophage of <i>Aphidius colemani</i>	
6	Number of mobile entomophageous lawns used for plant protection, pcs./ha	238.8	358.2
7.	Mobile lawn irrigation	available, mobile lawns with entomophage are connected to the cucumber drip irrigation system	not available, the greenhouse accommodates mobile lawn-cut plants with an entomophage.
8	Bioproduct output, ex. mummies aphids from one mobile lawn	1580	1150
9	Cucumber yields, kg/m ²	67.1	60.2
Energy indicators of agricultural crop cultivation, % to control			
10	Energy intensity of bio-product production	66.7	100
11	Energy intensity of seedling production	89.8	100
12	Energy intensity of vegetable production	89.7	100

Source: Basarygina, Shershnev, 2018.

This table contains the results of a study on two options for growing parthenocarpical greenhouse cucumber "Demarrage" F1, bred specifically for growing on a high trellis in the light culture. The first variant is experimental, which includes the use of ultrasound for growing this type of bioproduct, and the second one assumes the absence of such ultrasound. The list of indicators considered is approximate, so it can be modified to take into account the development of agro-technological information processes.

Discussion

The analysis of indicators presented in the table makes it possible to conclude that the application of the experimental variant in growing the parthenocarpical greenhouse cucumber "Demarrage" F1 is economically efficient, and therefore appropriate. It is possible to notice that in comparison with the current applied technologies the energy intensity of vegetable production is reduced by more than

10%; the bio-product - by more than 33%. In the pilot version, the efficiency of the biomethod increases, and this leads to higher yields.

Conclusion

The proposed list of indicators allows comparing and analyzing innovative solutions with applied technologies, which allows using them for digitalization in greenhouse vegetable production. Only comprehensive and systematic use of certain measures will be able to ensure an increase in the level of informatization and digitalization of the Russian economy, for this purpose it is necessary:

1. Stimulation of transition to electronic document circulation between enterprises (invoicing, etc.);
2. Identification of the latest standards in the field of information and telecommunication technologies (ICT) for its unification and maximization of development for opportunities for cooperation between different types of businesses;
3. Due formation of all "electronic habits" for effective and rational application of technologies in all branches of economy.

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