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Digital Farming as Direct of Digital Transformation State Policy

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Abstract
Article is devoted considerations of digital agriculture as directly public policy. By authors it is considered terminological a variety of the studied phenomenon with which scientists of different specialties allocate an object of research. If at first among landowners arose and became settled the term "exact agriculture", then the names "E-Agriculture" and "digital farming" become even more relevant now, however in their work it is considered as synonyms. The essence and advantages of electronic agriculture, prospect revival of economic activity and efficiency of using technologies of digital agriculture and also a condition of legal regulation of digital agriculture in Ukraine are analyzed. Special relevance the idea of use of electronic agriculture in Ukraine enters in connection with plans of the Verkhovna Rada of Ukraine and the government to finish a land reform - to open the market of the land. Offers on further development of state regulation of digital agriculture are formulated.

Keywords: computer aided farming, digital farming, digital transformation, digitalization, e-agriculture, precision agriculture, smart farming, state regulation

1. Introduction

The 21st century implicitly already became an era of digitalization of the most various spheres of public life, including not only the latest, but also such traditional as agriculture. From the English-speaking environment where a number of different technologies appears earlier and quicker develops, to us also the term "digitalization" which is not shifted more often came, though transfer by Cyrillics - a digitalization.
With extremely dynamic scientific and technical development of information and communication technologies options of use of these technologies annually extend, for example, since 2017 using of blockchain technology for updating of work of the state land registry of Ukraine is offered and also this technology promotes use of smart contracts, the objective analysis of huge data arrays by means of Big Data and also even artificial intelligence is possible (E-agriculture in action: blockchain for agriculture, 2019). Already there are results from use of a number of technologies of satellite shooting of lands of different function, GPS, pilotless lethal devices (drones) (E-agriculture in action, 2018), complex technologies of association and data processing of various sensors on the land plots reminding the agrarian Internet of Things systems. Application of such

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complex information and communication systems allows to update maps of soils, to consider heterogeneity of fields, better, to count necessary quantity introduction of seeds according to a plant variety, organic and/or inorganic fertilizers, chemical mixes of insecticides and so forth more precisely on square meter of the land plot which is subject to processing. Eventually uses at least of a part of these difficult, and it is frequent, and expensive, technologies creates "conditions for introduction of elements of exact agriculture for the purpose of increase in its efficiency" (Tsylyuryk R.A., 2019).
Taking into account rhetoric of the new President of Ukraine Volodymyr Oleksandrovych Zelensky about need and priority as it is possible for the fastest realization digitalization of everything that can be didzhitalized, concepts "The State in the smartphone" the prospects of introduction in Ukraine of digital or exact agriculture have more and more real chances. The president officially supports the beginnings of state policy of digital transformations as it can help with fight against corruption. According to authors potential Digital is much wider than transformations also global in various sectors of economy and spheres of social development. Especially useful the potential of digital agriculture can appear for the real persons interested to be engaged in agrarian business of businessmen who will use in the future opening of the market of the agricultural land in Ukraine. However, whether views of understanding of digital agriculture are rather created in scientific community.

2. Purpose and Tasks of Article

The purpose of this article is disclosure of essence of digital agriculture as powerful directly public policy. For achievement of this purpose are seen necessary performance of the following tasks: analysis of approaches to understanding of digital agriculture; Comparison of digital, exact agriculture and other similar concepts; Definition of a concept of digital agriculture as directly (or more precisely even vector) public policy; Researches of councils of influential subjects (actors) of international policy on development of the national directions of policy of digital agriculture, a condition of legal regulation of exact / digital agriculture in Ukraine; formations of an author's position of rather further development of state regulation of digital agriculture.

3. Variety of Terms

The first attempts and practical application of various information and communication technologies in agrarian business, and theoretical developments on this subject in various branches of science began at the end of the 20th century. During this time scientists came to various conclusions about entities and even the name of Digital farming. If at first in the 1990s, terms "exact agriculture" appeared (other definition "precision farming") or the name (without literal translation) "precision agriculture", the terms "automated agriculture" or "computer aided farming", then "reasonable agriculture" or more popular today "smart farming"), "Electronic agriculture" (or just E - Agriculture) and "Digital agriculture" or "Digital farming" were added to XXI century a concept. By analogy with the Fourth industrial revolution of Industry 4.0 (includes also the newest transformations of agrarian business), digital agriculture is allocated

sometimes as Agriculture 4.0. (Christian Rose D., & Chilvers J., 2018). In fresher scientific research from the different industries, including the international profile organizations like Food and Agriculture Organization of the United Nations and International Telecommunication Union the most popular is used the term E - Agriculture (E-agriculture in action: blockchain for agriculture, 2019). In the newest normative legal acts of Ukraine the term "Digital farming" is used. In work these terms are considered as synonyms as any essential signs scientists of the different industries do not separate them.

From 1990th years the concept of exact agriculture began to be understood as the strategy of management which uses information technologies, obtaining data from many sources to make decisions about management of crops (Yakushev V. P., 2002). In more modern works of the 2010th years define that exact agriculture is "a resource concervated, soil-protective, innovative and competitive technology which promotes structurally technological reorganization of the agrosphere and accumulation of economic capacity of the state" (Sklyar V.V., Odarushchenko O.M., Ivasyuk O.O., & Bulba Ye.M., 2014). Savitsky E.E. (2017) describes exact agriculture as follows: "Innovative, soil-protective, a resource-efficiencied technology which will promote restructuring of the agrarian sphere and accumulation of economic capacity of Ukraine". However, both the strategy of management, and the technologies promoting accumulation of economic capacity of the state concern public policy either as a way, or as means by means of which the result necessary to the state is achieved.

Digital farming has become so popular gradually and has become especially relevant due to the dynamic development of scientific and technological progress, the invention or improvement of technologies that can be used to improve certain indicators important to agricultural business, such as restoring land quality, reducing fertilizers or other chemicals, yield improvement, etc. Colossal progress at a new level has given digital agriculture information and communication technologies because“the quality, granularity and variety of information can help make the agricultural sector more efficient” (E-agriculture in action: Big Data for agriculture, 2019) according to the Gerard Sylvester. Ukrainian researchers also note: "An important component in the system of precision agriculture is information technology, which allows to increase the productivity of agricultural production through the rational use of land" (Sklyar V.V., Odarushchenko O.M., Ivasyuk O.O., & Bulba Ye.M., 2014).

Quite a lot of such information technologies appeared at the turn of the XX-XXI centuries, especially at the beginning of the XXI century. Since the basic “precision farming tools are monitoring the current state of crops and analysis of long-term data” (Savitsky E.E., 2017), this is a large amount of information both by region and in large countries such as Ukraine, especially if such data are stored and analyzed for years. Given this, now the most relevant is such a comprehensive information technology as Big Data as “high-volume, high-velocity, and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation” according to Gartner Corporation in 2012 (Big Data in Gartner Glossary). Nowadays more modern definition describes this technology as"a paradigm for enabling the collection, storage, management, analysis and visualization, potentially under real-time constraints, of extensive datasets with

heterogeneous characteristics" (E-agriculture in action: Big Data for agriculture, 2019).
As this technology has the greatest analytical potential for processing large amounts of different data, we believe that its application is especially valuable for research on digital agriculture and for the formation and / or adjustment of public policy to support the introduction of digital agriculture, which is especially important in Ukraine now.
Food and Agriculture Organization of the United Nations and International Telecommunication Union concluded: "ICTs and data can enhance decision-making throughout the broader supply chain with features such as:
- geolocation and land use (e.g. GIS maps, satellite images);
- digital identity and individual linked data (e.g. agriculture subsidies);
- financial services (e.g. banking details, digital payments);
- communications (e.g. telephone, email, television, radio, instant messaging, web pages, social media);
- agricultural statistics and databases;
- agricultural market related data (e.g. prices, supply, demand, export/import regulations);
- advisory, awareness and capacity-building (e.g. good agricultural practices content);
- logistics data (e.g. transport, cold storage availability and location);
- data relating to the management of disasters and/or pests (e.g. pests and disease alert and analysis, weather-related disasters);
- provenance and trust across the value chain (e.g. traceability using blockchain);
- passive observation of herds and livestock, to monitor their health and wellbeing, identify sick individuals and potentially even trigger treatments using artificial intelligence (AI) and machine learning (ML) models." (E-agriculture in action: Big Data for agriculture, 2019).

However, of course, digital agriculture is not limited to Big Data technology, but only the integrated application of various technologies, sensors, equipment that can be connected to the Internet of Things in regions with different geographical and environmental conditions gives the most effective results. Researchers come to the conclusions about very interesting results achieved through the use of precision farming technologies.
Researchers have achieved very impressive results through the use of precision farming technologies. Sklyar V.V., Odarushchenko O.M., Ivasyuk O.O., & Bulba Ye.M. think, that among the main results are:
"- optimization of the use of consumables (cost minimization);
- increasing the yield and quality of agricultural products;
- minimization of the negative impact of agricultural production on the environment;
- improving the quality of land;
- information support of agricultural management "(Sklyar V.V., Odarushchenko O.M., Ivasyuk O.O., & Bulba Ye.M., 2014). Such achievements now, in an era when the world's population is growing extremely fast, are needed not only by Ukraine with a strong agricultural sector (but it is poorly developed technologically), but also by many countries on all inhabited continents.

4. The State Policy of Development of Digital Agriculture in Ukraine

Position, popular in the world, understanding and development of digital agriculture is relative one of the international organizations conducting in the sphere of economic development – Organisation for Economic Co-operation and Development (OECD) expresses. The last emphasizes essential advantages of digital agriculture and advises the national governments to pay attention to 3 questions to take advantage of digital agriculture:

1) as the government policy and programs can promote as appropriate implementation of digital technologies in agriculture and the food sector;
2) as the governments can use digital technologies for development and granting the best agrarian policy;
3) as digital technologies can change a role of the government[1].

Regarding the first to two questions the OECD considers that at state regulation the politicians "will need to consider potential benefits, expenses and risks and to understand the factors influencing implementation of technologies that intervention could be focused where there is a market, or public interest"[2]. Both in the world, and in Ukraine in introduction of digital agriculture certainly is and public interest, and it is a lot of favorable the market of aspects. There is other question of ought extent of intervention of public authorities.

To a role of the government the OECD describes a double situation: "On the one hand, digital technologies can create new roles or duties for the governments, including for providing digital infrastructure (whether the government takes place to be provider or producer of norms of new digital infrastructure and under what circumstances); But, on the other hand, if technologies can reduce asymmetry of information and transaction expenses, perhaps, less intervention of the government" will be required[2]. Ukraine needs to weigh this question seriously too, considering national interests and opportunities.

As a matter of fact it is a fairly typical, even more classic, problem of the role of the state and its impact on the economy. In this eternal issue, everyone is trying to find their own version of the "golden mean" that would be effective for its economic and social development. In situation with government's influence to the development of digital farming Ukrainian ministers and other officials should understand all the potential benefits and weigh the costs from the state budget, the necessary of organizational and coordination measures for the implementation of digital agriculture. In the process of weighing all the pros and cons, it can be concluded that the benefits of digital farming technologies can be implemented with lower public spending through public-private partnerships model. For example, during implementing some measures from the Action Plan for the implementation of the Concept of Digital Economy and Society of Ukraine for 2018-2020, which related to the implementation of digital infrastructure, Internet projects in more remote villages of Ukraine, it became clear that the result is possible only if interesting for all participants constructive dialogue and fair cooperation with private providers of the required services.

[1] New technologies and digitalisation are transforming agriculture and offering new opportunities to improve policy (2018). URL: https://www.oecd.org/agriculture/topics/technology-and-digital-agriculture/

The legislation of Ukraine is directed to a combination of various positions, the principles, in particular, of market bases of managing and social orientation of economy that is displayed on multitasking of state regulation, and besides, in different types of public policy. Digitalization as the general phenomenon really influences many spheres therefore it is possible to consider the impact of digitalization on agrarian, information, social policy, etc., and it is possible even to allocate so global the direction of the state influence on development economic and public life in Ukraine in separate policy of digitalization.

On the one hand, digital agriculture can be considered from more traditional positions as a part of agrarian policy that it, in turn, belongs to structurally branch policy as one of the main of the directions of public policy according to Subparagraph 1 of Part 1 of Article 10 of the Economic code of Ukraine. On the other hand, if to consider more modern realities of public policy, digitalization as global process already is separate global Interindustry the direction of public policy (on settled legal term), and now it is possible to call it rather even a vector because how long it is process it will be unknown and hardly it will have an accurate final point.

From the newest normative legal acts where exact agriculture is mentioned, separately it is necessary to select the concept of development of digital economy and society for 2018 - 2020 as for today it remains the only act that more or less in a complex considers digitalization and managing, and social development, and the plan of measures of its realization provides a number of various actions, including for introduction of digital agriculture together with the accompanying phenomena. In general, the condition of legal regulation of exact / digital agriculture in Ukraine remains at the initial stage of the formation.

In the global direction of digital development - digitalization of the real sector of economy - the concept underlines importance of introduction of digital agriculture as "essentially new strategy of management that is based on use of digital technologies, and a new stage of development of the agrosphere, connected with use of geographic information systems, global positioning, onboard a computer "computers and an equipment Smart and also the management and performing processes capable to differentiate ways of processing, application of fertilizers, chemical ameliorants and means of protection of plants"[2].

Definitions in the mentioned concept is rather difficult, even a little obfuscatory as understanding of essence of digital agriculture includes several aspects at once:

1) and as new stage of development of the agrarian industry;

2) and as essentially new strategy of management. Underlining essential signs of basing on use of digital technologies partially repeats line of connection with use of geographic information systems, global positioning (GPS), onboard a computer "computers and an equipment Smart, that is some digital technologies. In our opinion, in it considerably a certain shortcoming definition - cannot be listed all technologies which can do agriculture digital as it is unknown on how many the new technology of improvement of

[2] On approval of the Concept of development of the digital economy and society of Ukraine for 2018-2020 and approval of the action plan for its implementation: the order of the Cabinet of Ministers of Ukraine of January 17, 2018 № 67-r. *Uryadovyy kuryer* of May 11, 2018. № 88.

exact agriculture can quickly appear.

This process of introduction of digital agriculture, judging from the following paragraph, are called digitization of the agricultural sector that are connected with digitization of rural infrastructure which are together positioned as the tool of the large-scale program of digitalization of villages, connections them to digital infrastructures, overcoming a digital divide and social and economic revival of rural territories[3].

On implementation of the concept Paragraph 15 provided in the plan of measures "development of the draft of the act of the Cabinet of Ukraine concerning an intensification of development of digital agriculture and digitalization of agricultural sector" and it is even specified what the draft of such act was provided the Cabinet of Ukraine in II quarter 2018. However, on the middle of 2020 such act not only it was not accepted, but also on the official site of the government its project is not, therefore, is braked implementation of key point of the concept of digitalization of agricultural sector.

Except mentioned in the main concept, digitalization of agriculture is supposed among the priority directions of innovative activity of nation-wide and branch levels. Definition of such priority directions of development of science and technology, innovative activity the state pursues policy of stimulation of scientific, scientific and technical and economic activity (among which there is innovative most a bazhana as progressive because provides use of the latest technologies, innovations that it is so important in agriculture of the 21st century) in the respective spheres in which development Ukraine is interested first of all. In particular, technological updating and development of agro-industrial complex with 7 directions is referred to the medium-term priority directions of innovative activity of nation-wide level till 2021[3].

In comparison with 8 medium-term priority directions for 2012 - 2016[4] was excluded the direction "developments and deployments of production technologies of products of baby and dietary food". These directions in the list of the medium-term priority directions of innovative activity of branch level where among development and deployment of production technologies, storage and processing of high-quality vegetable products "creation of energy saving and resource-saving technologies of cultivation of crops with elements of exact agriculture" is provided[5] are specified. In general all these directions can form a technological basis of development of digital agriculture.

However, for formation of councils rather further state, including standard and legal, regulations introduction of digital agriculture in Ukraine it is necessary to consider modern practical realities. For today developments and deployments of the various technologies listed as the priority directions of innovative activity and even the order of complex analyses of soils of the land plots of farms, digital maps taking into account

[3] Some issues of determining the medium-term priority areas of innovation at the national level for 2017-2021: Resolution of the Cabinet of Ministers of Ukraine of December 28, 2016 № 1056. *Uryadovyy kuryer* of January 21, 2017. № 12.

[4] Some issues of determining the medium-term priority areas of innovation at the national level for 2012-2016: the resolution of the Cabinet of Ministers of Ukraine of March 12, 2012 № 294. *Uryadovyy kuryer* of May 16, 2012. № 85.

[5] Some issues of determining the medium-term priority areas of innovation at the industry level for 2017-2021: Resolution of the Cabinet of Ministers of Ukraine of October 18, 2017 № 980. *Uryadovyy kuryer* of December 29, 2017. № 246.

spatial heterogeneity of the field, installation and maintenance at the due technological level of work of monitoring systems the Smart the equipment remain quite expensive. It is an essential barrier to really large-scale introduction of digital agriculture in Ukraine as it remains it can do only for large subjects of managing, that is agrarian holdings.

For really effective distribution of exact agriculture the state has to promote also achievement of its bigger availability to average and even small business (MSP). For example, for introduction simplification at least of some technologies of digital agriculture it is possible to enter programs of the state support of MSP which dolgosrochno rent the land plots of agricultural purpose. It would be ideally expedient to analyze including by means of digital infrastructure which is already planned to be developed, quality of soils of all land fund of agricultural purpose and to fix in the corresponding register. First, such large-scale actions would allow to estimate the actual cost of rent of more fertile lands that acquires special relevance in connection with plans of parliament, the President and the government finally to open the market of lands in Ukraine. And secondly, it will help to control safety of quality of soils. At the state registration of farm and/or the lease agreement of the land plot of MSP it is necessary to issue cards of the respective sites with their characteristic, the description of non-uniform parts of fields, etc. and the main thing - with the list at least of standard councils concerning maintenance of appropriate quality of soils, recommendations on plant varieties which are expedient for landing on the corresponding soil taking into account climatic conditions and also introduction of chemical ameliorants, the means of protection of plants (MPP), fertilizers, etc. The special attention, according to us, should be given MSP wishing to grow up ECO products on the special land plots what it is worth helping all technologies of exact agriculture available to Ukraine with.

And after the termination of term of rent of the land plot, including big subjects of business activity, it is necessary to check its state, and in case of identification of consequences of conscientious attitude of the landowner to the earth to offer it repeated signing of the lease agreement on favorable terms, and at detection of managing consequences, negative for soils, because of the landowner - to impose the financial penalties capable to cover losses and to restore standard of fertility of a soil cover on the respective land plot. Such measures of the public agrarian policy are capable to reflect foresight of the state strategy of preservation and improvement of quality of the Ukrainian chernozems and other soils, providing the population with high-quality agricultural products and increases in the export potential of Ukraine in this market.

Besides, now agrarian policy of Ukraine endures the sharp period – The Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Concerning the Conditions of Circulation of Agricultural Lands" of March 31, 2020 was adopted in order to finally open the market of agricultural lands in Ukraine. Nearly two decades ago, when the Land code of Ukraine was accepted, it was established the moratorium - the ban of direct purchase and sale of the land plots of agricultural purpose. However the Law of Ukraine "about land lease" by means of which norms businessmen - landowners and large agroholdings adapted to such legislative restrictions with long-term rent of the land plots at owners - citizens of Ukraine works.

When 2019 it was submitted bills to parliament which provided to open the market of the earth, society apprehended these offers ambiguously because a lot of criticism and

political speculation appeared, especially concerning the underestimated assessment of the earth of chernozems and insufficient material security of peasants - farmers who will not be able to buy enough land or because of a difficult financial position the land plots will be forced to sell. Besides, society expressed disorders concerning a condition of the agricultural land in Ukraine and potential influence of sale of land to irresponsible owners who because of rigid operation of valuable soils can worsen quality of the earth considerably.

Before opening of the market of the agricultural land in Ukraine the majority of speculative questions is capable to allow to remove use of technologies of electronic agriculture. In particular, carrying out complex analyses of soils of the land plots, drawing up digital maps with introduction of data about qualitative structure of lands in the unified state register with use of blockchain technology, the analysis of data of this register by means of Big Data Analytics would stop any speculation, corruption at delimitation of the land plots, would allow to estimate objectively a condition of soils and taking into account geographic location - the market value of each land plot. At the same time important to make such information of the land register open that would allow to open transparently and fairly the market of the earth and to hold all auction about online of maintenance and public control (and it is possible also with use of smart contracts) when the cost of everyone of the land plot at the auction would begin with the market value of each site.

Data from digital maps or other indicators which can provide technologies of digital agriculture can help to be engaged in agrarian business more precisely and effectively, using it is most useful properties of certain soils. Moreover, in the long term data of digital maps of the land plots have to be updated, for example, each 5 years to estimate by means of Big Data analytics properly as influence of natural factors, including global warming, and anthropogenic factors. Then the irresponsible relation of owners of the land plots will be noticeable all and objectively assessment of the market value of the earth will fall that is unprofitable to the owner, so, will constrain farmers from harmful effects on the earth and will promote establishment of the healthy market economic relations.

5. Conclusions

Thus, the concept of digital or exact agriculture can be considered in many aspects, however understanding of digital agriculture as directly (vector) of the public agrarian policy and policy of decentralization and developments of evidence-based bases which would be displayed in the corresponding strategy and concepts of development of digital agriculture with the plan of consecutive effective actions of their realization that quality of such acts was at the due high level acquires especially sharp relevance so far, and introductions of digital agriculture became more available to different subjects of managing in the agrarian market. For such introduction it is necessary to minimize influence of non-automated bureaucratic procedures whenever possible.

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