

Increasing the efficiency of agricultural production based on digital technologies

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Abstract — Modern agriculture is one of the priority sectors contributing to the strategic development of the country in the following directions: increase in food security, sustained growth of agrarian territories and severe socio-economic situation, providing high standard of living on the periphery. Digital technologies promote attainment of these purposes and tasks, promoting adaptation of the industry to the complicated external conditions concerned with geopolitical and macroeconomic factors. The problem is in the severe climatic conditions of formation of agricultural production of many regions, the demand for innovations and evidence-based approach to increase crops yield of the state subjects which take the leading positions in agricultural production, such as Krasnodar Krai.

The research objective is the identification of the perspective directions of agriculture development of Krasnodar Krai on the basis of digital technologies, the assessment of possible effect of their introduction in a production cycle.

Methods: modeling of social and economic processes, system and situational approaches.

Use of digital technologies in agriculture of Russia and the Krasnodar Krai in particular contributes to the growth of profitability due to reduction and optimization of labor costs and optimum distribution of resources. Achieved results positively affect competitiveness of agricultural products, increase productivity and rational environmental management.

Keywords — digital technologies, innovative technologies, availability, agriculture, crop production, potential, programs, efficiency

I. INTRODUCTION

Modern agriculture is one of the priority sectors supported by the state. Regions of Russia possess differentiated potential for formation of agricultural branches concerned with climatic, socio-economic and technological factors.

Digital technologies represent new direction of increase in efficiency of agro-industrial complex and agriculture. Domestic and foreign researches highlight a number of scopes of innovation in the considered types of activities.

Many scientists rightfully consider the development of environmentally friendly agriculture, creation of enterprises and processing complexes based on the "green economy" principles: Bryukhanov A.Yu. [1], Kozlova N.P. [1; 2],

Vasilyev E.V. [1; 2], Shalavina E.V. [1], Ivanova S.V. [3], Ilyasov O.R., Neverova O.P., Pechura E.V. [4]. The importance of innovations for agriculture, the financial and staff support for its proper implementation are the primary factors for economic and production feasibility.

An integrated approach to production, economic and environmental efficiency is noted by the following authors: Buklagin D. of Page [5]; Komlatsky V.I. [6]; Lebedeva O.I., Gafiyatov I.Z. [7]. The authors focus their attention on commercial results and increase in productivity, noting that the congestion of soil with supplements and fertilizers should not affect ecology and quality of consumer products.

According to some authors, the introduction of innovations and digital technologies is mainly a problem of the management efficiency at region and branch subjects levels [8]. Parameters of high-quality management are connected with professional competence and production-specific knowledge, technological feasibility, assessment of consequences of production cycle changes with respect to its effect on labor productivity, processes profitability and cost reduction.

Foreign studies can be divided into three main directions. The first one is concerned with application of new agricultural technologies of developing countries, as well as areas with a severe socioeconomic status yet favorable natural and climatic conditions for the production of the respective industries. The studies point out the existence of specific business conditions, government support, rapid growth rates.

The substantial role of digital technologies in the development of the agro-industrial complex and agriculture is noted: workspace automation, increase in labor productivity, marketing opportunities, production efficiency and the resource potential optimization.

Another group of studies is related to the identification of opportunities for application of digital technologies with respect to business scale, forms of business ownership, including small farming, which form the mainstay of agricultural economy of developed and developing countries.

II. MATERIALS AND METHODS (MODEL)

Research methods: system and situational approaches, modeling of social and economic processes.

III. RESULTS AND DISCUSSION

The interest to introduction and assessment of the effectiveness of innovative technologies in agriculture and agro-industrial complex is associated with the growth of commercial and production results, as well as with new opportunities associated with the implementation of accelerated import substitution models. Both traditional and new technologies ensure the achievement of high results, contribute to the actualization of reserves for increasing labor productivity and production. The introduction of changes in production and management technologies of agriculture should be affordable, which is achieved when a certain set of criteria is met (Fig. 1).

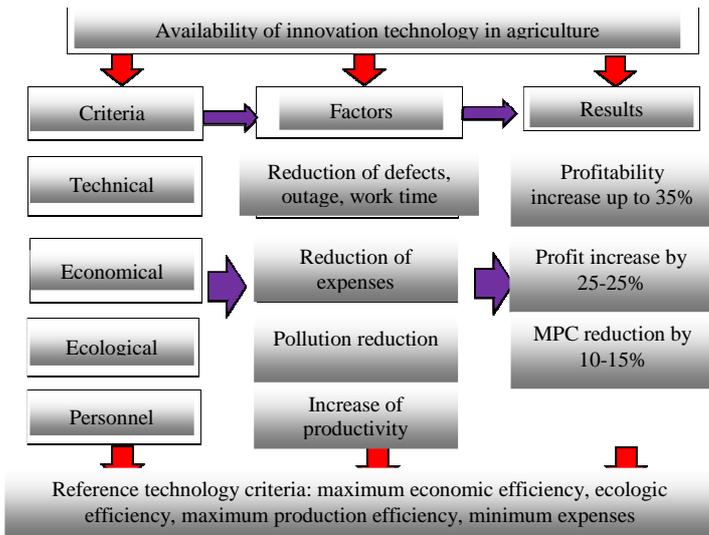


Fig. 1. Parameters of accessibility of innovative technology for introduction into the production cycle (author's compilation)

The technical accessibility means that the technology complies with the norms and standards of industrial safety for humans and environment, and there are no conflicts with the equipment that is used in production process.

The economic feasibility is determined by several significant factors: cost reduction, growth of profit indicators and profitability of the main production directions.

The ecological availability is concerned with a possibility of rational environmental management, decrease in the soil pollution.

The personnel availability is concerned with the ability to make use of digital technologies in production and management process, high qualification of the staff, its industrial and academic education and advanced training. It is also appropriate to mention creation of the necessary working conditions, relevant safety standards and hygienic factors which make the work with new technologies convenient, safe, and economically feasible in terms of working time and productivity.

The traditional means and methods of agricultural activities remain relevant as they make possible the steady increase in production yield: economical agricultural machinery; productive plant varieties; advanced fertilizers;

rationalization of agrotechnological techniques. However, their potential has almost been exhausted, thus making the pace of application of digital technologies and innovations based on a program-oriented approach at federal and regional levels of prospects and technologies consistently increasing. Table. 1 presents certain types of technologies that have already been introduced in the production process of agriculture in the regions of Russia.

TABLE 1 INNOVATIVE AGRICULTURAL TECHNOLOGIES IN REGIONS OF RUSSIA [3]

| Destination (Russia & worldwide) | Application | Effect |
|--|--------------------|---|
| Bioprocessing of organic raw materials (manure, litter, peat, etc.) at agricultural enterprises into environmentally friendly highly effective organic fertilizers with specified properties | | |
| Russia: 22 federal, 43 agricultural enterprises | Crop cultivation | 2-3 fold energy consumption reduction, 25-50% increase in crop yield vs. traditional organic fertilizers |
| Programmed harvesting using elements of precision agriculture | | |
| Worldwide: USA, EU, Brazil. Russia: Central Federal district, North-Western Federal district, Southern Federal district | Crop production | 25-40% cost reduction, 25-30% yield increase, 20-25% production profit increase |
| Online and offline differentiated introduction of agrochemicals | | |
| Worldwide: USA, EU. Russia: Central Federal district, North-Western Federal district, Southern Federal district, Amur region, Western Siberia region | Crop production | 25-40% expenditures reduction, 25-30% production yield, 20-25% production profit increase |
| Biotechnology of potato cultivation | | |
| Russia: Amur region | Potato cultivation | |
| Resource-saving technology of primary tillage in crops cultivation | | |
| Russia: West Siberian region | Plant cultivation | 27-55% expenditures reduction, 31-79% productivity increase, 20-56% fuel and lubricant consumption reduction, 10-79% labor cost reduction |
| Advanced pre-sowing tillage and seeding technology | | |
| Russia: West Siberian region | Plant cultivation | 40-53%, fuel and lubricant consumption reduction, 145% performance increase |
| Biologically-active biogenic metallic nanoparticles application technology | | |
| Russia: Krasnodar Krai, Ryazan, Voronezh, Rostov Oblast's | Plant cultivation | 10% material consumption reduction, 16% profitability increase, 15-35% product yield increase |

Every considered technology is capable of bringing notable production, social and economic effects provided the existence of appropriate equipment and operational capabilities of agricultural enterprises.

The agricultural complex of Krasnodar Krai provided the net production of 333.6 billion rubles in 2016 taking leading position across the Russian Federation as depicted in Fig. 2.

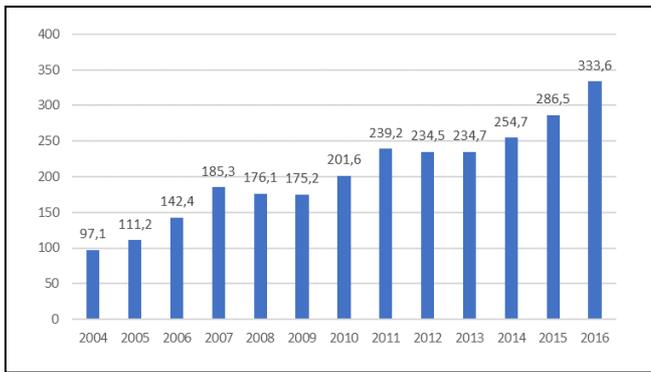


Fig. 2. Agricultural production in the Krasnodar Krai in actual prices in 2004 - 2016, billion rubles (author's compilation from data presented in [9])

The agricultural production in the Krasnodar Krai has been steadily increasing over the past 12 years, rising from 97.1 billion rubles up to 333.6 billion rubles, with net increase of 236.5 billion rubles, which positively characterizes the development of considered sector.

The share of agriculture produced in the Krasnodar Krai in the total value of agricultural products of Russia was over 6.6%. The per capita agricultural production in Kuban region in 2016 amounted to 60.8 thousand rubles in actual prices that ranks 11th across the regions of the Russian Federation (with the Belgorod region ranking first amounting to 140.8 thousand rubles per capita). At the same time the average of all regions of the Russian Federation was 34.4 thousand rubles.

The agriculture of the Krasnodar Krai is mainly crop production-specialized with the share of crop production in the total cost of agriculture goods production was 72.7% (242.4 billion rubles) in 2016, while the share of animal husbandry was 27.3% (91.1 billion rubles).

IV. CONCLUSION

The Krasnodar Krai ranks first in the production of agricultural products in 2017-2018 both in Russia and in the Southern Federal district. The agro-industrial and agricultural specialization of the subject is based on favorable climatic conditions and state support for innovative development of the sector. The positive dynamics of production is based on the application of digital technologies aided by the scientifically based approach to the development of crop production, precision farming and the use of biologically active preparations based on biogenic metallic nanoparticles. The regional support program for small and medium-sized businesses of agro-industrial production has been developed; there exists a preferential taxation system for agricultural enterprises. The digital technologies that have proven their effectiveness are being actively introduced.

The further innovations in crop production will contribute to the annual growth of the sector by 3-5%; the expansion of exploitation areas might result in the extra growth by up to 8-

9%. The innovations are mainly limited by the physical capacity of arable land and by necessity of maintaining the quality of products. Digital technologies will contribute to the formation of favorable working conditions and to the demand for engineering and information technology specialists. This will undoubtedly increase the prestige of labor in the agricultural industry and will solve a number of the regional socio-economic issues. The positive experience of introduction of digital technologies can be extended to other agrarian regions of the Russian Federation.

References

- [1] Bryukhanov A.Yu., Kozlova N.P., Vasil'yev E.V., Shalavina Ye.V. Rekomendatsii po opredeleniyu nailuchshikh dostupnykh tekhnologiy dlya intensivnogo zhitovnovodstva (Recommendations for determining the best available technologies for intensive animal husbandry). Sankt-Peterburg. 2016. 87p.
- [2] Vasil'yev E.Z., Bryukhanov A.Yu., Kozlova N.P. Otsenka effektivnosti nailuchshikh dostupnykh tekhnologiy dlya intensivnogo zhitovnovodstva (Evaluation of the effectiveness of the best available technologies for intensive livestock) // Tekhnologii i tekhnicheskiye sredstva mekhanizatsii proizvodstva produktsii rasteniyevodstva i zhitovnovodstva. 2016. № 86. P.131-142.
- [3] Ivanova S.V. Nailuchshiye dostupnyye tekhnologii v rasteniyevodstve dlya regionov Sibiri (The state of the art technologies in crop production for the regions of Siberia) // XXI vek. Tekhnosfermaya bezopasnost'. 2016. № 8. P. 69-73.
- [4] Il'yasov O.R., Neverova O.P. Pechura Ye.V. Perspektivy ispol'zovaniya metodov ekobiozashchity otkrytykh vodoistochnikov ot vozdeystviya stochnykh vod (Prospects for the use of methods of ecological bioprotection of open water sources from the effects of wastewaters) // Agrarnyy vestnik Urala. 2016. №4 (96). P.47-49.
- [5] Buklagin D.S. Informatsionnoye obespecheniye razrabotki spravochnikov NDT v APK Rossii (Information support for the development of reference books on state of the art technologies in the Russian agricultural sector) // Tekhnologii i tekhnicheskiye sredstva mekhanizatsii proizvodstva produktsii rasteniyevodstva i zhitovnovodstva. 2016. №88. P.5-19.
- [6] Komlatskiy V.I. Nailuchshe dostupnyye tekhnologii kak element ekologicheskoy modernizatsii svinovodstva (The state of the art technologies as an element of the ecological modernization of pig breeding) // Polimatcheskiy setevoy elektronnyy nauchnyy zhurnal Kubanskogo gosudarstvennogo agrarnogo universiteta. 2017. № 3. P.98-106.
- [7] Lebedeva O.I., Gafiyatov I.Z. Organizatsiya effektivnogo zemlepol'zovaniya v ramkakh «zelenoy ekonomiki» (Organization of effective land use in the framework of the «green economy») // Problemy sovremennoy ekonomiki. 2015. № 1 (53).
- [8] Oborin M.S. Osobennosti organizatsii sistemy prirodopol'zovaniya i khozyaystvovaniya na kurortno-rekreatsionnykh territoriyakh (Peculiarities of organizational system of environmental management and management in recreational areas) // Vestnik Dagestanskogo gosudarstvennogo tekhnicheskogo universiteta. 2014. № 4 (tom 35). S. 183-192.
- [9] Ofitsial'nyy sayt federal'noy sluzhby statistiki (Official site of the Federal Statistical Service of the Russian Federation) // Rossiyskiy statisticheskiy yezhegodnik. 2017. URL: http://www.gks.ru/free_doc/doc_2017/year/year17.pdf (access date: 03.02.2018).