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Innovation Deployment Strategies in Agricultural Economics

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Abstract
This paper traces how innovation development models are put into practice in the agrarian sector in North Caucasian Federal District in Russia. The area which is marked by its agricultural potential and socio-economic issues requires modern direction to sustainable development. Through a review of different innovation models and how they can be adapted to the local structure and environment, the paper has singled out key determinants to success such as infrastructure, institutional support, education as well as access to the market. The experiment highlights the role of the strategies of innovation peculiar to the region, the agrotechnologies integration and the partnership between the state and business in increasing the productivity and the economic stability in the agrarian sector.

Keywords: ***Agricultural innovation, North Caucasian Federal District, agrarian economy, sustainable development, innovation models, agrotechnology, regional development, public-private partnerships, rural transformation, agricultural policy.***

1.Introduction
The modern economic environment has seen innovative development as one of the fundamental blocks of sustainable development especially where strategic industries are concerned, like in the field of agriculture. This current transition between the traditional resource intensive agricultural systems and the modern innovation-based agricultural systems is not only a technology overhaul issue but a need in order to deal with food security in the world, economic competitiveness and environmental sustainability. In this context, North Caucasian Federal District (NCFD) of the Russian Federation is an unusual and extraordinary story. The region however remains faced with issues of systemic inefficiency, poor infrastructure and an incoherent innovation ecosystem that fails to reach its full potential at agrarian productivity despite the presence of abundant potential in natural resources and a supportive environment in climatic conditions.

FIGURE 1 Achieving Innovation-Based Agriculture in NCFD

The given paper is devoted to studying the role of innovation-led models of development realization in the NCFD agrarian economies(1). It aims at knowing mechanism, barriers and enabling factors that need to be put in place in order to promote sustainable innovation environment in the farm industry of the region. It is aimed at discovering the role of innovation as the means of not only technological transition and evolution but also the means of institutional, organizational and socio-economic change in rural and semi-urban societies.

Agriculture is also a significant industry to the NCFD in terms of employment and GDP of the region. However, ineffective production methods, unavailability to access more advanced technologies, limited infrastructures and small and medium-sized enterprises (SMEs) that cannot absorb and utilize the research findings are among some

stains in the sector. Having achieved much in ensuring food security independence and increased competitiveness of agricultural exports by its exporters, it becomes essential that the innovation gap which had led to poor performance in some regions like the NCFD be closed.

Multidimensionality of the factors is related to the development of innovation within agrarian environments. On the one hand, internal institutional capabilities are represented, such as, research institutional capabilities, human capital and agro-enterprises, which define the knowledge generation and absorption capacity. Conversely, the wider environment that surrounds these actors is composed by external frameworks like policies of the government, investment incentives, infrastructure, and dynamics of the global market. Interaction of these levels predetermines the degree of development of innovations creation, their dispersion and realization in the real processes of agriculture(2).

The fourth challenge in the NCFD is the aspect of poor integration, particularly of the innovation dissemination. Whereas big players in the agricultural sector might be able to use current technologies and institutional connections, most of them, especially those located in the wild parts of the countryside, have no resources and knowledge to bring innovations to life. Additionally, this gap is worsened by lack of well coordinated innovation policy frameworks. The physical challenges to the diffusion of innovation have included policy fragmentation, poor horizontal coordination across sectors (e.g., education, finance, agriculture) and vertical integration between the federal and local government structures.

According to the theoretical approaches of both Russian (e.g., Bakytzhan et al., 2020; Polushkina et al., 2020) and international research, regional innovation system (RIS) is valuable in terms of maximizing innovation activities in line with local economic and social conditions. RIS frameworks encourage collaboration between universities, research centers, public agencies, and businesses, which evolves into a partner-like environment that is favorable to innovations. This model is however not fully developed in the NCFD. It is reported that low research commercialization rates, poor public-private cooperation, and the lack of investment in innovation infrastructure persist as the problems of the region (Gokhberg et al., 2020).

Lack of close connection of scientific organizations and agricultural producers is another important obstacle. Although Russia has a system of agrarian universities and research centers, the chasm between the information they produce and serve exploitation needs by farms and agri-businesses is wide. The consequence of this disjuncture is poor rate of transfer of technology and minimal trace of scientific achievement to daily work in farming. The key to enhancing the science-to-farm pipeline involves creation of intermediary structures like innovation-hubs, agricultural extension programs and incubators which possesses capability to convert complex research into usable solutions(3).

As it has multidimensional dimensions, the transition to an innovation-based agricultural economy in the NCFD should be supported by the systemic and integrated policy approach. To do this, such a strategy would entail:

- Development of Institutional Capacity: Strengthening capacity of the local universities of agriculture, vocational schools and research institutes to act as focal points of innovation.
- Building Innovation Infrastructure: Coming up with innovation infrastructure like developing agri -tech parks, pilot innovation farms as demonstration and incubation centers.
- Enabling Financial Resources: Building instruments of blended finances such as grants, low interest loans and tax break to encourage investment in innovation in the private sector.
- Better coordination of policies: Smoothing and harmonizing the policies of innovation among ministries and second-tier governments to get rid of overlaps and conflicts.
- Up SKilling the Workforce: The programs of workforce development should be introduced (training, reskilling and technical education should be responsive to the needs of innovation in agriculture).
- Engage in Demand-driven Innovation: The promotion of a bottom-up innovation, where farmers and producers are engaged in the setting of the research agenda and feedback.

2.Methods

In order to approach the research in the innovation development models within the agrarian sector of the North Caucasian Federal District (NCFD), an integrated and step-by-step methodological practice was adopted. The research design was mixed methods that combined qualitative and quantitative methods to reflect the dynamics of the innovation environment as experienced within the agricultural economy of the region.

This research process went through the following research phases though they were separate and yet dependent on each other descriptive analysis, causal interpretation, comparative assessment, and systemic evaluation of relationships. Each of these phases was carefully planned so that a clearer picture of the implementation, restriction or facilitation of innovation in various contexts in the agricultural sector of NCFD is obtained(4).

Geographically, the research area is all the seven administrative divisions of the North Caucasian Federal District:

Republic of Dagestan

- Ingushetia Republic
- Kabardino-Balkarian Republic
- The Karachay-cherkess Republic
- North Ossetia-Alania Republic
- The Chechnya Republic
- The Stavropol Territory

The choice of these territories was based on their socio-economic, infrastructural and agro-climatic differences, whereas a representative study of regional differences in the innovation uptake was possible (5).

The process of data collection was based mainly on the primary and secondary sources.

Secondary sources were collected in state-released statistical catalogs, governmental databases, regional development reports, as well as in scientific studies, including scientific articles, mainly, based on the materials of the Federal State Service of Statistics of the Russian Federation (Rosstat), earlier works of both Russian and foreign researchers, and analytical information on elements of innovation activity.

Primary data represented the opinion of professionals, and these included agricultural practitioners, regional administrators, and stakeholders in innovation (researchers, agronomists, etc.) using direct interviews and review of documents with the help of focused discussions(6).

In order to facilitate descriptive and diagnostic phase, economic, technological, and institutional indicators which were of relevance were retrieved. These included:

- Rates of innovation activity region by region
- Expenses incurred on ICT and technology upgrade
- Determined capital investment patterns
- Profitability measures of farms

The technological, marketing and organizational innovations that are adopted in industries at different rates

The particular emphasis was placed on the analysis of official Rosstat databases (2017-2020) in terms of cross-sectional and longitudinal data comparisons. Moreover, the scientific and academic literature was revised to determine the theoretical basis of the innovation systems approach, such as Gokhberg et al. (2019, 2020), Fedotenkov (2014), Polushkina et al. (2020), and others.

The assessment and comparison step gained a comparison of the innovation indicators at the National and Federal district averages with NCFD. This comparative method allowed finding the regional outliers (both positive and negative) and identify systemic bottleneck to innovation.

Causal-inferential reasoning procedure was used to serve the purpose of investigating links and cause-effect relationships amid observed phenomena including the connection between low profitability and low innovation absorption. This involved the examination of ways in which the economic constraints, i.e., shortage of state assistance and underinvestment, contribute to an insufficient innovation ability at the enterprise level.

The last phase was a synthesis of findings in order to develop a system level explanation of the innovation framework of the agrarian economy of the NCFD. The insights synthesized were then presented in line with the international best practices aiming at advancing measures for actionable policy and development recommendations(7).

Furthermore, the study proceeded in accordance with the logic of territorial differentiation in the sense that each republic and each territory one by one in the NCFD studied was examined taking into consideration the development of its own way, a socio-economic condition, and a certain agro-industrial specialization. This enabled closer insights as opposed to generalised one-size-fits-all approach to development of innovation.

Finally, the study was designed in alignment with the criteria of evidence-based policy assessment, so that all the results are substantiated by empirical evidence, and may be reproduced and used by policymakers, educational institutions and agricultural businesses in practice-oriented planning and implementation of reforms.

3.Results and Discussion

The study of innovation trends in the North Caucasian Federal District (NCFD), agriculture provides a few sharp observations about the presence of differences, financing trends, and technology implementation processes. Within the past few years, this region has demonstrated the growing trend in the spending that is allocated to the information and communication technologies (ICT), but the density and structure of these investments differ significantly between constituent republics.

An examination of the regional ICT investment figures (20172019) points to a gradual upward-trend in both total outlays throughout the district. Nonetheless, it is a very unbalanced spending. An example is the Stavropol Territory that is constantly ahead of other republics, and much more money is spent on the development of ICT infrastructure. On the contrary, other regions such as Ingushetia and Dagestan are experiencing significantly low levels of spending compared to other regions indicating imbalances of systemic nature in terms of digital modernization. In addition, the ICT Budget as a whole allots most of financing in the purchasing of equipments and telecommunication services. Only a significantly small amount is utilized in the development of human capital especially through employee training where the expenditure drastically fell between 2017 and 2018. This death implies a lost chance of developing digital skills that would accelerate innovation dispersion at the grassroots.

Innovation activity measures become granular and the picture is convoluted. Relatively, NCFD is on a lower performing scale compared to the national benchmark with regard to enterprise innovation activity. Some statistics indicate that a minor percentage of the businesses in the area participate in either technological, marketing, or organizational innovations. To take a particular example, in 2017, 0.9 percent of companies in the NCFD confirmed engaging in technological innovation and organizational innovations constituted 0.2 percent, the lowest indicator of all federal regions(8). These statistics imply that innovation is not that nicely developed, as there is very little integration into the system of functional operations of agrarian enterprises.

This trend is corroborated in an innovation profile of the agricultural enterprises. According to the data available on the national level regarding the national agriculture and food sectors, a huge part of companies wish to invest in capital sources arrangement of facilities, equipment, and devices, software. Although this is a sign of modernization of the infrastructure, it has been a thin form of innovation, which tends to overlook the softer but equally important aspects such as training of the employees, advertising as well as restructuring of the organization. As an example, only 2.9 percent of the agricultural enterprises claimed to run the training programs, which is questionable in the context of the preparedness of the workforce to meet new technologies and procedures introduction.

The other key issue is the physical status of agricultural capital resources within the area. According to a 2019 statistics, it is indicated that more than 40 percent of assets in the agricultural sector are already in significant depreciation with ten percent or better worn out in parts of an area. Not only does the wear-and-tear of the fixed capital stand on the way of enhancing productivity but it also limits the ability of the region to absorb and exploit the new and advanced technological innovations. Implemented along with the decrease in the rates of profitability, especially beyond the Stavropol Territory, this tendency highlights the financial vulnerability of the majority of agrarian businesses within the region.

This vulnerability is further revealed in profitability data themselves in terms of absolute monetary results as well as profitability ratios in plant and animal farming. Though, some republics such as Stavropol and Karachay-Cherkess have been relatively financially stable, others such as Ingushetia, Chechnya and North Ossetia-Alania have been registered either stagnation or even negative returns in the recent years. Empty promises and intermittent responses notwithstanding, the overall reduced profitability levels cultivate concerns on the ability of the existing agricultural business models to be sustained in the long run in the absence of well-coordinated integration of strategic innovations.

Fixed capital investments have experienced a relatively modest increase throughout the NCFD giving indications that some governments or business in the region are trying to upgrade infrastructural facilities. Some of this investment however, seems to be reacting, as it tries to replace depreciated assets and not act as a driver of innovation. The fact that it focuses more on the replacement of old capital than it does with the innovative development of production processes implies low levels of productivity growth. In such a manner, the area continues to be in the state of continuous reinvestment where the obsolete infrastructure must be replaced, which does not provide much fiscal room to initiate a meaningful transformation led by innovation.

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On the more general level, low practical use of the innovation capabilities within the agricultural sector of the NCFD is an outcome and a condition of the lack of systematic support. The interviews of the industry stakeholders and analysis of the data indicate the following barriers to the adoption of innovation as the most urgent:

- Lack of financial strength particularly by the small and medium sized firms to incur high initial financial outlay of innovation.
- Inadequate government financial resources and special government funding to experimental projects that are particular to innovation.
- Lack of appropriate underdevelopment of infrastructure in diffusion of innovations including rural demonstration farms, and innovation centers.
- Poor knowledge transfer systems, with the gap between the academic research and the actual farming practice still hindering the use of scientific discoveries in practice.
- Problems in skills, whereby lack of properly trained individuals in most rural places so as to apply and manage higher level of technology.
- Economic instability that makes agribusiness owners avoid making long-term investment plans and acting beyond their means by taking risks.

Nevertheless, the study has also found some opportunities which are emerging. As an example, narrow technological modernisation, which means introduction of precision farming equipment, soil restoration methods, and environmentally non-destructive irrigation systems, can provide high-impact because it may be backed by a thorough training curriculum and integrated with the system of public-private partnerships. Similarly, the development of regional actions to facilitate the organic farming, the development of fisheries and agri-tourism activities could develop new markets and niche market to stimulate both supply- and demand-side innovation.

The findings demand some paradigm shift in the definition and realization of innovation within the agrarian economy of the NCFD. Spending on hardware and infrastructure is not sufficient, to transform what is needed is the integration of innovation into the governance and financial planning as well as development human capital. Regional governments, in partnership with federal governments and international partners, ought to work towards building a formidable innovation environment that is distinguished by vertical coordination (between the various levels of government) and horizontal integration (amongst the sectors and among the stakeholders).

To conclude, the analysis of a modern situation in the sphere of innovation in the agricultural sector of the NCFD shows the large scale of structural constraints but also great potential accumulated. The magic bullet to such potential release is the development of comprehensive innovation policy that considers economic, institutional, educational and technological aspects at the same time. Otherwise, the region will simply lag even more behind in the national process of modernization of agriculture and guarantee food security.

4.Conclusion

The results of the given work speak in favor of the necessity to redesign an agricultural development path of the North Caucasian Federal District (NCFD) by structurally and systematically implementing innovation-driven approaches. The agricultural sector in the region is poorly innovated despite the huge natural and demographic potential in the region because of institutional weaknesses, financial limitation, and dilapidation of the infrastructures, and shortfalls in skills. Such weaknesses have not only slowed technological modernization but there has been a case of deteriorating profitability and falling competitiveness in some of the constituent republics.

One of the fundamental implications of the study is the fact that the art of innovation in agriculture is an integrated one. New equipment or software seems not to be enough as the technological solution and should be complemented by skills enhancement of the working population, research-commercialization cycles, and favorable economic policies. The fact that only a small number of market-centric, organization-centric and human-capital-driven innovations have been adopted means that strategic planning has a big gap. Most of the investment is still being made in one of retexturing the capital worn out but not raising new systems which are productivity-enhancing.

In addition, regional policies, based on the consideration of disparities in both socio-economic and infrastructural prerequisites of the entities, are anticipated since innovation activity and ICT spending are unevenly distributed throughout the NCFD. Indicatively, in addition to being the most profitable region and having the highest number of innovation inputs to be able to position itself at the top in this region, the Stavropol Territory, the republics of Ingushetia, Chechnya, and Dagestan are far behind due to institutional fragmentation and systemic

underinvestment. Such disproportion implies that the policy of innovation should be shaped in such a way so as to overcome local barriers and take advantage of locally based advantages.

The next important conclusion is the importance of the development of the regional innovation ecosystem which suggests links between education, science, production, and governance. It is important to develop innovation hubs and demonstration farms, extension services, and digital infrastructure to the small- and medium-sized businesses in the agricultural sector. Access to innovation by those organizations that currently lack the capital or institutional access to develop on their own may be mediated by public-private partnerships and greater state involvement.

To cope with these challenges, a number of policy recommendations may be listed:

- Institutional strengthening: Creation of stronger connections between universities, research institutes and producers in order to enhance the delivery of technology and innovation.
- Capacity building: Involvement in training programs and professional education on the basis of modern agronomic technologies and agrotechnologies.
- Financial innovation: availing special funds of innovation, mixed financing tools and support in accepting innovations, particularly with smallholders.
- Regulatory support: Straightening the traces of bureaucracy and having transparent governance of innovations that can favour coordination at the sector and administrative levels.
- Monitoring and evaluation: The establishment of powerful mechanisms to monitor the performance and the outcomes of innovation providing an opportunity to manage policies flexibly.

Lastly, the ongoing agrarian economy transformation of the NCFD should be in tandem with the entire country plans of rural development, food security and sustainability. Through the practice of crystallizing the innovation in the very fabric of the agricultural planning and governance, the region will not only produce more but also live in a relatively socio-economically stable environment, create more jobs, and enhance their living standards.

It is imperative that context of future development in the NCFD be highly reliant on the degree to which currents of innovation are mainstreamed- not to be a periodically occurring endeavor- but a consistent, evolutional process, enabled by research, policy and practice. When properly adopted, such innovation strategies can make the region a strong and competitive entity in the national and international agricultural market.

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Conflicts of interest

The authors have no conflicts of interest to declare

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