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INNOVATIVE CLUSTERING AS A STRATEGIC VECTOR FOR THE DEVELOPMENT OF THE AGRICULTURAL SECTOR OF THE LIBERATED TERRITORIES OF AZERBAIJAN

This article investigates the agricultural potential of the liberated territories of Azerbaijan (LAEO) and proposes strategic directions for clustering agriculture as a tool for sustainable rural development. In the context of global challenges such as demographic change and climate fluctuations, the study emphasizes that agricultural growth in the deoccupied regions requires not only land reforms but also the establishment of an innovative ecosystem supported by research centers, digital technologies, and public-private partnerships. Institutional transparency, a developed agro-technological infrastructure, and effective public policy are highlighted as crucial preconditions for long-term success.

The research is grounded in the principle of objectivity, enabling the analysis of agricultural development as a complex socio-economic process. General scientific methods, including analysis and synthesis, comparison and analogy, and the processing of statistical data, were employed to identify the key factors influencing agricultural potential and strategic directions for clustering.

The scientific novelty of this study lies in introducing a new strategic concept for the agricultural development of the liberated territories, shifting the focus from traditional small-scale farming to integrated agricultural clusters. These clusters are envisioned to combine large farms, research centers, innovation platforms, and institutional support. Drawing on the example of the Netherlands, the paper offers a comparative framework for establishing innovative agroecosystems in post-conflict zones.

The study concludes that adjustments to existing legislation or the adoption of a new legal act on agricultural clustering are necessary. While the current agricultural policy—characterized by subsidies, tax incentives, loans, and simplified export procedures—is effective, it is insufficient to ensure global competitiveness. The state is therefore urged to assume a leading role in fostering partnerships between agribusiness, research institutions, universities, and venture financing. Following the European Union model, the creation of agricultural research centers in cities such as Aghdam and Fizuli is recommended, alongside the integration of advanced foreign technologies and the promotion of applied research. Special emphasis is also placed on state-supported training of agricultural specialists at Karabakh University to secure long-term sectoral development.

Key words: agricultural clustering, liberated territories, innovation, agropark, Dutch experience, land reform, sustainable agriculture

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ІННОВАЦІЙНА КЛАСТЕРИЗАЦІЯ ЯК СТРАТЕГІЧНИЙ ВЕКТОР РОЗВИТКУ АГРАРНОГО СЕКТОРУ ЗВІЛЬНЕНИХ ТЕРИТОРІЙ АЗЕРБАЙДЖАНУ

У статті досліджується аграрний потенціал звільнених територій Азербайджану (ЗТА) та пропонуються стратегічні напрями кластеризації сільського господарства як інструменту сталого розвитку села. В умовах глобальних викликів, таких як демографічні зміни та кліматичні коливання, підкреслюється, що розвиток аграрної сфери у деокупованих регіонах потребує не лише земельних реформ, але й створення інноваційної екосистеми, яку підтримують науково-дослідні центри, цифрові технології та державно-приватні партнерства. Важливими передумовами довгострокового успіху визначено інституційну прозорість, розвинену агротехнологічну інфраструктуру та ефективну державну політику.

Методологічною основою дослідження є принцип об'єктивності, що дозволяє розглядати розвиток сільського господарства як складний соціально-економічний процес. Використано загальнонаукові методи, зокрема аналіз і синтез, порівняння й аналогію, а також обробку статистичних даних, що дало можливість визначити ключові чинники аграрного потенціалу та напрями кластеризації.

Наукова новизна полягає у розробці нової стратегічної концепції аграрного розвитку звільнених територій, яка передбачає перехід від традиційного малоземельного господарства до інтегрованих аграрних кластерів. Такі кластери мають об'єднувати великі фермерські господарства, дослідні центри, інноваційні платформи та інституційну підтримку. На прикладі Нідерландів запропоновано порівняльну модель створення інноваційних агроєкосистем у постконфліктних зонах.

У висновках зазначається, що необхідні зміни до чинного законодавства або ухвалення окремого закону про аграрну кластеризацію. Хоча сучасна аграрна політика, що включає субсидії, податкові пільги, кредити та систему «єдиного вікна» для експорту, є ефективною, вона недостатня для досягнення глобальної конкурентоспроможності. Держава повинна взяти на себе провідну роль у налагодженні партнерств між агробізнесом, науковими установами, університетами та венчурним фінансуванням. За зразком країн ЄС пропонується створення аграрних дослідних центрів у містах Агдам та Фізюлі, їхня участь у впровадженні передових зарубіжних технологій і проведенні прикладних досліджень. Також наголошено на важливості державної підтримки підготовки аграрних кадрів у Карабахському університеті для забезпечення довгострокового розвитку сектора.

Ключові слова: сільськогосподарська кластеризація, звільнені території, інновації, агропарк, досвід Нідерландів, земельна реформа, стійке сільське господарство

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INTRODUCTION

Thus, it is necessary for Azerbaijan, a country that insists on ensuring sustainable food security and seeks to maximize the benefits of agricultural exports, to benefit from the greatest material wealth, land, gained from the Great Victory. Why would it be right for agrarian progress in the CIS to rely on the policy of agrarian clustering? After all, in the post-Soviet period, agriculture showed good results based on land reform and the established state support mechanism. True, these results may seem somewhat weaker than the results of the collective farm stage, but when considering resource consumption, it is revealed that private property and active state assistance together are a more efficient tool than the collective farm system. From the picture of some production and resource consumption results of the Azerbaijani agrarian sphere for 1985 and 2023, this aspect is revealed - the power of the harmony of private property with state assistance.

METHODS

The main theoretical and methodological principle of the study is the principle of objectivity, which allows us to analyze the process of personnel loyalty as a complex socio-economic phenomenon. In addition, other general scientific methods were used in the work, such as: analysis and synthesis, comparison and analogy, the method of processing and analyzing various data from official and unofficial statistics, which made it possible to identify factors that have a direct impact.

SCIENTIFIC INNOVATION

This study highlights a novel strategic framework for the development of the agricultural sector in the liberated territories of Azerbaijan (IAER), emphasizing the necessity of innovation-based clustering as a key vector of rural advancement. Unlike previous land reform strategies focused solely on small-scale farming, this research proposes a shift toward integrated agricultural clusters involving large farms, research centers, digital technologies, and supportive institutions. The comparative analysis with the Netherlands' agricultural success offers a new conceptual basis for constructing an innovation-driven agro-ecosystem in post-conflict zones.

PRACTICAL SIGNIFICANCE

The research provides practical policy recommendations for the effective utilization of natural resources in the IAER by establishing agro-clusters based on institutional development, innovation adoption, and multi-stakeholder collaboration. The findings can guide policymakers in designing legal frameworks, infrastructure investments, and educational initiatives needed to transform the region's agricultural potential into sustainable economic outcomes. The emphasis on scaling up production through digital technologies, smart farming, and research-based development has significant implications for national food security and rural employment.

MAIN PART

Firstly, global trends – demographic and climate change trends – have eliminated the approach of considering the agricultural sector as an insignificant element of the economic structure, and today each country is trying to make the most of the potential of this sphere. Various studies suggest that by 2050 the population of our planet will be 9.4–10.1 billion people, and according to some, the peak - 9.7 billion people - will occur in 2064. (138, p1073-1074) In addition, global droughts – the frequency and duration of which have increased by 29% since 2000, causing losses of 124 billion dollars, and which are expected to affect 129 countries of the world in the near future, and which are expected to affect 30% of the territory of India in 2018-2019, are already exacerbating the problem of food security. The country produces 8 times less grapes and 2.8 times less cotton than 40 years ago. However, the increase in grain production was 2.5 times, in vegetables 2.2 times, in potatoes 4.6 times, and in meat and milk production 2.3 times. (140,141) This increase was realized with 2.7 times less fertilizer costs per hectare than 40 years ago, a 700-unit reduction in the number of grain combines, etc. (140,141). It seems that the existing economic mechanism has proven its effectiveness and in the IAEA it is possible to ensure agrarian progress in this way. That is, it is enough to transfer the land to private ownership - to the peasants and support the farmer. However, in the past period there was no completely miraculous progress in the agrarian sphere. The average world productivity has not yet been achieved for many crops, and for example, the average grain productivity in the world was 41.8 centners/hectare (2022), while in Azerbaijan it was 33 centners/hectare (2023). (141,142) It is also known that land reform, with all its unparalleled successes, led to the creation of numerous small family farms - farms with limited long-term growth opportunities, and due to management shortcomings, the purpose of a certain part of the land has actually changed. Due to these aspects, it was necessary to choose a slightly different path for agrarian progress in the IAEA, and such proposals were put forward in the studies. For example, it was proposed that in the IAEA, land should be given on a deferred sale basis only to those who want to work on the land and create the basis for the creation of large farms (143, p. 31). It is already noticeable that land ownership relations will be established differently in relation to the IAEA, and the changes in the Milli Majlis regarding land lease are still focused on the investment competition and preferential lease of IAEA lands. True, it is not a final decision, and it is also clear that the state is conducting research on this issue, and probably the main intention is not to repeat previous shortcomings. The integrity of land ownership rights is undoubtedly the foundation of an effective agricultural sector, but this solid foundation alone, or large farms, does not

create all the opportunities for qualitative progress. On the example of two EU countries, we can conclude that this assumption is not wrong. In two countries of the Union - the Netherlands with a population of 18.3 million people and France with a population of 66.6 million people, there are no problems with ownership and small farms in the agricultural sphere. But the results of production efficiency are different.

Thus, the Netherlands, which has a population 4 times smaller than France, a cultivated area 19 times smaller, and a population 3 times smaller, produced almost as many vegetables, potatoes, meat, and milk as France, and most importantly, the Netherlands' agricultural exports were \$20 billion more than France's. How did the Netherlands even come out on top in the EU in terms of the efficiency of its agricultural sector and become the world's second largest agricultural exporter? On November 21, 2022, The Washington Post newspaper examined how this small country - a country with an area of 41.5 thousand square kilometers - became the second largest agricultural exporter on the planet. According to the newspaper, the country's agricultural sector has 4 million cattle (2.5 million in Azerbaijan), 13 million pigs, and 108 million chickens (the number of birds in Azerbaijan is 28.7 million). The area of the Netherlands' greenhouses is 24,000 acres. That is, the area of greenhouses is 9.7 thousand hectares. The total area of greenhouses in Azerbaijan is 1.6 thousand hectares. (145,146, p. 44) Of the 124 billion euros in agricultural exports of the Netherlands in 2023, 12 billion euros were dairy products and eggs, 11.2 billion euros were meat products, 11.5 billion euros were horticultural products (mainly famous Dutch flowers), 8.7 million euros were vegetables, and 7.7 billion euros were fruits. (147) The list of these success indicators of the Netherlands is not short, but it is important to honestly answer the question "How was success achieved?". One of the important conditions for success is the support of the Dutch state for agricultural research, and in 2023 the state allocated 439.2 million euros for agricultural research. (148) 79% of Dutch farms use digital technologies. The Netherlands has precision farming – a system that accurately determines the level of soil moisture and the level of soil fertilization needs. Currently, the first bananas have been produced in Dutch greenhouses based on a surface composite made of coco peat and rock wool (a composite used instead of soil). The Dutch agricultural sector is also a leader in waste management, and the Nijssen Granico company produces 90,000 tons of livestock feed per year from food waste. "Twice as much production with half the resources!" is one of the main slogans of farmers in this country, and the dependence on water in the production of major crops is reduced by 90%, and the use of chemical pesticides in greenhouses is a reality (149). These advances in the agricultural sphere in the Netherlands are achieved through aeroponics (vertical crop production), AI (artificial intelligence), IoT, and other technologies. In this country, the Royal Philips corporation is working on LED lighting for greenhouses - lighting that optimizes plant growth, the Lely company is known for its robotics and automation work in dairy farms, the Rijk Zwaan company is developing productive and disease-resistant vegetable varieties, the Thetatron company is developing sensors for precision farming, and Aoerofarms is working on aeroponics. It is also known that Wageningen University and Delft University of Technology play an important role in the implementation of these innovative technologies, and LNV – the Dutch Ministry of Agriculture and Food Quality, RVO – the entrepreneurship agency, LTO – the agricultural federation, InnovationQuarter and Leapfouners – organizations that provide venture finance to agricultural startups also have an important place in the innovative progress of the agricultural sector. (150) One aspect of the described moments regarding the agricultural progress of the Netherlands is clearly revealed. It becomes clear that a modern and effective agricultural sector can be built on an innovative level and with the joint work of numerous partners – the state, research centers, companies, farmers, etc. Or we can conclude that the main vector of agricultural progress is the implementation of agricultural clustering with the support of an innovation ecosystem. In our opinion, the line of agricultural progress in the IAEA should be defined in this way and only With the implementation of agrarian clustering together with an improved institutional foundation, it will be possible to derive maximum benefit from a very valuable natural resource - land - that is, from individual, corporate and public interests. In other words, although the improvement of land ownership relations is a necessary condition for agrarian progress, agrarian clustering is an important and sufficient condition. Thus, the question "How did the Netherlands become the second largest agricultural exporter in the world?" was clarified and the main line of the agricultural progress of the EAEU was revealed. Probably, the next question – "What needs to be done to implement agricultural clustering in the EAEU?" should be answered. A comparison of some indicators of the agricultural sphere of the Netherlands with our country will help in finding an answer. The average land area per farm in the Netherlands is 41.4 hectares, there are 52 thousand agricultural enterprises in this country, there are 11,200 land-based (traditional) farms, and the number of greenhouses is 2,800. (151) In Azerbaijan, the number of family-peasant farms that replace traditional farms is around 800 thousand, and the average area in these farms is close to 1 hectare, although the number of greenhouses is not less than in the Netherlands, as seen earlier, the land area used by greenhouses in the country is 8 times less than in the Netherlands. There are only 1203 agricultural enterprises in the country - that is, 40 times less than in the Netherlands. From what has been said, one important aspect for clustering in the IAEA is noticeable. It is clear that clustering can be implemented more successfully on the basis of large agricultural enterprises, and in this regard, we must definitely dwell on one point. It is known that perhaps the most spectacular reform of independent Azerbaijan is related to land, and this reform was more focused on protecting the interests of the rural population, and the formation of many small farms cannot actually be considered a completely positive aspect of the reform. However, it is also wrong to implement such spectacular innovations only on the basis of economic benefits and is generally impossible. The fact that the IAEA provides for preferential lease of land to the population living in the region in the amendments to the lease law is also partially consistent with the principle of justice (in principle, the earlier reform in

this region would have been fully consistent), but it is not a successful solution in terms of building an effective agrarian system. Such a system, as mentioned earlier, should rely on large enterprises, innovative agricultural companies, and such a process is taking place in Azerbaijan - the enlargement of farms and the proliferation of agroparks in the agricultural sector. This hypothesis, put forward with a very simple example - the importance of large farms and agricultural companies in efficiency, is confirmed. For example, in 2023, the area of vegetables in the country was 61,227 hectares. It is known that the area of greenhouses is approximately 3% of the total area of vegetable crops (1.6 thousand hectares), and according to statistical data, 279 thousand tons of tomatoes and cucumbers were produced in greenhouses in 2023. That is, 15.2% of vegetables produced in the country were grown in greenhouses. But as mentioned earlier, and it was also known from the experience of the Netherlands, agrarian clustering is not limited to these issues. Chapter II shows that very dynamic work is being done in Azerbaijan on the line of agrarian clustering, and we can characterize these works in 8 years - the policy of creating agroparks, which began in 2016, with the registration of 24 agroparks and the activity of 22 agroparks in 2023. 24 new agroparks should also be created in the coming years, and it is said that new technologies are being implemented in these agroparks, both in production and irrigation, and these ideas are probably not wrong. Some information about the success of the agroparks' activities was mentioned in the previous chapters, but we can say that all this successful activity cannot yet be considered an example of a systematic agrarian clustering policy. In particular, the "Dost" Agropark, a joint project of Azerbaijan and Turkey - a park that will produce products under the "Made in Karabakh" brand, is not a complete example of a cluster. According to some information, progressive irrigation systems are being applied in certain agroparks. There is no information about the use of IoT in these systems, and probably IoT sensors are not used in these systems yet. However, the use of certain technologies - sensors, AI - in an agropark does not indicate the lack of systematization of agrarian clustering. In general, the issue of agrarian clustering is not interpreted fairly in some studies conducted in the country. For example, in the article "Determining the possibilities of creating agroparks: on the example of the Guba-Khachmaz economic region" by Elnur Alakbarov, Alvan Suleymanova and Rauf Musayev, socio-economic, infrastructure-geographic, agricultural and industrial factors are attributed to the factors influencing the creation of an agropark. Of course, clustering cannot be viewed as any business project or as a choice of production location, and clustering is not determined solely by population size, availability of railways and highways, crop productivity, or industry size. (152, p. 88) In general, it is clear from the analyses conducted that agroparks are only one element in agrarian clustering. To create a cluster, it is necessary to concentrate on the territory of various supporting service organizations - banks, venture funds, expertise centers, export consortia, etc., agrarian research centers, higher education institutions that train personnel in agrarian and biotechnological specialties, producers - large agrarian firms, small agribusiness structures, and agrarian startups, and state policy aimed at clustering should also be directed in this direction. In the regulations on "Agroparks" - a document approved by the President in 2021, this issue has been largely resolved, and according to paragraph 4.6.3. of the Regulations, it is necessary to provide some services in terms of organizing activities in the agropark - for example, consulting, business incubation, vocational training, etc.

CONCLUSION

To transform IAEΘ into a model of agricultural excellence, Azerbaijan must adopt a systemic approach. This includes developing agricultural clusters with solid institutional foundations, advanced infrastructure, and innovation ecosystems. Public policy should prioritize partnerships, education, and research in key regions such as Aghdam and Fuzuli. Land ownership reforms, while necessary, are not sufficient; true progress lies in cluster-based development supported by modern technology and collaborative governance.

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