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AGRO-ECONOMIC SYNERGY: ENHANCING FOOD SECURITY THROUGH INNOVATIVE AGRICULTURAL PRACTICES IN AZERBAIJAN

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Abstract: *This paper examines the critical role of agro-economic synergy in enhancing food security in Azerbaijan. Amid global challenges such as climate change, population growth, and economic uncertainty, Azerbaijan has significant potential to modernize its agricultural sector through innovative practices like precision agriculture, biotechnology, and sustainable farming techniques. The research highlights the country's strategic initiatives, including the "State Program for Ensuring Food Safety in the Republic of Azerbaijan for 2019-2025," which emphasizes the integration of technological advancements and economic strategies to boost agricultural output while reducing environmental impact. By employing a qualitative methodology based on secondary data from governmental and global organizations, the study explores how advanced agricultural practices can improve both food availability and export potential. Case studies such as the development of agroparks and partnerships with international institutions further demonstrate Azerbaijan's efforts to modernize its food systems and achieve long-term sustainability. Despite facing infrastructural and policy challenges, the paper underscores the importance of continued innovation and investment to secure food sovereignty and strengthen Azerbaijan's position in global markets. The findings contribute to a broader understanding of how agricultural modernization can drive economic growth while ensuring food security.*

Keywords: *Azerbaijan, agriculture, food security, economic development, agricultural practices*

INTRODUCTION

In recent years, food security has become a critical global concern, driven by challenges such as climate change, population growth, and economic uncertainty, all of which have raised questions about the sustainability and effectiveness of agricultural systems. Amid these global challenges, Azerbaijan finds itself at a pivotal point, with the opportunity to harness its distinctive geographic, climatic, and economic attributes to build a resilient agricultural sector. The concept of agro-economic synergy—integrating modern farming techniques with economic sustainability—is increasingly seen as essential for enhancing food security, particularly in Azerbaijan, where agriculture plays a significant role in both GDP and employment. Food security, encompassing the availability, accessibility, and effective use of food, has emerged as a strategic priority for the Azerbaijani government. Agriculture, vital for

meeting domestic needs and generating export revenues, is central to achieving this objective. As Azerbaijan continues its commitment to sustainable development, exploring how agro-economic synergies can enhance agricultural output while reducing environmental impact is crucial. Tackling these challenges will not only safeguard the nation's food sovereignty but also bolster its standing in global agricultural markets. The key lies in modernizing the sector in a way that ensures sustainability and inclusivity. Contemporary research in agricultural economics has highlighted the importance of integrating technological innovations with robust economic policies. Studies indicate that the adoption of innovations like precision agriculture, climate-resilient farming, and biotechnology can substantially improve both productivity and resource efficiency. In Azerbaijan, such practices are gaining ground, particularly in areas like digital agriculture, water resource management, and the cultivation of high-value crops. However, the potential of these innovations is not yet fully realized, as the country continues to face challenges in policy development, infrastructure enhancement, and capacity building. The Republic of Azerbaijan has consistently prioritized food security as a critical component of its national policy, ensuring that the population has access to sufficient, safe, and nutritious food. To this end, the "State Program for Ensuring Food Safety in the Republic of Azerbaijan for 2019-2025," approved by Presidential Order No. 1143 on April 29, 2019, serves as a strategic framework to bolster the country's agricultural sector and safeguard its food systems against potential vulnerabilities. The 2020 Impact Assessment Report published by the Center for Analysis of Economic Reforms and Communication offers a detailed review of the progress achieved in implementing the program's objectives and highlights both successes and areas for further improvement. (State Program, 2020)

The 2020 Impact Assessment Report highlights several milestones achieved under the State Program. One of the major successes has been the significant improvement in the country's agricultural output. Enhanced irrigation systems, coupled with the promotion of precision agriculture technologies, have contributed to higher yields in key crops such as wheat, cotton, and fruits. The use of digital agriculture platforms, allowing farmers to monitor soil health, crop growth, and weather patterns, has further optimized farming practices. Additionally, the establishment of several food safety agencies and laboratories has improved the capacity to monitor and regulate food quality standards across Azerbaijan. The increased focus on training and certifying food producers to meet international standards has also facilitated the expansion of Azerbaijani agricultural products into foreign markets, boosting the country's export revenues.

Methodology

This research employs a qualitative methodology to explore agro-economic synergies that enhance food security in Azerbaijan. Utilizing secondary data from reputable sources, including the State Statistical Committee and World Bank reports, the study aims to analyze the interplay of agricultural practices, economic strategies, and environmental factors. Key data sources include the "State Program for Ensuring Food Safety in Azerbaijan" and relevant scholarly articles. The methodology incorporates content analysis to identify themes related to innovation and policy strategies, alongside comparative analysis to benchmark Azerbaijan's agricultural performance.

Literature review

Several scholars have underscored the significant role that agriculture plays in fostering economic development and ensuring food security, particularly in developing nations such as Azerbaijan. Schultz (1964) posits that agriculture in traditional societies must undergo modernization to become more productive and contribute effectively to economic progress. (Schultz, 1964) He emphasizes that with proper investments in areas like education, infrastructure, and technology, even subsistence farming can be transformed into a dynamic sector. This argument holds particular relevance for Azerbaijan, where agricultural productivity has yet to reach its full potential due to outdated farming methods and fragmented landholdings. Schultz's ideas on modernizing traditional agriculture resonate strongly with Azerbaijan's current needs. Lipton (2009) builds upon this by stressing the essential role agriculture plays in reducing poverty, particularly in rural areas. (Lipton, 2009)He argues that improvements in agricultural productivity can drive economic growth by creating demand for non-agricultural products and services, thus contributing to rural industrialization. Given that a large portion of Azerbaijan's population resides in rural areas, policies aimed at increasing agricultural output—especially in important agricultural regions like Ganja-Dashkasan and Shaki-Zagatala—could yield significant economic benefits. Lipton's theory supports the idea that well-targeted agricultural investments can create positive ripple effects throughout the economy, promoting sustainable development and enhancing food security.

Mellor (1995) also highlights agriculture's critical role in boosting overall economic development. He asserts that increased productivity in the agricultural sector can lead to higher incomes while simultaneously lowering food prices, thereby improving food security. Mellor's insights are particularly pertinent to Azerbaijan, where rising food costs have the potential to disproportionately impact the most vulnerable segments of society. By boosting agricultural efficiency and productivity, Azerbaijan can make food more affordable—a key factor in improving nutrition and alleviating poverty, according to Mellor's framework. (Mellor, 1995)

The value chain development approach, as discussed by Kaplinsky and Morris (2001), further supports the notion that integrating farmers into larger regional and global markets is vital for agro-economic growth. In Azerbaijan, developing value chains could significantly boost the production and export of high-value agricultural products like fruits, vegetables, and hazelnuts. According to Kaplinsky and Morris, improving farmers' market access and product quality can raise incomes and strengthen the broader agricultural economy. This is particularly relevant for regions such as Absheron-Khizi and Lankaran-Astara, where horticulture and export-oriented agriculture are emerging as key growth areas.

Chayanov's (1966) theory of the peasant economy offers additional insights into the challenges faced by Azerbaijan's rural farmers. Chayanov notes that smallholders tend to be risk-averse, often prioritizing subsistence over market-based production. (Chavanov, 1966) This is particularly applicable in Azerbaijan, where fragmented landholdings and limited access to credit and technology frequently hinder smallholders from scaling up production. However, the adoption of cooperative farming models—successfully employed in countries like Switzerland—could help Azerbaijani farmers pool resources, share risks, and gain better access to markets.

In the realm of innovative agricultural practices, Pretty et al. (2018) advocate for sustainable agricultural intensification, which focuses on boosting productivity while minimizing environmental impact. They argue that practices such as organic farming, conservation agriculture, and integrated pest management are crucial for achieving long-term food security. Azerbaijan, where challenges like climate change and land degradation are significant, can benefit greatly from this approach. For instance, the introduction of water-efficient irrigation technologies, successfully implemented in Germany, aligns with Pretty's recommendations for sustainable farming. Germany's experience in adopting eco-friendly practices while maintaining high levels of productivity offers valuable lessons for Azerbaijan as it seeks to transition toward sustainable agriculture.

Furthering the discussion, Ellis and Biggs (2001) emphasize the importance of agricultural innovation systems in promoting technological advancements and improving farm productivity. They argue that successful agricultural transformation requires not only technological innovation but also robust institutional support, including policies that facilitate access to credit, markets, and agricultural services. Azerbaijan's ongoing modernization efforts, which include partnerships with international organizations and government initiatives, align with the principles outlined by Ellis and Biggs. The development of modern greenhouse technologies in regions like Mil-Mughan and Shirvan-Salyan exemplifies how technological advancements, combined with supportive policy frameworks, can bolster food security and economic resilience. (Ellis & Biggs, 2001).

Finally, Pingali (2012) underscores the importance of diversifying agricultural production systems to ensure food security and economic stability. He warns that monoculture farming systems are highly vulnerable to environmental and market fluctuations and advocates for diversification into high-value crops, livestock, and agroforestry as a means of building resilience. In Azerbaijan, particularly in regions like Guba-Khachmaz and Karabakh, diversifying crop production aligns with Pingali's recommendations. Encouraging the cultivation of fruits, vegetables, and nuts not only reduces the country's dependence on staple crops but also increases its export potential, contributing both to food security and overall economic development. (Pingali, 2012)

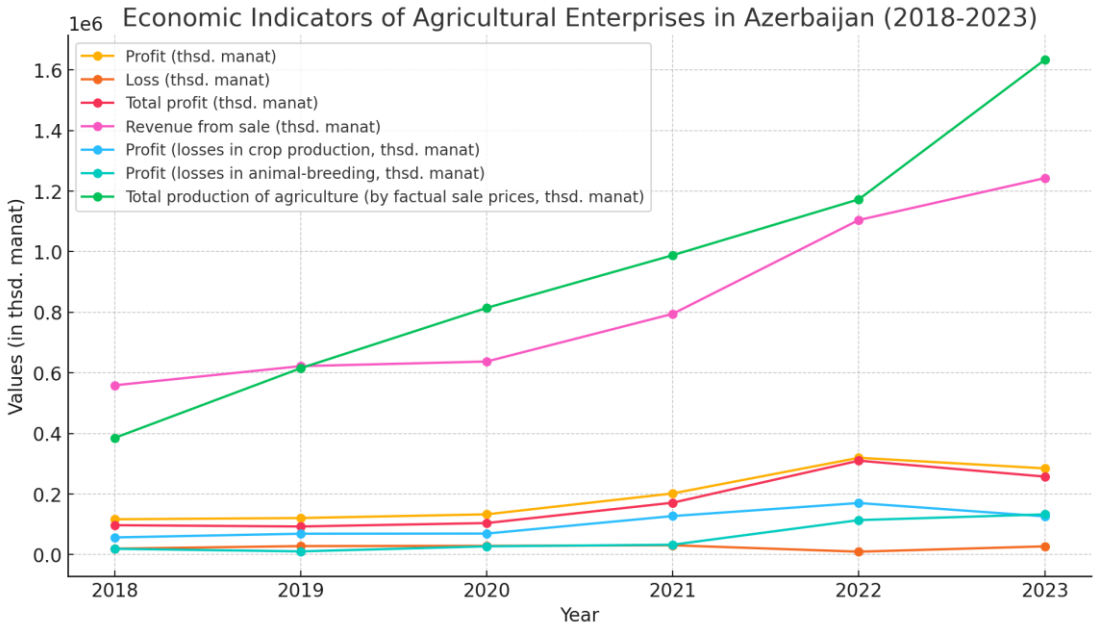
Discussion

The establishment of agro parks, like those in Baku and Khachmaz, plays a pivotal role in these reforms, facilitating large-scale, high-tech agricultural production across the country. These parks are equipped with advanced irrigation systems, modern greenhouse technologies, and support services for local farmers, enabling them to increase productivity while maintaining environmentally sustainable practices. (Agroparks,2024) Agroparks not only increase food production but also contribute to economic development by creating jobs, fostering local entrepreneurship, and enabling rural communities to engage in profitable agricultural activities. They serve as vital nodes in the country's food supply chain, ensuring year-round production and improving Azerbaijan's food security. Agro Dairy operates in various regions of Azerbaijan, including key agricultural zones in the country's western and southern districts. With access to vast tracts of fertile land, the company primarily focuses on crop production, livestock farming, and dairy production. The company's large-scale

operations are aligned with Azerbaijan's broader agricultural strategy, which aims to develop export-oriented, high-yielding agricultural enterprises that contribute significantly to national food security. (Agro Diary, 2024)

One of the primary innovations brought in by Agro Dairy is the use of precision agriculture, which involves applying data-driven technology to optimize farming practices. This includes soil analysis, the use of advanced irrigation systems, and GPS-guided machinery, all of which help to maximize crop yields while minimizing environmental impact. The company has been instrumental in introducing smart farming technologies in Azerbaijan, which include automated systems for planting, irrigation, and harvesting. With access to vast agricultural land, Agro Dairy has introduced precision farming technologies, which optimize farming processes through data-driven decision-making. This includes the use of satellite imagery, GPS-guided machinery, and soil sensors to monitor crop health, manage water usage, and improve yields. These technologies are crucial for maximizing productivity while reducing environmental impact. One of Agro Dairy's primary focuses is sustainable agriculture, ensuring that the farming methods employed preserve soil health and promote long-term land productivity. The company's use of automated drip irrigation systems conserves water in Azerbaijan's arid regions, while crop rotation practices help maintain soil fertility. By integrating these modern farming techniques, Agro Dairy plays a crucial role in boosting the country's agricultural output, particularly in grain, dairy, and livestock production. (Agro Diary, 2024)

Figure 1. Economic Indicators of Agricultural Enterprises in Azerbaijan (2018-2023)

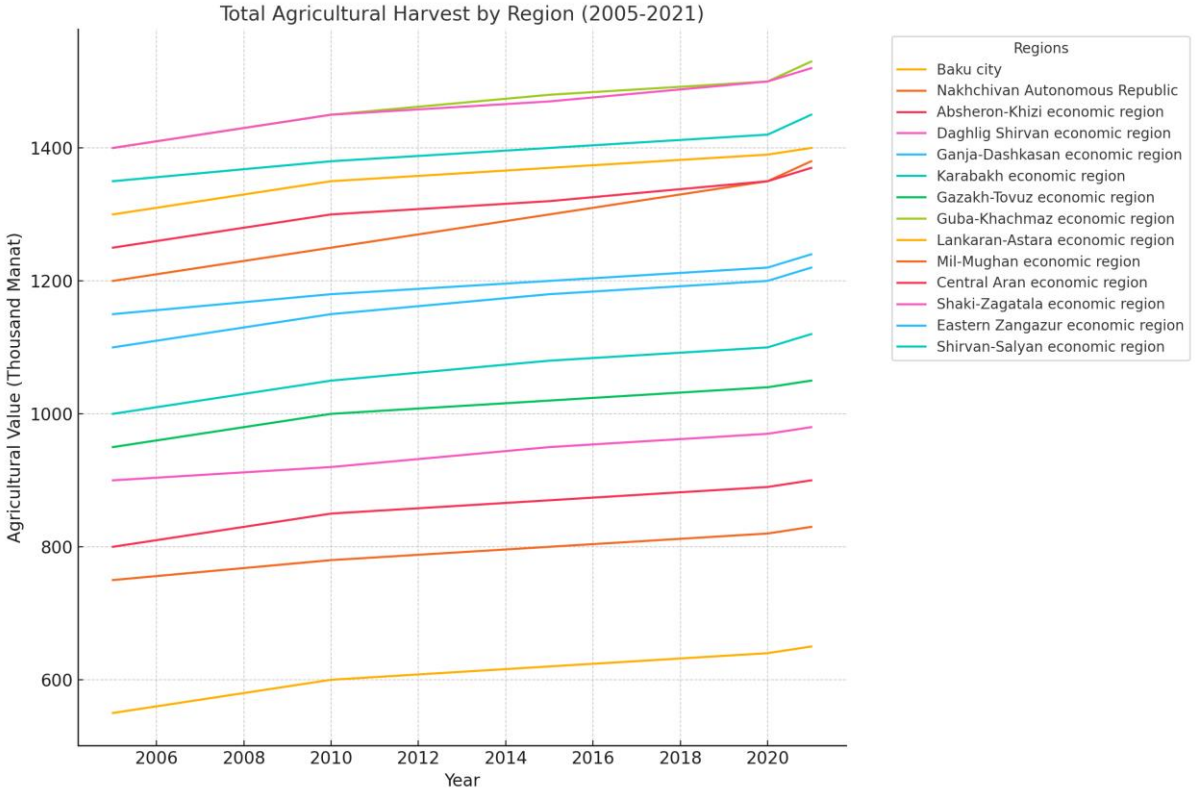


Source: State Statistical Committee of the Republic of Azerbaijan

The Figure 1 provides a comprehensive overview of key financial metrics related to the agricultural sector in Azerbaijan over six years. The indicators represented in the chart include profit (thsd. manat), loss (thsd. manat), total profit (thsd. manat), revenue from sales (thsd.

manat), profit (losses in crop production and animal breeding, thsd. manat), and total production of agriculture (by factual sale prices, thsd. manat). The most prominent upward trends can be observed in total production of agriculture and revenue from sales, which show continuous growth throughout the years. The total production of agriculture by factual sale prices rises steeply, almost doubling from 2018 to 2023. Similarly, revenue from sales follows a steady increase, reflecting a growing demand for agricultural products or improved market conditions. In contrast, the values for profit and loss remain much lower in comparison but display a subtle, consistent rise until 2022, after which they slightly dip in 2023. Despite fluctuations, profits in crop production and profits in animal breeding stay relatively stable, with no significant changes throughout the years, though a slight growth is visible towards the end of the period. This chart underscores the overall positive financial trajectory of the agricultural sector in Azerbaijan between 2018 and 2023, driven primarily by increased production and sales revenue, despite more moderate changes in profit and loss figures.

Figure 2. Total Agricultural Harvest by Region of Azerbaijan

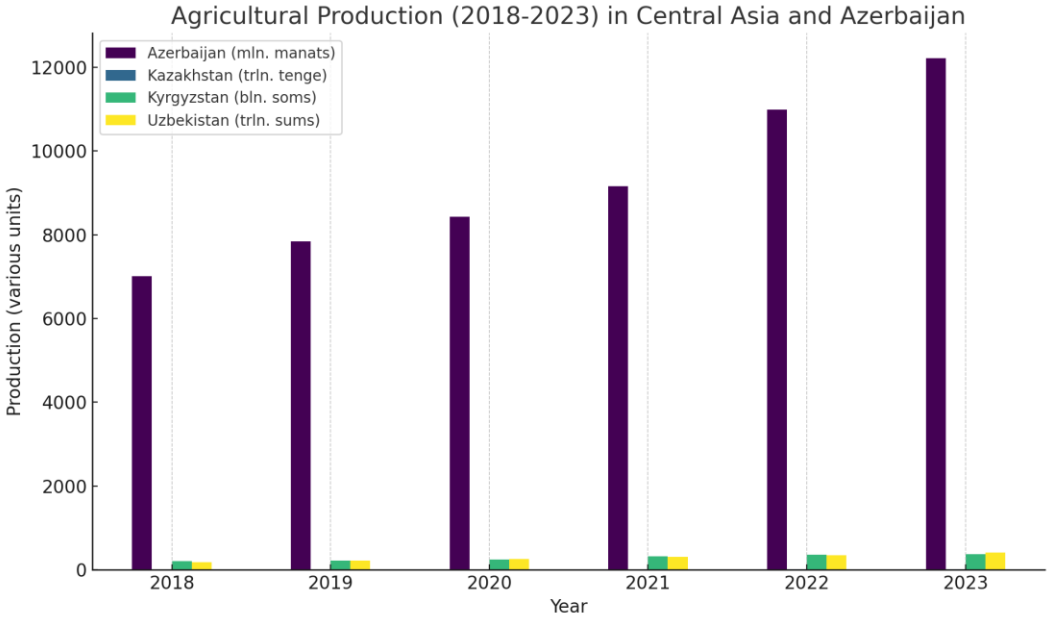


Source: State Statistical Committee of the Republic of Azerbaijan

Figure 2 illustrates the agricultural harvest performance in thousand manats across various economic regions of Azerbaijan from 2005 to 2021. Key regions, including Baku City, Nakhchivan Autonomous Republic, Absheron-Khizi, Daghlig Shirvan, Ganja-Dashkasan, Karabakh, Gazakh-Tovuz, Guba-Khachmaz, Lankaran-Astara, Mil-Mughan, Central Aran, Shaki-Zagatala, Eastern Zangazur, and Shirvan-Salyan, are represented, offering insights into agricultural productivity over time. During this period, some regions showed steady growth in agricultural output, reflecting regional development and investment in the agricultural sector.

For example, the Central Aran and Ganja-Dashkasan regions demonstrated notable increases, likely due to improved infrastructure and government policies promoting agricultural advancement. Lankaran-Astara, a traditionally fertile region, maintained relatively high productivity throughout the years, benefiting from its favorable climate for subtropical crops. Eastern Zangazur and Karabakh regions saw fluctuations due to historical conflicts, but the data post-2020 reflects a revitalization of agricultural activities following Azerbaijan's control over these territories. Regions like Baku City had relatively lower agricultural contributions due to urbanization.

Figure 3. Agricultural Production (2015-2023) in Central Asia and Azerbaijan



Source: State Statistical Committee of the Republic of Azerbaijan

Figure 3 represents the agricultural production from 2018 to 2023 in Central Asia countries (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan) and Azerbaijan, based on the economic indicators you provided. The chart visualizes the economic growth trends in these countries, reflecting their agricultural outputs.

The government of Azerbaijan has actively supported agricultural development through reforms and the establishment of agro parks—large-scale agricultural zones that integrate advanced technology with modern farming practices. Agro parks serve as hubs for innovation, allowing both domestic and foreign companies to invest in high-tech farming solutions. One of the most prominent agroparks is the Baku Agropark, located in the Zira settlement, known for its high-quality tomato production. The park covers more than 10 hectares and includes state-of-the-art greenhouses that employ 4th-generation technology to grow several hundred tons of tomatoes monthly. The facility's greenhouses are equipped with modern climate control systems, ensuring optimal growing conditions year-round. Baku Agropark also operates a quality control laboratory that ensures all crops meet stringent hygienic standards, making its produce fully ecological. Agroparks like the Baku Agropark and others in Khachmaz are

crucial for enhancing Azerbaijan's agricultural output. These parks not only contribute to local food production but also play a significant role in exporting agricultural products to CIS and European markets. (Agro Parks, 2024)

1.1. Revitalized Karabakh and agriculture sector

The revitalization of Karabakh following the Second Karabakh War in 2020 is a key priority for the Azerbaijani government, especially in terms of developing the agricultural sector. Before the conflict, Karabakh was known for its high agricultural productivity, contributing significantly to the country's grain, cotton, grape, meat, and silk production. Now, the Azerbaijani government is focusing on reclaiming and restoring these areas to their former agricultural prominence, while also aiming for export-oriented farming. The government has started leasing agricultural land in Karabakh to several companies, many of which have connections to top officials. According to an investigation by Abzas Media, in 2021, 8,376.5 hectares of land were leased to five companies, including Agroinkishaf-2017, Agro Fresh, Agro Dairy, Azersun, and Kraun Ko. Notably, these companies are either directly linked to or are close to high-ranking officials, with some being owned by individuals related to the President's family. Large agricultural enterprises such as Azersun and Agro Dairy have been given prime land for agro-business development in districts like Gubadli, Zangilan, and Fuzuli. Azersun, for example, received a 9,000 square meter plot for a project worth 40 million manats. These lands are being developed for agricultural production, especially in strategic sectors such as grain cultivation, vineyards, and livestock farming. (SACCI, 2024)

The Azerbaijani government has committed to prioritizing food security and is pushing forward with various agricultural initiatives in Karabakh. According to President Ilham Aliyev, a 2021 plan aimed to cultivate around 40,000 to 50,000 hectares of land to ensure national food security. The Ministry of Agriculture has been temporarily tasked with managing the leasing of agricultural lands and ensuring that the new projects are aligned with Azerbaijan's broader agricultural goals. The revitalization efforts extend beyond agriculture, with major investments being made into infrastructure like roads, airports, and "smart villages" in regions such as Zangilan. These efforts are also designed to support the eventual return of displaced Azerbaijanis to their homelands, a process that will go hand-in-hand with agricultural and economic recovery.

The establishment of agro-businesses in Karabakh also aligns with Azerbaijan's post-conflict development strategy, where large-scale reconstruction is underway, and foreign and domestic investments are encouraged. Agricultural initiatives are seen as a key driver in boosting the region's economy and creating jobs for future residents. (Republic of Azerbaijan, 2024, State Program, 2021) Local farmers, many of whom were displaced during the conflict, are eager to return to their land. With plans to revive grape production, wheat farming, and animal husbandry, these former residents represent the broader agricultural revival in the region. The Azerbaijani government's efforts to rebuild the agricultural sector in Karabakh are underpinned by the creation of the Karabakh Revival Fund, aimed at supporting socio-economic development, infrastructure reconstruction, and sustainable resettlement.

This holistic approach to redevelopment reflects a commitment to long-term agricultural productivity and economic stability in Karabakh, ensuring that the region plays a

vital role in the national economy once more. In conclusion, the revitalization of Karabakh's agriculture after the 2020 war is an ambitious but achievable goal. With government support, strategic investments, and local farmer involvement, Karabakh is set to reclaim its place as a key agricultural hub in Azerbaijan, contributing to national food security and export potential. Overall, the liberated territories will significantly boost Azerbaijan's agricultural capacity in the coming years. By President Aliyev's directives, work has already begun to develop agriculture in these areas. In collaboration with Azercosmos, the Ministry of Agriculture has used satellite imagery to map arable land in the region. In Azerbaijan, the agricultural sector saw a 2% increase in 2020, and to support farmers, over 7,260 pieces of agricultural equipment were distributed to more than 3,000 farmers, and 8,758 breeding animals were sold. Additionally, over 3,400 farmers received microloans that year. (Republic of Azerbaijan, 2024)

1.2. Educational and International Collaborations in Azerbaijan's Agricultural Sector

Azerbaijan is actively expanding its educational and international collaborations in the fields of food security, food engineering, and agricultural technologies to address the growing global challenges in agriculture and food production. By partnering with leading international institutions, the country aims to develop a new generation of experts equipped with the knowledge and skills required to advance its agricultural sector. These collaborations not only foster academic exchange but also promote research and innovation, helping Azerbaijan to enhance its agricultural productivity, ensure food security, and meet international standards.

1.2.1. ADA University and University of Bologna PhD Program in Food Engineering and Technology

One of the key educational partnerships is the PhD program in Food Engineering and Food Technology offered by ADA University in collaboration with the University of Bologna in Italy. This program is designed to cultivate expertise in sustainable food production, food engineering, and cutting-edge agricultural technologies. Through this partnership, students from Azerbaijan gain access to world-class research facilities and expertise from both institutions, allowing them to develop innovative solutions to pressing issues in the global food system. The collaboration between ADA University and the University of Bologna emphasizes research that promotes sustainable practices in agriculture, such as reducing waste in food production, improving energy efficiency in food processing, and ensuring the long-term viability of agricultural resources. For example, one of the research projects focuses on biotechnological innovations that could enhance the efficiency of food preservation techniques, significantly reducing food waste and increasing shelf life. Such research is critical for Azerbaijan, which is working towards reducing food imports and boosting domestic production. By engaging in joint research projects, students in this program gain a broader understanding of global trends in food engineering while being equipped to address local challenges in Azerbaijan. Graduates from this program are expected to take on leading roles in Azerbaijan's agricultural sector, contributing to food security and the modernization of food production systems. (ADA University, 2023; University of Bologna, 2024)

1.2.2. UNEC and Ege University Double Degree Program in Food Engineering

Another notable collaboration is the double degree program in Food Engineering between the Azerbaijan State University of Economics (UNEC) and Ege University in Turkey. This program prepares students for dynamic careers in modern agriculture and food production, focusing on the development of advanced food engineering techniques and the application of innovative technologies to meet industry demands. Students enrolled in the UNEC-Ege University program benefit from a curriculum that combines the strengths of both universities. Ege University, known for its cutting-edge research in agro-food technologies, provides students with exposure to innovative approaches in food production, processing, and safety standards. This experience is crucial for Azerbaijan, which is working to modernize its food industry by improving efficiency, increasing production quality, and meeting international export standards. An example of this collaboration's impact can be seen in the training students receive in food quality control and food safety regulations. By learning how to implement these standards, Azerbaijan's future food engineers will be better prepared to develop safe, sustainable, and high-quality food products for both domestic consumption and international markets. Graduates of this program are poised to play critical roles in Azerbaijan's food industry, helping to improve the country's competitiveness and ensure that its food products meet global standards. (UNEC, 2023)

1.2.3. Azerbaijan State Agrarian University and German Universities Partnerships

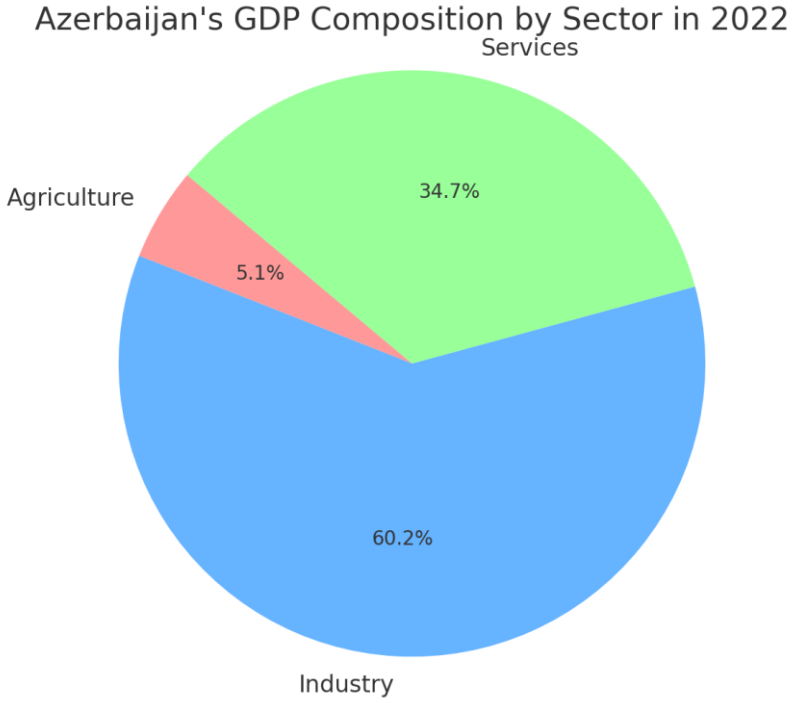
The Azerbaijan State Agrarian University (ASAU) has established a range of collaborations with several German universities, focusing on advancing agricultural education and introducing modern agricultural techniques in Azerbaijan. These partnerships emphasize the importance of agricultural sustainability, environmental conservation, and technological innovation in farming practices. Germany is renowned for its advancements in sustainable agricultural practices, and its universities offer Azerbaijani students valuable opportunities to learn and apply these techniques. Through joint programs, students at ASAU gain practical knowledge in areas such as precision agriculture, crop management, and livestock breeding technologies. This exposure enables them to implement the latest technologies in Azerbaijan's agricultural sector, improving productivity and sustainability. One of the success stories from this collaboration is a project focusing on organic farming and sustainable land use. In partnership with German universities, ASAU has introduced a pilot project in which students apply organic farming techniques on experimental plots. These techniques include using biological pest control instead of chemical pesticides, rotating crops to preserve soil health, and applying natural fertilizers. The results from this project are promising, showing an increase in crop yields and a reduction in the environmental impact of farming. (ADAU, 2022)

Challenges and recommendations

Oil is the main driver of the Azerbaijani economy. However, in recent decades, the country and its development partners have worked to reduce this dependence by enhancing other sectors to create a more diversified economy. Agriculture has been recognized as a key area with significant potential for poverty alleviation; in 2008, more than half of the country's poor lived in rural areas, with most engaged in agricultural activities. When the Agricultural

Competitiveness Improvement Project (ACIP) was evaluated in 2013 by the World Bank, agriculture employed 40% of the Azerbaijani workforce—more than any other sector—but only accounted for 5% of GDP. (World Bank, 2023) This disparity was attributed to several challenges, including a lack of improved seeds and productive livestock breeds, outdated processing technologies, a market structure that discouraged long-term investment and planning, and limited access to financing. (Trade Gov, 2023) Agricultural land is encountering significant issues, including the depletion of soil fertility, erosion, salinity, and pollution. Despite these challenges, the quality and yield of wheat produced in the country are still low. However, private farmers are starting to see improvements in yields due to their efforts. As seen from Chart 1, industry dominates the GDP with approximately 55.94%, followed by services at 32.2%, and agriculture contributing 4.76%.

Figure 4. Azerbaijan's GDP Composition by Sector in 2022.



Source: State Statistical Committee of the Republic of Azerbaijan

Urbanization and inadequate agricultural practices have led to significant soil degradation in Azerbaijan. Reports indicate that approximately 60% of arable land is affected by degradation, impacting both productivity and sustainability. A study by Abbasov (2019) indicates that soil degradation is linked to poor land management practices and urban expansion, resulting in diminished agricultural output. To combat these challenges, Azerbaijan should adopt sustainable land management practices that promote soil health. Encouraging practices such as crop rotation, organic farming, and agroforestry can enhance soil quality and increase agricultural productivity. The agricultural sector in Azerbaijan suffers from inadequate infrastructure, including poor transportation and storage facilities. According to World Bank (2020) reports, about 25% of agricultural products are lost due to inadequate

logistics and infrastructure, leading to substantial post-harvest losses. Farmers often find it challenging to access markets, which hampers their income potential. Significant investment in rural infrastructure is vital to address these issues. Improving rural roads and enhancing storage facilities will facilitate the efficient distribution of agricultural products. Furthermore, fostering public-private partnerships can leverage additional resources for infrastructure development, creating a more robust agricultural supply chain that connects producers with consumers effectively.

The Azerbaijani agricultural sector has historically focused on a limited number of crops, particularly cotton and grains. This narrow focus renders the sector vulnerable to price fluctuations and limits its capacity to meet the diverse dietary needs of the population. As highlighted in a FAO report (2023), the reliance on a few key crops, such as cotton, exposes farmers to economic risks, particularly during periods of declining global prices. Many smallholder farmers in Azerbaijan live in poverty, with limited access to financial resources, technology, and education. The National Statistical Committee reports that around 25% of the rural population lives below the poverty line, which severely affects their capacity to invest in agricultural improvements. The lack of access to credit and modern farming technologies contributes to low productivity levels among smallholders. (FAO, 2023)

Creating microfinance programs tailored for rural communities can alleviate some of these challenges. Additionally, strengthening agricultural extension services will provide farmers with the knowledge and resources needed to improve their practices. These services can offer training in modern farming techniques, business management, and financial literacy, empowering farmers to enhance their productivity and livelihoods. Farmers in Azerbaijan often struggle with accessing markets due to high transportation costs and insufficient market information. The COVID-19 pandemic in 2020 highlighted this vulnerability, causing significant price volatility for key agricultural products and negatively impacting farmers' incomes. The lack of reliable market access often leads to financial instability for producers. To improve market access, fostering the formation of cooperatives and farmer associations can be highly beneficial. These cooperatives enhance farmers' bargaining power, facilitate resource sharing, and provide access to larger markets, ultimately leading to better prices for their products. Additionally, developing market information systems that provide farmers with real-time data on market trends and prices will enable them to make informed decisions about production and sales.

CONCLUSIONS

Azerbaijan stands at a critical juncture where the integration of innovative agricultural practices with economic strategies offers immense potential for enhancing food security and economic development. Through initiatives like the "State Program for Ensuring Food Safety in the Republic of Azerbaijan" and the establishment of agroparks, the country is making strides toward modernizing its agricultural sector. Precision agriculture, sustainable farming, and biotechnology have emerged as key drivers in improving productivity, resource efficiency, and environmental sustainability. While Azerbaijan has seen success in areas such as irrigation improvements and the promotion of digital agriculture, challenges related to infrastructure, policy development, and smallholder participation remain.

To fully realize the potential of agro-economic synergies, continued investment in technological advancements, education, and international collaboration is essential. Additionally, policies that support market access, capacity building, and financial resources for farmers will further enhance food security and economic resilience. The revitalization of regions like Karabakh and the ongoing international partnerships in agricultural education demonstrate Azerbaijan's commitment to sustainable agricultural development. As the country continues to modernize, the balance between economic growth and environmental sustainability will be key to securing long-term food security and bolstering its position in the global agricultural market.

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