

THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN AZERBAIJAN

 Zhala Aliyeva^{1,2*}

¹Institute of Economics, Ministry of Science and Education, Baku, Azerbaijan

²Azerbaijan University, Baku, Azerbaijan

Abstract. This article examines the impact of climate change on agriculture in Azerbaijan, highlighting key risks and adaptation opportunities. Climate change, manifested through rising temperatures, altered precipitation patterns, decreasing water resources and increased frequency of extreme weather events, negatively affects agricultural productivity, causes crop losses and raises production costs. Droughts and other climatic events significantly impact rural livelihoods and food security. The study emphasizes the importance of climate-smart agricultural practices, including the development of drought-resistant crop varieties, efficient management of soil and water resources, the use of digital technologies and the implementation of financial mechanisms such as agricultural insurance. Social inequalities and the vulnerability of different rural population groups to climate events are also considered. The findings indicate that adaptation to climate change and the adoption of green economy principles are essential for achieving sustainable agricultural development and ensuring national food security.

Keywords: *Climate change, agriculture, sustainable development, agricultural insurance.*

Corresponding Author: Zhala Aliyeva, Institute of Economics, Ministry of Science and Education, Baku, Azerbaijan; Azerbaijan University, Baku, Azerbaijan, Tel.: +994506722490, e-mail: jale-2015@rambler.ru

Received: 16 September 2025;

Accepted: 25 November 2025;

Published: 14 January 2026.

1. Introduction

Climate change is one of the most significant ecological and economic challenges at the global level today. Rising temperatures, changes in precipitation patterns and an increase in the frequency of extreme weather events have serious impacts on natural resources and economic activities. These effects are particularly pronounced in agriculture, as this sector is directly dependent on climate and natural conditions.

Agriculture is one of the most climate-sensitive sectors and climate change poses risks to food security, rural incomes and the socio-economic development of regions. In Azerbaijan, agriculture is a key non-oil sector and a significant portion of the rural population derives its livelihood from it. Therefore, the impacts of climate change on agriculture carry considerable social and economic importance for the country.

Rising temperatures, irregular precipitation and decreasing water resources negatively affect both the productivity and quality of agricultural products. Extreme weather events, such as droughts, floods and heatwaves, lead to crop losses, increased production costs and reduced farmers' incomes. These risks directly affect the well-being of rural populations and the stability of food supply.

In this context, adapting agriculture to climate change is of critical importance. Efficient use of land and water resources, the implementation of climate-resilient agricultural practices and the adoption of innovative technologies are key strategies in

this regard. In addition, financial mechanisms, such as agricultural insurance, play an increasingly important role in mitigating climate-related risks.

The purpose of this article is to analyze the impacts of climate change on agriculture in Azerbaijan, identify the main risks and assess adaptation opportunities based on the principles of a green economy.

This study contributes to the existing literature by providing a country-specific analysis of the impacts of climate change on agriculture in Azerbaijan. It links climate risks not only to agricultural productivity but also to rural employment, livelihoods and food security, with particular attention to vulnerable social groups. In addition, the study systematically assesses the role of agricultural insurance as a climate adaptation instrument within the framework of a green economy. By aligning national adaptation priorities with international climate frameworks, the research offers policy-relevant insights for climate-resilient agricultural development.

2. Methodology and data sources

This study employs an analytical research methodology to examine the impacts of climate change on agriculture in the Republic of Azerbaijan and to assess adaptation mechanisms within the framework of sustainable development and green economy principles.

The analysis is based exclusively on data obtained from reliable national and international sources. The main data sources include: official statistical data from the State Statistical Committee of the Republic of Azerbaijan (SSCRA); assessment reports of the Intergovernmental Panel on Climate Change (IPCC) (2023) on climate change impacts and vulnerability projections; policy documents, analytical reports and outlook publications of international organizations such as FAO and OECD, as well as national strategic documents including the Initial National Adaptation Plan of Azerbaijan (https://unfccc.int/sites/default/files/resource/2024_NAP_Azerbaijan.pdf) and sector-specific data and reports from the Ministry of Agriculture of the Republic of Azerbaijan, particularly materials related to the impacts of drought, crop losses and the development of agricultural insurance mechanisms.

The use of these sources ensures the reliability of the data and consistency with internationally recognized methodologies and climate assessment frameworks.

3. Empirical climate trends and agricultural productivity in Azerbaijan

Between 2005 and 2024, Azerbaijan experienced significant fluctuations in precipitation and temperature, indicating growing climatic variability.

Years such as 2016 and 2024 experienced above-average rainfall (570.7 mm and 533.1 mm, respectively), while 2017, 2019, 2021 and 2022 recorded notably lower precipitation (371-393.6 mm) (Figure 1).

Average annual temperatures ranged from 13.0°C in 2016 to 16.2°C in 2021, with maximum monthly temperatures exceeding 28°C in 2018, while minimum monthly temperatures fluctuated between 1.4°C and 4.2°C (Table 1).

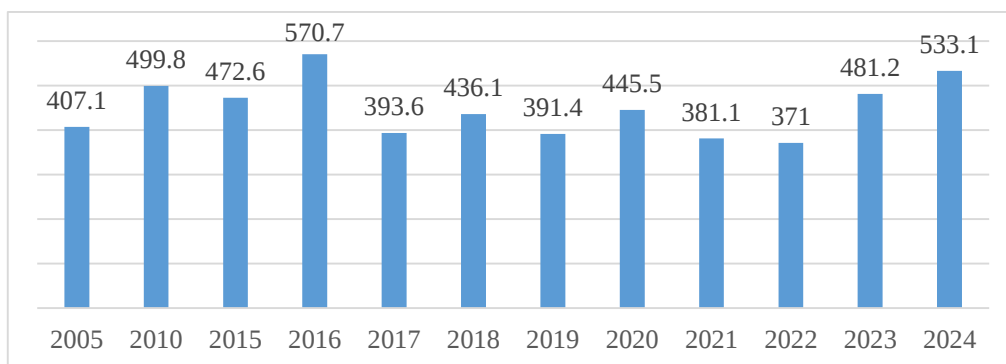
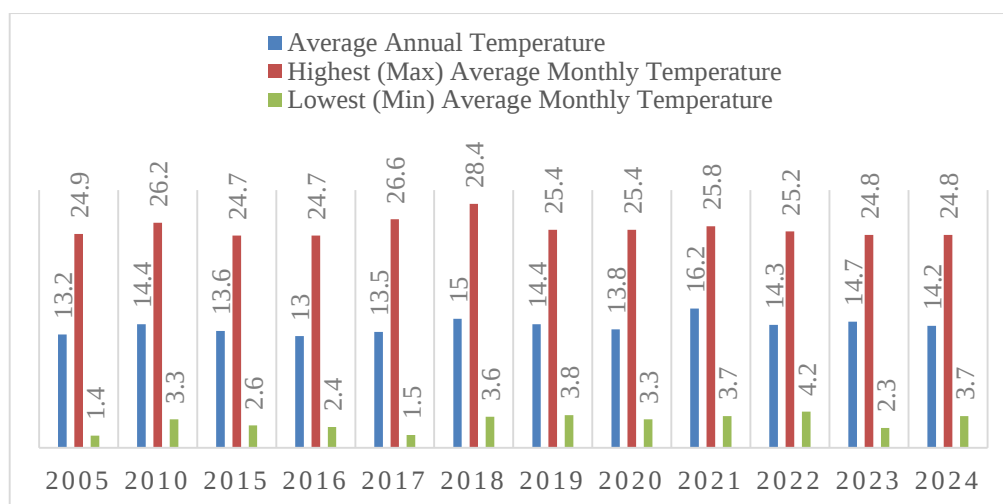


Figure 1. Average annual precipitation in Azerbaijan (mm)

Source: https://www.stat.gov.az/menu/6/statistical_yearbooks/source/environment_2025.zip

Table 1. Air temperature in Azerbaijan (°C)



Source: https://www.stat.gov.az/menu/6/statistical_yearbooks/source/environment_2025.zip

These variations have direct implications for agricultural productivity: Low precipitation combined with high temperatures (e.g., 2021-2022) contributed to drought events and reduced wheat yields. High rainfall years (e.g., 2016, 2024) generally supported better crop growth, although excessive precipitation may disrupt planting schedules. Temperature extremes may stress crops during growth or early sowing stages, highlighting the sensitivity of Azerbaijan's agriculture to climatic variability.

4. Risks of climate change for agriculture and rural areas

Climate change directly and indirectly affects many sectors of the economy, however, agriculture is considered one of the most vulnerable sectors to this process. This vulnerability stems from the fact that agricultural production is directly dependent on climate and natural conditions. In Azerbaijan, agriculture is one of the key non-oil sectors, playing a significant role both economically and socially. *“Although the share of agriculture in the country's Gross Domestic Product (GDP) is 5.7%, this sector holds a*

significant position in terms of employment” (State Statistical Committee of the Republic of Azerbaijan, 2025).

Analysis of statistical data shows that although the proportion of the employed population in agriculture, forestry and fisheries gradually declined between 2010 and 2024, this sector has consistently maintained a higher employment share compared to other economic activities (Figure 2).

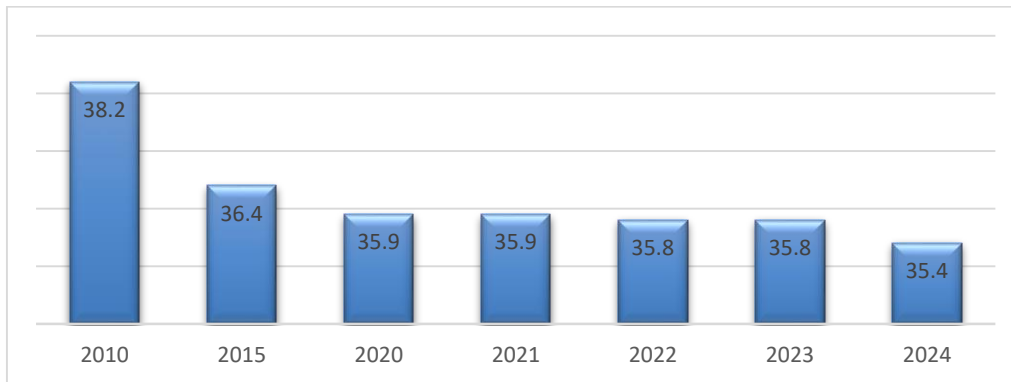


Figure 2. Share of employed population in agriculture, forestry and fisheries in Azerbaijan, %

Source: https://www.stat.gov.az/menu/6/statistical_yearbooks/source/emek_bazari_2025.pdf

Thus, while the share of the employed population in these sectors was 38.2% in 2010, it decreased to 35.4% by 2024. Although this decline can be explained by structural changes, agriculture remains the primary source of income in rural areas, which amplifies the social impacts of the risks posed by climate change.

As a result of climate change, rising temperatures, altered precipitation patterns and increased atmospheric carbon dioxide levels negatively affect the growth and productivity of agricultural crops. The increasing frequency of extreme weather events leads to damage to crops and livestock, water shortages, irrigation challenges and the spread of pests and diseases. These processes result in reductions in both the quantity and quality of agricultural output, causing production losses. Consequently, farmers' incomes decrease, production costs rise and consumers face increased risks of price volatility.

International evidence also shows that the impacts of climate change on agriculture are not limited to production levels alone. The U.S. National Climate Assessment states that *“climate change not only reduces agricultural productivity but also threatens livelihoods, food security and price stability in rural areas”* (Reidmiller et al., 2018). Another source emphasizes that *“climate change has significant effects on agricultural productivity and the availability of water resources”* (IPCC, 2023). These findings highlight the complex nature of climate risks and their broad impacts on socio-economic systems.

Climate change is making agriculture an increasingly unstable and risky sector. Farmers are compelled to make production decisions under growing uncertainty. Research conducted at both global and local levels indicates that climate change will exert further pressure on water and land resources in the future, which may intensify the long-term negative effects on agricultural production capacity.

According to the World Bank, approximately *“44% of the world's population currently lives in rural areas”* (United Nations, 2012). In Azerbaijan, this figure is higher, with *“45.5% of the population residing in rural areas”* (State Statistical Committee of the Republic of Azerbaijan, 2025). Since a substantial portion of rural incomes is derived

from agriculture, the risks associated with climate change are of particular significance for the country.

The 2024 report by the Food and Agriculture Organization (FAO), *Unfair Climate: Measuring the Impacts of Climate Change on Rural Poor, Women and Youth*, highlights that the effects of climate change on income and adaptation opportunities in rural areas vary across social groups. According to the report, “*rural women, people living in poverty and the elderly are more vulnerable to climate risks due to limited capacity to adapt to extreme weather events*” (FAO, 2024). This underscores the potential for social inequality in rural areas to deepen.

In summary, climate change poses multifaceted economic and social risks for agriculture and rural areas in Azerbaijan. Improving the welfare of agricultural populations and mitigating these risks are essential to achieving sustainable and resilient agriculture. In this context, the implementation of climate-adaptive strategies and approaches based on green economy principles is of particular importance (Aliyeva, 2024).

5. Drought risk in agriculture

Climate change and global warming increase both the frequency and intensity of drought events, one of the most serious risks for agriculture. “*Rising temperatures disrupt the soil moisture balance, which reduces crop yields and contributes to soil erosion and degradation processes*” (IPCC, 2023). Climate projections for Azerbaijan indicate that in recent years, many regions of the country have been highly vulnerable to drought and this vulnerability is expected to intensify in the future.

The rising temperatures caused by climate change lead to excessive soil heating, resulting in decreased moisture and increased aridity. The effects of global warming are further exacerbated by growing water demand and population increase. Azerbaijan is among the countries with a high risk of drought. According to official data, “*in 2022, drought caused damage to approximately 100,000 hectares of wheat fields in Azerbaijan, which represents about 10% of the country’s wheat-growing land. As a result, the self-sufficiency level of wheat dropped from 62% to 57% that year, increasing the need for wheat imports. The cost of wheat imports in 2022 rose by up to 100 million USD, reaching a total of 437 million USD*” (<https://agro.gov.az/az/>).

It should be noted that “*the negative impacts of drought affect not only agricultural producers but also food security, rural incomes and the socio-economic resilience of the country*” (OECD & FAO, 2024). This underscores the necessity of climate adaptation in agriculture.

Adapting agriculture to climate change requires innovative approaches. These include improved soil management, water-saving technologies, the adaptation of crops to local conditions, the introduction of diverse crop varieties, crop rotation, proper use of fertilizers and the support of community-based adaptation strategies.

6. Climate adaptation in agriculture

Climate change presents new challenges for the agricultural sector. There are several key measures to adapt agriculture to climate change. First, the development of crop varieties that are resistant to drought and temperature fluctuations is essential. This ensures the preservation of productivity during drought periods and positively impacts

the agricultural income chain. Alongside the cultivation of new varieties, sustainable soil management technologies that protect and enhance soil fertility are applied. Additionally, reducing the use of chemical inputs and minimizing harmful gas emissions helps ensure the sustainability of both soil and the broader environment.

Second, technologies for the sustainable use of water and soil resources play a crucial role in agricultural adaptation to climate change. Drip irrigation, water collection and storage systems, modernization of hydraulic infrastructure and efficient management of local water resources are key strategies in this regard. These approaches aim not only to maintain productivity but also to secure rural livelihoods and ensure food security.

Third, the application of digital technologies and smart agriculture systems helps minimize the impacts of climate change. *“The collection, monitoring and analysis of climate data are essential tools in adaptation measures against climate change. Satellite observations and climate forecasts enable increased agricultural productivity, efficient use of water and soil resources and optimization of farming operations”* (https://unfccc.int/sites/default/files/resource/2024_NAP_Azerbaijan.pdf).

Fourth, the implementation of agricultural insurance and other financial mechanisms is vital in reducing climate-related risks. Financial protection for farmers against drought, floods, frost and other extreme events not only facilitates risk management but also encourages investment and the adoption of innovative technologies.

7. Agricultural insurance and climate adaptation in agriculture

Agricultural insurance serves as an effective and efficient financial mechanism to minimize the impacts of natural disasters. Developing an insurance system in agriculture enables farmers and agricultural enterprises to be protected against unforeseen climate events, including droughts, floods and other extreme weather conditions. Widespread adoption of agricultural insurance also facilitates access to financial resources, stimulates investment in the agricultural sector, enhances production efficiency, ensures food security and expands export opportunities for agricultural products.

In recent years, the coverage of agricultural insurance in Azerbaijan has significantly expanded. The Agricultural Insurance Fund was established in 2019. The agricultural insurance system, based on public-private partnership, was established under the “Law on Agricultural Insurance”, which came into effect on January 1, 2020 and operates on a voluntary basis. In 2020, the “Rules on Agricultural Insurance” were approved. The number of farmers and agricultural enterprises benefiting from the insurance mechanism, as well as the insured areas and insurance payments, have increased. According to the Agricultural Insurance Fund, *“in 2023, the total insured area reached 380,476 hectares, representing a 43% increase compared to 2022. Insurance premiums collected for crop production amounted to 13 million AZN, an increase of 4.2 million AZN compared to 2022”* (<https://www.agro.gov.az/az/news/030420241>).

Despite these developments, the full potential of the insurance mechanism has not yet been realized. Although the state budget supports insurance payments for certain wheat cultivation areas, a significant portion of agricultural lands in the country remains uninsured. Expanding insurance coverage, particularly for wheat producers and family farms, is critical for ensuring economic resilience.

The role of agricultural insurance in reducing the impacts of climate change on agriculture and promoting sustainable development in the sector is increasing. In parallel, raising awareness among farmers about climate change and its expected effects is of

significant importance. Including drought events in insurance coverage, promoting the efficient use of water resources and implementing climate-smart agricultural technologies can strengthen adaptation measures. Although the government covers part of the insurance premiums, interest in agricultural insurance among farmers remains low. Expanding insurance coverage is therefore highly desirable.

8. Conclusion

Climate change poses significant economic, social and environmental risks to agriculture in Azerbaijan. Rising temperatures, irregular precipitation patterns and increasing frequency of extreme weather events, such as droughts and floods, reduce crop productivity, increase production costs and threaten rural livelihoods and national food security. Vulnerable groups, including rural women, the elderly and low-income households, are disproportionately affected, highlighting the social dimension of climate risks.

To mitigate these impacts, climate-smart agricultural practices are essential. These include developing drought-resistant crop varieties, sustainable soil and water management, adoption of digital and precision farming technologies and strengthening financial risk management tools such as agricultural insurance. Expanding the coverage of agricultural insurance, promoting efficient water use and raising awareness among farmers about climate risks are particularly critical.

Overall, integrating adaptation strategies with green economy principles will enhance the resilience of Azerbaijan's agricultural sector, secure rural incomes and ensure sustainable food production in the face of ongoing and future climate challenges.

References

- Aliyeva, Zh. (2024). *Living Standards of Rural Population: Towards Inclusive Development*. Baku, 228. <https://doi.org/10.62476/Zh.2025.268> (In Azerbaijan).
<https://agro.gov.az/az/>
https://unfccc.int/sites/default/files/resource/2024_NAP_Azerbaijan.pdf
<https://www.agro.gov.az/az/news/030420241>
- IPCC (2023). *Climate Change 2023: Impacts, Adaptation and Vulnerability*. Contribution of working group ii to the sixth assessment report of the intergovernmental panel on climate change. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>
- OECD, FAO. (2024). *OECD-FAO Agricultural Outlook 2024-2033*. https://www.oecd.org/en/publications/2024/07/oecd-fao-agricultural-outlook-2024-2033_e173f332.html
- Reidmiller, D.R., Avery, C.W., Easterling, D.R., Kunkel, K.E., Lewis, K.L.M., Maycock, T.K. & Stewart, B.C. (2018). *Impacts, risks and adaptation in the United States: Fourth National Climate Assessment*, 2. U.S. Global Change Research Program. <https://nca2018.globalchange.gov/>
- Sitko, N., Cavatassi, R., Staffieri, I., Heesemann, E., Rossi, J.M., Becerra Valbuena, L., ... & Azzarri, C. (2024). *The Unjust Climate - Measuring the Impacts of Climate Change on Rural Poor, Women and Youth: Annexes*. Rome, 106. <https://doi.org/10.4060/cd1281en>
- State Statistical Committee of the Republic of Azerbaijan (2025). *National Accounts of Azerbaijan*, 135. https://www.stat.gov.az/menu/6/statistical_yearbooks/source/system_nat_accounts_2025.pdf

- State Statistical Committee of the Republic of Azerbaijan (2025). Demographic indicators of Azerbaijan. <https://www.stat.gov.az/>
- United Nations (2012). *World Urbanization Prospects: The 2011 Revision*. New York, 318. https://population.un.org/wup/Publications/Files/WUP2011_Highlights.pdf