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Methods Of Assessment Of The Impact Of Climate Change On Food Security In Uzbekistan

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Abstract. Climate change is an important factor affecting food security and innovative solutions and effective public policy are needed to mitigate its consequences. A comprehensive approach is needed to assess the impact of climate change on food security in Uzbekistan. An important role in this is played by the analysis of agricultural productivity, food security indicators, food prices, water resources and government policy. Using economic analysis, it is possible to determine the risks caused by climate change and measures to reduce them. One of the important tasks in Uzbekistan is the introduction of climate-adapted agricultural technologies and the efficient use of resources.

Keywords: public policy, climate change, impact of climate change, food security, food security indicators, assessment of the state of food security, agricultural yield, labor productivity.

INTRODUCTION

Today, the increasing impact of humans and wildlife on the environment and natural resources, unsustainable agricultural practices, excessive consumption, the growing disparity in food balance between developed and developing countries, global warming, water scarcity, loss of biodiversity, and declining soil fertility leading to degradation are causing a range of negative consequences. As stated by the President of the Republic of Uzbekistan, Shavkat Mirziyoyev, in his speech at the United Nations Climate Change Conference (COP28):

“Climate issues have become the main threat to sustainable development. These risks are even affecting the geopolitical architecture of the world. The negative consequences of climate change are especially acute in Central Asia due to the Aral Sea tragedy” [1].

Drastic climate changes pose serious risks such as reduced water resources, increased natural disasters, and decreased agricultural productivity, thereby hindering sustainable development in our region. These consequences primarily affect vulnerable population groups.

Climate change has a significant impact on food security, which necessitates a reassessment of systems for food production, distribution, and consumption.

LITERATURE REVIEW

Various studies have analyzed the problems arising from climate change and the mechanisms for addressing them. Climate change is one of the main factors influencing agricultural production, affecting water resources, soil fertility, and the spread of plant diseases [2]. These changes can reduce food production volumes and increase food prices [3]. Research by G. Nelson, H. Valin, R. Sands, P. Havlík, H. Ahammad, and D. Deryng has shown that climate change decreases agricultural productivity and reduces the production of key food products [4].

In the context of Uzbekistan, A. Mirzabayev has examined how climate change affects agricultural production processes [5]; efficient use of water resources has been studied by I. Bobojonov, E. Berg, J. Franz-Vazdeki, S. Martius, and J. Lamers [6]; and the formation of effective institutions has been addressed in the works of I. Ochilov [7, 8]. In Uzbekistan, ensuring food security under climate change conditions requires the rational use of water-saving technologies and energy sources in greenhouses.

Different countries are employing various strategies to reduce the impact of climate change and ensure food security, such as the efficient use of water resources, the application of climate-resilient technologies in agriculture, and reducing greenhouse gas emissions. Many countries are implementing programs aimed at ensuring food security in the context of climate change. Organizations such as the European Union [9] and the USA [10] have developed roadmaps for adapting to climate change and ensuring food security.

In Uzbekistan, long-term strategies are being adopted and implemented to ensure environmental safety, make rational use of natural resources, and introduce new, environmentally friendly technologies in various sectors of the economy. These include the Strategy for Transition to a Green Economy (2019–2030), the Environmental Protection Concept (until 2030), the Water Resources Development Concept (2020–2030), and the Strategy for Managing Solid Waste (2019–2028) [11]. Presidential Decree No. PF-36, dated February 16, 2024, “On Additional Measures to Ensure Food Security in the Republic,” set a goal to increase the production of high value-added food products by 1.5 times and to

double export indicators over the next five years, in response to climate change and to ensure food security and healthy nutrition [12].

RESEARCH METHODOLOGY

The research employed theoretical methods such as induction, deduction, generalization, and comparison. Relevant materials were gathered through typological analysis, and statistical data were verified through synthesis.

To assess the impact of climate change on food security in Uzbekistan, several key methods can be used. This assessment should consider economic, environmental, and social factors. The following approaches support effective evaluation:

1. **Analysis of Productivity and Agricultural Production:**

Yield dynamics: analyzing the yield performance of major crops over recent years;

Climate-related risks: evaluating issues arising from drought, temperature increases, water shortages, and the spread of plant diseases.

2. **Food Security Indicators:**

Utilizing the FAO Food Security Index to assess access to food, price stability, and consumption indicators;

Studying food price trends in Uzbekistan due to climate change.

3. **Water Resource Analysis:**

Forecasting flows of the Amu Darya and Syr Darya rivers to evaluate how water scarcity affects food security;

Evaluating the effectiveness of drip irrigation and resource-saving technologies under climate change conditions.

4. **Economic Modeling and Scenario Analysis:**

Calculating the impact of climate change on the economy and food security;

Assessing effects on product cost and market prices;

Estimating production costs in conditions of rising temperatures and droughts.

5. **Social and Political Approaches:**

Using surveys and interviews to understand how climate change affects food security for farmers and consumers;

Analyzing government policies and legislation aimed at ensuring food security.

RESULTS

It is known that one-third of Uzbekistan’s population lives in areas prone to natural hydrometeorological disasters, such as droughts, mudflows, floods,

avalanches, frosts, and dust storms. Naturally, in these regions, an increase in precipitation or abnormal temperature fluctuations—whether extreme cold or heat—can aggravate the situation.

Uzbekistan is among the countries at high risk from climate change. Since 1880, the average annual temperature in the country has risen by 1.6°C (from 13.2°C to 14.8°C). *"In our region, the increase in air temperature is twice the global average. The number of extremely hot days has doubled, and one-third of the glacial area has disappeared. Soil erosion processes are negatively impacting the livelihoods of 30 million people. Intense dust and sandstorms have become commonplace. Problems such as water scarcity, air pollution, biodiversity loss, and declining agricultural productivity are worsening. These global risks are reaching a critical level in our wider region"* [13].

It is projected that between 2030 and 2050, the air temperature in Central Asia may rise by another 1.5–3°C. The most significant temperature increases are expected in the Aral Sea region, where the drying of the sea has caused unique local climatic changes. The consequences of climate change will impact the well-being of the Uzbek population in various ways. By 2030, at least 8 million people are expected to live in areas of very high climate risk across urban and rural regions. Without adaptation measures, by 2050, the size of the national economy may be 10% lower than what it would have been without climate change, significantly reducing employment and household incomes.

Globally, increasing water scarcity by 2060 and plans to decarbonize the economy will require special attention to Uzbekistan's energy sector, which accounts for nearly 75% of greenhouse gas emissions.

Reducing dependence on depleting natural gas reserves by improving energy efficiency and expanding the use of renewable energy sources will help strengthen the country's energy security. Dependency on fossil fuels also contributes to air pollution, one of the top ten factors associated with premature death and disease in the country. Without appropriate responses to climate change, Uzbekistan will not achieve its development goals and may face severe negative consequences for its economy and population welfare.

Implementing urgent adaptation and decarbonization measures will accelerate Uzbekistan's transition to a "green" economy and support long-term economic growth.

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On April 19, 2017, Uzbekistan officially signed the Paris Agreement, and in November 2018, by ratifying it, committed to helping keep the global average temperature rise well below 2°C above pre-industrial levels.

Uzbekistan's Nationally Determined Contribution (NDC) outlines a goal to reduce greenhouse gas emissions per unit of GDP by 35% compared to 2010 levels by 2030. It also defines measures to reduce the negative impacts of climate change and increase adaptive capacity.

Long-term strategies are being adopted and implemented in Uzbekistan to ensure environmental safety, use natural resources wisely, and introduce new, eco-friendly technologies in various sectors of the economy. These include the Environmental Protection Concept of Uzbekistan until 2030, the Water Management Development Concept for 2020–2030, the Green Economy Transition Strategy for 2019–2030, and the Strategy for Solid Waste Management for 2019–2028.

Currently, 3 million hectares of pastures and arable lands in the country are degraded, and nearly 2 million hectares are affected by salinization to varying degrees. In 2022, water flow in the Amu Darya and Syr Darya basins decreased by 10–15%, leading to a 7–10% reduction in irrigated land. Foreign experts predict that climate change may reduce the region's water resources by around 6% by 2030.

Greenhouses play a key role in maintaining continuous agricultural production. In recent years, their total area has increased by 2.6 times, and production volume by more than three times. This sector provides permanent employment for 80,000 people and seasonal work for another 70,000.

To protect the interests of the most vulnerable population groups affected by climate risks, Uzbekistan must continue to develop a national social protection system. Enhancing basic and technical skills through education and retraining will help prepare citizens for new job opportunities in the green economy. Large-scale investments are required to implement measures for both decarbonization and climate adaptation.

To mitigate the impacts of climate change on labor productivity, roads and bridges, livestock farming, and the irrigation sector in Uzbekistan, an estimated $60 billion will be needed. Additionally, about $340 billion will be required by 2060 to replace outdated energy infrastructure and decarbonize the energy sector—most of which could be funded by the private sector.

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A comprehensive approach is essential to assess the impact of climate change on food security in Uzbekistan. This involves analyzing agricultural productivity, food prices, water resources, and government policies. Using computer models and economic analysis, it is possible to identify climate-related risks and outline effective mitigation strategies.

To analyze food security indicators, it is necessary to use international standards, as well as economic and social indicators. This analysis helps assess the factors affecting food security under climate change conditions. The following are the main approaches:

1. Identifying Food Security Indicators International organizations such as FAO, WFP, and IFPRI propose the following indicators for assessing food security:

1. Food Availability
Volume of food production
Food imports and exports
Area of irrigated and non-irrigated land
2. Economic, social and Physical Access to Food
Income levels of the population
Food prices and inflation
Food access for rural and urban populations
3. Food Utilization
Daily calorie consumption
Nutritional balance
Nutritional status of children and adults
4. Food Stability
Volatility of food prices
Risks affecting food security due to climate change
Government policies and food reserves
2. Assessing the State of Food Security
● Food security trends in UzbekistanVolume of food production
Dynamics of import and export
● Food inflation and price changes
Impact of drought and climate change
Water supply in irrigation systems
Impact of heat stress on productivity

3. Methods of Assessing Food Security

● Using indices from FAO and WFP

Global Food Security Index (GFSI): Uzbekistan's position and trends in the index

Hunger Index: Indicators of food shortage

Undernourishment Rate: Level of undernourishment

Assessing the link between food security and climate change

4.Strategies for Ensuring Food Security

●Introduction of water-saving technologies

●Use of climate-resilient crop varieties in agriculture

●Improvement of government policies to stabilize food inflation

● Creation of food reserves and maintaining the balance of import-export

CONCLUSION

Climate change is a significant factor negatively affecting food security, and innovative solutions and government policies are crucial to mitigate its consequences. In the context of Uzbekistan, introducing climate-resilient agricultural technologies and ensuring the efficient use of resources are among the key priorities.

The main adaptation measures to climate change include:

1. In agriculture and land management:

Strengthening mechanisms that guarantee the rights of land tenants, including local farmers, to attract investment in climate-resilient agriculture;

Improving soil conservation practices;

Expanding the scale of climate-smart agriculture;

Developing a specific "roadmap" backed by an investment plan to implement the above measures.

Reforms at the national economic level:

Accelerating current reform programs aimed at creating favorable conditions for doing business and investing, as well as developing the private sector, which plays a key role in transitioning to a green economy.

It is recommended to establish mechanisms for monitoring, reporting, and impact assessment to support the implementation of climate and green projects.

2. **In financial and investment regulation:**

Developing regulatory frameworks to attract investment in environmental projects and manage climate risks is essential.

It is also recommended to introduce market-based incentives, including carbon taxation, to reduce atmospheric emissions.

3. **In water resources and irrigation system management:**

Implementing measures to widely introduce water-saving technologies in Uzbekistan to improve water management under climate change conditions;

Promoting agricultural policies that encourage adaptation to climate change and mitigation of its consequences (e.g., efficient use of water resources);

Transferring irrigation system management to the private sector;

Introducing adaptive water distribution mechanisms;

Continuing the modernization of irrigation and drainage infrastructure as well as water accounting systems.

Water scarcity is largely due to inefficient water use in agriculture and industry, as well as the poor condition of water infrastructure and insufficient funds allocated for its maintenance and development. This limits the potential to expand agricultural land. Addressing food security is closely linked to the application of moisture-saving technologies.

To reduce the impact of climate change on food security in Uzbekistan, large-scale private investments in green technologies are required. Directing public and private investments into adaptation and decarbonization efforts will bring substantial benefits and high returns to the country.

A comprehensive approach is needed to assess the impact of climate change on food security in Uzbekistan. This should include the analysis of agricultural productivity, food prices, water resources, and government policies. Using computer models and economic analysis, it is possible to identify climate-related risks and appropriate mitigation measures.

To analyze food security indicators, it is necessary to use international standards, statistical data, and modeling. Factors influencing food security due to climate change—such as productivity, price increases, water scarcity, and access to food—must be analyzed separately.

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