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## Impact of Global Climate Change on Agricultural Development

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**Abstract:** The process of globalization significantly influences not only the system of international relations and socio-economic development but also has profound effects on the environment and natural geographic processes. This is most evident against the backdrop of global climate change. The most significant manifestations of global climate change are first felt in agriculture. Research indicates that global climate change, primarily in the context of global warming, results in the destruction of green spaces, water resource shortages, and other harmful phenomena, adversely affecting agricultural development. The harmful effects of global climate change on agriculture primarily lead to a decline in soil fertility and negatively impact the growth of crops due to warmer air masses. It is important to note that climate change, when considered independently, creates numerous problems for the development of agriculture not only in individual countries but globally. Global warming primarily causes a reduction in precipitation, leading to longer drought periods, which negatively affects agricultural productivity. Consequently, this results in a decrease in agricultural production. Therefore, mitigating the harmful effects of global climate change can play a significant role in fostering positive developments in agriculture. Investment is necessary to neutralize the impacts of global climate change on agriculture. Additionally, developing new crop strategies and implementing innovative technologies for cultivating specific plants are crucial. Notably, Azerbaijan has substantial potential for agricultural production due to its favorable natural climate conditions and diverse soil types. Azerbaijan's eleven climate zones provide suitable conditions for the production of various crops. Historically, including during the Soviet era, Azerbaijan's comparative advantages in agriculture were utilized to meet the food needs of the former Soviet Union's central regions. The production of early vegetables played a significant role in satisfying the food demands of these regions. Global climate change does not only result in global warming but also increases precipitation in certain areas, which can negatively impact the quality of agricultural products. Changes in climate conditions also affect the quality of agricultural products. Rising temperatures can significantly reduce the nutritional value of agricultural products and, in some cases, adversely affect their taste and quality. Climate change leads to the degradation of land and agricultural areas, reducing soil fertility and the efficiency of agricultural production. This paper presents scientifically grounded and practically significant proposals for mitigating the harmful effects of global climate change on agriculture.

**Keywords:** Globalization; global climate change; agriculture; global warming; water resources; land degradation

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## **Introduction**

As is well known, agriculture is a crucial and strategic sector of the economy, essential for ensuring food security, meeting the population's demand for food products, and providing the industry with agricultural raw materials. Unlike other sectors of the economy, agriculture has unique specific characteristics, particularly its sensitivity to climate change. In other words, agriculture is highly dependent on climatic conditions. Any changes in climate significantly affect agriculture, which in turn impacts the social life of society. A decline in agricultural production, a decrease in productivity, and other factors adversely affect the food market, particularly impacting the social conditions of the low-income population.

## **Globalization and Global Climate Change**

As is well known, globalization involves the free movement of goods, capital, technology, and labor. The deepening of globalization is evident in the development of trade and the increase in industrial and agricultural production. Modernization and intensification measures lead to mass production, which, in turn, requires more energy and economic resources. This results in more efficient use of the workforce but also leads to increased harmful emissions into the environment. The negative impacts on the environment have been occurring not only since the late 20th century but long before that. These processes began with the primitive stages of globalization. The manifestations of global climate change were not as severe during the early periods of natural farming. As production processes evolved, negative environmental impacts increased, linked to the types of social labor division. After the development of animal husbandry and agriculture, the process of human impact on the biosphere intensified, resulting in soil and water degradation. Significant environmental deterioration began approximately 200 years ago, closely associated with industrial development.

Since the late 20th century, the wave of globalization in the international relations system has led to a further acceleration of market economy development and intensified global competition. This, in fact, stems from the desire of transnational corporations to gain more profit. Naturally, the pursuit of profit has been accompanied by the destruction of greenery and increased harm to ecological processes. In the late 20th century, the rate of desertification reached 60,000 square meters, leading to the global deforestation of 150,000 square kilometers annually and the extinction of 150 plant and animal species each year (1, p. 53). From the author's views, it can be concluded that the deepening of the globalization process is characterized by increased environmental damage, which can be considered a primary factor in the emergence of global climate changes. There are contradictory points between economic efficiency and social and ecological efficiency. Economic efficiency is always aimed at generating more income.

Research shows that since the 1970s, over 30% of living organisms have become extinct, and the consumption of sea fish has more than doubled. Consequently, fish stocks worldwide have been depleted. Over 80% of corals in the Indian Ocean have died due to the onset of global warming caused by human industrial activity. In the last 40 years, the consumption of natural resources and carbon dioxide emissions have doubled. It is predicted that in the next 20 years, the use of transport will increase by 40%, and energy consumption will increase by 35% (2, p. 337). One of the points on which we agree with the author's research is that the deepening of the globalization process has resulted in temperature warming due to industrial activity, an increase in environmental waste, and an increase in carbon dioxide emissions. Furthermore, the expansion of transport resource usage, particularly in developed countries, has increased the use of depletable energy resources, contributing to global warming and climate changes. In other words, globalization acts as a catalyst for global climate changes.

The change in the ecological map of the climate is the most serious global problem of the new century. Global warming and the greenhouse effect should be evaluated as the most disastrous events created by technical progress in the atmosphere in the 20th century. 90% of the sun's heat is reflected on the earth's surface. The greenhouse effect is mainly caused by the impact of CO<sub>2</sub>. Annually, 20 billion tons of carbon dioxide are released into the atmosphere as a result of burning coal, oil, gas, etc. The amount of CO<sub>2</sub> released into the atmosphere increases by 0.5% each year, methane by 0.9%, nitrogen oxides by 0.25%, and halogen carbon compounds by 4%. This creates a greenhouse effect in the atmosphere. In the 20th century, the average temperature of the earth's atmosphere increased by 0.6 degrees. Compared to the previous century, the rate of warming in the last century has tripled (3, p. 68). The conclusion that can be drawn from the points noted by the author is that the release of carbon dioxide and other heat-producing gases into the atmosphere ultimately makes environmental protection problems an objective necessity and leads to the emergence of ecological crises. The most affected by this process are the population and, in terms of economic sectors, agriculture. As is known, agriculture plays an important role in solving food and raw material problems. In this regard, global climate changes and the resulting global desertification processes ultimately lead to the degradation of agriculture. Global climate changes, including warming and pollution caused by harmful substances in the environment, create a severe economic situation in agriculture. More precisely, the productivity of agricultural plants decreases, and the destruction of livestock occurs. All this reflects a sharp decline in agricultural production. In developing countries, including the Republic of Azerbaijan, this process also brings about social contradictions. Agriculture still represents the only and non-alternative employment sector for people living in rural areas. All these factors worsen the economic situation in agriculture. It should be noted that agriculture is less profitable compared to other sectors of the economy, and global climate changes manifesting as global warming create an even more acute situation in agriculture. This leads to urbanization processes. In other words, people leave remote rural areas in large numbers, primarily aiming to achieve better living conditions. The migration of people from rural to urban areas increases the economic burden on cities.

Anthropogenic impacts play a higher role in the emergence of global climate changes. Against the background of these impacts, it should be particularly noted that the increase in the population ultimately raises the level of interference with nature and the environment. In the year 1000, the world population was 400 million, in 1800 it was 1 billion, in 1900 it was 1.656 billion, in 1980 it was 4.434 billion, in 1990 it was 5.263 billion, in 2000 it was 6.070 billion, and in 2013 it reached 7.162 billion (4). In 2023, the world's population increased by 66 million, and currently, 8,073,859,407 people live on Earth. Mathematical calculations show that in 2023, the world population has increased eightfold compared to 1800, 4.9 times compared to 1900, 50% compared to 1990, 33% compared to 2000, and 12.7% compared to 2013. Both technogenic processes and the increase in the population and other anthropogenic factors limit the world's supply of water suitable for drinking, irrigation, and industrial use. The main reason is the pollution of water by industrial, transport, and domestic wastewater. Rivers flowing from agricultural areas become enriched with fertilizers. The discharge of untreated domestic wastewater causes the spread of infections. 80% of diseases and one-third of deaths are associated with the use of polluted water (5,6). In addition to agreeing with the authors' views, it should be added that in recent years, the discharge of wastewater and the pollution of the environment, as well as the destruction of greenery, result from the efforts to develop the market economy and the prioritization of private corporate interests over ecological efficiency. In other words, as the globalization process deepens, human anthropogenic and economic efficiency interests outweigh the ecological expectations of other people.

Agriculture, unlike other sectors of the economy, is more affected by various changes in the environment. This impact is especially exacerbated by global climate change, which shows its negative effects both directly and indirectly. Indirect impacts include rising average temperatures, changes in precipitation and extreme weather events, increased pests and diseases, higher concentrations of carbon dioxide in the atmosphere and ozone at ground level, and changes in the nutritional qualities of certain foods. All these factors lead to unique destructive manifestations in agriculture under the influence of climate change. Notably, these effects are distributed unevenly across the world. The author concludes that the contradictions caused by global climate change are more pronounced in developing countries, affecting agriculture and the social conditions of the population more severely. This is because these countries do not employ innovative technologies to solve ecological problems. In contrast, developed countries are already using digital technologies and artificial intelligence, mitigating the harmful manifestations of global climate change on the population's standard of living and agriculture. In developed countries, there has been an increase in the use of environmentally friendly technologies in the production processes of agriculture and other economic sectors.

The impact of global climate change on agriculture also necessitates the efficient use of water resources. Specifically, water shortages will be one of the critical factors threatening the global community. Academician Z.A. Samedzade notes that, according to the World Health Organization, 20% of the world's population uses contaminated water. Over the past 50 years, water consumption has increased by 3.1 times in households, 39 times in industry, and 28 times in agriculture. In 1990, the global irrigated area was 48 million hectares, which increased to 94 million in 1950 and 260 million hectares by the end of the 20th century. Currently, 40% of global food production is based on irrigated land. The expansion of irrigated areas is happening twice as fast as population growth. Asia has the most irrigated agricultural areas, accounting for two-thirds of the world's irrigated land. In grain production, 70% of the land in China, 50% in India, and 15% in the USA rely on irrigation. Since the late 20th century, North African and Middle Eastern countries have struggled with food shortages and hunger due to water scarcity. Globally, 70% of river water used in channels goes to land irrigation, 20% to industry, and 10% for population needs. Thirty-one countries, with a population of 500 million people, suffer from water scarcity.

Wastewater plays a significant role in pollution, particularly from food processing and pulp-paper industry enterprises. A medium-sized pulp-paper plant's waste pollutes as much as a city with a population of 500,000. Chlorination is commonly used in our country for disinfecting water from infectious agents. The main problem with this method is that chlorine reacts with unsolved hydrocarbons in water, forming some chlorinated hydrocarbons with carcinogenic effects. Ozonation methods are also used globally for water purification.

From the authors' perspectives, it can be concluded that the manifestation of global climate changes in agriculture, particularly in terms of water scarcity and pollution, creates a more acute situation. This leads to the consumption of polluted water by the population and inefficient use of water resources in agriculture, resulting in the production of environmentally problematic and harmful food products. Therefore, it is necessary to use advanced technologies to neutralize the manifestations of global climate changes in agriculture.

Farmers are already feeling the consequences of global warming, which increases risks in crop production, fisheries, and livestock. Developing sustainable agriculture is one of the biggest challenges in the context of the global climate crisis. Farmers and producers must now develop climate-smart products that can withstand the pressures of climate change. Using climate-smart technologies in

agriculture can reduce the risks of climate change on crop shortages. There is a need to create new varieties of seeds that can withstand environmental impacts to adapt to climate change in the future .

Mitigating anthropogenic impacts plays a significant role in combating global climate change. It is important to recognize that global climate changes are progressing alongside globalization. Although this process is inevitable, it is possible to minimize the damages. For this, it is essential to use digital technologies and the capabilities of artificial intelligence. Globally, the practice of adapting agriculture to changing climate conditions is being implemented to protect against global climate changes, especially global warming. However, it is unfortunate that this process cannot be realized in developing countries due to insufficient financial resources to finance the adaptation of agriculture to global climate changes. In global practice, ecological farming is also proposed to relatively insure agriculture against global climate changes. However, it should be noted that this approach is more successful in countries with substantial arable land. Azerbaijan, for instance, is among the countries with limited land resources. Despite having a total agricultural land area of 4,756 thousand hectares, only 1,808 thousand hectares are arable. This problem requires a serious scientific and organizational approach. For example, Kazakhstan has 200 million hectares of arable land. During the Soviet era, Azerbaijan ranked 14th among the 15 republics in terms of arable land per capita (0.7 ha). In 2022, the per capita arable land in Azerbaijan was 0.47 hectares . Over the past 30-40 years, the humus content in our soil has decreased (approximately 20-30%), and the thickness of the arable layer has reduced by 0.2-1.5 cm. Since the amount of nutrients taken from the soil with each harvest is not "compensated," fertility is rapidly declining. In the last 20-25 years, the humus content in the 1-meter soil profile has decreased by 15-25%, leading to a significant shortage of nutrients. In our opinion, a more complex approach to global climate change in agriculture is needed, and multi-faceted efforts should be expanded to address this process.

## Conclusion

To mitigate the impact of global climate changes on agriculture, it is advisable to implement the following measures:

- Preventing soil salinization in agricultural lands;
- Implementing sustainable melioration and irrigation measures in agriculture;
- Creating green areas and particularly forest areas at the edges of fields to protect agricultural lands, including croplands, from various types of erosion and wind effects;
- Applying crop rotation systems in large farms to prevent soil degradation;
- Using artificial intelligence to efficiently utilize irrigation water in agriculture;
- Developing and applying seed varieties in agricultural production that can withstand global climate changes, including global warming;
- Using innovative technologies to reduce the emission of greenhouse gases into the environment.

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