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RESEARCH PAPER

Toward Sustainable Solutions: Understanding Climate Change Impacts on Food Security in the OIC Context

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ABSTRACT

This research is of utmost importance as it delves into the intricate relationship between climate change and food insecurity in Organization of Islamic Cooperation (OIC) member states. The prevalence of food insecurity in these states, affecting a staggering 35.8% of the population compared to the global average of 29.5%, underscores the urgent need for tailored measures. The research takes a comprehensive approach, using high-alert OIC nations as case studies. It combines quantitative data analysis with qualitative case studies to explore the diverse impacts of climate change on agricultural productivity, water scarcity, and socio-economic vulnerabilities across different OIC contexts. The study's findings underscore the pressing need for adaptive strategies and policy interventions to combat the adverse effects of climate change on food security in each OIC nation. Drawing from these findings, the research proposes strategies and policy recommendations to establish a more resilient and secure food system across the OIC member states.

KEYWORDS Climate Change, Food Insecurity, OIC States, Socio-economic Challenges, Sustainable Development

Introduction

Climate change is increasingly recognized as a critical global challenge, with wide-ranging impacts on natural and human systems (Zhao et al., 2022). One of the most severe effects is the impact on food security, defined as the availability, access, usage, and stability of food resources. The Organization of Islamic Cooperation (OIC), which has 57 member nations and many impoverished countries, is incredibly responsive to the negative consequences of climate change. These countries confront specific problems due to their geographical location, socioeconomic situations, and reliance on climate-sensitive industries such as agriculture and fishing.

Food insecurity, the inability to obtain enough safe, nourishing food to maintain a healthy (Menhas et al., 2016), is prevalent among OIC member states. Numerous factors, such as socioeconomic instability, conflicts, ineffective governance, and environmental pressures, are the root causes (Security, 2023). Chronic food insecurity in many OIC nations is caused by structural shortcomings such as inadequate agricultural infrastructure, a lack of access to modern farming practices, and a scarcity of financial resources for smallholder farmers. Food insecurity also exists in OIC member states such as Palestine and Afghanistan as a result of prolonged battles that disrupt food production and distribution routes. Meanwhile, even wealthy OIC members, such as Brunei, experience food insecurity issues due to their reliance on food imports and sensitivity to global market changes.

Furthermore, fast population expansion in many OIC countries exacerbates the need for food, putting extra strain on already stressed agricultural systems. The Global

Food Security Index (GFSI) often ranks many OIC nations poorly regarding food affordability, availability, quality, and safety, exposing pervasive vulnerabilities (SESRIC, 2016).

This research investigates the complex relationship between climate change and food security in the OIC context. This study intends to emphasize the scope of the problem by investigating specific effects, like increasing temperatures and shifting precipitation patterns, and by evaluating current climate-related occurrences. Furthermore, it examines the policy responses and green transformation initiatives implemented by OIC member states and the international community to reduce these effects and strengthen resilience. The research study suggests long-term strategies to increase food security and encourage climate adaptation in the OIC region.

Climate change and food insecurity are humanity's most critical challenges today. Climate change, caused primarily by human activities such as fossil fuel combustion and deforestation, has resulted in rising temperatures, shifting weather patterns, and environmental damage. These changes have far-reaching consequences for food security, worsening poverty and malnutrition worldwide. Addressing these interconnected concerns necessitates a holistic approach that combines climate change theory and a framework for understanding food insecurity.

Climate Change's Impacts on Food Security

Climate change has far-reaching consequences for food security, notably by changing weather patterns, increasing the frequency of extreme weather events, and reducing agricultural production. According to the Intergovernmental Panel on Climate Change (IPCC), rising temperatures, changing precipitation patterns, and more frequent and severe droughts and floods hurt crop yields and livestock production worldwide (Mbow et al., 2019).

These effects are especially severe in OIC countries. Arid and semi-arid regions, such as the Middle East and North Africa (MENA), face severe water scarcity aggravated by climate change. Reduced rainfall and increased evaporation have depleted water supplies, directly decreasing agricultural production (Mahmoud, 2024). Crop yields in countries such as Sudan and Pakistan, which rely primarily on agriculture, are expected to fall significantly due to these climate trends.

Coastal OIC states, particularly Bangladesh and Indonesia, face the simultaneous challenge of rising sea levels and increased saline intrusion into freshwater systems, which affect agriculture output and potable water supply. Sub-Saharan Africa's drought is becoming increasingly frequent and severe, resulting in crop failures, animal losses, and intensifying food insecurity.

The socioeconomic consequences of climate change, such as displacement, loss of livelihoods, and greater poverty, exacerbate food security concerns. Because climate-related stressors can intensify already-existing tensions and cause more instability and displacement, populations in OIC states threatened by war are especially vulnerable (United Nations Secuirty Council, 2024).

Recent occurrences illustrate the critical need to address the effects of climate change. For example, Heatwaves and wildfires in Türkiye and Central Asia demonstrate the difficult conditions produced by climate change (Sarwar, 2023a). In 2022, Pakistan

saw record-breaking heatwaves, severe droughts, and devastating floods, displacing millions and demonstrating its vulnerability despite its small share of global greenhouse gas emissions. Pakistan also faces some of the highest disaster risk levels in the world, ranked 18 out of 191 countries by the 2019 Inform Risk Index (Climate Change Knowledge Portal, n.d.).

Climate Change Theory

Climate change theory is based on the fundamental concepts of the greenhouse effect, which describes how specific gases in the Earth's atmosphere trap heat, resulting in global warming. Human activities such as using fossil fuels and deforestation have considerably raised the concentrations of greenhouse gases in the atmosphere, including carbon dioxide, methane, and nitrous oxide. These emissions drive climate change, resulting in consequences such as rising temperatures, shifting weather patterns, and melting ice glaciers.

Food insecurity is a lack of consistent access to inexpensive, nutritious food. Its characteristics include physical access, economic access, use, and stability. Complex circumstances, including poverty, inequality, conflict, and environmental damage, produce food insecurity. Food insecure populations frequently suffer from hunger, malnutrition, and health difficulties, aggravating their vulnerability.

Climate change worsens food insecurity in various ways. Temperature and precipitation patterns can shift, affecting crop yields, animal production, and fisheries, resulting in food shortages and price instability. Soil deterioration, water shortages, and biodiversity loss all contribute to the breakdown of food production systems. Droughts, floods, storms, and heatwaves impair food production and distribution networks, aggravating food insecurity and humanitarian catastrophes.

On the other hand, migration and changing land use are two ways that food shortages can fuel climate change. People may choose unsustainable behaviors like deforestation, which increases carbon emissions and worsens climate change, to deal with food shortages. Food insecurity can also cause population displacement and fighting over limited resources, further destabilizing communities and contributing to environmental damage.

OIC States' Natural Assets and Their Impact on Climate

Natural capital is a critical source of wealth for many countries, particularly those in the Organization of Islamic Cooperation (OIC). This type of capital includes many assets, such as subsurface resources, agricultural lands, forests, and conservation areas. Natural capital is not only a source of economic wealth for OIC nations, which are frequently heavily reliant on natural resources, but it is also an essential component in preserving rural livelihoods and promoting ecological balance. The importance of natural capital in OIC countries has grown dramatically over the last two decades, with a 90% increase between 1998 and 2018 (SESRIC, 2023). This resource base is fundamental to their economic frameworks, consisting primarily of subsurface assets, which account for 77% of natural capital, followed by agricultural lands at 17%, protected areas at 4%, and forests at 2% (Organisation of Islamic Cooperation, Statistical, 2021). Countries that rely heavily on minerals and fossil fuels for their economy, like Kazakhstan, the United Arab Emirates, and Oman, are prime examples of this dependence.

However, the heavy reliance on natural capital poses substantial environmental challenges, especially in light of climate change. The 2022 Environmental Performance Index (EPI) reveals that OIC countries struggle to reach global standards for environmental health, ecosystem vitality, and climate change mitigation (Yale Center for Environmental Law & Policy, 2022). These complex challenges include land degradation, deforestation, water scarcity, air pollution, and rising greenhouse gas emissions. For example, over 20% of the world's land surface is degraded, exacerbated by deforestation in the OIC region, which disturbs biodiversity and contributes to climate change. Water scarcity is another primary concern, with countries such as Yemen and Uzbekistan experiencing severe shortages, jeopardizing agricultural output and security. In 2021, Iraq experienced its second driest season in 40 years due to record low rainfall (United Nations Sustainable Development Group, 2022).

Furthermore, air pollution, which caused about 1.6 million premature deaths in 2019, remains a widespread health problem in these countries. The most pressing issue, however, is climate change, which has resulted in a 91% increase in greenhouse gas emissions in OIC countries since 1990, primarily from the energy sector. Climate change's effects are becoming more visible, manifesting as more erratic water supplies and diminishing agricultural yields, threatening both environmental sustainability and regional economic stability.

Overreliance on groundwater for agriculture causes depletion, a significant concern in nations such as Iran (Noori et al., 2023) and Pakistan (The World Bank, 2021). Groundwater depletion affects long-term water supply, imperiling agricultural sustainability.

Challenges

In addition to the severe climate change and food insecurity issues, OIC nations face many other obstacles to agricultural development and sustainability. Agricultural efficiency is severely hindered by fragmented land ownership, which results in less-than-ideal land use and management methods. Soil health and the availability of quality inputs, particularly in the seed system, are critical factors influencing crop yields and overall agricultural production. Furthermore, inefficient resource usage exacerbates these difficulties, restricting the sector's growth potential. Despite agriculture's importance, the sector frequently lacks considerable investor interest, impeding technical developments and modernization attempts. Import/export imbalances burden agricultural economies, undermining trade balances and food security. High unemployment, poverty, and poor income make rural populations more vulnerable and limit their ability to invest in sustainable farming practices. Regulatory limits and insufficient protection of farmers' rights stymie agricultural innovation and production, creating cycles of poverty and inequality. Addressing these multidimensional difficulties necessitates comprehensive policies and targeted actions to promote sustainable agriculture and fair development among OIC member nations.

Initiatives Taken By Organization of Islamic Cooperation (OIC)

To address food security concerns, the Organization of Islamic Cooperation (OIC) has devised a comprehensive strategy centered on several sectors of industry development, job creation, entrepreneurship, and product development. This technique combines best practices in primary and secondary processing, assisted by Model Support Centers (MSCs), to improve production efficiency and quality. Packaging and

production standards are prioritized, with capacity-building training programs in place. Innovative climate agriculture strategies, such as water and pest control management, are incorporated into agricultural practices to increase resilience and productivity. Additionally, programs such as seed banks, agricultural laboratories, and trade route optimization help to secure food supplies and boost agrarian innovation. Collaboration among agencies, trade shows, and gene banks empowers stakeholders and encourages knowledge exchange. Agri-tech developments and trade platforms enhance intra-trade and increase access to food balance data, ensuring appropriate governance and regulatory frameworks. The OIC's strategy stresses intra-regional collaboration, laws, and regulations to ensure equitable access to trade routes and enhance long-term food security among member states.

The Organization of Islamic Cooperation (OIC) has recently exhibited a renewed commitment to combating global climate change, with member countries actively participating in various environmental programs. One prominent component of this commitment is the broad acceptance of the Paris Agreement, with most OIC states promising to respect its principles and actively update their Nationally Determined Contributions (NDCs) to reflect their climate pledges. The financing for climate-related projects is becoming more accessible in OIC member countries despite the remaining gaps in climate finance. This makes it easier to adopt sustainable practices and projects.

Furthermore, numerous OIC countries have taken major moves toward enacting more vital climate legislation, including setting significant targets such as reaching net-zero emissions. Algeria and Morocco, for example, have launched efforts to address food insecurity through the transforming food systems (Sarwar, 2023b). Azerbaijan developed green energy in 2023 for solar and onshore wind projects totaling 135 gigawatt (GW) (EU Reporter, 2024). This action represents a practical effort to shift to cleaner and more sustainable energy sources, minimizing the effects of climate change.

In addition to government efforts, there has been a noticeable drive for green transformation and policy solutions in OIC countries. Many countries have passed climate-related legislation and policies, emphasizing lowering emissions and encouraging sustainability. Notable programs include Saudi Arabia's Green Initiative, Pakistan's 10 Billion Tree Tsunami, and the Great Green Wall project in Africa's Sahel region. These programs seek to mitigate desertification, increase environmental sustainability, and boost biodiversity, demonstrating a regional commitment to addressing climate change.

Literature Review

OIC countries, many of which are located in climate-sensitive areas, are highly exposed and sensitive to climate impacts due to their reliance on agriculture and poor adaptive capacity due to socioeconomic restrictions.

For example, Carlo Azzarria, and Sara Signorellib (2020) note that poverty, political instability, and inadequate infrastructure exacerbate vulnerability in regions such as Sub-Saharan Africa, which contains numerous OIC member nations. These variables undermine communities' ability to adapt to and recover from climate-related shocks, aggravating food insecurity.

Various empirical research has thoroughly documented climate change's impact on agriculture. Crop simulation models, such as those used by Rosenzweig and Parry

(1994), predict significant losses in crop yields when temperatures rise and precipitation patterns change. According to these models, every one °C increase in temperature may result in a 5-10% decline in substantial cereal harvests in tropical regions, affecting food availability and security.

Lobell and Gourdji (2012) show that heat stress and changed rainfall patterns interrupt planting and harvesting schedules, resulting in poorer agricultural yield. Temperature increases and shifting monsoon patterns are already impacting crop output and escalating food poverty in OIC nations like Bangladesh and Pakistan.

Understanding food security in climate change requires understanding the water-food nexus. Falkenmark's Water Stress Index classifies numerous OIC countries as "high" or "extreme" regarding water stress. Climate change exacerbates water scarcity by altering precipitation patterns and increasing evaporation rates, affecting irrigation and drinkable water supplies.

Sowers, and Weinthal (2010) examine how climate change is expected to significantly reduce water availability in the Middle East and North Africa (MENA) region, which includes several OIC member states. This decline immediately threatens food security by reducing agricultural production and limiting household water consumption.

Droughts, floods, and storms that occur more frequently and intensely disturb food systems by killing crops, tainting water supplies, and causing infrastructural damage. For example, recurring droughts in Somalia, Mali and Nigeria have caused enormous crop failures and livestock mortality, prompting food crises and humanitarian emergencies. Similarly, the 2010 floods in Pakistan, which affected over 20 million people, highlight the disastrous effects of extreme weather on food security.

Emrah Sofuoğlu & Ahmet Ay (2020) state that political instability and violence in OIC countries such as Syria, Afghanistan, and Yemen enhance climate change vulnerabilities by affecting governance and institutional capacities. These disruptions impede effective climate adaptation and food security efforts, exacerbating poverty and food insecurity. Human Rights Watch and Amnesty International have recently revealed Israel's use of white phosphorus weapons on Palestine in its military operations, which have had a significant impact on neighboring countries.

Material and Methods

The Research study combines both quantitative and qualitative methods, drawing on a wealth of credible data sources. The quantitative analysis examines the data from renowned institutions such as FAO, WFP, IPCC, and World Bank on food security and climatic indicators. This data, known for its reliability, was used to forecast future climate scenarios and their influence on food security. For the qualitative analysis, qualitative case studies were examined to identify country-specific obstacles and adaptive techniques—interviews conducted with government officials, NGO workers, and natives. Finally, content analysis is performed by reviewing national reports, policy documents, and field reports, all of which are authoritative sources, to gather qualitative data on adaptive methods and policy responses.

Result and Discussions

This research study delves into the severity of climate change on food security in OIC member countries, underlining the pressing need for urgent adaptive strategies and policy formulation. The stark reality is that agricultural productivity is experiencing a significant reduction due to climate change. Pakistan and Sudan, for instance, are grappling with a substantial decline in crop yields due to the rapid increase in temperature and a significant shift in precipitation patterns. In Pakistan, agricultural yields have dropped by approximately 20% over the past decade due to rising temperatures and erratic precipitation patterns. It is predicted that by 2040, as the temperature increases, agricultural production will reduce by around 8%–10% (Cradock-Henry et al., 2020). A similar scenario unfolds in Sudan, where crop productivity has declined by nearly 30%, exacerbating food insecurity and economic instability. According to the OCHA white note, nearly 18 million people across Sudan are currently facing acute food insecurity, described by the Integrated Food Security Phase Classification (IPC) as crisis-level conditions or worse (IPC Phase 3 or above). This is the highest recorded share of people facing this level of food insecurity during Sudan's harvest season (October to February). Of this total, five million people are currently experiencing emergency levels of food insecurity (IPC Phase 4), some of whom may face catastrophic conditions (IPC Phase 5) over the coming months, particularly in West and Central Darfur (OCHA, 2023). The reliance on traditional farming practices in both countries highlights the urgent need for climate-resilient technologies and efficient water management systems.

The issue of water scarcity is escalating daily due to climate changes and resource depletion in various regions like MENA, impacting countries such as Iran and Yemen. Iran's renewable water resources have declined from 130 billion cubic meters (bcm) to less than 90 bcm in the last 50 years. Yemen, already ravaged by conflict, experiences acute water scarcity, with per capita water availability dropping to less than 100 cubic meters annually, far below the water poverty line of 1,000 cubic meters (UNESCO, 2021). Freshwater contamination, impacts on agriculture, and the rise in sea level along with saline intrusion in coastal states like Bangladesh and Indonesia are exacerbating this critical issue. In Bangladesh, saline intrusion has rendered 1.2 million hectares of arable land unproductive, affecting millions of farmers. Indonesia faces similar challenges, with 2.1 million hectares of coastal rice paddies at risk from sea-level rise, threatening the livelihoods of millions (ADB, 2021).

Severe climatic conditions worsen socio-economic vulnerabilities, leading to displacement, livelihood loss, and increased poverty. In Sub-Saharan Africa, droughts frequently result in crop failures and economic instability. For instance, in Somalia, recurrent droughts have resulted in a 25% reduction in cereal production, while Nigeria's agricultural sector faces a loss of approximately $9 billion annually due to climate-induced disruptions (FAO, 2015). Conflict-ridden states like Syria and Yemen face compounded challenges from climate change and political instability. In Syria, prolonged droughts have displaced over 1.5 million people, while Yemen's agricultural output has plummeted by 40% since the onset of the conflict, exacerbating food insecurity (WFP, 2022).

The study highlights specific climate-resilient agricultural practices that have shown success. For instance, Egypt and Pakistan have introduced self-irrigating wheat varieties and highly efficient irrigation systems, which have proven effective in mitigating the impact of climate change on agriculture. Egypt's introduction of self-irrigating wheat varieties has increased yields by 15%, while Pakistan's implementation of efficient irrigation systems has resulted in a 20% improvement in water use efficiency,

demonstrating significant potential for mitigating climate impacts (Latif et al., 2016). The Indus Basin irrigation system serves as the principal agricultural base of Pakistan (Qureshi & Ashraf, 2019). Under the Green Plan initiatives, Morocco has adopted sustainable agriculture practices, resulting in a 10% increase in crop productivity and a 15% reduction in water usage. Bangladesh's floating gardens, which utilize waterlogged areas for cultivation, have proven successful, with yields increasing by 25%, providing a reliable food source during monsoon seasons (Irfanullah, 2024).

This study calls for the advancement of climate-resilient technologies, the promotion of sustainable agriculture, and better agricultural water management. It also emphasizes the need for food hubs to increase market access and entrepreneurship in rural areas. However, the most crucial aspect is for OIC member nations to strengthen regional collaboration. Through this approach, they may address environmental concerns that span international borders and strengthen their ability to withstand the effects of climate change.

The research study, taken as a whole, emphasizes the critical need for specialized adaptive methods and legislative initiatives to counteract the effects of climate change on food security in OIC member nations. Organization of Islamic Cooperation (OIC) member states can increase resilience and guarantee food security for their people by emphasizing sustainable practices and encouraging regional cooperation. With its thorough framework for understanding climate change consequences and creating practical solutions for food security, this research offers hope for a better future and a road map to get there.

Conclusion

Finally, this study emphasizes the critical need for comprehensive measures to address the complex relationship between climate change and food security across OIC member states. The study exposes these countries' acute sensitivity to climate impacts, exacerbated by sociopolitical and environmental variables. However, it also emphasizes the possibility of effective adaptation via targeted strategies such as integrated water management, climate-resilient agriculture, and economic diversification. Encouragingly, OIC member nations have demonstrated commitment and action to tackle climate change and improve food security. Improving these nations' resilience and sustainability will require prioritizing green initiatives, increasing regional cooperation, and instituting more sustainable practices. By stepping up their efforts, the Organization of Islamic Cooperation (OIC) member states can help build a better, more equitable future.

Recommendations

Addressing the interrelated concerns of climate change and food insecurity necessitates a comprehensive approach that combines mitigation and adaptation methods with foo d security initiatives.

- Encourage OIC member nations to enter into bilateral and multilateral agreements for environmental projects such as tree-planting ceremonies and other joint efforts to promote green goodwill and support one another's sustainability goals.
- Facilitate establishing food hub projects to improve efficiency and competitiveness along the food value chain, thereby enhancing farmers' access to markets and fostering entrepreneurship in rural communities among all OIC states.

- Encourage developing and implementing climate-resilient technologies, such as wheat hybrids and self-irrigating wheat varieties, to improve agricultural production and food security in the face of climate change.
- Advocate for the availability and acceptance of technology and e-platforms that allow farmers to access markets and scale up sustainable agricultural practices, particularly in micro, small, and medium-sized enterprises (MSMEs).
- Support projects to develop green jobs and entrepreneurship opportunities, notably in renewable energy, sustainable agriculture, and environmental conservation, to promote economic growth and ecological sustainability.
- Promote the use of efficient irrigation systems, artificial intelligence (AI), the Internet of Things (IoT), and biochar technologies to optimize water management, increase agricultural output, and reduce the impact of drought on crop yields.
- Promote regional cooperation among OIC member nations to address transboundary environmental issues like pollution and ecosystem conservation through agreements and partnerships that decrease environmental degradation and promote sustainable development.
- Incorporate the Sustainable Development Goals (SDGs) into national policies and programs to achieve alignment with global targets for climate action and environmental conservation.
- Increase renewable energy sources to minimize greenhouse gas (GHG) emissions and encourage sustainable energy production and use.
- Improve disaster management systems, such as early warning systems and emergency preparedness plans, to better respond to extreme weather events and other climate-related calamities.
- Increase public knowledge and education about climate impacts and sustainable practices to develop an environmental stewardship culture and encourage behavior change toward more sustainable lives.
- Facilitate global venture capital funding and collaboration among OIC member nations on climate tech solutions, guaranteeing a comprehensive focus on leveraging technologies to mitigate climate change and promote sustainability effectively.
- Encourage the construction of eco-friendly buildings and infrastructure to reduce the environmental impact and promote sustainable urban development practices.

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