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RESEARCH ARTICLE **OPEN ACCESS**

Climate Change in Jordan: Challenges and Mitigation Strategies

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Abstract:

Introduction: The present study focuses on Jordan, which is a small, arid country in the Middle East that is vulnerable to the impacts of climate change. The country experiences hot and dry conditions for much of the year and is prone to drought and water shortages. This can lead to water scarcity and a decline in agricultural productivity.

Methods: To mitigate the impacts of climate change in Jordan, this study focuses on the implementation of measures to conserve and manage water resources more efficiently.

Results: The proposed measures could include investing in water-saving technologies, such as drip irrigation systems, and promoting the use of drought-resistant crops.

Discussion: In recent years, Jordan has experienced an increase in temperature and a decrease in annual rainfall, leading to more frequent and severe droughts. One of the main impacts of climate change in Jordan is on its water resources. Rising temperatures increase water demand while declining rainfall reduces water availability.

Conclusion: This study serves as a foundation for further investigation. It highlights the importance of promoting the use of renewable energy sources, such as solar power, to reduce greenhouse gas emissions and slow the rate of climate change. It also summarizes the potential measures that could be taken to mitigate the impacts of climate change in Jordan.

Keywords: Adoption, Climate Change, Jordan, Mitigation, Water Scarcity, Jordan.

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1. INTRODUCTION

The current study aims to explore potential methods to minimize the effects of climate change. The idea is to establish a comprehensive analysis of the challenges and enhance the concept of mitigation. Climate change is a global phenomenon that is caused by the emission of greenhouse gases, such as carbon dioxide, into the atmosphere. These gases trap heat from the sun, heating the Earth and leading to rising temperatures and changes in weather patterns. Climate change is having a range of negative impacts on the Earth, including more frequent

and severe heatwaves, droughts, flooding, and sea-level rise. These impacts can lead to a range of consequences, including damage to infrastructure, loss of biodiversity, and negative impacts on human health and well-being (Gbode *et al.,* 2015; Kunstmann *et al.,* 2007; Lelieveld *et al.,* 2012; Matua *et al.,* 2013).

Jordan, like many other countries, is experiencing the impacts of climate change. The country is located in a region that is particularly vulnerable to the impacts of climate change due to its arid climate and limited natural resources. Jordan is facing a range of challenges related to climate change, including rising temperatures, declining water resources, and more frequent and severe heatwaves (EPA, 2014; Fischer *et al.,* 2008; Al Qatarneh *et al.,* 2018; The National Climate Change Adaptation Plan of Jordan, 2022; Abbass *et al.* 2022).

These impacts are causing significant consequences for the environment of Jordan, its economy, and society (EPA, 2014). For example, the country's agricultural sector, which is a major contributor to its economy, is being impacted by changing weather patterns and water shortages. Jordan is also experiencing more frequent and severe flash flooding, which can damage infrastructure and disrupt transportation and communication networks (Lelieveld *et al.,* 2012; Matua *et al.,* 2013).

In order to address these challenges, Jordan is taking steps to mitigate and adapt to climate change. For example, the country has implemented several policies and initiatives to promote the use of renewable energy, increase energy efficiency, and reduce greenhouse gas emissions. Additionally, the country is also working to improve its water management systems and to develop more drought-resistant crops.

However, the magnitude and complexity of the problem of climate change require collective action at the global level, as well as at the national and local levels. It is important that all countries work together to address this global challenge and take steps to reduce greenhouse gas emissions and mitigate the impacts of climate change (Watts *et al.,* 2015; Weed *et al.,* 2013; Tebaldi *et al.,* 2006).

Climate change is affecting Jordan in a number of ways, including rising temperatures, more frequent and severe heat waves, and declining water resources (Matouqa *et al.,* 2013; Abbass *et al.,* 2022).

Jordan has experienced a significant increase in average temperatures in recent decades and the number of heatwaves in Jordan has also increased in recent years.

Additionally, the country is facing a serious water scarcity problem, with the country experiencing some of the lowest levels of water availability in the world. According to the World Bank, Jordan has only 145 cubic meters of water per person per year, which is significantly lower than the water scarcity threshold of 500 cubic meters per person per year.

Furthermore, the declining water resources in Jordan are having a significant impact on the country's agriculture sector, which is a major contributor to the economy, as mentioned earlier. Data from the Food and Agricultural Organization of the United Nations (FAO) show that the area of irrigated land in Jordan decreased by 8% between 2005 and 2015, with further decreases expected.

2. METHODOLOGY

There are a number of actions that Jordan can take to mitigate the impacts of climate change and reduce its greenhouse gas emissions. Some potential mitigation strategies include:

2.1. Promoting the use of Renewable Energy

Jordan has significant potential for renewable energy sources, such as solar and wind power, and increasing the use of these technologies can help reduce the country's reliance on fossil fuels and lower its greenhouse gas emissions.

2.2. Increasing Energy Efficiency

Improving energy efficiency in buildings, transportation, and industry can help reduce energy consumption and lower greenhouse gas emissions. This can be achieved through measures, such as improving insulation in buildings, using more efficient appliances and vehicles, and implementing industrial processes that are less energy-intensive.

2.3. Implementing a Carbon Pricing System

Implementing a carbon pricing system, such as a carbon tax or cap-and-trade program, can incentivize businesses and individuals to reduce their greenhouse gas emissions (Christophe *et al.,* 2014; Kongsager, 2018; Lipczynska-Kochany, 2018).

2.4. Developing Green Infrastructure

Investing in green infrastructure, such as green roofs and urban forests, can help mitigate the impacts of climate change by reducing the amount of heat absorbed by urban areas and increasing the capacity of cities to absorb and store water (Hussain *et al.,* 2019; Hussain *et al.,* 2018; Mall *et al.,* 2017).

2.5. Promoting Sustainable Transportation

Encouraging the use of public transportation, biking, and walking, and investing in infrastructure that supports these modes of transportation can help reduce greenhouse gas emissions from the transportation sector.

2.6. Conserving and Protecting Natural Resources

Protecting and conserving natural resources, such as forests and wetlands, can help reduce greenhouse gas emissions by reducing the amount of carbon dioxide in the atmosphere and providing natural buffers against extreme weather events.

These are just a few examples of potential mitigation strategies that Jordan could consider in order to address the challenges of climate change. It is important to note that addressing climate change will require a range of

actions at the national and international levels and that all countries will need to work together to reduce greenhouse gas emissions and mitigate the impacts of climate change (Mall *et al.,* 2017).

Lastly, other measures that could be taken to mitigate the impacts of climate change in Jordan could include developing adaptation strategies to help communities and industries cope with the impacts of climate change, such as improving early warning systems for extreme weather events.

3. RESULTS

Climate change is already having a range of negative impacts on Jordan, with rising temperatures, declining water resources, and more frequent and severe heat waves being among the most prominent effects (Schuurmans, 1995). Here are some specific ways in which climate change is affecting the country (EPA, 2014; Fischer *et al.,* 2008).

3.1. Rising Temperatures

Jordan has seen a significant increase in average temperatures over the past several decades, with data from the World Bank showing that the average annual temperature in the country increased by 0.6°C from 1960 to 2018. Higher temperatures can lead to a range of negative impacts, including more frequent and severe heatwaves, increased water demand, and decreased crop yields.

3.2. Declining Water Resources

Jordan is facing a serious water scarcity problem, with the country experiencing some of the lowest levels of water availability in the world. The combination of rising temperatures and changing weather patterns is leading to declining water resources in the country, which is having a significant impact on the agricultural sector and other industries (Schuurmans, 1995).

3.3. More Frequent and Severe Heatwaves

The number of heatwaves in Jordan has also increased in recent years, with data from the United Nations Development Program (UNDP) showing that the number of heatwaves in the country increased by nearly 50% between 1960 and 2015. Heatwaves can have serious consequences for human health, particularly for vulnerable populations, such as the elderly and young children. They can also lead to increased water demand, which can further strain the country's limited water resources (National Climate Change Policy of the Hashemite Kingdom of Jordan, 2022; Schuurmans, 1995; Sovacool *et al.,* 2021; GTZ and JEM, 2015).

3.4. Flooding

Jordan is also experiencing more frequent and severe flash flooding, which can damage infrastructure and disrupt transportation and communication networks. These events can have significant economic and social impacts and can also lead to displacement of communities.

Overall, these impacts highlight the negative impacts of climate change on Jordan, including on its environment, economy, and society, calling for mitigation and adaptation strategies in order to minimize their consequences (Asseng *et al.,* 2009; Ayers *et al.,* 2014; Gosling and Arnell, 2016; Gössling *et al.,* 2012).

4. DISCUSSION

Al-Qatarneh *et al.,* (2018) discussed the impacts of climate change on Jordan, including rising temperatures, declining water resources, and more frequent and severe heat waves. They also discussed the country's efforts to adapt to these impacts and reduce greenhouse gas emissions. In addition, they also addressed the challenges in Jordan's agricultural sector, particularly due to climate change and water scarcity, exploring strategies to improve water management in the sector. Similarly, Kunstmann *et al.,* (2007) discussed the challenges that Jordan is facing regarding water scarcity in the context of climate change, emphasizing the impacts of climate change on Jordan's water resources and the measures Jordan is taking to address these challenges. On the other hand, The National Climate Change Adaptation Plan of Jordan (2022) highlighted the impacts of climate change on Jordan's tourism industry, identifying both the challenges and opportunities that climate change presents for the sector, along with the steps being taken to adapt to these impacts. Based on the aforementioned studies, there are certain measures that could be adopted, which are as follows:

4.1. Adoption Techniques

There are several techniques that can be used to promote the adoption of climate-friendly policies and practices in Jordan (The National Climate Change Adaptation Plan of Jordan, 2022), which are as follows:

4.1.1. Education and Outreach

Providing information and education about the impacts of climate change and the benefits of climate-friendly practices can help to increase awareness and understanding of these issues among the public. This could include outreach campaigns, public lectures and workshops, and educational materials for schools and other organizations.

4.1.2. Incentives and Rewards

Implementing incentives and rewards for individuals, businesses, and organizations that adopt climate-friendly practices can help to encourage the adoption of these practices. This could include financial incentives, such as grants or subsidies. For example, the government could provide financial incentives to individuals or businesses that install solar panels, invest in energy-efficient appliances or vehicles, or adopt other climate-friendly practices. Non-financial incentives, such as recognition or awards, can also be used to encourage the adoption of climate-friendly practices. For example, the government could establish a program to recognize and award individuals or businesses that adopt climate-friendly practices or create a public information campaign to highlight the benefits of these practices.

4.1.3. Regulatory Measures

Implementing regulatory measures, such as laws, regulations, or standards, can help to encourage the adoption of climate-friendly practices by setting a minimum level of performance or establishing requirements that must be met.For example, the government could set minimum energy efficiency standards for buildings or vehicles or require certain industries to reduce their greenhouse gas emissions.

4.1.4. Public-private partnerships

Collaborating with the private sector and other stakeholders, such as NGOs and community organizations, can help to promote the adoption of climate-friendly practices. This could include partnering on initiatives to reduce greenhouse gas emissions or working together to develop and implement programs or projects that promote climate-friendly practices.

4.1.5. Market-based Mechanism

Using market-based mechanisms, such as carbon pricing or tradable permits, can help to incentivize the adoption of climate-friendly practices by providing a financial reward for reducing greenhouse gas emissions.

These are just a few examples of techniques that can be used to promote the adoption of climate-friendly policies and practices in Jordan. It is important to consider the specific context and needs of the country when selecting and implementing these techniques and to ensure that they are tailored to the local situation.

4.2. International Support for Addressing Climate Change Problem In Jordan

There are a number of ways in which the international community can support Jordan in its efforts to address the challenges of climate change (The National Climate Change Adaptation Plan of Jordan, 2022).

4.2.1. Providing Financial Assistance

Providing financial assistance to help Jordan implement climate-friendly policies and projects can be an effective way to support the country's efforts to address climate change. This could include providing funding for renewable energy projects, water management initiatives, or other efforts to mitigate and adapt to the impacts of climate change.

4.2.2. Sharing Knowledge and Expertise

Sharing knowledge and expertise on climate change and related issues can help to support Jordan's efforts to address these challenges. This could include providing technical assistance, training programs, and other forms of support to help the country develop and implement effective climate-friendly policies and practices.

4.2.3. Collaborating on Research and Development

Collaborating with Jordan on research and development initiatives related to climate change can help to support the country's efforts to address these challenges. This could include conducting joint research projects, sharing data and other resources, and working together to develop new technologies or approaches to address climate change.

4.2.4. Encouraging International Action

Encouraging the international community to take action on climate change can help to support Jordan's efforts to address these challenges. This could include advocating for stronger international climate agreements, supporting initiatives to reduce greenhouse gas emissions, and encouraging other countries to provide financial and technical assistance to Jordan and other countries facing similar challenges.

Overall, it is important for the international community to work together with Jordan and other countries to address the challenges of climate change. By providing financial and technical assistance, sharing knowledge and expertise, and collaborating on research and development, the international community can help support Jordan's efforts to mitigate and adapt to the effects of climate change.

CONCLUSION

In conclusion, climate change is a global phenomenon that is having a range of negative impacts on Jordan, including rising temperatures, declining water resources, and more frequent and severe heat waves. These impacts are having significant consequences for the country's environment, economy, and society, and it is important that Jordan takes steps to mitigate and adapt to these impacts to minimize their consequences. There are several strategies that Jordan can consider in order to address these challenges, including promoting the use of renewable energy, increasing energy efficiency, implementing carbon pricing, developing green infrastructure, promoting sustainable transportation, and conserving and protecting natural resources. The international community can also play a role in supporting Jordan's efforts to address these challenges by providing financial and technical assistance, sharing knowledge and expertise, collaborating on research and development, and encouraging international action. By working together, Jordan and the international community can take effective action to address the challenges of climate change and protect the country's future.

RECOMMENDATIONS

This article aimed to explore potential methods for minimizing the effects of climate change. However, further studies should be carried out to develop more effective solutions.

Nonetheless, as recommendations, Jordan should develop a comprehensive climate change strategy that outlines the country's goals and objectives for mitigating and adapting to the impacts of climate change. This strategy should include specific actions for the government and other stakeholders based on a thorough analysis of the country's vulnerabilities and strengths.

Promoting the use of renewable energy, such as solar and wind power, can reduce reliance on fossil fuels and lower greenhouse gas emissions, supported by incentives like feed-in tariffs or tax credits. Increasing energy efficiency in buildings, transportation, and industry through policies such as building codes or appliance efficiency standards can also contribute to emission reductions. Implementing carbon pricing, such as a carbon tax or cap-and-trade program, can further encourage climate-friendly practices and technologies. Additionally, investing in green infrastructure like green roofs and urban forests can help mitigate climate impacts by reducing urban heat and enhancing water absorption.

Overall, it is important for Jordan to take a comprehensive and integrated approach to addressing the challenges of climate change and to work with a range of stakeholders, including the private sector, NGOs, and the international community, to implement these recommendations effectively.

DECLARATION

The English language of the article was improved with ChatGPT to enhance the overall language quality and readability of the text.

AUTHORS' CONTRIBUTIONS

The authors confirm their contribution to the paper as follows: Data collection: NAH; analysis and interpretation of results: AFA; draft manuscript: ZAH. All authors reviewed the results and approved the final version of the manuscript.

ABBREVIATION

UNDP = United Nations Development Program

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIAL

All the data and supporting information are provided within the article.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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