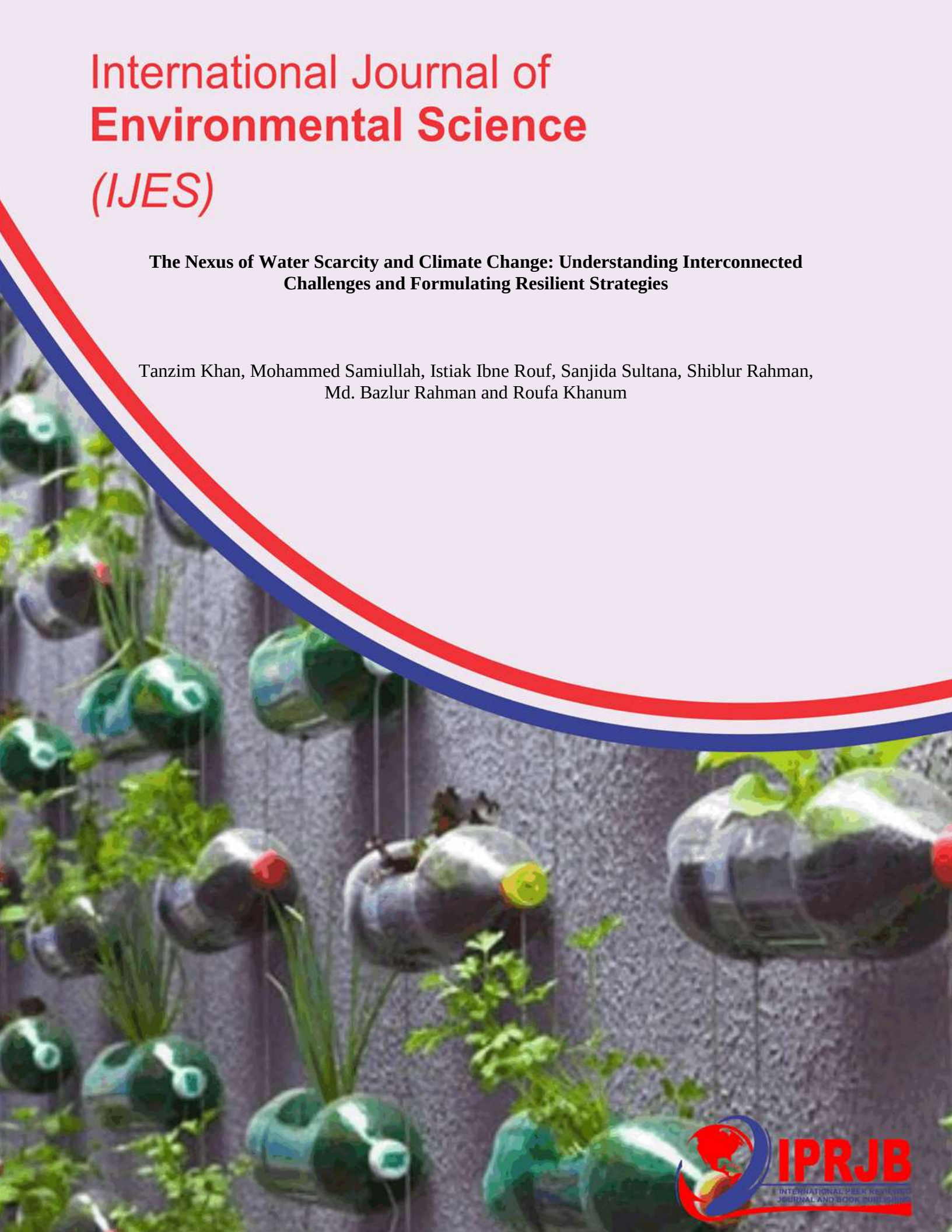
International Journal of
Environmental Science
(IJES)

The Nexus of Water Scarcity and Climate Change: Understanding Interconnected Challenges and Formulating Resilient Strategies

Tanzim Khan, Mohammed Samiullah, Istiak Ibne Rouf, Sanjida Sultana, Shiblur Rahman, Md. Bazlur Rahman and Roufa Khanum



IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

International Journal of Environmental Sciences

ISSN 2519-5549 (online)

Vol.7, Issue 3, No.5. pp 57 - 68, 2024

www.iprjb.org

The Nexus of Water Scarcity and Climate Change: Understanding Interconnected Challenges and Formulating Resilient Strategies

Tanzim Khan
Public Health Specialist, Centre for Climate Change and Environmental Research (C3ER), BRAC University

Mohammed Samiullah
Lead, Project Management, Centre for Climate Change and Environmental Research (C3ER), BRAC University

Istiak Ibne Rouf
Environmental Specialist, Centre for Climate Change and Environmental Research (C3ER), BRAC University

Sanjida Sultana
Khulna University

Shiblur Rahman
Department of Geography and Environment, University of Dhaka

Md. Bazlur Rahman
Students Advisor, Department of Public Health, Anwar Khan Modern University

Roufa Khanum
Assistant Director, Centre for Climate Change and Environmental Research (C3ER), BRAC University

Article History

Received 4th July 2024

Received in Revised Form 7th August 2024

Accepted 4th September 2024

How to cite in APA format:

Khan, T., Samiullah, M., Rouf, I., Sultana, S., Rahman, S., Rahman, B., & Khanum, R. (2024). The Nexus of Water Scarcity and Climate Change: Understanding Interconnected Challenges and Formulating Resilient Strategies. *International Journal of Environmental Sciences*, *7*(3), 57–68. https://doi.org/10.47604/ijes.2915

Abstract

Purpose: This research explores the intricate relationship between water scarcity and climate change, recognizing their interconnected challenges and the need for resilient strategies. Through a multifaceted approach, the study examines global impacts, socio-economic ramifications, and strategies for mitigation.

Methodology: Using qualitative research methods, diverse perspectives from 40 individuals across various sectors are captured through interviews. Thematic analysis of these insights reveals the nuanced dynamics of the nexus between water scarcity and climate change.

Findings: The results underscore the urgent need for comprehensive understanding and action. Rising temperatures, altered precipitation patterns, and melting glaciers exacerbate water stress, threatening ecosystems, societies, and economies globally. Socioeconomic implications include reduced agricultural productivity, compromised food security, and increased vulnerability of marginalized communities. Resilient strategies are proposed, including Integrated Water Resource Management, Climate Resilient Infrastructure, and Sustainable Agricultural Practices. Additionally, fostering Community Engagement, Policy Reform, and International Cooperation are vital. Nature-based solutions offer promise in mitigating impacts, while education and awareness-raising efforts are crucial for building resilience.

Unique Contribution to Theory, Practice and Policy: This research provides a roadmap for addressing the interconnected challenges of water scarcity and climate change, emphasizing the importance of coordinated action and sustained commitment at all levels. By implementing these strategies, we can pave the way for sustainable water management and adaptation to a changing climate, ensuring the well-being of present and future generations.

Keywords: *Water Scarcity, Climate Change, Interconnected Challenges, Resilient Strategies, Socio-Economic Ramifications*

International Journal of Environmental Sciences
ISSN 2519-5549 (online)
Vol.7, Issue 3, No.5. pp 57 - 68, 2024
www.iprjb.org

INTRODUCTION

Water scarcity and climate change represent two of the most pressing challenges of the 21st century, with far-reaching implications for human societies, ecosystems, and economies. The intricate relationship between these phenomena underscores the urgent need for comprehensive understanding and proactive strategies to address their interconnected impacts.

According to the United Nations World Water Development Report 2020, climate change exacerbates water scarcity, as changing precipitation patterns, rising temperatures, and extreme weather events disrupt water availability and quality. The Intergovernmental Panel on Climate Change (IPCC) highlights in its Special Report on Climate Change and Land that water scarcity is projected to increase in many regions due to climate change, including Africa, Asia, and the Mediterranean. Climate change intensifies hydrological variability, leading to more frequent and severe droughts in vulnerable regions, as emphasized in a study published in Nature Climate Change by Vörösmarty et al. (2010). Additionally, the impacts of climate change on water resources are multifaceted, affecting not only water availability but also quality, timing, and distribution, as argued by Gleick (2014) in Science magazine.

Water scarcity, exacerbated by climate change, poses significant risks to economic growth, food security, and human well-being, as underscored in the World Bank's report "High and Dry: Climate Change, Water, and the Economy." Moreover, climate change alters the hydrological cycle, leading to shifts in precipitation patterns, increased evaporation rates, and changes in river flows, as stated in the assessment report by the European Environment Agency. The interaction between climate change and water scarcity varies geographically, with some regions experiencing more pronounced impacts due to their vulnerability and exposure, according to the Global Water Forum. Furthermore, water scarcity induced by climate change disproportionately affects marginalized communities, exacerbating social inequalities, as asserted by Mirza and Haider (2019) in their research published in Environmental Science & Policy.

The need for integrated water resource management approaches that consider climate variability and change is stressed in the Asian Development Bank's publication "Addressing Water Scarcity and Climate Change in the Asia and Pacific Region." Adaptation strategies to address water scarcity and climate change must be context-specific, taking into account local environmental, social, and economic conditions, as highlighted by Alcamo et al. (2007) in Global Environmental Change. The United Nations Sustainable Development Goal 6 aims to ensure availability and sustainable management of water and sanitation for all, recognizing the crucial link between water security, climate resilience, and sustainable development.

In light of these perspectives, it is evident that the nexus between water scarcity and climate change demands urgent attention and concerted action. By understanding the interconnected challenges and formulating resilient strategies, we can strive towards a more sustainable and equitable future.

Research Objective

This research endeavors to unravel the intricate relationship between water scarcity and climate change, recognizing their interconnected challenges. Through a multifaceted approach, the study aims to elucidate global patterns, assess socio-economic ramifications, and devise resilient strategies to mitigate the impacts of this critical nexus.

- ✓ Examine the global impact of climate change on water scarcity, analyzing regional variations and severity to understand the interconnected challenges.
- ✓ Investigate the socio-economic and environmental consequences of climate-induced water scarcity on vulnerable populations, aiming to inform equitable adaptation strategies.
- ✓ Develop resilient strategies to address the nexus of water scarcity and climate change, integrating technological, policy, and community-based approaches for sustainable water management.

In conclusion, by comprehensively understanding the dynamics of the water scarcity and climate change nexus, and through the development of resilient strategies, we can pave the way for sustainable water management and adaptation to a changing climate, ensuring the well-being of both present and future generations.

LITERATURE REVIEW

Water scarcity and climate change are two critical challenges that are intricately interconnected, exacerbating each other's impacts and posing significant threats to human societies and ecosystems worldwide. Understanding the complex interplay between these phenomena is crucial for devising effective strategies to address them. This literature review explores the current state of knowledge regarding the nexus between water scarcity and climate change, highlighting interconnected challenges and proposing resilient strategies for mitigation and adaptation.

Climate change alters precipitation patterns, leading to changes in the distribution, timing, and intensity of rainfall. This results in alterations in water availability, affecting both surface water and groundwater resources (IPCC, 2014). Growing population, urbanization, and industrialization are key drivers of water scarcity, intensifying competition for limited water resources (UN-Water, 2020). Water scarcity exacerbates climate change impacts by limiting water availability for agriculture, energy production, and human consumption, further contributing to greenhouse gas emissions and climate variability (Wisser et al., 2010). Water scarcity and climate change negatively impact ecosystems, disrupting biodiversity, altering habitats, and threatening the survival of species dependent on specific water regimes (Döll et al., 2009). Certain regions, such as arid and semi-arid areas, are particularly vulnerable to the combined effects of water scarcity and climate change, posing challenges for sustainable development and poverty alleviation (Bates et al., 2008).

Adaptive water management practices, including water conservation, efficient irrigation techniques, and integrated water resource management, are crucial for building resilience to water scarcity and climate change (UNEP, 2016). Advancements in water treatment technologies, desalination, and rainwater harvesting offer promising solutions for addressing water scarcity challenges in the context of climate change (Shannon et al., 2008). Effective policy frameworks at local, national, and international levels are essential for addressing the interconnected challenges of water scarcity and climate change, promoting sustainable water governance and equitable resource allocation (UNESCO, 2015). Water scarcity and climate change have profound socio-economic implications, affecting livelihoods, food security, health, and human well-being, particularly in vulnerable communities (Rosenzweig et al., 2014).

Integrated approaches that foster collaboration across sectors such as water, energy, agriculture, and urban planning are critical for addressing the complex nexus between water scarcity and climate change (UNDESA, 2017). Engaging local communities and stakeholders in decision-making processes, knowledge sharing, and capacity building is essential for fostering resilience and adaptive governance in the face of water scarcity and climate change (Adger et al., 2009). Investment in water infrastructure, climate-resilient technologies, and sustainable water management practices requires innovative financing mechanisms, including public-private partnerships and international aid (World Bank, 2018).

Promoting public awareness, education, and behavioral change regarding water conservation and climate adaptation is crucial for building societal resilience and fostering a culture of sustainability (Leal Filho et al., 2020). Incorporating indigenous knowledge systems and traditional water management practices can complement modern scientific approaches, offering holistic perspectives and culturally appropriate solutions to water scarcity and climate change (Berkes, 2009). Developing robust monitoring networks and early warning systems for water scarcity and climate-related risks enables timely interventions and adaptive responses, enhancing resilience and reducing vulnerability (UNEP-DHI, 2018).

Investment in interdisciplinary research, innovation, and technology transfer is essential for advancing understanding of the water scarcity and climate change nexus and developing effective strategies for mitigation and adaptation (IPCC, 2018). Enhancing international cooperation, knowledge sharing, and capacity building is imperative for addressing Tran's boundary water challenges and promoting collective action to mitigate the impacts of water scarcity and climate change on a global scale (UN-Water, 2021).

The nexus between water scarcity and climate change presents multifaceted challenges that require comprehensive and integrated approaches for mitigation and adaptation. By understanding the interconnected nature of these challenges and formulating resilient strategies, societies can effectively address the impacts of water scarcity and climate change, safeguarding water security, ecological integrity, and human well-being for present and future generations.

While the literature reviewed provides valuable insights into the interconnected challenges of water scarcity and climate change, there remains a notable research gap regarding the integration of social, economic, and environmental dimensions within resilience-building strategies. Specifically, there is a need for comprehensive studies that examine the differential impacts of water scarcity and climate change on vulnerable populations, particularly in developing regions, and explore context-specific adaptation pathways that prioritize equity and social justice.

Existing research predominantly focuses on technological and engineering solutions for water management and climate adaptation, often overlooking the social dynamics and governance structures that shape access to and distribution of water resources. Moreover, limited attention has been given to the role of indigenous knowledge systems and community-based approaches in enhancing resilience to water scarcity and climate change impacts.

Furthermore, while there is recognition of the importance of cross-sectoral collaboration and integrated water resource management, empirical studies that assess the effectiveness of such approaches in real-world contexts are scarce. There is a need for interdisciplinary research that

bridges the gap between natural and social sciences, facilitating holistic understandings of the water scarcity and climate change nexus and informing evidence-based policy and decision-making processes.

Overall, addressing this research gap requires interdisciplinary collaborations, participatory methodologies, and engagement with diverse stakeholders to co-produce knowledge and develop contextually relevant strategies for building resilience to the interconnected challenges of water scarcity and climate change. By filling this gap, researchers can contribute to more inclusive, sustainable, and adaptive approaches to water management and climate adaptation that prioritize the needs and rights of marginalized communities and promote environmental justice.

METHODOLOGY

In addressing the intricate relationship between water scarcity and climate change, a qualitative research approach is adopted to comprehensively explore the experiences and insights of individuals directly affected by these challenges. The primary objective of this research is to elucidate how water scarcity and climate change intersect, examining their impacts on various stakeholders and ecosystems while identifying resilient strategies to mitigate these effects.

Participant selection for interviews is guided by the aim to capture diverse perspectives and expertise related to water management, environmental conservation, agriculture, policymaking, and community development. Efforts are made to ensure demographic diversity among participants, encompassing factors such as geographical location, gender, age, occupation, and level of experience. Approximately 40 individuals are interviewed, chosen strategically to ensure a rich and varied dataset that encompasses a broad spectrum of perspectives.

Each participant undergoes a semi-structured interview, either in person or virtually, with careful consideration given to obtaining informed consent and ensuring participant confidentiality. The interview process is facilitated by a flexible interview guide that covers a range of topics, including personal experiences with water scarcity and climate change, perceived impacts on livelihoods and ecosystems, existing challenges, successful interventions, and recommendations for resilience-building strategies.

To capture the nuances of participants' responses, all interviews are recorded using video technology, allowing for the preservation of verbal and non-verbal communication cues. Following the interview phase, transcripts are generated from the video recordings and subjected to thematic analysis. This process involves systematically coding the data using qualitative data analysis software to identify recurring patterns, themes, and insights across the interviews.

Ethical considerations are paramount throughout the research process, with measures in place to safeguard participant confidentiality and respect their viewpoints and experiences. Additionally, efforts are made to maximize the benefits of the research outcomes for both participants and broader stakeholders by disseminating findings to inform policy and practice. By following this structured methodology, this research endeavors to contribute to a deeper understanding of the interconnected challenges of water scarcity and climate change, ultimately facilitating the development of resilient strategies to address these pressing issues.

RESULT

The intricate relationship between water scarcity and climate change underscores one of the most pressing challenges of our time. As temperatures rise, weather patterns shift, and glaciers melt, the availability and distribution of water are profoundly affected, amplifying existing vulnerabilities and posing significant threats to ecosystems, societies, and economies worldwide. Understanding the nexus between water scarcity and climate change is paramount for formulating resilient strategies that can effectively address these interconnected challenges.

This introduction sets the stage for exploring the multifaceted dynamics at play, highlighting the critical need to comprehend how water scarcity and climate change intersect and impact various aspects of human and natural systems. By unraveling the complexities of this nexus, we can unlock insights that inform the development of robust and adaptive solutions, bolstering resilience and fostering sustainable development in the face of evolving environmental pressures. Through a comprehensive examination of the interlink ages, implications, and potential pathways forward, this study aims to contribute to a deeper understanding of the water scarcity and climate change nexus and pave the way for transformative action.

What are the primary factors contributing to the nexus between water scarcity and climate change?

The interconnection between water scarcity and climate change is primarily driven by factors such as increased temperatures leading to higher evaporation rates, altered precipitation patterns, and melting glaciers, all of which exacerbate water stress in various regions.

How does water scarcity exacerbate the impacts of climate change on ecosystems and biodiversity?

Water scarcity intensifies the impacts of climate change on ecosystems and biodiversity by reducing available habitats, altering species distribution, and increasing competition for limited water resources, ultimately leading to ecosystem degradation and loss of biodiversity.

What are some socioeconomic implications of the nexus between water scarcity and climate change?

The socioeconomic implications include reduced agricultural productivity, compromised food security, increased vulnerability of marginalized communities, heightened risk of conflicts over water resources, and economic losses due to water-related disasters, all of which amplify existing inequalities and threaten sustainable development goals.

How can understanding the interconnected challenges of water scarcity and climate change inform resilient strategies?

Understanding the interconnected challenges enables the development of resilient strategies that integrate water management with climate adaptation and mitigation efforts, promote sustainable water use practices, enhance ecosystem resilience, foster community engagement, and prioritize investments in infrastructure and technology for water security.

What role do policy interventions play in addressing the nexus between water scarcity and climate change?

Policy interventions play a crucial role in addressing the nexus by establishing regulatory frameworks, promoting water-efficient practices, incentivizing investments in climate-resilient infrastructure, fostering international cooperation for Tran's boundary water management, and integrating water and climate considerations into broader development strategies.

How do climate change-induced extreme weather events exacerbate water scarcity?

Climate change-induced extreme weather events, such as droughts, floods, and storms, exacerbate water scarcity by disrupting water availability, damaging water infrastructure, compromising water quality, and increasing the frequency and intensity of water-related disasters, thus amplifying the vulnerability of communities and ecosystems.

What are the implications of the water-energy nexus in the context of addressing water scarcity and climate change?

The water-energy nexus highlights the interconnectedness between water and energy systems, where water scarcity impacts energy production and vice versa. Addressing this nexus involves promoting water-efficient energy technologies, reducing energy consumption in water supply and treatment processes, and integrating water and energy policies to enhance resource efficiency and climate resilience.

How can nature-based solutions contribute to mitigating water scarcity and climate change impacts?

Nature-based solutions, such as reforestation, wetland restoration, soil conservation, and sustainable land management practices, can contribute to mitigating water scarcity and climate change impacts by enhancing water retention, regulating water flow, improving soil moisture, sequestering carbon, and enhancing ecosystem resilience, thereby providing multiple co-benefits for both people and the environment.

What are the challenges associated with implementing resilient strategies to address the nexus between water scarcity and climate change?

Challenges include limited access to financial resources, inadequate institutional capacity, competing interests and priorities, lack of political will, uncertainties in climate projections, conflicting stakeholder interests, and social barriers to behavioral change, all of which require coordinated action and sustained commitment at local, national, and global levels.

How can education and awareness-raising efforts contribute to building resilience to the nexus between water scarcity and climate change?

Education and awareness-raising efforts can contribute to building resilience by fostering understanding of the complex interactions between water scarcity and climate change, promoting sustainable water management practices, empowering communities to adapt to changing conditions, mobilizing public support for policy action, and nurturing a culture of stewardship and collective responsibility towards water resources and the environment.

To address the interconnected challenges of water scarcity and climate change outlined in the effects, a comprehensive approach involving various strategies and stakeholders is necessary. Here's a roadmap for solving these challenges:

- **Integrated Water Resource Management (IWRM):** Implement IWRM approaches that consider the holistic management of water resources, taking into account social, economic, and environmental dimensions. This involves balancing competing water uses, promoting water efficiency, and ensuring equitable access to water for all stakeholders.
- **Climate Resilient Infrastructure:** Invest in climate-resilient infrastructure for water storage, distribution, and treatment to withstand extreme weather events and ensure water supply reliability. This includes updating and upgrading existing infrastructure to adapt to changing climate conditions.
- **Sustainable Agricultural Practices:** Promote sustainable agricultural practices that optimize water use efficiency, reduce water pollution from agricultural runoff, and enhance soil moisture retention. This can include adopting precision irrigation techniques, promoting agroecological approaches, and integrating water-saving technologies.
- **Ecosystem-Based Adaptation (EbA):** Implement EbA measures to enhance ecosystem resilience and restore natural water-related infrastructure such as wetlands, forests, and watersheds. Healthy ecosystems provide essential services like water purification, flood regulation, and groundwater recharge, mitigating the impacts of water scarcity and climate change.
- **Community Engagement and Capacity Building:** Engage local communities in water management decision-making processes, empower them with knowledge and skills for sustainable water use, and build their capacity to adapt to climate change impacts. Community-led initiatives can be effective in identifying and implementing context-specific solutions.
- **Policy and Governance Reform:** Strengthen water governance frameworks and enact policies that integrate water and climate considerations into development planning at all levels. This involves promoting cross-sectoral coordination, establishing clear regulations, and fostering partnerships between governments, civil society, and the private sector.
- **Investment in Research and Innovation:** Support research and innovation to develop new technologies, tools, and approaches for water management and climate adaptation. This includes investment in water-saving technologies, climate modeling, drought-resistant crops, and early warning systems for extreme weather events.
- **International Cooperation:** Foster international cooperation and collaboration to address transboundary water issues, share best practices, and mobilize financial and technical support for vulnerable regions. Multilateral agreements and partnerships can facilitate joint action on water scarcity and climate change adaptation at the global scale.

- **Behavioral Change and Public Awareness:** Promote behavioral change and raise public awareness about the importance of water conservation, climate resilience, and sustainable lifestyle choices. Education campaigns, outreach programs, and incentives can encourage individuals and communities to adopt water-saving practices and support collective efforts to address the water scarcity and climate change nexus.
- **Monitoring and Evaluation:** Establish robust monitoring and evaluation mechanisms to track progress, assess the effectiveness of interventions, and adapt strategies as needed. Regular monitoring of water resources, climate indicators, and socio-economic impacts can inform evidence-based decision-making and ensure accountability in addressing the interconnected challenges of water scarcity and climate change.

Conclusion

Water scarcity and climate change are two of the most pressing challenges facing humanity in the 21st century. While these issues are often discussed separately, they are deeply interconnected, with each exacerbating the other. As temperatures rise and weather patterns become more erratic, water resources are increasingly strained, leading to scarcity in many regions around the world. Understanding the complex relationship between water scarcity and climate change is essential for developing effective strategies to address these challenges and build resilience in the face of uncertainty.

At its core, the nexus between water scarcity and climate change revolves around the delicate balance of the Earth's water cycle. Climate change alters precipitation patterns, leading to more frequent and severe droughts in some areas and intense rainfall events in others. These shifts in precipitation, coupled with rising temperatures, contribute to changes in evaporation rates and water availability, further exacerbating water scarcity. Moreover, climate change can also affect the quality of water resources, as higher temperatures and altered weather patterns can lead to increased contamination and pollution.

The impacts of water scarcity and climate change are far-reaching, affecting ecosystems, economies, and human well-being. In regions already prone to water stress, such as arid and semi-arid areas, the consequences of dwindling water resources can be devastating. Agriculture, which accounts for the largest share of global water use, is particularly vulnerable to water scarcity, leading to reduced crop yields, food insecurity, and economic hardship for farmers. Additionally, water scarcity can exacerbate conflicts over water resources, further destabilizing fragile regions and exacerbating social tensions.

However, while the challenges posed by water scarcity and climate change are significant, there are also opportunities for resilience and adaptation. By understanding the interconnected nature of these challenges, policymakers, scientists, and communities can develop holistic strategies that address both the causes and consequences of water scarcity and climate change. This requires a paradigm shift in how we manage and govern water resources, moving away from siloed approaches towards integrated water management that considers the entire water cycle and its interactions with the climate system.

One key aspect of building resilience to water scarcity and climate change is investing in sustainable water management practices. This includes improving water efficiency in agriculture, industry, and households, promoting water recycling and reuse, and restoring natural ecosystems that provide essential water services, such as wetlands and forests. By maximizing the value derived from each drop of water, we can ensure that water resources are used more effectively and sustainably, even in the face of changing climatic conditions.

REFERENCES

Adger, W. N., et al. (2009). "Adaptation to climate change in the developing world." Progress in Development Studies, 8(3), 179-195.

Alcamo, J., Doll, P., Henrichs, T., Kaspar, F., & Lehner, B. (2007). Development and testing of the WaterGAP 2 global model of water use and availability. Hydrological Sciences Journal, 48(3), 317–337. https://doi.org/10.1623/hysj.48.3.317

Asian Development Bank. (2019). Addressing Water Scarcity and Climate Change in the Asia and Pacific Region. Asian Development Bank. https://www.adb.org/publications/addressing-water-scarcity-and-climate-change-asia-and-pacific-region

Bates, B. C., et al. (2008). "Climate change and water." Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, Switzerland.

Berkes, F. (2009). "Indigenous ways of knowing and the study of environmental change." Journal of the Royal Society of New Zealand, 39(4), 151-156.

Döll, P., et al. (2009). "Impact of water withdrawals from groundwater and surface water on continental water storage variations." Journal of Geodynamics, 48(3-5), 223-232.

European Environment Agency. (2017). Climate change, impacts and vulnerability in Europe 2016: An indicator-based report. Publications Office of the European Union. https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016

Gleick, P. H. (2014). Water, drought, climate change, and conflict in Syria. Weather, Climate, and Society, 6(3), 331–340. https://doi.org/10.1175/WCAS-D-13-00059.1

Global Water Forum. (n.d.). Climate Change and Water Scarcity. https://www.globalwaterforum.org/2012/06/05/climate-change-and-water-scarcity/

IPCC. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

IPCC. (2018). Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change.

IPCC. (2019). Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. IPCC. https://www.ipcc.ch/srccl/

Leal Filho, W., et al. (2020). "Water, climate change, and the SDGs: Challenges and opportunities." International Journal of Sustainable Development & World Ecology, 27(5), 392-400.

Mirza, M. M. Q., & Haider, H. (2019). Climate change-induced water scarcity and food security: A review of the challenges, mitigation strategies, and opportunities in sub-Saharan Africa and South Asia. Environmental Science & Policy, 97, 130–142. https://doi.org/10.1016/j.envsci.2019.03.003

Rosenzweig, C., et al. (2014). "Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison." Proceedings of the National Academy of Sciences, 111(9), 3268-3273.

Shannon, M. A., et al. (2008). "Science and technology for water purification in the coming decades." Nature, 452(7185), 301-310.

UN World Water Development Report. (2020). United Nations. https://www.unwater.org/publications/world-water-development-report-2020-water-and-climate-change/

UNDESA. (2017). "Policy brief: Climate change and water." United Nations Department of Economic and Social Affairs.

UNEP. (2016). "Water management and climate change adaptation: Promoting a sustainable approach to water resources management in a changing climate." United Nations Environment Programme.

UNEP-DHI. (2018). "Water scarcity and droughts." United Nations Environment Programme and DHI Centre on Water and Environment.

UNESCO. (2015). "The United Nations world water development report 2015: Water for a sustainable world." United Nations Educational, Scientific and Cultural Organization.

United Nations. (2015). Sustainable Development Goal 6: Ensure availability and sustainable management of water and sanitation for all. United Nations. https://sdgs.un.org/goals/goal6

UN-Water. (2020). "Water and climate change." UN-Water Policy Brief.

UN-Water. (2021). "Transboundary waters." UN-Water Policy Brief.

Vörösmarty, C. J., Green, P., Salisbury, J., & Lammers, R. B. (2000). Global water resources: Vulnerability from climate change and population growth. Science, 289(5477), 284–288. https://doi.org/10.1126/science.289.5477.284

Wisser, D., et al. (2010). "A comparison of two hydrological models for climate impact assessment over the Mississippi River Basin." Journal of Geophysical Research: Atmospheres, 115(D16).

World Bank. (2016). High and Dry: Climate Change, Water, and the Economy. World Bank. https://openknowledge.worldbank.org/handle/10986/25100

World Bank. (2018). "Water scarcity: The missing piece in the climate change adaptation puzzle." World Bank Group.

World Economic Forum. (2020). The Global Risks Report 2020. World Economic Forum. https://www.weforum.org/reports/the-global-risks-report-2020