The Impact of Climate Resilience on the Sustainable Management of Water Supply Schemes in Sri Lanka

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Abstract: As climate continued to pose significant challenges to water resources globally, developing climate-resilient strategies for managing water supply schemes became critical, particularly in vulnerable regions like Sri Lanka. Accordingly, the research explored the interplay between climate resilience and the sustainable management of water supply schemes, with a specific focus on Sri Lanka. Comprehensively literature review conducted to understand the existing knowledge and practices. The review examined the climate change impacts on and identified potential strategies for enhancing the resilience. Data set were collected through the Information System of DNCWS and Quantitative statistical techniques were used to, analyse the collected data. The study revealed that water service reliability in the 'severe' category of water supply schemes fluctuated significantly between dry and wet periods, around 42%, in response to changing climate conditions in the country. However, further studies need to carry out to test the water quality parameters in water supply schemes in relation to climate resilience.

Keywords: Climate Change, Community Based Organizations, Water Service Reliability

1. Introduction

The Panel on Climate Change states that human activities, mainly the emission of greenhouse gases, are causing global warming, with the globally surface temperature reaching 1.1°C above 1850–1900 in 2011–2020 (UNEP, 2023). The icebergs are already beginning to melt of rise in global ambient temperature, which may have a direct detrimental effect on humanity (Hamza et al., 2020). Because water resource management and climate change are fundamentally related tasks, water availability determines by the extent of resilience to climate change (DeNicola et al., 2015). Due to the climate change availability, availability of water in water supply schemes constantly fluctuates. Increasing water scarcity and

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population growth are the challenges that water supply schemes are facing, and about 4 billion people are facing severe water scarcity for at least one month every year. As the impact of climate change increases, grows interest in society in strategies to build resilience to cope with it (Howard et al., 2021).

2. Literature Review

Strong cyclones, heavy rainfall and drought are becoming more frequent and intense in many places, and people living in less developed countries and regions are more vulnerable. Apart from this, showing a rate of water consumption growth globally is also a huge challenge that has to be faced. (World Health Organization (WHO), 2020).

Access to the safe drinking water is a significant determinant of human health, access to the quality water is a difficult challenge for rural communities in developing countries (Eslamian & Eslamian, 2022). According to that, a demand driven approach to providing drinking water to rural and state communities as a decentralized mechanism started many years ago, resulting in the emergence of Community Based Organizations (CBOs) with the aim of improving the social and infrastructural development of these communities (Fernando & London, 2019).

Over 3000 community-managed rural water supply schemes, primarily funded by donors, have been implemented in Sri Lanka since the 1980s. Currently, approximately 4500 Community Based Organizations (CBOs) successfully functioned under DNCWS as water supply schemes.

Given the relationship between climate change and water resource management, resilience to climate change has played a pivotal role in ensuring water availability in these schemes (Sinclair, 2020). Consequently, the emergence of climate-induced challenges underscores the necessity to formulate climate-resilient strategies and practices to safeguard water resources for the well-being of future generations (Amerasinghe, 2009).

As there has been a lack of in-depth research that incorporates the concept of resilience in disaster and climate change (Tsuchida & Takeda, 2021) the research has been undertaken to identify the impacts of climate resilience on water service reliability of water supply schemes in Sri Lanka. And also, purpose to recommend acceptable solutions to ensure the long-term sustainability of water supply schemes in Sri Lanka , considering water service reliability in dry and wet periods using a quantitative methodology (Femi Monday, 2020).

3. Methodology

The Department of National Community Water Supply (DNCWS) regulate community-based organizations (CBOs) and provided safe drinking water to people in remote areas that is unable to reach in easily. By now, approximately 4250 community-based organizations engaged under

the department, and for this research endeavour, 4000 Community Based Organizations (CBOs) have selected. For that, the dataset had sourced from the Management Information System (MIS) of the DNCWS.

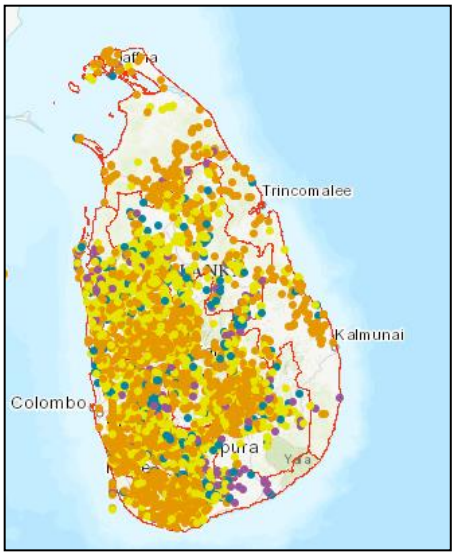

Figure 01: CBOs in Sri Lanka (www.rwss.lk)

The dataset served as the foundation for this research, offering valuable insights into the performance of water supply schemes across different regions of the country.

The research aimed to assess the water service reliability of the water supply schemes during dry and wet periods. For that, the "water service reliability" dash board's statistics (www.rwss.lk) selected from the system to collect the dataset.

The collected dataset for the research comprises information on the reliability of water service in water supply schemes in Sri Lanka categorized into three levels as "Good," "Moderate," and "Severe".

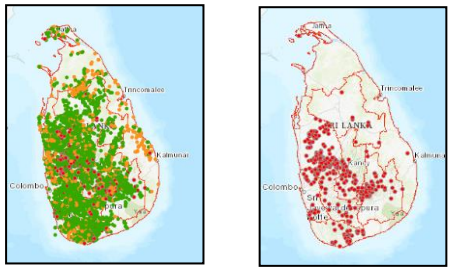

Figure 02: Water Service Reliability in Dry Period (www.rwss.lk)

This dataset offered a snapshot of the performance of water supply schemes during both dry and wet periods. In particular, there were 2,760 water schemes with "Good" level, 853 with "Moderate" level, and 387 with "Severe" level water supply reliability during dry periods. In contrast, the data showed that during wet seasons, water systems had a 3,086 "Good" dependability level, 685 "Moderate" reliability level, and 229 "Severe" reliability levels.

These data offered a fundamental understanding of water service reliability in water supply schemes and laying the groundwork for a thorough examination of the effects of climate resilience. The dataset was acquired from the official records of the DNCWS MIS system, ensuring the confidentiality and privacy of the water supply schemes and no sensitive information was accessed or disclosed during the analysis.

Descriptive statistics were utilized to gain a comprehensive understanding of the central tendencies and dispersion of water service reliability within each classification and Statistical metrics were computed to capture the

distributional characteristics of the dataset.

4. Results

The results of the study aimed to provide insights into the performance of schemes under various climatic conditions. A brief overview of the data set for this research was given before delving into the specific findings, and important points such as the nature of the data and the classification of water service reliability levels were outlined in this portion of the article.

Parameters	Mean	Median	SD
Good	690	641.5	589.44
Moderate	213.25	92	303.26
Severe	96.75	85.5	100.26

Table 01: Water Service Reliability in Dry Period

Parameters	Mean	Median	SD
Good	771.5	705.5	684.76
Moderate	171.25	62.5	251.28
Severe	57.25	50	58.93

Table 02: Water Service Reliability in Wet Period

The comprehensive analysis of water service reliability levels across three distinct categories: "Good," "Moderate," and "Severe," served as crucial benchmarks for assessing the reliability of water service in the study area. The provided data for water service reliability in dry and wet periods presented a valuable comparative analysis. During dry periods, the mean reliability for "Good" water service was 690, while for "Moderate" and "Severe" categories, it was 213.25 and 96.75, respectively.

These figures suggested variations in performance levels, with the "Good" category indicating a higher level of reliability and the "Severe" category showing more challenges in maintaining consistent service. The accompanying statistics, including median, standard deviation, sample variance, and range, further illuminated the distribution and variability of reliability values during dry periods.

Conversely, in wet periods, there were notable improvements in water service reliability. The mean reliability values increased to 771.5 for "Good," 171.25 for "Moderate," and 57.25 for "Severe" categories. Reduced standard deviations, smaller sample variances, and narrower ranges signified a more stable and consistent water supply during wet periods.

Furthermore, these findings highlighted the ability of water supply schemes to meet the challenges of climate resilience under various climatic circumstances for sustainable water management in Sri Lanka.

5. Discussion

The findings of the study underscore the challenges faced by water supply schemes during different climatic conditions and highlight the need for tailored climate resilience strategies. They also emphasize the significance of focusing on the "Severe" reliability level, where the impact of climate change is most pronounced.

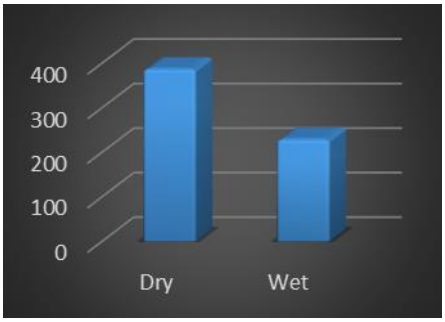

Figure 03: Water Service Reliability at Severe level

Such strategies are essential for reducing the effects of climate change and harsh weather on water supply plans. These results align with the research's primary aim of ensuring the long-term sustainability of water supply schemes in Sri Lanka.

Accordingly, it can embrace a multi-pronged approach to ensure the sustainability of water supply schemes with respect to climate changes in Sri Lanka. Thus, by establishing a climate-resilient infrastructure system in water supply projects, we can successfully address the challenges posed by climate change. It is equally important to organize capacity development programs aimed at empowering water professionals with the knowledge and skills required for managing climate change.

Additionally, by implementing Water Safety Plans into practice, we may increase the safety of water supply systems and reduce the risks related to the effects of climate change. At the same time, strategies for the biodiversity will ensure the long-term security of the ecosystem and strengthen the country's resilience to climate change.

Taken together, these steps will ensure Sri Lanka a sustainable and prosperous future with safe drinking water that can successfully withstand climate change.

The potential limitations of this study open new avenues for investigation. There are unknown areas to take into account, even though our focus was on water service reliability in dry and wet periods in Sri Lankan water supply networks.

Future research could look into the dynamics of water consumption and water quality during these climatic changes. Because these factors have the potential to shed more light on valuable techniques for sustainable water management and climate resilience.

6. Conclusion

The study, extensively analysed water service reliability in Sri Lanka's water supply schemes,

focusing on dry and wet periods. The exploration of reliability levels, categorized as "Good," "Moderate," and "Severe," revealed dynamic patterns under diverse climatic conditions. Notably, the "Severe" level emerged as a critical concern, highlighting situations where schemes face heightened risks, particularly from climate change.

The findings emphasize the urgency of addressing the "Severe" level, which is most impacted by climate change. The observed variability underscores the need for tailored strategies that can navigate unforeseen challenges while ensuring consistent service delivery.

As a consequence, the research findings contribute to the safeguarding of critical drinking water services and sustainable water supply management of water supply schemes in the face of climate change through the implementation of long-term strategies and policies and providing climate-resilient approaches.

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References

Amerasinghe, N. M. (2009). *A study of the factors affecting the sustainability of community managed rural water supply schemes in Sri Lanka*. 93. http://hdl.handle.net/1721.1/49740

DeNicola, E., Aburizaiza, O. S., Siddique, A., Khwaja, H., & Carpenter, D. O. (2015). Climate change and water scarcity: The case of Saudi Arabia. *Annals of Global Health*, *81*(3), 342–353. https://doi.org/10.1016/j.aogh.2015.08.005

Eslamian, S., & Eslamian, F. (2022). Disaster Risk Reduction for Resilience: Disaster and Social Aspects. *Disaster Risk Reduction for Resilience: Disaster and Social Aspects*, *April*, 1–473. https://doi.org/10.1007/978-3-030-99063-3

Femi Monday, I. (2020). Investigating Effects of Climate Change on Health Risks in Nigeria. *Environmental Factors Affecting Human Health*, *May*. https://doi.org/10.5772/intechopen.86912

Fernando, C. C., & London, W. (2019). *The Sustainability of Community Managed Water Supply Schemes in Sri Lanka*. *1*(1), 162–191.

Hamza, Y. G., Kumar Ameta, S., Tukur, A., & Usman, A. (2020). Overview on Evidence and Reality of Climate Change. *IOSR Journal of Environmental Science*, *14*(7), 17–26. https://doi.org/10.9790/2402-1407021726

Howard, G., Nijhawan, A., Flint, A., Baidya, M., Pregnolato, M., Ghimire, A., Poudel, M., Lo, E., Sharma, S., Mengustu, B., Ayele, D. M., Geremew, A., & Wondim, T. (2021). The how tough is WASH framework for assessing the climate resilience of water and sanitation. *Npj Clean Water*, *4*(1). https://doi.org/10.1038/s41545-021-00130-5

Sinclair, N. D. (2020). *Integrating Women and Entrepreneurship for Sustainable Rural Water Supply Schemes in Sri Lanka*. *71*. https://www.adb.org/sites/default/files/publication/613116/sawp-071-women-entrepreneurship-rural-water-supply-sri-lanka.pdf

Tsuchida, R., & Takeda, S. (2021). Is

resilience socially emerging or embedded?: A review of "resilience" under climate change in Sri Lanka. *Journal of Safety Science and Resilience*, *2*(4), 258–266. https://doi.org/10.1016/j.jnlssr.2021.11.001

UNEP. (2023). *Climate Change 2023: Synthesis Report | UNEP - UN Environment Programme*. https://www.unep.org/resources/report/climate-change-2023-synthesis-report

World Health Organization (WHO). (2020). *WHO Global Strategy on Health, Environment and Climate Change and wellbeing sustainably through healthy*. https://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377-eng.pdf%0Ahttps://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377-eng.pdf?ua=1