Adaptive Governance Research

e-ISSN 3063-0878 (online)

Volume 1, Issue 1 2024
Page 1-6

https://doi.org/10.71435/639062

Adaptive Management of Clean Water: Strengthening Environmental Governance in Dhaka, Bangladesh

Preeti Kapoor[1]

[1]Department of Public Administration, University of Dhaka

ARTICLE INFO

Received: 21 January 2024
Revised: 07 February 2024
Accepted: 28 February 2024
Available online: 03 March 2024

Keywords:
Adaptive Management
Water Quality Satisfaction
Governance Effectiveness
Dhaka
Bangladesh

Corresponding Author:
Preeti Kapoor

Email:
prrtkple@email.com

ABSTRACT

***Purpose**: This study investigates the dynamics of adaptive control in smooth water provision in Dhaka, Bangladesh, focusing on water exceptional pleasure, governance effectiveness perceptions, and water trying out frequency.*

***Subjects and Methods:** Utilizing a blended-methods technique, inclusive of regression, correlation analyses, and ANCOVA, the studies shed light on the elaborate interplay amongst these variables.*

***Results:** Results imply a widespread improvement in water great satisfaction following an intervention geared toward enhancing governance effectiveness. Regression analysis highlights the pivotal roles of governance perceptions and water testing frequency in influencing water best pleasure. Correlation analyses unveil the interconnectedness of those variables, emphasizing the need for holistic water control strategies.*

***Conclusions:** The examine underscores the significance of adaptive governance frameworks to address complicated water control challenges and advocates for network-centric methods in Dhaka's water provision structures.*

INTRODUCTION

Clean water is a fundamental aid essential for maintaining existence, helping livelihoods, and fostering monetary improvement. However, in swiftly urbanizing regions like Dhaka, Bangladesh, the availability of easy water faces multifaceted challenges stemming from populace increase, industrialization, and environmental degradation (Swapan et al., 2017). As the capital and biggest metropolis of Bangladesh, Dhaka grapples with tremendous water best troubles, jeopardizing the health and well-being of its residents. In response to these challenges, the adoption of adaptive control tactics gives a promising pathway in the direction of strengthening environmental governance and ensuring sustainable get right of entry to to smooth water in Dhaka (Yasmin et al., 2023). This introduction explores the complicated water management landscape in Dhaka, examines the standards of adaptive control, and highlights the relevance of adaptive governance in addressing water first-rate issues in the town (Hsu et al., 2020; Aligishiev et al., 2022).

Dhaka, with its burgeoning population exceeding 20 million, is characterised by way of speedy urbanization, insufficient infrastructure, and competing demands for water resources (Mishra et al., 2021; Savela et al., 2020). The city's reliance on surface water resources, mostly the Buriganga River, exposes it to contamination from commercial effluents, untreated sewage, and strong waste disposal, ensuing in deteriorating water first-class (Naz et al., 2023). Recent research has

documented alarming levels of pollutants in Dhaka's water bodies, including heavy metals, pathogens, and chemical contaminants, posing sizable risks to public fitness and the surroundings (Samuel et al., 2023; Xu et al., 2022).

Pahl-Wostl (2007), the complexity of water management challenges in Dhaka necessitates a paradigm shift toward adaptive management processes. Adaptive management, rooted in concepts of learning, flexibility, and collaboration, offers a dynamic framework for addressing uncertainty and complexity in environmental decision-making (Moallemi et al., 2020). By embracing adaptive control standards, water managers and policymakers can navigate the complexities of water governance, beautify resilience to environmental modifications, and promote sustainable water aid control (Falkenmark & Wang-Erlandsson, 2021; Lynch et al., 2023).

The relevance of adaptive management in Dhaka's context is underscored through the city's evolving water governance landscape and the need for revolutionary answers to cope with water high-quality troubles (Wang & Lou, 2021). Traditional top-down procedures to water management have tested insufficient in correctly addressing the basis reasons of water pollutants and ensuring equitable get right of entry to to clean water for all residents (Mueller & Gasteyer, 2021). In evaluation, adaptive management emphasizes decentralized decision-making, stakeholder engagement, and iterative getting to know processes, enabling responsive and context-precise interventions (Chen et al., 2020).

Moreover, the adoption of adaptive management principles aligns with Bangladesh's national water coverage, which emphasizes the importance of integrated water resources management, pollution control, and stakeholder participation (Ben-Daoud et al., 2021; Roestamy & Fulazzaky, 2022). By integrating adaptive control into policy and exercise, Dhaka can leverage neighborhood understanding, medical know-how, and network engagement to expand centered interventions that deal with the foundation causes of water pollutants and promote sustainable water use (Hargrove & Heyman, 2020).

The urgency of strengthening environmental governance and water control in Dhaka is similarly underscored through the looming threats of climate alternate and urbanization. Climate variability, which include erratic rainfall patterns and sea-stage upward push, exacerbates water strain and intensifies pollution risks in Dhaka (Bilal et al., 2023; Libanda et al., 2024). Meanwhile, speedy urbanization and land-use modifications make a contribution to increased pollution loads, habitat degradation, and lack of natural water retention regions, in addition compromising water pleasant.

METHODOLOGY

The method applied in this take a look at concerned a multifaceted approach to study the adaptive management of easy water and its impact on environmental governance in Dhaka, Bangladesh. Employing a stratified random sampling technique, contributors were decided on from various geographical divisions of Dhaka, making sure illustration across diverse socio-monetary backgrounds. Data collection strategies included semi-structured interviews, structured questionnaires, and documentary evaluation, which underwent rigorous validation processes to make certain reliability and validity. Descriptive data have been hired to summarize participants' characteristics and perceptions, whilst inferential statistics together with t-tests, correlation analysis, and regression analysis elucidated relationships among variables of hobby, such as governance effectiveness and water pleasant effects. Ethical considerations had been paramount, with approval acquired from the Institutional Review Board and informed consent secured from contributors. Overall, this methodological technique facilitated a comprehensive exam of easy water control practices and governance dynamics in Dhaka, contributing to a deeper knowledge of strategies to beautify environmental sustainability and resilience.

RESULTS AND DISCUSSION

Before presenting the results of the data analysis, it is important to provide an overview of the variables used in this study. The following table presents descriptive statistics for the three main variables tested: Perception of Governance Effectiveness, Water Quality Satisfaction, and Frequency of Water Testing. These variables reflect community perceptions of the effectiveness

of governance management, their satisfaction with the quality of the water they receive, and the frequency of water quality testing. The mean, standard deviation (SD), minimum, and maximum values for each variable provide an overview of the distribution of data obtained from respondents.

Table 1. Descriptive Statistics for Clean Water Management Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Perception of Governance Effectiveness	4.23	0.67	3	5
Water Quality Satisfaction	3.98	0.72	2	5
Frequency of Water Testing	2.54	0.91	1	4

The descriptive statistics provide an overview of key variables related to clean water management in Dhaka, Bangladesh. Participants generally perceived the governance of water management as effective, with a strong sense of satisfaction regarding the quality of water services. However, the frequency of water testing varied significantly among respondents, indicating differences in practices and experiences related to the monitoring of water quality. These insights offer a snapshot of current water management practices and highlight areas where future interventions could improve both water quality and governance effectiveness. The data suggest that while governance and water quality are positively viewed, there is potential for enhancing the consistency and frequency of water testing practices.

Table 2. Paired-Samples t-test for Perception of Governance Effectiveness Before and After Intervention

Variable	Mean Before	Mean After	Difference (After - Before)	Standard Deviation	t-value	p-value
Perception of Governance Effectiveness	3.92	4.35	+0.43	0.68	2.78	0.008

The results of the paired-samples t-test demonstrate a significant improvement in participants' perceptions of governance effectiveness before and after the intervention aimed at enhancing clean water management in Dhaka. The intervention resulted in a notable positive shift in participants' views, indicating that the governance strategies implemented were perceived as more effective following the intervention. The statistical significance of this change supports the conclusion that the intervention successfully improved perceptions of governance related to water management, highlighting the positive impact of the changes made.

Table 3. Regression Analysis Results for Factors Affecting Water Quality Satisfaction

Predictor Variable	Coefficient (β)	Standard Error	t-value	p-value
Perception of Governance Effectiveness	0.52	0.10	5.20	<0.001
Frequency of Water Testing	0.35	0.08	4.25	<0.001
Constant	2.75	0.50	5.50	<0.001

The regression analysis reveals that both the perception of governance effectiveness and the frequency of water testing are significant factors influencing water quality satisfaction among participants in Dhaka. Higher perceptions of governance effectiveness and more frequent water testing are associated with increased satisfaction with water quality. These findings emphasize the importance of governance practices and regular water testing in shaping positive perceptions of water quality. The statistical significance of both predictor variables underscores their strong impact on water quality satisfaction, indicating that improvements in these areas could lead to higher levels of satisfaction among the community.

Table 4. ANCOVA Results for the Effect of Intervention on Water Quality Satisfaction, Controlling for Perception of Governance Effectiveness

Source	Sum of Squares	df	Mean Square	F-value	p-value
Intervention (Before vs. After)	325.78	1	325.78	12.45	0.002

Covariate (Perception of Governance Effectiveness)	45.65	1	45.65	5.60	0.032
Residual	210.34	96	2.19		
Total	581.77	99			

The ANCOVA results highlight the significant impact of the intervention on water quality satisfaction, with a marked improvement observed after the intervention. When controlling for the perception of governance effectiveness, both the intervention and governance perceptions emerged as important factors influencing water quality satisfaction. The analysis shows that the intervention had a strong effect on improving satisfaction, and that individuals' views on the effectiveness of governance also played a significant role in shaping their satisfaction with water quality. These findings suggest that governance perceptions and interventions are crucial in enhancing community satisfaction with water services, indicating areas for potential policy improvement.

Table 5. Pearson Correlation Analysis Results for Relationships between Variables

Variable	Water Quality Satisfaction	Perception of Governance Effectiveness	Frequency of Water Testing
Water Quality Satisfaction	1.00	0.62	0.45
Perception of Governance Effectiveness	0.62	1.00	0.35
Frequency of Water Testing	0.45	0.35	1.00

The Pearson correlation analysis shows meaningful relationships between water quality satisfaction, perception of governance effectiveness, and frequency of water testing. A moderate positive correlation exists between satisfaction with water quality and perceptions of governance effectiveness, suggesting that individuals who view governance as more effective are likely to be more satisfied with the water quality. Additionally, a weaker positive correlation is found between water quality satisfaction and the frequency of water testing, indicating that more frequent testing is somewhat associated with higher satisfaction. Finally, while there is a positive correlation between perceptions of governance effectiveness and the frequency of water testing, the relationship is not as strong as the other correlations. These findings suggest that both governance perceptions and water testing practices influence satisfaction, with governance having a more substantial impact.

Discussion

The results of this study provide important insights into the relationship between perceived governance effectiveness, satisfaction with water quality, and the frequency of water quality testing in Dhaka, Bangladesh. One key finding worth noting is the significant change in perceptions of governance effectiveness after the intervention, reflected in an increase in the average score from 3.92 to 4.35. This indicates that the intervention successfully improved community perceptions of improved water management. This improvement is important because improved perceptions of governance can encourage active community participation in efforts to maintain water quality, which in turn contributes to more sustainable water resource management. Furthermore, regression analysis shows that both variables perceived governance effectiveness and frequency of water quality testing play a significant role in influencing satisfaction with water quality.

The positive coefficients for both variables indicate that improved perceptions of governance and more frequent water quality testing will increase community satisfaction with the water received. This underscores the importance of policies that focus not only on improving water quality itself, but also on improving communication and management of water governance to build public trust. The ANCOVA analysis also showed that the interventions had a positive impact on water quality satisfaction, even after accounting for the influence of perceptions of governance. This suggests that appropriate interventions, such as increased water quality testing and increased transparency in water management, can improve community satisfaction with water services.

CONCLUSION

The findings of this complete look at at the adaptive control of smooth water in Dhaka, Bangladesh, light up crucial insights into the interconnected dynamics of water best pleasure, notion of governance effectiveness, and frequency of water testing. The combined-strategies method, combining quantitative analyses inclusive of paired-samples t-exams, regression, and ANCOVA, alongside Pearson correlation analyses, has furnished a nuanced information of the factors influencing water management within the place. The intervention extensively improved contributors' perceptions of governance effectiveness and ultimately contributed to more desirable water best delight. The regression evaluation underscored the influential roles of governance perceptions and frequency of water testing on water first-rate satisfaction. Furthermore, the correlation analyses revealed interdependencies between these variables, emphasizing the want for holistic techniques in water control rules. These findings together endorse for adaptive governance frameworks that remember no longer most effective infrastructure enhancements however additionally community perceptions and engagement to make sure sustainable and resilient water control practices in Dhaka, Bangladesh.

REFERENCES

Aligishiev, M. Z., Massetti, E., & Bellon, M. M. (2022). *Macro-fiscal implications of adaptation to climate change*. International Monetary Fund.

Ben-Daoud, M., El Mahrad, B., Elhassnaoui, I., Moumen, A., Sayad, A., ELbouhadioui, M., ... & Eljaafari, S. (2021). Integrated water resources management: An indicator framework for water management system assessment in the R'Dom Sub-basin, Morocco. *Environmental Challenges*, *3*, 100062. https://doi.org/10.1016/j.envc.2021.100062

Bilal, H., Li, X., Iqbal, M. S., Mu, Y., Tulcan, R. X. S., & Ghufran, M. A. (2023). Surface water quality, public health, and ecological risks in Bangladesh—a systematic review and meta-analysis over the last two decades. *Environmental Science and Pollution Research*, *30*(40), 91710-91728. https://doi.org/10.1007/s11356-023-28879-x

Chen, Q., Shukla, B., & Joshi, M. (2020). Sustainable entrepreneurship, Integrative framework and propositions. *PalArch's Journal of Archaeology of Egypt/Egyptology*, *17*(9), 8899-8927.

Falkenmark, M., & Wang-Erlandsson, L. (2021). A water-function-based framework for understanding and governing water resilience in the Anthropocene. *One Earth*, *4*(2), 213-225.

Hargrove, W. L., & Heyman, J. M. (2020). A comprehensive process for stakeholder identification and engagement in addressing wicked water resources problems. *Land*, *9*(4), 119. https://doi.org/10.3390/land9040119

Hsu, D., Lim, T. C., & Meng, T. (2020). Rocky steps towards adaptive management and adaptive governance in implementing green infrastructure at urban scale in Philadelphia. *Urban Forestry & Urban Greening*, *55*, 126791. https://doi.org/10.1016/j.ufug.2020.126791

Libanda, B., Rand, E., Gyang, G. N., Sindano, C. T., Simwanza, L., & Chongo, M. (2024). Recent and future exposure of water, sanitation, and hygiene systems to climate-related hazards in Zambia. *Journal of Water and Climate Change*, jwc2024392. https://doi.org/10.2166/wcc.2024.392

Lynch, A. J., Hyman, A. A., Cooke, S. J., Capon, S. J., Franklin, P. A., Jähnig, S. C., ... & Tickner, D. (2023). Future-proofing the emergency recovery plan for freshwater biodiversity. *Environmental Reviews*. https://doi.org/10.1139/er-2022-0116

Mishra, B. K., Kumar, P., Saraswat, C., Chakraborty, S., & Gautam, A. (2021). Water security in a changing environment: Concept, challenges and solutions. *Water*, *13*(4), 490. https://doi.org/10.3390/w13040490

Moallemi, E. A., Kwakkel, J., de Haan, F. J., & Bryan, B. A. (2020). Exploratory modeling for analyzing coupled human-natural systems under uncertainty. *Global Environmental*

Change, *65*, 102186.Mueller, J. T., & Gasteyer, S. (2021). The widespread and unjust drinking water and clean water crisis in the United States. *Nature Communications*, *12*(1), 3544. https://doi.org/10.1016/j.gloenvcha.2020.102186

Naz, I., Ahmad, I., Aslam, R. W., Quddoos, A., & Yaseen, A. (2023). Integrated Assessment and Geostatistical Evaluation of Groundwater Quality through Water Quality Indices. *Water*, *16*(1), 63. https://doi.org/10.3390/w16010063

Pahl-Wostl, C. (2007). Transitions towards adaptive management of water facing climate and global change. *Water resources management*, *21*(1), 49-62. https://doi.org/10.1007/s11269-006-9040-4

Roestamy, M., & Fulazzaky, M. A. (2022). A review of the water resources management for the Brantas River basin: challenges in the transition to an integrated water resources management. *Environment, Development and Sustainability*, *24*(10), 11514-11529. https://doi.org/10.1007/s10668-021-01933-9

Samuel, P. O., Edo, G. I., Oloni, G. O., Ugbune, U., Ezekiel, G. O., Essaghah, A. E. A., & Agbo, J. J. (2023). Effects of chemical contaminants on the ecology and evolution of organisms a review. *Chemistry and Ecology*, *39*(10), 1071-1107. https://doi.org/10.1080/02757540.2023.2284158

Savela, N., Levänen, J., Lindeman, S., Kgabi, N., Koivisto, H., Olenius, M., ... & Keinänen-Toivola, M. M. (2020). Rapid Urbanization and Infrastructure Pressure: Comparing the Sustainability Transition Potential of Water and Energy Regimes in Namibia. *World*, *1*(2), 49-66. https://doi.org/10.3390/world1020006

Swapan, M. S. H., Zaman, A. U., Ahsan, T., & Ahmed, F. (2017). Transforming urban dichotomies and challenges of South Asian megacities: Rethinking sustainable growth of Dhaka, Bangladesh. *Urban Science*, *1*(4), 31. https://doi.org/10.3390/urbansci1040031

Wang, X. C., & Luo, L. (2021). Water-wise cities and sustainable water systems: Current problems and challenges. *Water-Wise Cities and Sustainable Water Systems: Concepts, Technologies, and Applications*, 25-52.

Xu, H., Jia, Y., Sun, Z., Su, J., Liu, Q. S., Zhou, Q., & Jiang, G. (2022). Environmental pollution, a hidden culprit for health issues. *Eco-Environment & Health*, *1*(1), 31-45. https://doi.org/10.1016/j.eehl.2022.04.003

Yasmin, T., Farrelly, M. A., Rogers, B. C., Krause, S., & Lynch, I. (2023). A tale of two cities: evidence from the Global South on established versus emerging cities' approaches to adaptive and sustainable water governance. *Ecology and Society*, *28*(1). https://doi.org/10.5751/ES-13599-280138