SOCIO-SPATIAL DISPARITIES IN ECOSYSTEM SERVICES AND DISSERVICES: A CASE STUDY OF KHULNA, BANGLADESH

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ABSTRACT

In the Global South, urban environments are rapidly changing , often producing unequal sociospatial outcomes that raise critical environmental justice concerns. For environmental justice and urban resilience to be achieved, it is essential to comprehend the sociospatial differences in ecological services and disservices. This study focuses on Wards 15, 21, and 22 of Khalishpur and Kotwali Thana in Khulna, Bangladesh, to examine the unequal distribution of ecosystem services (ES) and ecosystem disservices (EDS) among income levels. Using a mixed-methods approach that includes field observations, structured household surveys, and stratified random sampling of 385 respondents, the study assesses perceived disservices as well as providing, regulatory, cultural, and supporting services.
Results show significant intra-urban variations. Despite only having a 0.732 square kilometer area, Ward 22 had the highest normalized ES score (311.5) and EDS score (24.6), suggesting that the advantages and responsibilities were more intense. Compared to 91% of respondents in Wards 21 and 22, 98% of respondents in Ward 15 indicated being available for delivering services. While supporting services displayed larger gaps, with 17% of respondents in Ward 15 reporting problems, regulatory services were highest valued in Wards 21 and 22 (100%). Fewer than 15% of the respondents on every ward referred to the obvious benefits of nutrient cycling or wildlife-related services, although 83-100 % of them reported the importance of pollination, carbon sequestration, and flood control. These findings indicate the ecological inequality between the regions and the shared experiences. The findings reveal the need of the urban ecological design that is income-sensitive and ward specific. Targeted community engagement, equal distribution of resources, and comprehensive green infrastructure must be of high priority in policy responses to reduce environmental burdens on the disadvantaged groups. This study emphasizes the need to consider equity in the ecosystem-based urban design, and it contributes to the growing body of urban ecology in developing countries.

Keywords: *Disservices, Ecosystem, Inequality, Services, Urban.*

1. INTRODUCTION

1.1 Background

Urban environments, mostly in emerging countries, are gradually formed by the availability and quality of ecosystem services. It is more important than ever to comprehend how nature sustains urban life as cities expand and landscapes change (Sobhani, 2024). The benefits that human beings are able to receive through natural ecosystems, play a vital role in sustaining life and livelihood worldwide (Das & Mallick, 2024). that Approximately 60 % of the world ecosystem services have been degraded in the past 50 years and this threatens the food security of the 2.6 billion direct users of natural resources (Mondal & Palit, 2022). Over three point three billion of the world population relies on the ecosystem to support their living, earn income and protection against the natural calamities but the ecosystems are getting worse annually at 1.5 % (Dasgupta et al., 2021). The expense of decreased ecological services is also unbalanced within low-income metropolitan areas (Haque & Sharifi, 2024) and those in the lowest quintile of income earners are 30-50 more likely to be exposed to ecosystem disservices including poor waste disposal, diseases transmitted by vectors and air and water pollution. Bangladesh is a deltaic country which has a population of more than 170 million people with a population density of 1,265 people per square kilometer. (World Bank, 2023). The Sundarbans, the world's biggest mangrove forest, is home to over 4.5 million people and covers 10,000 square kilometers. It provides fishing, wood, and storm protection (Zaman & Chowdhury, 2024). Having over 18.2 million people, the coastal metropolis of Khulna has disproportionate access to the ecosystem services with the emerging urbanization and socioeconomic disparity (Siddikui et al., 2024). According to recent surveys, low-income families face a lack of freshwater resources and frequent flooding in Khulna, while higher-income groups report fewer of these problems (Rakib et al., 2025). These show how difficult it is to achieve environmental justice and sustainable urban resilience in coastal cities of Bangladesh.

At both the global and regional levels, ecosystem services and disservices have been extensively studied using a variety of approaches, including field surveys, GIS spatial analysis, and socioeconomic evaluations. Numerous studies on the ecological service and disservice in cities have been conducted worldwide. Urban plant research is primarily concentrated on terrestrial systems, short-term studies, and regulatory ecosystem services (Stroud et al., 2022). Alien plant invasions in urban ecosystems produce a complicated balance of advantages and disadvantages that calls for fine-scale evaluations in order to be managed effectively (Potgieter et al., 2019). However, another study found that opinions about ecological disservices differ according to age, level of education, and type of dwelling, indicating a complicated link impacted by regional socio-environmental factors in Poland (Lorek & Lorek, 2025). In response to the rising deprivation of ecosystem services, Nature-based Solutions (NbS) have arisen as a planning and management strategy that specifically seeks to preserve and increase ecosystem service delivery in urban environments by protecting, restoring, and improving ecosystems. Although Nature-based Solutions (NBS) improve ecosystem services, biodiversity, and urban livability, they also run the risk of escalating ecosystem disservices (Pereira et al., 2023) revealed that. Another study revealed that opinions on the ecosystem services and drawbacks of urban trees differ depending on the context (Teixeira et al., 2019). While cultural and regulatory benefits are highly regarded, drawbacks like allergies and infrastructure damage are also mentioned, highlighting the necessity of site-specific, balanced urban tree management. Many people value Galician communal forests, especially Mount Xalo, for a variety of ecosystem services like drinking water, recreation, and cultural identity (Rodríguez-Morales et al., 2020).

Local contexts have been used for certain studies on ecological service and disservice. The economic assessment of forest-based ecosystem services in Bangladesh is uneven and limited, with the majority of studies concentrating on the Sundarbans and providing services (Barua et al., 2020). Another study observed that the significant losses in urban green and blue spaces in five major cities in Bangladesh with Dhaka and Chattogram being the most affected, caused an estimated USD 628.58 million in ecosystem services over a 30-year period (Abdullah et al., 2022). These declines were mostly caused by urban sprawl, population development, and infrastructure expansion. Another study discovered that uncontrolled urban growth in Jashore caused ecosystem service values to drop by 24.47% between 2000 and 2020 (Morshed et al., 2022). Future losses are expected to be even worse. Although ecosystem services are mentioned in all of Bangladesh's forest-related policies, they are largely lacking in operational clarity and thorough integration of the concept, especially when it comes to provisioning and cultural services (Ahammad et al., 2021). A study observed that, between 1999 and 2019, changes in land use in coastal Bangladesh resulted in a decrease of US$ 0.47 billion in ecosystem service values (Ziaul Hoque et al., 2022). This decline was mostly caused by a reduction in agricultural land, which resulted in significant losses in food and raw material services. On the other hand, gains in mangrove areas marginally enhanced the protection of biodiversity and the regulation of water.Between 2014 and 2019, Khulna City's ecosystem services value significantly decreased, mostly as a result of the loss of vegetation and water bodies (Patwary et al., 2020),. This underscores the urgent need for sustainable land use policies to lessen the negative environmental effects of urbanization.

There is still a significant study gap in understanding how ecosystem services and disservices are dispersed among various income levels in Khulna city, despite increased awareness of urban ecological disparities. By concentrating on Khalishpur and Kotowali Thana, which were chosen for their unique socioeconomic characteristics and exposure to a range of urban growth pressures, this study fills this gap. The need to pinpoint specific service inequalities and opportunities for equitable environmental management is made more pressing by Khulna's fast urbanization and climate change vulnerability. The intra-urban income-based distribution of ecosystem burdens (such as pollution and waste) and benefits (such as clean air and green spaces) is frequently ignored in current work. Using stratified random sampling and mixed-methods research, this study's main goal is to investigate the intra-urban distribution of ecosystem services and ecosystem disservices among various income levels in Khulna City, Bangladesh. The specific objectives are to: (i) compare perceived ecosystem disservices between communities with higher and lower incomes; (ii) evaluate ward-level differences in provisioning, regulating, supporting, and cultural ecosystem services; and (iii) identify spatial and socioeconomic disparities in ecosystem service benefits and burdens. By analyzing ecosystem services and disservices at the ward level rather than the city scale, this study will provide fresh insights and make it possible to clearly identify local disparities.

2. METHODOLOGY

2.1 Study Area Profile

Khulna is located on the coast of the Bay of Bengal in south-western Bangladesh and provides a perfect location to examine the variation in ecological services and disservices. Some of the natural systems of the region include rivers, canals, marshes, urban green spaces, and Sundarbans, the largest continuous mangrove forest in the world, covering more than 10,000 square kilometers out of which 60 % is covered by Bangladesh. These ecosystems support more than 3.5 million individuals in critical processes such as carbon absorption, biodiversity conservation, protection, and livelihoods. Khulna City with an area of 45.65 sq km has a population of approximately 1.1 million (BBS 2022). Approximately 35 % of the population lives in informal settlements, which are highly susceptible to environmental hazards Waterlogging, saline intrusion and seasonal flooding affect approximately 70 % of the houses during the monsoon season. This proves the extreme vulnerability of the city (World Bank 2021), demonstrating the city's extreme vulnerability. Green spaces are being lost as a result of the city's rapid urban growth, which is occurring at an annual rate of 2.8 %. In addition to worsening social and environmental inequality, this urbanization reduces natural services. This study examines the intricate relationships between social vulnerability, ecological degradation, and urban expansion in Khulna

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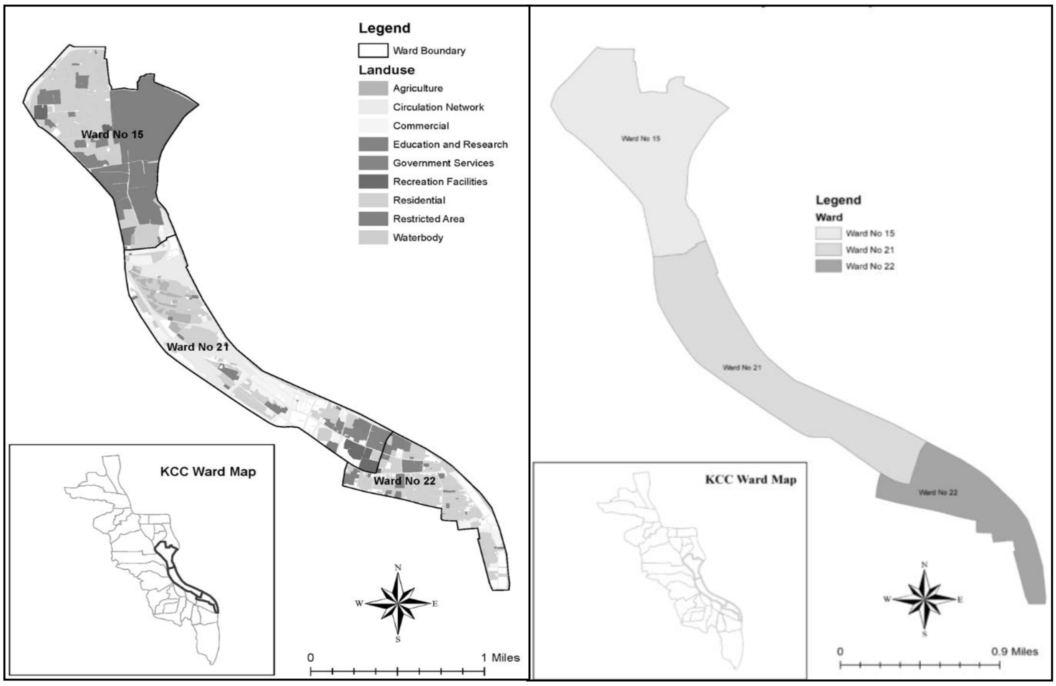


Figure 1: Study area (Ward 15, 21, 22) Khulna

2.1.1 Field Surveys

To gather information on ecosystem services and environmental conditions, field surveys were conducted in the chosen communities. Direct observation, ecological evaluations, and unofficial interviews with locals were among the methods used to learn about service accessibility, availability, and local difficulties.

2.1.2 Survey Method

The study employed structured home questionnaires to gather primary data on socioeconomic factors and ecosystem services. Aspects including flood protection, water availability, household demographics, environmental opinions, and access to green spaces were all examined in the poll.

2.1.3 Sampling Strategy

To ensure sufficient representation from both high-income and low-income populations within the study area, a stratified random sampling technique will be used [Eq. (1) and (2)].
The classic formula for estimating proportions in large populations has been applied:

$$n = \frac{Z^2 p(1-p)}{e^2} \tag{1}$$

n = necessary sample size, Z = Z-score for the target level of confidence (1.96 for 95%) , p = estimated population proportion (maximum variability at 0.5), e = error margin (0.05 for ±5%).

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = \frac{3.8416 \times 0.25}{0.0025} = 384.16 \tag{2}$$

Therefore, a sample size of roughly 385 responders is needed.

2.2 Analytical Methods

The stated study objectives were directly aligned with the methodological framework. Using household questionnaire responses, perceived ecosystem disservices (Objective I) were investigated. Aggregated survey results and spatial comparison between Wards were used to evaluate ward-level differences in ecosystem services (Objective ii). Income-stratified survey data were combined with ward-level normalization and comparative interpretation to examine spatial and socioeconomic differences in ecosystem service benefits and burdens (Objective iii).

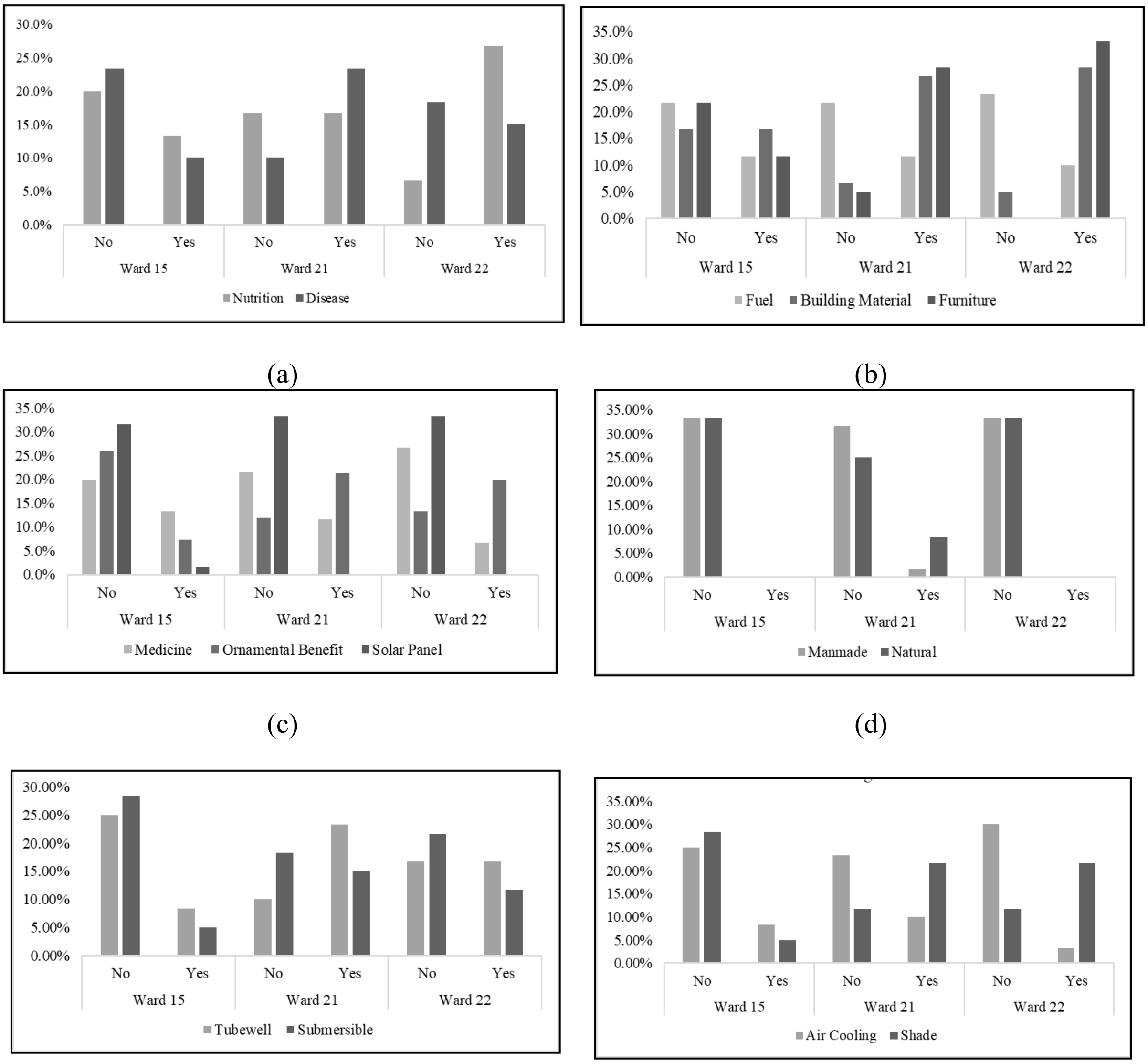
3. ANALYSIS AND INTERPRETATION

3.1 Ecosystem Services

3.1.1 Provisioning Services

Provisioning ecosystem services showed clear spatial disparity across the three study wards, reflecting differences in land use patterns, resource accessibility, and household dependence on natural systems (Figure 2). Ward 22 showed the highest access to food-related services indicating a stronger interaction between residents. Water-related provisioning services also revealed spatial contrasts. Wards 21 and 22 relied more on natural water sources for irrigation whereas Ward 15 depended more on artificial systems, suggesting relatively better service provision.

In addition, air cooling and shade provision were most favourably perceived in Ward 22, highlighting a concentration of ecosystem benefits within dense urban settings. Overall, the findings demonstrate that provisioning services in Khulna are unevenly distributed and closely shaped by urban form and service access, underscoring the need for ward-specific and equity-oriented urban ecological planning.



(a) (b) (c) (d) (e) (f)

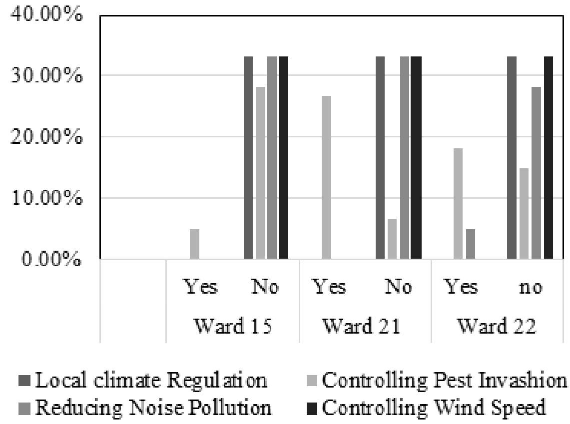
Figure 2: (a) Food, (b) Wood Timber, (c)Medicine, (d) Irrigation, (e) Fresh Water, (f) Air cooling

3.2 Regulatory Services

Regulatory services were widely recognized across all three wards, indicating a strong general awareness of their ecological importance (Figure 3). The greatest perceived benefits were noted in Wards 21 and 22, especially in services pertaining to pollination, carbon sequestration, and pollution control. This implies that these regions have comparatively greater ecological functioning or regulatory process visibility.

However, opinions about flood management and waterbody drainage varied significantly between wards. Wards 15 and 21 residents were more dissatisfied, citing insufficient drainage capacity and increased vulnerability to water-related risks. Ward 21 showed a well-balanced impression of both ecological and cultural regulatory benefits, but Ward 15 reported restricted access to visually pleasant green spaces.

Overall, these results show that although regulatory services are widely appreciated, different parts of the city have different experiences with their efficacy and dependability. This disparity emphasizes the need for context-sensitive regulatory ecosystem planning, improved green infrastructure, and localized flood management to lessen risk in underprivileged wards.



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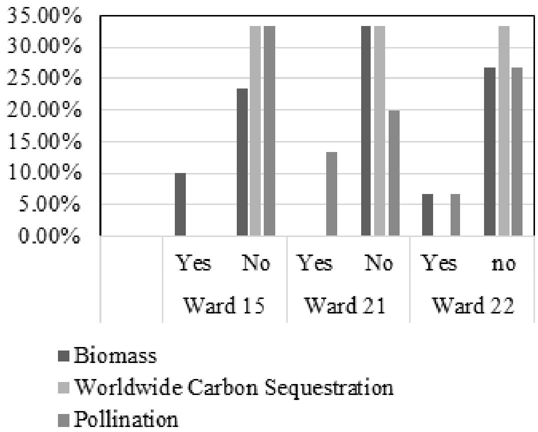

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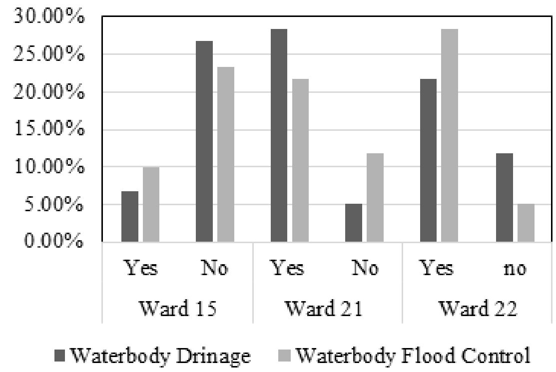

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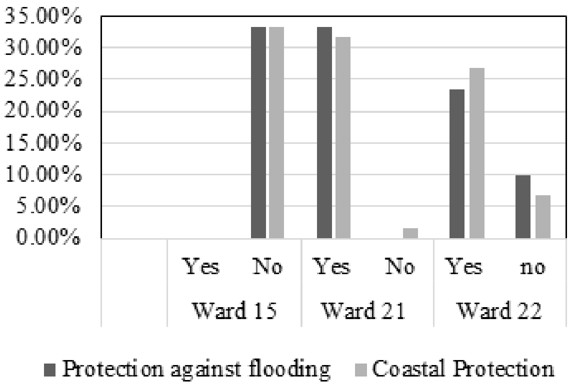

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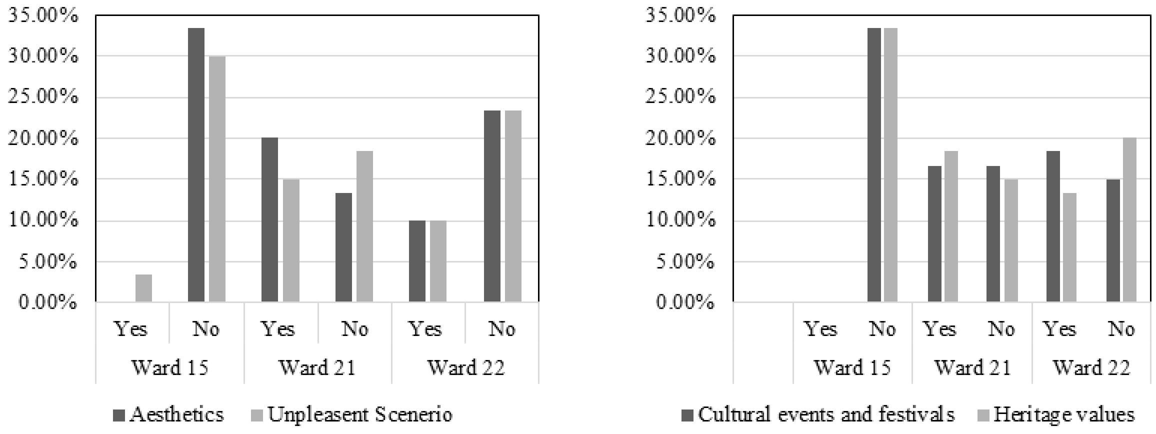


(e) (f)

Figure 3: (a) Controlling, Regulation and Reduction, (b) Biomass, Pollination and Carbon Question, (c) Water body, (d)Protection, (e) Green and open spaces, (f) Cultural Events and Festivals and Heritage Values

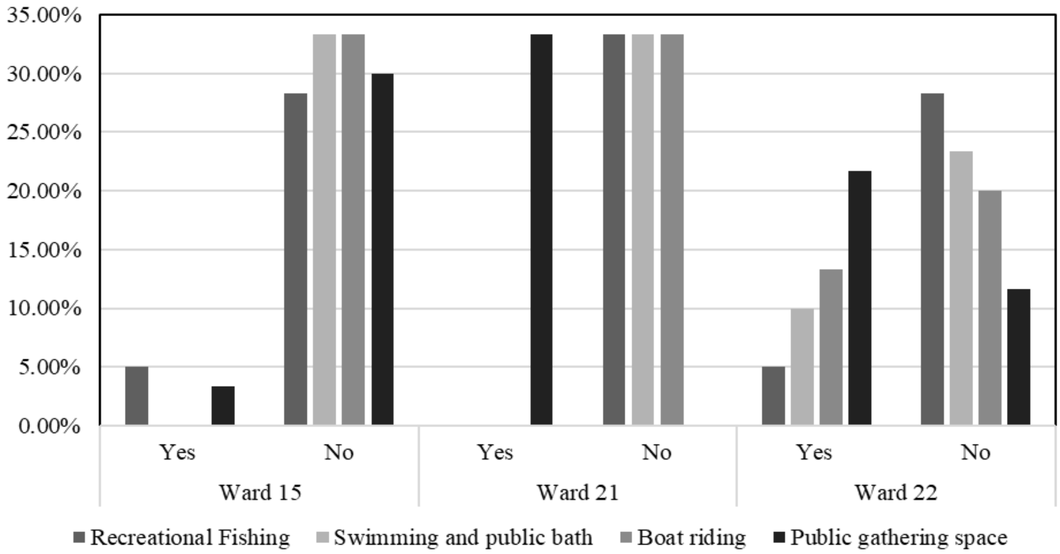
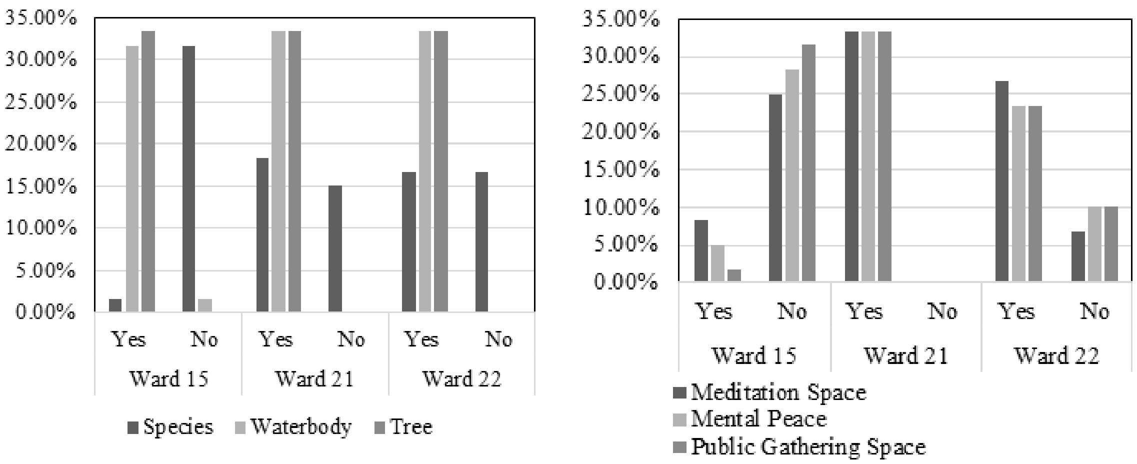


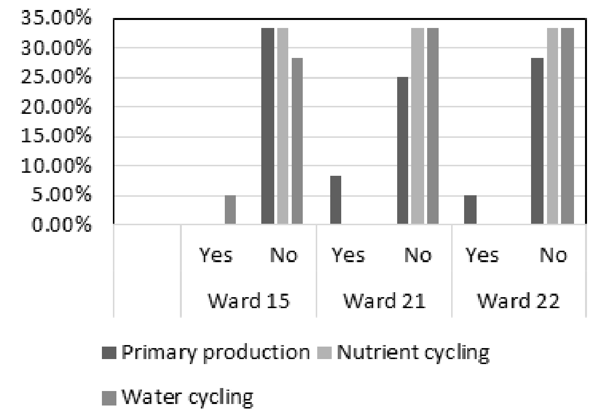
Figure 4: Recreational activities



(a) (b)

Figure 5: (a) Religious values/special Symbol, (b) Service of Vegetation

3.2.1 Supporting Services



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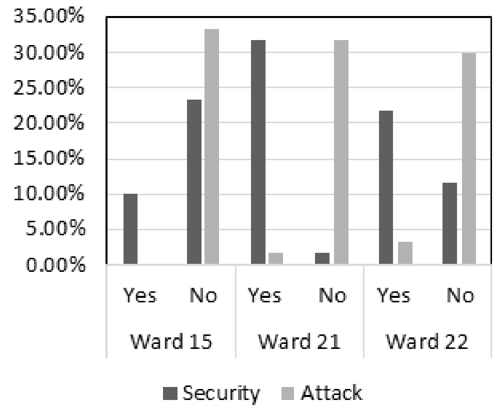

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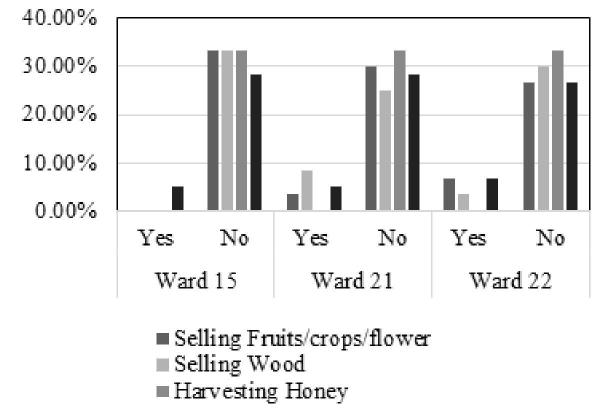

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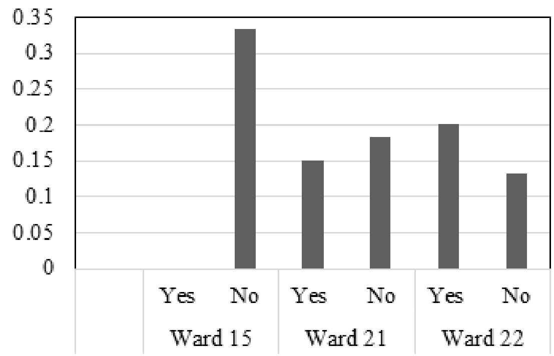

(d)

Figure 6: (a) Cycling and Production, (b) Animal, (c) Economic Benefits, (d) Natural habitat for animal/birds

The assessment of the provisioning and regulation of ecosystem services revealed that the various wards had varying views. It was often found that primary production, nutrient cycling and water cycling were not present in adequate amounts in all wards [Figure 6] implying that these simplest ecological processes are not well-known or easily visible. When it comes to the impressions of the people who stayed at the homes about animals, a low percentage of the residents felt that animals gave them a sense of security but a significant proportion of the people in each ward said that they feared attacks by animals and thus, the perception of a threat was clear. Since most residents cannot directly observe supporting ecosystem services like nitrogen cycling and habitat provision, their low reporting is probably more indicative of a lack of awareness than of a genuine ecological absence. Therefore, rather than reflecting the biophysical significance of these processes, poll results reflect public perception of them.

3.3 Ecosystem Disservices

Figure 7 demonstrates the perceived presence of various Ecosystem Disservice (EDS) components and mitigation actions in different incomes using different patterns. Direct health-related problems like infections (like dengue and malaria) and pests (like pest rodents) were thought to be more common in lower-income areas. Conversely, the incomes of the residents were higher and people reported more water-related and infrastructure-related issues, such as weeds, algae blooms, waterbody overflow, heavy falling fruit, and branches collision. Individuals with greater incomes continuously stated higher rates of proactive environmental stewardship such as donations, lifestyle alteration, carbon offsetting and investments in green infrastructure despite the fact that both groups recognized the importance of environmentally aware businesses promotion and creation of awareness. This points to disparities in perceived involvement in environmental solutions as well as exposure to certain environmental concerns based on affluence.

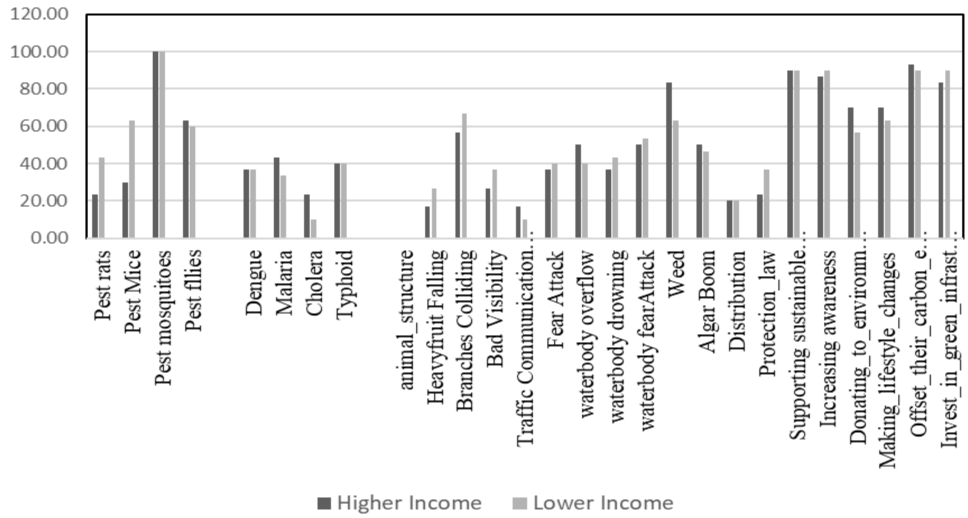

Figure 7: Presence of EDS Component in Higher vs. Lower Income Community

3.4 Overall Service and Disservice Scenario

Across all wards and service categories, service perceptions clearly outnumber disservices in Table 1, which shows the overall experience of ecosystem services and disservices. Wards 21 and 22 reported no related disservices, indicating that regulatory services were particularly highly valued among them. Supporting services, on the other hand, showed the greatest proportion of disservices.

Despite being one of the smaller wards, Ward 22 had the highest normalized values for ecosystem services (311.5) and ecosystem disservices (24.6) per square kilometer, suggesting that both ecological benefits and burdens are concentrated in densely populated areas.

Table 1: Experience of Ecosystem Service

Ecosystem Services	Ward 15		Ward 21		Ward 22	
	Service	Disservice	Service	Disservice	Service	Disservice
Provisioning Services	98%	2%	91%	9%	91%	9%
Regulatory Services	95%	5%	100%	0%	100%	0%
Supporting Services	83%	17%	86%	14%	86%	14%
Cultural Services	92%	8%	96%	4%	95%	5%
Total Experienced Service and Disservice	**202**	**13**	**250**	**19**	**228**	**18**
Area (sq. km)	1.453	1.453	1.417	1.417	0.732	0.732
Normalized value	**139.0**	**9.0**	**176.4**	**13.4**	**311.5**	**24.6**

Significant differences can be seen when comparing ecological service and disservice experiences across income levels (Table 2). Communities with lower incomes reported fewer disservices and more provisioning services (50% vs. 41%). Although marginally higher for higher-income groups, regulatory services were reasonably balanced overall. There was a clear disparity in Supporting Services, with lower-income communities reporting more disservices (48%) and less benefits (11%). While disservices were more prevalent in affluent communities, cultural services were viewed similarly. Overall, the results show socioeconomic disparities in urban ecosystem service burdens and access. So environmental benefits and burdens enhancing both ecological health and human well-being across all segments of its urban population.

Table 2: Comparison of experience in higher income and lower income community

Ecosystem Services	**Higher Class**		**Lower Class**	
	Service	**Disservice**	**Service**	**Disservice**
Provisioning Services	41%	48%	50%	43%
Regulatory Services	24%	7%	21%	5%
Supporting Services	16%	24%	11%	48%
Cultural Services	19%	21%	18%	5%

Ecosystem service are mostly available in ward 21 and ecosystem disservice as well. On the other hand, ward 15 shows lack of both ecosystem services and disservices. The map represents that ward 21 holds higher value in both cased and the planning and regulations should be more focused on this area (Figure 8).

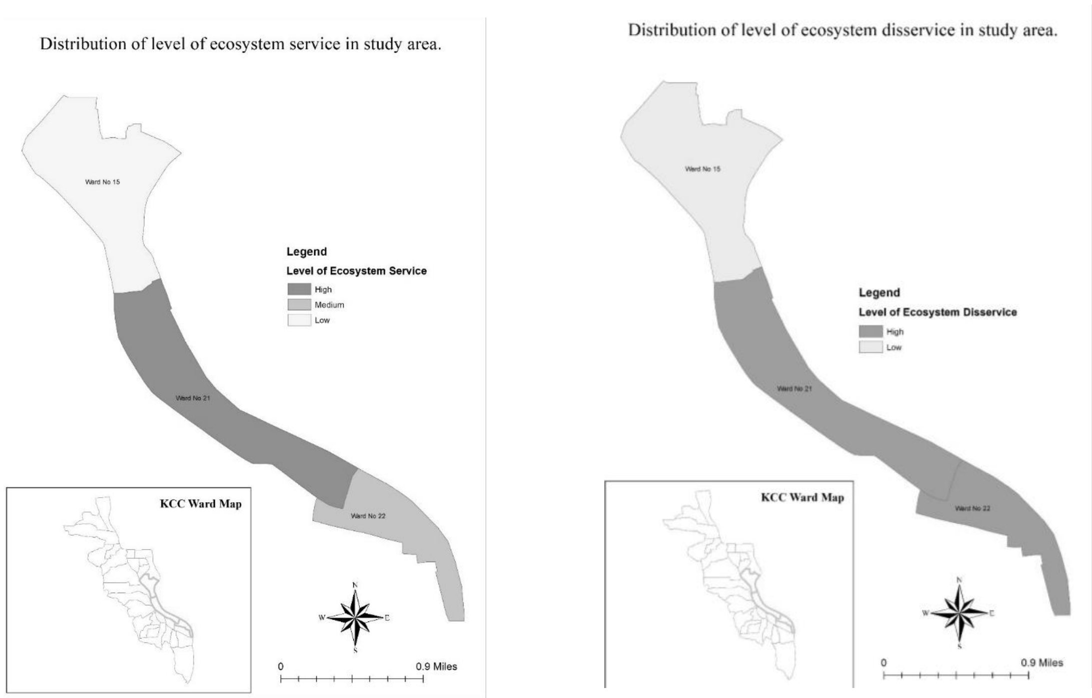

Figure 8: Ecosystem Service and Ecosystem Disservice Distribution Map

4. CONCLUSIONS

In conclusion, this study directly addressed the stated research aims by methodically examining the intra-urban distribution of ecological benefits and ecosystem disservices using ward-level analysis and income-based household classification. The results indicate that there is an inverse situation in which the Ward 21 of Khulna is a bright spot of rich ecosystem services and Ward 15 and 22 are comparatively under-provision of these essential environmental goods. Further, the analysis sheds light on the relationship that exists between income levels and the presence of regulatory, supporting and cultural ecosystem services where higher income communities have a higher portion of regulatory and supporting services and lower income communities have a disproportionate number of supporting disservices.

These variations highlight the need for fundamental and rational actions to advance ecosystem services throughout the research area. To respond to this, the active steps must be pursued to enhance the delivery of ecosystem services in Ward 15 and 22, promoting the restoration activity, sustainable land management and the community engagement program. Moreover, it is important to reduce disservices in the low-income population and deal with cultural disservices in the higher-income population with the help of specific interventions and policy frameworks that would help to promote sustainable practices and equal access to environmental benefits.

Towards a harmonious and sustainable future, the cooperation of the community members, local organizations, and government bodies should be encouraged, and the focus should be made on the education and awareness campaigns.

Declaration of Use of AI

The authors declare that this study made limited and helpful use of artificial intelligence (AI) tools. During the manuscript preparation phase, AI-assisted technologies were used to enhance the overall readability, academic language quality, clarity, and grammar of the text.

The authors independently carried out and validated every aspect of the research, including the design of the study, the choice of the study region, the creation of the questionnaire, stratified random sampling, field observations, the execution of the household survey, data analysis, the interpretation of the findings, and the creation of policy recommendations. Artificial intelligence (AI) techniques were not used at all in the creation of raw data, statistical analysis, computation of normalized ecosystem service scores, or derivation of scientific findings.

To guarantee accuracy, contextual relevance, and consistency with empirical data, the authors meticulously examined, validated, and modified all AI-assisted outputs. The application of AI did not affect methodological choices or skew how socio-spatial disparities in ecological services and disservices were interpreted.

REFERENCES

Abdullah, S., Adnan, M. S. G., Barua, D., Murshed, M. M., Kabir, Z., Chowdhury, M. B. H., Hassan, Q. K., & Dewan, A. (2022). Urban green and blue space changes: A spatiotemporal evaluation of impacts on ecosystem service value in Bangladesh. *Ecological Informatics*, *70*, 101730. https://doi.org/10.1016/j.ecoinf.2022.101730

Ahammad, R., Stacey, N., & Sunderland, T. (2021). Analysis of forest-related policies for supporting ecosystem services-based forest management in Bangladesh. *Ecosystem Services*, *48*, 101235. https://doi.org/10.1016/j.ecoser.2020.101235

Arefin Siddikui & Nahida Sultana, Md Mazharul Islam, Abdullah-Al Abid, L. T. Z. J. (2024). ASSESSING THE DYNAMICS OF CLIMATE CHANGE IN KHULNA CITY: A COMPREHENSIVE ANALYSIS OF TEMPERATURE, RAINFALL, AND HUMIDITY TRENDS. *GLOBAL MAINSTREAM JOURNAL*, *1*(1), 15–32. https://doi.org/10.62304/ijse.v1i1.118

Barua, S. K., Boscolo, M., & Animon, I. (2020). Valuing forest-based ecosystem services in Bangladesh: Implications for research and policies. *Ecosystem Services*, *42*, 101069. https://doi.org/10.1016/j.ecoser.2020.101069

Das, A., & Mallick, P. H. (2024). Exploring livelihood dependency on provisioning ecosystem services in a protected tropical forest area of eastern India: keys to sustainable forest management. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-024-04933-7

Dasgupta, P., Dasgupta, A., & Barrett, S. (2021). Population, Ecological Footprint and the Sustainable Development Goals. *Environmental and Resource Economics*. https://doi.org/10.1007/s10640-021-00595-5

Haque, M. N., & Sharifi, A. (2024). Who are marginalized in accessing urban ecosystem services? A systematic literature review. *Land Use Policy*, *144*, 107266. https://doi.org/10.1016/j.landusepol.2024.107266

Lorek, A., & Lorek, P. (2025). Ecosystem disservices in urbanized areas – an economic and social perspective. *Economics and Environment*, *92*(1), 997. https://doi.org/10.34659/eis.2025.92.1.997

Mondal, S., & Palit, D. (2022). Challenges in natural resource management for ecological sustainability. In *Natural Resources Conservation and Advances for Sustainability* (pp. 29–59). Elsevier. https://doi.org/10.1016/B978-0-12-822976-7.00004-1

Morshed, S. R., Fattah, M. A., Haque, M. N., & Morshed, S. Y. (2022). Future ecosystem service value modeling with land cover dynamics by using machine learning based Artificial Neural Network model for Jashore city, Bangladesh. *Physics and Chemistry of the Earth, Parts A/B/C*, *126*, 103021. https://doi.org/10.1016/j.pce.2021.103021

Patwary, M. M., Ashraf, S., & Shuvo, F. K. (2020). Land Use Changes and Their Effects on Urban Ecosystem Services Value: A Study of Khulna City, Bangladesh. *2020 IEEE India Geoscience and Remote Sensing Symposium (InGARSS)*, 62–65. https://doi.org/10.1109/InGARSS48198.2020.9358927

Pereira, P., Yin, C., & Hua, T. (2023). Nature-based solutions, ecosystem services, disservices, and impacts on well-being in urban environments. *Current Opinion in Environmental Science & Health*, *33*, 100465. https://doi.org/10.1016/j.coesh.2023.100465

Potgieter, L. J., Gaertner, M., O'Farrell, P. J., & Richardson, D. M. (2019). A fine-scale assessment of the ecosystem service-disservice dichotomy in the context of urban ecosystems affected by alien plant invasions. *Forest Ecosystems*, *6*(1), 46. https://doi.org/10.1186/s40663-019-0200-4

Rakib, M. A., Roy, K., Newaz, M. A., Rahman, M. A., & Valenzuela, V. P. B. (2025). Exploring local responses to coastal risks in Khulna City slums: Towards strengthening resilience. *International Journal of Disaster Risk Reduction*, *120*, 105349. https://doi.org/10.1016/j.ijdrr.2025.105349

Rodríguez-Morales, B., Roces-Díaz, J. V., Kelemen, E., Pataki, G., & Díaz-Varela, E. (2020). Perception of ecosystem services and disservices on a peri-urban communal forest: Are landowners' and visitors' perspectives dissimilar? *Ecosystem Services*, *43*, 101089. https://doi.org/10.1016/j.ecoser.2020.101089

Sobhani, P. (2024). Urban development impacts on natural ecosystems in urban protected areas of Tehran province, Iran. *Heliyon*, *10*(23), e40572. https://doi.org/10.1016/j.heliyon.2024.e40572

Stroud, S., Peacock, J., & Hassall, C. (2022). Vegetation-based ecosystem service delivery in urban landscapes: A systematic review. *Basic and Applied Ecology*, *61*, 82–101. https://doi.org/10.1016/j.baae.2022.02.007

Teixeira, F. Z., Bachi, L., Blanco, J., Zimmermann, I., Welle, I., & Carvalho-Ribeiro, S. M. (2019). Perceived ecosystem services (ES) and ecosystem disservices (EDS) from trees: insights from three case studies in Brazil and France. *Landscape Ecology*, *34*(7), 1583–1600. https://doi.org/10.1007/s10980-019-00778-y

World Bank. (2023). *Annual Report 2023: A New Era in Development*.

Zaman, M. S., & Chowdhury, T. H. (2024). *The Sundarbans , the World ' s Largest Tidal Halophytic Mangrove Forest : Its Economic and Ecological Significance*. *October*. https://doi.org/10.5281/zenodo.12683069

Ziaul Hoque, M., Islam, I., Ahmed, M., Shamim Hasan, S., & Ahmed Prodhan, F. (2022). Spatio-temporal changes of land use land cover and ecosystem service values in coastal Bangladesh. *The Egyptian Journal of Remote Sensing and Space Science*, *25*(1), 173–180. https://doi.org/10.1016/j.ejrs.2022.01.008