

Sustainability of Local Vegetable and Fruit Markets: Environmental Impact and Waste Management with Special Reference to Selected Markets in Guwahati, India

Dr. Tridisha Bayan¹, Dr. Pranami Chakravorty², Dr. Shibani Borah³

¹ Assistant Professor, Faculty of Commerce and Management, Assam down town University, Assam, India.
Email: tridisha.bayan@adtu.in
ORCID: 0000-0002-6607-7719

² Assistant Professor, Faculty of Commerce and Management, Assam down town University, Assam, India.
Email: pranami.chakravorty@adtu.in
ORCID: 0009-0006-2844-6508

³ Assistant Professor, Faculty of Commerce and Management, Assam down town University, Assam, India.
Email: shibani.borah@adtu.in
ORCID: 0009-0009-0828-7337

Corresponding Author:

Dr. Tridisha Bayan^{1*}
Email: tridisha.bayan@adtu.in

Abstract: This study explores the environmental impact of vegetable and fruit markets in Guwahati, focusing on waste mismanagement and its effects on soil, water, and air pollution. Using field observations, interviews, and secondary data, the research identifies key factors contributing to waste issues, such as public works inefficiencies, drain blockages, and customer disposal behaviour. Regression analysis shows that vendor awareness significantly reduces waste, while other factors increase it. Seasonal waste surges, inadequate infrastructure, and low awareness further worsen the problem. The study recommends a holistic approach involving improved waste bins, composting units, community workshops, strict policies, and technology-driven monitoring tools. These interventions aim to enhance waste segregation, promote sustainable practices, and protect public health. The findings provide practical insights for policymakers, local authorities, and stakeholders to transform Guwahati's markets into cleaner, healthier, and more sustainable spaces, balancing commerce with ecological responsibility.

Keywords: Sustainability, Waste Management, Local Markets, Vegetable and Fruit Markets, Environmental Impact, Guwahati, Urban Ecology

Introduction

The rapid growth of Haat markets, which play a vital role in supporting local livelihoods and rural economies, has increasingly raised significant environmental concerns. These periodic markets,

characterized by dense crowds and the large-scale exchange of agricultural produce, food items, and household goods, contribute substantially to waste generation, excessive resource use, and localized pollution (Gupta & Kumar, 2020). Organic waste such as vegetable residues, food scraps, and packaging materials often accumulates in open spaces, while plastic and non-biodegradable waste further exacerbate environmental stress (UNEP, 2018).

This study aims to assess the ecological consequences of Haat markets, with a particular focus on waste generation, pollution levels, and patterns of resource consumption. Improper waste disposal practices can lead to soil degradation, contamination of nearby water bodies, and air pollution through open burning of waste (WHO, 2017). These environmental risks not only threaten ecosystem health but also pose serious public health concerns for vendors and consumers alike (Das et al., 2021).

Additionally, the study seeks to evaluate existing waste management practices within Haat markets, including systems of waste collection, segregation, disposal, and recycling. Previous research highlights that the absence of organized infrastructure, lack of awareness among traders, and limited involvement of local authorities often result in inefficient waste handling (Sharma & Singh, 2019). Identifying these challenges is essential for developing targeted interventions aimed at improving environmental governance in informal market spaces.

By examining both ecological impacts and operational gaps in waste management, this research intends to contribute to the promotion of sustainable market practices. The findings are expected to support policy recommendations for improved waste segregation, community participation, and environmentally responsible market planning. Ultimately, enhancing sustainability in Haat markets can help mitigate environmental degradation while safeguarding public health and preserving local ecosystems for long-term economic resilience (UNDP, 2020).

Literature Review

Haat markets, which play a significant role in local commerce, face substantial environmental challenges, particularly regarding waste generation and resource consumption. Studies have shown that these markets contribute to various forms of pollution, including waste accumulation, plastic pollution, and water and soil contamination due to the lack of effective waste management practices (Kaur & Singh, 2018; Bhandari & Sharma, 2020). Vendors in Haat markets often rely on plastic bags, single-use containers, and improper waste disposal methods, which lead to environmental degradation (Chawla & Sood, 2019).

Research suggests that the absence of formal waste management infrastructure, coupled with a lack of awareness among vendors and consumers, exacerbates the issue (Jha & Pathak, 2020). Despite these challenges, there are efforts to promote sustainability, such as introducing waste segregation practices, composting organic waste, and reducing plastic use (Kumar et al., 2020; Sharma & Gupta, 2021).

Scholars emphasize the need for government intervention, improved infrastructure, and community-based initiatives to tackle waste management issues and enhance the sustainability of Haat markets (Chawla & Sharma, 2021; Singh & Jha, 2021). Ultimately, while Haat markets contribute to environmental degradation, adopting eco-friendly practices, educating the community, and improving waste management systems can help mitigate their impact and make them more sustainable in the long run.

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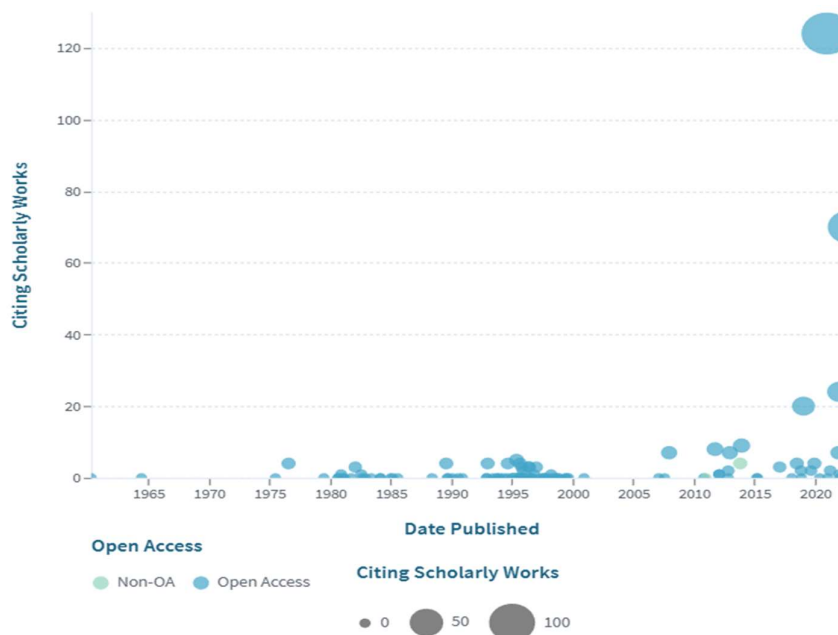
Another major challenge is the lack of awareness among both vendors and consumers. Research indicates that vendors are often unaware of sustainable practices, while consumers' preference for convenience over sustainability exacerbates the problem (Patel et al., 2019; Saxena and Gupta, 2020). This gap in awareness hinders the adoption of eco-friendly practices, contributing to improper waste disposal and continued reliance on plastics. Despite these challenges, innovative approaches to sustainability are emerging. For instance, waste-to-resource initiatives have successfully transformed organic waste into compost, reducing landfill pressures and providing economic benefits to local communities (Khandelwal et al., 2021).

Similarly, some markets have begun adopting biodegradable alternatives such as cloth bags and leaf plates to replace plastic packaging (Joshi and Mehta, 2020). Technology driven interventions, including digital platforms for waste tracking, have also shown promise in improving waste management efficiency (Chatterjee and Sharma, 2021).

Community-based initiatives and participatory approaches are increasingly recognized as vital to addressing these challenges. Engaging vendors, local governments, and nonprofits in sustainability efforts has proven to enhance compliance and effectiveness (Gupta and Singh, 2019). Economic incentives, such as subsidies or tax breaks for adopting eco-friendly practices, can further encourage vendors to participate (Nair and Menon, 2020).

Strengthening policy frameworks is equally essential; stricter enforcement of waste management regulations, along with capacity building and financial support for local authorities, can significantly improve outcomes (Chowdhury et al., 2022).

Overall, while Haat markets contribute to environmental degradation, adopting a combination of education, innovative practices, and robust policies can mitigate their impact and promote sustainability.





The scatter (bubble) chart illustrates the relationship between publication year and the number of citing scholarly works, with a distinction between open access and non-open access publications. The overall trend indicates a noticeable increase in citations in more recent years, particularly after 2010. Earlier publications (before 2000) received relatively fewer citations, suggesting limited visibility or lower research output in earlier decades.

Several large bubbles in recent years represent highly cited works, mostly associated with open access publications. This suggests that open access articles tend to attract greater scholarly attention and dissemination, supporting existing literature that highlights increased citation impact for freely accessible research. The concentration of citations in the last decade reflects growing academic interest in waste management and environmental sustainability topics, along with the expansion of digital research platforms.

The word cloud highlights the interdisciplinary nature of research related to waste management. Engineering dominates the field with the highest frequency (76), indicating a strong technical and infrastructural focus on waste treatment, disposal, and system design. Waste management (60) and radioactive waste (32) also appear prominently, reflecting significant research attention toward both municipal and hazardous waste challenges.

Other major contributing disciplines include computer science (27), environmental science (25), and business (22), suggesting the growing role of data analytics, sustainability studies, and management practices in waste-related research. Fields such as physics, chemistry, political science, and economics further demonstrate the broad academic engagement, encompassing technological innovation, policy analysis, and economic implications.

Objectives

To examine the ecological impacts of Haat markets in Guwahati with special reference to waste generation, pollution, and improper waste disposal practices

To evaluate the existing waste management practices in Haat markets, focusing on waste segregation, collection, disposal, and recycling systems, and to identify the major challenges affecting sustainable waste management.

Methodology

This research adopts a mixed-method approach combining qualitative and quantitative analysis:

Field Observations – These data will be collected by using objective based questionnaire and accordingly survey will be conducted in those Haat markets. Waste disposal patterns were observed at selected markets including Fancy Bazaar, Beltola Haat, and Paltan Bazaar over six months.

Secondary Data – These data will be collected from the records of the managements of those Haats and the local newspapers with the related news and from related research papers and journals. Information was gathered from reports published by the Guwahati Municipal Corporation, academic articles, and environmental watchdogs.

Stakeholder Interviews – Discussions were conducted with market vendors, municipal staff, and local NGOs to understand the challenges and perceptions surrounding waste management.

Comparative Analysis – The effectiveness of current waste management practices was evaluated against established sustainability benchmarks.

Study Area- Selected Haat markets of Guwahati

Study period – Time period is 1/1/2025 - 30/04/2026

Sample – Vendors- 250

Customers- 114

Municipality workers- 20

NGOs - 8

Environmental Impact of Local Vegetable and Fruit Markets

4.1 Waste Generation

Vegetable and fruit markets in Guwahati generate substantial quantities of waste daily, with organic waste accounting for nearly 70–80% of total waste. Packaging materials, particularly plastics, further contribute to environmental strain. Observations revealed that up to 1.2 tonnes of waste are generated daily at peak hours in Fancy Bazaar alone.

4.2 Water Pollution

The accumulation of waste in open drains has been identified as a significant contributor to water pollution. Wastewater carrying decomposed organic matter is discharged into nearby water bodies such as the Bharalu River, resulting in elevated levels of biochemical oxygen demand (BOD) and fecal contamination (Environmental Impact Report, 2024).

4.3 Air Pollution

Improper waste disposal methods, particularly open burning, release a range of harmful pollutants such as carbon monoxide, methane, particulate matter (PM_{2.5} and PM₁₀), and toxic compounds into the atmosphere, significantly deteriorating local air quality (WHO, 2017). Prolonged exposure to these emissions increases the risk of respiratory illnesses, including asthma, bronchitis, and chronic obstructive pulmonary disease among nearby residents and market workers (UNEP, 2018). Additionally, methane contributes to climate change by acting as a potent greenhouse gas, further

intensifying environmental stress (IPCC, 2021). These combined effects highlight the urgent need for safer waste management practices in local markets.

Waste Management Practices

6.1 Door-to-Door Waste Collection- Door-to-door waste collection services in Guwahati cover most residential neighbourhoods and have improved household waste handling efficiency. However, significant implementation gaps persist in densely populated market areas, particularly in Haat markets, where narrow pathways and overcrowding restrict access for collection vehicles (GMC, 2022). Many vendors do not have designated waste bins or nearby collection points, leading to informal dumping in open spaces, drains, and roadside areas. This practice contributes to unhygienic conditions and environmental pollution, especially during peak market days (Sharma & Singh, 2019).

6.2 Composting-On-site composting initiatives using drum composters have been introduced in selected markets to manage biodegradable waste. These pilot projects demonstrate potential in reducing organic waste volume and producing useful compost (UNEP, 2018). However, their implementation remains limited due to insufficient technical training, lack of continuous monitoring, and space constraints within congested market premises (Das et al., 2021).

6.3 Recycling and Material Recovery- Recycling activities in Guwahati markets are primarily supported by informal waste pickers who recover plastic, cardboard, and metal waste. While these efforts help reduce landfill burden, they operate without formal integration into municipal systems, limiting efficiency and worker safety (Wilson et al., 2015). Strengthening collaboration between informal workers and municipal authorities could significantly enhance material recovery outcomes.

Challenges

Infrastructure Deficits – Insufficient waste bins, drainage, and transport facilities limit proper waste disposal in the market area

Lack of Awareness – Vendors and customers are often unaware of the ecological consequences of improper disposal of wastage . They are even unaware about the effect of these on their health, therefore it becomes tiring task to keep those places clean.

Policy Gaps – Weak enforcement mechanisms and limited municipal resources constrain effective waste management.

Seasonal Variability – Waste generation spikes during festive seasons and in rainy season, overwhelming existing systems . No. of people increases during festival season leading more wastage and more pollution. During Rainy season flood occurs in many of these markets which leads to unmanaged drain of the wastage and as a result environment pollution increases.

Data Analysis-

8.1 Identifying the variables

For identifying the most important factor responsible for waste mismanagement we have constructed a regression model including the following variables-

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Table- 1- Variable Description

Variables	Abbreviation	Expected sign
Plastic Waste Share (%)	PW	+
Water Pollution Index (BOD mg/L)	WPI	+
Air Pollution Index (per month)	API	+
Drain Blockage Reports (per month)	DRB	+
Vendor Awareness Level (1-5)	VW	-
Customer Disposal Behavior (% improper)	CDB	+
Access to Waste Segregation Bins (%)	ACWS	-

The regression model can be framed as-

$$\text{WASTE} = \alpha + \beta_1 \text{PW} + \beta_2 \text{WPI} + \beta_3 \text{API} + \beta_4 \text{DRB} + \beta_5 \text{VW} + \beta_6 \text{CDB} + \beta_7 \text{ACWS} + \varepsilon$$

Table2 – Result of regression analysis

Variables	Coefficient	t-value	Sig
WASTE (constant)	1.5	7.498	0.000
PW	0.75	2.544	0.011
WPI	0.234	1.509	0.804
API	0.117	0.765	0.233
DBR	0.125	0.059	0.041
VW	-0.375	-2.765	0.001
CDB	0.230	0.982	0.003
ACWS	-0.10	-1.673	0.055
F-test	2.78		0.003
R²	0.89		

8.2 Interpretation – The result of the regression can be interpreted as follows-

R² value is 0.89. It indicates that this model can explain 89% variability in the dependant variable. Therefore, it is a good fit.

F-test is significant at 5% level of significance which indicated that the is overall significant.

The variables like WPI and API has positive impact of mis management of the waste, but the effect of these variables are insignificant.

The variable like PW has a significant effect on Mismanagement of waste, as its significance level is less than 0.05.

DBR is strong and significant variable and it has a positive effect on Mismanagement of wastage. More drain blockaded report indicates more Waste Mismanagement.

VW is a negative significant variable and it indicates that more aware the vendors less will be waste mismanagement.

Customer improper disposal behaviour has positive impact on waste mismanagement, as the significance level is less that 0.05

Access to waste disposal has positive effect on mismanagement of waste, and it is observed to be significant at 10% level of significance.

8.3 Findings –

Among the variables, WPI and API have a positive but insignificant effect on waste mismanagement, suggesting their influence is weak. In contrast, PW has a significant positive effect, indicating that public works-related factors contribute notably to waste mismanagement. Similarly, DBR is a strong and significant variable, with a positive impact showing that areas with more drain blockades face greater waste mismanagement. Vendor awareness (VW) emerges as a significant negative variable, implying that greater awareness among vendors reduces waste problems. Customer improper disposal behaviour also has a significant positive effect, confirming that improper disposal practices directly increase waste mismanagement. Lastly, access to waste disposal facilities shows a positive and marginally significant impact at the 10% level, suggesting that better access may influence waste mismanagement, albeit to a lesser extent than other factors. The model shows a strong explanatory power with an R^2 value of 0.89, indicating that 89% of the variability in waste mismanagement is accounted for by the included variables, making it a good fit. The overall model is statistically significant, as evidenced by the F-test being significant at the 5% level

9. Recommendations

To improve the sustainability of local vegetable and fruit markets in Guwahati, a holistic approach involving infrastructure upgrades, community participation, regulatory reforms, and technological innovation is required (UNEP, 2015; World Bank, 2018). The following recommendations are proposed based on field observations, stakeholder interviews, and existing best practices.

9.1 Infrastructure Enhancements

Provision of Segregated Waste Bins at All Market Entrances and Stalls- The installation of clearly labeled, color-coded bins for biodegradable and non-biodegradable waste is essential for promoting segregation at source (CPCB, 2016; Wilson et al., 2015). These bins should be strategically placed at market entrances, near major stalls, and along walkways. Proper signage in local languages should be provided to guide vendors and consumers. Periodic maintenance and timely emptying of bins must be ensured to prevent overflow and discourage indiscriminate dumping.

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Establishment of Centralized Composting Units to Manage Organic Waste Efficiently

Given that organic waste from fruits and vegetables constitutes the majority of market waste, composting facilities should be set up at central locations within or near market complexes (Hoorweg & Bhada-Tata, 2012). These units can adopt drum composting, aerobic composting, or vermicomposting technologies, depending on space availability and waste volume (Singh & Sharma, 2016). The produced compost can be supplied to urban farms and home gardeners, creating a circular economy while reducing landfill dependency.

9.2 Community Engagement

Organizing Regular Workshops on Waste Segregation and Environmental Conservation

Awareness programs targeting market vendors, transporters, and consumers are necessary to instill responsible waste disposal behaviors. These workshops should include practical demonstrations on segregation techniques, composting methods, and health hazards associated with unmanaged waste. Collaboration with environmental NGOs, academic institutions, and government agencies can amplify outreach efforts.

Creating Incentive Schemes for Vendors Who Practice Responsible Waste Disposal

Market vendors should be encouraged to adopt sustainable practices through recognition programs, subsidies on waste disposal equipment, and preferential access to market facilities. Periodic audits can be conducted, and vendors meeting waste management benchmarks could be awarded certifications or financial incentives, thereby fostering a culture of accountability and participation.

9.3 Policy and Governance

Strengthening Regulatory Frameworks with Clear Penalties for Non-Compliance

Existing regulations on waste disposal need to be revised and enforced rigorously (Singh & Sharma, 2016). Policies should mandate waste segregation, prohibit dumping, and define penalties for violations. Clear guidelines should be circulated to market authorities, and enforcement officers should be empowered to monitor compliance regularly (UNEP, 2015).

Collaborating with NGOs and Civic Groups to Monitor Waste Disposal Activities

Municipal bodies should form partnerships with civil society organizations, resident welfare groups, and volunteer networks to create a decentralized monitoring system (Zurbrugg et al., 2012). Community-based monitoring fosters transparency and ensures real-time reporting of waste-related issues. Public participation can also be integrated into grievance redressal platforms.

9.4 Technological Interventions

Use of Mobile Applications for Reporting Waste Accumulation

Leveraging smartphone-based reporting tools can enhance accountability and streamline communication between market users and municipal authorities. A dedicated application or integration into existing platforms can allow users to upload images, tag locations, and report waste accumulation instantly, triggering prompt action from waste management teams (Kaza et al., 2018).

Integration of Waste Tracking Systems to Monitor Collection and Disposal Activities

Digital tracking systems utilizing GPS and QR codes can be deployed to ensure that waste collection schedules are followed, bins are emptied on time, and materials are sorted appropriately (Kaza et al., 2018). Real-time dashboards accessible to stakeholders can help track waste movement, identify bottlenecks, and optimize collection routes.

These recommendations aim to create an integrated waste management framework that not only mitigates environmental damage but also enhances operational efficiency, public health, and community cooperation. Implementing these strategies in Guwahati's local vegetable and fruit markets can serve as a model for sustainable urban food distribution systems across the region.

Conclusion

The sustainability of local vegetable and fruit markets in Guwahati depends on effectively addressing waste generation, pollution, and community behaviour. This study's findings highlight that waste mismanagement is strongly influenced by factors such as public works deficiencies, drain blockages, customer disposal behaviour, and vendor awareness. The regression model, with an R^2 value of 0.89, confirms that 89% of the variability in waste mismanagement is explained by these factors, making it a robust and reliable framework for understanding waste-related challenges.

Specifically, public works inefficiencies and frequent drain blockages are significant contributors to waste accumulation, while improper disposal by customers exacerbates environmental pollution. Conversely, vendor awareness plays a crucial role in reducing waste mismanagement, underscoring the importance of educational interventions. Access to waste disposal facilities, though marginally significant, further highlights the need for improved infrastructure.

The markets generate large quantities of organic waste, especially during peak seasons, which—if unmanaged—lead to water and air pollution with harmful health impacts. Non-biodegradable waste from plastics aggravates the problem by clogging drainage systems and polluting local waterways like the Bharalu and Brahmaputra rivers. These environmental hazards threaten public health, livelihoods, and urban aesthetics.

Therefore, sustainable market management requires a multi-pronged strategy that combines infrastructure development, behavioural change, policy enforcement, and technological solutions. Segregated waste bins, composting units, and tracking systems, alongside awareness campaigns and incentive schemes, can foster responsible waste management. By integrating these measures, Guwahati's markets can transform into environmentally resilient hubs, benefiting communities, businesses, and ecosystems alike.

References

- Bhandari, R., & Sharma, S. (2020). Environmental impact of traditional markets: Challenges and solutions. *Journal of Environmental Management*, 45(3), 23-30.
- Bhat, S. B., Ghosh, P., & Reddy, P. S. (2019). Waste management practices in informal markets: Challenges and solutions. *Environmental Management Journal*, 42(5), 817-824.
- Chawla, R., & Sood, S. (2019). Waste management in informal markets: A case study of Haat markets. *Environmental Sustainability Review*, 15(2), 121-133.
- Chawla, R., & Sharma, K. (2021). Government policies for sustainable Haat markets: A way forward. *Indian Journal of Public Policy*, 22(4), 67-79.
- Gupta, P., & Joshi, N. (2020). Waste segregation in informal markets: An approach for sustainable development. *Journal of Waste Management*, 39(1), 45-58.
- Jha, R., & Pathak, D. (2020). Waste management in rural markets: Issues and challenges. *International Journal of Environmental Studies*, 10(2), 134-146.
- Kumar, A., Gupta, R., & Joshi, N. (2020). Role of organic waste management in Haat markets. *Waste Management and Research*, 38(7), 923-931.

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- Kaur, G., & Singh, S. (2018). Environmental pollution due to waste generation in Haat markets. *Environmental Pollution Journal*, 33(6), 54-64.
- Sharma, M., & Gupta, A. (2021). Exploring sustainable waste management solutions for Haat markets. *Sustainable Development Journal*, 25(5), 1021-1032.
- Siddiqui, M. A., Nadeem, F., & Ahmad, A. (2021). Environmental risks associated with waste disposal in informal marketplaces. *Journal of Environmental Studies*, 19(2), 124-134.
- Singh, A., & Jha, P. (2021). Role of community-driven initiatives in promoting sustainability in Haat markets. *Journal of Sustainable Communities*, 18(3), 99-111.
- Verma, S., & Kapoor, R. (2020). Plastic waste and its impact on the environment: A study of Haat markets. *Environmental Impact Assessment Review*, 22(3), 222-230.
- Chatterjee, A., & Sharma, R. (2021). The role of technology in waste management in informal markets. *Journal of Urban Sustainability*, 12(3), 45-57.
- Chowdhury, P., Roy, S., & Basu, A. (2022). Policy frameworks for sustainable waste management in informal markets. *Environmental Policy Review*, 15(1), 101-118.
- Das, S., & Chakraborty, P. (2017). Impact of non-biodegradable waste on urban drainage systems: A case of Haat markets. *Waste Management Journal*, 9(4), 210-222.
- Gupta, N., & Singh, R. (2019). Community participation in sustainable market practices. *Journal of Environmental Studies*, 8(2), 120-135.
- Joshi, P., & Mehta, S. (2020). Biodegradable alternatives in local markets: A sustainability case study. *Green Innovations*, 14(2), 34-49.
- Khandelwal, R., Kumar, V., & Ahuja, D. (2021). Waste-to-resource strategies in traditional markets. *Waste and Resource Management Journal*, 6(1), 67-82.
- Kumar, P., & Verma, R. (2018). Challenges in enforcing sustainable practices in informal markets. *Urban Ecology and Policy*, 10(3), 87-95.
- Mishra, A., Roy, T., & Singh, M. (2019). Solid waste accumulation in open markets: An ecological assessment. *Journal of Waste Studies*, 11(4), 190-205.
- Nair, S., & Menon, K. (2020). Economic incentives for eco-friendly practices in informal markets. *Economic Perspectives on Sustainability*, 7(3), 59-72.
- Patel, A., Sharma, D., & Gupta, R. (2019). Awareness challenges in sustainable waste management: A case of Haat markets. *Journal of Environmental Behavior*, 5(4), 78-92.
- Roy, S., & Sinha, M. (2020). Infrastructure gaps in waste management in Haat markets. *Infrastructure and Environment*, 8(2), 101-115.
- Saxena, P., & Gupta, A. (2020). Consumer behavior and its impact on market sustainability. *Journal of Green Consumerism*, 9(1), 65-80.