

**ORIGINAL ARTICLE**

Present Scenario of Plastic-Bottle Waste Recycling Practice in Natore Sadar

*Frazana Yesmin Rafina, Shahariar Shakil and Md. Zakir Hossain Khan

Bangladesh Army University of Engineering and Technology, Bangladesh

ABSTRACT - The study investigates the current practices of plastic-bottle waste recycling in Natore Sadar Upazila, Bangladesh, focusing on environmental challenges and socio-economic dynamics. Utilizing a structured questionnaire survey conducted from August 2023 to October 2023. Data were collected from 8 shops—comprising 4 processing and 4 collection shops—about shop characteristics, workforce demographics, types and quantities of plastic bottles recycled, and economic aspects. The research identifies three main types of plastic bottles being recycled: pet bottle white (PBW), pet bottle green (PBG), and pet bottle brown (PBB). Variations in shop sizes, workforce details, and wage levels were noted. Collection shops accumulate 500-1000 kg of plastic waste weekly, while processing shops handle 20,000-27,000 kg. Workers in these shops, typically aged 30-40 years, earn between 600 and 700 BDT per day. The study highlights inadequate infrastructure, low wages, and poor working conditions as significant challenges. Environmental concerns such as microplastic pollution and chemical hazards from the recycling process were also identified. To address these issues, the study recommends policy interventions, infrastructure improvements, and awareness programs. These measures aim to enhance recycling efficiency, worker conditions, and environmental safety. The findings underscore the critical need for improved recycling practices and policy support to achieve sustainable waste management in Natore Sadar.

ARTICLE HISTORY

Received: 15 June 2024

Revised: 18 July 2024

Accepted: 23 July 2024

KEYWORDS

Sustainable development, Plastic bottle recycling, Socio-economic dynamics, Environmental challenges, Waste management.

INTRODUCTION

Plastic pollution is a critical environmental issue that has garnered global attention due to its pervasive and persistent nature [1]. Among the various forms of plastic waste, plastic bottles are particularly problematic because of their widespread use and the challenges associated with their disposal and recycling [2]. In recent years, efforts to mitigate the environmental impact of plastic waste have intensified, with recycling emerging as a key strategy [3]. Natore Sadar, a region in Bangladesh, reflects the broader national and global struggle with plastic waste management. The rapid urbanization and increased consumerism in this area have led to a surge in plastic bottle usage, subsequently escalating the volume of plastic waste [4]. Despite the growing environmental awareness and efforts to promote recycling, the effectiveness of these initiatives remains questionable [5]. The local context of Natore Sadar presents unique challenges and opportunities for plastic bottle recycling. The region's waste management infrastructure is still developing, and there is a lack of robust policies and regulations to support efficient recycling practices [6]. Moreover, public participation in recycling programs is limited due to insufficient awareness and educational campaigns [7]. Economic constraints also play a significant role in hindering the adoption of advanced recycling technologies and practices [2].

*Corresponding Author: Md. Zakir Hossain Khan. Bangladesh Army University of Engineering and Technology (BAUET), email: enr.zakir@yahoo.com

This paper aims to provide a comprehensive analysis of the current state of plastic bottle waste recycling in Natore Sadar. By examining the existing recycling practices, identifying the challenges faced, and proposing strategic recommendations, this study seeks to contribute to the development of a more sustainable and effective recycling system in the region. The insights gained from this research can also offer valuable lessons for other regions facing similar challenges in plastic waste management. In the following sections, the study's objectives, research questions, and methodology are outlined, followed by a detailed presentation of the results. The discussion section interprets these findings, highlighting their implications for policy and practice. Finally, the paper concludes with recommendations aimed at improving plastic bottle recycling in Natore Sadar, thereby enhancing environmental sustainability in the region. The primary objectives of this research were:

1. To find out the type of plastic waste and the condition of plastic bottle waste management practice of the Natore Sadar Upazila area.
2. To find out the collection process of plastic and the amount of recycling process of the plastic waste of Natore Sadar Upazila area.

MATERIALS AND METHODOLOGY

The research was conducted in Natore Upazila, located in the Rajshahi Division of Bangladesh, covering an area of 1896.05 square kilometers. The geographic coordinates range from 24° 25' to 24° 58' north latitude and from 88° 01' to 88° 30' east longitude. Location of study area is shown in below Figure 1. Data was collected from eight locations for the survey, consisting of four processing shops and four collection shops. The selection was made to ensure a comprehensive understanding of the recycling practices across different types of establishments in Natore Sadar Upazila. GPS coordinates of selected shops are shown in Table 1.1.

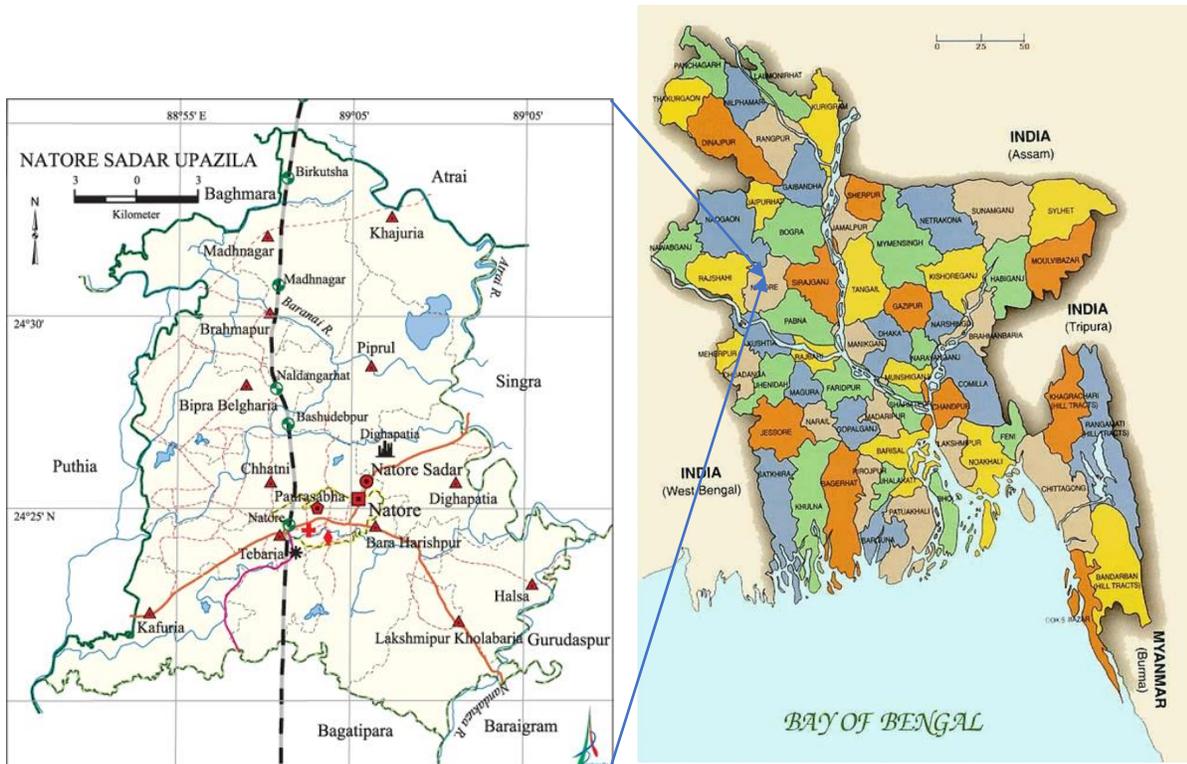


Figure 1. Study Area (Courtesy: Google).

Table 1. Location of Shops with co-ordinate

Shops	Location Co-ordinate
C1	24.403613, 89.029235
C2	24.404414, 88.985242
C3	24.404733, 88.984818
C4	24.401911, 88.970604
P1	24.403164, 86.029091
P2	24.402817, 89.029360
P3	24.402387, 89.029536
P4	24.401957, 88.969780

Data were collected through a structured questionnaire survey targeting shop owners and workers. The questionnaire covered shop size, workforce details, types of plastic bottles processed, wage levels, and quantities of plastic waste handled. The collected data were analyzed using statistical tools to identify trends and correlations. Descriptive statistics provided insights into the demographics of workers, shop operations, and economic factors.

Data study was collected through a structured questionnaire survey, conducted from August 2023 to October 2023. The survey was designed to gather detailed information about plastic bottle recycling practices in Natore Sadar Upazila, targeting both shop owners and workers involved in the collection and recycling processes. For the questionnaire survey, 12 questions were prepared. They are as follows:

1. Type of size of the shop?
2. Numbers of workers?
3. Age of the workers?
4. Salary of the workers?
5. Type of waste?
6. Amount of waste per day/week/month/year?
7. Collection process?
8. Buying price?
9. Selling price?
10. Destination of recycled products?
11. Transportation system?
12. Others?

Our questionnaire survey was conducted by Natore Sadar Upazila from August 2023 to October 2023, and we came up with the question paper. The second stage was to begin visiting different Natore Sadar Upazila areas. We used public transportation to go to our first store in Natore Upazila. We questioned the shop owners of Natore Sadar Upazila where the initial stage in our survey was to create a question paper to gather accurate data for this study. We examined a large number of publications connected to plastic bottle collecting and processing business to generate the question papers. After that, we went to the first collection store. We also inquired about the location of the other business while gathering data from the shop owner. The owners were gentlemen who gave us all the information we needed to perform the study. Then, we decided to evaluate the information we received from the stores we visited and continue our investigation using the information we had.

RESULTS AND DISCUSSION

In our study area of Natore Sadar Upazila, There are different categories and type of plastic waste collected in the shops such as PET, HPDE, LPDE, PVC. They are collected by those workers who collect the plastic. There are difference of workers who separate the plastic from collected plastic waste in the shop. Generally plastic waste generated from household and various type of shop and also food shops. They are basically hand-picked from door to door by local scavengers and they sell the waste to the collection shops then they sort the waste and sell the processing shop.

With a short description, the shops are collect the plastic bottle waste first from the local scavengers and sort them into different categories. After sorting of the materials and shred them in shredding machine then wash them and pack them for final destination where they are heated and turned into mold for re-use. Where the plastic trashes are stored at the processing business. They divided them into three categories:

- a) Pet bottle white (PBW)
- b) Pet bottle green (PBG)
- c) Pet bottle brown (PBB)

Our study on plastic bottle waste management in Natore Upazila revealed interesting details about the people involved and the current recycling process. Shops employ a mix of male and female workers, with an average age range of 38-47. Thankfully, no child labor was observed. The number of workers varies depending on the shop's function, with collection centers averaging 7 workers and processing centers averaging 12. The average worker earns 700-800 BDT per day.

The plastic bottle recycling process starts with local scavengers collecting plastic waste and selling it to collection shops. Here, the plastic is sorted and shredded before being sold to processing centers. Processors take things a step further by sorting the plastic again, this time by color (PET white, green, brown). Finally, most of the recycled plastic is shipped to Dhaka for conversion into molds. Our key findings highlight the weekly plastic waste collection capacity, with collection shops averaging 1000-500 kg and processing shops handling a much larger volume of 20000-27000 kg. However, a significant challenge lies in the fluctuating market value of recycled plastic. To address these issues and improve the overall system, we recommend several actions. Firstly, implementing more advanced recycling methods would improve efficiency and reduce contamination. Secondly, establishing a minimum wage would attract more workers to the sector. Thirdly, public awareness campaigns are crucial to promote proper waste management and recycling practices.

Developing a well-organized waste collection system with designated bins for different plastic types would also be highly beneficial. Upgrading recycling facilities to handle a wider variety of plastic waste is another important step. Furthermore, encouraging the use of reusable alternatives and enacting bans on specific single-use plastics would significantly reduce plastic waste generation. Finally, implementing stricter regulations on plastic use and disposal, with measures like levies or fines, would deter improper practices. Establishing a producer responsibility system would incentivize manufacturers to prioritize using recycled content in their products, creating a more sustainable closed-loop system.

This study identified several critical issues hindering the effectiveness of the plastic bottle recycling sector in Natore Sadar, Bangladesh. These findings are discussed below, drawing upon relevant existing research.

Inadequate Infrastructure

The current study was regarding the limitations of existing plastic waste management infrastructure in Natore. Their research suggests the facilities are insufficient to handle the growing volume of plastic waste efficiently [6]. This finding is further supported by another study that emphasizes the need for improved infrastructure for effective plastic waste management practices in Bangladesh [7].

Economic Challenges

The low wages and poor working conditions faced by recycling workers in Natore Sadar resonate with the broader challenges also highlighted regarding the plastic waste management sector in Bangladesh [3]. That emphasizes the need to address the economic well-being of workers for a sustainable waste management system.

Environmental Concerns

The potential release of microplastics and harmful chemicals during the recycling process raises environmental and health concerns. This aligns with the discussion on the environmental impact of conventional plastics and the need for biodegradable alternatives [8]. Further emphasizes the environmental risks associated with plastic waste management in Bangladesh [2]. It is important to note that while the study by Bangladesh Centre for Communication Programs in 2018 focuses on bottled water specifically, it highlights the broader environmental impact of plastic usage ([9].

Additional Considerations

While the focus of this study was on the plastic bottle recycling sector, it is important to acknowledge the potential role of alternative materials like jute, as discussed by Bangladesh Jute and Textile Associates in 2018 [10]. Some photos of field visit is and data collections shown in below Figure 2.



Figure 2. Field Visit and Data Collections.

CONCLUSION

This study contributes to the existing body of research on plastic waste management in Bangladesh by highlighting the specific challenges faced in Natore Sadar. By addressing the issues of inadequate infrastructure, economic hardship for workers, and potential environmental risks, the plastic bottle recycling sector in Natore Sadar can be improved towards a more sustainable future. Further research could explore potential solutions for each challenge identified. For instance, investigations into improved recycling technologies that minimize environmental impact (e.g., microplastic release) could be beneficial. Additionally, exploring economic models that ensure fair wages and safe working conditions for recycling workers is crucial. Finally, studies on the feasibility of integrating alternative, sustainable materials like jute into the waste management system could be explored. By implementing these recommendations and fostering collaboration between researchers, policymakers, and industry stakeholders, a more robust and sustainable plastic bottle recycling sector can be established in Natore Sadar and beyond. This will contribute to mitigating plastic pollution and fostering a healthier environment for the community.

RECOMMENDATIONS

- 1. Policy Interventions:** Implementing stricter regulations and providing incentives for proper waste management practices and promote the benefits of 3R strategy.
- 2. Improving Infrastructure:** Investing in modern recycling facilities to enhance processing efficiency and safety by exploring new techniques to expand recyclable plastics and improve economic viability.
- 3. Awareness Programs:** Educating the public and businesses about the importance of proper plastic waste management and the benefits of recycling.
- 4. Ban on single-use plastics:** Implement and enforce bans on specific problematic plastics like thin carry bags, straws, and cutlery. Promote jute or cloth alternatives.
- 5. Deposit return schemes:** Introduce deposit return schemes for plastic bottles and beverage containers, incentivizing their return for reuse.
- 6. Informal sector integration:** Integrate informal waste pickers into the formal waste management system by providing training, equipment, and social security.
- 7. Develop bioplastics:** Research and develop bioplastics made from renewable resources like cellulose or sugarcane.
- 8. Extended Producer Responsibility (EPR):** Introduce EPR schemes that make producers financially responsible for the collection and recycling of their plastic packaging.

ACKNOWLEDGEMENT

The authors would like to thank Civil Engineering Department, Bangladesh Army University of Engineering and Technology to conduct this research.

REFERENCES

- [1] Roy, S. (2010). The Dhakeshwari Temple and the Telegraph in Colonial Calcutta. *Economic and Political Weekly*, 45(49), 84-91.
- [2] Ayan, A. H. (2018). Plastic waste management in Bangladesh: A review. *Journal of Environmental Management*, 223, 344-354.
- [3] Ahmed, S. (2019). Plastic waste management in Bangladesh: Challenges and opportunities. *Waste Management & Research*, 37(11), 1095-1102.
- [4] Hasan, M. K. (2019). Municipal solid waste management in Bangladesh: A review. *Waste Management*, 84, 71-84.
- [5] Rahman, M. M. (2017). Awareness and knowledge level of household people about plastic waste management in Chittagong city, Bangladesh. *International Journal of Recycling of Organic Waste in Agriculture*, 6(2), 189-197.
- [6] Hossain, M. M. & Shams, M. S. A. (2017). Plastic waste recycling practice in Natore district, Bangladesh. *Journal of Waste Management & Resource Recovery*, 5(3), 121.
- [7] Khan, F. (2020). Plastic waste management practices in Bangladesh: A review. *Journal of Material Cycles and Waste Management*, 22(3), 709-722.
- [8] Alam, J. (2018). A review on the biodegradable alternatives for conventional plastic. *International Journal of Waste Resources*, 8(2), 1-8.
- [9] Bangladesh Centre for Communication Programs. (2018, July 11). The environmental impact of bottled water.
- [10] Bangladesh Jute and Textile Associates. (2018). Jute geo-textiles and geo-grids for soil erosion control and infrastructure development. Retrieved from <https://bjgeotextile.com/jute-geotextile-jute-pad-form-microgreen/>