

COMMUNITY-DRIVEN PLASTIC WASTE RECYCLING IN COASTAL BANGLADESH FOR ECOSYSTEM AND LIVELIHOOD ENHANCEMENT

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ABSTRACT

Plastic pollution poses a severe threat to coastal ecosystems and livelihoods in Bangladesh. This paper proposes a scalable waste management strategy with actionable insights for other vulnerable coastal regions. Communities in areas like Dacope (Khulna), faces escalating environmental and socio-economic challenges due to the accumulation of plastic waste, which degrades ecosystems, disrupts fisheries and threatens public health. These regions is chosen based on their vulnerability to plastic waste influx, high dependency on natural resources, and existing gaps in waste management infrastructure. Using the Driving Force-Pressure-State-Exposure-Effect-Action (DPSEEA) framework, this research systematically examines the sources and impacts of plastic waste, its effects on local ecosystems and communities and feasible recycling strategies. The findings highlight that community-driven plastic recycling can address environmental degradation while providing alternative livelihood options, particularly for vulnerable groups such as women and marginalized populations. By integrating local knowledge, strengthening institutional support and fostering public-private partnerships, recycling initiatives can contribute to ecosystem preservation and resilience.

Keywords: Plastic waste recycling, coastal Bangladesh, community engagement, DPSEEA framework, alternative livelihoods

INTRODUCTION

Recently ecosystems, biodiversity and human livelihoods are all seriously threatened by plastic waste, which has turned into a worldwide environmental calamity. Coastal places are especially vulnerable due to their reliance on natural resources and delicate ecosystems. Around 0.79 million tons of plastic garbage are produced each year in Bangladesh, making the issue particularly noticeable there (Hasan et al., 2023). The excessive use of single-use plastic, poor waste management systems and lack of recycling infrastructure all contribute to the serious effects of plastic pollution in coastal communities like Dacope, Khulna. This area is crucial to socioeconomic structure of Bangladesh, since it supports fisheries, agriculture, tourism and other vital ecosystem services all of which support millions of people. However they have become hotspots for plastic debris accumulation from different sources. Predominant types of plastic waste include PET bottles, polythene bags, discarded fishing nets and packaging materials (Jahan et al., 2022). This waste disrupts biodiversity, contaminates agricultural lands and exacerbates disaster risks by obstructing drainage systems, increasing flood risks and affecting water quality (Rahman et al., 2023).

The ecological consequences of plastic waste in coastal regions are profound. For example, the Sundarbans mangrove forest, a UNESCO World Heritage site in Khulna, is at risk from plastic pollution that alters water quality and endangers aquatic species (Islam et al., 2021). Similarly, Cox's Bazar's coastline, vital for tourism and fishing, faces degradation that threatens its economic viability (Chowdhury et al., 2020). Barisal and Chattogram, known for their agricultural productivity, are experiencing reduced crop yields due to micro plastic contamination of soil and water systems. The socio-economic impacts are equally alarming. Fishing communities suffer income losses as ghost nets entangle marine life, reducing fish stocks (Hossain et al., 2023). Clogged drainage systems from plastic waste exacerbate urban flooding and waterlogging during heavy rains, particularly in cyclone-prone areas (Ahmed et al., 2021). Marginalized groups, including women, are disproportionately affected, facing heightened economic insecurity and environmental stress. Despite these challenges, plastic waste also presents an opportunity to enhance economic resilience through recycling. Transforming waste into marketable products can reduce environmental hazards while creating alternative livelihoods. Successful recycling initiatives in coastal regions have engaged local entrepreneurs to produce recycled plastic goods, reducing pollution and generating income scaling such models to other

coastal regions could foster a circular economy. Moreover, integrating women and marginalized groups into waste collection and product manufacturing value chains can address both environmental and social inequities (Khan et al., 2023). Public-private partnerships and international collaborations are essential for advancing recycling efforts. These can provide technical and financial support to establish efficient recycling facilities in underserved regions like Dacope, significantly mitigating plastic pollution while empowering communities. This research aims to contribute critical data for policymakers and community leaders by mapping the sources, types and impacts of plastic waste in Dacope region. By employing the DPSEEA (Driving Force-Pressure-State-Exposure-Effect-Action) framework, it identifies actionable strategies such as incentivizing community-based recycling initiatives, improving waste management infrastructure and raising awareness about plastic consumption. Furthermore, the findings align with international efforts under the Basel Convention and the United Nations Sustainable Development Goals (SDGs), particularly Goals 12 (Responsible Consumption and Production) and 14 (Life Below Water). By addressing the environmental and socio-economic dimensions of plastic pollution, this study offers pathways for reducing pollution and enhancing livelihoods.

METHODOLOGY

Study Area

The study was conducted in Dacope Upazila, Khulna District, Bangladesh, known for its vulnerability to natural disasters. Total area of this Upazila is approximately 991.98 sq. km, located in between 22°24' and 22°40' north latitudes and in between 89°24' and 89°35' east longitudes. It is bounded by Batiaghata Upazila on the north, Pasur river on the south, Rampal and Mongla Upazila on the east, Paikgachha and Koyra Upazila on the west. Total Population is consists of 158309; male 79292 and 79017 female (Upazila Administration, Dacope) with livelihoods based on agriculture, shrimp farming and resources from the Sundarbans mangrove forest Main rivers are Pasur, Shibsra, Manki, Bhadra; Palashbari, Churia, Nalian and Jugra canals are notable. Each of the water body is special for understanding the impacts of plastic pollution and developing community-driven recycling strategies. Its proximity to the Sundarbans makes it highly vulnerable to plastic pollution. Figure 1 shows the study locations for this study.

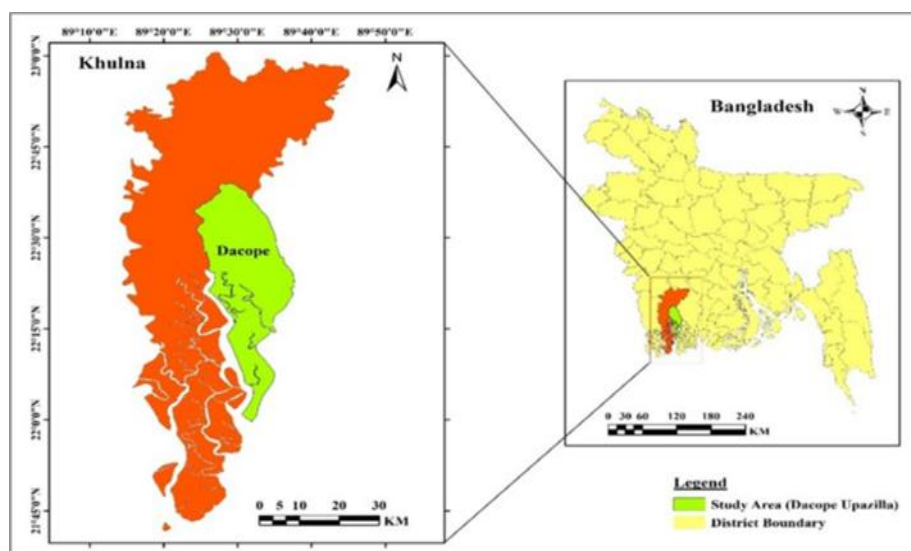


Figure 1 Location map of the study area

Data Collection

Structured questionnaires were administered to 300 households across various unions in Dacope Upazila. These locations were selected to represent different community settings, from rural to coastal areas, ensuring a comprehensive understanding of plastic waste generation and recycling practices. Door-to-door visits were conducted in different unions, allowing for direct engagement and clarification of survey questions. Additionally, Focus Group Discussions (FGDs) were conducted with local stakeholders such as fishermen in Bajua Union, small business owners in Kachikhali Union, and women's groups in Dacope Sadar and Pankhali Union. These discussions explored socio-cultural perceptions, challenges and opportunities related to recycling. The FGDs took place in community local gathering spaces within these unions to ensure participation from a diverse group of residents. Key Informant Interviews (KIIs) were conducted with local government officials from Dacope Union

Parishad, representatives from NGOs such as Social Development Foundation (SDF), Department of Public Health Engineering (DPHE) - Rural Water Supply and Sanitation Project (PRWSP) and waste management experts active in the region. These interviews provided valuable insights into existing policies, logistical barriers and institutional perspectives on recycling efforts. The interviews were arranged through formal appointments and conducted in the officials' offices or neutral locations to encourage open dialogue.

To validate the survey responses and enhance the reliability of the data, photographic documentation and physical sampling of plastic waste were carried out in key locations, including local markets in Kachikhali and Dacope Union. These physical samples helped cross-check the types and quantities of plastic waste informed by the households. Data analysis followed a mixed-methods approach: quantitative data from household surveys were analyzed statistically to detect patterns, while qualitative data from FGDs and KIs were subjected to thematic analysis

The knowledge and policy gaps

In plastic waste management and recycling in Dacope delay the development of effective and efficient native solutions to the growing ecological crisis. Addressing these gaps through detailed studies, community engagement and the development of integrated recycling systems will be key to improving plastic recycling and management practices. Weak enforcement of regulation of single used plastic bag and less incentive for eco-friendly adaptation are the main policy gap. This research focused on the specific types of waste, community behavior and active engagement as well as the broader environmental and economic impacts that will establish a solid basis can lead to more focused and impactful interventions.

Current State of Plastic wastages in Dacope

The current state of plastic waste Dacope coastal Bangladesh is a pressing environmental issue, with significant impacts on both ecosystems and human health. The data presented in the tables highlight key aspects of plastic waste generation, its types, sources, pathways and effects in coastal livelihood of Dacope Upazila. Plastics, especially polyethylene (PE), polypropylene (PP) and polyethylene terephthalate (PET), dominate the waste stream in Dacope. These plastics are commonly found in packaging materials, beverage bottles, and fishing nets. Their non-biodegradable nature means they persist in the environment for hundreds of years, contributing to the increasing volume of waste. Households, small business owns, fishermen generate a huge volume of plastic waste and the survey revealed the plastic waste production per household not less than 20 kg per month. Local population often uses plastic bags for everyday tasks, such as carrying groceries, and they lack proper disposal facilities. On the other hand fishermen are significant contributors due to discarded fishing gear, such as nets, ropes and floats which are often not disposed of properly. The improper disposal of fishing gear exacerbates plastic pollution where plastic waste enters the ocean and directly harming marine ecosystems.

RESULT AND DISCUSSION

The plastic waste generation in the coastal base of Dacope provides a complex interplay of waste generation, inadequate infrastructure, lack of awareness, and environmental degradation. While some efforts are underway, there is a clear need for greater community its harmful effects on the environment and public health. The household's survey supplied clears insights and strategies based on the collected data from different part of the survey.

Table 1 Plastic Wastages-types, sources and Pathways in coastal zone

Types	Sources & commonly used	Percentages (%)	Main pathways	Quantity – Approximate (tons/month)
Polyethylene (PE)	Plastic bag, fishing gear, packaging,	45%	Water ways, landfill	500-600
Polypropylene (PP)	Container, bottle, caps	15-20%	Improper disposal	250
Polyethylene Terephthalate (PET)	Beverage bottles	10-15%	Littering, different water ways	150
Polystyrene (PS)	Foam packaging.	10%	Wind	100-300

Others (LDPE, PVC)	Utensils Construction, electronics	15%	dispersal Mixes stream of waste	200
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According to the survey, the most common source of waste production through plastic is plastic bag and packaging and contributes about 45% of the coast waste of the community. Directly flowed from different waterways caused serious harm to the nature

Table 2 able Types of Plastic Waste Produced by Different Community Groups

Community group	Primary waste types	Key activities leading to waste	Direct impact on environment and livelihood
House holds	Food container, single use plastic bag, wrapper, bottles	Improper disposal of household goods	Direct soil and water contamination, health risk from burning plastics
Fishing community	Rope, fishing net, plastic container, packaging materials	Packaging waste from fishing boat trips, discarding damaged net	Marine arena pollution, harm to flora and fauna, financial losses to finishing community due to resources degradation
Market vendor	Plastic bag, packaging materials, bottles, tetra pack	Excessive use of plastic bags, product selling packaging	Continuous clogging of drainage system, increased flood, unhealthy environmental condition
Tourism activities	Water bottles, disposable cutleries, food wrapper, straw	Lack of recycling or disposal facilities, littering in public spaces	Degradation of scenic beauty of nature, harm to diversified wildlife, ultimate reduction of tourism appeal
Agricultural workers	Fertilizer bad, seeds packet, irrigation equipment	Disposing empty bags and equipment	Water pollution, soil degradation and erosion and reduced production yield

Different types of plastic waste are prevalent among community groups. Fishing communities primarily generate robust plastics like nets and ropes, while households and market vendors contribute significantly to single-use plastics such as bags and bottles. Agricultural workers dispose of heavier-duty materials like fertilizer bags and irrigation equipment. Encouragement on recycling fishing nets, rope can mitigate the direct pollution.

DPSEEA Framework

In this study DPSEEA (Driving force-pressure-State-Exposure-Effect-Action) framework provides a clear and structured way to analyze the relationship between environments. Briggs (2008), elaborates on the application of the DPSEEA framework to assess systemic environmental health risks. Here driving force indicates the underlying factors or activities that leads to environmental changes as; population growth or rapid urbanization. In case of Dacope Increased use of plastic packaging in local markets for fish and other seafood, contributing to higher plastic waste generation. On the other hand pressure is the strain these this forces have on the environment. For example, different pollution or depletion. State refers the condition of surrounding environment or ecosystem. It includes current air or water quality. Exposure is the degree human environmental components are exposed to the already harmed condition. In this research the livelihood exposure to the contaminated air condition produced from burning plastic. The term effect is the direct impact or control over human health or environment. The measures that should be taken to prevent or mitigate the adverse condition is the ultimate action. Here innovative recycling policies with community engagement, pollution control measures are effective actions for better livelihood.

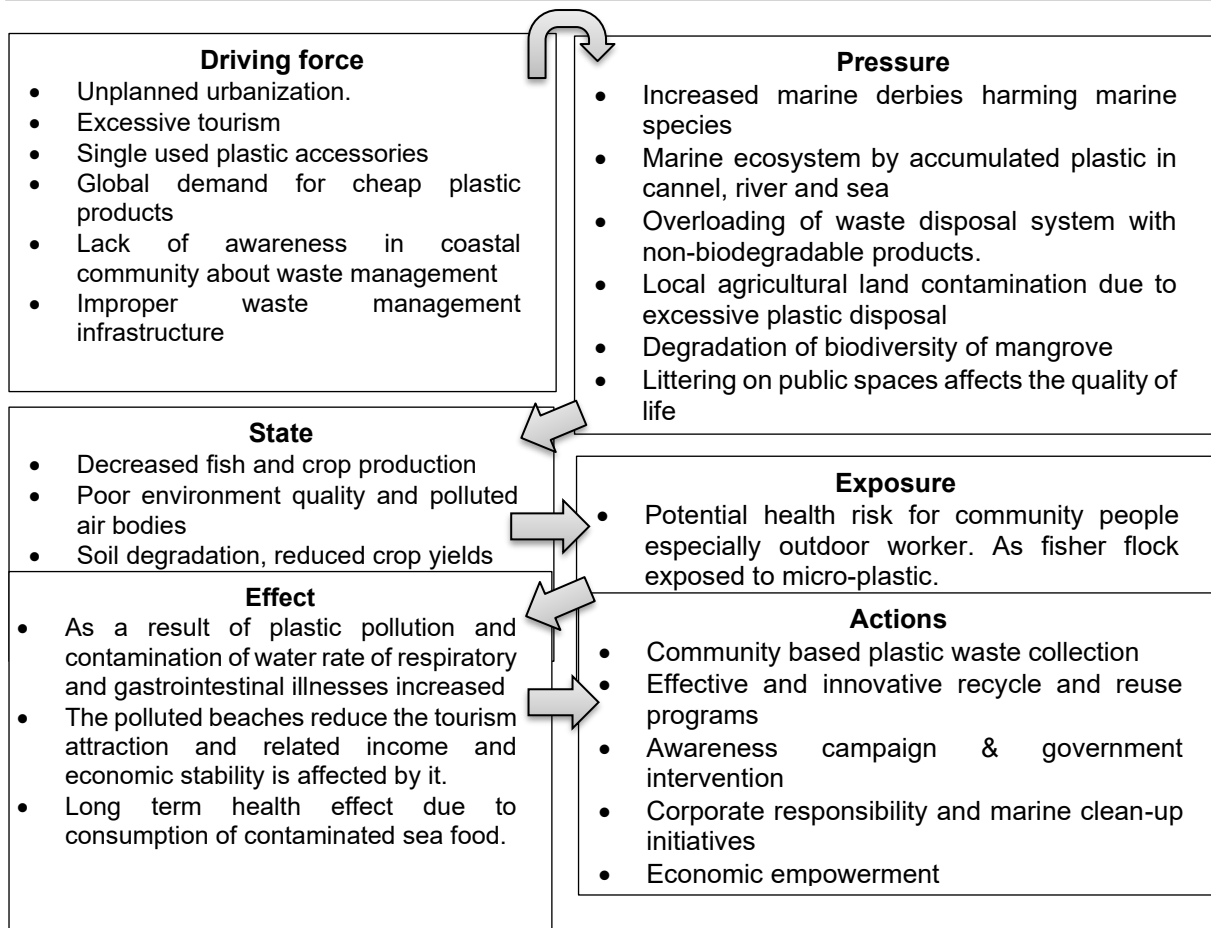


Figure: 2 DPSEEA framework for Plastic waste consequences and actions

Community Driven Waste Recycling in Dacope

The current state of waste disposal and management system in Dacope and nearby locality is really alarming. Nearly 60% of the produced wastages being openly dumped and leading serious environmental and health issues. Historically, the physical environment has been a target for public health policy across the globe. This remains the case in developing countries where the enduring infectious and toxic challenge posed by the environment is tangible and its health impact is manifest. (Morris et al., 2006). This study reveals that over 75% people of the community are willing to actively participate in waste disposal and management initiatives but lack behind proper initiatives, guidance and infrastructural facilities. Despite this obstacles, the community demonstrated a very high level of willingness to actively participate in plastic waste recycling process and the amount is about 80%- 90% of the percipients who expressed their strong desire to learn and adopt any sustainable recycling policy. Table 3 and 4 shows the willingness of different groups and their potentials with tactical plans.

Table 3 willingness of different group of the community

Different community group	Participant's interest	Key challenges /prospects
Fisher folk	75%-80%	Investment cost, time management
Households (Mainly women)	85%	Lack of raining& infrastructure additional responsibilities (senior and child care), family habit, inconsistent waste collection
Local vendors	55%	Less awareness, time and cost concern, no incentives, ease availability of plastic accessories with no alternatives
Youth (aged 18-40) approximately	90%	More education and awareness, environmental concern and responsibilities, peer group influences, skill development and financial opportunities,

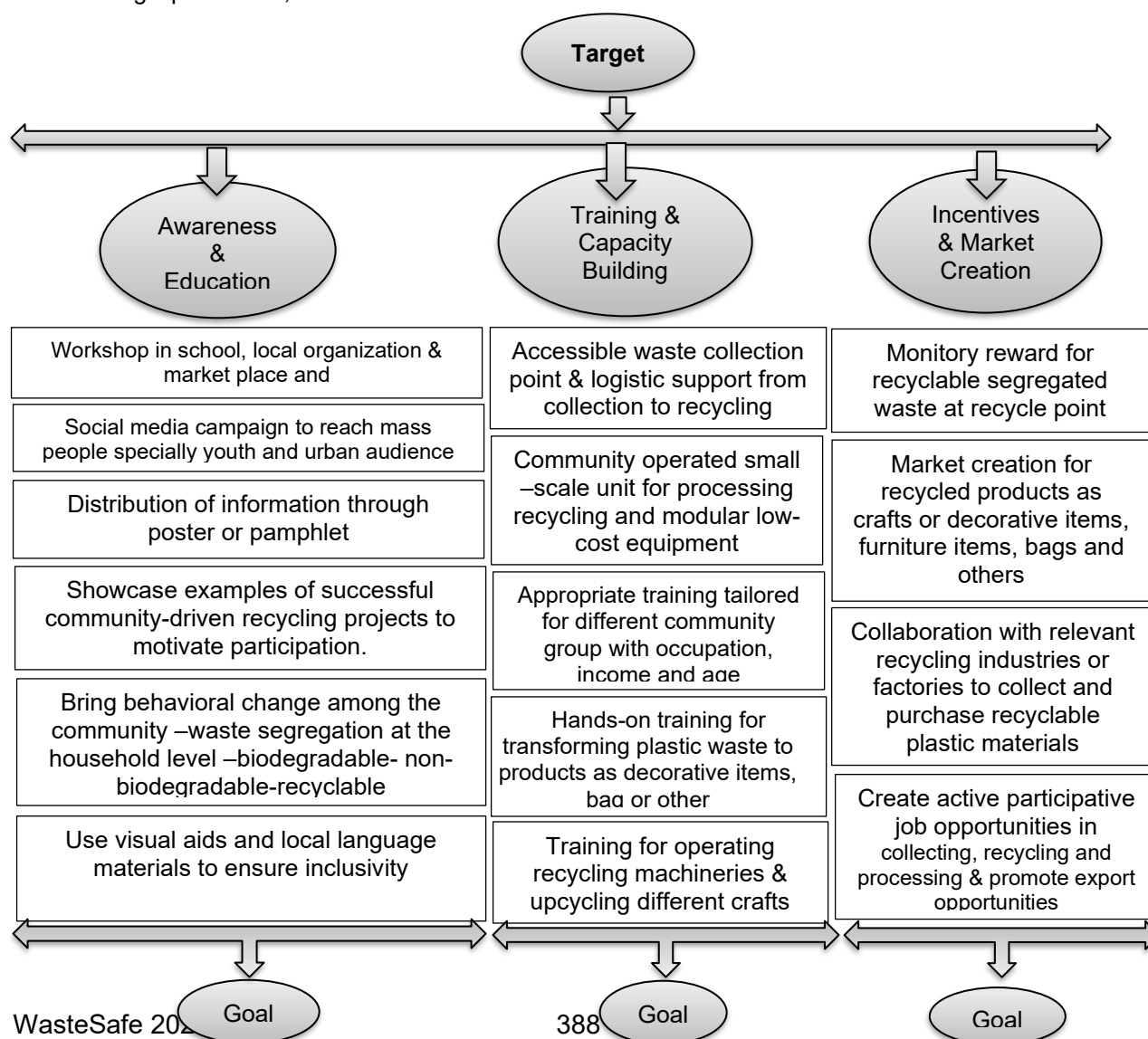
Table 4 Recycling and potential community engagement

Aspects of recycling	Key insights	Proportion	Remark
Willingness	Households participation	70%	High potential for active engagement.
Awareness	Awareness about health benefit of recycling	34%	Target awareness campaign
Interest	Learning about sustainable recycling and reuse method	80%-90%	High potential for skill based training programme
Participation in existing recycling	Informal or organized recycling	10%	Lack access to infrastructure
Barrier of recycling	Lack of awareness and time	60%	Strategic intervention plan

Strategic Intervention Plan for Reuse and Recycling

For properly addressing the current crisis of plastic waste, it is very crucial to introduce strategic intervention plan for recycling. Community engaged effective plan can reduce the environmental degradation, promote sustainable development and resource management and create financial opportunities with concern of direct public health. Dacope is able to empower communities by converting trash into resources. By building infrastructure, knowledge and financial incentives, a well-planned approach guarantees long-term advantages. The plan can be like taking initiatives to engage the maximum number of the community member in this plan and ensure their participatory involvement so that their real life experience can provide a better pathway. For the implementation to achieve goal the series phases are find out for the community of Dacope.

The strategic plan is like;



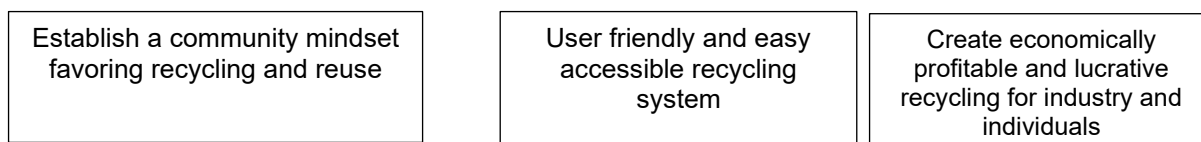


Figure 3 Effective Reuse and Recycling Strategies for Dacope

Along with the straight strategies, some other policies and approaches should be taken in account to make the output fruitful and sustainable. Collaboration with local government and interested non-government organization is crucial for resource allocation and proper funding. Technological integration for streamline and recycling operation as; deploy low cost compressing and processing plastic can create economically feasible project. Mobile app and GIS support should be used to identify high waste zone for waste collection and targeted intervention. A sense of ownership and responsibilities should be always encouraged among the community people for active participation and engagement. Especially women and you may have a great contribution. Regulation and policy support helps to ensure sustainability through supportive framework. Implementation of local and prevailing government law for waste segregation and penalty for open space dumping or littering are included in this strategic plan. The two most important aspects should be carried out throughout the implementation plan are community engagement and monitoring and evaluation to measure the progress and keep the improvement continuing with feedback from the stakeholder to refine strategies where necessary.

Recycling for Better Livelihood

Reuse and recycling plastic wastage form coastal region provide immense opportunity to enhance the livelihood. It is very special in those places where waste management is a big challenges. In case of Dacope Upazila, it is a great chance for the community people to turn the waste to resources. Not only different groups but individuals can foster environmental sustainability that ultimately create economic opportunities and also bring a behavioral shift towards a responsible consumption pattern.

Table 5 Recycling benefits for eco-system of Dacope

Dimensions	Benefits
Reduced pollution, health concern	Soil, water, air and less entering of micro plastic in food chain
Improved habitant quality	Marine life and water bodies will be improved by reduced debris and preservation of wildlife habitats
Circular use of natural resource	Dependency on sustainable materials and reduced dependency on virgin plastic materials
Ecological and bio-diversity conservation	Ensured a balanced ecosystem and wildlife because of less exposure to plastic particles. Climatic impact will be mitigated.

Table 6 Better livelihood opportunities through recycling

Area of opportunities	Beneficiaries
Entrepreneurship	Local vendors, youth and women by starting small scale business of plastic based products
Transportation service	Small vehicles drivers-Logistic support for collecting and delivering plastic
Market linkage of plastic materials	Connection between recycler and industries-business developers, exporters
Advocacy role for policy making	Environmental organizations, non govt. organizations
Recycling activities	Collaboration with local and national level workers

In the above tables, ecosystem and livelihood opportunities are identified. It demonstrates how plastic recycling with direct participation with community people can preserve ecological biodiversity and forester financial empowerment

CONCLUSION

Plastic recycling in coastal regions of Bangladesh represents a transformative prospect for the community people. It is crucial to address the challenges as well as shift to sustainable development for better environmental and public health. The integration of strategic intervention like capacity building, skill development and technological and infrastructural support can unlock the diverse opportunities to the community group. By encouraging community driven plastic collection, segregation and innovative upcycling process in Dacope, not only the pollution of the environment reduced but also contributes to ecological and biodiversity conservation. More than 80% of the plastic waste is disposed in open spaces due to lack of infrastructure, whether more than 90% of the local vendors are just unaware about the benefit of reuse, recycling or upcycling. Availability of biodegradable alternatives and its low cost can make the local vendors interested about using single-used plastic bag, as a significant amount of plastic waste is generated by this group of people. Community engaged participation will not be effective without the presence of alternative. Reverse vending machine to exchange plastic alternative or returning plastic incentives can be a very potential way of systematic plastic gathering. Most of the community people of Dacope Upazila is straggling with hard level poverty and exposure to natural as, river erosion. Salinity, flood as well as social disaster all around the year. The situation demands to underscore the strategies that are not only sustainable but also culturally sensitive and ecofriendly. It would be not a feasible or a wise decision to shift their traditional occupation without proper alternative livelihood. A steady, gradual transition to the sustainable development is essential to ensure financial stability as well as biodiversity conservation. Strategies would be designed such a way that must closely align with the current lifestyle and cultural norms. It will ensure participative and long term adaptation. By empowering community people specially women and youth, through skill development and alternative economic opportunities, it will not only enhance the lifestyle but also ensure an inclusive, resilient, eco-friendly and conscious community

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