



How plastic recycling plants are tackling solid waste hazards in Cox's Bazar refugee camps, Bangladesh

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Summary

The Rohingya Refugee camps in Cox's Bazar district of Bangladesh caters to almost one million people. Several UN agencies and implementing partners (NGOs) provide services to the beneficiaries, and most of the areas are well covered by the water supply network and solid waste management system. Plastic water bottles (Polyethylene terephthalate, also called PET), however, are still often used in the camps; with plastic waste becoming a severe hazard. Besides the PET bottles, other items wrapped in plastic are supplied to the beneficiaries, or the camp residents themselves purchase them required for their daily life. Considering the environmental and public health threats from unmanaged plastic waste such as the inhalation of toxic gases and particles from the burning of plastic, UNICEF initiated a solid waste management plan in its Area of Responsibilities (AoR). This initiative resulted in the establishment of material recovery facilities (MRFs), Compost plants, and Plastic Recycling Units (PRUs).

Today, three PRUs efficiently manage approximately 3,600 kg of plastic waste per month. This results in the management and reduction of significant amounts of plastic waste that does not end up in the environment. The recycling units comprise segregation, washing, drying, shredding, molding, and the recycled plastic is used to produce new WASH products such as slabs, man-hole covers, pit/ring covers, etc. However, more items could be produced if the PRU equipment were to be modified as to produce more refined products. These products could potentially attract the market. Currently, the products are used within the camps only. Modifying equipment to attain proper heat to melt Low-Density Polyethylene (LDPE) materials and giving refined shape to the products, can be a good shift for upscaling. The local government should lead such endeavors and help sustain PRUs and support the development of business plans to attract private entrepreneurs is crucial.

Introduction

Since late 2017, Cox's Bazar has received an influx of around one million Forcibly Displaced Myanmar Nationals (FDMN). The government of Bangladesh (GoB) allocated space in the administrative divisions of Teknaf and Ukhiya for temporary shelter. This space was covered by forest with small hills and plain land. The GoB had to clear much land to construct temporary shelters.

The huge influx of people in a relatively small area generated up to 10,000 m³ of solid waste each month. This newly allocated space had no provision for solid waste management (SWM), and the overcrowded settlements produced large amounts of waste, which ultimately ended up in drainage systems, water bodies, and open public areas close to households and markets. Solid waste comprises a significant portion of plastic waste, which simple waste management methods can't manage. This plastic comes from packaged food, water bottles, etc., and the improper disposal of this plastic waste has caused massive environmental pollution in the area. There is a valid concern over plastic waste as it doesn't decompose and poses a great threat to the soil and water bodies, resulting in decreased soil fertility and the blockage of drains, causing water inundation in the lowland areas. Ultimately public health is impacted through the direct ingestion of toxic plastic micro-particles, the inhalation of plastic fumes when plastic is burnt, or indirectly through the improper management of plastic waste leading to the clogging of WASH services, resulting

in stagnant water and unusable latrines. Besides this, water-borne and vector-borne diseases are also more likely to occur due to water stagnation.

Practical Action (INGO) introduced a PRU at the Rohingya refugee camp in 2019 as UNICEF's implementing partner. Following the positive results from this first experience, Practical Action (PA) set up a further three plastic recycling plants in Ukhiya, with the support of UNICEF, to protect the community's environmental health and overcome the challenges of tackling the enormous amount of unmanaged plastic waste. As part of the Integrated Solid Waste Management, PA introduced context-specific recycling technologies to tackle the plastic waste generated across the Rohingya camps in Cox's Bazar.

Most of the plastic waste in the camps is recyclable. Considering the need for solid waste management, UNICEF and its implementing partners (NGO Forum for Public Health, VERC, and CARE Bangladesh) initiated the installation of the Plastic Recycling Unit (PRU)¹. The project aims to establish an integrated waste management system (IWM) to address solid and liquid waste, including recycling and composting of relevant waste. Currently, a couple of material recovery facilities (MRF)² are already established, aiming to work towards the concept of IWM. UNICEF is promoting plastic recycling in its area of responsibility through customized technology. In fact, UNICEF HQ has continuously supported IWM through a dedicated unit in HQ and many UNICEF country offices are following suite.

¹ PRU refers to the site where only recyclable plastic is taken and recycled.

² MRF refers to the solid waste management site including segregation and composting.

The government of Bangladesh has more than 15 environment-related Policies, Acts, Regulations etc., that include waste management. Although the complete implementation of these is proving challenging, the local government has been supportive of the installation of the PRU's. The government's waste management policy has been instrumental in the waste management activities in the camps.

Description of Interventions

Social interventions:

Community members of the camps benefited from a behavior change campaign through the Clean Camp Campaign-People-Led Total Hygiene (CCC-PLTH) approach. This approach helped the community understand the consequences of improper solid waste management on the environment and public health. CCC-PLTH is a people-led total hygiene approach aiming to promote comprehensive good WASH practices through behavior change techniques.

This is a customized version of Community Led Total Sanitation (CLTS) approach as per the context, it also uses participatory learning and action techniques to facilitate collective action. The process focuses on multiple WASH behaviors.

The approach promoted comprehensive hygiene and sanitation practices through evidence-based behavior change techniques. It facilitated observing, learning, communicating, and collectively carrying out decision-making to improve hygienic conditions and hygiene practices at the household and community levels. Several awareness-raising campaigns were organized to inform the community

of the adverse impact of improper solid waste management and the required practices for proper waste segregation. Community members, preferably adults, were informed to transfer segregated waste to the color-coded communal bins. The approach comprised awareness-raising campaigns and monitoring of community practices carried out by the volunteers.

Figure 1: Communal waste collection



The RANAS approach (Risk, Attitude, Norms, Abilities, and Self-regulation) was applied to evaluate and design behavior change strategies that target people's behavior toward solid waste management. Under RANAS, two activities were implemented: 1) waste segregation at the household level and 2) No littering in the communal places. The RANAS model assesses beliefs about Risks, Attitudes, Norms, Abilities, and Self-regulation related to target behavior. This approach is based on psychological theory and is population-tailored and evidence-based. Under the supervision of project staff, the solid waste management volunteers conducted several activities to engage the community and raise

awareness of waste management. Community meetings, household visits, people-targeted discussions, discussion sessions with children's groups, IEC materials, provision of color-coded waste bins, etc., were the activities conducted to engage the community. Mass media, and peer-to-peer meetings supported the former activities.

Figure 2: Household-level segregation



Solid waste management volunteers were recruited through an open announcement made by the Implementing Partners (IPs), and they acted as facilitators within the camps. The potential volunteers approached the focal point of the implementing partners showing their interest in the task. The candidates then underwent a screening process and were asked for documents/credentials (if any), and an interview was held to assess their motivation to work for the waste management sector. The successful candidates' list was shared with the Camp in Charge (CiC) for approval and information. The volunteer selection was based on one volunteer for 500 beneficiaries. This accounts for around 530 SWM volunteers working in UNICEF's AoR. The female volunteers make up around 15 per cent of total volunteers. The female volunteers are mainly involved in waste segregation at

the MRFs and awareness-raising activities at the household level. Volunteers received a financial incentive as agreed by the Government of Bangladesh through the Refugee Relief and Repatriation Commission (RRRC). The RRRC, in consultation with the stakeholders, categorized the volunteers as Skilled, semi-skilled, and non-skilled. The incentives ranged from USD 90 to 110 per month. The IP provided training to the solid waste management volunteers, focused on practical exercises such as demonstrating waste segregation, collection, transportation, etc. IP's staff regularly monitored the SWM volunteers' tasks and were even provided with a refresher training.

Steps involved in plastic recycling

The PRU includes different processes of segregation, collection, transportation, re-segregation of recyclable plastics, cleaning, sun-drying, shredding/crushing, and molding. The first three processes apply to all types of solid waste, and the latter specifically addresses plastic waste management.

Recyclable plastic segregation and storage

The camps' communities now follow a proper solid waste management process. They segregate organic and inorganic waste at the household level, which is then carried to the communal bins as per the color-coded bins. Trained solid-waste management volunteers transfer the waste from communal bins to material recovery facilities (MRFs). From there, the recyclable plastic waste is re-segregated.

Figure 2: Segregation of recyclable plastic



Reusable plastics are recovered for reuse as far as possible. Finally, re-segregated recyclable plastics are stored separately, and non-recyclable plastics are disposed of in designated areas. There are designated landfill sites where non-recyclable and inorganic waste is dumped. These dumping sites are located outside of the shelter area but near the camps. The solid waste assessment shows that organic waste comprises around 60 to 70 per cent, and non-recyclable plastic comprises one and a half to three per cent of the total waste generated. Total waste production and plastic waste depends on the population size of the camps, and the recyclable waste also depends on the season. For instance, during the dry season, bottled water supplementation is carried out due to the shortage of water supply, this causes more recyclable waste production. Emergency responders supply bottled water and should also provide a solution to the pollution this creates. This is the case in the Rohingya refugee camps of Cox's Bazar, as the emergency responders are, to some extent, responsible for producing plastic waste. The PRU's have been installed to manage the solid waste issue to which emergency response measures have contributed to a certain extent.

Cleaning of segregated plastics

Segregated recyclable plastics are transferred to the PRUs for cleaning. This is properly washed to remove the soil/dust or any other dirt from the plastic. First, the plastic is washed with only water, and then it is cleaned with a detergent to ensure the plastic is entirely free from any dirt.

Drying plastics

Detergent-washed plastics are dried under open air and sunlight. Once the plastics are completely dry, they are taken for crushing.

Figure 3: Drying of cleaned plastic



Shredding/Crushing

The dried polythene/plastic is then crushed into pellets by the crushing machine. These pellets are used as raw materials to produce different items. The pellets are subjected to melting and molding.

Figure 4: Shredding of cleaned plastic



Molding

Molding happens when crushed pellets are melted and are used to produce different-shaped products.

Figure 5: Recycled product



Considering the need to reduce the volume of waste at the disposal site, the plastic recycling units play a vital role. Additionally, composting can be another critical initiative to reduce organic waste going to the disposal site. This was addressed by developing 17 composting plants and 25 solid waste management sites. These 17 composting plants are within UNICEF's area of responsibility in 8 out of the 33 camps. The PRUs project has helped reduce the drastic amounts of plastic waste and manage organic waste. The camp people use compost for their flower and vegetable gardens. Recently,

the sanitation technical group, through the WASH cluster, has agreed to supply compost to the local agriculture department. CiCs will support coordination with agriculture departments and ensure all the compost will be utilized as fertilizer.

The data from the PRUs (Table 1) shows a drastic reduction in the weight of plastic waste after segregation, washing, and drying. Only 30 to 40 per cent of the plastic waste remains after processing. However, once the remaining plastic has dried and shredded, the weight remains largely the same (approximately 95 per cent of plastic remains). **Consequently, the waste management process has effectively reduced plastic waste by approximately 70 per cent.** This is waste that will not end up in the environment in Cox's Bazar.

There is a difference in the performance of the three PRUs. Namely, the PRU from camp 15 was less efficient due to the high volume of polythene bags received in this PRU, which was impossible to recycle.

Table 1: Summary of the recycling plants operations in the month of May 2023

CAMPS	ACTIVITY	AMOUNT OF PLASTIC	ADDITIONAL INFORMATION
Ukhiya, Camp 7 The design capacity of unit-1200 Kg/month	Total plastic waste produced	760 Kg	Waste collected only from two camps (6 and 7)
	Plastic that remains after segregation, washing, and drying	250 Kg (33per cent remained)	
	Pellets produced after shredding	241 Kg (96per cent remained)	
	Melted and moulded pellets for the end product	228 Kg (94per cent remained)	
Camp 15 The design capacity of the unit- 1,320 kg	Plastic waste produced	1345 kg	Waste from camps 15 and 16 Very old stock of polyethylene with heavy dirt. The decrease in production was due to interrupted electricity, and there was some loss!
	Plastic after segregation, washing, and drying	280 kg (21per cent remained)	
	Pellets after crushing	280 kg (100per cent)	
	Waste after molding (product weight)	190 kg (68per cent remained)	
Camp 8W Design capacity of the unit- input- 1200kg/month Output- 200kg/month	Plastic waste produced	1,312 kg	Old stock of polyethylene with heavy dirt. Interrupted electricity caused some loss.
	Plastic after segregation, washing, and drying	223 kg (17per cent remained)	
	Pellets after crushing	223 kg	
	Waste after molding (product weight)	190 kg (85per cent remained)	

Operation cost (including HR) of the units/month:

The estimated operation and maintenance costs for the PRUs are the same for all. This is included in the long-term agreement with the implementing partners. However, the PRU at camp 8W

included staff costs as well. Thus, the operation cost seems higher than others. But the estimated operation and maintenance cost for these PRUs is 160-170 thousand Taka (Bangladeshi currency). This equals to around USD 1,500 per month. Despite UNICEF's estimated operating cost, these three

PRUs still have different operating costs. UNICEF is working with the concerned operators (implementing partners) to sort out the difference in the operating costs since all the PRUs operate in similar conditions like land leases, electricity, machine maintenance, staff, etc.

Outcomes

Establishing the PRUs has significantly helped to develop a proper waste segregation system. This has resulted in an approximately 70 per cent reduction in plastic waste going to the dumping site. The PRU establishment is an excellent example of Reduce, Reuse, Recycle, and Recovery. Furthermore, WASH facilities now need fewer cleaning and maintenance services, as the improper disposal of plastic waste caused fewer blockages.

Moreover, the PRUs produce man-hole covers, latrine rings, drain cover slabs, pit cover slabs, hard plastic sheets for site protection, washing platforms, alphabet blocks and educational materials, etc. Initially, their production focused on educational materials such as alphabet blocks, however, they quickly decided to discontinue the production of alphabet blocks to eliminate any potential chemical exposure risks for children.

Figure 6: Recycled product



Source: NGOF

The recycled items can be used for many purposes. The drain covers, pit covers, etc. are robust and have even been tested for strength. Their use is recommended for multiple purposes.

BOX 1.

VOICES FROM THE CAMPS

Hamida is a 31-year old female Rohingya living in Camp 15. There are six members in her family. Her husband and herself work in the camp on a daily wage basis. Hamida works as a solid waste management volunteer in the PRU. She said “I work as a waste segregator in the recycling unit. The establishment of the PRU has helped me to earn some money. I need money to buy medicine for my husband. I am happy to be part of the recycling unit. Our living environment is free of plastics, and our children can play in open spaces.”

Shafi Ullah lives in Camp 8W. He said, “there used to be lots of plastic waste thrown on the ground, in drains or nearby the shelter. I felt it to be very unhygienic. VERC/UNICEF staff taught us to segregate waste and put it in colored boxes. I heard about the plastic recycling unit and its products. Now we are using recycled products on stairs, paths etc. Now, I understand the importance of waste segregation and recycling to reduce waste going to the dumping site.”

Figure 7 Household segregation



The PRUs are fully operational though there is an irregular electricity supply which can impede full efficacy and hamper the full-phase operation of the plants. Since the PRUs are established to respond to the important waste issues in refugee camps, little attention has been given yet to commercializing the by-products from the PRUs. Although there is a scope to widen the PRU activities and invite the private sector partners to participate, private entrepreneurs are yet to be engaged in the operation and maintenance of the PRUs. Local NGOs still operate the existing PRUs and will continue to do so for the foreseeable future. The high operational cost of PRUs and low cost-recovery rates are one of the reasons why private entrepreneurs are not attracted to this business. UNICEF has recommended the sustainable operation of PRUs and has advocated for this in relevant fora. This flagged the discussion about the funding requirement or any other possibilities of cost-recovery business models. The donors, government bodies, private

entrepreneurs, community, etc., should work together to find a solution for the sustainability of the PRUs to address solid waste management issues in the long run.

Today, the open spaces in the camps are less hampered by plastic waste, which has improved the environmental conditions of the camps. The FDMN community shared that the blockage of drains due to plastics and the environment is now less common and children can play freely in the open spaces. The MRF and dumping site operators found a drastic reduction (approx. 70per cent) in the volume of waste thrown in the dumping sites. The community members mentioned that the surrounding environment is cleaner, and the children can play around happily.

Lessons Learned

Plastic recycling units in Cox's Bazar are unique infrastructures established to manage plastic waste properly. This initiative has been a strong advocate to protect the environment and provide awareness-raising for proper solid waste management. The PRU installations demonstrate the practicality of plastic waste management, technology, and simplified operating procedures. However, this initiative has flagged a couple of issues, like the need for more community involvement to increase the coverage area, the sustainability of recycling, proper waste segregation at the source, etc. Local government involvement is crucial for the sustainability of PRUs and environmental protection. Furthermore, developing PRUs as businesses through a proper business plan involving interested private entrepreneurs will need further reflection. Refining products will improve the market

value and increase the potential of making PRUs commercially viable.

Next Steps

Use of plastics may be convenient to people's lives, but it has negative impacts, particularly on the environment and public health. Despite the installation of PRUs by UNICEF and its implementing partner, there is still a lot that should be done to improve solid waste management in Cox's Bazar.

With relevant stakeholders' support, local government bodies should promote integrated waste management, including solid and liquid waste. A short-term waste management strategy and guidelines might be helpful for waste management in refugee camps and host community areas.

The local government should liaise with private sector partners to promote an integrated waste management plan with a feasible business plan. A bailing machine can be used to reduce the volume of plastic; so that more plastic can be stored at the plant site. Furthermore, if plastic shredding can be done outside the PRU, then the PRU can use these shredded materials as raw materials. This will help get more raw materials, promote separate business opportunities, and reduce operating costs for PRUs.

The volume of recyclable plastic waste largely depends on the supply of plastic-wrapped items by emergency response organizations. This should be controlled by minimizing PET bottles or plastic packaged items. However, this is difficult during the onset of emergencies, but the reduction of PET and plastic packaging is possible if the organizations plan accordingly—for instance, supply five-litre

water bottles instead of half or one-litre PET bottles. UNICEF is aware of the burden of plastic in emergency response supply drives; a greener, more waste-conscious supply chain is being developed.

References

Hossain, S & Rahman A et al. (2021) *Plastic pollution in Bangladesh: a review on current status emphasizing the impacts on environment and public health*. Environ. Eng. Res. 2021: 26(6)

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Photos are taken by UNICEF partners CARE, NGO Forum for Public Health (NGOF), and VERC.

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