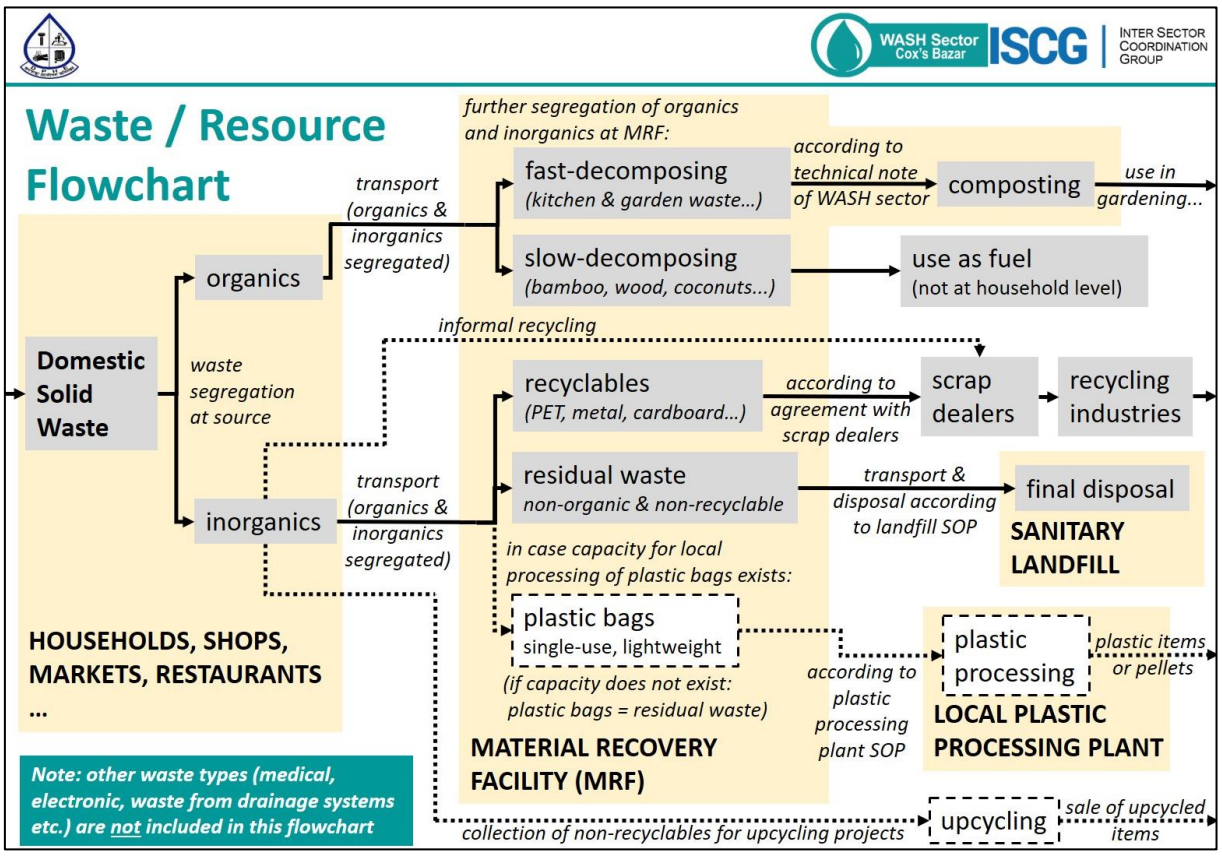
FINAL VERSION

WASH Sector Cox's Bazar

Bangladesh

Solid Waste Management Strategy



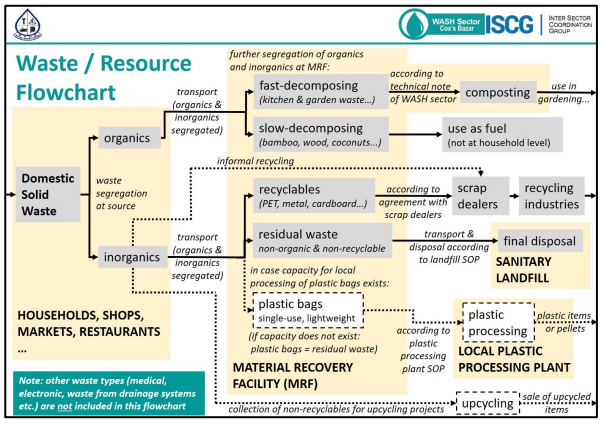
Part 2 (of 2): **Text Document**

July 2021

The Cox's Bazar WASH Sector Solid Waste Management Strategy consists of the following two parts:

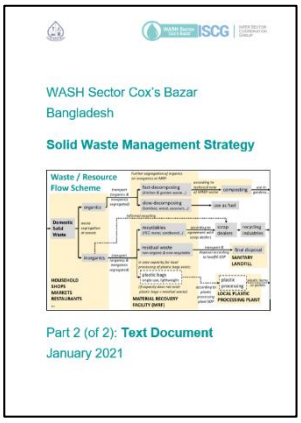
Part 1: **Illustrations**

(brief graphic summary of the strategy)



Part 2: **Text Document** (this document)

(in case more detail is needed)



The Strategy was compiled by the WASH Sector in Cox's Bazar and is based on:

- Field visits to SWM project sites in host and refugee communities.
- Bilateral meetings with humanitarian organizations, governmental entities and private-sector recycling enterprises.
- Exchanges with the *Site Planning and Site Management*, *Food Security*, and *Shelter/NFI* Sectors of the Humanitarian Response.
- A literature review of general SWM literature, national legislation related to SWM, SWM project documentation from humanitarian organizations, and SWM guidance previously compiled by the WASH Sector in Cox's Bazar.
- 4 consultation workshops with WASH partners:
    1) Kick-off workshop on agenda and timeline of SWM strategy drafting.
    2) Thematic workshop on the SWM process of segregation > collection > transport > value recovery > safe disposal.
    3) Thematic workshop with detailed analysis of value recovery and safe disposal.
    4) Thematic workshop on how to improve waste segregation at source.
- Extensive review phase with WASH partners, other humanitarian sectors and governmental entities.

July 2021

WASH Sector Cox's Bazar

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EXECUTIVE SUMMARY

The lack of adequate Solid Waste Management (SWM) in the camps poses a threat both to the environment and to public health. In the short term, the unsafe handling of solid waste creates a breeding ground for disease vectors, leads to the emission of toxic gases from uncontrolled waste burning, and blocks essential storm water drainage systems. In the long term, inadequate disposal of waste leads to contamination of food and water sources, and ultimately contributes to climate change.

In the Rohingya refugee camps in the Cox's Bazar district in Bangladesh, SWM is imperative due to the high population density and the widespread use of individually wrapped and packaged commercial goods and distributed non-food items (NFIs), both of which generate a significant amount of waste. In 2020, SWM was voted the Number 1 thematic priority by the WASH Sector partner organisations.

The development of the SWM strategy was initiated by the WASH Sector and supported by the Swiss Agency for Development and Cooperation (SDC). Through field visits, stakeholder meetings, consultation workshops, reviews of literature and Bangladeshi directives, the content of this document was compiled in collaboration with and with the approval of various SWM actors. The SWM strategy will set out the needs and commitments by multiple sectors in unifying and synchronizing efforts for the safe handling of solid waste – an approach that is rather new in humanitarian responses, and for which humanitarian organizations still depend on clear guidance.

The content of this document provides all relevant information on "why" and "how" SWM should be implemented, including the core information on the establishment of a functional system for SWM, from **(1) source segregation** of waste to **(2) collection** and **(3) transport** of segregated fractions to **(4) value recovery** (for compostable, reusable and recyclable resources) to the eventual **(5) safe disposal** of the remaining waste. This approach is very much in line and based on Bangladesh's "*National 3R Strategy (Reduce – Reuse – Recycle) for Waste Management"* from 2010.

While SWM comes under the WASH Sector's responsibility within the humanitarian cluster approach, a joint approach by all sectors is needed to avoid the generation of waste whenever possible, and to make sure that all unavoidable waste is handled in a safe and systematic manner.

Key Recommendations:
With the overall aim to minimize the hazardous impact of domestic solid waste on human health and the environment, and based on the Government of Bangladesh National 3R strategy, the SWM strategy of the WASH sector in Cox's Bazar recommends the following:

1.) **Avoidance of waste generation:** All humanitarian actors should aim to avoid the generation of waste (especially inorganic and non-recyclable waste) whenever possible while promoting the usage of reusable and recyclable materials. Particular attention should be paid to the distribution of food and NFIs, with relation to wrapping, packaging and containers.
2.) **Establishment of an environmental impact focused SWM system:** To ensure the safe and correct handling of waste a comprehensive SWM system for all waste which cannot be avoided has to be established by the responsible entity. This includes all components of a SWM system, from waste segregation, collection, transport, value recovery to safe disposal and provides an enabling environment for all stakeholders of the SWM process.
3.) **Community Acceptance:** Without community acceptance and participation, any SWM system is likely to fail. To ensure adequate waste handling and disposal, awareness raising and behaviour change is fundamental to disseminate knowledge and to promote good SWM practices. This is crucial for all stakeholders involved – from the beneficiaries, organizations and humanitarian actors, to local utilities and governmental entities.
4.) **Source segregation of waste:** To help prevent cross contamination and enable an effective and efficient recovery of compostable, reusable and recyclable materials, the segregation of waste at source is paramount. Waste should at least be segregated into organic and inorganic waste, with a possibility of segregating recyclable materials separately.
5.) **Reuse and recycling:** In order to reduce the residual waste that needs to be landfilled, an effort has to be made to reuse, recycle or repurpose any recovered materials where possible. Priority must be given to transferring the recyclable materials to local dealers who are the main suppliers of such materials to the recycling industry.
6.) **Disposal of residual waste in sanitary landfills:** To protect the environment and public health, all residual waste which cannot be avoided, reused or recycled must be safely disposed in a sanitary landfill. The use of sanitary landfills has been identified as the only adequate technological solution for the safe disposal of residual domestic solid waste in Cox's Bazar district.

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1. INTRODUCTION

1.1. Context

After the eruption of violence in Rakhine State, in August 2017 an estimated 737,000 persons have fled from Myanmar and are now hosted in Ukhiya and Teknaf Upazilas in Cox's Bazar district in Bangladesh.

In collaboration with the Bangladesh Department of Public Health Engineering (DPHE), the humanitarian WASH Sector provides services related to water, sanitation and hygiene to both refugee and neighbouring rural host communities. These services also include the management of solid waste.

1.2. Importance of SWM

For actors involved in Solid Waste Management (SWM), and for discussions with other humanitarian sectors, governmental entities and local authorities, it is important to understand that:

- Solid Waste Management is not about the acceptance or tolerance of solid waste pollution.
- Solid Waste Management is about the protection of public health and the protection of the environment

To underline this statement, here some negative impacts caused by the lack of proper SWM or the ineffectiveness of SWM:

- Uncontrolled burning of solid waste can lead to the emission of toxic gases and fumes.
- Uncontrolled deposits of solid waste are an ideal breeding ground for disease vectors, such as rodents, mosquitos etc.
- If dumped in the environment, solid waste can contaminate both drinking water and food sources.
- Uncontrolled deposits of solid waste in the environment may lead to the entering of solid waste into water bodies and eventually the oceans (marine plastic pollution).
- Uncontrolled deposits of solid waste can lead to the emission of greenhouse gases.
- Uncontrolled disposal of solid waste can lead to the blocking of storm water drainage systems, and to the corresponding flooding.

Furthermore, it is important to acknowledge that SWM is not simply about waste collection or the removal of waste out of sight:

- SWM is a systematic procedure to safely and sustainably manage solid waste. It includes the aspects of waste segregation, waste collection and transportation, value recovery from waste and the eventual safe disposal of waste.

1.3. SWM in Bangladesh

A multitude of legislation and guidance papers related to SWM exist in Bangladesh, including the Environment Conservation Act (MoEF, 1995) and the National 3R (Reduce, Reuse, Recycle) Waste Management Strategy (MoEF, 2010). Matter et al. (2015) provides a good overview on the relevant legislation and the corresponding stakeholders.

Despite the existing framework in Bangladesh, there is room to improve SWM in practice, as regularly reported in the media (Daily Star, 2020, and Dhaka Tribune, 2020).

The potential to improve SWM is also true for Cox's Bazar district. The SWM activities of the humanitarian response can therefore not be integrated into regular SWM services, but are required to be initiated separately.

1.4. Previous SWM initiatives within the Humanitarian Response

For the management of solid waste in refugee camps and neighbouring rural host communities, a first draft of a SWM strategy was developed in 2019 and an operational plan was published in

the same year (WASH Sector Cox's Bazar, 2019a). However, up to now there is still no finalized and approved SWM strategy providing a long-term approach for resolving the solid waste issue.

Once approved by the WASH Sector, the relevant Bangladeshi governmental departments and the Strategic Advisory Group (SAG), this document will be the first long-term SWM strategy for the humanitarian response in Cox's Bazar District.

2. TERMS OF REFERENCE FOR THE SWM STRATEGY

2.1. Expectations

The aim of the SWM strategy is to provide long-term guidance on SWM for WASH partners and organizations active in SWM, including other humanitarian sectors, governmental entities, local authorities and private sector entities. The strategy addresses:

- Scope on refugee camp context

  This SWM strategy is focusing on the refugee camp context in Ukhiya and Teknaf Upazilas.

  As described in chapter 3.3, it is important not to solve a solid waste issue by simply relocating solid waste. Or in this context, not to move solid waste to locations outside of the operation of the WASH Sector. In addition, it is important not to create an imbalance in SWM service provision between refugee and neighbouring host communities.

  While there may be a certain transferability of some of the principles and directives in this strategy to neighbouring rural host communities or other rural/urban areas in the district, this is clearly not the objective of this document, and the formal scope of this document is limited to the refugee camps only.

- Facilitation of systematic, uniform and coordinated SWM

  SWM needs to be conducted in a systematic, uniform and coordinated manner. In this way synergies can be used, organizations can take over the responsibility of parts of the SWM system, and the complete coverage of the SWM system can be ensured. An example of this would be the operation of one sanitary landfill by one organization for a multitude of organizations providing SWM in a multitude of camps or communities.

- Recommendations for effective, safe and cost-efficient SWM

  The SWM strategy needs to promote and recommend effective, safe and cost-efficient approaches for SWM. In order not to compromise future core operational decisions, these recommendations need to be as generic as possible (in order not to compromise future operational in-depth decisions) and as detailed as necessary (in order to be still effective and useful).

- Adaptation to local context

  The SWM system, its interphases and its technical solutions need to be adapted to the local context.

- Enabling collaboration between all SWM-relevant stakeholders

  SWM has a multitude of connections with other humanitarian sectors, local authorities and the private sector. In addition, SWM needs to be in line with national legislation and guidelines. It is therefore essential to have a functional collaboration and communication with all relevant stakeholders.

2.2. Limitations

The SWM strategy described in this document focuses on domestic solid waste only

As well as waste from households, domestic solid waste also includes similar waste from restaurants, shops, markets etc.

The SWM strategy does not include medical waste, construction waste, industrial waste, electronic waste etc.

Once the strategy is implemented at a satisfactory level of performance, it is recommended to extend its scope at a later stage to cover other waste types, in collaboration with the relevant stakeholders.

Furthermore, the SWM strategy is intended to be applied in the refugee camp context in Ukhiya and Teknaf Upazilas only.

3. OBJECTIVES AND PRINCIPLES OF THE SWM STRATEGY

3.1. Objectives

The uncontrolled handling and depositing of solid waste can lead to negative effects on human health and the environment (cf. chapter 1.2). As long as the generation of solid waste cannot be fully avoided, the negative effects induced by solid waste on human health and the environment need to be at least minimized.

The overall and specific objective of the SWM strategy is as follows:

Overall objectives

Minimization of hazardous impact of domestic solid waste on human health and environment

Specific objectives

Reduction of waste generation

Minimization of need for safe disposal (through waste avoidance, reuse & recycling)

Safe disposal of residual waste in sanitary landfill

Awareness raising and behaviour change towards adequate waste handling

To achieve the overall and specific objectives, it is necessary to apply the working principles of the SWM strategy listed in the following chapter.

3.2. Working Principles

Working principles (in order of priority)

1) **Avoidance of waste generation** (especially inorganic and non-recyclable waste)
2) **Establishment of a complete SWM system** (for waste which cannot be avoided, as proposed under 1.): waste segregation > collection > transport > value recovery > safe disposal
3) **Ensuring adequate waste handling** (through awareness raising and behaviour change)
4) **Source segregation of waste** (and maintaining of segregation throughout SWM system)
5) **Reuse** of segregated waste
6) **Recycling** of segregated waste
7) **Safe disposal** of residual waste (which cannot be avoided, reused or recycled)

The working principles of the SWM strategy above are listed in order of priority and need to be applied in all SWM interventions, initiatives related to SWM, or activities generating waste or dealing with waste. The principles are detailed as follows:

1) Avoidance of waste generation (especially inorganic and non-recyclable waste)

Avoidance of waste generation is the most effective principle within SWM and has the highest priority. If waste generation is avoided, the effort of handling and safely disposing the waste can be spared.

Avoiding of waste generation is particularly important for waste categories which are difficult to handle and dispose. In case of domestic solid waste, this refers to waste which cannot be recycled (and correspondingly needs to be landfilled).

Although waste avoidance is the most effective SWM principle, avoiding waste is challenging. For inorganic and non-recyclable materials, it would be necessary to avoid them being used in the consumer market. This could be achieved through enforcing a ban on or regulating the use of inorganic and non-recyclable materials, or through the renunciation of the use of these materials by producers.

In humanitarian responses, it is important to avoid waste generation resulting from the distribution of food and non-food items (NFI), as well as from other sector activities. Agencies involved in these activities need to be reminded of their responsibility for waste avoidance and the usage of reusable and recyclable materials. Ideally, a return / recovery system should be put in place for those consumables that are likely to end up in the waste, such as food packaging.

2) Establishment of a complete SWM system for waste which cannot be avoided (cf. point 1 above): waste segregation > collection > transport > value recovery > safe disposal

A SWM system involves waste segregation, collection, transport, value recovery, and safe disposal. It ensures that solid waste is disposed of according to its characteristics.

Once the system is established (including its infrastructure, staffing and service provision) the optimization of the system and the minimization of residual waste can be targeted as a next priority (cf. principles 3 - 7).

3) Ensuring adequate waste handling (through awareness raising and behaviour change)

Awareness raising for the importance of adequate waste disposal is making sure that the established SWM system is used in a correct manner. If necessary, this included community engagement activities, behaviour change interventions and information campaigns. Only if people understand why and how to correctly dispose solid waste, the established SWM system will be accepted and applied.

Activities related to the awareness raising need to consider cultural and social norms. In addition, the current inadequate handling of waste needs to be considered and the reasons for this handling need to be analysed and thematised.

Awareness raising might not only be limited to involved communities. Likely, there is also a need for it in the collaboration with other humanitarian organizations and sectors as well as with governmental entities.

4) Source Segregation of waste (and maintaining segregation throughout SWM system)

Source segregation of waste is the only way to correctly dispose of the different waste types according to their characteristics. It will also facilitate the reuse and recycling of resources found in the waste.

Source segregation of waste enables the efficient and effective reuse and recycling of waste, and its transformation into resources. Moreover, source segregation of waste creates business opportunities and enables the reduction of costs for SWM services.

Source segregation of waste is the most efficient way to enable segregation. However, this is difficult to implement as it requires a change in behaviour of the population. Source segregation of waste facilitates the recovery of reusable and recyclable materials, and avoids contamination or spoiling of these materials.

Without waste segregation, safe disposal remains the only acceptable option for handling waste – this, however, requires a landfill, which is costly. The only other way to dispose of waste is disposal in dumps, which is not costly but is unsafe, both for the population and the environment.

5) Reuse of segregated waste

Whenever possible, recovered reusable materials should be reused. This not only creates business opportunities, but also helps to reduce the amount of residual waste which needs to be landfilled.

6) Recycling of segregated waste

Whenever possible, recovered recyclable materials should be recycled. This not only creates business opportunities, but also helps to reduce the amount of residual waste which needs to be landfilled.

7) Safe disposal of residual waste (which cannot be avoided, reused or recycled)

Residual waste (after reusable and recyclable materials have been recovered) needs to be safely disposed. The disposal needs to be adjusted to the local context and the available technologies.

3.3. Do No Harm

When implementing SWM activities, the "Do No Harm" principle needs to be complied with at all times. Here are some examples of potential violations of the principle:

- **Competing with existing private sector industries:** The trading of recyclable materials is an important business for private sector entities. Whenever possible, the handling of recyclable and reusable materials should be done in collaboration with the relevant private sector partners. Setting up parallel recycling or processing facilities within the humanitarian response should be avoided whenever the private sector is able to do it.
- **Relocation (but not resolving) of solid waste issue:** Solving a local solid waste management issue by simply shifting it outside of its system borders needs to be avoided. For example, the transport of solid waste to other locations (outside of the organization's responsibility) and without safe disposal does not solve the solid waste issue, and cannot be considered as SWM.
- **Inadequate and unsafe approaches for SWM:** When trying to solve a solid waste issue, creating a new, different or even a worse situation needs to be avoided at all times. One example is the incineration of solid waste without adequate treatment of exhaust fumes and safe disposal of the ashes, which then end up in the environment. Another example is the inadequate melting of mixed plastic types, and the corresponding emission of toxic gases.

4. SOLID WASTE MANAGEMENT SYSTEM

4.1. Overview of the SWM System

A SWM system consist of the following elements (from the generation of waste until its final disposal):

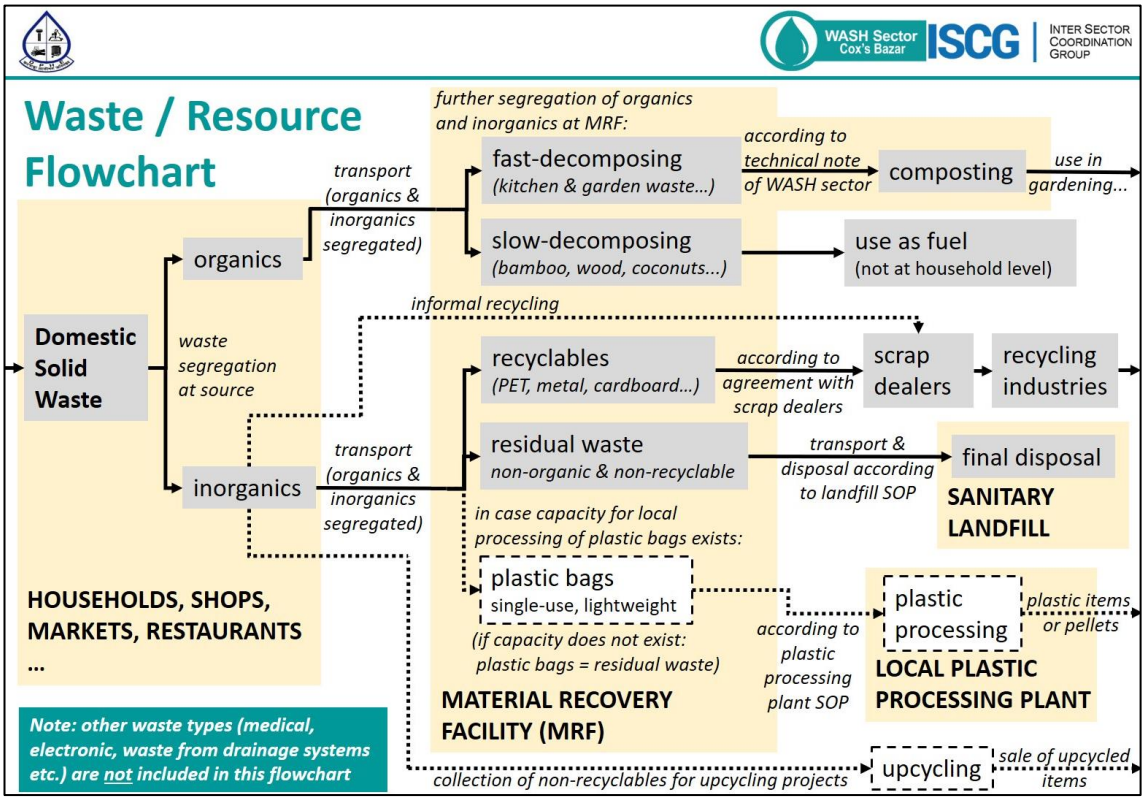
1) waste segregation – 2) collection – 3) transport – 4) value recovery – 5) safe disposal

The following ground rules apply to this system and the generated waste:

- All waste which cannot be avoided in the first place needs to be handled by the SWM system, while at the same time respecting the sequence of activities above (1 to 5).
- The sequence of the five activities in the SWM system needs to be respected, and no activity can be skipped (e.g. value recovery always needs to be considered before final disposal).
- Alternative waste disposal behaviours/habits or mechanisms need to be prevented (such as the disposal of waste in drains, the disposal in illicit waste dumps, and the uncontrolled incineration of waste etc.).

4.2. Flowchart for Waste and recovered Resources

The following flowchart provides an overview of the material flow within the SWM system, as well as the SWM activities and their corresponding location. More information on the handling of the waste is provided in the next chapter.



4.3. Key Elements of the SWM System

Please note that the use of the terms “organics” and “inorganics” is not entirely correct in this SWM strategy: Most plastics (which are considered and categorized as “inorganics” in this strategy) are manufactured using organic polymers.

Nevertheless, due to the generalised use of the terms “organics” and “inorganics” in Cox’s Bazar, these will be used in this strategy (and for instance not replaced by “biodegradable waste” and/or “non-biodegradable waste”).

4.3.1. Source Segregation of Waste

Source segregation of waste is the most pivotal element in the SWM system

If waste is not segregated into the different waste types, safe disposal remains the only option for handling it. The recovery of reusable and recyclable materials is not feasible or at least not efficient without source segregation. Moreover, without source segregation the corresponding business opportunities will not present themselves (cf. working principle 3 of the SWM strategy in chapter 3.2).

The segregation of waste at Material Recovery Facilities (MRF) can be seen as temporary solution while establishing source segregation (cf. chapter 4.3.4). However, due to its inefficiency and extensive work effort, segregating only at MRF is not recommended as a long-term approach.

Implementing source segregation of waste in households, restaurants, shops, markets etc. is challenging, even though the segregation is only into either "organics" or "inorganics". Source segregation is often not successful due to:

- Lack of understanding on how to segregate.
- Lack of motivation or incentive to segregate.
- Segregation by one member of the household (probably a female household member) and mix up of waste during depositing at collection points by another member.
- Lack of ownership or perceived responsibility to keep areas clean of waste (e.g. in markets).

Source segregation of waste can be improved through:

- Behaviour change campaigns for adequate segregation at source, e.g. using the "Segregation Intervention Strategy" defined by RANAS Ltd. (RANAS, 2020b). This intervention strategy is particularly designed for camps in Cox's Bazar. Apart from segregation, RANAS has also designed a strategy for the prevention of littering (RANAS, 2020a).
- Community engagement (consultation of both male and female from all ages, block leaders, religious leaders etc.).
- Provision of feedback, motivation and guidance for waste segregation during house-to-house collection of waste or at waste collection points. The blaming of households which do not yet succeed in waste segregation needs to be avoided.
- Creation of incentives for waste segregation…
    - Reduction of solid waste collection fees (for settings in which fees can be applied – most likely this is only possible in non-camp settings).
    - Rewarding waste segregation with coupons, vouchers, symbolic tokens etc. at household, block or community level.

Behaviour change interventions for households should include all family members (males, females and children) as they are all potentially involved in the handling of solid waste.

4.3.2. Collection of Waste

For the collection of domestic solid waste, the below-mentioned two options are possible. Each organization responsible for SWM needs to define which collection type is more suitable for them:

- Direct collection at households, shops, restaurants, market stalls etc.
- Collection of waste at collection points

Direct collection at households, shops, restaurants, market stall etc.: While the direct collection might be more labour-intense (larger staff requirements, more and smaller transportation means required for waste collection etc.) it has the advantage of observing and adjusting the segregation of waste at source. Collection teams can observe the segregation performance of households, shops, restaurants etc. and instruct them if necessary.

Recent experiences have shown that direct collection leads to larger amounts of collected waste. While this results in more waste needing to be processed in the SWM system, it also means that less waste ends up in the environment.

As women might be alone in the household, it is advisable to have collection teams with both male and female members.

To avoid the piling up of waste, and to avoid odour nuisance and attraction of rodents and insects, collection from households, shops, restaurants, market stalls etc. needs to happen frequently. Ideally, waste should be collected on a daily basis.

Collection of waste at collection points: The collection of waste at collection points requires that households, shops, restaurants, market stalls etc. transport their waste to collection points. Collection points need to be accessible, both for those depositing the waste, as well as for its collection and transporting to the MRF.

Ideally, collection points should be supervised in order to ensure correct segregation of the waste. In addition, information panels can illustrate the correct disposal of waste.

Collection points should be built with concrete or brick containment structures or equipped with larger waste containers (ca. 80 L). In any case, each collection point requires at least two colour-coded containments: one for organics, and one for inorganics. The maintenance of these containments, including the emptying, is done by waste collection teams. While it is recommended to empty and clean the collection points daily (especially for organic waste), the emptying frequency can be lowered depending on the location of the waste collection point, its storage volume, the volume of daily generated waste etc.

Collection points need to be sufficiently protected against flooding (e.g. raised platform and rain cover to avoid fill up with rainwater) and against animals (rodents, insects etc. but also domestic animals, such as cows.). Furthermore, in order to facilitate the emptying and to allow for the transportation of bigger waste volumes, locations for collection points along roads are recommended.

General aspects of waste collection: For the collection of waste it is not recommended to use plastic liners / plastic bags in the bins of households, shops, restaurants, market stall: Plastic liners may contaminate the collection of organic waste, and in case of inorganics, the use of plastic liners makes the further sorting of waste more difficult (especially when liners are tied up). Instead, it is recommended to use the bins and containers without plastic linings and wash them regularly.

4.3.3. Transport of Waste

For collection from households, smaller and manoeuvrable vehicles are preferred, such as push carts or non-motorized tricycles. In hilly areas where the accessibility for these vehicles is not given, waste might be collected from households and brought to vehicles using barrels or other hand-held containers.

For collection from collection points (which normally allows the collection of larger volumes and the transport on fortified roads) larger and motorized vehicles, such as motorized tricycles, are recommended.

The selection of transportation means lies with the organization responsible for the collection of waste. It should take into consideration their preference for motorized or non-motorized vehicles, the location of the MRF, and whether waste is being collected at households or from collection points.

For dimensioning the transportation fleet or for the selection of appropriate transportation means, accessibility, waste collection intervals (and the corresponding waste volumes), as well as the number of trips, etc., need to be considered.

4.3.4. Value Recovery from Waste

The recovery of value from waste happens in MRFs, where the segregated waste fractions (organics and inorganics) are further separated into additional categories of resources, as well as residual waste.

The Material Recovery Facility (MRF) is the heart of the value recovery from waste

The following activities are expected to happen in an MRF:

- Receiving segregated waste (organics and inorganics) from the waste collection.
- Processing of organic waste, including:
  - On-site composing of fast-decomposing waste, and temporary storage of compost (prior to its application in gardens or greening projects).
  - Storage and drying of slow-decomposing waste (for further use as fuel).
- Processing of inorganic waste, including:
  - Recovery of recyclables from inorganic waste.
  - Further segregation of recyclables into different categories, as negotiated with scrap dealers.
  - Temporary storage of recyclables (prior to the handover to scrap dealers).
  - Separation of residual waste from recyclables, and temporary storage of residual waste (prior to its transport to and disposal in a sanitary landfill).
  - If applicable: recovery of non-recyclables for upcycling projects (needs to be initiated and defined by organizations conducting the upcycling, cf. chapter 6.2).
- Recording of received and processed amounts of waste, ideally disaggregated into the different waste categories.

With this further segregation, the MRF makes sure that all reusable and recyclable materials are recovered, and that only residual waste is further sent for final disposal.

Only residual waste from the MRF is transported to a final disposal site

Further relevant aspects of an MRF:

- The MRF should provide protection from wind, rain and sun for all work and storage spaces.
- In order to facilitate the logistics of waste and resources handling, MRFs are ideally located along fortified roads.
- In order to avoid odour nuisance and not to compete with other land users, MRFs should be located far from households, restaurants etc.
- MRFs should have at least the following amenities…
  - Changing rooms for staff and an office for monitoring the waste handling.
  - Gender segregated toilets and water and soap for personal hygiene.
- Access to MRFs needs to be restricted, and completely banned for animals and children.

For the further processing of recyclables and the residual waste, each MRF should:

- Be in contact with the relevant scrap dealer association (or one or several scrap dealers or recycling enterprises).
- Be in contact with the relevant operator of the sanitary landfill within its area of operation.
- Be in contact with neighbouring MRFs for the purposes of coordination, e.g. transport of residual waste, recyclables or compost etc.

For information on recovery of inorganic non-recyclable materials from waste, e.g. for upcycling projects, please refer to chapter 6.2.

Although this recovery often takes place outside of the SWM system – usually the relevant materials are collected before they end up in the waste – it is not in conflict with the SWM system: The recovery and upcycling of these inorganic non-recyclables helps to avoid that these materials need to be landfilled.

4.3.5. Safe Disposal of residual Waste

For the safe disposal of residual waste, the use of a sanitary landfill is currently the only adequate technical solution in the context of Cox's Bazar district.

After the removal of organics and recyclables from solid waste at the MRF, the residual solid waste needs to be safely disposed.

Sanitary landfills provide a safe disposal of residual waste, which is not the case for unsafe waste dumps. In sanitary landfills the impermeable layer for the collection of leachate, the regular covering of deposited waste with sand, and restricted access ensure that deposited waste does not contaminate the groundwater and is not transferred into the environment (e.g. by wind, animals etc.). As none of these measures exist in waste dumps, depositing solid waste there is unsafe for human health and the environment.

At the time of writing, one functional sanitary landfill in Ukhiya upazila has been set up by international organizations. Two more landfills are being planned for the Teknaf upazila.

Only residual waste from the MRF is transported for final disposal in a sanitary landfill

The transport and disposal of waste needs to be coordinated with the operator of the sanitary landfill and conducted according to the relevant Standard Operating Procedures (SOP) (UNDP, 2020b).

4.4. Behaviour Change, Community Engagement and Awareness Raising

The correct handling of waste and the segregation of waste at source is the most pivotal part of the SWM system. For the correct handling and segregation of waste, the SWM service provider needs to count on the ability and willingness of individual persons and households properly handle waste.

Behaviour change, community engagement and awareness raising are therefore highly relevant for a successful implementation of SWM.

For waste segregation and non-littering, two RANAS intervention strategies have been designed for the camps in Cox's Bazar district (Ranas, 2020a, and Ranas, 2020b)

4.5. Adequate Disposal and Processing of different Waste Categories

4.5.1. Organic Material

Organic material include all natural material which is biodegradable. Depending on its biodegradability, organic materials can be divided into the following sub-categories:

- Fast-decomposing organic material (biodegradable waste from kitchen and garden etc.)
- Slow-decomposing organic material (wood, bamboo scraps, coconuts etc.)

The disposal of organic materials needs to be conducted as follows:

- Organic materials need to be segregated from inorganic materials in order to avoid the spoiling of the inorganics (and the contamination of the organics with non-biodegradable substances). Ideally, segregation should be conducted at source.
- Organic material is ideally collected daily, as it can create undesirable odours and attract rodents and insects.

Fast-decomposing organic material is easily composted. During the composting process, the organic waste is transformed into compost, which is a valuable soil amendment. The technical note on composting from the WASH Sector Cox's Bazar provides relevant information on the implementation of composting (WASH Sector Cox's Bazar, 2021a; currently in review). For further information, Rothenberger et al. (2006) provides information on composting in cities in low and middle-income countries, which was compiled based on the case of Bangladesh.

Composting is a simple process and does not require sophisticated infrastructure or operation. Nevertheless, the following parameters need to be considered to ensure a sound composting process:

- **Aeration** (oxygen supply) is essential for composting. Regular mixing, the use of passive ventilation pipes (e.g. perforated plastic pipes) or active ventilation with air blowers is required.
- It is essential to maintain an ideal **moisture content**. The compost matrix should be wet but should not drip when squeezed. Protection from rain is necessary. In case the compost is too dry, additional water needs to be added.

- Different organic materials need to be mixed together to create an ideal **carbon-to-nitrogen C/N ratio** in the compost matrix. Both "greens" (fresh raw waste from kitchen; high in nitrogen) and "browns" (leaves, garden waste etc.; high in carbon, low in nitrogen) are required. For example, leaves (high in carbon, low in nitrogen) can be blended with food waste (high in nitrogen) to balance the C/N ratio. A C/N ratio ranging from 20/1 to 25/1 is ideal. For a rough estimation, the C/N ratio of a compost matrix can be estimated by multiplying the percentage of the different organic fractions by their specific C/N ratio (World Bank, 1999).

The choice of how the compost can be used is up to the MRF operating organization, as well as the decision on whether it can be given away free of charge. Compost produced by an MRF can be used:

- For household or community gardening
- In greening and reforestation projects etc.
- As a give-away incentive for source segregation of waste

The leachate from composting plants is ideally not infiltrated or discharged, but collected and used as liquid fertilizer (or used for increasing moisture levels in compost heaps, if needed).

How compost is used within the humanitarian response should be coordinated between the involved sectors, ideally in the Solid Waste Management Technical Working Group (SWM TWiG cf. chapter 5.5) or in collaboration with the Energy and Environment Technical Working Group and Livelihood Technical Working Group.

Compost from domestic organic waste usually has no or low contamination levels from heavy metals or chemical compounds. Nevertheless, the general quality of the compost and its potential uses (e.g. for reforestation only, or acceptable for vegetable gardening), needs to be discussed and eventually evaluated by the SWM TWiG, the Energy and Environment TWiG and other relevant panels.

It is not recommended to market or sell compost outside of the camps for the following reasons:

- As mentioned in chapter 3.3, humanitarian organizations should not get into competition with existing industries, in this case private-sector compost producers.
- Selling compost requires the certification of the compost production facilities as well as the compost itself (for compliance with Bangladeshi standards for compost).
- Logistic impediments (both within the camps and for the transport of compost to locations outside of the camps), as well as the large number of compost production sites would complicate the commercial sale of compost.

Depending on the community setup in the camps, it is also conceivable to conduct household or community based composting. In this case, the organic material would not be fed into the SWM system.

For slow-decomposing organic material, there is no systematic disposal mechanism put in place or foreseen. This is not a particular problem, as slow-decomposing organic materials do not pose a significant risk to public health or the environment (as long as uncontrolled burning is prevented).

If the corresponding machinery or labour exists, slow-decomposing organics, such as bamboo scraps, wood or coconuts, could be chopped into small pieces and mixed into the composting matrix. However, if not yet existing, this approach is not recommended as the effort of manual or mechanical chopping might be too large compared to the benefit of composting slow-decomposing organics.

Alternatively, slow-decomposing organic materials could be used for various purposes, such as fuel for fires, or as feedstock for charcoal production. However, due both to the prioritization of liquefied petroleum gas (LPG) as fuel in camps, and to the risk of fire, it is not recommended to use slow-decomposing organic materials as fuel at household level in the camps. It needs to be evaluated, whether there would be other needs for fuel inside or outside of the camps (e.g. combustion in Omniprocessor, brick kilns, charcoal production facilities, sale to neighbouring rural host communities etc.).

In any case, the burning of slow-decomposing organic materials in the MRF or the onsite production of charcoal is not recommended as there is a risk that other materials from the MRF would also be burned.

How slow-decomposing organic materials are to be used should be addressed in coordination with other sectors, and ideally within the SWM TWiG (cf. chapter 5.5) or in collaboration with the Energy and Environment Technical Working Group.

4.5.2. Recyclables

In Bangladesh, recycling industries exist; recovered recyclables should be fed into the corresponding recycling stream.

In order not to create competition with the existing national recycling sector the humanitarian response should not implement a separate recycling infrastructure and recyclables should not be handed over free-of-charge. Recovered recyclables should be sold to scrap dealers.

A detailed list of recyclables with an approximate market value was compiled by UNDP and is added to the annex of this strategy (cf. chapter 9). Due to changing interests in the recycling sector, changing prices for recyclables, and/or new technological approaches for recycling, the attached list needs to be updated at least once per year. In addition to the list of recyclables, a contact list of scrap dealers and scrap dealer associations can be found in the annex.

Experience has shown that private sector recycling enterprises are reluctant to buy unclean recyclables. As especially the washing of recyclables does not seem to be reasonable or applicable within the SWM system, an early recovery of recyclables prior to the contamination with other waste types is essential.

For more information on recycling, please refer to the recycling value chain analysis from UNDP (UNDP, 2019).

4.5.3. Residual Waste

After organic materials and recyclables have been removed from solid waste, the remaining waste needs to be safely disposed of in sanitary landfills. The unsafe disposal in waste dumps, or the general dumping of waste into the environment needs to be prevented.

For the safe disposal of residual waste, the use of a sanitary landfill is currently the only adequate technical solution for the context of Cox's Bazar district.

Only residual waste from the MRF should be transported to sanitary landfills for final disposal.

In the Cox's Bazar District, several sanitary landfills are currently planned or already operating. The transport to and disposal in these sanitary landfills needs to be conducted in close collaboration with the landfill operating organizations and be in line with the relevant SOPs (UNDP, 2020b).

4.6. Required Infrastructure and Equipment for a SWM System

The following infrastructure, equipment and staffing are the minimum requirements for the operation of the SWM system described in the previous chapters:

4.6.1. Per Household

Provision of at least two (2) colour-coded waste bins per household – one for organics, and one for inorganics.

Bin colours:

- The current colour code for refugee communities / camps is green = organic waste, red = inorganic waste.
- The current colour code for host communities is green = organic waste, blue = inorganic waste.
- In the long-term, the colour-coding for waste in camps and neighbouring rural host communities should be aligned, with the same colour code for both.

Bin characteristics:

- Bins need to have a storage volume of around 10-15 L.

- Bins need to be closable and need to have an attached lid.

Bin characteristics and usage:

- The use of the bins for purposes other than for waste collection should be prevented and monitored.
- It is not recommended to use plastic liners / plastic bags in the bins (e.g. for easier removal of waste, or protection of bins). Plastic liners for the organic waste may contaminate the organic material; plastic liners for inorganic waste complicate waste segregation at a later stage, especially when the bags are tied (cf. chapter 4.3.2)

4.6.2. Per Restaurant, per Shop, per small Business

For restaurants, shops and small business, at least two (2) colour-coded waste bins are required, with the characteristics as described in chapter 4.6.1.

Depending on the size of the restaurants, shops and small business, and the corresponding generation of waste, it is recommended to use colour-coded waste containers (ca. 80 L) instead of bins.

4.6.3. Per Market

In the market, at least two (2) colour-coded waste bins are required per market stall, with the characteristics as described in chapter 4.6.1.

Depending on the generation of waste from the market stalls, it is recommended to use colour-coded waste containers (ca. 80 L) instead of bins.

In addition to bins/containers at market stalls, for the disposal of public waste it is recommended to place a sufficient number of pairs of colour-coded waste containers (ca. 80 L; one for organics, one for inorganics).

4.6.4. Per Camp

Material Recovery Facility (MRF): At least one MRF is in operation per camp. Depending on the number of inhabitants per camp, the geographical expansion of the camp and the space availability, it is conceivable to have more than one MRF per camp.

Each MRF is supposed to be in contact with:

- The relevant scrap dealer association (or in direct contact with several scrap dealers and recycling enterprises) in order to be able to sell recovered recyclables.
- The relevant sanitary landfill in order to make sure that residual waste can be transported to the landfill and be safely disposed.

Waste Collection Points are used instead of (or in addition to) direct collection of waste at households (or at shops, restaurants, market stalls etc.). One collection point includes two colour-coded compartments – one for organics, one for inorganics. Ideally, waste collection points are equipped with information panels illustrating the correct disposal of waste.

Waste collection points need to be easily accessible, both for those disposing the waste, as well as for the collection teams. Ideally, they should be located along the roads. The number of collection points depends on:

- The type of collection point (container or concrete / brick structure) and the corresponding volume.
- The number of households linked to the collection point.

  (This can be calculated based on the volume of the collection point, the planned collection frequency, and the daily waste generation rate. Based on the 2018 Sphere Standards, 1 litre per person per day (L/p/d) can be assumed as a first rough estimate of the daily waste generation rate.)
- Land availability, especially along roads.
- The transport distance from households to the waste collection points – should be maximum ca. 200 m.

- The topography and accessibility by households – significant differences in altitude and impeded accessibility should lead to shorter transport distances.

Ideally, waste collection points should be supervised by SWM staff, in order to ensure the segregation of waste.

Public bins should be placed in populated locations (e.g. markets, meeting places etc.). As in waste collection points, colour-coded waste containers (ca. 80 L) can be used for public bins. It is important to include public bins for waste collection. Ideally, public bins are equipped with illustrations displaying the correct disposal of waste.

4.7. Required Staffing for the SWM System

The Sphere Minimum Standards for Solid Waste Management in humanitarian responses indicate a 2.5-person maintenance team per 1,000 persons (Sphere Association, 2018).

For the humanitarian response in Cox's Bazar, the adequate number of specific staffing still needs to be defined. The effective staff requirement is based on the number of people needed for:

- Collecting all generated domestic waste (ideally on a daily basis), and
- Handling of the average daily amount of waste in the MRF

This includes the following activities:

- Collecting waste from households, shops, restaurants, market stalls etc.
- Collecting waste from collection points and public waste bins.
- Supervising the waste collection points.
- Transporting waste to an MRF.
- Operating an MRF, including data recording of received and processed waste.

To ensure waste segregation and the coordination of waste collection from market stalls and public bins, it is recommended to have designated SWM staff permanently on site in markets.

Relevant information on aspects of gender mainstreaming related to SWM staffing is provided in chapter 6.9.

5. PARTICULARITIES RELATED TO HUMANITARIAN RESPONSE

This chapter highlights particularities relating to the provision of SWM within the humanitarian response, and in particular within the camps. This chapter might not be applicable for SWM outside of the humanitarian response.

5.1. Roles and Responsibilities within the SWM System

5.1.1. Individual Persons, Households and Small Business Owners

Individual persons, households and small business owners (of restaurants, shops, market stalls etc.) are required to:

- Segregate solid waste at source.
- Correctly dispose the segregated solid waste in the designated containers or collection points, or hand them over to collection teams.
- Not dump waste into drains, in the environment or in illegal waste dumps.

5.1.2. Humanitarian Organization

All humanitarian Sectors are required to:

Respect the principles of the SWM strategy of the WASH Sector (cf. chapter 3.2), in particular:

- Coordinate with the relevant WASH partners in regard to SWM activities (e.g. cleaning campaigns) and the avoidance of waste from distributions.
- Take into consideration the needs of SWM, and provide support whenever possible (e.g. land use, access, staffing etc.).
- Take into consideration SWM objectives when procuring and distributing materials and items:
    - Minimize the entering of non-recyclable materials into camps.
    - Maximize the use of reusable and recyclable material.
    - Establish a return or collection mechanism for potential waste material distributed in camps (e.g. packaging, food wrapping etc.).

The WASH Sector is required to:

- Provide coordination among the different WASH partners involved in SWM.
- Provide coordination with other humanitarian sectors (especially SMSD and Shelter/NFI, but also with Education Sector etc.).
- Provide technical guidance for the implementation of SWM in camps and neighbouring rural host communities (e.g. through technical notes, SMW Technical Working Group etc.).
- Provide SWM trainings, if/as required.
- Ensure the mainstreaming of the SWM strategy and all further documentation and guidelines.

All organizations involved in SWM are required to:

- Implement SWM according to:
    - The technical guidance and coordination provided by the WASH Sector.
    - The SWM strategy of the WASH Sector (this document).
    - The SWM Operational Plan (WASH Sector Cox's Bazar, 2019a).
    - Technical notes related to SWM (e.g. WASH Sector Cox's Bazar, 2021a).
    - Recommendations and guidance from SWM TWiG etc.
    - Recommendations and guidance from the Hygiene Promotion TWiG (especially in regard to community engagement and behaviour change).

- Develop their own operational action plan for SWM, including internal roles and responsibilities.
- Ensure that SWM is mainstreamed within their organization (not just for the WASH unit, but also in other units and divisions).
- Ensure sufficient funds are available for the implementation of SWM.
- Monitor SWM interventions within their area of operation (incl. monitoring of SWM interventions of implementing partners).
- Be accountable for their SWM activities and performance.
- Ensure that their implementing partners are held accountable for their SWM activities and performance.
- Monitor and report illegal dumping of waste (outside of the SWM system) to the CiC, and provide solutions to avoid illegal dumping of waste.
- Include hygiene promotion, behaviour change and community engagement considerations when implementing SWM programs, including feedback from populations.

In addition to the responsibilities of all organizations involved in SWM, **the Camp Focal Agencies (CFA)** are required to:

- Operate one (or more) MRF (or subcontract operation to qualified actor), including the collaboration with landfill operators and the recycling industry.

In addition to the responsibilities of all organizations involved in SWM, **the Block Focal Agencies (BFA)** are required to:

- Collect and transport waste to the MRF.
- Implement outreach activities to communities (e.g. information and behaviour change campaigns)

5.1.3. Governmental Organizations

The Office of the Refugee Relief and Repatriation Commissioner (RRRC) is requested to:

- Ensure that SWM services in camps are considered as essential.
- Ensure that requirements for operating a SWM system are met (land, access etc.).
- Whenever possible prevent the entering of non-recyclable materials into camps.
- Enforce the correct disposal of waste in camps, and prevent littering.
- Develop and enforce statutory orders relating to SWM.

The Camp in Charge (CiC) is requested to:

- Ensure that SWM services in camps are considered as essential
- Ensure that requirements for operating a SWM system are met (land, access etc.).
- Ensure that individuals, households and businesses handle waste according to directives.
- Whenever possible prevent the entering of non-recyclable materials into camps.
- Enforce the correct disposal of waste in camps, and prevent littering.

The Bangladesh Department of Public Health Engineering (DPHE) is requested to:

- Provide technical support and coordination for the implementation and operation of SWM systems.
- Support the Coordination of WASH activities, including SWM.

The Bangladesh Department of Environment (DoE) is required to:

- If not under the responsibility of DPHE or RRRC: Provide approval for constructing SWM infrastructure and implementing SWM services (in so far as infrastructure and services are in line with national legislation).

5.1.4. Private Sector

The private sector recycling industry is expected to take over recyclables which are recovered in MRFs. The handover should not happen free of charge, but according to the predefined value of the various recyclables given by the relevant Scrap Dealer Association.

5.2. Solid Waste Cleaning Campaigns

Cleaning campaigns in the camps should be conducted regularly in close collaboration with relevant humanitarian sectors (e.g. SMSD, Shelter/NFI etc.), as well as with the relevant office of the Camp in Charge (CiC), community based organizations, religious groups, volunteer networks, community committees, households etc.

Nevertheless, an increased need for cleaning campaigns is also an indication that the implemented SWM system is not functioning.

For more information on the organization and roll-out of solid waste cleaning campaigns, please refer to the SWM operational plan (WASH Sector Cox's Bazar, 2019).

The roll-out of cleaning campaigns should be addressed and coordinated in the SWM TWiG (cf. chapter 5.5).

5.3. Solid Waste from Drains

The removal and disposal of waste from storm water drains involves the work of various humanitarian sectors, including SMSD, Shelter/NFI, Food Security and WASH.

As described in chapter 3.2, the most important working principle for SWM is the avoidance of waste generation. The same applies to the issue of solid waste in drains, where the incorrect disposal of waste in drains should be avoided in the first place. In order for the principle of avoidance to be adopted, there will be a need for information campaigns and the provision of alternative disposal options within a functioning SWM system.

After slow-decomposing organics and recyclables are removed on-site as much as possible from drain waste, the further processing of the drain waste depending on the percentage of sand and silt and the degree of contamination with solid waste.

- If drain waste contains predominantly solid waste, solid waste is removed as much as possible and disposed in landfill. The remaining sand and silt can be used as cover material in landfill.
- If drain waste contains predominantly sand and silt, it can be used as cover material in landfill.
- If drain waste consists only of sand and silt, it can be used as cover material in landfill or for refilling in construction sites.

For more information on the management of solid waste from drains, please refer to the corresponding technical note (WASH Sector Cox's Bazar, 2021b).

The roll-out of drain cleaning campaigns should be addressed and coordinated in the SWM TWiG (cf. chapter 5.5).

5.4. Waste from Food and NFI Distributions

As described in chapter 3.2, the most important working principle for SWM is the avoidance of waste generation. This principle also needs to be applied to the distribution of food and non-food items. Agencies are therefore expected to reduce waste as follows:

- Waste from distributions should be reduced to a minimum, especially inorganic and non-recyclable materials.
- As far as possible, unnecessary packaging should be removed and disposed of before handing out items.
- Whenever possible, reusable and recyclable materials should be used.
- For waste which cannot be avoided, such as packaging (e.g. food containers, cans, bottles), agencies should establish a mechanism which ensures and promotes the

return of those items, for instance by using incentives (e.g. vouchers for exchange of packaging material).

The reduction of waste from distributions should be addressed and coordinated in the SWM TWiG (cf. chapter 5.5).

5.5. The SWM Technical Working Group (TWiG)

For all technical and operational aspects of SWM, it is recommended to launch an SWM TWiG. Although the TWiG will very likely be initiated by and subordinated to the WASH Sector, it will be important to include other humanitarian sectors. The following topics need to be addressed in the SWM TWiG:

- Coordination of the various interphases of SWM with other sectors (e.g. waste collection, recycling and waste processing; usage of compost; education and information campaigns on correct waste handling etc.).
- Coordination of SWM activities which involve other sectors (e.g. cleaning campaigns, cleaning of drains etc.).
- Disposal or use of slow-decomposing organics.
- Community engagement and behaviour change related to SWM (in close collaboration with the Hygiene Promotion TWiG).
- Reduction of waste from Food and NFI distributions.
- Monitoring and recording of SWM infrastructure and services (and corresponding definition of gaps).
- Monitoring and recording of waste collection and disposal.
- Assessing representative unit costs of SWM.
- Coordination of the safe disposal of other waste types (e.g. electronic waste).
- Establishment of a return policy for recyclable materials.

Ideally, selected representatives of the SWM TWiG should take part in the activities of the Energy and Environment Technical Working Group, and vice-versa.

The SWM TWiG should maintain a constant dialog with the Hygiene Promotion TWiG in regard to community engagement and behaviour change.

5.6. Sphere Standards for SWM

The recommendations in this Strategy are in line with the following standards of the 2018 Sphere Minimum Standards for SWM in humanitarian responses:

- **Environment free from solid waste** (Sphere standard 5.1): Solid waste is safely contained to avoid pollution of the natural, living, learning, working and communal environments.
- **Household and personal actions to safely manage solid waste** (standard 5.2)**:** People can safely collect and potentially treat solid waste in their households.
- **Solid waste management systems at community level:** Designated public collection points do not overflow with waste, and final treatment or disposal of waste is safe and secure.

6. FURTHER ESSENTIAL INFORMATION

6.1. Development and Enforcement of Statutory Orders related to SWM

Relevant authorities are required to develop and enforce statutory orders related to the generation, handling and disposal of solid waste.

Statutory orders ideally include:

- Prohibition of waste disposal outside of the SWM system (e.g. littering and disposal in illegal waste dumps).
- Banning of non-recyclable materials (such as composite plastics, single-use plastic bags etc.).
- Reasonable and applicable penalty systems in case of violations of SWM related statutory orders.

While in some cases statutory orders already exist (e.g. the ban on plastic bags in Bangladesh), it is important to also enforce these orders, inform the population and the relevant industries, and to promote and support alternatives (such as jute or paper bags instead of plastic bags).

6.2. Recovery of inorganic non-recyclable Materials for Upcycling Projects

The recovery of inorganic non-recyclable materials for upcycling projects is desirable and not in conflict with the SWM system: recovering of non-recyclables helps to lower the amount of waste which needs to be landfilled.

One example for this recovery is the collection of used food packages by partners of the Food Security Sector. Due to the mixed composition of the packages (various plastics and aluminium coating), these cannot be recycled and are required to be landfilled. Nevertheless, with the corresponding processing techniques, the food packages can be used as a raw material for the tailoring of handbags, umbrellas and other accessories.

Non-recyclables are ideally recovered before they are disposed of in the SWM system. This prevents the spoiling of the materials, and requires less protective measures for the involved workers.

6.3. Prevention of Usage of non-recyclable Materials

The usage of non-recyclable materials should be prevented through regulations, whose enforcement needs to be ensured by the authorities and law enforcement agencies.

It is in the interest of the Bangladeshi authorities to prevent the use of non-recyclable materials (e.g. composite plastics in the form of packaging material, food wrapping etc.), as this reduces the need for landfilling and will save considerable investment of public money.

The alternative usage of recyclable materials (instead of non-recyclables) should be encouraged by the authorities, and promoted with adequate measures (e.g. information campaigns, financial subsidies).

6.4. Monitoring of Solid Waste Generation and Mapping of SWM Infrastructure

The generation of solid waste as well as its disposal needs to be monitored and recorded.

Ideally, a mass balance should be compiled for solid waste generation and its disposal in given areas of operation. Based on this information, the extent of littering or inadequate disposal can be estimated.

In addition, the SWM infrastructure and its capacity need to be mapped.

Both the estimation of waste generated and existing capacities for solid waste handling will help to identify gaps in SWM service provision.

6.5. Health and Safety of SWM Workers

All staff and volunteers involved in SWM need to be equipped with Personal Protective Equipment (PPE). The selection of PPE depends on tasks and responsibilities of the staff, and

also needs to meet the requirements of new public health risks, such as the 2019 Coronavirus virus (COVID-19).

All staff and volunteers need to be trained on potential health risks, the use of PPE and the use of cleaning equipment. All staff and volunteers, especially the ones being in close contact with solid waste need to have access to changing rooms, gender segregated toilets, and water and soap for personal hygiene.

The immunization of SWM staff needs to be considered.

6.6. Illicit Disposal of Medical Waste

Medical waste - especially sharps, infectious waste and pharmaceuticals - must not be disposed of as domestic solid waste.

As described in chapter 2.2, this SWM strategy focuses on domestic solid waste only, and does not consider medical waste. Due to its infectious and hazardous character, it is paramount to dispose of medical waste separately from other waste types.

In case medical waste is found in domestic waste, it will be necessary to investigate whether hospitals, health wards, pharmacies or practices are incorrectly disposing medical waste together with domestic waste.

Medical institutions need to ensure that medical consumables are not handed out. Or in case of a controlled handing out, medical institutions need to ensure that the generated medical waste is disposed of in a medical waste management system.

6.7. Incineration of Domestic Solid Waste

Incineration of domestic solid waste is not a recommended technical approach for resolving the solid waste issue in the Cox's Bazar district.

- Incineration of waste may cause the release of toxic gases in the exhaust air. Incineration of domestic solid waste therefore requires sophisticated exhaust air cleaning systems.
- Incineration of waste is not the final step in its disposal, it only reduces the volume of waste. In order to avoid the hazardous contamination of the environment, the ashes and fly ashes produced during incineration require sophisticated landfilling – this is far more sophisticated than the current sanitary landfill implemented in the Ukhiya upazila. Preferably, the ash and fly ash from waste incineration should be deposited in decommissioned deep underground mines.

For now, the deposit of residual waste in a sanitary landfill is the only adequate technological solution for safe disposal of domestic solid waste in Cox's Bazar district.

6.8. Financial Aspects

A majority of the fractions within solid waste have either a market value (e.g. recyclables) or can be used as a resource for the creation of value (e.g. organic material). Nevertheless, despite the financial value of waste, it is commonly not feasible to cover SWM costs by the resale of those valuable items or generated products. For the financially sustainable operation of SWM services, the additional collection of service fees is necessary.

In the refugee context, the collection of fees from the users of the SWM service is not applicable, at least not for households. The feasibility and acceptance of fee collection from small businesses needs to be evaluated.

Nevertheless, this means that SWM systems in the refugee context in Cox's Bazar district can never become financially sustainable. This is neither surprising nor the goal within humanitarian service provision: within WASH, both water supply and faecal sludge management also rely heavily on external funding.

In host communities, the collection of fees already takes place to some extent, especially in more semi-urban settings like the Teknaf municipality. When initiating the fee collection in host communities, the following aspects need to be considered:

- As the provision of SWM services is free of charge in refugee settings, initiating a fee-collection system for SWM might be difficult in communities with comparable economic perspectives, or communities living in close distance to refugee camps.
- The affordability and the willingness to pay for SWM services needs to be evaluated.
- When installing a fee collection system, the segregation of waste or the returning of recyclables could be promoted through a fee reduction.
- The collection of high-value recyclables might still be conducted by the informal sector.
- The impact on the informal sector needs to be evaluated and considered when initiating a fee-based SWM service. Ideally, existing informal elements should be incorporated into SWM systems and transformed into formal services. This will facilitate improvement of working conditions, prevent child labour, etc. (see chapter 6.13 for more information on informal waste sector).

6.9. Gender in SWM

Gender equality is an important aspect in SWM. Both for the operation of SWM systems (e.g. considering opportunities of employment, requirements for different SWM tasks etc.), as well as in order to create SWM services which are accessible for everybody. For comprehensive information on gender aspects within SWM, please refer to UNDP's Solid Waste Management Gender Strategy (UNDP, 2020a).

6.10. Waste from Menstrual Hygiene Management

Menstrual hygiene and disposal of menstrual materials is a topic that still requires a lot of investigation as stigma, perceptions and norms related to menstrual blood impacts how Menstrual Hygiene Management (MHM) materials are disposed and dealt with by collectors.

As described in the MHM Strategy of the WASH Sector (WASH Sector Cox's Bazar, 2020), it is recommended to distribute reusable menstrual hygiene materials only. Furthermore, in order for women and girls to practice changing, washing, drying and disposal of MHM materials in a safe, private and hygienic manner, MHM-friendly sanitation facilities should be provided.

According to the MHM strategy, the disposal of menstrual hygiene material should take place in discrete and appropriate disposal facilities located inside latrines (e.g. container with lid). Containers need to be regularly emptied by cleaning personal with relevant protective equipment. The disposal of menstrual hygiene material should be separated from domestic waste, for instance through adequate incineration (as executed in medical facilities), disposal in the medical waste management system (if available) or direct disposal in sanitary landfills.

IFRC (2018) provides additional information on waste handling from menstrual hygiene management.

6.11. Solid Waste from Markets

Experience has shown that the level of solid waste pollution is significantly higher around market places. This is both relevant for refugee and neighbouring rural host communities, and even urban areas. It can be assumed that more waste is generated in markets (in comparison to purely residential areas), and that at the same time the ownership for the generated waste, as well as for the cleanliness of the location is low. In case cleaning is conducted in market places, it is very likely that the collected waste is dumped nearby, e.g. in drains or in the environment.

Correspondingly, particular attention needs to be given to waste in markets. The segregation and frequent collection of waste in market places is essential.

The exhaustive provision of bins and containers is paramount in markets, both for each market stall, as well as for community bins (see chapter 4.6.3). Furthermore, waste from markets should be collected daily, and instructions and information should be provided to market stall owners and customers.

Ideally, market stall owners are incentivised to make use of bins and containers, and the waste collection, for instance through reduction of fees for SWM services, but also due to the fact that clean market stalls might be more appealing for customers.

It is recommended to deploy SWM staff permanently to markets. Designated SWM staff could both ensure waste separation at source and coordinate the collection of waste from market stalls or public bins.

6.12. Single-use, light-weight Plastic Bags

Single-use, light-weight plastic bags are banned in Bangladesh since 2002.

Despite this almost 20-year old ban, single-use plastic bags are commonly used across Bangladesh, including in the refugee and neighbouring rural communities in Cox's Bazar district.

There is no or only little interest from the recycling sector to trade and process recovered plastic bags. This is due to the fact that plastic bags are often soiled and dirty, but is also due to the low market value for recovered single-use, light-weight plastic bags.

In order to recycle single-use, lightweight plastic bags, and in order to avoid that they end up in the residual waste required to be landfilled, some organizations initiated the processing of plastic bags in the camps: Plastic bags are cleaned, dried, shredded, melted into pellets, which are then used to produce plastic items. So far, alphabet cubes, writing boards and other items were produced in the camps from plastic pellets

While this initiative is certainly very innovative and helps to reduce the residual waste, it is questionable whether an upscaling would be reasonable, especially within the camps:

- Plastic processing, especially the production of plastic items, requires industrial electric connections and the corresponding electric supply.
- If not processed with care, melting plastic can cause toxic fumes.
- As plastic bags are banned theoretically, it is questionable to invest in the infrastructure needed for processing them.

Instead of processing plastic bags locally in the camps, it would be better to minimize the use of plastic bags in the first place. And if possible, to negotiate terms with the recycling sector for handing over recovered plastic bags.

6.13. Informal Recycling Sector

The recovery and resale of recyclables from waste is an important revenue generating activity for the informal recycling sector. While the informal recycling sector contributes to the reduction of residual waste, it generally focuses on high-value recyclables and recyclables which can easily be recovered from waste. Despite its contribution to waste reduction, informal recycling has its limitations and cannot replace a formal, systematic SWM service.

When initiating SWM services, the impact on the informal recycling sector needs to be considered.

Competition with the informal recycling sector should be avoided.

Ideally, the informal recycling sector can be integrated in a SWM system. This does not only facilitate improvement of the working conditions of the waste pickers (e.g. through regular daily wages, the use of PPE, prevention of child labour etc.) but can also be used to regulate the value recovery from waste (e.g. compliance with environmental and safety policies etc.).

For more information on the informal recycling sector, please refer to the recycling value chain analysis from UNDP (UNDP, 2019).

6.14. Disposal of other Waste Types (not Domestic Solid Waste)

As described in chapter 2.2, this strategy focuses only on domestic solid waste and waste with similar characteristics from restaurants, shops, markets etc.

While this limitation is accepted for the sake of simplifying this first SWM strategy of the WASH Sector, it needs to be considered that other waste types, for instance electronic waste and medical waste, may pose a far bigger risk for human health and environment.

In addition, and in parallel to this strategy, it is therefore recommended to also initiate the management of other relevant waste types. While it can be assumed that the health sector has a systematic approach for medical waste, very likely there is no system for the disposal of

electronic waste. The separate collection of electronic waste and the handing over to the recycling sector should again be coordinated with the relevant private sector entities.

7. ABBREVIATIONS

AFA	Area focal agency (of a camp)
BFA	Block focal agency (of a camp)
CFA	Camp focal agency (of a camp)
CIC	Camp in Charge
DPHE	Bangladesh Department for Public Health Engineering
LPG	Liquefied petroleum gas
MHM	Menstrual hygiene management
MRF	Material recovery facility
NFI	Non-food item
RRRC	Refugee Relief and Repatriation Commissioner
SAG	Strategic Advisory Group (of the humanitarian WASH Sector)
SMSD	Site Management and Site Planning (humanitarian sector)
SOP	Standard operating procedures
SWM	Solid waste management
TWiG	Technical working group (of humanitarian sectors)
PPE	Personal protective equipment
WASH	Water, sanitation and hygiene

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9. ANNEX

1. **List of Recyclables** (provided by UNDP)
2. **Price List of Recyclables** (provided by UNDP)
3. **Contact Information for Scrap Dealer Associations from Ukhiya and Teknaf** (provided by UNDP)