



Feasibility Study Report

Rural Waste Management



Submitted to
'My Village-My Town' Technical Assistance Project
Local Government Engineering Department (LGED)
Department of Public Health Engineering (DPHE)



Executive Summary

The Election Manifesto 2018 and the other Policies- Strategies of the Government for Rural Waste Management

In its article 3.10 of the Election Manifesto 2018 of the present government, the government has articulated its pledge for ‘MY VILLAGE - MY TOWN’: EXTENSION OF MODERN CIVIC AMENITIES IN EVERY VILLAGE. The manifesto says “The Awami League has always considered villages as their central philosophy for development and prosperity. In the independent country, Father of the Nation Bangabandhu Sheikh Mujibur Rahman incorporated a promise in Article 16 of the Constitution that the State shall adopt effective measures to bring about a radical transformation in the rural areas through the promotion of an agricultural revolution, the provision of rural electrification, the development of cottage and other industries, the improvement in education, communications and public health, in those areas, so as progressively to remove the disparity in the living standards between urban and rural areas. The present government will undertake a programme and implement it to upgrade every village to town”. In its specific plan section, it says “Initiatives will be taken to provide every village with facilities of modern town, including developed roads, communication, safe drinking water, modern healthcare and proper treatment, standard education, developed sewerage and waste management, increasing electricity and fuel supply, computer and high-speed internet facilities, electric equipment and standard consumer goods”.

Emphasis on rural waste management started with the introduction of Local Government (Union Parishad) Ordinance 2009. It has been reassured in the Solid Waste Management Policy of 2021. In its chapter 10, there are specific discussion regarding the responsibility of Upazila Parishad and Union Parishad. The 8th Five Year Plan (2021-2025) and the Bangladesh Perspective Plan (2021-2041) has specific directives for improvement of Rural Waste Management and capacity building of Local Government Institutions for that purpose.

The Study Area

The Country has a good number of densely populated Unions in the districts of Dhaka, Narayanganj, Gazipur, Munsiganj, Cumilla, Chattogram, Cox’s Bazar, Khulna, Rajshahi, Rangpur and Bogura. These unions have similar population of urban areas. In Dhaka, Narayanganj and Gazipur, the populations of the unions are much more than average urban population. These areas need immediate attention of the government and the respective Upazila Parishads, Union Parishads need capacity building for waste management. Four Unions from these districts were under study. Besides that, eleven out of fifteen pilot villages were under the study area. In addition to the study of the unions, forty hat bazars were studied.

District	Upazila	Union	Pilot Village	Total Surveyed Village	Total Population	Comments	
Narayanganj	Bandar	Bandar	Kushiara	14	28141	Density: 3896	
Dhaka	Keraniganj	Shakta	Atibazar	16	58075	Density: 3542	
Gazipur	Gazipur Sadar	Bhawalgarh	Monipur	14	98912	Density: 2012	
Cox's Bazar	Cox's Bazar Sadar	Jhilangza	Jhilangza	10	30288	Density: 1359	
Kurigram	Bhurangamari	Pathardubi	Pathardubi	07	21369	Pilot Village	
Rajshahi	Bagmara	Sonadanga	Sonadanga	07	7847		
Netrokona	Barhatta	Sahata	Demura	23	2907		
Sylhet	Gowainghat	Rustampur	Bagaiya	12	4016		
Sunamganj	Shantiganj	Shimulbak	Shimulbak	07	29147		
Narsingdi	Monohardi	Chalakchar	Hafizpur	02	19421		
Satkhira	Shyamnagar	Buri Goalini	Datinakhali	09	24735		
Barishal	Hizla	Memania	Induria	08	24735		
Gopalganj	Musudpur	Jalirpar	Bilchanda	06	20912		
Cumilla	Monoharganj	Bipurshar	Sheikchail	06	24294		
Chattogram	Mirsarai	Ichakhali	Charsarat	09	27865		
Total				150	386243		

Rural Waste from Villages and Markets

There was no previous study on rural waste in villages and markets. Perhaps, this is the first initiative to explore the waste in rural areas. In Bangladesh, the urban waste per capita was measured as 0.56 Kg (Waste Concern, 2014). Under this study, the rural waste per capita has been found as 0.328 Kg. Among the waste, 87% are organic and 13% are other wastes. The villagers dump the organic waste in pits/holes, the dump other waste in nearby streets, water bodies or open spaces. In some villages, the valuable plastic wastes are being sold to vendors. But the non-valuable plastic waste (polythene, packaging materials etc.) are being dumped in the adjacent field, water bodies and any open spaces.

The fecal sludge management is also poor. The homesteads in the study area have 54.73% single pit latrine. 29.04% households have septic tank. Only 8.55% households have double pit latrine but not with appropriate design. Only 0.16% households have double pit latrine with appropriate measures for fecal sludge management. 1.43% houses found with no latrine at all.

The emptying method of latrine is not safe. It has been observed that, 53.28% latrine was never emptied. 36.89% was emptied by sweeper, 2.47% by pump and 5.95% by owner of the household. All of the emptied latrines (45.31%) are being dumped in pits or water bodies. The success against open defecation is being dulled as a huge quantity of fecal waste is being dumped in the water bodies polluting the aquatic environment.

The rural markets are the hub of rural waste. The study reveals that, there are around 1500 rural markets where the daily waste production is more than 2 ton. There are 9728 enlisted rural markets in the country where 348 is very big, 1025 is big, 2814 is medium, 2196 is small and 3365 is emerging. These markets approximately produce 4300 tons waste per day.

The rural markets produce around 27-19% plastic waste. Depending on size, the organic waste varies by 73-81%. A good portion of organic waste is from slaughtered chicken and other animal which is critical for environment.

Strategy for Developing Clean Villages, Clean unions and Clean Upazilas

The development of the rural waste management system has been emphasized in “the Solid Waste Management Rules 2021’ and other related policies as well. Moreover, the development of clean villages, and clean cities were included in the 8th Fifth Year Plan, the Perspective Plan and the plan to celebrate the Mujib Year, where there is a strategy or work plan yet to develop to address the issue. In this perspective, the ‘My Village - My Town’ Technical Assistance Project has formulated a strategy aiming at developing clean villages, clean unions, clean upazilas. This strategy is explained in a simple manner in the below newly developed model-1, 2 & 3.

The synopsis of the strategy for developing Clean Village-Clean Unions-Clean Upazila presented below:

To develop a clean upazila household based, paurashava/upazila based and community or village-based waste management system will be developed. To this, model-1 is proposed for those villages located far from the paurashava/upazila, Model-2 is applicable for those villages located near to hatbazar and growth centres and model-3 is proposed for the villages located adjacent to the paurashava/upazila headquarters. In addition, Union and upazila level sustainable waste management will be developed in combination of the models.

Model-1: For those villages that have no growth centre/hat bazar within 2-3 kilometers to be included in the model-1. Household/house-wise disposal of organic waste, community-based organic waste management where applicable, non-organic hazardous waste will be collected fortnightly and disposed of at union/upazila level. Two bins (organic, hazardous) will be provided to the households to dispose of organic waste at household/community level and three bins (organic, inorganic, hazardous) will be provided to the households to dispose of organic waste built at union/upazila level plants.

Model-2: Villages/Unions located at the Growth Centre/Hatbazar within 2-3 kilometres are included in Model-2 and it will be comprised of the Growth Centre/Hatbazar waste system. Organic waste will be disposed of at home or send to hatbazar-based waste management centres and will be managed with hatbazar waste. Where applicable, waste from several nearby hatbazar will be collected through a joint management.

Model-3: Those villages closely located to the paurashava/upazila headquarters (within 2-3 kilometers) and have access to modern waste management, will go for model-3. Waste from all these villages will be processed at upazila/ paurashava level through integrated waste management plant or along with rural waste. Where applicable, waste from one or more nearby hatbazars will be collected through a joint management.

The study revealed that establishment of 'Rural-Urban Linkage' is pivotal for waste management. Meanwhile, waste management plants have already been set up in various paurashava. Rural waste management will be easier and more sustainable if the waste adjacent to the paurashava areas and densely populated villages managed together.

Strategy to Develop Clean Village: Villages far from the Paurashava/Upazila Sadar or Villages far from the Hatbazar (Model-01)

SL No.	Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
1	Faecal sludge free rural water body	<ul style="list-style-type: none"> - Stop open defecation - Stop toilet water run to the water body 	-Twin pit latrine for all/ set septic tank with soak well for affluent	Raise family-based awareness	<ul style="list-style-type: none"> - Grants for ultra-poor - Partnership with others - Use UP Act 2009 on Faecal Sludge management 	<ul style="list-style-type: none"> - Conduct awareness campaign in educational institution, mosque, and others religious intuitions - Appoint Clean Ambassador at Para, Village level, Provide them training/building network
2	Kitchen waste free rural drain, water body and road	Provide household-based waste management system, where applicable	Establish small community-based organic fertilizer plant where required	Community-based management team	Operate community-based management Team and household or family-based compost fertilizer production	Same
3	Plastic waste free rural drain, road and water body	Household based waste management (provide bins)	Arrange rickshaw or van under the management of union parishad	Collect waste from household fortnightly/ monthly basis	Preserve plastic waste/collection/supply chain related guideline	Same
4	Medical waste free rural drain, road and water body	Household based waste management (provide bins)	Arrange rikshaw or van under the management of union parishad	Collect waste from household fortnightly/ monthly basis	Medical waste preservation/ collect/ disposal guideline	Same

Strategy to Develop Clean Village: Villages far from the Paurashava/Upazila Sadar or Community-centered Hatbazar (Model-02)

SL No.	Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
1	Faecal sludge free rural water body	<ul style="list-style-type: none"> - Stop open defecation - Toilet water will not run to the water body 	<ul style="list-style-type: none"> - Set septic tank with soak well for affluent; and - Twin pit latrine for others - Clean tank using Vacutug in appropriate cases 	Raise family-based awareness	<ul style="list-style-type: none"> - Comply UP Act 2009 on faecal in construction of soak well for faecal sludge management - Grants for ultra-poor to develop twin pit latrine - Partnership with others - Develop guideline to maintain Vacutug 	<ul style="list-style-type: none"> - Conduct awareness campaign in the educational institution, mosque, and others religious intuitions - Appoint Clean Ambassador at Para, Village level, Provide them training/building network
2	Kitchen waste free rural drain, water body and road	<ul style="list-style-type: none"> - Preserve waste in three separate bins - Dispose waste to the municipality/upazila sadar/hatbazar separately, where necessary - For other cases follow model-01 	<ul style="list-style-type: none"> - Establish hatbazar-based waste management plant where required - For other cases follow model-01 	Under the UP hatbazar appoint operators to run the transports	<ul style="list-style-type: none"> - Guideline for collecting compost waste from hatbazar and adjacent villages disposed by UP in the plant - Rule for deploying operators where necessary - Guideline for municipality or upazila to collect organic waste for plants 	Same

Strategy to Develop Clean Union

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make organic waste free courtyard, drain, water body and road of all villages under the union parishad	Follow organic waste management guidelines aiming at developing clean union parishad	Set family/ community based organic waste management plant	Appoint officers at Union Parishad (Sub-Assistance Engineer - Manage by operators	Follow the guideline of model-01, Model-02	Improve marketing of organic fertilizers through engaging Upazila Agriculture Officer/ Sub Assistant Agriculture Officers
Make faecal sludge free villages of the union parishad	<ul style="list-style-type: none"> - Stop defecation in the open space - Stop running toilet to the water body - Set soak well in the sanitary latrine - Use Vacutug machine in appropriate aspects following the strategy 	<ul style="list-style-type: none"> - Set septic tank for affluent of the UP - Twin pit latrine for all - Vacutug machine 	<ul style="list-style-type: none"> - Raise awareness - Arrange twin pit latrine for UP/Government funded projects - Build partnership management with neighbor upazila 	<ul style="list-style-type: none"> - UP Act 2009 on Faecal Sludge management - Grants for ultra-poor to set twin pit latrine - Partnership with others - Guideline to operate Vacutug at paurashava/upazila level 	<ul style="list-style-type: none"> - Appoint Clean Ambassador at Para, Village level, Provide them training/building network - Include agenda in the monthly meeting and review its progress - Take steps to popular Vacutug machine
Plastic waste free drain, road and water body of all villages of the union parishad	Use model-01, 2 where applicable	<ul style="list-style-type: none"> - For model-01, collect waste fortnight/monthly using UP rickshaw or van - For model-02 collect waste on regular basis 	<ul style="list-style-type: none"> - Supply chain for model-01 to manage solid waste - For mmodel-02, waste disposal through supply chain or plant 	Preserve plastic waste/collection/supply chain related guideline	Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Medical waste free rural drain, road and water body of all villages of the union parishad	Use model-01, 2 where applicable	<ul style="list-style-type: none"> - For model-01, collect waste fortnight/monthly using UP rickshaw or van - For model-02 collect waste on regular basis 	<ul style="list-style-type: none"> - For model-01 at hatbazar/paurashava disposal the waste to incinerator - For model-02 hatbazar or model-3 at upazila or paurashava level waste will be disposal to the plant 	Medical waste preservation/ collect/ disposal guideline	Set three chambers waste bin while collect inorganic or hazardous

Strategy to Develop Clean Hatbazar

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Organic waste (vegetable and restaurant waste) free hatbazar	Follow guideline to develop organic waste free hatbazar	<ul style="list-style-type: none"> - Set three separate compartment-based dustbin, where applicable set shop-based dustbin - Set small plant 	<ul style="list-style-type: none"> - Managed by Union Parishad - Appoint operators in the hatbazar 	Follow the guideline waste management in the hatbazar	<ul style="list-style-type: none"> - Organize motivational workshop - Launch Upazila based Clean Heart Award - Appoint clean ambassadors for growth centre and hatbazar
Organic waste (waste from slaughter house) free hatbazar	Centre slaughter house management	Construction of slaughter house and build drainage system	Develop technical knowledge of hatbazar management committee	Same	Building capacity of the hatbazar management committee members and operators as well
Organic waste (waste from chicken) free hatbazar	Collect in the separate compartment of the waste bins	Disposal at hatbazar/near centre as appropriate	Same	Same	Same
Plastic and medical waste free hatbazar	Chicken waste management system	Disposal at biogas plant	Same	Same	Same
Faecal sludge free hatbazar	Set public toilet with soak well septic tank	Set public toilet with soak well septic tank	Leasing the public toilet	Leasing related rules	same
Waste management of the neighboring villages of the hatbazar	Set small plant for remissible and refinement the waste	Set sanitary land field/incinerator for segregation or composting waste	Private sectors operators under the supervision of union parishad or hatbazar committee	As per guideline	same

Strategy to Develop Clean Upazila

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make organic waste free courtyard, drain, water body and road of all villages of the upazila	Follow the organic waste management model 1-2 to develop clean village	Develop plant using model-1-2 for rural level and design the comprehensive waste management plant for upazila Or Upazila/Paurashava and adjacent villages focused waste management plant	Follow rural level model 1-2 and develop guideline to appoint operators	Follow the guideline of model-01, Model-02	Engage Upazila Agriculture Officer or Sub Assistant Agriculture Officers to popularize organic fertilizers at villages level
Make faecal sludge free water body of all villages of the upazila	-Stop defecation in the open space -Toilet water will not go to the water body -Set soakwell in the sanitary latrine	- Set septic tank for affluent of the UP -Twin pit latrine for all	- Raise awareness -Arrange twin pit latrine from the UP/Government funded projects	- UP Act 2009 on Faecal Sludge management -Grants for ultra-poor to set twin pit latrine -Partnership with others -Guideline to operate Vacutug at paurashavao/upazila level	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress -Take steps to popular Vacutug machine
Make faecal sludge free water body of all villages of the upazila	Ensure use of Vacutug machine following the guideline	Purification faecal sludge of the waste at paurashava/upazila using Vacutug machine	If necessary, build collaboration with neighbours upazila	-Guideline to operate Vacutug machine by paurashova or upazila parishad	Take steps to popular Vacutug machine

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make plastic waste free drain, water body and road for all villages of the upazila	Follow model 1-2 where necessary	Disposal waste following model 1-2 at upazila or pourashova level	operators	Preserve plastic waste where necessary/collect/ and supply chain related guideline	Set three chamber or Secondary Transfer Station/STS to manage inorganize or hazardous waste
Medical waste free rural hospital, drain and water body of all villages of the upazila	-Use model-01, 2 where applicable to dispose media waste	-Set incinerator in the plant	Dispose by using incinerator	Medical waste preservation/ collect/ disposal guideline	Same
Clean hatbazar of the upazila	Hatbazar based waste management value chain	To manage waste of the hatbazar by setting slaughter house, biogas plant and compost plant etc.	Operators/Hatbazar Management Committee	Regular monitoring the activity of hatbazar	Declare upazila based clean hatbazar and awarded the best hatbazar committee
Make faecal sludge free villages of the union parishad	-Stop defecation in the open space -Toilet water will not go to the water body -Set soak well in the sanitary latrine -Use Vacutug machine in appropriate aspects following the strategy	- Set septic tank for affluent of the UP -Twin pit latrine for all -Vacutug machine	-Raise awareness -Arrange twin pit latrine for UP/Government funded projects -Build partnership management with neighbor upazila	- UP Act 2009 on Faecal Sludge management -Grants for ultra-poor to set twin pit latrine -Partnership with others -Guideline to operate Vacutug at paurashavao/upazila level	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress -Take steps to popular Vacutug machine

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Plastic waste free drain, road and water body of all villages of the union parishad	-Use model-01, 2 where applicable	-For model-01, collect waste fortnight/monthly using UP rickshaw or van -For model-02 collect waste on regular basis	-Supply chain for model-01 to manage solid waste -For mmodel-02, waste disposal through supply chain or plant	Preserve plastic waste/collection/supply chain related guideline	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress
Medical waste free rural drain, road and water body of all villages of the union parishad	-Use model-01, 2 where applicable	-For model-01, collect waste fortnight/monthly using UP rickshaw or van -For model-02 collect waste on regular basis	-For model-01 at hatbar/paurashava disposal the waste to incinerator -For model-02 hatbazar or model-3 at upazila or paurashava level waste will be disposal to the plant	Medical waste preservation/ collect/ disposal guideline	-Set three chambers waste bin while collect inorganic or hazardous

Business Model for Rural Waste Management

It has been observed that, business model can be feasible in most places at Community level, Hat-bazar / Union level and Upazila level. But the business needs to be operated by ‘good operator’. It will take at least 18 months’ time for the operator to make the business model profitable. The initial 18 months is to be run by project fund or other revenue fund.

The most critical rural waste situation is being observed in rural markets. A huge number of chickens is being slaughtered every day or during hat day depending on location of rural market. Only a limited number of markets has the slaughter house for cows, goats. The waste of slaughtering and others are continuously degrading the rural environment. In addition to that, polythene and plastic waste are being dumped in the nearby waterbodies or dumping site near the market.

Most of the major waste producing rural market is being leased out yearly. There is a provision to utilize 15% of the lease money for ‘cleaning and waste management’ of the rural market. It has been observed that, the rural markets can be sustainable as a business model if the 15% of the lease money is given to the operator involved in waste management.

The business model may not be sustainable at some community, Hat-bazar and Upazila level. Yet, the initiative of the rural waste management is very important. The polythene and other nonvaluable plastic waste have seen to occupy the water bodies and public lands of the villages. The proper utilization of the revenue from the markets (15% of the total leased value) can make a big difference at the areas where the waste management cannot be made sustainable.

It is recommended that the WATSAN committee at Upazila level will take the lead in overall waste management. They will oversee the activities of the operator and certify their payments.

Use of Non-valuable Plastic as pavement materials and with bitumen

The valuable plastic waste of the country has got a big market extended up to a good number of villages. Yet, the danger is non-valuable plastic. Every day, 500 tons nonvaluable plastic is being deposited in the country. The small rural villages at haor or char or coastal are not out of danger from it. A Char of Meghna River, the Memania Union of Hizla Upazila, Barishal has been seen to be water-logged during rainy season as its water bodies running throughout the villages has been seen to partially filled by plastic waste.

Some green entrepreneurs are now making road pavement materials and other show-pieces from the non-valuable plastic. The small plants can be set up at Upazila level waste management plants. The Upazila can utilize the road pavement materials to promote waste management initiative and free the Upazila from non-valuable plastic waste.

In addition to that, LGED conducted a study to utilize the plastic waste with the bitumen for road construction. With this initiative, the road will get more life at lower cost. The government can take more initiatives to scale up the use of non-valuable plastic in road construction.

A great Opportunity of Improvement of Soil Health, Agriculture Productivity of the Nation

In the stakeholder workshop, The Department of Agriculture Extension (DAE) has expressed their deep concern for the deterioration of the soil health because of overuse of chemical fertilizer and pesticides. The soil of the country is now being used 2-3 times a year for multiple cropping in most of the villages of the country. They use chemical fertilizer and pesticides. The prolonged use of chemical fertilizer for 2-3 a year may turn the soil unproductive. The DAE is already concerned for the future.

The study team along with DAE sees a great opportunity from the challenge. If the villages produce community-based compost fertilizer locally- it will be cost effective, environmentally safe for the aquatic ecosystem and will provide the best solution to restore the soil health. If it can upscaled in most of the villages, the country can also export bio-fertilizer after managing its own need. The DAE will work with LGED/ DPHE to develop market of the fertilizer at every Upazila.

Capacity Enhancement of Upazila Parishad, Union Parishad, Municipalities, Rural Market Management Committee, WATSAN Committee

Rural Waste Management is a prioritized plan of the government. Yet, the government agencies and the LGIs do not have adequate policy/ institutional/staff support to undertake this responsibility. The Union Parishad has been assigned for solid waste management by Union Parishad Ordinance-2009. But they do not have any staff to plan and work for it. The study recommends provision of a SAE at every union to work for solid waste management and other issue.

In the Upazila Parishad Ordinance-2009, there are no directives for involvement of Upazila Parishad for waste management. The study recommends ‘Integrated Waste Management Plant (Solid Waste and Fecal Waste)’ under Municipality or Upazila Parishad. It is to be mentioned that, it is not viable to run the plant at Union level considering waste production and operational cost. It should involve one or more municipalities, Upazila Town, a number of rural markets etc. At least, it may be viable to take one total Upazila town/ municipalities, markets under the Upazila and the villages (with good communication) to run a plant sustainably. Therefore, Upazila Parishad should also have reasonable staff to run the waste management plant. The Upazila Parishad Ordinance should also have necessary amendment.

The rural markets are the hubs of waste at Upazila, Union level. The market management committee is not adequately concerned about the waste generated in the market. Therefore, there should be clear policy directive and motivational work to overcome the situation.

The WATSAN committee has been assigned to take the lead at Village level, Union level and Upazila level. In most places, the WATSAN committee has not started functioning. There should be a major thrust of the Local Government Division to make the WATSAN committee active and play their appropriate role.

Rural Waste Management: Huge Employment Opportunity, Clean Environment and a stepping stone toward a developed nation

Rural waste management at household, community, village, market, and Union and Upazila level can create huge employment opportunity at rural level. Waste collection, delivery,

operation of different types of plant at community, village, market, Union/ Upazila level will create a huge employment opportunity. It will help the rural economy to grow at the desired economic growth.

Clean Environment is an important agenda for quality of lives at rural or urban areas. Rural waste management will lead the nation to clean environment and will be treated as a stepping stone toward a developed nation.

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Abbreviations

BNBC – Bangladesh National Building Code
BRDB – Bangladesh Rural Development Board
BWDB – Bangladesh Water Development Board
CAPEX – Capital Expenditure
CBO – Community Based Organization
CHGs – Community Help Groups
DAE – Department of Agriculture Extension
DPHE – Department of Public Health Engineering
ECA – Environmental Condition Assessment
ECP – Environmental Code of Practice
EIA – Environmental Impact Assessment
EMP – Environment Management Plan
FGD – Focus Group Discussion
FS – Faecal Sludge
FSM – Faecal Sludge Management
FSTP – Faecal Sludge Treatment Plant
GED – General Economic Division
GIS – Geographical Information System
GoB – Government of Bangladesh
IRF – Institutional Regulatory Framework
IT – Information Technology
KII - Key Informant Interview
LGED - Local Government Engineering Department
LGD - Local Government Division
LGI – Local Government Institutions
MRF – Material Recovery Facility
MVMT - My Village My Town
NGO – Non-Government Organization
NHA – National Housing Authority
O & M – Operation and Maintenance

OPEX – Operating Expenditure
PAPU – Public Awareness Planning Unit
PCG – Public Consultation Group
PMO – Project Management Office
SDGs – Sustainable Development Goals
SW – Solid Waste
SWM- Solid Waste Management
SWOT – Strength Weakness Opportunity Threat
TA – Technical Assistance
ToR – Terms of Reference
UE – Upazila Engineer
UNO – Upazila Nirbahi Officer
UP – Union Parishad
UZP – Upazila Parishad
WATSAN- Water and Sanitation

1. Introduction

Bangladesh has been facing many challenges (like environment pollution, public health hazards, animal health hazards, increasing landfill areas etc.) relating to unsafe and non-environment friendly waste management especially solid waste (SW) and faecal sludge (FS) in both rural and urban areas. There is already high pressure on the available land for SW and FS disposal along with surface and ground water contamination. In order to meet the challenges of rural areas considering present SW and FS management, are posed by anticipated waste management plan along with operation and maintenance guidelines. It is necessary to implement sustainable waste management projects ensuring the proactive role of beneficiaries and relevant stakeholders to safely managed the generated rural wastes (like SW and FS) following the 3R approach, Solid waste management rules 2021, and the Institutional Regulatory Framework of FSM for rural areas/ paurashavas.

As a part of sustainable and environment-friendly SW and FS management in rural areas, the government of Bangladesh has taken initiatives to conduct a feasibility study under a technical assistance project namely 'My Village My Town'. The feasibility study aims to find out the safe SW and FS management in rural areas. The government of Bangladesh has assisted through the Local Government Engineering Division (LGED) and Department of Public Health and Engineering (DPHE) to study team for conducting the feasibility study in a total of fifteen unions which eight unions of eight districts under eight divisions and rest seven selected from haor, hill, coast, barind, midland beels and two adjoining economic zones of the country.

The feasibility study has nine sections consisting of sub-sections also on selecting issues which are Introduction, Study Methodology, Case study analysis, Present status of Solid waste and Faecal sludge management, Legal aspect of solid waste and faecal sludge management, Safe as well as sustainable solid waste and faecal sludge management model, Economic and Financial analysis, Conclusion and overall recommendation, and the last of is Annexes. The report will play a vital role to take further initiatives for rural solid waste and faecal sludge management in targeted areas as well as relevant areas across the country.

1.1 Background

Bangladesh is one of the most populous and most densely populated country in the world. The rapid urbanization and population growth of the country are largely responsible for increasing solid waste generation. The country is produced around 23,688 tons of municipal solid waste per day which around 78% of waste is biodegradable and 22% non-biodegradable. The produced waste per year (8,646,120 tons) requires 157.20 hectares of landfill area. Increased waste generation and increased dependence on landfilling are having a significant impact on the greenhouse gas emissions of Bangladesh, contributing to climate change. Most of the waste management follows unimproved, non-environment friendly ways which pollute the environment and increase CO₂ emission to 86.38 Kg per capita per year, and cause severe harmful diseases of humans and animals in the country. Numerically, if all generated waste was collected and if out of this all organic waste were recycled into compost, Bangladesh could potentially create an additional 24,981 jobs, produce 911,816 tons of organic compost per year, reduce 2,279,541 tons of CO₂ per year, and reduce its landfill area requirement by 5,014,991 m³ (appx. 300 acres) every year (Waste Database, 2015).

Though poor waste management practices (like source segregation, door-to-door collection, transportation, recycling, and final disposal etc.) have been found in the urban areas by the concern city corporations and paurashavas, it is absent in rural areas of the country. It is observed that dwellers generate more waste than rural dwellers. According to relevant rules and regulations, the service providers of urban areas should collect the generated wastes (biodegradable, non-biodegradable, and hazardous) separately from residential, commercial, and industrial areas but the real scenario is reversed. Most of the valuable non-biodegradable waste has been sold by supporting people of urban dwellers to scrap dealers or vangaris in urban areas. In rural areas, people have also sold valuable non-biodegradable waste to waste pickers or vangaris. Most of the dwellers of Low-Income Communities (LICs) and rural areas have burned non-valuable waste like polythene, labels of bottles and food packets etc. instead of kerosene fuel.

The country has made better progress in increasing sanitation coverage over the past 10 years with almost 1.5% open defecation (MICS 2019). Though it has witnessed remarkable growth in on-site sanitation facilities, the issue of safe handling of sludge has emerged as an important and challenging issue of concern. The challenge is even more acute due to the factors like high population density, rapid and unplanned growth, and inadequate and often inaccessible containment emptying service provisions. There are two types of faecal sludge management facilities available in the country which one is on-site sanitation and decentralized sludge management facility. The decentralized sludge management facility like the sewerage system is only available for selected households in a few areas of the capital. The rest of the households have practiced on-site sanitation facilities. Most of cases, they have emptied the filled containment like septic tanks or pits by manual emptier, and few cases mechanical emptying. Most people have faced problems with onsite sanitation management-related issues like high emptying costs, scarcity of emptiers, scarcity of disposal land, the spread of odors, and even causes of environment pollution, water pollution, and public health hazard. The scenario has been found in both urban and rural areas.

A safe and environment-friendly FS management facility is an emerging need in both urban and rural areas. Few organizations in the country have been introduced to improve and environment-friendly faecal sludge management in selected towns which isn't sufficient for the rest areas. There is no doubt that if the safe disposal of sludge is not ensured, gains achieved by increased sanitation coverage cannot be realized.

Considering the negative effects of the existing waste management system in rural areas, the Government of Bangladesh has taken a technical assistance (TA) project namely "My Village My Town" ensuring the improve and environment-friendly waste management services in the selected unions along with extending urban amenities to each village for reducing the gap between village and urban town. The TA project has been executed by the Local Government Engineering Department (LGED) and Department of Public Health and Engineering (DPHE) fulfilling Bangabandhu's dream of golden Bengal ensuring the essential facilities to all villages. The objectives of the TA project are to

- develop 30 guidelines, 36 feasibility studies, and a Pilot Village Investment Project that will work as basic input for the implementation of the Election Manifesto commitment "My Village My Town: Extension of Modern Civic Amenities in every village"

- provide necessary input to mainstream and align the existing projects in line with the government's Election Manifesto commitment.

The feasibility study of Solid waste and Faecal sludge management in rural areas in Bangladesh is one out of 36 feasibility studies on selected issues.

1.2 Goal of the feasibility study

The goal of the feasibility study is to contribute to achieving relevant sustainable development goals, and country rules/regulations/policies through the design and implementation the safe, sustainable, and environment-friendly solid waste and faecal sludge management projects in rural areas of the country.

1.3 Objectives of the feasibility study

The objectives of the feasibility study are to

- a) Find out the best bet SW and FS management system as well as facilities reviewing relevant case studies within/ beyond the country;
- b) Assess the current situation of SW and FS management in rural areas along with its effect and opinion of target beneficiaries as well as stakeholders;
- c) Institutionalize the SW and FS management issues to fulfill the identified gaps by reviewing the country rules, regulations, policies, and laws;
- d) Assess the feasibility of SW and FS management systems based on institutional arrangements, technological aspects, Economic and financial analysis;

2. Study Methodology

The development of working methodology including implementation guidelines of feasibility study play always a vital role to achieve the targeted goal and objectives. The working methodology of this study consists of three parts study design and conducting process, study-related data collection along with presentation or visualization, and finally report preparation along with dissemination. The three sections have illustrated the methods of achieving the four selected studies' goals and objectives.

2.1 Study area selection

The study team selected study areas (eight unions in eight upazilas of eight divisions and rest seven selected areas of haor, hill, coast, barind, midland beels, and two adjoining economic zones) with the consultation of their district/ upazila/ union level concern offices and prior approval project authority. The list of the selected unions and pilot villages is given below.

Table 2.1: Name of target unions along with pilot village under the upazila, district, and division

SL No	Division	District	Upazila	Union	Pilot village
01	Dhaka	Narsingdi	Monohardi	Chalakchar	Hafizpur
02	Dhaka	Narayanganj	Bandar	Bandar	Kusiara
03	Dhaka	Gopalganj	Muksudpur	Jalirpar	Bilchanda
04	Dhaka	Gazipur	Gazipur Sadar	Bhawalgarh	Manipur
05	Dhaka	Dhaka	Keraniganj	Sakta	Ati bazar
06	Dhaka	Cumilla	Monoharganj	Bipulashar	Seikhchail
07	Chattogram	Chattogram	Mirsarai	Ichakhali	Charsarat
08	Chattogram	Cox's bazar	Cox's Bazar Sadar	Jhilonjwa	Jilanja
09	Sylhet	Sylhet	Gowainghat	Rustampur	Bagaiya
10	Sylhet	Sunamganj	Shantiganj	Simulbak	Shimulbak
11	Khulna	Satkhira	Shayamnagar	Burigoalini	Datiankhali
12	Khulna	Barishal	Hizla	Memania	Induria
13	Mymensigh	Netrokona	Barhatta	Sahata	Demura
14	Rangpur	Kurigram	Bhurungamari	Pathardubi	Patahrdubi
15	Rajshahi	Rajshahi	Bagmara	Sonadanga	Sonadanga

Map of The Study Area

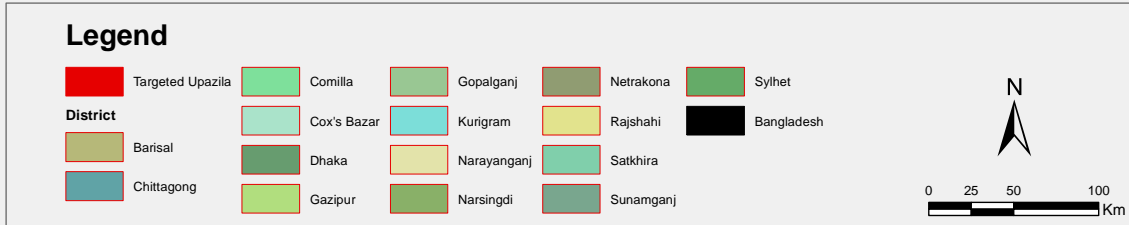


Figure 2.1 Map of the studied upazilas (sub-district)

2.2 Sample size determination and sampling technique

The sample size of household-level data collection is estimated following Cohen's formula for calculating the unknown population and Cochran's for the known population. The sample size for unknown and known populations by using the following formulas is given below.

The sample size for the unknown population

$$n_0 = \frac{2(Z_\alpha + Z_\beta)^2}{d^2}$$

$$n_0 = \frac{2(1.96 + 0.842)^2}{(0.043)^2}$$

$$n_0 = 84.92 \cong 85$$

The sample size for the known population

Where,

n_0 = Sample size for unknown population

n = Sample Size for known population

Z_α = 95% confidence level gives us Z values as 1.96

Z_β = 95% confidence level gives us Z values as 1.96

d = Precision rate or margin of error (4.3%)

P = Total Population

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{P}}$$

The sample size using the known population of the targeted unions is shown in table 2.2.

Table 2.2 The union-wise calculated sample size distribution

SI No	District	Upazila	Union	Total Population	Calculated Sample size	Sample surveyed
1	Narsingdi	Monohardi	Chalakhchar	19421	85	84
2	Narayanganj	Bandar	Bandar	28141	85	84
3	Gopalganj	Muksudpur	Jalirpar	20912	85	84
4	Gazipur	Gazipur Sadar	Bhawalgarh	13552	84	83
5	Dhaka	Keraniganj	Sakta	58075	85	85
6	Cumilla	Monoharganj	Bipulashar	24294	85	84
7	Chattogram	Mirsarai	Ichakhali	27865	85	84
8	Cox's bazar	Cox's Bazar Sadar	Jhilongjwa	30288	85	84
9	Sylhet	Gowainghat	Rustampur	40163	85	85
10	Sunamganj	Shantiganj	Shimulbak	29147	85	84
11	Satkhira	Shayamnagar	Burigoalini	24913	85	84
12	Barishal	Hizla	Memania	24735	85	84
13	Netrokona	Barhatta	Sahata	29073	85	84
14	Kurigram	Bhurungamari	Pathardubi	21369	85	84
15	Rajshahi	Bagmara	Sonadanga	7847	84	81
Total sample households					1269	1261

During household-level data collection, the study team followed a simple random sampling technique to identify 1269 respondents while reaching 1261 respondents due to the unavailability of 8 respondents (0.63%) in the targeted house.

The study has decided to collect the required data from the Upazila Nirbahi Officer, Upazila Chairman, Union parishad chairman, Sanitary Inspector, representative of Civil society organizations, and relevant service providers through Key Informant Interviews. It has also decided to collect the required data from relevant committees of SW and FS through Focus Group discussions. These respondents are selected following snowball and purposive sampling techniques.

Table 2.3: Union-wise calculated sample size distribution

No.	Tools	Respondents	Sample Size
1.	Key Informant Interviews (KII*)	Upazila Chairman	15
		Upazila Nirbahi Officer	15
		Union parishad chairman	15
		Sanitary Inspector	15
		Civil society organization	15
		SWM service providers	15
		FSM service providers	15
2.	Focus Group Discussions (FGD**)	SW management committees	15
		FS management committees	15
		Hat-Bazar Management Committee	45

* Sample size of KII may vary based on the availability of the Key Informant available in the surveyed upazilas;

** Sample size of FGD may vary based on the existence of the relevant committees.

2.3 Data collection tools preparation, field test, and finalization

The study team has developed a semi-structured questionnaire, KII checklist, and FGD checklist as required data collection tools. A semi-structured questionnaire is developed for collecting both quantitative and qualitative from selected households. KII and FGD checklists are developed for collecting mainly qualitative along with few quantitative data from the selected representative of Upazila parishad, Union parishad, shops/markets etc. The study team has tested the questionnaire and checklist in the field and modify as required before finalization.

2.4 Data collection, analysis, visualization, and interpretation

After the finalization of data collection tools, the study team developed an online data collection system for saving time and resources. In the meantime, they hired 2 (two) Supervisors and 6 (six) Data Collectors/ Enumerators for 4 (four) consecutive months for field surveys and data processing. The study team tested the online data collection system and improved based on testing requirements before going to the field. The study team organized a two-day long training for the hired supervisors and enumerators on data collection tools and techniques. During the training session, project officials participated and described the project and context of the study to data collection and also provided an explanation to the queries of the training participants pertaining to the project.

Multistage cluster sampling with PPS (probability-proportional-to-size) has been used to collect primary data in the project areas following face-to-face (F2F) interviews, Focus Group Discussion (FGD), Key Informant Interviews (KII) and observation (transact walk) as required. The data collection has covered all 15 sample villages. The checklist method will be applied for FGD, KII, Hat Bazar (Growth Center) Survey, Transect walk, and other

Geospatial Data collection. The draft data collection tools will be pre-test before finalization and then field-level data collection.

The collected data will be cleaned and assembled based on the assignment’s objectives. The collected data and information will be presented in tabular, graphical, and other required formats. Available statistical packages like Microsoft Excel, Microsoft Access, SPSS, and GIS software will be used for analysis and visualization.

2.5 Feasibility study report preparation and sharing

After the completion of data interpretation, analysis, and visualization, a draft report will be produced and will be shared through a validation workshop with the relevant organizations’ personnel for validating the collected data and information which will assist to report finalization. The study team will be incorporated inputs from relevant personnel/organizations and will be finalized as well as disseminated the four study outputs accordingly.

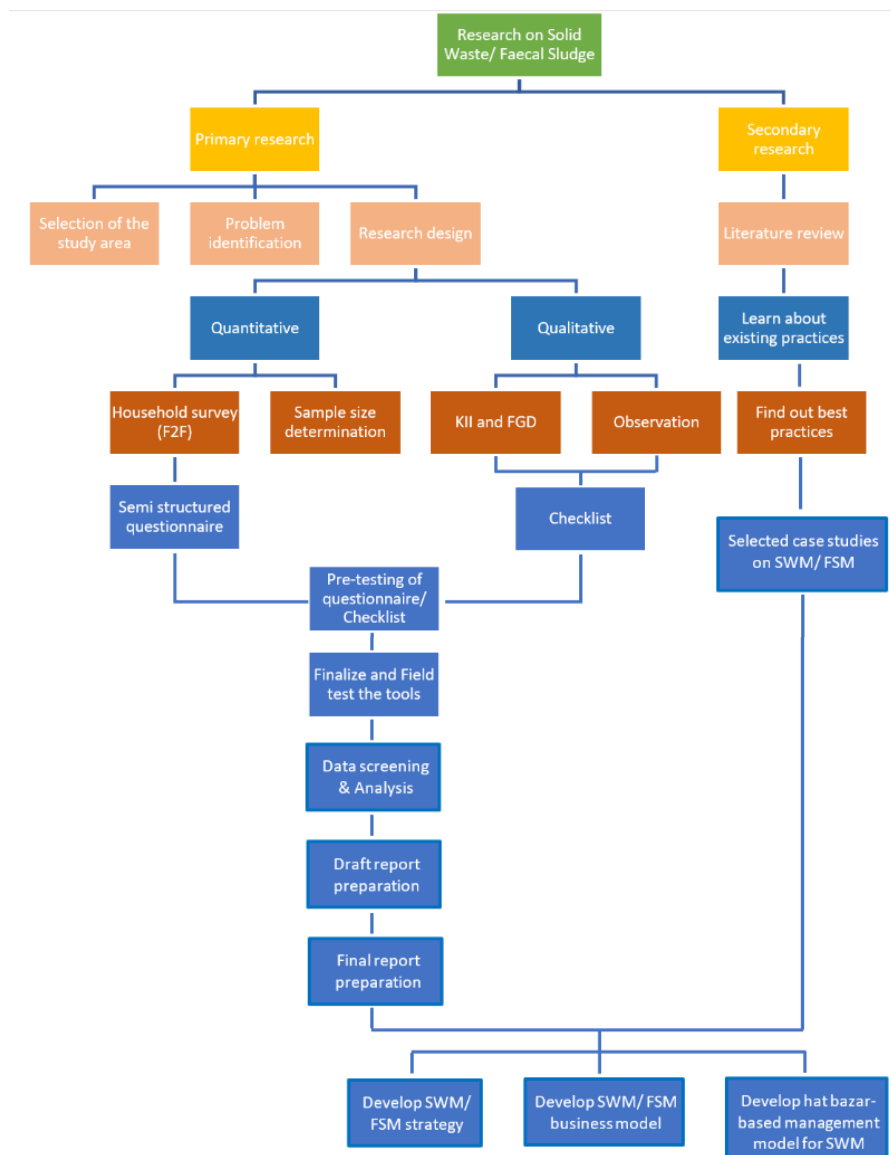


Figure 2.2: Flowchart of the Methodology

3. Case Study Analysis

The study team follows five steps to achieve study objectives. Firstly, the study team has collected case studies (see Annex 01 for SWM and Annex-02 for FSM) relating to available technological options for rural solid waste and faecal sludge management reviewing secondary resources and information. Then they matched these options in the rural context of the country and conduct SWOT analysis to find out as well as best bet options for the targeted areas. The data has been collected through various secondary sources and is also based on field observations. They will share analytical reports based on the case study analysis with the study team, LGED for further improvement and seek approval for finalization.



3.1 SW and FS management-related technology selection criteria

The study team selected the technological options for SW and FS management in terms of social, economic, environmental, and sustainability aspects. They thought the selected technologies should be socially acceptable, economically affordable, and environment friendly. The technologies should be suitable considering the operation and maintenance capacity of users, in both technical and financial inputs during the lifetime of the technologies. However, the following issues should be considered in selecting any technology:

- ✓ Health: Select those technologies' causes of least or zero health risks.
- ✓ Environment: Select or recommend those technologies which environment friendly and least chances of air, soil, water pollution, and so on.
- ✓ Economy: Selected technologies should be low-cost in CAPEX and OPEX.
- ✓ Socio-cultural aspects: Considerations of the appropriateness to the local cultural context, institutional viability.
- ✓ Technical function, operation, and maintenance: Strength/sustainable against inverse conditions, easy to operation and maintenance by the users.

3.2 Technological options for SW management

In rural areas, SW management is perhaps the most neglected aspect of environmental sanitation. It is comparatively much easier to maintain solid wastes in rural areas than in urban areas. Most household contains biodegradable wastes, with little quantity of non-biodegradable waste which is completely free from toxic wastes. Considering the mentioned issue, the following technologies are recommended by the study teams.

- a) Pit or Trench composting: Pit composting, also called trench composting, is less unsightly than a compost pile and less work than building a homemade compost bin. For this composting, dig a hole or trench using a shovel then add compost material to it. The storing waste pit might be open or closed tank.
- b) Pile or Heap composting: Pile composting is also called heap composting. It is a very simple, passive gardening technique. The storing place of a waste pile or heap might be in open or closed tank with/ without covered by relevant materials. It is also known as

the Bangalore method. For this composting, select a suitable area that would pile compostable materials into a heap. The size of the pile or heap depends on the generated waste. It takes 3-18 months to turn the Household or community wastes into fertilizer.

- c) Windrow composting: Windrow composting is a process of compost production by piling biodegradable waste, such as animal manure and crop residues, in long rows (windrows). It is suitable for producing a large volume of compost. It takes place for a period of 22 weeks in open narrow heaps. It requires the mechanical turning of each windrow by appropriate machinery to ensure an adequate supply of oxygen.
- d) Bin composting: Bin composting is a process of using an outdoor container in which biodegradable wastes are deposited to produce compost. The composting bin is produced by plastic, ceramic, stone, brick, wood, or wire fencing. It takes 3-4 months for compost production. Generally, the bins are static.
- e) Rotary drum composting: Rotary drum is an efficient and decentralized composting technique. It helps in proper mixing, and aeration and produces stable and matured compost. The rotary drum can easily be installed on the site of the organic waste generation. It requires 2-3 weeks to compost production using organic wastes. It is useful for a single household's organic waste to turn into compost.
- f) Vermi composting: Vermicomposting is an environment-friendly technique that accelerates the process of composting by the interaction with earthworms and microorganisms, whose joint action provides degradation and detoxification of biodegradable wastes as well as conversion into a product to be used for agronomic purposes. It requires 6 months to harvest the final compost.
- g) Sanitary landfills: Sanitary landfills are similar to landfills which work in a planned and methodical way. It is built using concrete, closed areas with facilities to collect the leachate and gases released. These also prevent pest breeding and pathogen spread.

3.3 Technological options for Faecal Sludge Management

In Bangladesh, as per MICS 2019, access to basic sanitation services is 64% in rural areas while limited access is 19%, unimproved sanitation is 19% and no service is 2%. There is no environment-friendly and improved faecal sludge management system in rural areas. As per the prevailing rural conditions of the TA project, 8 different options are suggested for safe wastewater (Grey water, Black water, combined wastewater & sewage) collection, treatment, and disposal/reuse as per the end user requirement. The study team proposes two different methods of FS management one is onsite sanitation and another FS collection and treatment. The onsite sanitation technologies are

- 1) Basic latrine or ring slab latrine
- 2) Sanitary latrine
- 3) Y Junction Twin pit latrine
- 4) Eco-toilet for water scarcity areas
- 5) Biolet for water scarcity areas

The FS collection and treatment technologies are

- 1) FSTP (Small or medium or large)
- 2) DEWATS

3.4 SWOT analysis of the identified SW and FS management-related technologies

The study team design and conducts a SWOT analysis to identify the relevant technologies from the mentioned (above) based on the findings for the targeted areas. The SWOT analysis divides into two parts one for SW management and another for FS management.

- ❖ SW management-related technologies
- ❖ FS management-related technologies

Table 3.1 and table 3.2 show the findings of the SWOT analysis to define the potential technologies for the target areas.

Table 3.1: SWOT analysis of SW management-related technologies

Technologies	Strength	Weakness	Opportunities	Threat
Pit NADEP composting (Case study SW01)	<ul style="list-style-type: none"> • No need to be turned • The easiest way to produce compost • Plants also get the nutrients as required without the hassle of aerating and sifting 	<ul style="list-style-type: none"> • Dig a hole or construct a pit and covered it with dirt every time • Cannot refill until decomposed of buried waste • Require more space and time • Take a long time to produce compost 	<ul style="list-style-type: none"> • No need to feed compost to the plants • Odors are free if burry correctly • Won't attract vermi • Suitable for both HH and community level 	<ul style="list-style-type: none"> • May contaminate soil and water • 100% composting may not occur • Rain and water level may create problem
Pile or heap composting (Case study SW02)	<ul style="list-style-type: none"> • No need to be turned • Produce high-quality compost 	<ul style="list-style-type: none"> • The temperature may rise more than 60^oc. • Slow production system 	<ul style="list-style-type: none"> • Low-cost composting • Reduce biodegradable wastes • Have business opportunity 	<ul style="list-style-type: none"> • Compost production up and down based on waste collection • Changing mindsets of compost producers/ users
Windrow composting (Case study SW03)	<ul style="list-style-type: none"> • Rapid drying with elevated temperatures • Drier product, resulting in easier product handling • Ability to handle high volumes of material • Good product stabilization • Low capital investment 	<ul style="list-style-type: none"> • Requires a lot of land for composting • Often produces odors • Requires large buffer zone • High operational costs • Piles should be turned to maintain aerobic conditions • Turning equipment may be 	<ul style="list-style-type: none"> • Production quality as per requirement • Easy to implement and operate 	<ul style="list-style-type: none"> • Vulnerable to climate changes • Odors released on turning of compost • Attracts scavengers • Compost can become anaerobic in rainy seasons

Technologies	Strength	Weakness	Opportunities	Threat
	<ul style="list-style-type: none"> • Handles a large volume of material 	<ul style="list-style-type: none"> required 		
Vermi composting (Case study SW04)	<ul style="list-style-type: none"> • Rich in all essential plant nutrients • Easy to apply, handle, and store and does not have a bad odor • Improves soil structure, texture, aeration, and water-holding capacity • Free from pathogens, toxic elements, weed seeds etc. • Minimizes the incidence of pests and diseases 	<ul style="list-style-type: none"> • Slow production system • Vertical expansion isn't possible • Commercial production requires many lands and infrastructure • Commercial production isn't cost-effective • Temperature level should keep at 20°C to 30°C • Organic certification is very costly • Cannot reduce the production time 	<ul style="list-style-type: none"> • Enhances the decomposition of organic matter in the soil • Contains valuable vitamins, enzymes, and hormones like auxins, gibberellins etc. • Possibility of commercial production • Profitable for both manufacturer and consumer 	<ul style="list-style-type: none"> • Poor environment of vermi causes death and hampers compost production
Sanitary landfills (Case study SW05)	<ul style="list-style-type: none"> • It is ecofriendly • Keep cities, towns, sub-towns, and rural areas keep clean • It prevents pollution of groundwater or other environmental problems 	<ul style="list-style-type: none"> • Sometimes it affects wildlife and human health nearby sanitary landfills • 	<ul style="list-style-type: none"> • It supports job and local business • Comparatively cheap • Keep hazardous wastes are segregated 	<ul style="list-style-type: none"> • One ton of biodegradable waste can produce about 400–500 cubic meters of landfill gas (CH₄ and CO₂) • Methane Lights up Easily
Bin composting (Case study SW06)	<ul style="list-style-type: none"> • The least labor is required during stone/ wooden/ brick bin made • No labour is required during composting • No loss of plant nutrients in compost 	<ul style="list-style-type: none"> • Expenditure on the transport of construction materials like stone/ brick/ wood is high • Mason cost for super structure made using stone/ brick/ wood is required 	<ul style="list-style-type: none"> • Very simple to construct • Easier to operate 	<ul style="list-style-type: none"> • Open bin composting system creates odor • Filling of bin/ tank is cumbersome during the rainy season

Technologies	Strength	Weakness	Opportunities	Threat
Rotary drum composting (Case study SW07)	<ul style="list-style-type: none"> • Require small land • Use in all seasons • Rapid composting of kitchen and other organic wastes 	<ul style="list-style-type: none"> • Manual rotation system requires • Manual rotation system is not suitable for community-based composting • Commercial production isn't suitable 	<ul style="list-style-type: none"> • Produce compost in 15-20 days • Free from odor and vector 	<ul style="list-style-type: none"> • Improper rotation hamper in compost production • If leachate, causes odor, soil, water, and environmental pollution

Table 3.2: SWOT analysis of FS management-related technologies

Technologies	Strength	Weakness	Opportunities	Threat
Basic latrine or ring slab latrine (Case study FS01)	<ul style="list-style-type: none"> • Easy to install considering socio-economic aspect • Easy to operation • Increase the percentage of user • Low water consumption 	<ul style="list-style-type: none"> • Flies entrance and exit into the containment • Unhygienic • Non-environment friendly • Poor access of physically challenged people 	<ul style="list-style-type: none"> • Low cost to installation • Installation materials available in the country 	<ul style="list-style-type: none"> • Very dangerous to human health • High risk to ground/surface water contaminated • Causes of soil pollution • Threats for high water table
Sanitary latrine (Case study FS02)	<ul style="list-style-type: none"> • Easy to install considering socio-economic aspect • Easy to operation • Increase the percentage of user • Containment and sitting slab are water sealed • Clean and odor free • Squat hole and the pit must be sealed • Preventing disease transmission 	<ul style="list-style-type: none"> • Skilled masons needed • Filled out the pit quickly and need to empty 	<ul style="list-style-type: none"> • Low cost to installation • Installation materials available in the country • Least possibility to pollute soil and environment • Discharge the treated wastewater in the ground or surface • Block flies and other insect vectors 	<ul style="list-style-type: none"> • No ventilation systems • Anaerobic decomposition causes of methane gas • Low risk of groundwater contamination
Y Junction Twin pit latrine (Case study FS03)	<ul style="list-style-type: none"> • Manage faecal waste locally unlike regular toilets • Convert human waste into manure 	<ul style="list-style-type: none"> • Cannot be used in high-water table areas • It may lead to groundwater 	<ul style="list-style-type: none"> • Double pits are used alternately • Excavation of humus is easier 	<ul style="list-style-type: none"> • Higher risk of groundwater contamination due to more leachate than with waterless

Technologies	Strength	Weakness	Opportunities	Threat
	<ul style="list-style-type: none"> • Recommends by World Health Organization (WHO) • Treat human waste naturally without polluting water, air, or the soil • Two pits are used alternatively • Ensure onsite faecal sludge management at the household level 	<p>contamination without water sealed pit</p> <ul style="list-style-type: none"> • It is very difficult to install in rocky areas • Sometimes forget to change the junction or gate valve • Clogging is frequent when bulky cleansing materials are used • Water-based technology 	<p>than faecal sludge</p> <ul style="list-style-type: none"> • Potential for use of stored faecal material as a soil conditioner • Flies and odors are significantly reduced • Can be built and repaired with locally available materials • Low (but variable) capital costs depending on materials; no or low operating costs if self-emptied • Small land area required 	<p>systems</p>
Eco-toilet (Case study FS04)	<ul style="list-style-type: none"> • Ecosan toilets can be built anywhere • Affordable to the mass public • Saves water and electricity • Minimizes the risk of introducing pathogens into water or soil • Increase soil quality and crop production 	<ul style="list-style-type: none"> • <i>Requires strong support for the principle</i> by the population and appropriate prior training • <i>Requires more frequent emptying</i> (but easier, every 6 to 8 months (faeces) and 30 days (urine)) than other types • <i>Ash, sawdust, or dirt needs to be added</i> after use 	<ul style="list-style-type: none"> • Produce organic fertilizer • Earn money selling the produced fertilizer • No need to flush • No need for sewage treatment 	<ul style="list-style-type: none"> • <i>Risk of rejection</i> for psychological reasons involving taboos or customs • <i>There is a risk of urine piping</i> being blocked by faeces • Breaks down the pathogen in the faces
Faecal Sludge Treatment Plant (Case study FS05)	<ul style="list-style-type: none"> • Waste treated aerobically in a controlled way • Proven technology in sewage treatment • Eco-friendly 	<ul style="list-style-type: none"> • Very large infrastructure cost • Heavy dependence on energy source • Large amount of sludge generated 	<ul style="list-style-type: none"> • Produce co-compost • Earn money selling compost and STP-related services like emptying containment and transportation 	<ul style="list-style-type: none"> • Poor maintenance hampers in proper treatment of sludge
DEWATS (Case study FS06)	<ul style="list-style-type: none"> • Treated wastewater locally • Easy to operate and maintenance 	<ul style="list-style-type: none"> • Requires greater awareness and participation of communities 	<ul style="list-style-type: none"> • Collect, treat, reuse or dispose at or near source of FS generation 	<ul style="list-style-type: none"> • Potential threat to ground water contamination

Technologies	Strength	Weakness	Opportunities	Threat
	<ul style="list-style-type: none"> • Cost-effective options for rural and hilly areas • Reduce infiltration and exfiltration • All sewage captured and treated • No pump stations, no outfalls, and no electricity requires 	<ul style="list-style-type: none"> • Finding challenges fragmented regulatory structure 	<ul style="list-style-type: none"> • Treat wastewater from individual buildings, clusters, small community • Discharge to ground or reuse of FS 	
Bio-Toilet (Case study FS07)	<ul style="list-style-type: none"> • 99% aerobic treatment • No dependence on energy • High effluent quality • 100% maintenance-free • Easy to install, and maintain 	<ul style="list-style-type: none"> • High logistics cost to bacteria transportation 	<ul style="list-style-type: none"> • Doesn't require much space • Does not require a septic tank or external sewage treatment infrastructure • Suitable for all conditions 	<ul style="list-style-type: none"> • Poorly or improperly maintained systems could lead to odors, insects, and health hazard
Soak pit (Case study FS08)	<ul style="list-style-type: none"> • Build with locally available materials • Easy to repair • Very simple technology to construct, operate and maintain for all kinds of users • Requires quite a small land area compared to other technology such as say a leech field • Power conservative technology and is sustainable 	<ul style="list-style-type: none"> • Necessary to prevent the high risk of clogging • May negatively affect groundwater and soil properties • Not a suitable technology for countries/areas with colder climates • Not very effective and efficient technology where the daily volume of discharged effluents is high 	<ul style="list-style-type: none"> • Suitable for areas where the soil is porous and allows the percolation of water • Helps to recharge the groundwater table below • Very minimal initial cost and operation cost • Suitable technology for rural or suburban areas without a proper drainage system 	<ul style="list-style-type: none"> • If the groundwater table is at least 2 m below the soak pit, then it is suitable • It is not an appropriate technology for the highly congested area • In case it is too near the groundwater table or effluent is highly toxic •
Septic tank (Case study FS08)	<ul style="list-style-type: none"> • Primary treatment of wastewater from individual houses • It is suitable even for high-water table areas • Septage/Sludge collection and treatment facility is available nearby sources 	<ul style="list-style-type: none"> • Lack of any such policy septage is disposed of in open spaces, lowland areas, or drains causing health and environmental pollution • Lower treatment efficiency (30-60 % BOD and SS Removal) and associated cost 	<ul style="list-style-type: none"> • Doesn't require a connection to sewage treatment plant 	<ul style="list-style-type: none"> • Hydraulic shock loads, as peak flow disturbs the settling zone and causes highly suspended solids in the effluent

Technologies	Strength	Weakness	Opportunities	Threat
		and space requirements for the construction of soakage pit is comparatively higher • Huge sludge removal cost		

3.5 CAPEX and OPEX of the relevant technologies of SW and FS management

The study team collected the CAPEX and OPEX of SW and FS management-related technologies within/beyond the country. The following table reveals the required materials and their cost for installation, operation, and maintenance.

Table 3.3: Required materials and their CAPEX and OPEX for the mentioned SW management technologies

Mentioned technologies	Required materials	CAPEX (BDT)	OPEX (BDT)
Pile composting	Bulkier organic materials, kitchen wastes, green clippings, beneficial microbes, water, human resources (HR), spade etc.	Depends on capacity	
Trench composting	Kitchen waste, green clippings, trench (as required), spade, HR, microbes, worms, insects etc.	Depends on capacity	
Rotary drum composting	Uncooked vegetable waste, cow dung, tree leaves, sawdust, drum (as required), angles are welded longitudinally inside the drum etc.	Depends on capacity	
Windrow composting	Animal manure, crop residues, kitchen waste, green clippings, HR, bulkier organic materials, windrows, compost turners etc.	Depends on capacity	
Vermi composting	Bin, earth worm, kitchen waste, green clippings, animal manure etc.	Depends on capacity	

Table 3.4: Required materials and their CAPEX and OPEX for the mentioned FS management technologies

<i>Mentioned technologies</i>	<i>Required materials</i>	<i>CAPEX (BDT)</i>	<i>OPEX/Year (BDT)</i>
Basic latrine or ring slab latrine	Ring, sanitary pan without water seal, pit volume (as required), HR, superstructure (s required) etc.	3,000-5,000	100-500
Sanitary latrine	Ring, sanitary pan with water seal, pit volume (as required), wall and base sealed, HR, super structure etc.	7,000-1,00,000	500-1,500
Y Junction Twin pit latrine	Ring, sanitary pan with water seal, pit volume (as required), pit wall and base sealed, gate valve, HR, super structure etc.	20,000-1,00,000	1,000-4,000
Eco-toilet	Brick, cement, sand and reinforcement made two chambers, vault size (as required), mason/ HR, super structure etc.	25,000-1,50,000	3,000-5,000
Sewage Treatment	Brick/stone, cement, sand and		

<i>Mentioned technologies</i>	<i>Required materials</i>	<i>CAPEX (BDT)</i>	<i>OPEX/Year (BDT)</i>
Plant	reinforcement made chamber (as required), vault size (as required), mason/ HR, etc.		
DEWATS	Brick/stone, cement, sand, and reinforcement made chamber (as required), vault size (as required), mason/ HR, etc.	4,000-8,000 per m ²	5,000-15,000
Biolet	Biolet tank, bacteria, superstructure, mason/ HR, etc.	50,000-2,00,000	1,000-5,000
Soak pit	Brick/stone, cement, sand, and reinforcement made pit (as required), filtering materials, pit size (as required), mason/ HR, etc.	10,000-1,50,000	3,000-5,000
Septic tank	Brick, cement, sand, and reinforcement made tank (according to BNBC), PVC pipe, elbow, mason/ HR, super structure etc.	50,000-2,00,000	3,000-10,000

3.6 Feasibility analysis of SW and FS management technologies

The study team finds out the suitable or best bet SW and FS management technologies based on the geographical location and stakeholders' requirements of the target areas under the MVMT TA project. The following table shows areas specific SW and FS management technologies.

Table 3.5: Feasibility analysis of the mentioned SW and FS management technologies

Areas	Where	SWM technology	FSM technology
Haor/ bill	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Eco Toilet, Sanitary latrine with Septic tank, and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP
Hill tracts	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Y Junction Twin pit latrine, Eco Toilet, Sanitary latrine with Septic tank and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP

Areas	Where	SWM technology	FSM technology
Coastal	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Y Junction Twin pit latrine, Eco Toilet, Sanitary latrine with Septic tank and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP
Barind tracts	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Y Junction Twin pit latrine, Eco Toilet, Sanitary latrine with Septic tank, and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP
Plain land	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Y Junction Twin pit latrine, Eco Toilet, Sanitary latrine with Septic tank, and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP
Economic zones	Household	Pit composting, vermi composting, barrel composting, rotary drum composting	Y Junction Twin pit latrine, Eco Toilet, Sanitary latrine with Septic tank, and soak pit
	Community	Pile composting, windrow composting, vermi composting	Eco Toilet, DEWATS, Small or medium scale FSTP

4. Present status of waste management

4.1 Basic information

4.1.1 Socio-Economic Status of surveyed households

Basic socio-economic data were collected regarding all the household members of the survey household. Occupations of the surveyed household members varied as shown in Fig 4.1. The majority of the household members of the surveyed families were in agriculture (32%) followed by medium business (15%), small business (13%), private job (11%), daily labor (10%), large business (2%), government job (2%), informal sector (less than 1%), students (3%), housewives (28%) and the rest were different other occupational groups.

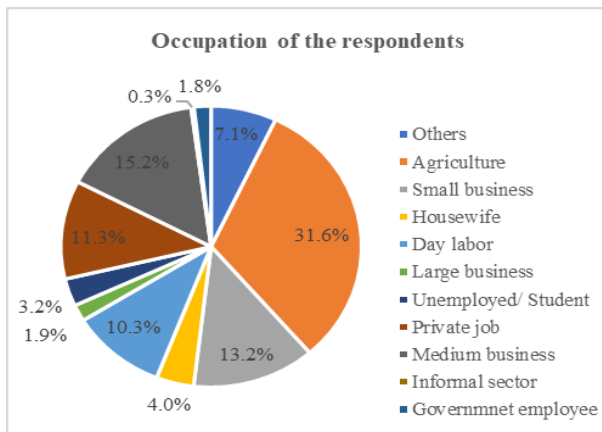


Figure 4.1: Occupation of the respondents

The household survey data on the educational attainment of the respondents reveals that 20% of respondents had read upto class five, 13% class six-ten, 13% SSC/ equivalent, 9% JSC, 6% HSC/equivalent, 4% Bachelor or equivalent, 2% master degree/equivalent, 18% literate, and 3% others. However, it is to be noted that 12% of the respondents were illiterate. The average family size of the household has been found at 5.56.

The incomes of the respondents and households under different income groups are below BDT 10000 (25%), 10001-20000 (34%), 20001-30000 (22%), 30001-40000 (11%), 40001-50000 (4%), 50001-60000 (2%), 60001-70000 (1%) and above 70000 (1%).

4.2 Rural solid waste management facilities, its effects and way forward

The solid waste generation is about 0.328 Kg per capita per day, a total of 4076.11 tons per month and 48913.32 tons per year which 94% of waste are biodegradable and the rest of the non-biodegradable waste (6%). The biodegradable wastes are food waste, fruit waste, fish/meat waste, fabric, and paper.

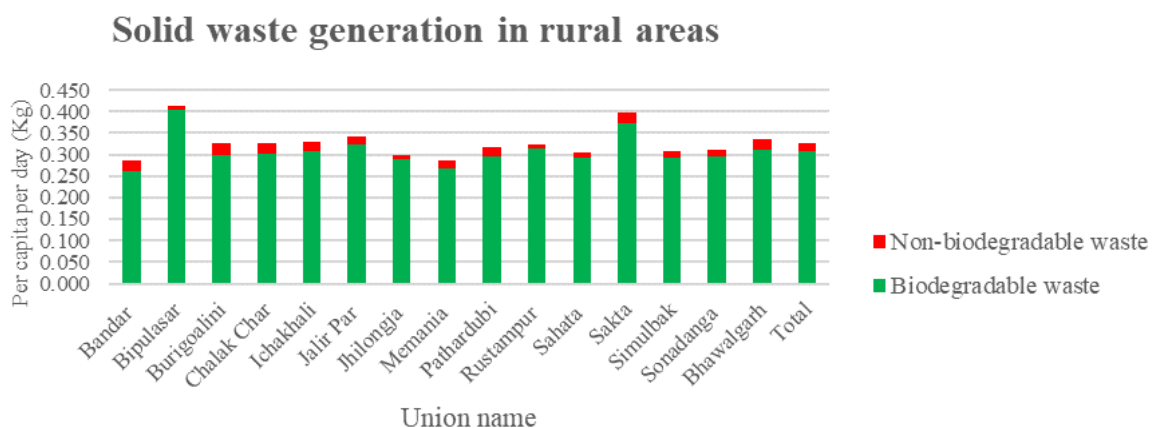


Figure 4.2: Solid waste generation in rural areas

On the other hand, e-waste, metals, plastic, polyethylene, footwear, glass, and medical waste are non-biodegradable waste. The beside figure indicates waste composition and the below figure is solid waste generation status in rural areas.

It is observed that the total daily urban waste generation average is estimated to be 23,687.78 tons per day, or 0.56 kg per capita per day in urban areas of Bangladesh (Waste Concern, 2014). On the other hand, the waste generated per capita and per house is 0.207 kg per day and 0.758 per day in rural areas of India (D'Silva, T.C. Priyadarsini, K. Sil, A. 2018).

The targeted union dwellers dispose of their generated biodegradable waste in the trench, open places, beside roads, dustbins etc. (for detail see figure 3). The dwellers dispose of the generated non-biodegradable waste at the same place as biodegradable waste except the valuable or saleable waste and polythene (for detail see figure 4). They burn the polyethylene and sell the valuable non-biodegradable waste to waste pickers and vanganis.

Figure 4.3 and figure 4.4 present the disposal of biodegradable and non-biodegradable waste.

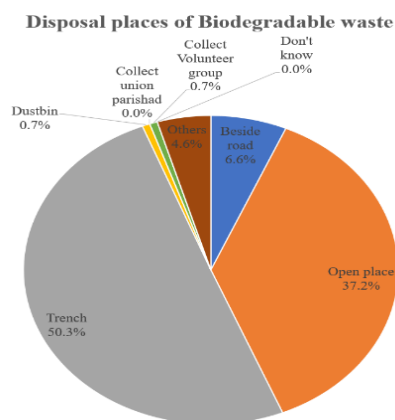


Figure 1.3: Disposal place of biodegradable waste

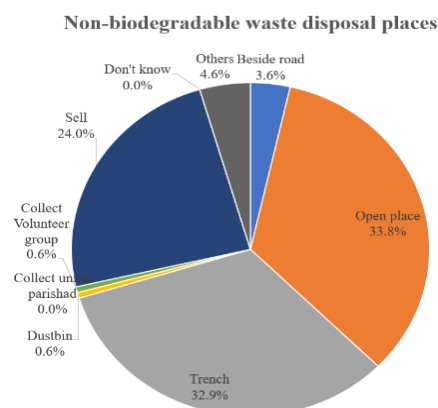


Figure 4.4: Non-biodegradable waste disposal place

There is only 0.79% of people out of a total of 4,14,545 have access to waste management facilities which are provided by a volunteer group in the adjacent area of Manipur bazar under Gazipur district. The volunteer group is collected the generated waste using a van and takes BDT 50-100 service fee per month.

In rural areas, 31% of people have stored separately their generated biodegradable wastes and non-biodegradable wastes. However, the people dispose of their waste beside roads, open places, trenches, and dustbin, and collected by the volunteer groups. The volunteer group disposes of the collected waste at a fixed place near the bazar. The waste disposal practice in Manipur bazar is not only improper, unsafe safe, and non-environment friendly but also similar in the rest of the surveyed areas which are caused for water pollution, environment pollution, and public health hazards.

Figure 6 and figure 7 indicate union-wise disposal practices of biodegradable waste and non-biodegradable waste. Most union dwellers dispose of their biodegradable wastes in open places and trenches (see figure 6). A certain portion of non-biodegradable waste sell to waste pickers or vangaris and the rest of the waste dispose of in the trench and open places.

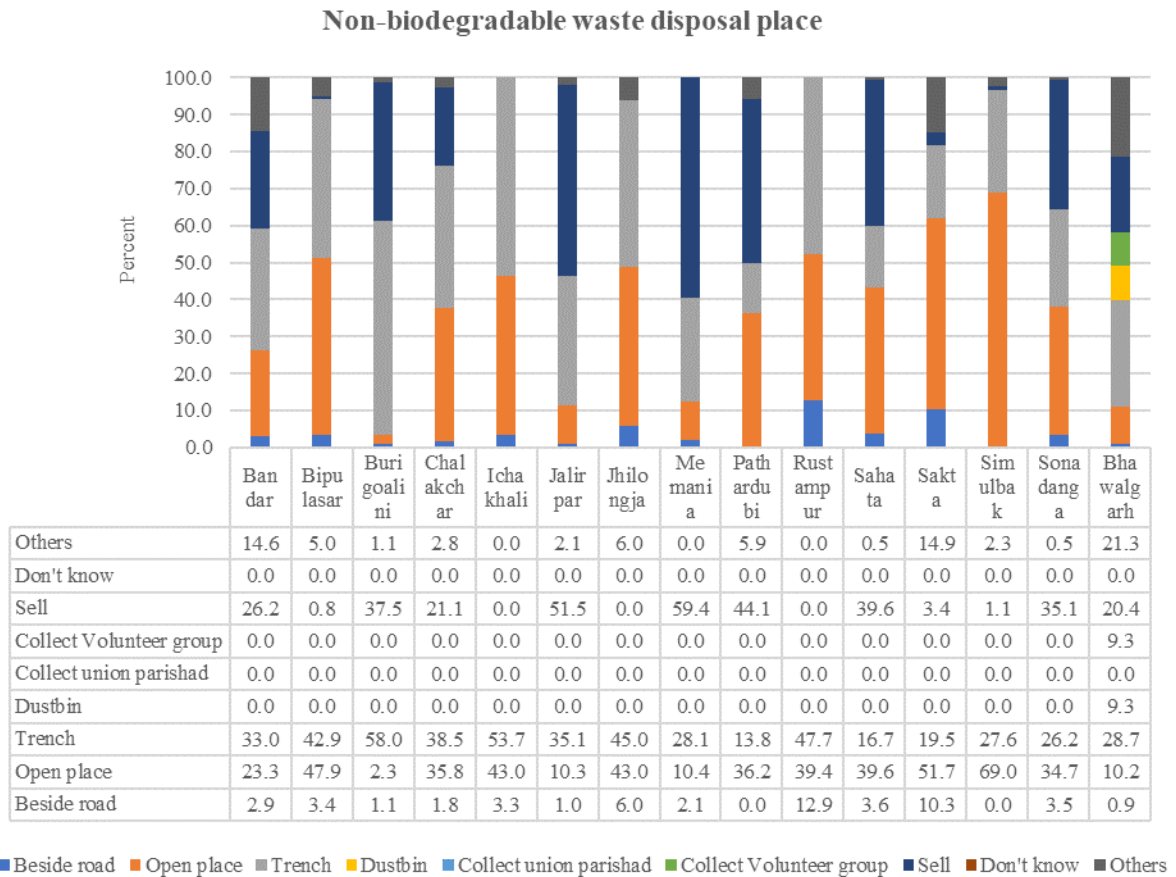


Figure 4.5: non-biodegradable waste disposal place

Effects of poor waste management- Around 79% of people of in the union assume environmental pollution is causes by poor rural solid waste management practices while 64% air pollution, 63% water pollution, 70% soil pollution, and 54% negative effects on public health. Figure 7 represents the multiple perceptions of union dwellers on poor solid waste management in rural areas.

Effects of poor, unsafe and non-environment friendly solid waste management

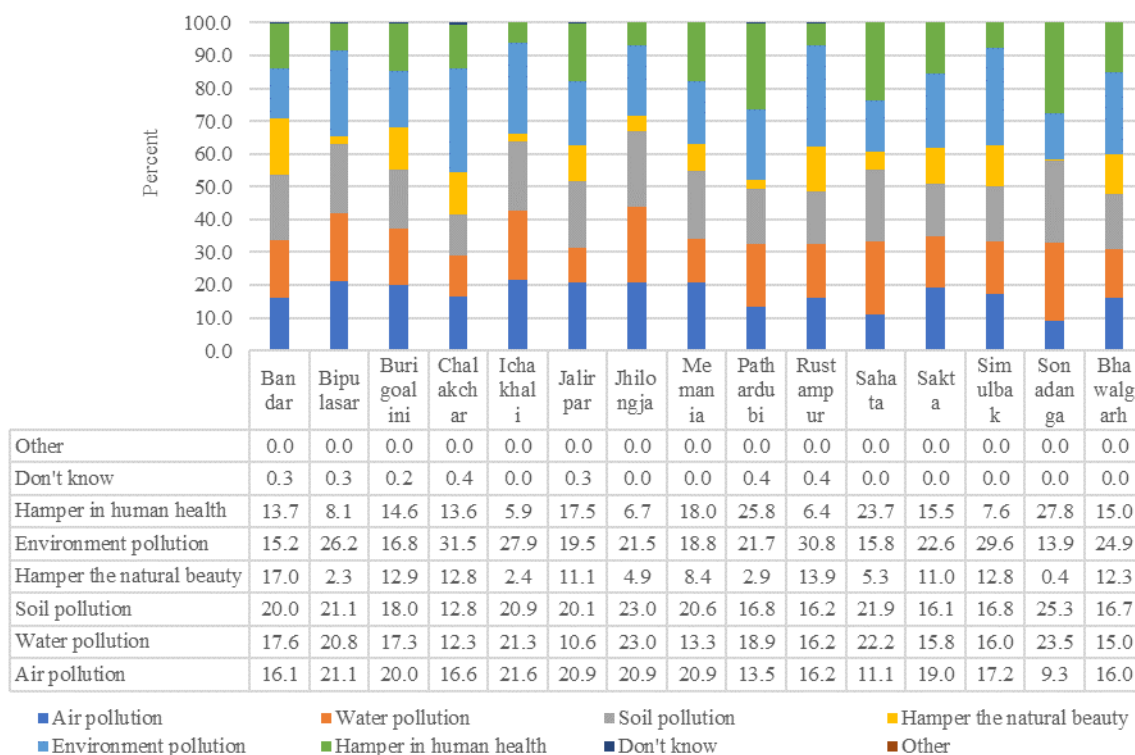


Figure 4.6: Effects of poor solid waste management practices in rural areas

Way forward- Considering existing poor solid waste management, unavailable proper waste management services and its negative effects, around 88% of people feel the necessity of safe and environment-friendly waste management facilities in their concern unions.

- For safe solid waste management facilities, 83% of people prefer union parishad as a waste management-related service provider while 12% develop organizations, 9% private organizations, and 6% cooperative associations.
- 83% of people have an interest to pay an average of BDT 27-106 or BDT 56 per month as a service fee or which will fix by the union parishad or service provider.
- To sustain safe waste management-related services, 74% of people share their opinion to aware the people while 10% use print and electronic media, 44% collect the waste using the vehicle, 74% provide dustbins for storing, 47% transport the collected waste, 3% recommend to reuse/recycle and 5% recommend to law enforcement.

4.3 Rural Faecal sludge management facilities, its effects and way forward

Rural sanitation has made remarkable progress in advancing access to sanitation services and reducing open defecation practices to almost zero (1%) in 2022. It is now facing to improve practices and quality of sanitation services i.e., hand washing practices, safe containment, and safe disposal of human excreta to fully realize health and wellbeing outcomes for the poorest. It is observed that 55% of people have used single pit latrines while 8% twin pit latrines, 29% septic tanks, 6% have cubicles without containment, and more than 1% have no own toilet (see figure 9).

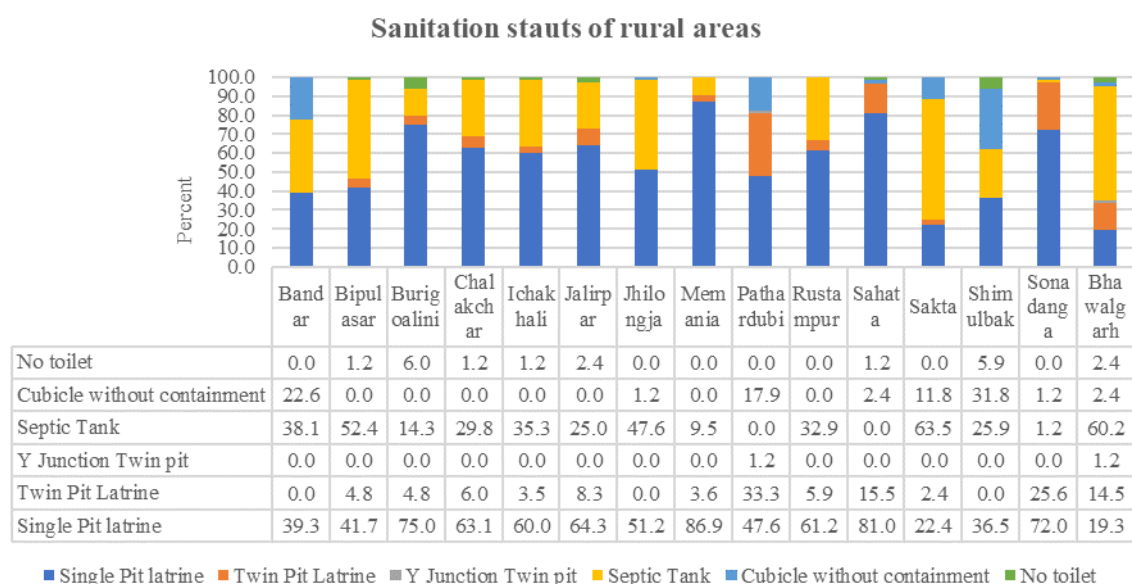


Figure 4.7: Type of toilet in rural areas

In the concern unions, 45% of toilets have water-sealed options among the containments while 45% of toilet's containment is sealed protecting against soil pollution and groundwater contamination. Only 16% of toilets have hand washing facilities and 14% flash water facilities (see below table).

Union	Water sealed (%)		Pit Sealed (%)		Air tight (%)		Flash water (%)		Hand washing (%)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Bandar	14.3	85.7	11.9	88.1	8.3	91.7	46.4	53.6	29.8	70.2
Chalakhchar	38.1	61.9	57.1	42.9	28.6	71.4	25.0	75.0	25.0	75.0
Ichakhali	58.3	41.7	59.5	40.5	1.2	98.8	1.2	98.8	21.4	78.6
Jalirpar	76.2	23.8	36.9	63.1	13.1	86.9	2.4	97.6	0.0	100.0
Memania	94.1	5.9	18.8	81.2	9.4	90.6	2.4	97.6	0.0	100.0
Pathardubi	19.0	81.0	73.8	26.2	9.5	90.5	1.2	98.8	0.0	100.0
Rustampur	45.2	54.8	85.7	14.3	0.0	100.0	0.0	100.0	0.0	100.0

Union	Water sealed (%)		Pit Sealed (%)		Air tight (%)		Flash water (%)		Hand washing (%)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Sahata	11.9	88.1	77.4	22.6	9.5	90.5	0.0	100.0	0.0	100.0
Sakta	27.4	72.6	21.4	78.6	0.0	100.0	39.3	60.7	67.9	32.1
Sonadanga	65.9	34.1	55.3	44.7	42.4	57.6	0.0	100.0	0.0	100.0
Bhawalgarh	13.1	86.9	21.4	78.6	4.8	95.2	39.3	60.7	25.0	75.0
Shimulbak	21.2	78.8	10.6	89.4	1.2	98.8	22.4	77.6	0.0	100.0
Burigoalini	68.2	31.8	38.8	61.2	8.2	91.8	0.0	100.0	1.2	98.8
Bipulasar	59.8	40.2	63.4	36.6	3.7	96.3	13.4	86.6	37.8	62.2
Jhilwanja	66.3	33.7	42.2	57.8	0.0	100.0	18.1	81.9	28.9	71.1
Total	45.3	54.7	44.9	55.1	9.4	90.6	14.0	86.0	15.7	84.3

The filling time of a single pit latrine is 15 months while a twin pit latrine requires 27 months, a Y junction twin pit latrine (24 months), and a Septic tank (58 months). The filled containments are emptied by manual emptier (81%), trash pump (6%), and self (13%).

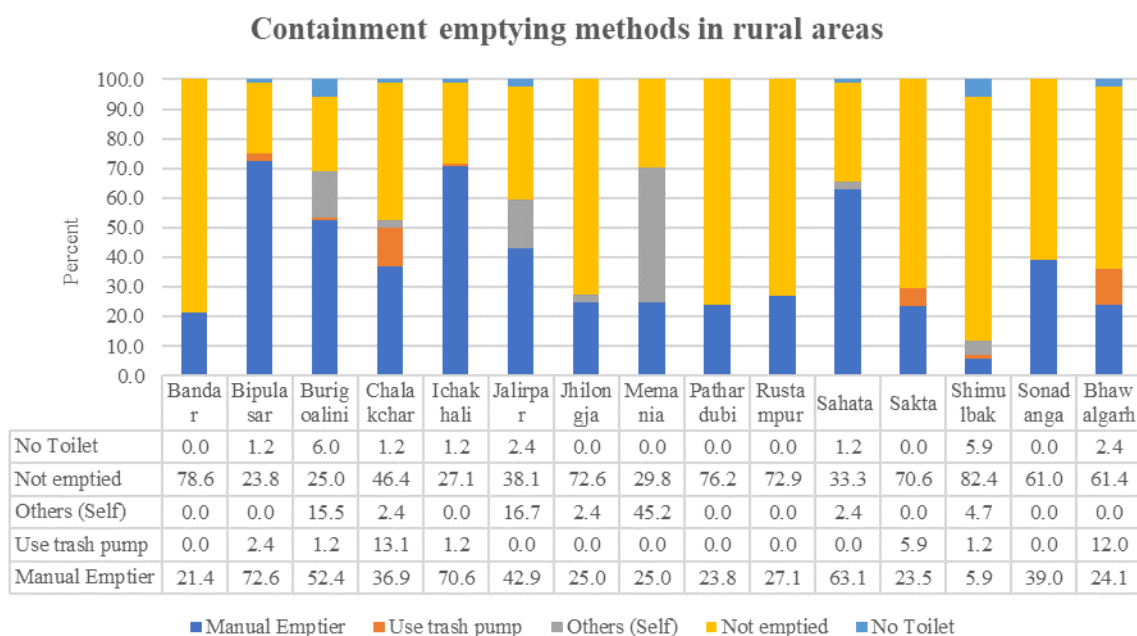


Figure 4.8: Containment emptying methods in rural areas

The emptied sludge disposes of in the trench (70%), adjacent pond/rivers (21%), open places (4%), low land (4%), and others (less than 1%). Figure shows the union-wise disposal practice of the emptied sludge.

Effects of poor faecal sludge management and emptying cost- The above information indicates that more than half of the containments are caused for spreading odor, soil pollution and ground water contamination along with waterborne diseases of human beings of the concern areas. The people who emptied the containment spent BDT 363 per cubic meter (m³) in the concern unions.

Way forward- Considering the unsafe, unplanned, and non-environment friendly faecal sludge management in rural areas, 86% of people feel the necessity of safe and environment-friendly faecal sludge management services. These people have an interest to pay the emptying fee which will fix by the service provider. 79% of people prefer union parishad as faecal sludge management-related service provider while 12% develop organizations, 9% private organizations and cooperative associations. They recommend to aware the community people, built improve toilets, improving the existing toilet, building Septic tanks, providing mechanical sludge collection and transportation, provide improve latrines, provide drainage facilities as well as introduce safe and environment-friendly services relating to treatment, reuse and finally dispose of the collected sludge.

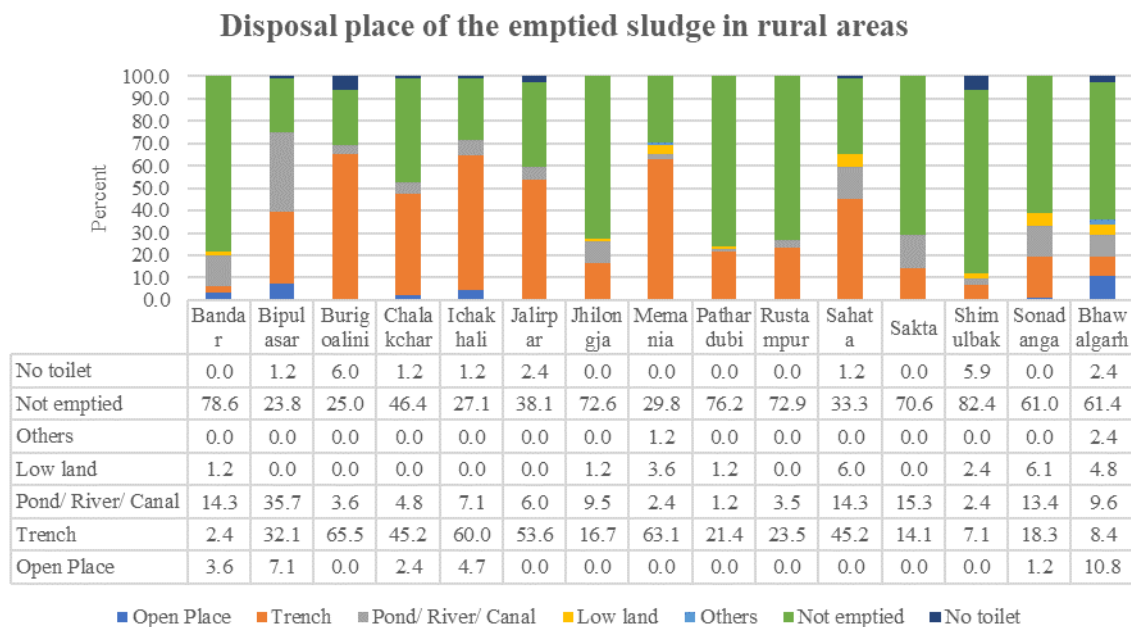


Figure 4.9: Disposal place of the emptied sludge in rural areas

4.4 Existing practices of Local government institutions and relevant committee

The adjacent Local government institution like Paurshava in the surveyed areas has been providing solid waste management services to the selected household through its conservancy section and equipment which aren't sufficient for the Paurashava dwellers in the surveyed areas. The organization collects, and transports using van/ dump truck and disposes of in fixed places like the roadside following conventional approaches. It isn't providing any recycling or treatment relating service as part of safe and environment-friendly biodegradable and non-biodegradable waste management. Even it doesn't provide faecal sludge management-related services.

The concerned union parishad has no separate staff relating to rural waste management even solid waste management-related services. The organizations have a WATSAN committee and most of the committees aren't properly active. These organizations know the existing waste management practices of dwellers which are unsafe and non-environment friendly along with causes of water pollution, environment pollution, and human health hazards. The organizations realize the necessity of separate sections like the conservancy section of paurashava/ city corporations. The organizations request to the government add a conservancy section in the organogram and recruit relevant personnel for a sustainable waste management system in the union.

Most of the union parishads could introduce village/union-based composting and biogas production from biodegradable waste, animal waste, and human sludge. The organizations could also introduce safe and environment-friendly non-biodegradable waste management like recycling or final disposal. But they aren't capable technically or financially to introduce an integrated waste management system and strengthen their capacity to provide quality services. If the waste management facilities' establishment costs, operations, and maintenance costs are high, they propose upazila-based solid waste and faecal sludge management facilities like a waste recycling center, faecal sludge treatment plant, sanitary landfill, and so on.

5. Legal Aspect of solid waste and faecal sludge management

The legal aspect of solid waste management describes the overall summary of the rules, laws, policies, and strategies with the implementing agencies involved in planning and implementation. It also gives a summarized view of the action plans taken against this legal aspect. Several action plans were developed and implemented based on these different rules, laws, policies, and strategies for improving solid waste management in Bangladesh (especially in urban areas). The action plans and their implementation gaps have been discussed elaborately in further sections, triangulating with the qualitative findings and extensive literature review.

5.1 Key actors for Solid waste and Faecal sludge management

As regards solid waste and faecal sludge management sub-sectors in Bangladesh, the Local Government Division (LGD) under the Ministry of Local Government Rural Development and Cooperatives (MoLRD&C) at the national level is responsible for the overall planning, identification of investment projects, monitoring and observance of rules governing local bodies i.e. city corporations, municipalities, union parishad and agencies under it (viz. Department of Public Health Engineering, Local Government Engineering Department and WASAs), private sector and NGOs/CBOs. However, each organization is responsible for its activities.

5.2 Relevant Government policies, ordinances, and strategies

Solid waste and faecal sludge management-related government policies, ordinances, and strategies are followed.

Table-5.1: Framework of relevant waste management policy directives

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
1. Constitution of Bangladesh (CoB) 1972	<p>The CoB in Article 18A focuses on the improvement of the environment and natural resources for future generations, a positive aspect of the fifteenth amendment (Article 18A).</p> <ul style="list-style-type: none"> <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh 	1. Protect and improve the environment by preserving and safeguarding the natural resources, bio-diversity, wetlands, forests, and wildlife for the present and future citizens
2. The Environmental Pollution Control Ordinance (1977)	<p>This ordinance includes the following action points:</p> <ol style="list-style-type: none"> Makes provision for the constitution of the Environment Pollution Control Board consisting of representatives of various public bodies. Allows the Board to formulate policies for the control, prevention, and abatement of pollution of the environment <ul style="list-style-type: none"> <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh – Department of Environment (DoE), Ministry of Environment and Forest (MoEF) 	<ol style="list-style-type: none"> The board director may allocate a person/organization to construct, modify, extend, or alter any disposal system including the waste disposal system Provision of information by the owner/occupier of a specific building/land relating to wastes, sewerage system, or treatment works of that building/land All persons/organizations must grant permission to enter, inspect and search their owned/occupied land or building and to inspect and test any wastes, air, water, and materials of the disposal system
3. Dhaka City	This ordinance was formed to consolidate	DCC actions include:

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
Corporation Ordinance, 1983	<p>and amend the law relating to the municipal administration of Dhaka City. The ordinance states regarding the MSW management that</p> <ol style="list-style-type: none"> 1. Dhaka City Corporation (DCC) is responsible for: <ol style="list-style-type: none"> a. Removal, collection, and disposal of wastes, b. Cleaning drainage, cleansing of streets 2. Building occupiers are responsible for removing refuse from residing buildings. <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, local government (DCC), NGOs and INGOs, and private companies 	<ol style="list-style-type: none"> 1. Providing public dustbins and receptacles within the city corporation area 2. Public notification of refuse accumulation by building occupiers in provided dustbins 3. Employing manpower for MSW collection and refusal of MSW 4. Making adequate arrangements for the refuse removal from all public streets, public latrines, urinals, drains, and all buildings and lands within the area. <p>Civil society actions include:</p> <ol style="list-style-type: none"> 1. Carrying/disposing of their waste in the waste receptacles installed by DCC either by themselves or by contacting an NGO/CBO/Private Company
4. National Environment Policy 1992	<p>This policy includes the following objectives to ensure environmental sustainability:</p> <ol style="list-style-type: none"> 1. Aim to provide protection and sustainable management of the environment; 2. Maintain the ecological balance and overall development through protection and improvement of the environment; 3. Identify and regulate polluting and environmentally degrading activities; 4. Ensure environmentally sound development; 5. Ensure sustainable and environmentally sound use of all-natural resources; and 6. Actively remain associated with all international environmental initiatives <ul style="list-style-type: none"> • <i>Implementing partners:</i> Ministry of Environment and Forest, A National Environment Committee chaired by the Head of Government 	<ol style="list-style-type: none"> 1. Establish a “waste permit/consent order” system in the industrial sector; 2. Encourage recycling 3. Take appropriate measures on an emergency basis to remove and properly dispose of garbage & waste of oil/oil products from ships at Chittagong and Mongla ports.
5. National Environmental Management Action Plan (NEMAP), 1995	<p>This action plan focuses on sanitation, solid waste management, water supply, and environmental awareness among the citizen to fulfill the following objectives:</p> <ol style="list-style-type: none"> 1. Strengthen local government institutional capacity for integrated planning of the policies 2. Create better housing facilities for the urban population including the poor and middle class 3. Properly manage the urban sewage and disposal of solid waste/ household waste <ul style="list-style-type: none"> • <i>Implementing partners:</i> Ministry of 	<ol style="list-style-type: none"> 1. Proper management of the urban sewerage and disposal of urban solid waste/household waste 2. Properly handle sewerage and garbage disposal issues and ensure better garbage disposal and sewerage facilities 3. Develop garbage disposal and sewerage treatment capability by recycling and economic use of wastes.

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	Environment and Forest (MoEF), Local Governments, and NGOs	
6. Environment Conservation Rule, 1997	<p>The Environment Conservation Rule focuses on the following:</p> <ol style="list-style-type: none"> 2. Specifies the inclusion of the following: i. Pollution Under Control Certificate, ii. Fees for Environmental Clearance Certificate and other services etc. <p>2. To declare any area as an Ecologically Critical Area these factors need to be considered by the Government: Human habitat, ancient monument, Archeological site, Forest sanctuary, National Park, Game reserve, Wild animals' habitat, Wetland, Mangrove, Forest area, Biodiversity of the relevant area.</p>	<ol style="list-style-type: none"> 1. Determine standards for Waste from Industrial Units. 2. Enforce determined standards in a more stringent manner if considered necessary in view of the environmental conditions of the particular situation. 3. Determine the standards of odors 4. Determine the Standards for Sewage Discharge 5. Categorize landfill activity with industrial, household, and commercial waste as a red category activity 6. To undertake any landfill project, consider environmental impact assessment and obtain no-objection certificates
7. National Policy for Water Supply and Sanitation, 1998	<p>This policy includes the following provisions for waste management:</p> <ol style="list-style-type: none"> 1. Special emphasis on the private sector and NGO participation in urban water supply and sanitation 2. Clearance for local government to transfer collection, removal, and management of solid waste to the private sector where feasible 3. Promotion of maximum waste recycling and use of organic waste materials for compost and biogas production in the private sector <p>Implementing partners: Government of the People's Republic of Bangladesh, Local Government and Rural Development, private sector, and NGOs</p>	<ol style="list-style-type: none"> 1. Feasible collection, removal, and management of solid waste involving the private sector. 2. Recycle the maximum amount of waste 3. Promote the use of organic waste materials for compost and biogas production.
8. National Agriculture Policy 1999	<p>The National Agricultural policy includes the following aims:</p> <ol style="list-style-type: none"> 1. Making the nation self-sufficient in food through increasing production of all crops including cereals 2. Ensuring a dependable food security system for all. 3. Develop processing facilities to reduce wastage of rapidly perishable crops, increase utility and maintain the quality of agricultural commodities <ul style="list-style-type: none"> • <i>Implementing partners:</i> Ministry of Agriculture 	<ol style="list-style-type: none"> 1. Develop processing facilities to reduce the wastage of rapidly perishable crops
9. Private Sector Infrastructure Guideline 2004	<p>These guidelines include waste management relevant infrastructural guidelines that</p> <ol style="list-style-type: none"> 1. Promotes the development of 	<ol style="list-style-type: none"> 1. Private sector firms to submit a solicited/unsolicited proposal to pursue a project

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>infrastructure projects through the private sector.</p> <p>2. States that infrastructure projects on environmental, industrial, and solid waste management may be implemented as private infrastructure projects</p> <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, private infrastructure committee (shall be established under the prime minister’s secretariat), project company (which gets tender) 	<p>2. The government to identify the codes and standards for the design, construction, operation, and maintenance of proposed infrastructure, following the proper sanitation and waste management systems</p>
<p>10. Dhaka Declaration on Waste Management by SAARC countries during 10–12, October 2004</p>	<p>The Dhaka Declaration on waste management addressed the following:</p> <ol style="list-style-type: none"> 1. Stop open dumping immediately 2. Replace the open dumping sites with new safe disposal options (controlled landfill sites). 3. encourage NGOs and private companies to establish <ol style="list-style-type: none"> a. Community-based composting b. Segregation of waste at source, c. Separation, collection, and resource recovery from wastes with a particular focus on composting <ul style="list-style-type: none"> • <i>Implementing partners:</i> SAARC countries. 	<ol style="list-style-type: none"> 1. Promote an effective, efficient, affordable, safe, and sustainable waste management system for all the urban/rural settlements 2. Establish a SAARC network on waste management; 3. Incineration of waste; 4. Put a particular focus on composting; 5. Ensure special treatment of hospital waste; 6. Privatize waste collection, disposal, and treatment.
<p>11. Dhaka Environment Management Plan 2005</p>	<p>The Dhaka Environment Management plan included the following initiatives:</p> <ol style="list-style-type: none"> 1. Ensure sustainable urbanization through decentralized development and a hierarchically structured urban system. 2. Emphasize recycling as a means to reduce solid waste management costs, under the urban environmental management dimension <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, local government, and rural development and cooperation 	<ol style="list-style-type: none"> 1. Promote waste recycling 2. Encourage less landfilling 3. Promote the development of an EMS (Environmental Management System) among industries
<p>12. Poverty Reduction Strategy Paper (PRSP) 2005</p>	<p>The PRSP emphasizes on:</p> <ol style="list-style-type: none"> 1. Ensuring environmental balance in all sorts of development activities. 2. Importance of proper waste management and recycling activities, 3. An environment-friendly energy policy and social forestation <ul style="list-style-type: none"> • <i>Implementation partners:</i> Local Government Division, Ministry of Environment and Forest, Ministry of 	<ol style="list-style-type: none"> 1. Introduce segregation of organic and nonorganic waste at the household level 2. Encourage public-private partnership for MSW management 3. Formulate and implement a solid waste management master plan for each municipality, and replicate them in other major cities 4. Popularize private-public partnerships in the waste removal process in cities

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	Law Justice and Parliamentary Affairs, Ministry of Local Government and Rural Development and Cooperative, Ministry of Social Welfare, Ministry of Health and Family Welfare, City Corporation, Municipalities, Civil Society Organizations, and NGOs	5. Improve waste disposal systems and their management substantially 6. Introduce sanitary land-fill for all solid waste disposal 7. Recycle, reduce, and reuse industrial and other solid waste
13. Private Sector Housing Development Guideline 2005	The Private Sector Housing Development Guidelines provide assistance to the proper waste management systems in order to ensure waste minimization and waste removal and produce pollution-free goods. <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh (Ministry of Industry), private sector, NGOs 	1. Proposes waste recycling, composting, and biogas generation space in the housing areas following the development guideline
14. Solid Waste Management Action Plan for Eight Secondary Towns in Bangladesh 2005	This action plan was devised by Waste Concern and based on the 4 R principle i.e., Reduce, reuse, recycle, and recover the waste. It focused especially on the promotion of converting waste into resource activities. <ul style="list-style-type: none"> • <i>Implementing partners:</i> Local Government Engineering Department 	a) Solid Waste Management and Resource Recovery, b) Clinical & Hazardous Waste Management, c) Policy on Waste Management, d) Climate Change & Clean Development Mechanism, e) Industrial Pollution Control
15. National Renewable Energy Policy 2008	This policy includes directives on energy generation from waste and mentions the following key issues: <ol style="list-style-type: none"> 1. Sources for biomass gasification-based electricity, such as rice husk, crop residue, wood, jute stick, animal waste, municipal waste, sugarcane bagasse etc. 2. Defines biogas from mainly animal and municipal wastes as a probable promising renewable energy resource for Bangladesh. 3. Implementing partners: The Sustainable Energy Development Agency (SEDA), the business community, academics and/or representatives from Bangladesh Solar Energy Society, NGOs, financial institutions 	1. Promote awareness about biomass and composts among the public 2. Introduce new business models for renewable energy and other clean energy technologies 3. Create market opportunities and start-up business models for sustainable energy technologies in Bangladesh
16. Biomedical Waste Management Rules 2008	This set of rules defines the following activities: <ol style="list-style-type: none"> 1. Every occupier/institution generating bio-medical waste is responsible to ensure that such waste is handled without any adverse effect on human health and the environment. 2. Every occupier/operator is to submit an annual report to the prescribed authority by 31 January, including information about bio-medical waste handled during the preceding year. 	1. Set up a monitoring team for segregation and disposal of different kinds of medical waste 2. Categorize all medical waste into 10 categories with different handling protocols

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>3. In case of any accidents at any bio-medical waste handling site or during transportation, the authorized person shall report the accident to the prescribed authority forthwith.</p> <ul style="list-style-type: none"> • <i>Implementing partners:</i> The Government of every State and Union Territory, Municipal Corporation, Municipal Boards or Urban Local Bodies 	
<p>17. Local Government (City Corporations) Act 2009</p>	<p>This act holds city corporations responsible for the following activities:</p> <ol style="list-style-type: none"> a) Proper disposal of waste b) Collection of waste c) Management of waste. <ul style="list-style-type: none"> • <i>Implementing partners:</i> City corporation 	<p>1. Ensure proper disposal, collection, and management of waste</p>
<p>18. Bangladesh National Climate Change Strategy and Action Plan 2009</p>	<p>The action plan defines the following activities:</p> <ol style="list-style-type: none"> a) Water and sanitation in climate change areas b) Methane emission from urban waste may be controlled by organic waste recycling or capturing methane. <p><i>Implementing partners:</i> Ministry of Environment and Forests and its agencies (e.g., Department of Environment, Department of Forests, Disaster Management Bureau, Comprehensive Disaster Management Programme, Bangladesh Water Development Board, Local Government Division, Rural Development and Cooperatives, Local Government and Engineering Department, Department of Public Health Engineering</p>	<ol style="list-style-type: none"> 1. Implement drinking water and sanitation programmes in areas at risk from climate change 2. Expand the forestry programmes on government and community land
<p>19. The Local Government (Paurashava) Act, 2009</p>	<p>This act sets paurashavas responsible for the following activities:</p> <ol style="list-style-type: none"> a) Proper disposal of waste b) Collection of waste c) Management of waste. <p><i>Implementing partners:</i> Paurashava</p>	<p>1. Ensure proper waste disposal, collection, and management</p>
<p>20. Local Government (Union Council) Act, 2009</p>	<p>This act holds union parishads responsible for the following activities:</p> <ol style="list-style-type: none"> a) public welfare b) Improvement and preservation of the environment c) Standing Committees including on “Sanitation, Water Supply, and Drainage”. d) Awareness regarding environmental 	<ol style="list-style-type: none"> 1. Ensure the union’s public welfare through safe environment 2. Ensure proactiveness of the “Sanitation, Water Supply and Drainage” standing committee 3. Awareness raising activities relating to waste management, environmental preservation and cleanliness

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>preservation and cleanliness</p> <p><i>Implementing partners:</i> Union Parishad</p>	
<p>21. Solid Waste Management Rules, 2021</p>	<p>This rule defines the following activities:</p> <ol style="list-style-type: none"> Declares dumping waste on the drain road as a punishable offense Follow waste-related manner prescribed by the local government authorities and other authorities or institutions Waste creator segregates and stores in three separate bins Carry out solid waste management activities by the local government authority Full-fledged plan for solid waste management should be formulated following the national strategy and guidelines on solid waste management <p><i>Implementing partners:</i> Local government authorities</p>	<ol style="list-style-type: none"> Ensure waste is stored in three separate bins by the waste creator Ensure proper waste disposal, collection, and management by the institutions or service providers Ensure law enforcement for dumping waste on the drain road or open place or surface water
<p>22. National 3R Strategy 2010</p>	<p>This strategy aims to change the consumption and production patterns of waste by:</p> <ol style="list-style-type: none"> Directing the local government authorities to develop their own action plans through quantifiable targets Encouraging organic waste recycling through composting, bio-gas, and refuse-derived fuel. <p>The goals include:</p> <ol style="list-style-type: none"> Waste reduction by 20% Reuse and recycling Minimizing waste disposal in open dumps, rivers, flood plains, and landfills by at least 20% by 2015. <ul style="list-style-type: none"> <i>Implementing partners:</i> MOLGRD, MOEF, MOI, MOH 	<ol style="list-style-type: none"> Identifying pilot wards of Dhaka city Distributing collection vans and household garbage bins Producing source-separation instruction tools Raise awareness about waste reduction, recycling, and reusing through Environmental education & public relation activities Implement source separation; Develop Material Recovery Facility (MRF); Construct compost plant Sell and produce compost
<p>23. The Bangladesh Environment Conservation Act,2010</p>	<p>This act was amended in 2010 and includes the following waste management relevant issues:</p> <ol style="list-style-type: none"> Includes many important environmental concerns such as the conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. The discharge, disposal, and dumping of waste can cause adverse environmental effects and some types of waste can be considered environmental pollutants It also focuses on the <ol style="list-style-type: none"> Conservation of the environment, Improvement of the environmental 	<p>Provide restrictions on the production, import, storage, loading, transportation etc. of</p> <ul style="list-style-type: none"> hazardous waste, anything defined as waste, due to its physical or chemical properties if contraction with other waste or substances creates toxicity, infection, oxidation, explosion, radioactivity, decay or other harmful environmental effects

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	standards, c. Control and mitigation of environmental pollution; <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, NGOs, Private Sector 	
24. National Urban Sector Policy, 2011	This policy addresses the following issues: 1. Promotes sustainable urbanization through decentralized development and a hierarchically structured urban system 2. Reduce solid waste management costs by emphasizing recycling and ensuring government support for the same 3. Focuses on the improvement of urban infrastructure quality and technology for maintenance 4. Includes routine maintenance, periodic maintenance, emergency maintenance, and rehabilitation under the routine maintenance policy <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, Local Government, and Rural Development and Cooperation 	1. Introduce user fees for waste disposal, encourage composting, and formalize the function of scavengers for MSW management. 2. Ensure investment to replace and repair and maintain infrastructure facilities.
25. Directions from the High Court to stop dumping waste in the Buriganga River, Dhaka, 2011	The High Court of Bangladesh has enforced this law several times to stop illegal waste dumping on the banks of the Buriganga river and protect the river water	1. City authorities to run programmes to create awareness among people on dumping waste into and along the river and put-up placards sporting the High Court direction. 2. All sewerage lines connected to the Buriganga and waste treatment lines from industries have to be delinked from discharging liquid wastes into the rivers within a year. 3. Directed the authorities to stop dumping waste into the river and declared their inaction in preventing water pollution illegal and clean up the river and move all the sources of pollution from there. 4. Department of Environment to shut down industries built on the banks of Buriganga without clearance and the industries polluting the river by dumping waste, within the next one month, following June 2020. 3. Ordered the authorities to stop dumping all types of waste to keep the water pollution-free.
26. National Strategy for Water Supply and	This national strategy on sanitation: 1. Aims to ensure safe and sustainable water	1. Promote source-level waste segregation

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
Sanitation, 2014	<p>supply, sanitation and hygiene services for all</p> <p>2. Adopts 17 strategies (with strategy 6 focused on MSW management), which are broadly grouped into three themes:</p> <p>a. Increasing water, sanitation, and hygiene (wash) interventions</p> <p>b. Addressing emerging challenges</p> <p>c. Strengthening sector governance</p> <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, Department of Public Health and Engineering, Local Government Division, Local Government Engineering Department, Dhaka Water Supply and Sewerage Authority, and NGOs 	<p>2. Establish community-based primary collection and link with secondary collection transportation and final disposal</p> <p>3. Consider special handling and treatment for hazardous, electronic, and medical waste</p> <p>4. Pursue organic waste recycling through composting, bio-gas, and reuse-derived fuel</p> <p>5. Plan sanitary/regional landfills for an urban area/a group of urban areas</p> <p>6. Design sanitary landfills with the provision of using methane gas as fuel</p> <p>7. Prevent keeping waste materials on footpaths, roadsides, and other public places.</p>
27. Dhaka Structure Plan 2016	<p>Contains several articles that focus on MSW management and aim to</p> <p>1. Ensure minimized waste generation and create a clean and pleasant living environment</p> <p>2. Establish waste transfer stations at proper places and prevent public nuisance</p> <p>3. Ensure greater private sector participation in MSW management</p> <p>4. Introduce health and hygiene counseling and healthy practices at home and schools</p> <p>5. Create environmental awareness among people</p> <ul style="list-style-type: none"> • <i>Implementing partners:</i> Local Government Agencies, RAJUK, DOE and NGOs, Ministry of Education, Ministry of Culture 	<p>1. Adopt the 3R policy (Reduce, Reuse, and Recycle).</p> <p>2. Consider the necessity of alternative landfill sites as the least preferred option</p> <p>3. Introduce hierarchy classification to extract the maximum practical benefits from products whilst generating the minimum waste</p> <p>4. Manage medical waste with care and hygiene.</p> <p>5. Evolve various initiatives to design and ensure the safe recycling of electronic products</p> <p>6. Select feasible locations of STSs to prevent public nuisance.</p> <p>7. Consider underground tunnels for dispatching household waste to waste-treatment centers</p> <p>8. Engage the private sector to initiate ideas to make waste collection a profitable business</p> <p>9. Undertake programmes and projects and allocation of budget for projects to promote healthy living</p> <p>10. Engage in public awareness-raising actions in the form of seminars, workshops, TV advertisements, newspaper supplements, dramas</p>
28. Seventh Five-year plan (FY2016- 2020)	<p>The 7th five-year plan includes several action directives that aim the following:</p> <p>8. To ensure a proper MSW management system is in place for good environmental health.</p>	<p>1. Clean River waters as part of environmental sustainability</p> <p>2. Conservation and maintenance of natural resources, reducing air and water pollution, proper waste disposal, and liberating encroached rivers, water</p>

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>9. To implement the emission, effluent, and waste management strategy.</p> <p>10. Entrusts the Local Government Division with the following:</p> <ul style="list-style-type: none"> a) managing all matters related to drinking water; b) developing water supply, c) sanitation, and sewerage facilities in rural and urban areas d) Managing matters related to waste management. <p>11. To ensure the practice of 3R (Reduce, Reuse & Recycle), following the National 3R Strategy for Waste Management</p> <p>12. To enforce Solid Waste Management Rules.</p> <ul style="list-style-type: none"> • <i>Implementing partners:</i> Government of the People’s Republic of Bangladesh, LGED, Public Private agencies, NGOs 	<p>bodies, forest areas, and khas land</p>
<p>29. Urban Management Policy Statement 1998</p>	<ul style="list-style-type: none"> a) The policy considers the interest of providing economic, efficient and reliable services; b) municipalities shall endeavor to contract out solid waste disposal, public sanitation, drain cleaning, and road maintenance. 	
<p>30. Sustainable Development Goals (SDG)</p>	<p>The SDG includes several actions</p> <ul style="list-style-type: none"> a) SDG 3-Good Health and Well-being: The improper management of organic waste, waste water, plastic waste, and glass waste causes poor health and poor well-being across the country b) SDG 6-Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all c) SDG 7-Affordable and Clean Energy: A large amount of waste generates every day, every month, and every year. Take initiatives to reduce waste volume, mitigating pressure on land for waste disposal. d) SDG 11-Sustainable cities and communities: Make cities and human settlements inclusive, safe, resilient, and sustainable. e) SDG 13-Climate Action: Waste strongly contributes to climate change because greenhouse gases are emitted during food production and distribution activities, and methane is released during the decay of 	<ul style="list-style-type: none"> 1. Ensure the recycling of plastic waste, glass waste, and biodegradable waste 2. Ensure safe and environment-friendly sanitation facilities considering the FSM chain 3. Ensure access to initiatives for waste to energy like biogas, fuel etc. 4. Implement waste management through community activities 5. Implement the 3R approach to mitigating climate change

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>food waste.</p> <p><i>Implementing partners:</i> the People’s Republic of Bangladesh, and its relevant ministries, departments like DPHE, LGD, LGED etc., Public Private agencies, NGOs</p>	
<p>31. Institutional Regulatory Framework (IRF) for Faecal Sludge Management 2017 (Rural areas)</p>	<p>The IRF includes several action directives that aim the following:</p> <p>a) Defines Institutional Roles and Responsibilities (section 4.2)</p> <p>b) Capacity Building, Training and Research (section 4.3)</p> <p>c) Awareness Building (section 4.4)</p> <p>d) Technical Assistance and Funding Support (section 4.5)</p> <p><i>Implementing partners:</i> the People’s Republic of Bangladesh, and its relevant ministries like LGRD&C, MHFW, DPHE, Public Private agencies, NGOs</p>	<ol style="list-style-type: none"> 1. Carry out public awareness campaigns on resource recovery potentials (e.g., compost, biogas) of faecal sludge 2. Implement safe and environment-friendly Faecal sludge management facilities like Vacutug, FSTP etc. 3. Ensure onsite faecal sludge management facilities 4. Provide support to fill the knowledge gaps, technical assistance, training, and quality assurance of processes and products (e.g., compost) related to faecal sludge management 5. The GoB will increase funding support and provide other assistance for FSM-related activities 6. Develop standards/guidelines for emptying, transportation, and treatment of faecal sludge; operation and maintenance (O&M) of faecal sludge treatment plant; disposal of effluent from faecal sludge treatment facilities; quality control/ standardization of treated products/by-products; and protocol for securing license for using/ marketing of compost/organic fertilizer
<p>32. Bangladesh Delta Plan 2100</p>	<p>The Delta Plan policy includes the following aims:</p> <p>a) Strategy FW 2: Maintaining Water Quality for Health, Livelihoods, and Ecosystems</p> <p>b) Improved urban services: water supply, sanitation, wastewater, and solid waste management.</p> <p>c) Place special emphasis on the management of disposal of medical, electronic, and other hazardous waste/materials</p> <p><i>Implementing partners:</i> People’s Republic of Bangladesh, GED, WARPO, BWDB, and other related institutions</p>	<ol style="list-style-type: none"> 1. Implement safe and improved wash facilities 2. Ensure safe and environment-friendly waste management services
<p>33. Bangladesh National Building Code (BNBC) 1993</p>	<p>The BNBC indicates the safe sanitation issues:</p> <p>Chapter 7: Drainage and Sanitation of BNBC 1993.</p> <p>a) approval of drainage and sanitation plans</p>	<ol style="list-style-type: none"> 1. ensure septic design and drawing following BNBC 2. emptying the sludge following the BNBC guideline

National policies, ordinances & strategies	Waste management-related focusing areas	Necessary actions for Implementation
	<p>for the places where public sewers are not available.</p> <p>b) disposal method shall be designed by a licensed professional</p> <p>c) design of the such system shall be on the basis of location with respect to wells or other sources of water, soil permeability, groundwater elevation, available, and maximum occupancy of the building.</p> <p>d) Rainwater or groundwater shall not be discharged into the septic tank</p> <p>e) Septic tanks shall not discharge into open water courses.</p> <p>f) ensure minimum distance for various components of the disposal system</p> <p>g) septic tank shall be constructed of corrosion-resistant material and be of permanent water-tight construction.</p> <p>Implementing partners: the People’s Republic of Bangladesh, LGIs, PWD, and other related institutions</p>	

6. Recommended Solid waste and Faecal Sludge Management Model

The present practices of solid waste and faecal sludge management are mainly improper, unsafe, and non-environment friendly leading to environmental and public health hazard which hasn't been perceived by the practitioners even policy planners. As a result, the absence of proper waste management causes severe water and pollution, environment pollution consequently leading to adverse health impacts. To improve solid waste and faecal sludge management, the following issues are included in this strategy.

- Sensitize the target communities on solid waste and faecal sludge management through *Behavioral Change and Communication (BCC) activities* and *Information Education Communications (IEC) materials*,
- Introduce *participatory approaches* to empower the community people in every step of solid waste and faecal sludge management,
- Building capacity of relevant personnel at the local level to manage and maintain facilities,
- Promotion of user-friendly, safe, environment-friendly, and affordable technologies,
- Ensure segregation at the source of solid waste (biodegradable and nonbiodegradable),
- Ensure proper containment to store the faecal sludge,
- **Consider household-based waste management as a first option, community-based waste management as second option, union-based waste management as third option, and upazila-based waste management as fourth option.**
- Waste should be treated as close to the source as possible,
- Ensure proactiveness of the *involved community-based groups* (for example, youth clubs, community help groups (CHGs), Mahila samiti, cooperative associations, WATSAN committee etc.) in waste management operations,
- Involving recyclers and relevant entrepreneurs as partners,
- Emphasis on the adoption of recycling/reuse options,
- Ensure *institutional arrangements for solid waste and faecal sludge management*,
- Developing *an effective financial model* to address capital and operational costs, and
- Creating incentives for motivation and sustainability.

6.1 Institutional arrangements for solid waste and faecal sludge management

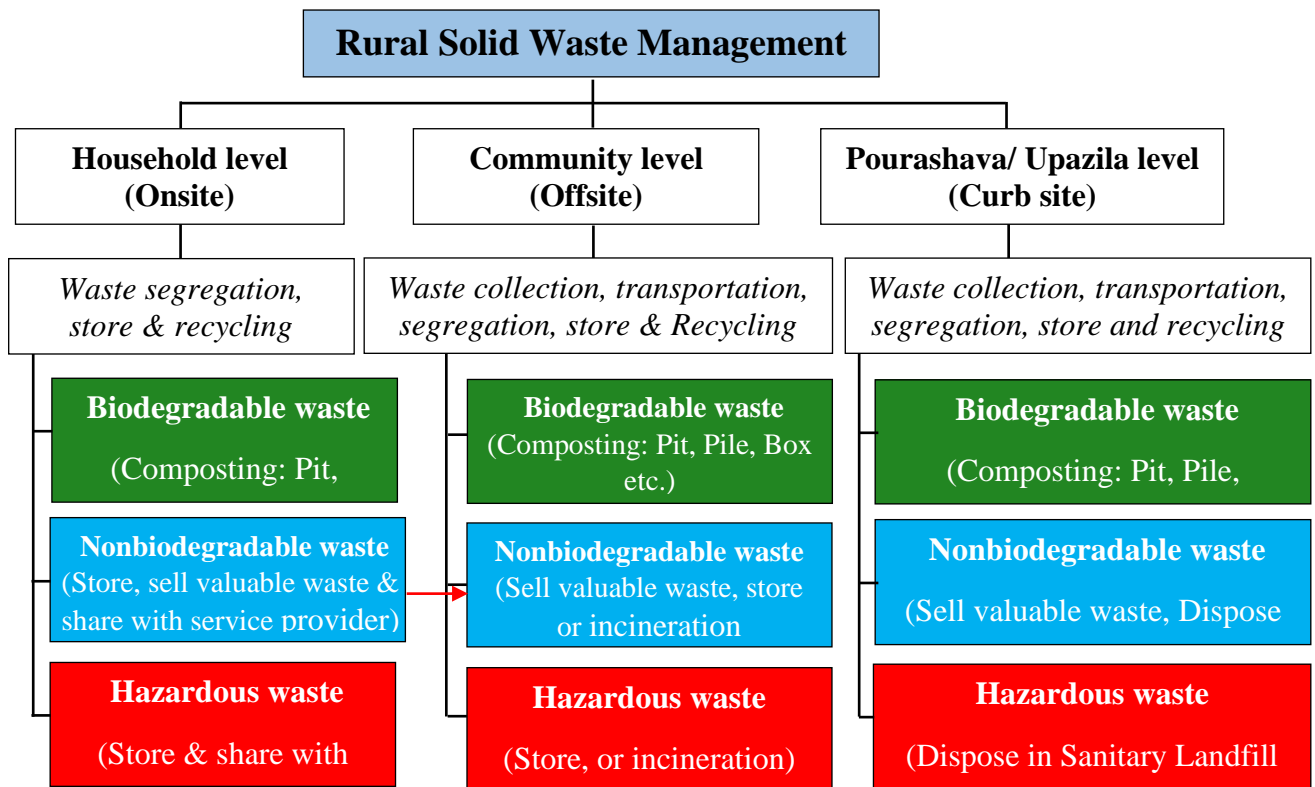
- Ensure Solid waste and Faecal sludge management resource team at national level, divisional level, district level, upazila level, union level, and ward level.
- Explore the need for qualified persons at the local level like ward level, union level etc. for O&M solid waste and faecal sludge management.
- Form community help groups (CHGs), if possible, take registration from the relevant organizations.
- Engage other community groups, local clubs, Mahila somite, cooperative associations, and private sector/entrepreneurs for SW and FS management as a 'Village Level Change maker' (service provider).
- Enable basic monitoring/recording systems at the village level or relevant level for measuring the results, further decision-making, ensuring quality service etc.

Table 6.1: Actors in Rural Solid Waste and Faecal Sludge Management

Level	Organization
National	LGRD&C, Ministry of Agriculture, Ministry of Cultural Affairs, Ministry of Food, Ministry of Education, Ministry of Power, Energy and Mineral Resources, Ministry of Environment and Forest, Ministry of Fisheries and Livestock, Ministry of Finance, Ministry of Housing and Public Works, Ministry of Law, Justice and Parliamentary Affairs, Ministry of Planning, Ministry of Social Welfare, Ministry of Women and Children Affairs, Ministry of Water Resources, Ministry of Youth and Sports, Ministry of Science and Technology, Ministry of Disaster Management and Relief, Ministry of Public Administration etc.
Divisional	LGED, DPHE, LGD, BRDB, DAE, DSS, DYD, ICT, NHA, WCA, WDB, Cooperative, Divisional Commissioner, NGOs, Private sector etc.
District	LGED, DPHE, LGD, BRDB, DAE, DSS, DYD, ICT, NHA, WCA, WDB, Cooperative, District Commissioner, Zila Parishad, NGOs, Private sector etc.
Upazila	LGED, DPHE, LGD, BRDB, DAE, DSS, DYD, ICT, NHA, WCA, WDB, Cooperative, Upazila Parishad, Upazila Nirbahi Officer, NGOs, Private sector etc.
Union	Union parishad, relevant committee, NGOs, Private sector etc.
Ward	Ward councilor, relevant committee/groups/clubs, NGOs, Private sector etc.
Village	CHGs, relevant committees/groups/clubs, NGOs, Private sector etc.

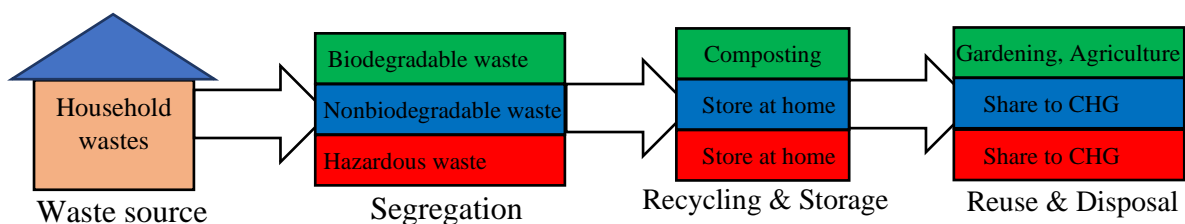
6.2 Solid waste management in rural areas

The solid waste management approaches see waste as a resource and emphasize 3R strategies such as reducing, reusing, and recycling waste. It is necessary to manage solid waste based on categories like biodegradable waste, nonbiodegradable waste, and hazardous waste. These categories of waste have been found at different levels like the village, ward, union, upazila, district, divisional and national levels. The generated waste volumes are changed based on population density, socio-cultural issues, seasons etc. However, the government considers villages, wards, and unions as rural areas. These rural areas have consisted of residential areas (like households and communities) and growth centers as commercial places. Considering the administrative boundaries, rural waste management should be household-based, community-based, and union based. The management model represents the following issues for proper solid waste management in rural areas. Sanitary landfill with MRF, FSTP & Composting.



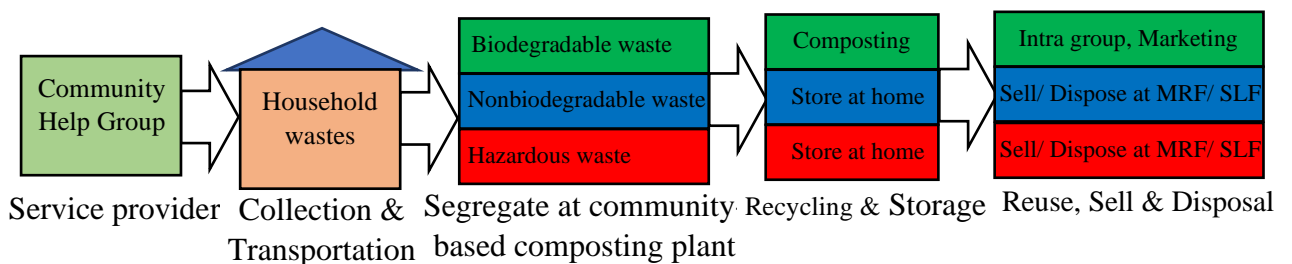
- Household-based solid waste management*-The targeted households are generated three types of waste such as biodegradable, nonbiodegradable, and hazardous waste whose amount varies according to economic circumstances, seasons, geographical issues etc. However, the management model proposes waste segregation at source can make a vital role in proper waste management. The union parishad or service provider should be sensitized to the target households should organize BCC activities and disseminate IEC materials on selected issues.

The household will be segregated their generated wastes and store them in three separate bins (red for hazardous waste, green for biodegradable waste, and blue for non-biodegradable waste) for further action. The households could be applied their learning on producing compost fertilizer using organic or biodegradable waste. The households could be stored nonbiodegradable and hazardous waste till collected by the Community Help Group (CHG) or service provider. If the households aren't decided to compost, they can be shared their wastes with the union parishad of the service provider. The waste collection frequency could be regular or selected days of the week. The household that will be sharing biodegradable/ non-biodegradable waste pays a monthly service fee to the service provider. The service fee for both biodegradable and nonbiodegradable waste might be higher than only non-biodegradable waste.



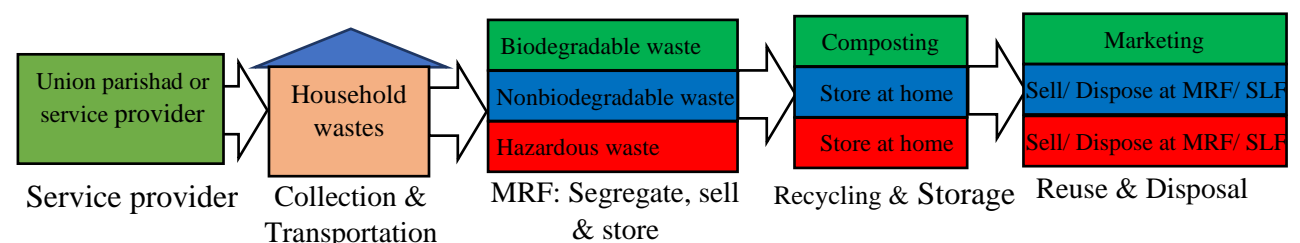
- Community-based solid waste management-The rural people will form a community help group (CHG) to ensure proper waste management at the household level, serve waste management services in the concerned community, and collect solid wastes from those households that can't manage their generated wastes. The members of CHG should be elected persons (councilors), local leaders, CSOs etc.

The CHG with the consultation of the service provider and concerned people will choose the relevant technologies like composting facilities with waste segregation shed. The service provider with the assistance of the government or other sources will install the composting plant and waste segregation shed. The CHG will produce compost from the collected biodegradable waste, and will store non-biodegradable and hazardous waste which will dispose of in union-based MRFs or Sanitary landfill (SLF). The service provider should take capacity-building initiatives relating to technological, financial, and social issues strengthening CHG's smoothly running assignments.



- Union-based solid waste management the union-based waste management model is suitable for those unions under the concern of upazila which have no sanitary landfill or waste management facilities of paurshava. This management model proposes total three Material Recovery Facilities (MRF) for nine wards of the union. Each MRF will be ensured three wards of safe solid waste management. The parishad with the financial and technical assistance of the government would be established MRF with composting facilities. The personnel of MRFs will operate and maintain the facilities like waste collection, proper segregation of waste, composting from biodegradable waste, stores the no biodegradable and hazardous waste for further actions.

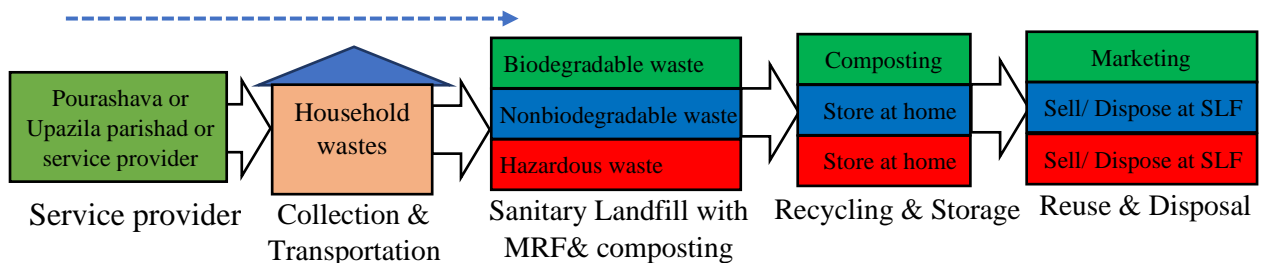
The CHG might be shared their collected biodegradable, no biodegradable, and hazardous waste with the MRFs for further action. If the MRF has nonbiodegradable waste management facilities, it could be recycled and produced tiles, blocks etc. If there is no recycling technology it could dispose of following proper guidelines or sell the wastes to waste pickers or scrap dealers or vagaries.



- Paurshava or Upazila-based solid waste management-Considering the proper waste management issues at paurshava or upazila town, its capital expenditures, operation, and maintenance cost, and economic cost, the union parishad is decided to establish a sanitary landfill with MRF, Composting plant, and FSTP to manage the wastes of concern upazila. The sanitary landfill with MRF, composting, and FSTP facilities would be established taking technical and financial assistance from the government which leads to operating by

upazila parishad or paurashava or service provider. If the targeting upazila has paurshava, the paurshava will be operated and maintenance the upazila-based waste management facilities. On the other hand, the upazila parishad will be operated and maintenance these facilities. The service provider will be imposed a service fee on the service seekers.

However, after collecting the wastes, the MRF will be ensured proper segregation of wastes for recycling of biodegradable and non-biodegradable wastes and final disposal of. The service provider will be produced compost fertilizer using collected biodegradable wastes and marketing within/beyond upazila. The concerned authority would be ensured proper marketing of the produced compost fertilizer along with the valuable non-biodegradable waste.

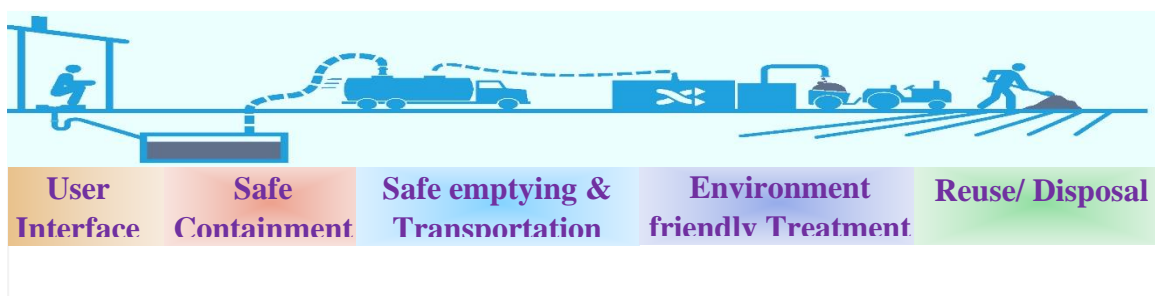


Finally, it is recommended for the union or upazila which has no capacity to ensure union/upazila-based waste management facilities, should follow and implement household and community-based waste management facilities. If the union has the capacity to ensure union-based waste management facilities, they should follow and implement household, community, and union-based waste management facilities. The upazila-based waste management facilities like a sanitary landfill with MRF and composting could be used by interested unions paying the fixed tipping fee to the concerned authority.

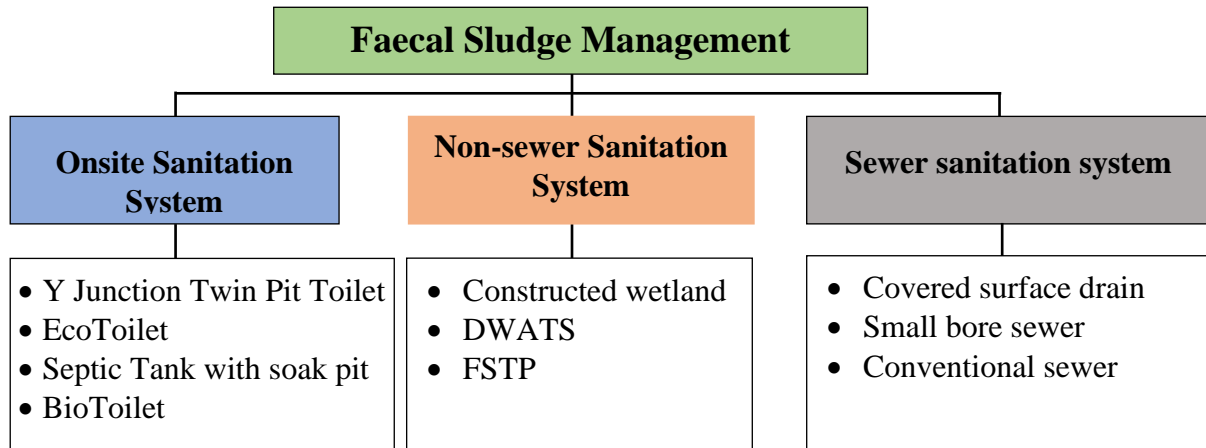
6.3 Faecal sludge management in rural areas

Faecal sludge is undigested sludge in liquid and the semi-liquid state as well as highly concentrated in suspended, dissolved solids and pathogens. The faecal sludge is stored in different types of containments like pit, septic tank etc. If the containments are unsafe and non-environment friendly, it is essential to look beyond toilets so that the pathogens are prevented from re-entering the environment. Similarly, there is a crucial need to stop overflow or seepage of waste from faulty sanitation systems. The generated sludge should be treated before any disposal according to the mandate of country rules, regulations, policies, and strategies.

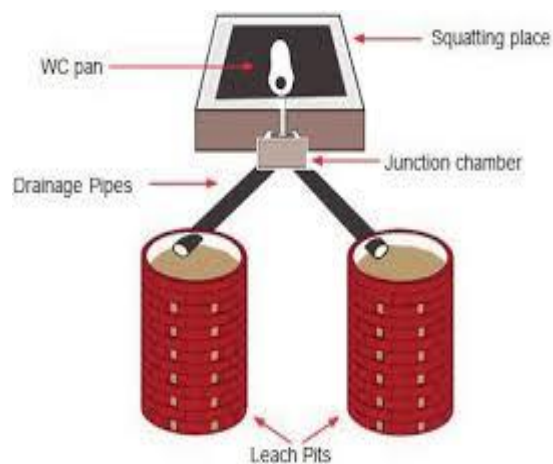
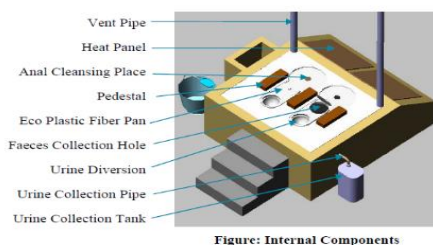
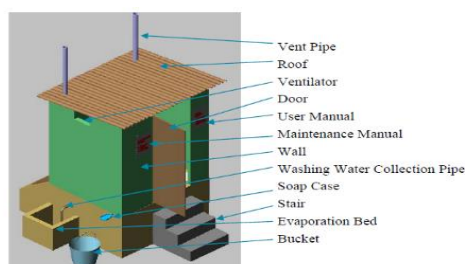
The faecal sludge management means ensuring of safe and environment-friendly issues with facilities in the user interface, containment, removing sludge from containment, transporting the emptying sludge, treatment of sludge, reusing or final disposal of treated sludge.



There are three different faecal sludge management facilities found for both rural and urban areas. The technologies are onsite sanitation, sewer sanitation, and non-sewer sanitation. Considering the safe, environmental and administrative issues, the faecal sludge management system in rural areas should be household-based, community-based and union based. The following discussion and figure show the proper faecal sludge management in rural areas.

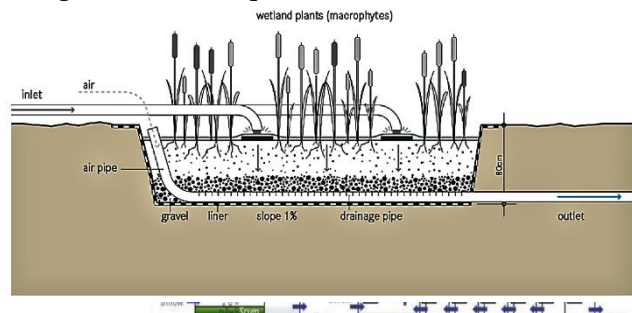


- Household-based faecal sludge management-** This model proposes to be installed onsite sanitation technologies (see annex-2) like Y junction twin pit latrine, septic tank and Eco Toilet etc. ensuring household-based faecal sludge management. These toilets could protect/stop groundwater pollution, environmental pollution, and public health hazard etc. Considering the safety and environment-friendly issues, the onsite sanitation system is suitable for household-based faecal sludge management. However, the filled containment of the mentioned sanitation options will be emptied using the Vacutug paying the emptying fee to the service provider. The containment emptying system would be based on demand or call or schedule. Other unions as well as paurashava dwellers under the concern upazila could improve or replace their containment with the proposed household-based sanitation technologies.



- Community-based faecal sludge management-It is observed that Low-Income Communities (LICs) have used pit latrines which most cases unhygienic, unsafe, and non-environment friendly. These LICs aren't capable to install safe and environment friendly toilet. Considering their socio-economic issues, it is required to ensure safe and environment friendly toilet facilities through the government initiatives. The DWATS and community-based Eco Toilet along with household-based sanitation technologies are suitable for community based faecal sludge management.

- Union based faecal sludge management-The union could be ensured union based constructed wetland for sludge treatment and emptying technology of containment like Vacutug for union based faecal sludge management. To install and operate constructed wetlands and Vacutug, the parishad is required technical and financial assistance from the government. The parishad would be operated the constructed wetland and Vacutug by itself or be outsourced. The constructed wetland and Vacutug would be accessible for other unions or paurashava or upazila towns paying the fixed tipping to the parishad or service provider.



- Paurashava or Upazila based faecal sludge management-Considering the upazila's proper faecal sludge management practices, capital

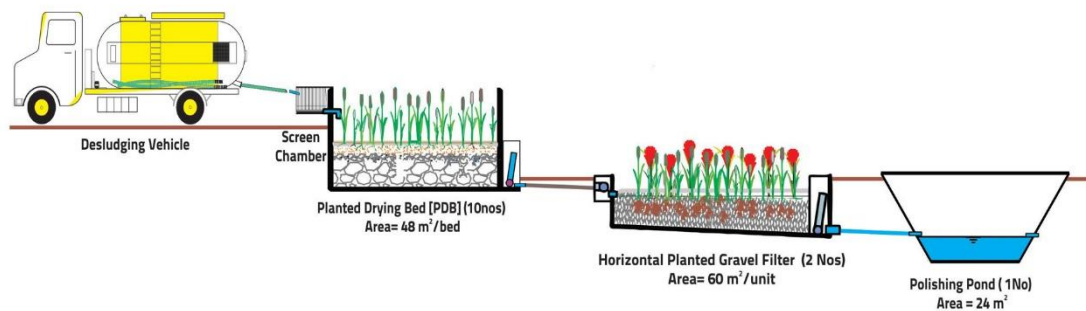


Figure 6.1: Faecal Sludge Treatment Plant

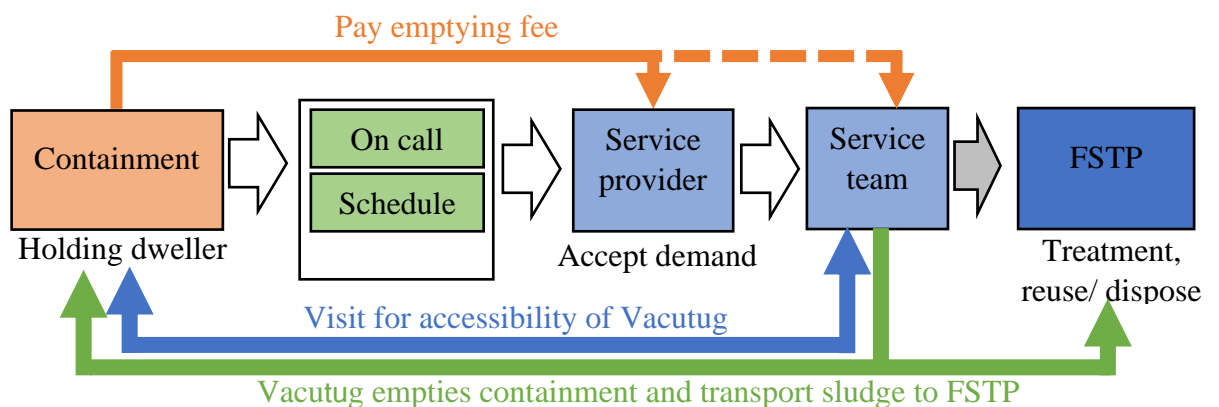
expenditures, operation and maintenance cost, and economic cost, it is proposed to establish a FSTP and purchase two Vacutug to serve within/beyond upazila. The FSTP will be established and purchase two Vacutug with the technical and financial support of the government which leads to being operated by paurshava or upazila parishad.

- Containment emptying, sludge transporting, treatment, reuse, or final disposal- The filled containment of the target areas will be emptied using the Vacutug (except Eco Toilet) paying the emptying fee by the containment owner to the service provider. The containment emptying system would be based on demand or call or schedule.

After emptying the containment using Vacutug, the service provider will be transported the sludge to feed it in the constructed wetland or FSTP for further proper treatment, reuse or final disposal. The service provider would be reused the treated sludge-producing co-compost/ briquette and its marketing. If the organization doesn't reuse the treated faecal, it could be used to fill the lowland. Other upazilas within/ beyond the district could be taken this FS management initiatives paying the fixed tipping fee.



Figure 6.2: Vacutug for desludging Pit/ Septic tank



7. Strategy for Developing Clean Villages, Clean unions, and Clean Upazilas

The development of the rural waste management system has been emphasized in “the Solid Waste Management Rules 2021’ and other related policies as well. Moreover, the development of clean villages and clean cities were included in the 8th Fifth Year Plan, the Perspective Plan, and the plan to celebrate the Mujib Year, where there is a strategy or work plan yet to develop to address the issue. In this perspective, the ‘My Village-My Town’ Technical Assistance Project has formulated a strategy aiming at developing clean villages, clean unions, and clean upazilas. This strategy is explained in a simple manner in the below newly developed model-1, 2 & 3.

The synopsis of the strategy for developing Clean Village-Clean Unions-Clean Upazila is presented below:

To develop a clean upazila household-based, paurashava/upazila based, and community or village-based waste management system will be developed. To this, model-1 is proposed for those villages located far from the paurashava/upazila, Model-2 is applicable for those villages located near to hatbazar and growth centres and model-3 is proposed for the villages located adjacent to the paurashava/upazila headquarters. In addition, Union and upazila level sustainable waste management will be developed in a combination of the models.

Model-1: For those villages that have no growth centre/hat bazar within 2-3 kilometres to be included in the model-1. Household/house-wise disposal of organic waste, community-based organic waste management where applicable, non-organic hazardous waste will be collected fortnightly and disposed of at union/upazila level. Two bins (organic, hazardous) will be provided to the households to dispose of organic waste at household/community level and three bins (organic, inorganic, hazardous) will be provided to the households to dispose of organic waste built at union/upazila level plants.

Model-2: Villages/Unions located at the Growth Centre/Hatbazar within 2-3 kilometres are included in Model-2 and it will be comprised of the Growth Centre/Hatbazar waste system. Organic waste will be disposed of at home or send to hatbazar-based waste management centres and will be managed with hatbazar waste. Where applicable, waste from several nearby hatbazar will be collected through a joint management.

Model-3: Those villages closely located to the paurashava /upazila headquarters (within 2-3 kilometers) and have access to modern waste management, will go for model-3. Waste from all these villages will be processed at upazila/ paurashava level through integrated waste management plant or along with rural waste. Where applicable, waste from one or more nearby hatbazars will be collected through a joint management.

The study revealed that establishment of 'Rural-Urban Linkage' is pivotal for waste management. Meanwhile, waste management plants have already been set up in various paurashava. Rural waste management will be easier and more sustainable if the waste adjacent to the paurashava areas and densely populated villages managed together.

Table 7.1: Strategy to Develop Clean Village: Villages far from the Paurashava/Upazila Sadar or Villages far from the Hatbazar (Model-01)

SL No.	Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
1	Faecal sludge free rural water body	-Stop open defecation - Stop toilet water running to the water body	-Twin pit latrine for all/ set septic tank with soak well for affluent	Raise family-based awareness	-Grants for ultra-poor -Partnership with others -Use UP Act 2009 on Faecal Sludge management	-Conduct awareness campaign in educational institution, mosque, and others religious intuitions -Appoint Clean Ambassador at Para, Village level, Provide them training/building network
2	Kitchen waste free rural drain, water body and road	-Provide household-based waste management system, where applicable	Establish small community-based organic fertilizer plant where required	Community-based management team	Operate community-based management Team and household or family-based compost fertilizer production	Same
3	Plastic waste free rural drain, road and water body	-Household based waste management (provide bins)	Arrange rikshaw or van under the management of union parishad	Collect waste from household fortnightly/ monthly basis	Preserve plastic waste/collection/supply chain related guideline	Same
4	Medical waste free rural drain, road and water body	-Household based waste management (provide bins)	Arrange rikshaw or van under the management of union parishad	Collect waste from household fortnightly/ monthly basis	Medical waste preservation/ collect/ disposal guideline	Same

Table 7.2: Strategy to Develop Clean Village: Villages far from the Paurashava/Upazila Sadar or Community-centered Hatbazar (Model-02)

SL No.	Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
1	Faecal sludge free rural water body	-Stop open defecation -Toilet water will not run to the water body	- Set septic tank with soak well for affluent; and -Twin pit latrine for others - Clean tank using Vacutug in appropriate cases	Raise family-based awareness	- Comply UP Act 2009 on faecal in construction of soak well for faecal sludge management -Grants for ultra-poor to develop twin pit latrine -Partnership with others -Develop guideline to maintain Vacutug	-Conduct awareness campaign in the educational institution, mosque, and others religious intuitions -Appoint Clean Ambassador at Para, Village level, Provide them training/building network
2	Kitchen waste free rural drain, water body and road	-Preserve waste in three separate bins - Dispose waste to the municipality/ upazila sadar/ hatbazar separately, where necessary -For other cases follow model-01	-Establish hatbazar-based waste management plant where required -For other cases follow model-01	-Under the UP hatbazar appoint operators to run the transports	-Guideline for collecting compost waste from hatbazar and adjacent villages disposed by UP in the plant -Rule for deploying operators where necessary -Guideline for municipality or upazila to collect organic waste for plants	Same

Table 7.3: Strategy to Develop Clean Union

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make organic waste free courtyard, drain, water body and road of all villages under the union parishad	-Follow organic waste management guidelines aiming at developing clean union parishad	-Set family/community based organic waste management plant	-Appoint officers at Union Parishad (Sub-Assistance Engineer - Manage by operators	- Follow the guideline of model-01, Model-02	Improve marketing of organic fertilizers through engaging Upazila Agriculture Officer/ Sub Assistant Agriculture Officers
Make faecal sludge free villages of the union parishad	-Stop defecation in the open space -Stop running toilet to the water body -Set soak well in the sanitary latrine -Use Vacutug machine in appropriate aspects following the strategy	- Set septic tank for affluent of the UP -Twin pit latrine for all -Vacutug machine	-Raise awareness -Arrange twin pit latrine for UP/Government funded projects -Build partnership management with neighbor upazila	- UP Act 2009 on Faecal Sludge management -Grants for ultra-poor to set twin pit latrine -Partnership with others -Guideline to operate Vacutug at paurashavao/upazila level	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress -Take steps to popular Vacutug machine
Plastic waste free drain, road and water body of all villages of the union parishad	-Use model-01, 2 where applicable	-For model-01, collect waste fortnight/monthly using UP rickshaw or van -For model-02 collect waste on regular basis	-Supply chain for model-01 to manage solid waste -For mmodel-02, waste disposal through supply chain or plant	Preserve plastic waste/collection/supply chain related guideline	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress
Medical waste free rural drain, road and water body of all villages of the union parishad	-Use model-01, 2 where applicable	-For model-01, collect waste fortnight/monthly using UP rickshaw or van -For model-02 collect waste on regular basis	-For model-01 at hatbazar/paurashava disposal the waste to incinerator -For model-02 hatbazar or model-3 at upazila or paurashava level waste will be disposal to the plant	Medical waste preservation/ collect/ disposal guideline	-Set three chambers waste bin while collect inorganic or hazardous

Table 7.4: Strategy to Develop Clean Hatbazar

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Organic waste (vegetable and restaurant waste) free hatbazar	-Follow guideline to develop organic waste free hatbazar	-Set three separate compartment-based dustbin, where applicable set shop-based dustbin -Set small plant	-Managed by Union Parishad -Appoint operators in the hatbazar	- Follow the guideline waste management in the hatbazar	-Organize motivational workshop -Launch Upazila based Clean Heart Award -Appoint clean ambassadors for growth centre and hatbazar
Organic waste (waste from slaughter house) free hatbazar	-Centre slaughter house management	-Construction of slaughter house and build drainage system	-Develop technical knowledge of hatbazar management committee	Same	-Building capacity of the hatbazar management committee members and operators as well
Organic waste (waste from chicken) free hatbazar	-Collect in the separate compartment of the waste bins	Disposal at hatbazar/near centre as appropriate	Same	Same	Same
Plastic and medical waste free hatbazar	-Chicken waste management system	Disposal at biogas plant	Same	Same	Same
Faecal sludge free hatbazar	-Set public toilet with soak well septic tank	Set public toilet with soak well septic tank	Leasing the public toilet	Leasing related rules	same
Waste management of the neighboring villages of the hatbazar	Set small plant for remissible and refinement the waste	Set sanitary land field/incinerator for segregation or composting waste	Private sectors operators under the supervision of union parishad or hatbazar committee	As per guideline	same

Table 7.5: Strategy to Develop Clean Upazila

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make organic waste free courtyard, drain, water body and road of all villages of the upazila	-Follow the organic waste management model ½ to develop clean village	-Develop plant using model-1/2 for rural level and design the comprehensive waste management plant for upazila Or Upazila/Paurashava and adjacent villages focused waste management plant	Follow rural level model 1. 2 and develop guideline to appoint operators	- Follow the guideline of model-01, Model-02	Engage Upazila Agriculture Officer or Sub Assistant Agriculture Officers to popularize organic fertilizers at villages level
Make faecal sludge free water body of all villages of the upazila	-Stop defecation in the open space -Toilet water will not go to the water body -Set soakwell in the sanitary latrine	- Set septic tank for affluent of the UP -Twin pit latrine for all	- Raise awareness -Arrange twin pit latrine from the UP/Government funded projects	- UP Act 2009 on Faecal Sludge management -Grants for ultra-poor to set twin pit latrine -Partnership with others -Guideline to operate Vacutug at paurashava/upazila level	-Appoint Clean Ambassador at Para, Village level, Provide them training/building network -Include agenda in the monthly meeting and review its progress -Take steps to popular Vacutug machine
Make faecal sludge free water body of all villages of the upazila	Ensure use of Vacutug machine following the guideline	Purification faecal sludge of the waste at paurashava/upazila using Vacutug machine	If necessary, build collaboration with neighbours upazila	-Guideline to operate Vacutug machine by paurashova or upazila parishad	Take steps to popular Vacutug machine

Objectives	Strategy	Infrastructure	Management	Guidelines	Training/Motivation
Make plastic waste free drain, water body and road for all villages of the upazila	Follow model 1/2 where necessary	Disposal waste following model 1/2 at upazila or paurashova level	operators	Preserve plastic waste where necessary/collect/ and supply chain related guideline	Set three chamber or Secondary Transfer Station/STS to manage inorganize or hazardous waste
Medical waste free rural hospital, drain and water body of all villages of the upazila	-Use model-01, 2 where applicable to dispose media waste	-Set incinerator in the plant	Dispose by using incinerator	Medical waste preservation/ collect/ disposal guideline	Same
Clean hatbazar of the upazila	Hatbazar based waste management value chain	To manage waste of the hatbazar by setting slaughter house, biogas plant and compost plant etc.	Operators/Hatbazar Management Committee	Regular monitoring the activity of hatbazar	Declare upazila based clean hatbazar and awarded the best hatbazar committee

8. Rural Waste: Necessary Infrastructures and management

Household/Road Waste Management Model



A. Waste Management at Household Level

1. 2 bins (yellow, red) for each household (1 for plastic/inorganic waste and 1 for hazardous waste).
2. Pit compost facility for interested households (Elevated site with canopy over by RCC or brick masonry).
3. Supply of plastic barrels to interested households for household composting.

Community Based Waste Management Model



B. Waste Management at Community Level (for 300-400 Households)

1. 3 bins (yellow, green, red) per household for waste management at community level (1 for organic waste, 1 for plastic/inorganic waste and 1 for hazardous waste) as per Solid Waste Management Rules 2021
2. Pit Composting/Pile Composting/Aerator Composting cum Waste Sorting Plant with Roof Top made of RCC or Brick Masonry
3. Rickshaw vans (man driven) 2 - for collection of organic waste from home
4. Trolley 2-3 Nos, Spade 2-3 Nos, Hand Shovel 6-8 Nos, Cutter 3-4 Nos, Sieve (Sand Sieve) 2-3 Nos.

Management Methods:

1. Encouraging for source segregation and waste management at household level and teaching bio-fertilizer production techniques
2. Informing the pros and cons of plastic and medical waste management and encouraging regular disposal of household plastic and medical waste in community bins.
3. Determining community area, assigning responsibility to Ward Water Supply and Sanitation (WATSAN) Committee, teaching waste collection and composting techniques.
4. Encouraging at Household level to donate waste for community level waste management
5. Sensitizing farmers about the benefits of using organic fertilizers and creating markets
6. Monitoring once every month and providing necessary hands-on training.

Potential adversities, challenges and solutions in rural waste management

Table 8.1: Household Based Waste Management

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
1	Increase Public Awareness	Listing Target Household	A list of suitable houses will be initially prepared for household-based waste recycling.	WATSAN Committee
		Effectively informing the rural public about waste management in a short period of time	The rural public will be informed quickly and effectively through local public representatives, community leaders (teachers, heads of religious institutions), VSOs, NGOs, CBOs, clubs, cleanliness ambassadors, green forces. Therefore, first the concerned elected representatives, two representatives of each organization and all cleanliness ambassadors will be qualified through subject-specific training. Segregation of waste at source, waste recycling and resource conversion, compost utilization methods and benefits, sanitation benefits-methods.	Project Office WATSAN Committee, Public Awareness planning Unit (PAPU), Public Consultative Group (PCG)
		Active public participation for sustainable waste management	Real markets will be created for resources derived from waste clean house Competition and prizes will be organized within the Green Force to disseminate information and advice through students	
		recommended procedure	Tools: Yard Meetings, Mother's Gatherings, Group Meetings, Posters/Stickers, Billboards, Educational Videos, APS-SMS, Cultural Programs, Rallies, Environmental Education, Environmental Fairs	
2	Household Based Waste management	Selection of proper household for Household Based Waste management	<ul style="list-style-type: none"> • After the initial list of households is prepared, the list of households will be finalized in the presence of the Ward WATSAN Committee subject to the fulfillment of the following conditions. • Conditions of house selection: <ul style="list-style-type: none"> - Must be interested in waste management at household level - There should be a place for waste management at household 	Project Office WATSAN Committee, Public Awareness Local Ward Councilor

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			<ul style="list-style-type: none"> - Must have at least 2 cows - Must have own agricultural cultivation • The number of member houses eligible for household waste management shall be maximum 10% of the total number of households in the village/union. • Houses that are not easily accessible will be preferred. 	
3	Household Waste 3R Policy Training	<ul style="list-style-type: none"> • Development of training materials, harmful effects of waste mismanagement, initial investment, • Proper training of selected households 	<ul style="list-style-type: none"> • Training will be organized by the project office. • Based on the opinion of the local ward councilor, training will be provided in any seminary/yard of the village. • Project Technical Staff/Sub-Assistant Engineers or appointed organization as required will provide training, Cleanliness Ambassador will assist. • Segregation of waste at source, Recycling and conversion of waste into resources, Compost utilization methods and benefits, cleaning benefits 	Technical staff (Sub-Assistant Engineer) Clean Ambassador
4	Distribution of materials- 2 buckets/bins of 2 colors with lids, peat/barrel arrangement for composting	2 buckets/bins of 2 colors with lids for segregation of waste at source to meet the challenge of proper waste management, collection of materials, timely distribution	Segregation of waste at source requires designated bins and appropriate training. Follow up for sustainable waste management with bins after appropriate training.	Project Fund, People's representatives
5	Segregation of waste at source	Provide proper training	After the training, at least once every month, one should go from house to house and practice from pen to pen.	Officer-in-Charge of Union Parishad/ Clean Ambassador
6	Making and using compost	<ul style="list-style-type: none"> • Ensuring production and regular use of compost according to standards • Technical knowledge of composting • Creating market and marketing, 	Technical Staff/Sub-Assistant Engineers and Assistant Agriculture Officers will provide regular training in manual production of compost/bio fertilizers, arranging marketing through Assistant Agriculture Officers.	Organization/Technical Staff/Sub-Assistant Engineer and Sub-Assistant Agricultural Officer,

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
7	Plastic and Medical Waste management	Segregation of plastic and hazardous/ medical waste	Collect/deposit inorganic/plastic and hazardous waste in two separate bins at home, Households will dispose in permanent bins (STS) with 2 compartments (plastic and hazardous) made for some houses. Once in every 15 days, vans under the control/operator of the Union Parishad will be collected from STS.	Sub-Assistant Engineer, Household
8	Drain, Road	Road and drain keep clean	Village roads and drains should be cleaned once every month. Cleanliness activities will be carried out on a rotational basis by the members of Clean Ambassador, Green Force, VSO, NGO, CBO, Club.	WATSAN Committee, Sub-Assistant Engineer

Table 8.2: Community Based Waste Management

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
1	Strengthening Waste management Committee	Awareness builds up management committee	<ul style="list-style-type: none"> Informing all the members of Ward WATSAN Committee about the responsibilities assigned to them. Involvement in waste management by imparting detailed concepts and training on the pros and cons of waste management, waste conversion and business success strategies. 	WATSAN Committee, Public Awareness planning Unit (PAPU), Public Consultative Group (PCG)
2	Waste Collection	Community area selection and prepare route map	<ul style="list-style-type: none"> Selection of community waste management areas based on dense settlement and connectivity, land availability and public interest and involvement. Determining waste collection routes, number of vans, timings to facilitate waste management. 	Project Staff, Local Councilor, Operator
3	Waste Management Plant and equipment distribution	Collection of land for waste management	<ul style="list-style-type: none"> Selection of interested persons from community members to provide land on rent basis for waste management, criteria for construction of waste management unit will be fixed, selection of best land from the land fulfilling all the conditions. 	Project Staff, Local Councilor, Sub-Assistant Engineer

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			<ul style="list-style-type: none"> • Execution of contract with selected land owner. 	Community WATSAN Committee, Sub-Assistant Engineer
4	Waste Recycling	<ul style="list-style-type: none"> • Construct Infrastructure in proper time • Segregation at source 	<ul style="list-style-type: none"> • Construct infrastructure so that community members can produce organic fertilizers regularly and choose easy-to-understand and applicable methods and technologies. • Collection of proper waste management (3 buckets/bins of 3 colors with lids), timely distribution • Procuring and providing manned and mechanized vans for plant operation. 	Project Office, Project Staff
5	Training and Monitoring	Training at every stage	<ul style="list-style-type: none"> • Basic Training of Assistant Engineers • Informing the village people through meetings, • Training of school green forces, • Giving public awareness training to public representatives. 	Project Staff Technical Staff Clean Ambassador
		Regular Monitoring	<ul style="list-style-type: none"> • Regular monitoring by project staff. 	Project Staff
6	Provide Waste management Expenses	Making financial resources for waste management	<p>From project initiation to construction of waste management plant (selection of land, finalization of community members, various trainings) the first 6 months of field level expenditure will not be required.</p> <p>Expenditure as per approved budget from the date of waste collection:</p> <ul style="list-style-type: none"> - From 1st to 9th month the project will bear full cost. - From the 10th to the 12th month 80% of the cost will be borne by the project, the remaining 20% will be executed from the income. - From the 13th to the 15th month 50% of the cost will be borne by the project, the remaining 50% will be executed from the income of Rs. - From 16th to 18th month 20% of project cost will be borne by project, remaining 80% will be executed from income. - From the next 19th month i.e., 1.5 years after the 	Management from Project Fund

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			commencement of work, the community will operate the community waste management plant as per the project guidelines through its own management and financial resources.	
		Sustainability of waste management	Primarily appointing operators for a temporary period if no interested community level committee or individual is found for waste management.	Project Staff
7	Composting, Marketing and making Sustainability	Appointing appropriate institutions for training in quality organic fertilizer production techniques	Easy-to-understand and user-friendly composting methods will be selected. Capacity building by appointing institutions to increase production capacity, making compost/organic fertilizers if required. Creation of market for organic fertilizers with direct support of Deputy Assistant Agriculture Officer of Department of Agriculture Extension, sustaining the plant by expanding the market.	Technical Staff, Sub-Assistant Engineer Department of Agriculture Extension
8	Strengthening of Community Waste Management Committees to develop a handover mechanism for the entire process	Strengthening of Community Waste Management Committees to develop a handover mechanism for the entire process	The community waste management plant will be handed over to the community committee within 2 months of financial viability, but for the next six months the project will provide necessary technical assistance.	Project Office, Sub-Assistant Engineer Ward WATSAN Committee

9. Hat-Bazar Waste: Necessary infrastructure and management



A. Internal Arrangement of market:

1. Slaughter House (Based on Animal Slaughter)
2. Biogas plant (based on quantity of slaughter house waste and poultry waste)
3. 3-compartment (organic, organic and medical waste) permanent bins
4. Single Bin (Organic waste generation shop, required number)

B. Market Based Waste Management Plant:

1. Semi-Structured Compost Shed - Cast iron and tin shed, paved floor, pile/aerator based composting equipment, waste-sorting system.
2. Rickshaw Vans (Man Driven) 2 Nos - For waste collection inside the market
3. Rickshaw Vans (Mechanized) 2 Nos - For waste collection from multiple markets or remote areas
4. Trolley 8-5 Nos, Spade 3-2 Nos, Hand Shovel 6-8 Nos, Cutter 4-6 Nos, Sieve (Sand Sieve) 2-3 Nos

Management Methods:

1. Encouraging all concerned about waste segregation and waste management at source
2. Informing about the pros and cons of plastic and medical waste management and encouraging them to dispose waste separately in bins.
3. Strengthening of Union Water Supply and Sanitation (WATSAN) Committees, teaching waste collection and waste management techniques
4. Recruiting operator companies for managing hat bazar-based waste management centers and teaching bio-fertilizer production techniques
5. Sensitizing farmers about the benefits of using organic fertilizers and creating markets
6. Monitoring once every month and providing necessary hands-on training to all concerned.

Potential adversity/challenges in rural waste management and solutions

Table 9.1: Hat bazar-based waste management

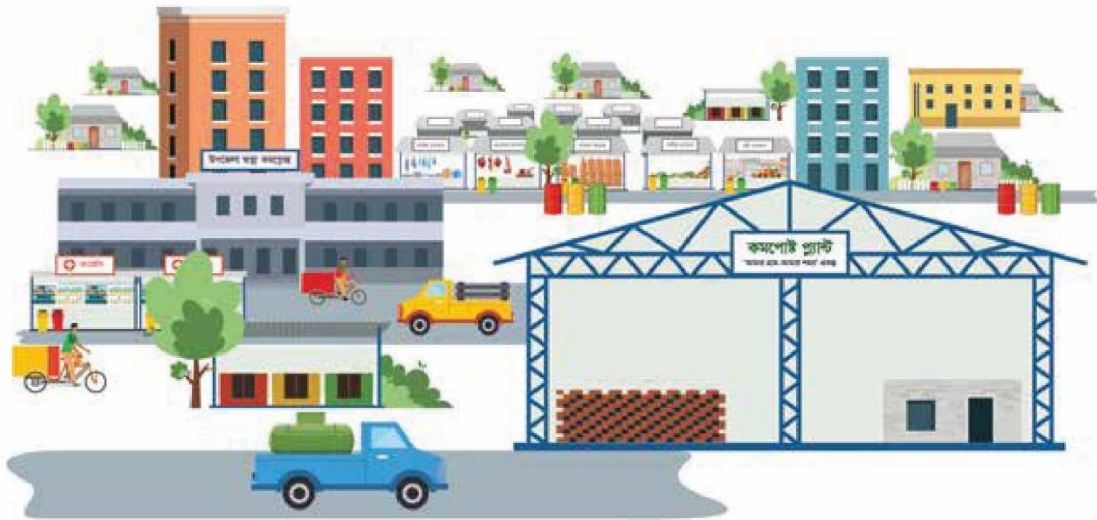
SL No	Activities	challenges	Implementation Method	Responsible for Implementation
1	Strengthening of Management Committee - Inclusion of representatives	To make aware and involve all the members of the Union WATSAN Committee	<ul style="list-style-type: none"> All members of the Union WATSAN Committee will be informed about the responsibilities assigned to them. Involvement in waste management by imparting detailed understanding and training on pros and cons of waste management, waste to resource conversion and business success strategies. Market committee, representatives of educational institutions, VSOs, NGOs, CBOs, clubs, will be involved for sustainable waste management. 	Project Office, WATSAN Committee, Public Awareness planning Unit (PAPU), Public Consultative Group (PCG)
2	Land acquisition for waste management	Land available nearby	<ul style="list-style-type: none"> For sustainable waste management, multiple markets within 2-3 km distance of the same union will be brought under single waste management and all the houses in the vicinity of the market will be covered. 	Union WATSAN Committee Bazar Committee
3	Waste recycling, manufacturing	Collection, distribution of infrastructure construction and waste management materials	<ul style="list-style-type: none"> Easy to understand and applicable methods and technologies will be selected, infrastructure will be built accordingly for regular production of bio-fertilizers in waste management plants. 	Project Office Technical Staff Assigned organization for Training Union WATSAN Committee
4	Management of waste management plants	Recruitment and regularization of operators	<ul style="list-style-type: none"> Organization with experience in waste management and hands-on experience in compost or bio-fertilizer production will be appointed for sustainable waste management. In the interest of sustainable waste management, the organization that will operate the plant will be given all the responsibilities of waste management including waste collection. If it is possible to give full responsibility of all the units of the same upazila to an organization then the waste management will continue in the right way, otherwise the 	Project Office, WATSAN Committee,

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			waste management activities will stop automatically when the project support ends.	
5	Waste management Expenses	Making financial resources for waste management	<p>From the initiation of the project to the construction of the waste management plant (selection of land, finalization of community members, various trainings) the first 6 months of field level expenditure will not be required.</p> <p>Expenditure as per approved budget from the date of waste collection:</p> <ul style="list-style-type: none"> - From 1st to 9th month the project will bear full cost. - From the 10th to the 12th month 80% of the cost will be borne by the project, the remaining 20% will be executed from the income. - From the 13th to the 15th month 50% of the cost will be borne by the project, the remaining 50% will be executed from the income of Rs. - From 16th to 18th month, 20% of project cost will be borne by the project, remaining 80% will be executed from sale money. - From the next 19th month i.e., 1.5 years from the commencement of work, the community will operate the community waste management plant as per the project guidelines through its own management and financial resources. 	Project Fund
		Sustainability of waste management	For sustainable waste management, the operator organization will be appointed with experienced and technical know-how.	Project Staff
6	Waste Value Chain	Preparation of waste collection route map	<ul style="list-style-type: none"> • Community waste management areas should be selected based on dense settlements and connectivity, land availability and public interest and involvement. • Waste collection routes, number of vans, time will be fixed to facilitate waste management. 	Project Fund Project Staff
		Waste processing, marketing and sustainability	<ul style="list-style-type: none"> • Easy-to-understand and user-friendly composting methods will be selected. • Capacity will be increased by appointing institutions to 	Technical Staff

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			increase production capacity, making compost/organic fertilizers if required. • Creation of organic fertilizer market with direct support of Deputy Assistant Agriculture Officer of Department of Agriculture Extension, the plant will be made sustainable by expanding the market.	
7	Training and Monitoring		Regular monitoring through project staff	Technical Staff

10. Cleaned Upazila: Necessary infrastructure and management

Upazila/municipality Based Integrated Waste Management Model



Strategy for Developing a Clean Upazila: Rural Solid Waste

জৈব বর্জ্য (Organic Waste)



কমপোস্ট
Compost



অজৈব/প্লাস্টিক বর্জ্য (Inorganic/Plastic Waste)



অমূল্যবান প্লাস্টিক
Non Valuable Plastic



মূল্যবান প্লাস্টিক
Valuable Plastic



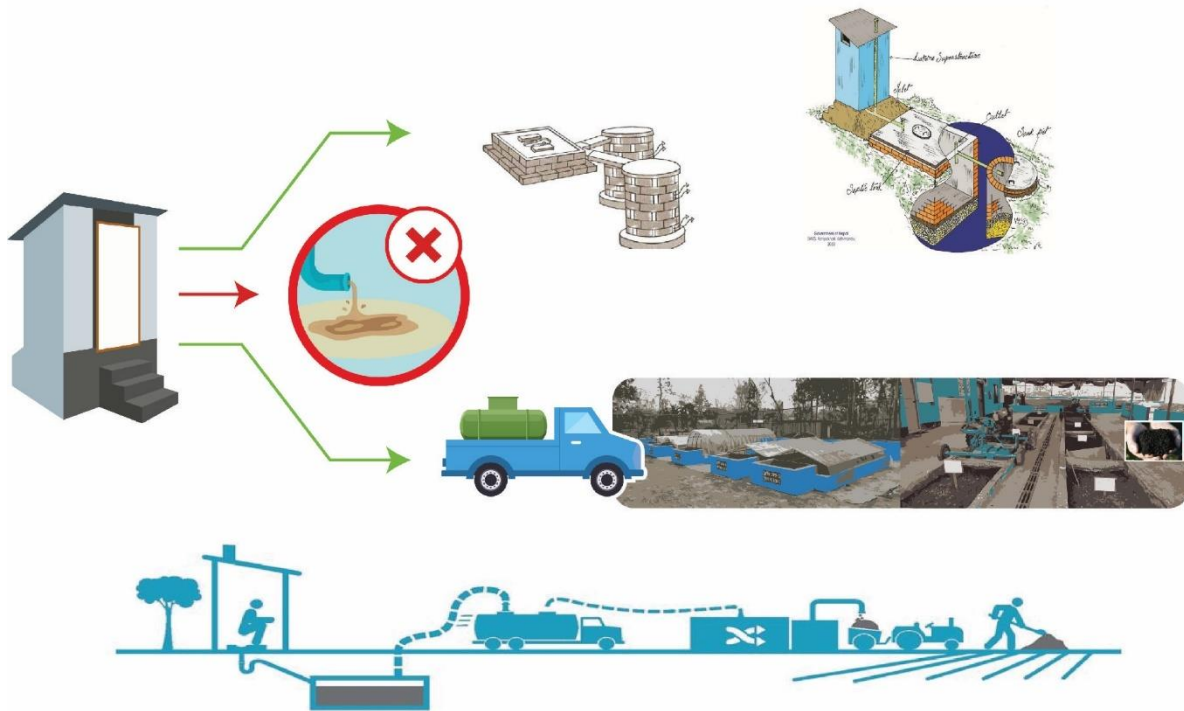
বিপদজনক বর্জ্য (Hazardous Waste)



ইনসিনারেশন
Incineration



Strategies for Developing a Clean Upazilas: Rural Sewage



Cleaned Upazila: Infrastructure and management

1. Integrated Waste Management Centre

- a. Material Recovery Facility (MRF)
 - b. Composting Facility (Pit/Pile/Box/Aerator Composting)
 - c. Inject molding machine, Crusher, Mixer machine, vibrate sieve machine, weighing machine, Sewing machine
 - d. Plastic waste (valuable and non-valuable) compartments and recycling facilities
 - e. Melting machines, ovens, press (heat/cold) machines, dies, blocks
 - f. Faecal Sludge Treatment Plant (FSTP)
 - g. Hazardous waste compartments and incinerators for medical waste management
 - h. Sanitary Landfill
 - i. Product Store (Organic Fertilizer/Plastic Products)
 - j. Office (all) and training center, rest room.
 - k. Workers changing room, toilet, rest room
2. Permanent bins with 3 compartments (organic, inorganic waste and hazardous waste) will be constructed in Paurashava/ Upazila Sadar, Bazar and nearby villages.
 3. Three bins (yellow, green, red) for each household - 1 for organic waste, 1 for plastic/inorganic waste and 1 for hazardous waste (as per Solid Waste Management Rules 2021)
 4. One Vacutug for sewage
 5. One small pick-up for transportation of plastic and hazardous waste
 6. Rickshaw Van (Mechanized) – For organic waste collection from multiple markets or remote areas
 7. Rickshaw Van (Man Driven) – For intra-upazila/Paurashava organic waste collection
 8. Trolleys, spades, hand shovels, cutters, sieves (sand sieves) for processing waste

Management

1. Encouraging all concerned about waste segregation and waste management at the source
2. Informing about the pros and cons of plastic and medical waste management and encouraging them to dispose waste separately in bins. Regular (once in 15 days or once a month) collection and disposal of plastic and medical waste from village level
3. Strengthening of Upazila Water Supply and Sanitation (WATSAN) Committee, providing training in waste collection and waste management techniques
4. Ensuring that every hospital, clinic, diagnostic center, pathology center, and medical center is covered under waste management.
5. Upazila/Paurashava-based waste (Solid & Faecal) Management (Waste Collection, Transportation, Recycling) Recruitment of operator company for management and teaching biofertilizer production techniques.
6. Providing training on modern waste management to the staff involved in waste management.
7. Taking arrangements for collection, transportation, recycling, and sale of solid and sewage through the same organization.
8. Encouraging farmers about the benefits of using organic fertilizers, controlling the quality of organic fertilizers through the Upazila Agriculture Officer, and creating an overall market.
9. Monitoring once every month and providing necessary training to all concerned.

Potential adversity/challenges in rural waste management and solutions

Upazila/ Paurashava-based waste management

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
1	Strengthening of Management Committee - Inclusion of representatives	To involve all the members of the Upazila WATSAN Committee aware and new members	<ul style="list-style-type: none"> All the members of the Upazila WATSAN Committee will be informed about the responsibilities assigned to them, Pros and cons of waste management will be involved in waste management by providing a detailed understanding of waste conversion strategies and business success strategies. Government/Private/Educational Institutions/Market Committee representatives will be involved to strengthen waste management in Upazila WATSAN Committee. 	Project Office WATSAN Committee, Public Awareness planning Unit (PAPU), Public Consultative Group (PCG)
2	Land acquisition for waste management	Land available nearby	<ul style="list-style-type: none"> For sustainable waste management, multiple markets with a distance of 2-3 km from the municipal headquarters will be brought under single waste management and the entire municipal area and all the houses in the surrounding areas will be covered. 	Project Fund
3	Waste recycling, manufacturing	Collection, distribution of infrastructure construction and waste management materials	<ul style="list-style-type: none"> Easy to understand and applicable methods and technologies will be selected, and infrastructure will be built accordingly for regular production of bio-fertilizers in waste management plants. 	Project Office WATSAN Committee, Operator Company
4	Management of waste management plants	Recruitment and regularization of operators	<ul style="list-style-type: none"> Institutions with experience in waste management and hands-on experience in compost or bio-fertilizer production will be appointed for sustainable waste management. In the interests of sustainable waste management, the organization that will operate the plant will be provided with all the waste collection work. If it is possible to give full responsibility (including sewage) to an organization for all the units of the same upazila, waste management will continue in the right way, otherwise the waste management activities will stop automatically when 	Project Office WATSAN Committee,

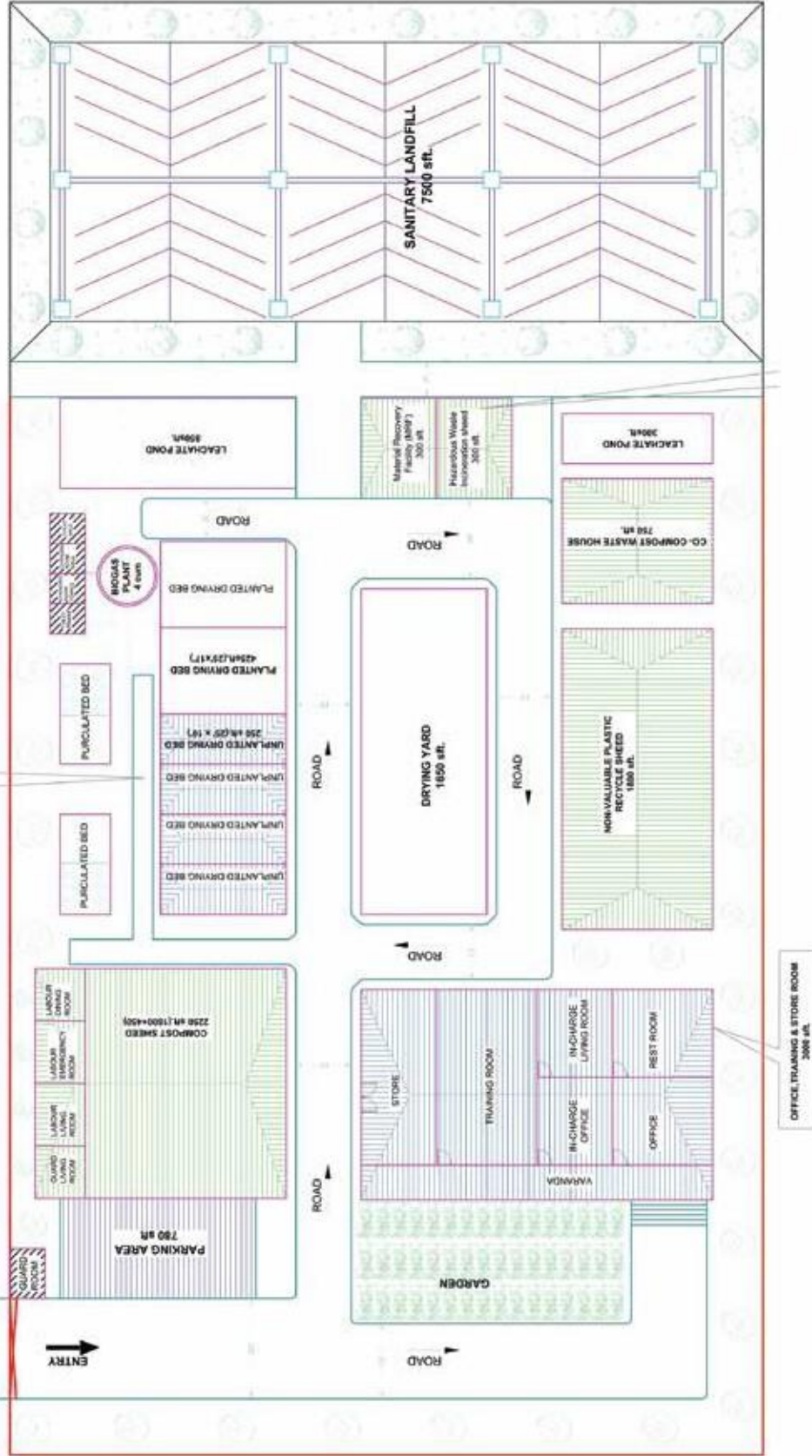
SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			the project support ends.	
5	Waste Management Expenses	Making financial resources for waste management	<p>From project initiation to the construction of waste management plant (selection of land, finalization of community members, various pieces of training) the first 6 months of field level expenditure will not be required. Expenditure as per approved budget from the date of waste collection:</p> <ul style="list-style-type: none"> - From 1st to 9th month the project will bear full cost. - From the 10th to the 12th month 80% of the cost will be borne by the project, the remaining 20% will be executed from the income. - From the 13th to the 15th month 50% of the cost will be borne by the project, the remaining 50% will be executed from the income of Rs. - From 16th to 18th month, 20% of project cost will be borne by the project, remaining 80% will be executed from sale money. - From the next 19th month i.e., 1.5 years from the commencement of work, the community will operate the community waste management plant as per the project guidelines through its own management and financial resources. 	Project Fund
6	Waste Value Chain	Waste segregation at sourced	<ul style="list-style-type: none"> • Three bins (organic/inorganic/hazardous) will be provided to all houses in the project area. 2 (Inorganic/Hazardous) bins will be provided to all the households which will produce farm based organic manure. • Each training will include training on the segregation of waste at source and regular monitoring. 	Project Fund Technical Staff Project Office Upazila WATSAN Committee Operator Company
		Prepare route map for waste collection	<ul style="list-style-type: none"> • Based on dense settlement and communication system, availability of land and interest and involvement of general public, multiple STS/dustbins of 2 rooms will be constructed in the villages around the municipal area/upazila headquarter. 	Project Fund Technical Staff Project Office Upazila WATSAN Committee

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
			<ul style="list-style-type: none"> Waste collection routes, number of vans, time will be fixed to facilitate waste management. 	Operator Company
		Waste processing, marketing and sustainability	<ul style="list-style-type: none"> Easy-to-understand and user-friendly composting methods will be selected. Technical assistance will be provided to the appointed organization to increase compost/biofertilizer production capacity for business success. The plant will be made sustainable by creating a market for organic fertilizers and expanding the market with the direct support of the Upazila Agriculture Officer of the Department of Agricultural Extension. 	Project Fund Technical Staff Project Office Upazila WATSAN Committee Operator Company DAE
		Formation of Valuable Plastic Waste Traders Association	<ul style="list-style-type: none"> Collecting an upazila level and government registration for all levels of businessmen currently involved in the plastic business. Tokai/waste pickers to wreckers/scrap dealers will all be brought on the same platform. Presently worthless plastic waste will be recycled in the plant through indigenous machinery to make blocks, sheets, tiles, pavement tiles, and equivalent waste including waste cloth will be used along with waste plastic. Alliances will be made with all organizations dealing with non-conventional plastic waste. 	Project Fund Technical Staff Project Office Upazila WATSAN Committee Operator Company
		Management of obsolete/worthless plastic waste	In cooperation with LGIs, plastic waste will be used for rural road maintenance work.	Project Office Upazila WATSAN Committee Operator Company
		Utilization of Inner Waste/Construction Waste	<ul style="list-style-type: none"> Hazardous waste or medical waste will be incinerated in Upazila level integrated waste management plant. Initiatives will be taken to incinerate waste generated from hospitals, diagnostic centers, and clinics at the source. If not incinerated, minimum sterilization (autoclaving) should be done. 	Project Office Upazila WATSAN Committee Operator Company

SL No	Activities	challenges	Implementation Method	Responsible for Implementation
		Hazardous waste management	<ul style="list-style-type: none"> • Hazardous waste or medical waste will be incinerated in Upazila level integrated waste management plant. • Initiatives will be taken to incinerate waste generated from hospitals, diagnostic centers, and clinics at the source. If not incinerated, minimum sterilization (autoclaving) should be done. 	Project Office Upazila WATSAN Committee DOE
		Faecal Sludge management	<ul style="list-style-type: none"> • The entire upazila will be brought under the service. However, priority will be given to urban/headquarters areas, and densely populated areas around markets. • Service will be provided through Vacutug machine. • Upazila level integrated waste management plant will handle sewage waste. • To be co-composted with organic waste. 	Project Office Upazila WATSAN Committee Operator Company

INTEGRATED WASTE MANAGEMENT PLANT
(POURASHAVA / UPAZILA BASED) Land Area - 01 Acre

FECAL SLUDGE TREATMENT UNIT
4000 sq. ft.



11. Case Study: Clean Upazila- Mirsarai, Chattogram

Mirsarai Upazila is a busy upazila of Chittagong adjacent to Bangabandhu Industrial City. The population density of Mirsrai Upazila is 826. There are 208 villages, 16 unions and 6 growth centers, and 44 hat bazars in the upazila. There are two Paurashavas in this upazila named Mirsrai and Baraiahat.

There is a plan to create employment for about 3 million people in the industrial city adjacent to the upazila by 2030. This will increase the population density in the two Paurashavas adjacent to the industrial city, and the villages of the upazila, and the transactions in the local market will increase several times. As a result, if proper steps are not taken, there will be a big crisis in waste management in this upazila.

The waste management information of two Paurashavas of Mirsrai Upazila and Hatbazar are given below.

Paurashava Name	Current Population	Village adjacent to Paurashava and their Population	Have own Landfill Facility	Total Vehicle for Waste Management	Total Van for Waste Collection	Total manpower for waste management
Mirsarai Paurashava	26348	Kachua (1292), Madhya Muradpur (994), South Maghadia (2486), West Mayami (2709), West Khaiyachara (2741)	No (Currently use forest division land)	2	10	24
Baraiya hat Paurashava	14870		Land available	3	10	

Hat-Bazar Name	Annual Revenue (2021-22)	Village adjacent to Hat-Bazar and their Population	Have own Slaughter House, Bio-gas Plant?	Total Waste (in Ton)	Total waste generated in adjacent villages
Abur hat	860000	Idilpur (1170), Temuhni Muradpur (1655), Sahebpur (2342)	No	2	1.69
Baman Sundor Darogar Hat	1921510	Baman Sundar (5258), West Mithanala (2248)	No	3	2.46
Bhorer Hat	760100	Shaherkhali (6599), Haikandi (3382), Domkhali (4174)	No	2	4.64
Hadi Fokir Hat	450000	East Mayami (7961), Gachbaria (2300), Maijgaon (1300), Wahedpur (12288)	No	3	7.8
Mirsarai Hat	1820835	Kismat Zafrabad (2610), Ast Maghadia (3386)	No	2	1.96
Shantir Hat	87500	West Hinguli (3126), Dhum (6105),	No	3	7.3

Hat-Bazar Name	Annual Revenue (2021-22)	Village adjacent to Hat-Bazar and their Population	Have own Slaughter House, Bio-gas Plant?	Total Waste (in Ton)	Total waste generated in adjacent villages
		Imampur (973), Jamalpur (5176), Khilurari (2741), Porgalpur (4253)			
Korer Hat	500000	Bhalukia (1564), Katagong (569), East Hinguli (13981)	No	2	5.28
Azampur Hat	48000	Osmanpur (1953), Morgaon (2976), Azampur (343), Patakot (2633)	No	2	5.5

Strategy to make Mirsrai Upazila a clean upazila

All the villages of the upazila are within 2-3 km, there are no growth centers/hat bazars (Example: Char Sharat Village), they are included in Model-1. In all these villages, household/household disposal of organic waste, community organic waste management where the applicable, non-organic hazardous waste will be collected fortnightly and disposed of at the municipal/upazila level. Households disposing of organic waste bins will be provided with two bins (inorganic and hazardous) and households disposing of organic waste at union/upazila level plants will be provided with three (organic, inorganic and hazardous) bins.

2-3 km from the village/union headquarters of the upazila. Among these, there are growth centers/hat bazaars (Example: Bhorer hat/Korer hat) those villages are included in Model-2 by coordinating with the growth center/hat bazaar waste system. Organic waste will be disposed of at the house or sent to bazar-based waste management centers and managed with bazaar waste. Where applicable, waste from several nearby hat-bazaars will be brought under joint management. Waste management of the market has been discussed in the chapter.

All the villages near to Upazila Sadar (within 2-3 km) have been covered under Upazila Headquarters Municipality based Model-3. Integrated waste management plant will be developed at upazila/municipal level. The plant will require 3 acres of land for Mirsrai Municipality and 3 acres for Bariahat Municipality. There is land for Barayahat Municipality. Land acquisition is proposed for Mirsrai Municipality.

The study proved that establishment of 'Rural-Urban Linkage' is essential in terms of waste management. Therefore, waste management plants will be set up in 2 municipalities. Along with municipalities, rural waste management will be sustainable and easier by bringing densely populated villages under waste management.

Rural waterbodies are being regularly polluted due to the dumping of sewage and other wastes. To improve sewage management, 'twin pit latrines' per household have been proposed in the pilot villages and Vacutug have been attached to upazila-based integrated waste management.

Waste Management: Management System

General methods of waste management:

- a. Public awareness raising – at all levels
- b. Clean up campaign

- c. Recruitment of operators for plant management at community, hatbazar and upazila levels and recruitment of institutes for training where applicable
- d. Collection, transportation and processing of organic waste
- e. Supply-chain and marketing of recyclable inorganic waste
- f. Establishing new recycling systems and supply-chains for non-recyclable inorganic waste.
- g. Hazardous waste disposal

Land and facilities for waste processing:

Municipal/Upazila Level: Integrated waste management plant has been proposed by acquiring two acres of land at Upazila/Municipal level. Upazila Sadar - Waste production at municipal level is 10-20 tons. Two acres of land has been proposed for such a plant considering the waste generation for the next 20 years. Photo of proposed plant on two acres of land is attached.

Establishments at Hatbazar/Union Level: Union/Hat-Bazar level may require 10-14th centuries of land. Land acquisition has been proposed in 10 out of 26 cases for this land. In case of other bazaars, these structures will be constructed on the existing land.

- a. slaughterhouse
- b. Biogas plant (mainly based on poultry waste)
- c. Composting plants and offices (separation, composting, waste chambers (by type),
- d. Plastic waste processing plant
- e. Incinerator - Hazardous waste disposal
- f. Small scale sanitary landfill

12. Entrepreneurship in Waste Management: Operators

There has been some experience with management practices in urban waste management in Bangladesh. In this experience, it has been shown that the involvement of private entrepreneurs or operators in the management of waste management is possible to get more benefits. In rural waste management also, the involvement of the private sector as operators has been recommended. Since the number of experienced operator organizations in the country is very less, moreover, there are even fewer interested and experienced organizations to work at the village level, so by creating entrepreneurs, current and future operator organizations and individuals will be created.

Eligibility of Operator Organization:

1. The organization should have government registration and a trade license.
2. Must have TIN/VAT registration
3. Must have a bank account in the scheduled bank.
4. The company should have at least one shareholder/director with experience in waste management.
5. Must have at least 3 years of experience in Waste Management.
6. Should have 2 years of experience in organic waste recycling/biofertilizer making.
7. Experience in waste plastic recycling will be considered an additional qualification.
8. Experience in Faecal waste recycling will be considered an additional qualification.
9. License holders for the production and marketing of organic fertilizers will be considered as an additional qualification.
10. Experience in hazardous waste disposal will be considered an additional qualification.

SL No.	Description	Point
1	Government registration and trade license	10
2	TIN/VAT registration	10
3	Bank account in the scheduled bank	10
4	At least one shareholder/director with experience in waste management	20
5	At least 3 years of experience in Waste Management	15
6	2 years' experience in organic waste recycling/biofertilizer making	10
7	Experience in waste plastic recycling	10
8	Experience in Faecal waste recycling	5
9	License holders for the production and marketing of organic fertilizers	5
10	Experience in the hazardous waste disposal	5
Total		100

Creation of new entrepreneurs/institutions through training:

Eligibility: Individual

1. Minimum Graduate Degree
2. Interested in waste management
3. Quality in Leadership
4. Mentality to stay in Village

Eligibility: Organization

1. Village Clubs, CBOs, and Local NGOs interested in waste management
2. Work experience engaging with the local people
3. The number of active members is at least 10 people

Procedure: Based on the application of interested persons and institutions, the project will take the following measures

1. Shortlisting of individuals and organizations will be done through the selection
2. Additional training will be provided periodically for different periods as per the list
 - a. All types of waste management
 - b. Recycling/processing of all types of waste
 - Production of organic fertilizers
 - Production of products from plastic waste
 - Municipal waste management
 - c. Organization structure and management method
 - d. Establishing the waste value chain
3. Certificates will be awarded to individuals and organizations who complete the training.
4. Further waste management activities will be conducted by appointing trained persons/institutions for project implementation.

Responsibilities of the operator Organization:

1. Operating integrated waste management plant/compost plant.
2. Daily collection of all organic waste from designated areas and preparation of co-compost/biofertilizer, and marketing arrangements.
3. Collection of all plastic/inorganic and hazardous waste from designated areas every 15 days, with shorter intervals if required.
4. Manufacture and marketing of plastic/inorganic waste products by recycling them in waste management plants.
5. Dispose of hazardous waste from home in a comprehensive waste management plant. Collection of waste from hospitals, clinics, and diagnostic centers in separate vans.
6. Collecting Faecal waste according to the public needs of the concerned upazila and recycling and composting in an integrated waste management plant.
7. Maintenance of all vehicles, door-to-door organic waste collection through vehicles, collection of plastic/inorganic and hazardous waste from STS/permanent bins, sewage collection.
8. Maintenance of Income and Expenditure Accounts, receipt of estimates from WATSAN Committee.
9. Daily income/revenue deposited in the designated bank the next morning, receipt of sanctioned expenditure by check from WATSAN Committee.
10. Bringing plants under sustainable management.
11. After the completion of the project period, he will serve for the next 5 years. If the plant fails to operate at a profitable level after 5 years of the project period, all funds received during the project will be refunded.
12. Initiatives will be taken during the project period as well as later to increase public awareness.

Facilities

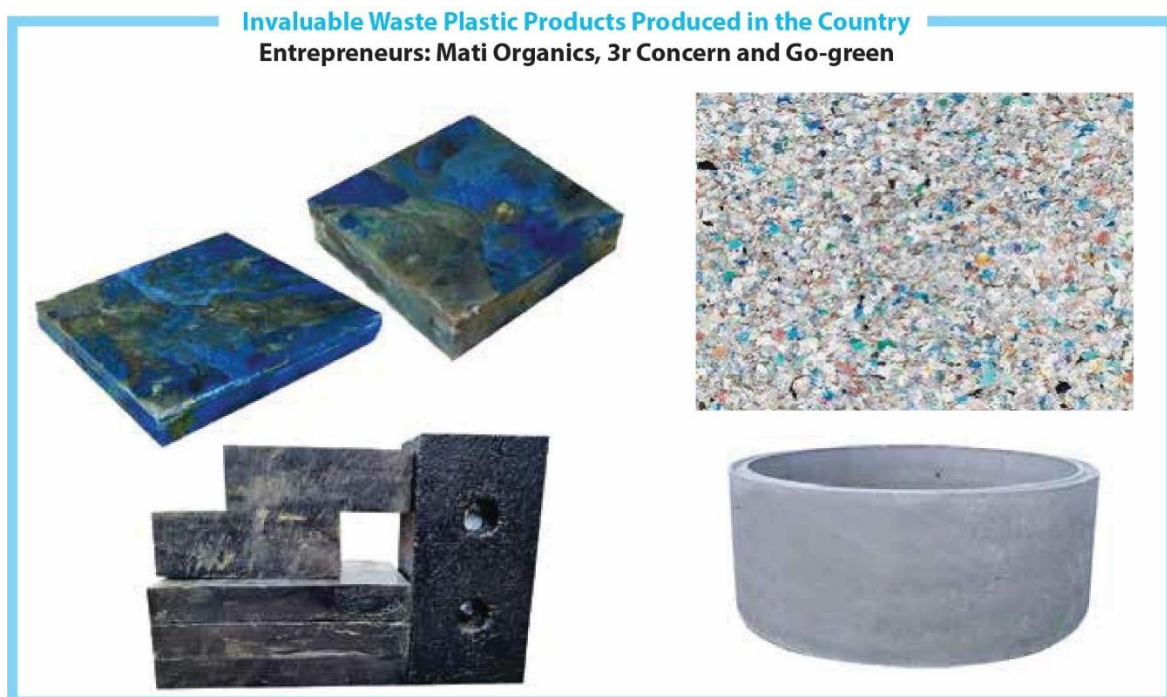
1. 15% of the projected income will be received as a service charge every month during the project period. At the end of the project will get the same rate as the service charge from the income.
2. An operator organization will carry out the entire responsibility of an upazila.

13. Non-valuable Waste Plastic Recycle

We observe plastic anywhere in the world. This is now part of civilization. A good part of the plastic is recycled able. These are usually different containers of water, oil etc. A small part of the plastic volume is nonvaluable and they are not being recycled. These are- polythene, different packaging materials (such as cookies, chips, and food packaging), used rubber shoes etc. It has been observed that a total 2% of the waste of Bangladesh are invaluable plastic. During the last decade, the country has been experiencing flood and water-logging frequently compared to the past. Two of the main reasons behind this are climate change and dumping of polythene and non-valuable plastic in the drains and waterbodies. Most of the dumping sites of the country are being filled very quickly because of the dumping of these nonvaluable plastic. Bangladesh produces around 25000-ton waste every day. 2% of the waste is 500 ton. Therefore, every day, 500-ton waste is being deposited that does not any decomposition or recycling. If the situation continues, we shall need more dumping sites every year. The country will become a series of dumping stations in near future if we cannot address it properly. But this is evident that all types of wastes can be recycled except medical waste. There are clear examples of recycling we can observe

- Organic wastes are recycled as compost fertilizer. They have been proven very important for the recovery of soil health.
- Recycling of valuable plastic has already a huge market in the country and abroad.
- Recycling faecal sludge to compost is popular abroad. Now, Bangladesh has also started this practice in some municipalities.

Recently, a number of green entrepreneurs have started recycling non-valuable plastics. They are recycling them as paving tiles, partition board, brick, and rings for pit latrines, different souvenirs, showpieces etc. It is very important to observe the process during recycling. It cannot be burnt or melted in the open because it pollutes the air severely and is very much harmful to the human breathing system.



LGED Initiative in asphalt pavement construction using plastic waste

Scientists, researchers, and highway engineers are continually working to improve the performance of bitumen that is widely used in road construction. In Bangladesh, the use of 60/70 grade bitumen is being recommended instead of 80/100-grade bitumen which were being used for decades. For continued research, the quality of bitumen is being improved. In spite of this, the road pavements are not sustainable as before because of hectic rainfall in aggravating the climate change situation. In this situation, a new avenue of research is being available. This new avenue of research is recommending use of plastic waste with bitumen. It has been observed that it improves the quality of bitumen to deal with the situation in extreme weather conditions such as erratic rainfall, water-logging or flood.

This research was led by Prof. Rajgopal Vasudeban of Thiajager University of Chennai, India. He applied his research into practice in India. It has been observed in India that use of plastic waste (around 6-9% of total bitumen) in bitumen gives the following advantages compared to usual bituminous road.

- Rutting and deformation in bituminous road are lower
- Lifespan of the road becomes double
- There is minimum low temperature cracking
- The surface property of the aggregates improved by the cover provided by plastic materials
- Road construction costs are lower
- It does not have a difficult construction procedure. It can be used easily.
- It improves the carbon footprint of any country
- It helps the road to withstand better erratic rainfall and water-logging.

A study of Waste Concern reveals that every year Bangladesh produces 821,250 tons of plastic waste. Out of this- only 64% (527,425 tons) are being recycled. The rest amount are being piled up every year in the dumping sites. The use of plastic waste can make a paradigm shift in Bangladesh. Recently, LGED has taken the initiative to apply the research in the Gazipur district. A rural road has been constructed in Gazipur at Piruzali village where the research has been effectively utilized.

LGED has Constructed Rural Roads using Waste Plastic at Piruzali in Gazipur District.



Waste plastic and asphalt are being laid on the base course



Asphalt Pavement with Waste Plastic

14. Conclusion and Recommendation

Capacity Building of Local Government Institutions

Capacity building of the Local Government Institutions is the most important issue for waste management in urban as well as rural areas. It is the demand of the nation for Urban Municipalities, Upazila Parishad, and Union Parishads. The Municipalities have staff for waste management in their organogram. With the help of different governments and developing partner-funded projects, the municipalities are getting waste management plants, waste-carrying vehicles, transfer stations etc. But there are no such initiatives for the Rural Local Bodies, i.e., Upazila Parishads and Union Parishads. Waste Management has been observed as very important in the study. Therefore, the capacity development of Upazila Parishad and Union Parishad will be the most important step for rural waste management. The following table illustrates some of the capacity needs.

Area of Capacity Development	Topics
Policy/ Guideline	According to the Upazila Parishad Manual 2009, there is no specific responsibility of the Upazila Parishad for waste management. On the other hand, The Union Parishad Manual 2009 has assigned the Union Parishads with a number of responsibilities for total waste management. But, considering the management part of an integrated waste management plant- the requirement of waste of a plant cannot be produced within a Union. Usually, Upazila Town/ Upazila level Municipality and a number of adjacent villages can supply the waste required by a plant. Therefore- considering the reality, it is important to involve the Upazila Parishad for better and scientific management of rural waste management.
Manpower	Upazila Parishad will require adequate staff for waste management. At the same time, one Sub Assistant Engineer is to be posted at each Union Parishad for waste management and other activities of the Union Parishad.
Vehicle, Equipment	Required vehicles and required equipment should be delivered in the pilot Union and pilot Upazilas. With the experience of the pilot LGIs, the waste management experience will be replicated in the whole country gradually.

Urban and Rural Integrated Waste Management

There are a number of good examples of integrated solid and faecal waste management in different municipalities in the country. It is estimated that Upazila-level municipalities can also be a profitable and sustainable example for integrated waste management plants. In that case, this plant can also process the waste from the rural markets and the villages adjacent to the municipalities. Therefore, municipal-level waste management plants can process a bigger area than the municipality and also can improve the overall governance of waste management that will include rural areas also. In this situation, the waste management staff (that are already in the organogram) can deal with the waste of the urban as well as adjoining rural areas.

On the other hand, the Upazilas that do not yet have municipalities can set up an integrated plant under the management of Upazila Parishad. Upazila Parishad will need the required staff in this situation.

Management of Waste Management Plant, Business Model, and Monitoring

From the experiences of waste management in urban bodies of Bangladesh, it can be said that it is better to hand over the waste management plant including collection of solid waste and faecal sludge. There, collection of waste and its management at Upazila and Union level should be handed over to ‘operators’. ‘Upazila/Union WATSAN Committee’ will oversee the activities and bill payment of the operator. The business model of waste management may not be profitable at each Upazila/ Union. In that case, revenue earned from the Growth Center/ Hatbazar can be spent on waste management of Upazila and Hatbazar. The Local Government Division can make an official circular regarding the topic.

Employment Opportunity, Investment, and Economic Feasibility of Waste Management

Rural Waste Management has three direct impacts. The improvements of the overall environment including the aquatic environment. Number two, the reduction of water logging. Number three, the creation of employment opportunities. It is possible to create a good number of employments by establishment of waste management plant and the subsequent collection of waste.

But initially, the business model may not be successful in all the Hatbazar, Union or Upazila. It will depend on the management experience of the LGI and the operators. A number of Union/ Upazila will depend on project funds or government revenue. Indeed, it is recommended to continue with waste management irrespective of success with the business model. It may not be successful in all Upazila/ Unions but the waste management will save the citizen from environmental hazards and the continued improvement of environment will improve the living standard of the rural people. Some people can ask, why we need to invest for waste management if it cannot be a good business model. In this situation, we can compare the investment of waste management with the investment in rural roads development and maintenance. The rural road requires maintenance funds every year. In return, it circulates the rural economy. Similarly, waste management can circulate a lively environment. Without waste management, the living standard will deteriorate gradually. Therefore, the government can allocate budget for rural waste management as it allocates budget for rural road maintenance.

Annexures

1 Case Studies on Solid Waste Management (SWM)

A. Compost Comes to Farmer's Rescue

Where/ context

Buchayyagari Palli is a small Village/hamlet in Bukkapatnam Mandal in Anantapur District of Andhra Pradesh State, India. It comes under Bukkapatnam Panchayath. It belongs to Rayalaseema region. Total population of Buchaiahgari Palli is 12069 (Males: 6210 and Females: 5,859) living in 2803 houses.

What/ initiation or planning process

Before practicing pit composting, the farmers of Buchayyagari village like Mr. Ramakrishna used chemical fertilizers as a result faced repeated incidents of crop failure. few of them were forced to look for an alternative livelihood option and took up mango plantation in their land with assistance of MGNREGS. In the past most of the farmers always used farm yard manure for agriculture. However, Mr. Ramakrishna collected manure from his farm which was inadequate. Every year he purchased two tractor loads of manure for Rs. 20,000. The DWMA (District Water Management Agency) in Anantapuramu was providing support to set up NADEP compost units under MGNREGS for individual households.



CAPEX and OPEX

The NADEP compost units was constructed at a cost of Rs.13,000 through MGNREGS. Under the technical guidance of the MGNREGS staff, Ramakrishna layered it with dung, dry and green agricultural waste and fine sieved soil. Rapid decomposition of organic waste through microbiological activity resulted in the making of compost. He can obtain high quality manure at a very low cost about 30 – 35 kgs of manure in a period of 3 – 4 months.

Service level

It is suitable also for household based or community based or union-based composting in Bangladesh.

Challenges

- Sensitize on proper waste management practices
- Reluctant to segregate dry and wet waste in separate bins
- Cannot refill until decomposed or buried waste
- Require more space and time for produce compost

Lesson learnt

- Obtain high quality manure at a very low cost in a period of 3 – 4 months.

B. An effective waste management system in Gandipet village

Where/ context

Gandipet village is located in Rajendranagar mandal of Rangareddy district in Telangana, India. It is situated 16km away from sub-district headquarter Rajendranagar (tehsildar office) and 20km away from district headquarter Hyderabad. As per 2009 stats, Gandipet village is also a gram panchayat. The village has a total 2,966 population (male: 1515; female: 1451) living in 537 Houses.

What/ initiation or planning process

Before 2016, the dump yard near Gandipet village doesn't look like one. The village has no designated landfill site. The area near the origin of Musi River in Gandipet was converted into a trenching ground. Two years ago, hundreds of cattle from a nearby Goshala died due to consumption of plastic along with wet waste in the village. This incident triggered Rajashree P, Aravind G and Venugopal Rao to take up the activity of making the village garbage free. The trio approached the local panchayat and with its



help, Gandipet Welfare Society sets up a composting plant in January 2016 on the very same dump yard. There are 15 piles, each in a different stage of composting, with labels indicating the initial date of waste and temperature recorded each day. The unit follows aerobic method of composting and each pile is turned over every three or four days to regulate temperature and let the microbes and maggots enable the composting process. Flowering plants lining the composting unit speak of the change in the area.

The awareness drive worked and 700 households and nearby Gated communities implemented the practice of source segregation on a daily basis. While no fee is levied on villagers for processing round 700 kilos wet waste per day, the Gated communities are charged a nominal fee and in return they are given back the compost produced. Around 1,000 kilos of dry garbage's are generated every month which is given to recycling centres.

CAPEX and OPEX

The Gandipet Welfare Society, with corporate funding (see box), generated ₹12 lakh to set up the composting unit shed, while the sarpanch helped in setting up the transformer to provide electricity at the unit to run the sieving and shredding machines, lights and CCTV cameras. The surveillance cameras help them identify anyone who dumps mixed waste in the area late at night.

The composting unit handles close to 1000kg waste per day. The composting plant produces and sells around 3-4 tons of compost every month. Some of the compost is given to houses in the village and gated communities for garden use and the rest is sold at ₹40 per kg, the proceeds going into a welfare fund. The compost is sent to Prof. Jayashankar Telangana State Agricultural University for quality check once in three months.

Service level

Target communities and gated communities. It is suitable also for union-based composting in Bangladesh.

Challenges

- Ensure the participation of target communities for sensitization on waste management
- Negative attitude towards waste management by Gandipet Welfare Society
- Change mindset government responsibilities to own responsibilities
- Reluctant to segregate dry and wet waste in separate bins

Lesson learnt

Combined effort of target communities could ensure proper waste management.

C. Windrow composting in Aurangabad Municipal Corporation

Where/ context

Aurangabad was recognised as one of the major industrial centre in central Maharashtra and the fastest growing industrial city in Asia with industries spread over different parts. The variety of Industrial centers located includes five stars at Shendra, Chikalthana, Waluj, Pandharpur and Paithan MIDC area. These industries have provided growth opportunity. The Aurangabad Municipal Council (AMC) was established in 1936. It became a Municipal Corporation in 1982. As per last census 2011, the total population of the district was 11,77,330. The current population of Aurangabad urban agglomerate is over 15.5 Lakh.

What/ initiation or planning process

Till 2014 the municipal body was collecting mixed waste from households and dumping points and transporting it all to the dumping ground at Naregaon-Mandki due to faced many problems relating to public health and environment. The AMC produces around 400 to 500 tonnes of solid waste per day. The unscientific disposal of solid waste at Naregaon is creating many environmental and pollution problems. Rag-pickers, workers, vehicle drivers, and those residing in the nearby areas are continuously exposed to air pollution.

The Aurangabad Municipal Corporation (AMC) has introduced windrow composting facilities in 12 civic wards for effective processing of the waste. The 12 wards generate a total of 100 tonnes of waste. About 60% of this, or 60 tonnes, of waste is expected to be processed at the windrow composting centres. The civic body has recently launched the phase I of Mazi City Taka Tak (MCTT) campaign in 12 wards focusing on segregation of waste. Now, in a bid to convert the waste into manure, the civic body is moving ahead with windrow or aerobic composting of waste, an AMC official said.

The windrow composting system and recycling waste centre established recently under the MCTT campaign in Zone A has become an attraction for all. Recently, civil engineering students from Amrut Vahini Polytechnic College, Sangamner visited Aurangabad specially to understand the processes being implemented under the MCTT campaign.

CAPEX and OPEX

Service level

- The community-based solid waste decomposition is an ideal and safe disposal method

Challenges

- The time required for windrow composting can range from two to six months depending on the level of maintenance applied.

Lesson learnt

- Biological decomposition of segregated organic waste is more beneficial for solid waste management, as it easily converts waste to valuable fertilizer, said an environmentalist.

D. Wealth from waste

Where/ context

Malkapur village is located in Tupran mandal of Medak district in Telangana, India. It is situated 14km away from sub-district headquarter Tupran (tehsildar office) and 68km away from district headquarter Sangareddy. As per 2009 stats, Malkapur village is also a gram panchayat. According to census 2011, the village has a total population of 1,358 peoples, out of which male population is 671 while female population is 687. There are about 292 houses in Malkapur village.

What/ initiation or planning process

Segregating wet and dry garbage at source has become a herculean task for the sanitation staff in both urban and rural areas. Despite repeated appeals, people are not responding positively, thereby increasing burden on the authorities. “Initially, people were reluctant to segregate. After attending Self Help Group (SHG) meetings and learned about the advantage of segregation. It took a few months to convince them. The villagers are now able to understand, making the job easy. It was made possible by involving youth and women.



Not only Malkapur village of Medak producing vermi compost but also more than 100 villages in the district are already producing that is being used by the farmers in their fields instead of chemical fertilizers. Collector K. Dharma Reddy personally took the responsibility and motivated the public in this regard.

CAPEX and OPEX

The Malkapur village has earned an amount of ₹ 10,500 by selling vermicompost that was produced from waste. This is in addition to supplying the compost to the nurseries in the village. Recently the village auctioned the compost for ₹ 6 per kilogram. They are getting ready for one more auction. Under normal weather conditions, worms take 40 to 45 days to produce the compost, which looks like soil and produces no odour.

Service level

It suitable for household, community or union level composting.

Challenges

- Reluctant to segregate dry and wet waste in separate bins
- Ensure proactive participation in Self Help Group (SHG) meetings

Lesson learnt

- Combined effort of communities could ensure proper waste management.

E. Public-Private Partnership for Sanitary Landfill in the West Bank and Gaza

Where/ context

For many years, solid waste in the West Bank and Gaza was disposed of in unregulated dumpsites or burned illegally. Unstable political and economic conditions hindered municipalities from investing sufficiently in solid waste management infrastructure and services. This area is home to nearly 1 million people who generate almost 500 metric tons of waste each day.

What/ initiation or planning process

To help mitigate this situation, The World Bank, the European Commission, the United States Agency for International Development, and the Government of Italy provided funding for a sanitary landfill at Al-Minya, two transfer stations, and related infrastructure for Hebron and Bethlehem in the Southern West Bank. Local governments did not have the capacity to sustainably manage this new infrastructure, so the Joint Services Council for Hebron and Bethlehem (JSC-H&B) worked with the International Finance Corporation to design a PPP to identify a private sector partner who could manage the landfill. In September 2013, JSC-H&B signed a contract with a Greek consortium, W.A.T.T. S.A.-MESOGEOS S.A. and EPEM S.A., to manage the Al-Minya landfill, two transfer stations at Hebron and Tarqoumiya, and the transfer of waste between the transfer station and the landfill. Local municipalities are still responsible for primary waste collection, and JSC-H&B provides a minimum waste guarantee of 500 metric tons per day and pays fees per ton of waste managed.

CAPEX and OPEX

JSC-H&B was not able to cover the costs of the PPP, the World Bank group also structured an \$8 million output-based grant from the Global Partnership on Output Based Aid to help cover operating fees and improve the sustainability of the solid waste management system. The project has created over 100 jobs, improved services for 840,000 residents, and will

reduce greenhouse gases by 13,400 metric tons by 2021. Additionally, another grant by The World Bank ensured that informal sector workers were trained to work in other areas.

Service level

This sanitary landfill covers targeted areas west bank and Gaza. This type of sanitary land is suitable for upazila or district level in Bangladesh.

Challenges

- Only local government institutes aren't capable to sustainably manage this new infrastructure.

Lesson learnt

- PPP will be a great initiative to construct, operation and maintenance of sanitary landfill.

2. Case Studies on Faecal Sludge Management (FSM)

A. A toilet to be proud of

Where/ context

Satkhira is a district in southwestern Bangladesh and is part of Khulna Division. It lies along the border with West Bengal, India. It is on the bank of the Arpangachhia River. According to the BBS census 2011, the total population is 19,85,959 (male: 9,82,777 and female: 10,03,182). Around 62% households of this district are coverage in sanitation which 60.54% are sanitary latrine, 35.98 non-sanitary latrine and 3.6% have no latrine.

What/ initiation or planning process

For a long time, Eti's father had been troubled by the poor sanitation situation for his family. He could see how it was making his wife and children sick. But Ziarul wondered how he could ever afford a better latrine for the family when all he earned was 200 taka (roughly \$2.30) a day as daily wage laborer. While scouting for work one day, Ziarul



came upon a shop selling latrine supplies. Hafizur, the owner, is one of hundreds of entrepreneurs involved in a UNICEF-supported project to improve sanitation for more than one million Bangladeshi households by 2024. The “Scaling Up Sanitation Market Systems in Bangladesh” programme aims to achieve this by ensuring toilets are available to all children and affordable by their families, however modest their income. One way is through financial subsidies in the form of vouchers worth \$50, which are given to 70,000 of the poorest households to spend on purchasing a twin pit toilet. As a participant of the programme, Hafizur received training on different types of improved latrines, how to make the parts, and how to source materials from private sector companies. He also learned about bookkeeping, customer service, strategies for increasing sales and the importance of raising awareness about good hygiene practices among his customers.

CAPEX and OPEX

Putting those skills to use, Hafizur convinced Ziarul to invest in new latrine parts that he could pay off in instalments. He also explained to Ziarul the benefits of handwashing with soap and water. In total, Ziarul spent 3,300 taka (approximately \$40) on toilet rings, pipes and a new slab.

Service level

This kind of latrine ensures that faces can be more safely disposed of through pipes connecting to a pit.

Challenges

- Totally unhygienic
- Non-environment friendly
- Flies entrance and exit into the containment
- Poor access of physically challenge people

Lesson learnt

The basic latrine will be more suitable for ordinary households and those with little capacity and land. Those households can easily afford the offset latrine.

B. An experience of hanging latrine to sanitary latrine

Where/ context

In Northern Bangladesh, Rojina and her family of five used a hanging toilet close to their home. A hanging toilet often consists of makeshift materials such as cloth or bamboo and is built over water. The toilet was completely open and without any privacy, Rojina and her family members did not feel comfortable or safe using it. In addition, hanging toilets contaminate the water below and increase the risk of disease.

What/ initiation or planning process

Imagine if you had no privacy while using the toilet. For Rojina Khatun and her family, this was a daily struggle. As low-income earners, Rojina's family could not afford to build a new toilet. In the mean time she observed that her neighbour, Selina, who is part of a water and sanitation committee that Habitat for Humanity has organized in Northern Bangladesh, informed Rojina of a low-interest micro-loan that they could use to build a new toilet.

Although her husband was initially hesitant to take up the loan, Selina and the committee convinced him about the importance of clean water and safe hygiene and sanitation practices in the community. Improved access to safe water and sanitation facilities along with enhanced knowledge around hygiene practices means healthier, stronger communities that can sustain themselves.

With the support of the Australian Aid program through the Civil Society WASH Fund and our local partners in Bangladesh, Rojina and her family were able to build themselves a new toilet in February this year. In addition, she received further training on safe hygiene practices which she was able to pass on to the rest of her family.

“Earlier, there was a lot of dirt at our toilet and the flies were everywhere – we had to defecate by covering our noses,” said Rojina’s son, Shoukot. “I am very happy now, because our family has a sanitary toilet, which will reduce waterborne diseases in my family. The



support of Habitat for Humanity to construct a toilet is a good opportunity for the poor families like us who don't have the ability to do this on our own.”

With your support, we have been able to impact Rojina's family and many others in Northern Bangladesh. Thank you for giving families in need a healthier, more secure future.

CAPEX and OPEX

- No available information

Service level

The sanitary latrine is installed at household level.

Challenges

- Ensure skilled/ trained masons to install in rural areas
- Filled out the pit quickly and need to emptying

Lesson learnt

- Low-interest micro-loan as WASH fund could be an alternate option to install sanitary latrine
- Sanitary latrine could be prevented disease transmission

C. An onsite faecal sludge management system in in Marora village of Haryana, India

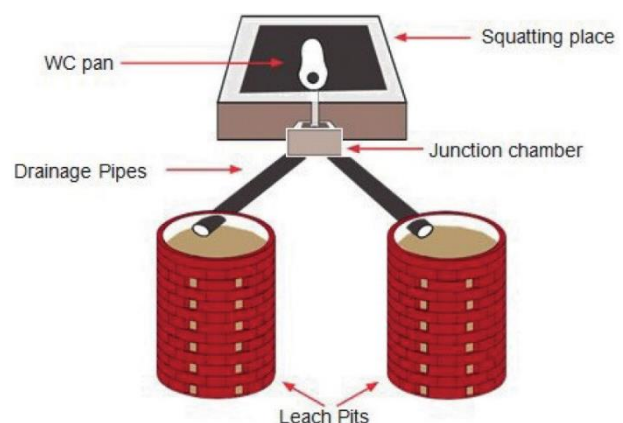
Where/ context

Marora is a Village in Nuh Tehsil in Mewat District of Haryana State, India. It belongs to Gurgaon Division. It is located 25 KM towards South from District headquarters Nuh. 26 KM from Nuh. 368 KM from State capital Chandigarh. The total population is 611 and number of households are 95. This Village Covered Under Total Sanitation.

What/ initiation or planning process

Until 2017, the village wasn't open defecation free and practices unhygienic toilets due to most of them were affected in waterborne diseases as well as pollute the environment and losses wellbeing day by day. To achieve SDG 6.2 and considering the negative effects, Sulabh International had constructed 95 Y junction twin pit toilets in the village in 2017-18. It is a recommended toilet technology as per the World Health Organization (WHO) and was promoted under Swachh Bharat Abhiyan as well.

Mehboobi, a resident of Marora village mentioned that we had to go to a barren land or in the fields far away to relieve ourselves before constructing the toilet. At night or when it rained water would accumulate, it would become difficult for us, especially for girls to go out and defecate. Now my husband and I can use the toilet whenever we want. She as well as her family members are felt proud and happy because they had a toilet which



looks and functions more or less like a regular toilet but with an added benefit of converting human waste into manure.

She said “Not only her but similar stories also were narrated by other villagers as “We are now one of the open defecation free (ODF) village in Haryana, India”. The villagers relive the transition from defecating in the open to now owning a toilet.

Mehboobi as well as the using households quotes as “After installing the twin pit latrine, we have received training on its operation and maintenance.” They are/will use the first until gets filled and stop using for two years to degrade and turn into manure which can then be used for agriculture purposes or sold at a nominal price. After first pit gets filled, they are/ will use the second pit until gets filled. Finally, she says “I think the villagers of other villages should install this toilet and converting the waste into manure which has been used in agriculture purposes as well as enhance healthy environment.”

CAPEX and OPEX

The construction cost of Y Junction Twin Pit toilet was Rs. 12,000, says Mr. Jha, Project Leader, Learning and Knowledge Management, India Sanitation Coalition, FICCI. Its OPEX was around Rs. 200 per month. The final emptying cost of each pit will depend on emptying system. If the toilet owner empties the pit by himself/ herself, it will no cost. If he or she hire manual labour or mechanical system to empty the pit, the cost will depend on that time which will set by the labour or service provider.

Service level

The Y junction twin pit toilets are constructed at household level.

Challenges

- This toilet couldn't use in high water table areas.
- It may lead to ground water contamination without water sealed pit.
- It is very difficult to install in rocky areas.
- The junction might clog due to bulky cleansing materials are used.

Lesson learnt

- The excavation of humus is easier than faecal sludge.
- This toilet could be built and repaired with locally available materials
- It treats human waste naturally without polluting water, air or the soil.
- It is easy to ensure onsite faecal sludge management at the household level.

D. My Toilet, Income generation Toilet

Where/ context

Ms. Tanzila Begum, a poor woman who live in Amarak village of Gobratola union under Chapai Nawabganj, Bangladesh with her four family members. She is very happy to use the EcoSan toilet provided by the SPACE with the financial support of *Ashar Gan Onlus*. She mentioned that her toilet is environment and public health friendly because it doesn't pollute our environment, soil and water, rather it assists to improves the soil quality and crop production producing the bio-fertilizer.

What/ initiation or planning process

She wasn't happy before installing the EcoSan toilet in her house because she has no toilet due to her family members practiced open defecation. It was very shameful and difficult for them to defecate in the open place during day time and sometimes faced health problems (dysentery, diarrhea etc.) also. In this situation the employees of SPACE met with her and advise to install environment friendly toilet like EcoSan toilet. After listening the benefits like compost fertilizer production, use of urine etc., she agreed to install the toilet in her house at 2015.

She had received training on use, operation and maintenance of EcoSan toilet through SPACE employee. As advise of the SPACE employee, she applied urine and compost of EcoSan toilet in her mango and lemon tree which weren't produce mango and lemon before applying urine and compost. After applying these, she observed that the lemon and mango trees produce lemons and mangoes which is very testy. She applies the products of EcoSan in their crop field and found better results than application of chemical fertilizers.



Figure: Applying urine to Mango tree



Figure: Drying the compost fertilizer

She said that she isn't not only the EcoSan Toilet user in her village. There are more than 60 EcoSan toilet has been installed by SPACE with the assistance of *UNICEF* and *Ashar Gan Onlus*. Now a day she has collected the compost of other EcoSan toilets and sell it to farmers of the village and make profit from it. She told, "I am very happy using the EcoSan toilet and its products. My toilet isn't a traditional toilet, *my toilet is money making toilet*".

Finally, she thanks *SPACE* and *Ashar Gan Onlus*, and requests the government to replicate this technology around the country.

CAPEX and OPEX

The construction cost of Eco Toilet is BDT 30,000 which was donated by the *Ashar Gan Onlus*. The O&M cost is BDT 100 per month for cleaning the inside of the toilet cubicle. However, she had earned BDT 300 selling EcoSan products like co-compost.

Service level

It is suitable for individual household or a community.

Challenges

- *O&M is very difficult without* appropriate prior training
- *Requires more frequent emptying* (but easier, every 6 to 8 months (faeces) and 30 days (urine)) than other types
- *Ash, sawdust, or dirt needs to be added* after use properly

Lesson learnt

- Community mobilization could ensure Eco Toilet in each household of a community.

E. Co-Composting of Faecal Sludge and Municipal Organic Waste in Sakhipur Municipality, Bangladesh

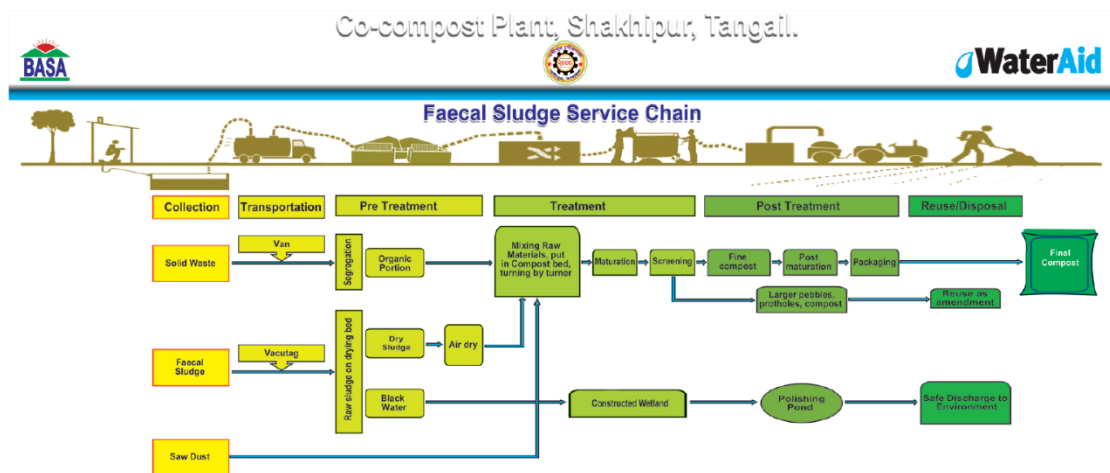
Where/ context

Sakhipur municipality is about 96 kilometres from Dhaka, the capital of Bangladesh. Covering an area of around 18 km², Sakhipur became a municipality in October 2000 and has a population of 32,000 people living in a residential area of around eight km², which translates as a population density of 2,611 people/km² (2011). In recent years, Sakhipur has been experiencing rapid increase in population, and this, coupled with insufficient waste management strategies, has led to the accumulation of considerable amount of waste in and around the city.

What/ initiation or planning process

The municipality does not have a dedicated sewerage system, and on-site sanitation technologies mainly comprise septic tanks and pit latrines of various types. The most common practice is to close a pit when it is full, and dig a new pit. When a pit or tank needs to be reused, professional sweepers are employed to do the emptying. The sweepers manually evacuate the pits and tanks and take the wastes to the disposal points. Due to lack of proper maintenance, emptying and collection services, accumulated sludge from the on-site sanitation units overflows and discharges in nearby open drains, water bodies and forest. This causes a considerable negative impact on public health and harm to the environment.

Solid waste management in the municipality is also inadequate. There are no dustbins nor any designated waste disposal sites. As a result, city dwellers generally dispose of their household waste in ditches, at the roadside or into drains. The municipality has the capacity to collect about 5.0 tons of municipal solid waste, and disposes of that waste on to land. The municipality has only one truck for solid waste collection and disposal.



Considering the solid waste and faecal sludge generation as well as management issues along with negative impacts, the municipality leased a 0.3-acre plot of land outside the city centre for the co-composting plant. WaterAid Bangladesh and Bangladesh Association of Social Advancement (BASA) during design of the co-composting plant in Sakhipur. Construction work started in 2015, and the plant became fully operational in January 2016.

The purpose of co-composting plant is to contribute to improving faecal sludge and solid waste management, and hence public health. The cocomposting plant also created an opportunity to inform scientific and practical knowledge on the technical and operational aspects of co-composting faecal sludge and solid waste in towns in Bangladesh. The cocomposting plant consists unplanted drying beds, constructed wetland and Aerobic decomposition (composting) unit of dried faecal sludge and organic solid waste. The plant has been used one VaccuTag for Faecal sludge collection and transportation along with the solid waste collection van and dumping truck. The co-composting plant handles 125 metric tons of solid waste and 1200 metric ton Faecal sludge a year, and organic components are screened during the separation process, and the inorganic part is recycled and used by industry.

CAPEX and OPEX

The fee for faecal sludge collection and transportation is BDT 500 (USD 6.50) per trip within the municipality; while study team outside the municipality pay more for the extra fuel. An estimated USD 7,000 is collected annually in fees for these services. An additional USD 6,000 per year has been raised from sales of compost. Operation of the co-composting plant is labour intensive, with a plant supervisor, two solid waste segregators and three personnel working with the Vacutug. Solid waste sorting is the costliest activity, accounting for around 30 percent of the total operation and maintenance cost.

Approximately 24 metric tonnes of compost is produced yearly. Demand for the compost is in and around the town, and local Department of Agriculture officials advise farmers to use

this compost. The municipal authority sells the compost directly to local farmers for BDT 15.00 (USD 0.20)/kg, and the farmers use this compost to produce different vegetables.

Service level

- This service covers whole Paurashava.

Challenges

- Very large infrastructure cost
- Heavy dependence on energy source
- Large amount of sludge generated
- •Poor maintenance hampers in proper treatment of sludge

Lesson learnt

- Produce co-compost
- Earn money selling compost and STP related services like emptying containment and transportation

F. Community based sanitation system

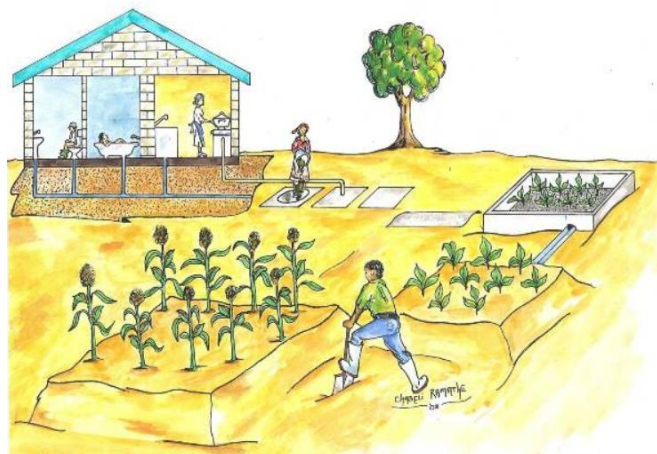
Where/ context

Chikkalli village is in Mysore Taluk of Mysore district in Karnataka, India. It is located 8 km far from Mysore. Both district & sub-district headquarter of Chikkalli village in Mysore. The total population of the village is 2213 along with 1133 men and 1030 women. There are approximately 528 homes in Chikkalli village.

What/ initiation or planning process

Every house has its toilets with a soak pit facility and bathrooms that are connected to the wastewater drainage. And drainage connects every house in the village and goes outside the village for nearly 500meters and reaches the nearest water body. but the problem is the water is directly disposing to the waterbody without treatment and that waterbody is indirectly connecting and will be affecting the Varuna Lake in this village.

Considering the negative effects and stop of directly dispose wastewater, the DEWATS is designed for the population of 2213 with the capacity of treating the wastewater of 133 m³/day. And designed the screening chamber of (LXBXD) 1.2X0.4X0.6m having 9 screening bars with 450 anglers with 0.36m Length. And the Anaerobic baffled reactor of 11X1.5X3m size with 3 chambers. And the Anaerobic filter of 7X1X2.25m length with 3 filter tanks with gravel filter of 1m depth. And Horizontal flow filter of 20X5X3m size



with 7 chambers out of 4 are for water collection and in between, 3 are containing the filter materials of gravel, Charcoal, sand for treatment. This DEWAT System treats the wastewater by removing the Turbidity, BOD, COD as the treatment and reuse that water for agricultural activities and gardening purposes for the village.

DEWATS is reliable, durable, and resistant to load fluctuations. They are successfully constructed and operated almost anywhere because they operate in the natural wastewater treatment process and do not require any special equipment, chemicals, or electricity.

CAPEX and OPEX

The design should be low budget. For this village, the cost of the DEWAT system is Rs 6,41,460. Compared with other treatments, it requires less maintenance.

Service level

- Suitable for community-based waste water management

Challenges

- Ensure the participation of target community people in awareness events and their proactiveness
- The willingness of relevant organizations to consider alternatives to conventional swearing and wastewater treatment
- Keeping up with Discharge and reuse Standards
- Improving efficiency of AF module
- Broadening the Application areas

Lesson learnt

DEWATS structures are effective, dependable, cost-efficient, and personalized wastewater treatment structures, that are ideally suited for small to medium-length structures on the community level.

G. Bio-Toilets in Low Income Communities (Slums)

Where/ context

Bhubaneswar is the capital of the Indian state of Odisha. It is the largest city in Odisha and is a center of economic and religious importance in Eastern India. Bhubaneswar is often referred to as a "Temple City of India". But there are 338 unauthorized slums in Bhubaneswar - many households do not have toilets and a few who have sanitary toilets have no drainage, water and maintenance facilities!!

What/ initiation or planning process

The slum dwellers who don't have toilets goes to adjacent fallow field for defecation. When the evening light fades, the woman balances little one on one hip and with her older daughters' head single-file towards the fields. Shrouded in dark ness, the girls spread out, pulling down their saris or shalwar's. They're frightened, uncomfortable and trying to hurry up as a tractor's shudders past about 20 meters away, driven by men. As they wash and walk back to the village, other girls and women appear in pairs and small groups from the gloom.

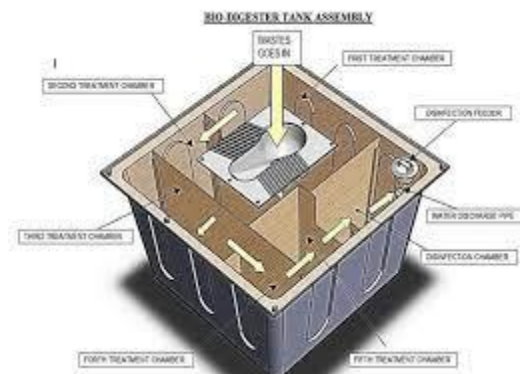
Since 1990, the Indian government has introduced nationwide campaigns to improve sanitation facilities across the country—first under the Total Sanitation Campaign (TSC), and most recently under the Swachh Bharat Mission (SBM). However, the lack of improved sanitation remains a major public health concern.



Individual pour and flush toilets are needed but this is not a feasible option due to the unavailability of required space. Most importantly, a water facility for the toilets is also necessary.

Since a bio-toilet is an innovative technology for disposal of solid human waste in an eco-friendly, economical and hygienic manner, this type of toilet is preferred over other types of toilets considering the local context particularly in urban slums.

The global Rotary project (GG1757749) has been implementing with aim to help deal with the chronic, acute shame, embarrassment and fear that Indian women and girls must deal with at least once a day, every day. The International Club facilitating the project is the Rotary Club of Chatswood Sunrise. The project is partnered with the Lutheran World Service India Trust (LWSIT) which will help measure success. Local community groups, Mahila Samity and SHG are promoted by LWSIT and are very active in taking initiatives to improve the conditions of their local communities.



CAPEX and OPEX

The project has installed 40 Bio Toilets spending total USD 31,500.

Service level

It is suitable for individual families and community level also.

Challenges

- Washout of existing Bio Inoculums.
- Frequent charging / replacement of bio culture (2-3 months).
- Depletion of culture because of use of harsh cleaning chemicals.
- Foul Smell making the whole system unfriendly, unhygienic.
- Bio-Digesters are anaerobic and requires anaerobic culture for better organic degradation.

- Supportive fast acting culture to multiply bacterial colonies will withstand various shocks.
- All existing efforts are to control odor from the surfaces whereas problem and source is elsewhere.

Lesson learnt

- Biology has increasing applications in the day-to-day life and Bio-products are perfect replacement for traditional technology like chemicals or so-called Green Chemicals.
- Bio products gives causative solution, they are environment friendly, economical and safe to use.

H. Sanitary toilet in water logged areas

Where/ context

Munroe Island is one of the small Grama Panchayats in Chittumala Block of Kollam District, Kerala. The origination of island was from the delta formation of the Kallada River. Altogether there are mainly six marooned islands. A railway line is passing through the island for a length of 2.50 kilo meter by dividing the panchayat into two. After the construction of the Thenmala Dam across Kallada river, the nature of the flow ceases and the natural ecological systems of the island changes drastically. Munroethuruth panchayat has total 10013 who lives in 2509 families.

What/ initiation or planning process

The tsunami occurred on 2004 made the conditions in the Island worse. Now the buildings in the islands are sinking in the ground considerably and during the high tide water enters upto the floor level of the houses. This phenomenon was very minimal in the beginning. But significant changes occurred post tsunami. A baseline survey conducted by the government in 2015 regarding the sanitation facilities revealed that 363 families were not having sanitary toilets. In houses having toilets, the outlets ended-up in the near-by stream which polluted the stream. The people are not concerned about the pollution caused by the insanitary toilets. Their concern was to have a covered cabin to defecate. Construction of two pit toilets or septic tank was not possible in the area having high-water table.

Out of the 363 families' sans toilets, 142 were living in almost dry area (eastern line of railway line). Hence, they were provided with two pit toilets under the ODF scheme. For the rest of 221 families, providing sanitary arrangements were actually a herculean challenge. In consultation with the District Sanitation Committee and Technical Committee number of options were discussed.



Bio-toilets and eco-san were not feasible. The committee finally decided to provide light weight readymade toilet cabins and advanced septic tanks.

M/s Ram Biologicals, one of the Service Providers of Suchitwa Mission was entrusted to provide the readymade toilets. The normal platform is made using solid cement blocks up to the floor level (90 cm height) and the PUF cabin of size (95 cm x 1.22 m) is fixed over the platform. The 800-litre capacity septic tank is having 1.5-meter height and 110 diameters; 90 cm of which is placed below the ground level and 60 cm above is found as an alternative to the conventional septic tanks. The closet is connected to the inlet of the septic tank. The effluent from the outlet passes through a filter tank (soak pit) 60 cm above the ground level having inside dimensions 50 cm x 50 cm. It is filled with different layers of 20mm metal, 6 mm metal chips, sand, coconut shell, charcoal and the clear water is allowed to seep under the ground.

CAPEX and OPEX

The unit cost for providing the above system was 57,900/- out of which 13000/- is for civil works and Rs.44,900/- for the super structure and other arrangements.

Service level

Suitable for individual families and water-logged areas

Challenges

- Require more space to construct septic tank and soakage pit
- Construction cost and sludge removal cost is too high
- Irregular emptying causes of sedimentation in septic tank
- High risk of clogging in soakage pit
- Not a suitable technology for countries/areas with colder climates
- Not very effective and efficient technology for high volume of discharged effluents daily

Lesson learnt

- Simple onsite sewage facility
- The accumulated faecal sludge must be periodically removed, which is commonly done with a vacuum truck or Vacutug