Sanitation Capacity Building Platform

DETAILED PROJECT REPORT 2018

IMPLEMENTATION OF FAECAL SLUDGE AND SEPTAGE MANAGEMENT SOLUTIONS FOR BAGRU, RAJASTHAN

National Institute of Urban Affairs (NIUA)
Sanitation and Capacity Building Platform (SCBP)

National Institute of Urban Affairs

ORGANISATION CONTACT DETAILS:

Layout &Design: CDD Society | knowledge-mgt@cddindia.org

CDD Society

Survey No.205 ,Opp. Beedi Workers Colony,

Kommaghatta Road, Bandemath, Kengeri Satellite

Town, Bengaluru, Karnataka 560060

PREPARED BY

Consortium for DEWATS Dissemination Society

IN ASSOCIATION WITH

National Institute of Urban Affairs

Detailed Project Report Part A: Sanitation situation assessment & Technology Design

1	Proposal	:	Faecal Sludge and Septage Management (FSSM)
2	Name of the State/UT	:	Rajasthan
3	Name of the City	:	Bagru
4	Objectives	:	To assess the current gaps in sanitation in the town of Bagru and suggest sustainable and cost-effective ways to manage the faecal sludge and septage generated within its boundaries. Furthermore, the DPR also estimates the quality and quantity of faecal sludge generated from Bagru and proposes a treatment solution along with transport and conveyance of faecal sludge.
5	Background	:	The Department of Local Self Government Rajasthan is keen on implementing Faecal Sludge Management in 100 towns which are not being funded by state or central schemes such as AMRUT, Smart Cities Mission or UIDSSMT. These are primarily towns with population less than 50,000 and water supply less than 100 LPCD.
6	Present Status	:	No faecal sludge treatment plant available
7	Need for the Project	:	To specifically provide faecal sludge management solutions for Bagru in Rajasthan.
8	Population - As per 2011 Census - Design year	:	 38,914 58,633
9	Faecal Sludge Generation - Design year	:	2028
10	Project Components i. Details ii. BOQs ready Yes/No iii. Analysis of Rate ready Yes/No	:	FSTP construction, cesspool vehicle requirement. BOQs ready and Analysis of Rate is ready
11	Land Required for Project and status of Land availability	:	5000 m^2 is required and Land is available with the Nagar Palika
12	Estimated cost(proposed)(Rs Lakh)	:	
13	Timelines for implementation of FSTP construction	:	Provided in the report
14	Funding Pattern	:	DLB
15	Whether the project (or part of the	:	No

	project) has been taken up for funding earlier through any other scheme? If Yes, please provide detail of components of the project taken up. Amount sanctioned and expenditure.		
16	Implementing Agency	:	Department of Local Self Government
17	Annual O&M Expenditure(Rs Lakh)	:	
18	Agency responsible for O&M	:	Bagru Nagar Palika
19	Revenue generation (Rs Lakh/ year)	:	
20	CPHEEO's Technical	:	Based on CPHEEO guidelines
21	Whether the project is recommended for Sanction or not(Y/N)	:	
22	If not, please mention reasons and area for improving DPR	:	
23	Estimated cost for consideration and approval (Rs Crore)	:	
24	Approval from Bagru Nagar Palika - Executive Officer - Chairman		

Service Level Benchmarking Indicators – Sewage/Faecal Sludge/Septage

Sl No	Indicator	Unit	Baseline before project	Reliability of measurement	After project	Reliability of measurement
1	Adequacy of Faecal Sludge Treatment Capacity	%	0			
2	Quality of Faecal Sludge Treated	%	0			
3	Extent of Reuse of Faecal Sludge	%	0			
4	Cost Recovery Faecal Sludge Management	%	0			

अधिशाषी अधिकारी
नगर पालिका, बगरू

Santosh Choudhary
अध्यक्ष
नगर पालिका बगरू

EXECUTIVE SUMMARY

The town of Bagru is situated in Jaipur district in Rajasthan. The Population of Bagru is 31,229 for the year 2011. Total 25 wards in the towns which are not planned with drainage system are considered in the generation of faecal sludge. The onsite sanitation systems such as pits and septic tanks in these wards are desludged using mechanical equipment such as vacuum trucks and are currently being disposed of in vacant farmlands on the outskirts of the city, which is an unsafe practice considering the associated health and environmental risks.

Consortium for DEWATS Dissemination (CDD) Society, through this DPR, proposes to implement a faecal sludge treatment plant to serve the households not having access to UGD in the city which can handle 12 Kilo Liters per Day (KLD) of faecal sludge emptied. The faecal sludge treatment plant proposes to convert sludge generated from onsite sanitation systems into safe and reusable products.

The technology proposed involves stabilization of sludge in stabilization reactor and drying in sludge drying beds thereby dewatering the sludge. The percolate water is then treated with DEWATS technology using settler, anaerobic filters, planted gravel filter and sand carbon filter. The by products such as bio solids can be reused in agriculture as soil conditioners and treated water can be used for irrigation or safely disposed into the nearby storm drains.

Following is a summary of the total cost for the project:

Abstract Costing for FSM Project/interventions in Bagru			
Sl No	**Description**		**Actual cost in INR**
1	**Faecal Sludge Treatment Plant(FSTP) - CAPEX**		**₹ 18,290,205**
2A	Faecal Sludge Treatment Plant(FSTP) - Operations and maintenance per year		₹ 1,365,532
2 B	**Faecal Sludge Treatment Plant(FSTP) - Operations and maintenance for 10 years**		**₹ 13,655,319**
3 A	Cesspool Vehicle - Operations and maintenance per year		₹ 1,280,419
3 B	**Cesspool Vehicle - Operations and Maintenance for 10 years**		**₹ 12,804,192**
	Total Project Cost		**₹ 44,749,716**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BOD	- Biological Oxygen Demand
COD	- Chemical Oxygen Demand
CT	- Community Toilet
DEWATS	- Decentralized wastewater Treatment System
EO	- Executive Officer
FS	- Faecal Sludge
FSM	- Faecal Sludge management
HH	- Households
IIHL	- Individual Household Latrine
INR	- Indian Rupees
ODF	- Open defecation free
O&M	- Operation and Maintenance
OR	- Operator Room
PDB	- Planted Drying Bed
PGF	- Planted Gravel Filter
PP	- Polishing Pond
PT	- Public Toilet
SDB	- Sludge Drying Bed
SSH	- Sludge Storage House

GLOSSARY

Biochemical Oxygen Demand

Biochemical oxygen demand is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20°C and is often used as a surrogate of the degree of organic pollution of water.

Bio-solids

They are nutrient rich organic materials resulting from the treatment of domestic sewage in a treatment facility. When treated and processed, these residuals can be recycled and applied as fertilizers to improve and maintain productive soil and stimulate plant growth.

Chemical Oxygen Demand

The chemical oxygen demand is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution. It is commonly expressed in mass of oxygen consumed over volume of solution which in SI units is mg/l. The most common application of COD is in quantifying the amount of oxidizable pollutants found in wastewater.

Cistern Flush Toilet

These are the factory manufactured toilet with a cistern or flush tank attached to the squatting pan where the water is flushed by pulling or pushing the lever of the flush tank which releases the water to flush out the excreta from the toilet.

Desludging

Desludging refers to the process of removing the accumulated faecal sludge or septage from the on-site sanitation systems.

Desludging Operator

A person involved in the collection and cleaning of domestic or commercial septic tanks and pits using a vacuum suction vehicle.

Faecal Sludge

Faecal Sludge (FS) comes from onsite sanitation technologies and has not been transported through a sewer. It is raw or partially digested, a slurry or semi-solid, and results from the collection, storage or treatment of combinations of excreta and black water, with or without grey

water. Examples of on-site technologies include pit latrines, unsewered public ablution blocks, septic tanks, aqua privies, and dry toilets. Faecal Sludge Treatment includes the storage, collection, transport and safe end use or disposal of FS. FS is highly variable in consistency, quantity and concentration.

On-site Sanitation Systems

The on-site Sanitation Systems is a system of sanitation whose storage facilities are contained within the plot occupied by a dwelling and its immediate surroundings. For some systems (e.g. Twin pits), faecal matter treatment is conducted on-site. With other systems (e.g. Septic tanks, single pits) the sludge has to be collected and treated off-site.

Pour Flush Toilets

These are the toilets with pedestals, squatting and water seal where the user pours the water in after every use, instead of coming from the flush tanks. Mostly 2 to 3 liters of water is poured into the toilet pan with certain height to flush out the excreta from the toilet.

Septage

The sludge (semi solid matter) removed periodically from a scientifically constructed septic tank connected to toilets

Septic Tank

A septic tank is a combined sedimentation and digestion tank where the sewage is held for one to two days. During this period, the suspended solids settle down to the bottom. This is accompanied by anaerobic digestion of settled solids and liquid, resulting in reasonable reduction in the volume of sludge, reduction in biodegradable organic matter and release of gases like carbon dioxide, methane and hydrogen sulphide. The effluent although clarified to a large extent, will still contain appreciable amount dissolved and suspended putrescible organic solids and pathogens.

Sewage or Black water

The wastewater generated from toilets that is a mixture of human excreta, urine, anal cleansing and flushing water.

Single Pit Latrine

A sanitation solution including a superstructure and a pit in which faeces, urine and anal cleansing material (water and/or solids) are disposed. The pit is lined to prevent it from

collapsing and provide support to the superstructure, but the bottom of the pit is permeable to release leachate. The ones that are left unlined in the base and sides are locally called kui.

Sullage or Grey water

The wastewater from bathroom, kitchen, washing areas and other anthropogenic activities other than wastewater coming from the toilet is called sullage or grey water.

Twin Pit

The single pit latrine with an additional pit for use, when the first pit is full is a twin pit. It should be possible to dig out a filled pit, after it has stood for a year, without any objectionable smell, whilst the other pit is in use.

1 INTRODUCTION

The waste generation in India has increased sharply owing to rapid population growth and urbanization over the past couple of decades. According to a study conducted by World Bank in 2006, it was estimated that approximately 50% of the Indian population lives in unhygienic conditions. Among the 350 million urban residents in India, 206 million (58.8%) urban households do not have access to a drainage network, of which 102 million (29% of the urban population) are connected to septic tanks, and 60 million (17%) use pit or vault latrines. Though the number of people in India practising open defecation has marginally reduced, the management of on-site sanitation facilities such as septic tanks and pits remain a neglected component of the provision of safe sanitation facilities. With around 102 million septic tanks and 60 million pits in the country (World Bank, 2006), India is yet to establish FSM as a mainstream sanitation approach.

Faecal sludge is a fluid mixture of untreated and partially treated sewage solids, liquids and sludge of human or domestic origin. In other words, faecal sludge is sludge from on-site sanitation systems that is a combination of raw primary sludge and anaerobically digested sludge. Generally, faecal sludge has three main components as follows:

- Scum – floats on top and is generally where the bacteria that live treat the waste
- Effluent – the semi-treated liquid that comprises the majority of the material in the septic tank
- Sludge – solids which collect at the bottom of the tank

The physiochemical characteristics of the faecal sludge can vary depending on the characteristics namely the size and type of onsite sanitation system, design, desludging interval and the local climatic conditions of the place where the tank is located, the quantity and quality of water supplied and the type of wastewater originating from the household (which is user specific).

Faecal Sludge when not managed properly can cause pollution of waterways including groundwater. Though faecal sludge management poses a national problem, it can also be viewed as a potential resource. When properly managed, faecal sludge can be a useful resource than a waste. Faecal Sludge contains plant nutrients such as nitrogen, phosphorous which is contributed by human urine and faeces. Faecal sludge can reduce reliance on chemical fertilizers, and when combined in adequate amounts with fertilizers can provide the requisite nutrients for crop production.

Majority of onsite sanitation systems such as septic tanks and pits require frequent desludging which should be in accordance with the design and capacity of the system. Desludging, however, takes place only when there is odour and overflow of the contents from the tanks, which is much after the treatment efficiency of such systems have fallen. The overflow of the tank then finds its way into the nearest waterways and pollutes it. Faecal sludge, which is rich in nutrients such as nitrogen and phosphorous, disposed of untreated into surface water bodies, could pose a threat of eutrophication.

Adequate facilities and services for collection, transportation, treatment and disposal of urban domestic faecal sludge are non-existent in the majority of Indian cities. Most OSSs are emptied manually in absence of suitable equipment by scavengers. Ideally, a septic tank system should be desludged regularly every 2-5 years. But ignorance towards Operation and Maintenance (O&M) procedures often results in accumulation of sludge at the bottom reducing the effective tank volume which leads to an overflow. This sequence of events ultimately causes failure of the system and release of partially treated or untreated faecal sludge from the septic tank. Private cesspool vehicle operators often do not transport and dispose of faecal sludge several kilometres away from human settlements or in a Sewage Treatment Plant (if existing) and instead dump it in drains, waterways, open land, and agricultural fields.

1.1 SCOPE OF DPR

The scope of this DPR is to assess the current gaps in sanitation in the town of Bagru and suggest sustainable and cost-effective ways to manage the faecal sludge generated within its boundaries. Furthermore, the DPR also estimates the quality and quantity of faecal sludge generated from Bagru and propose a treatment solution along with transport and conveyance of the faecal sludge generated. It includes the detailed design notes for each part of that treatment module and the cost estimations for implementing the same. It details the technical components of the treatment for the purpose of tendering out for civil construction.

2 PROJECT BACKGROUND

The Department of Local Self Government Rajasthan is keen on implementing Faecal Sludge Management in 100 towns which are not being funded by state or central schemes such as AMRUT, Smart Cities Mission or UIDSSMT. These are primarily towns with population less than 50,000 and water supply less than 100 LPCD.

The prime objective of this report is to understand the sanitation gaps in the town of Bagru and develop Bagru as a pilot town for the same. The activity is to specifically provide faecal sludge management solutions for Bagru in Rajasthan.

2.1 SANITATION CAPACITY BUILDING PLATFORM

The Sanitation Capacity Building Platform (SCBP) was formed to build capacities of individuals, government and private institutions working in the area of sanitation and ensure improved delivery of sustainable sanitation to the un-served and underserved in India.

The National Institute of Urban Affairs (NIUA), under the Ministry of Urban Development (MoUD), was appointed to build the capacity of governments at all levels and other sanitation actors, on decentralised sanitation. A sanitation capacity building platform was then created in March 2016 at NIUA, which acts as a hub for knowledge sharing, collaboration and training among local organisations and government bodies.

This platform is pivotal to ensure urban local bodies and other actors in the sanitation system obtain the knowledge and skills required to effectively implement decentralised sanitation. The platform will work with cities and states to analyze their situation, and to develop and offer appropriate capacity building activities addressing each area's unique needs and ambitions, walking alongside each urban local body as they plan, implement and maintain decentralised sanitation systems.

The section below discusses the work that the partners engage in:

National Institute of Urban Affairs (NIUA) - National institute of Urban affairs is a premier institute for research, capacity building and dissemination of knowledge for the urban sector in India. It conducts research on urbanization, urban policy and planning, municipal finance and governance, land economics, transit oriented development, urban livelihoods, environment & climate change and smart cities.

The institute was set up to bridge the gap between research and practice and to provide critical and objective analyses of trends and prospects for urban development. NIUA has assisted in policy formulation and Programme appraisal and monitoring for the Ministry of Urban Development, state governments, multilateral agencies and other private organisations. It contributed to the National Commission on Urbanization, participated in drafting the 74th constitutional amendment of 1992, prepared the Draft National Urban policy and other documents for the roll out of the Jawaharlal Nehru National Urban Renewal

Mission (JNNURM). It also guided the discourse on municipal finance by framing the Model Municipal Law.

Consortium for DEWATS Dissemination Society (CDD Society) - CDD Society is a not for profit organisations formally registered in 2005 to promote decentralised sanitation across the country. To make more of an impact, we work with a network of like-minded partners. We are the primary implementation partner of BORDA-South Asia in India. CDD society provides decentralised sanitation interventions with emphasis on leveraging existing infrastructure. With exploding populations urban infrastructures are severely challenged. Vertical growth maxes out capacity and horizontal growth results in unserved areas. Decentralised sanitation options complement existing solutions, enable fast implementation and require low investments thus preventing pollution. CDD Society provides solutions across the spectrum from treating the wastewater of communities to remediation plans for drains and lakes to sanitation plans for cities. In order to multiply the impact, CDD Society dedicates considerable resources to training stakeholders - skilled operators, professional practitioners, municipal engineers and decision makers.

3 NEED FOR FAECAL SLUDGE MANAGEMENT

India's largest cities have large centralized sewerage systems with vast underground pipelines, pumping stations and huge treatment plants. These systems are expensive to build and even more expensive to operate and maintain as they require continuous power, skilled operators and extensive electro-mechanical maintenance and a huge tract of land. It is for this reason that India's 7000+ smaller towns (most urban and peri-urban areas) do not have such systems.

In the absence of proper sanitation, many Indian cities are on the verge of drowning in their own sewage. According to a Central Pollution Control Board report, less than 50% of the urban sewage systems work effectively in India. Sewage has clearly been identified as the leading polluter of water sources in India, causing a host of after effects including diarrhea (which kills 3,50,000 children each year) agricultural contamination and environmental degradation. [1] Out of the 3.4 million plus households that make up urban Rajasthan, 24% are connected to the underground drainage system, while 67% are still dependent on on-site sanitation systems. 9% of these households do not have access to any form of toilet facilities and thus resort to open defecation or the toilets are directly connected to open drains. Only about 11% of sewage gets transported and effectively treated. The remaining 89% is

[1] FSM in 100 Towns report published by NIUA and CDD Society

dumped into water bodies, onto agricultural land or in the domestic environment. The absence of post-toilet infrastructure poses a huge risk to public health and the environment at large.

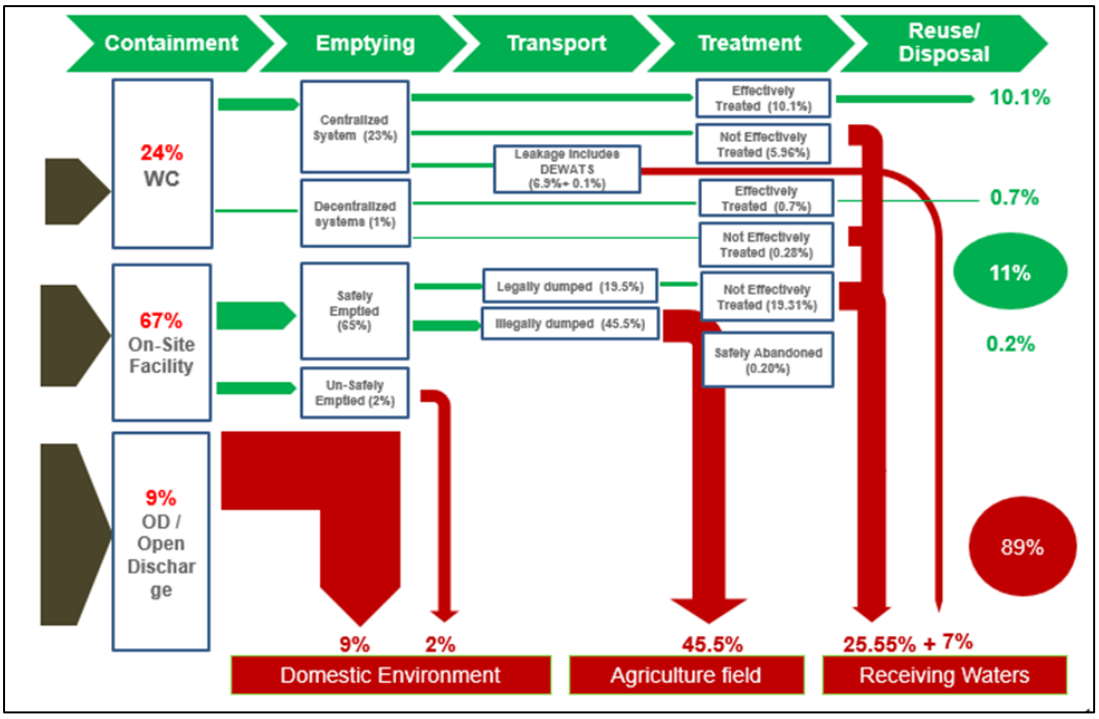


Figure 1: Shit flow diagram Rajasthan (CDD Society & NIUA, 2017)

4 CITY STATUS REPORT OF BAGRU

4.1 TOWN PROFILE

Bagru is a town located in south-west of district Jaipur, 28 Km from the city Jaipur, the divisional headquarters for the district. The closest station to the town is Bagru Station. The town can be reached by road and railways from Jaipur. It is spread of an area of 33 Km^2 and has a population of 31,229 (2011 census). Males constituted 52% of the population and females 48%. Bagru had an average literacy rate of 71.43%, lower than the national average of 74.04%, but higher than the state average of 66.11%; with 66% of the males and 34% of females literate. 18% of the population was under 8 years of age. Bagru is known for natural dyes and hand block printing.

Table 1: Town profile, Bagru

SL.No.	Particulars	Number
1.	Population (2011 Census)	31,229
2.	Population (2028, Projected)	56,925
3	Population Density	958/ Km^2
4.	Average Population Growth	4.1% Annually
5.	Floating population	Approx. 3% of the population
6.	Number of Households	5109
7.	Total Number of Wards	25
8.	Current Town Area	42 Km^2
9.	No. of commercial and institutional establishments	25
10.	% of HH practising Open Defecation	0%(ODF Declared)
11	Number of Community Toilets	5

4.2 CLIMATE

The following table gives the temperature and rainfall across different months in a year. There is a difference of 194 mm of precipitation between the driest and wettest months. The variation in temperature throughout the year is 18.2 °C. Bagru experiences maximum temperatures in the month of June. The temperature in June averages 33.7 °C. The driest

month is April with 1mm of rain. The greatest amount of precipitation occurs in August with an average of 195 mm [2]:

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	15.5	18.4	23.9	29.3	33.5	33.7	30.3	28.5	28.7	26.4	20.8	16.9
Min. Temperature (°C)	8.2	10.7	16	21.4	26.2	27.8	26	24.7	23.5	18.6	12.1	8.9
Max. Temperature (°C)	22.9	26.1	31.8	37.2	40.9	39.6	34.6	32.4	33.9	34.2	29.6	24.9
Avg. Temperature (°F)	59.9	65.1	75.0	84.7	92.3	92.7	86.5	83.3	83.7	79.5	69.4	62.4
Min. Temperature (°F)	46.8	51.3	60.8	70.5	79.2	82.0	78.8	76.5	74.3	65.5	53.8	48.0
Max. Temperature (°F)	73.2	79.0	89.2	99.0	105.6	103.3	94.3	90.3	93.0	93.6	85.3	76.8
Precipitation / Rainfall (mm)	7	6	3	1	12	36	168	195	75	7	3	2

Figure 2: Climate table of Bagru

4.3 WATER SUPPLY

The primary source of water is either municipal piped water supply or purchase from private tankers. A few households (HHs) also rely on tube wells. Municipal piped water is supplied once in 2 days. During extreme dry months, the water supply frequency reduces to once in a week. This compels HHs to purchase water from private tankers. The water supply is billed based on a fixed tariff that is constant throughout the state.

5 SITUATION ANALYSIS

To understand the existing sanitation situation in Bagru city, faecal sludge value chain approach was used. Faecal sludge value chain is the linear linkage of dependent components in the pathway of faecal sludge generated from onsite sanitation system. The value chain has components such as user interface, containment, collection and conveyance, treatment and reuse. Figure 3 shows a schematic representation of the value chain.

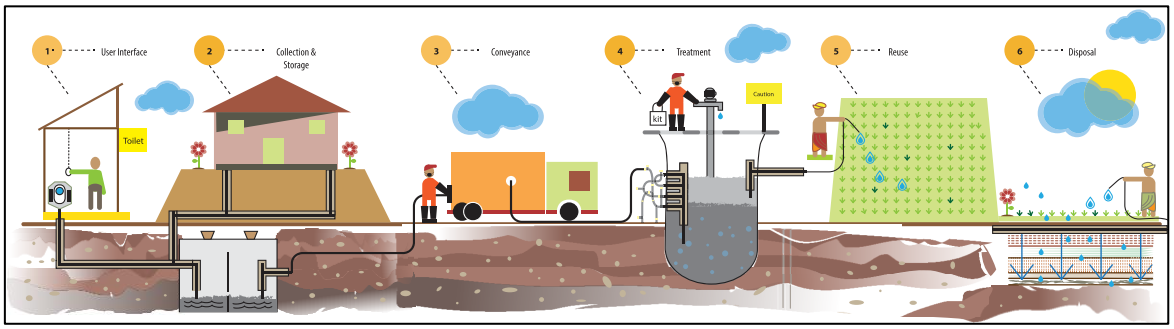


Figure 3: FSM value chain

[2] https://en.climate-data.org/location/963457/

The management of this value chain is termed as Faecal Sludge Management (FSM). FSM is an important and incremental approach catering to improved sanitation. In the past, faecal sludge management from onsite facilities has not been a major priority for engineers or municipalities and has traditionally received little attention. Several generations of engineers have considered waterborne, sewer-based systems as the optimum, long-term solution to fulfill sanitation needs. Onsite technologies have been looked upon as only temporary solutions until sewers could be built. It is a common perception that onsite technologies fulfill sanitation needs for rural areas, but in reality, around one billion onsite facilities worldwide are in urban areas. In many cities, onsite technologies have much wider coverage than sewer systems. Given that cities are expanding at an incremental rate and that the scope of funding from public sector remains unchanged, the plan to have all households connected to a sewer network remains a distant goal to be achieved. It is the cost and effort involved in constructing sewerage networks and associated treatment plants which lead practitioners and researchers in the field to think about a novel approach, thus mainstreaming FSM.

5.1 BAGRU- EXISTING SITUATION IN BAGRU

Following is a sanitation situation assessment of Bagru town across the sanitation value chain. It specifically includes the current situation as observed across the following components:

1. User Interface
2. Containment
3. Transportation
4. Treatment
5. Reuse/Disposal

Table 2: Description of FSM value chain

	1.User Interface	2.Storage	3.Transport	4.Treatment	5.Reuse
Description	Faecal sludge from a toilet is captured in either on-site sanitation systems or transported to an STP via UGDs	Faecal Sludge is stored in containment systems like pits and septic tanks to prevent contamination of the local environment.	This stage involves emptying the human excreta from the pits/ septic tanks and then transporting them to the disposal site.	The treatment is done using a wide range of technologies to make the end product safe to be released into the environment.	Utilizing the end products of the sanitation value chain like treated wastewater and dried sludge for a wide range of applications.

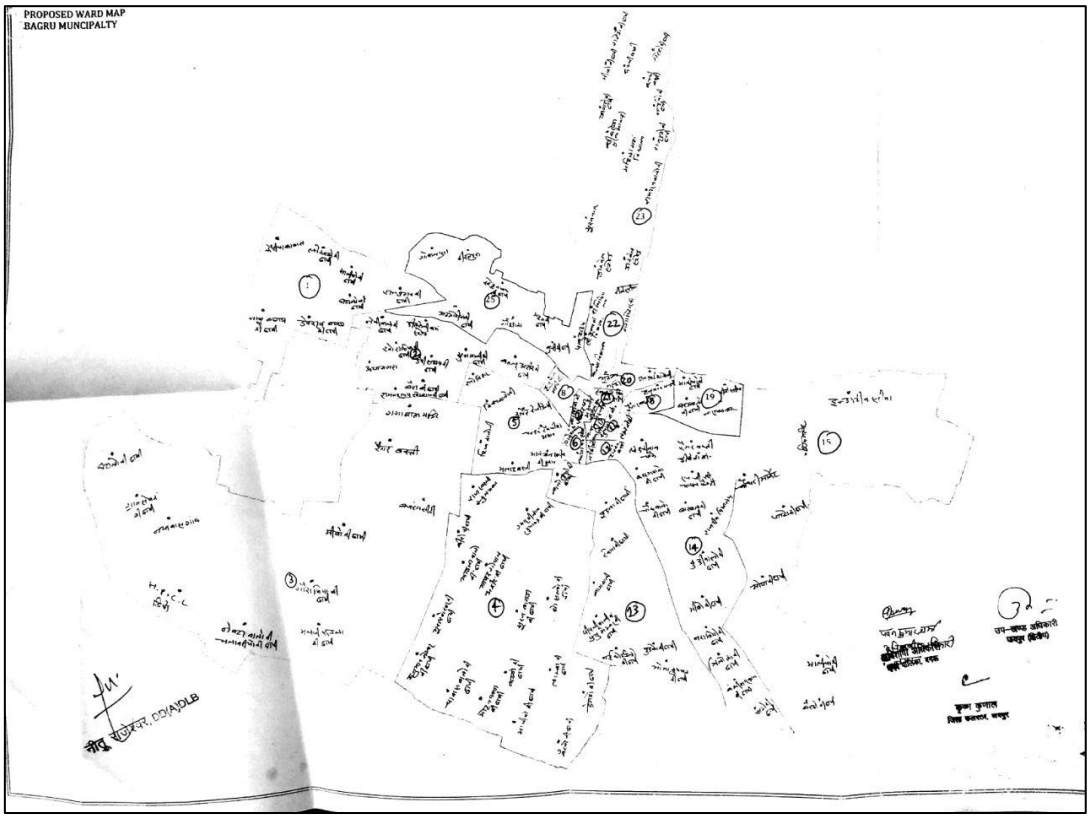


Figure 4: Bagru Map (ULB Bagru, 2017)

5.2 FSM GAP IDENTIFICATION

From the above situation analysis, gaps across the sanitation value chain as well as in the management framework can be highlighted as mentioned in the table below:

Table 3: FSM gap identification[3]

	1.User Interface	2.Storage	3.Transport	4.Treatment	5.Reuse
Current Situation	Toilets connected to pits/septic tanks or in some instances directly to open drains	The containment systems are mostly septic tanks and Single pits.	Total of 3 desludging vehicles. There are certain pockets within the town which are not accessible by the operator. No protocols or regulation on O&M or safety regulation	Partial Digestion in aseptic tank. Direct disposal in the open.	Few instances of using it in the farm land is being existing.
Corrective Measures	Toilets have to be connected to scientifically designed septic tanks/pits	Training of masons for scientific construction of Septic tanks Build awareness regarding improper design and operational procedures	ULB to provide desludging services by buying appropriate desludging vehicles to access the majority of the lanes in the town. Training for desludging service providers to scientifically empty septic tanks. Post construction of treatment plant, ensure disposal only happens in the treatment plant	Build a faecal sludge treatment plant to effectively treat all the Faecal sludge collected in the town	Spread awareness on the usage of the end product and elimination of stigma regarding usage of treated faecal sludge. Training for farmers using wastewater for safer reuse of treated wastewater and discourage use of raw wastewater

[3] Based on primary survey conducted in Bagru and FSM in 100 towns of Rajasthan by CDD,NIUA

6 RESEARCH METHODOLOGY

In furtherance to the team's initial assessment of Bagru in March 2017, there was a felt need to understand the town in a more detailed manner. Post discussion with the project partners and Nagar Palika officials it was decided that a team would be locally deployed to conduct an in-depth sanitation assessment. This section details the methodology based on which the survey was conducted. Data was collected through the following means:

- Primary HH survey
- Focused group discussion with stakeholders linked to sanitation
- Review of Secondary data

6.1 OBJECTIVE

The broad objective of the study was as follows:

1. To document the existing conditions of sanitation infrastructure related to treatment, collection, transportation and reuse of faecal sludge along the sanitation value chain.
2. To identify enabling conditions for FSM
3. To conduct pre-feasibility for establishing a faecal sludge treatment plant (FSTP), thereby identifying boundary conditions.

6.2 OUTCOME

The outcome of the study would be to identify gaps in the sanitation value chain and propose interventions which are appropriate and contextual that can bridge the gaps especially in the faecal sludge treatment and reuse. The study includes stakeholders who play a vital role in the faecal sludge value chain. All the stakeholders were interviewed about the different components of the sanitation value chain. The table below enlists the stakeholders and their involvement in FSM.

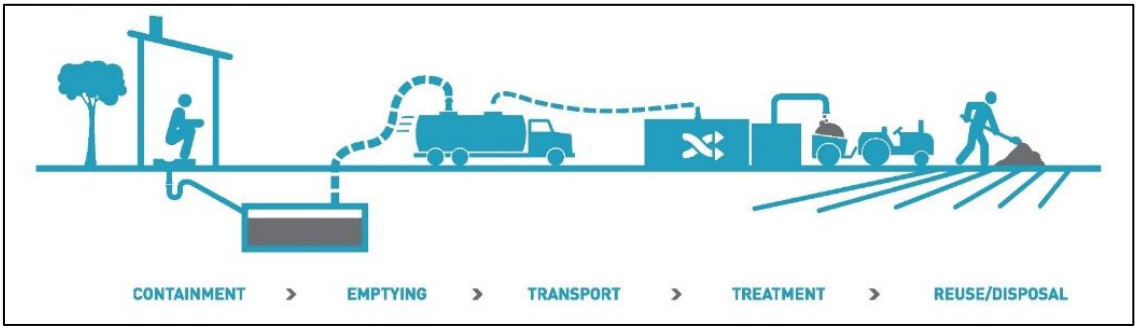


Figure 5: Sanitation Value chain was considered a base for collecting information across different stakeholder groups

Table 4: Stakeholders and the reason for their inclusion

Stakeholders	Sample Size	Role of FSM
Household	352	• Responsible for managing their Faecal waste at source by constructing a toilet and containment system within their premises
Non-Residential	30	• Responsible for managing their Faecal waste at source by constructing a toilet and containment system within their premises
ULB Officials	4	• Responsible for the overall cleanliness or the town and establishment along with operation and maintenance of any infrastructure within the town. • Primary Decision Maker being the administrative head for the town
Masons[4]	56	• Responsible for constructing containment systems as per design standards
Ward Councilors	2	• Responsible for disseminating information about new initiatives in the town. • Public Representative hence a primary decision maker
Desludging Operators	2	• Responsible for cleaning the containment systems and disposing them in a treatment facility.

6.3 PRIMARY DATA COLLECTION

Primary data collection usually involves direct interactions with the stakeholder groups. Direct interactions reveal data which have not been previously captured by secondary data sources or such data sources are not relevant in the present context. The primary objective of the survey was to capture information on infrastructure and operations of components across the value chain such as toilets, on-site sanitation systems, desludging and transportation vehicles etc. This information aids in planning effective solutions for faecal sludge management. Secondary objective of the study includes understanding the receptiveness and support systems that exist in enabling such proposed interventions.

[4] The masons were not reached out separately. As part of the Mason Training 56 masons were reached out to.

Surveys, semi-structured, structured interviews and unobstructed observations are a part of the primary data collection process. While a structured interview would pose the interviewee with options and multiple choices, semi structured questionnaires would have open ended questions that capture opinions and comments. In the case of Bagru, structured questionnaires were used by the local team hired by CDD Society while the expert team used a combination of structured questionnaires and informal discussions to understand the situation in whole. Primary surveys were conducted for a statistically representative portion of the population. The respondent groups for the survey were stakeholders from the Table 4.

Figure 6: Survey Team

Table 5: Survey and sampling methodology

Survey Universe	Sampling Methodology	Tools for data collections
Households	Quota Sampling[5]	Structured Interviews Direct Observations of the infrastructure
Commercial Establishments	Judgmental Sampling[6]	Structured Interviews Direct Observations of the infrastructure
ULB officials, Ward Councilors	Judgmental Sampling	Structured Interviews
Desludging Operators, Farmers	Snowball Sampling[7]	Structured Interviews Direct Observations of operations

[5] Quota Sampling is a technique where the sample universe is stratified based on a variable. In this case it has been roof type of the household. Once stratified, judgement of the surveyor is used to select the sample.

[6] Judgmental Sampling- It is a technique where the judgement of the surveyor is used to select the sample.

[7] Snowball Sampling- It is a technique where one sample leads or informs about the other sample.

6.3.1 SAMPLING METHODOLOGY FOR HHS

Sampling is the process of selecting units from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they were chosen. This section details out the survey universe and the method of sample selection from this survey universe in a way that it is a representation of the whole town of Bagru.

Town	No. of Households	% of Households with toilets	No. of Households with toilets (N)
Bagru	5,109	58.6%	2,994

$$n = \frac{\frac{Z^2 * p * q}{e^2}}{(1 + \frac{\frac{Z^2 * p * q}{e^2} - 1}{N})}$$

n = Sample Size
z = Standard Normal Distribution for the requested certainty of the confidence interval
e = Probability of error
p = range of variation
q = 1-p
N = Population Size

Assumptions for Calculation of Sample Size:

A statistical method by William G Cochran was adopted to calculate the sample size from the sample universe. The formula is as used above.

1. Confidence interval = 95%
2. Probability of Error (e) = 55
3. Range of Variation (p) is estimated from Census 2011, the proportion of septic tanks to the total number of HHs with toilets is used as the benchmark.

Town	No. of HHs with toilets (N)	Range of Variation	Sample Size (N)	
			e = 5%	% of sample universe
Bagru	2,993	0.55 - 7	337	1.12

Sample sizes has been calculated separately for each of the 20 wards.

Sample size for each ward = Proportion of toilets in the ward to the total toilet sin Bagru Town * n

Where:

n = Total Sample Size = 337

% of Households with toilets in each ward = Number of HHs in each ward * % of HHs with toilets for entire Bagru

The newly added five wards' on 15th August 1015 were surveyed separately with three HHs in each ward owing to the presence of farm lands majorly and very low density thus leading to 337+15 = 352 HHs.

The following table gives the ward wise sample size of HHs derived from the above formula:

Table 6: Ward wise Sample size for Bagru

Ward No.	No. of HHs	No. of HHs with toilets	% of HHs with toilets	Sample Size
Ward No. 1	142	83	2.78	9
Ward No. 2	208	122	4.07	14
Ward No. 3	228	134	4.46	15
Ward No. 4	130	76	2.54	9
Ward No. 5	351	206	6.87	23
Ward No. 6	347	203	6.79	23
Ward No. 7	216	127	4.23	14
Ward No. 8	218	128	4.27	14
Ward No. 9	185	108	3.62	12
Ward No. 10	208	122	4.07	14
Ward No. 11	295	173	5.77	19
Ward No. 12	197	115	3.86	13
Ward No. 13	429	251	8.40	28
Ward No. 14	554	325	10.84	37
Ward No. 15	153	90	2.99	10
Ward No. 16	150	88	2.94	10
Ward No. 17	224	131	4.38	15
Ward No. 18	287	168	5.62	19
Ward No. 19	376	220	7.36	25
Ward No. 20	211	124	4.13	14
Total	**5,109**	**2,994**	**100%**	**337**

The sample size at the ward level is further stratified based on the household roof structure; this is assumed to be a proxy indicator of the socio-economic condition.

Number of HHs to be surveyed under each roof structure category = Sample size of each Ward * % of HHs in each ward under each roof category

Apart from the above 337 HHs belonging to 20 wards as per Census 2011, we have surveyed a total of 15 HHs in the newly added five wards which are majorly farmlands and population density is low.

6.3.2 SAMPLING METHODOLOGY FOR NON- RESIDENTIAL UNITS, DESLUDGING SERVICE PROVIDERS AND ULB OFFICIALS AND WARD COUNCILORS

A survey with commercial establishments, institutions and industries (non-residential users) completes the data generated in the primary survey. The non-residential establishments with toilet facilities belong to the target group of the survey. As a result from a lack of reliable data concerning the numbers of establishments as well as about the toilet facilities, the target group cannot be described in concrete numbers. The sampling strategy between residential and non-residential users differs. In this study we used the snowballing sampling technique to survey Cesspool Operators. Non-residential samples were selected based on the judgement of the surveyor.

6.3.3 SURVEY PROCEDURE

Detailed survey questionnaires were developed in-house by CDD Society and have been digitized by CDD Society using the Survey Monkey Portal.

The various steps involved in this phase were:

- STEP 1- Authorization Letter from Nagar Palika for conducting the survey
- STEP 2- Survey Team Selection
- STEP 3- Orientation of the Survey Team
- STEP 4- Test the survey Instrument on the field.
- STEP 5- Actual survey conducted for 5 days. (27th October to 31st October 2017)[8]

Figure 7: Survey with GPS

[8] Note - The survey instrument was tested under various conditions so that it was as close as possible to the conditions the survey team would encounter during survey implementation.

For this purpose, a few colleges near Bagru were explored. Volunteers from National Service Scheme (NSS) of Sanskar Bharati P.G College, Bagru were recruited. Candidates were interviewed for their language, attitude and knowledge of the local areas. Selected candidates received an orientation in FSM and trained in data collection.

After the training was completed on the first day, the students were taken to the field and made to do three sample surveys each after which we have explained them about various scenarios.

We have ensured that the training is as realistic as possible, including anticipating possible complications that might occur in the field, to prepare survey teams adequately. There were few changes made to the survey instrument and procedures because of initial testing which are incorporated in the instruments.

Figure 8: Desludging Operator Survey

1. Survey Teams

- There were 10 students who were recruited for conducting the survey and they were divided into 2 teams of 5 members each.
- A survey administrator was part of the survey to ensure quality and support to the teams in the field. This person was responsible for overseeing the day-to-day management of the survey process, ensuring that procedures for obtaining high-quality survey results are followed, and providing support to survey teams as they collect the data.
- The survey administrator was available at all times when the survey teams were in the field to be able to answer questions and make decisions if teams encountered unexpected situations.

2. Strategies to Improve Broad Participation

- Ensuring the ULB officials are aware of the survey to be conducted and getting an authorization letter from the ULB for undertaking the survey in the town.
- The outreach informed the households/stakeholders about how taking the survey will help their community/town, described the ease of the process and were explained the measures taken to ensure confidentiality.
- Survey teams visited various households on different days and, just as importantly, an outcome is achieved. The entire process and procedure took place for 5 days.

6.4 QUALITATIVE STUDY IN BAGRU

After the completion of the household survey in Bagru, a small scaled Qualitative study was undertaken to capture the present sanitation situation of the involved stakeholders across the FSM value chain. Amongst this, these included households from new wards which has been included in the Bagru Nagar Palika since 2015 and which also include dense pockets of population located away from the main parts of the town, cesspool operators, farmers and members of the Bagru ULB.

This study was based on a method of snowball sampling which included an unstructured interview schedule as tool. The selection of the wards for the study was also done through snowball sampling where the interaction with one neighborhood leads to further knowledge about the fitness of another site for exploration.

Through interacting with the resident communities from the Shivnagar, Kachi Basti, Bada Kakheda located in ward number 23, it was found in ward number 15, there is another neighborhood where Community Toilets have also recently been built. This lead to an interaction with households from the Banjara Kachi Basti in ward number 15. For both these neighborhoods their present issues faced with respect to the new toilets and why owing to the absent maintenance in the newly installed community toilets these families still today resort to open defecation in both the wards was learned.

The Qualitative study lead to exploration of insights shared by households practicing agriculture. Amongst such families located in ward number 11, there are a few households which use wastewater flowing from the open drain running underneath Bagru as a primary source of irrigation on their crops grown during the winter season. For these households, the crops grown are predominantly for self – consumption. Details as to how the water is channeled and if having used such water lead to any found health problems after consumption of the same crops was explored.

Similarly, neighborhoods popularly shared to be ‘inaccessible’ by both a private and the Municipality outsourced cesspool operator was explored and the prevalent sanitation situation in that site was looked at.

Overall, the large theme of insights and findings received from this study was to cover areas not previously explored in the Quantitative survey and so the logic of the study was to complement the results of the survey and explore areas of enquiry that were excluded in the design of the survey. It was of relevance to show a complete picture of the present context in Bagru and so the Qualitative study is an addition to the work done in the survey.

6.4.1 SUMMARY OF SAMPLE SIZE FOR SURVEY IN BAGRU

This section distills the sample size for each household based on the derivations in the previous sections:

Table 7: Stakeholders part of the survey

S.No.	Stakeholders	Number
1	Household	352
2	Non- Residential	30
3	ULB Officials	4
4	Masons	56
5	Ward Councilors	2
6	Desludging Operators	2

6.4.2 LIMITATIONS OF THE SURVEY

The on-ground survey conducted had a few limitations that must be kept in mind while understanding the results of the same:

1. The survey does not address any controversial issues as the participants were unable to precisely answer because of the difficulty in recalling the information related to them. An effort was made to address the same, by conducting focused group discussions for capturing the qualitative part of the same.
2. Respondents may not have been encouraged to provide accurate or honest answers.
3. Respondents may not feel comfortable providing answers that present themselves in an unfavorable manner.
4. Respondents may not be fully aware of their reason for any given answer because of lack of memory/knowledge on the subject.
5. Data errors due to question non response may exist. The number of respondents who choose to respond to a survey question may be different from those who choose not to respond thus creating a bias.
6. Survey question answer options could lead to unclear data because certain answer options may be interpreted differently by respondents.
7. Due to lack of time and resources, instead of a full survey, a sample survey was resorted to. Keeping this in mind a representative sample was derived.

6.4.3 USER INTERFACE

The user interface section discusses about individual household toilets9, refurbishing of existing infrastructure which includes provision of superstructure and containment structure and access to public and community toilets[10].

Situation before the onset of Swachh Bharat Mission

As per Census 2011, 41.2% of households (1942 households) either had no toilets or had access to public/ community toilets. Of this, (96%) of those households (1872) practiced open defecation, (3.6%) of the households were dependent on community/ public toilets. Additionally, 7.6% of the households (356 households) had insanitary latrines which include single pit latrines (with and without slabs), service toilets (by humans and animals) and toilets directly connected to drains while 47% of the HHs (2216) have septic tanks as a primary form of containment unit.

Figure 9: Community Toilet: Bagru

Situation after implementation of Swachh Bharat Mission

Post the implementation of the Swachh Bharat Mission, Bagru Nagar Palika based on the data available in Census 2011 estimated and planned for toilet constructions. In the month of January 2018, Bagru was declared Open Defecation Free. At present five community[11] and one public[12] toilets have been provisioned in total for Bagru.

Figure 10: Makeshift bathing spaces for women

[9] Individual HH Toilets are used by the members of 1 HH.
[10] Community toilets are shared by a group of HHs primarily in low income or informal settlements, slums where due to space constraints, provisioning of a household toilet is difficult.
[11] Ward 14, 23,24,25
[12] Ward 17

6.4.4 CONTAINMENT SYSTEM

Residents of Bagru resort to the use of both septic tanks and single pits. The very recent ones constructed under the Swachh Bharat Mission were twin pits. While 52% of the HHs used septic tanks, roughly 45% resorted to the use of single pits.

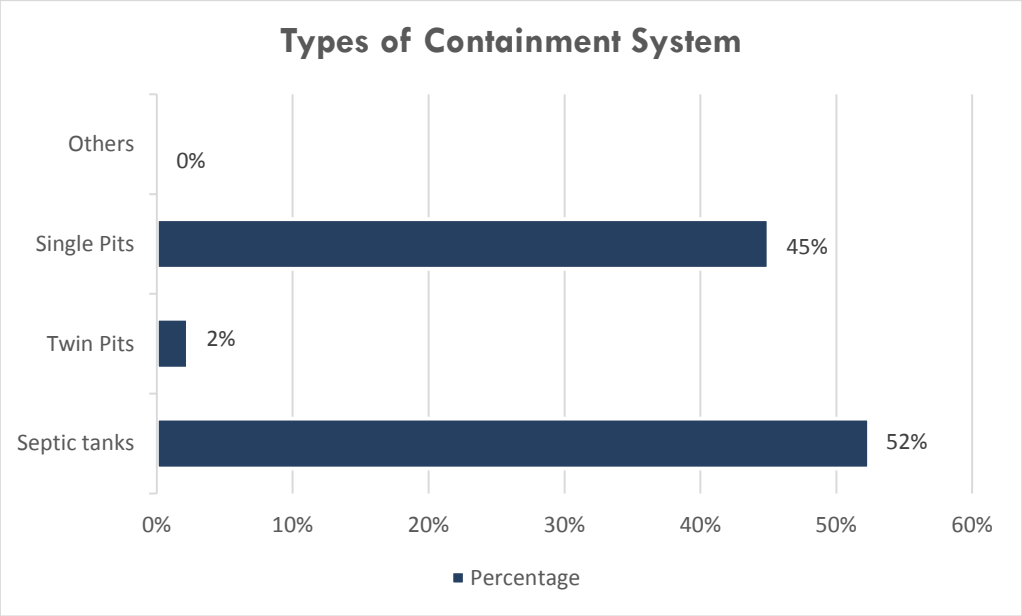


Figure 11: Types of Containment systems

The average length, width and depth of septic tanks are 8 feet, 6 feet and 14 feet respectively. Septic tanks were mostly two chambered with the outlet directly connected to the open drain. Septic tanks were lined both on the sides and the base. While the single pits are mostly unlined on the sides and base. These structures are locally called “Kui” and are made of brick masonry.

Bagru is famous for its block printing work. The HHs that practice block printing do not have a separate disposal mechanism for wastewater (printing dye). It is allowed to flow through the open drains, after which it gets collected in common containment systems. The responsibility of getting the septic tanks periodically lies with the Bagru Nagar Palika. The desludging operator working for the municipality does this.

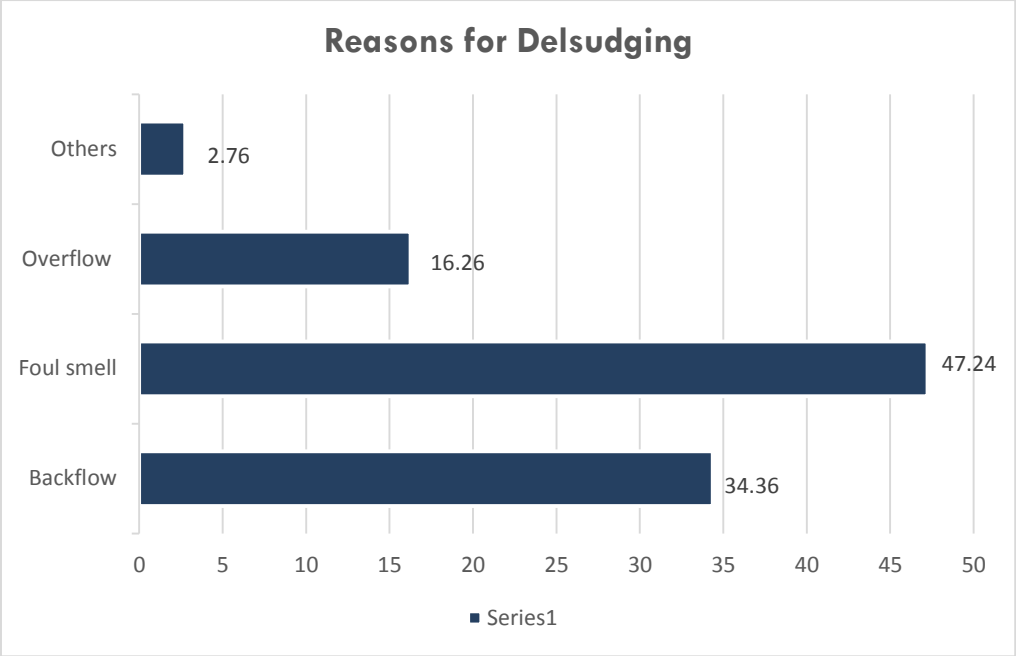


Figure 12: Reasons for Desludging

On conversation with the masons, the team came to know that the masons did not have any information about the design standards. The general practice was to construct the containment systems based on the customers' demands which in turn depends on the area available for the construction. They are paid on a daily wage system hence the masons were not aware of how much the toilet construction took. The time requirement for the construction of the toilet structure ranged from 8 to 10 days.

Desludging

Households in general opt in favor of getting the containment system desludged once filled instead of getting a new containment system constructed. While the reasons that prompt the HHs to get the containment system desludged varies. 3 major reasons emerged in the survey:

- Backflow of water inside the toilet
- Foul smell
- Overflow of containment system

Based on the discussion with the desludging operators, it was found that they encounter a lot of difficulty when the containment systems are cleaned for the first time.

In such a case the faecal sludge in the pit becomes very hard (often stone like). The desludging operator gives a maximum time of 30 minutes to desludge the system. Failing which the pit is left as it is. The HH is such as case is recommended to get a new containment system constructed.

Figure 13: Inaccessible Parts of Bagru Town

Desludging Frequency

Desludging Frequency is an important indicator of the health of the containment system. It also indirectly indicates the scale of faecal sludge that is disposed in the open environment. In Bagru the desludging frequency ranges from once every 6 months to more than 5 years. But primarily, the desludging frequency lies within 3 years.

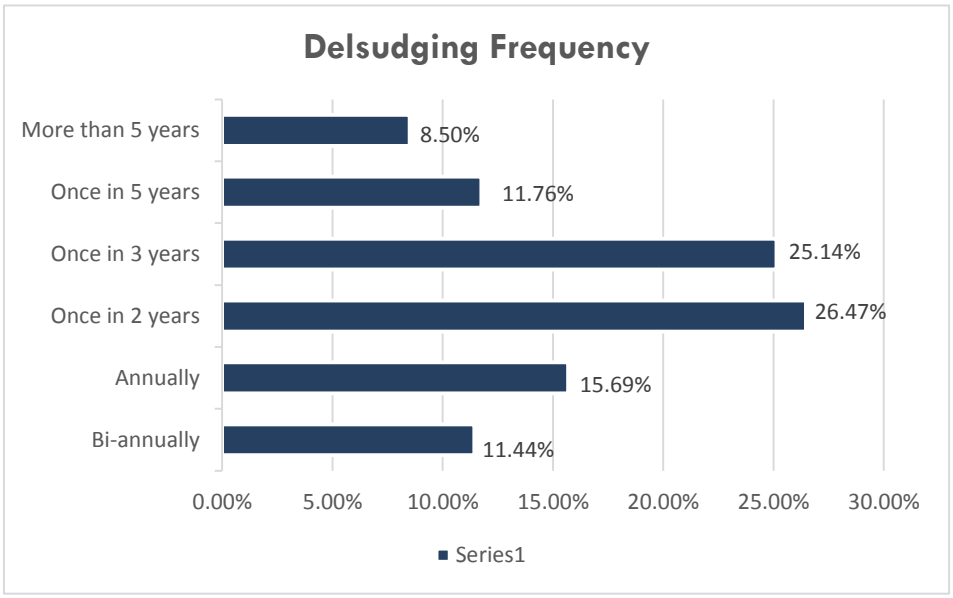


Figure 14: Desludging Frequency

Approximately 84% of the HHs used the private desludging services as against 7% who made their desludging request at the Nagar Palika Office.

The majority of the respondents were unaware of where the collected faecal sludge was being disposed. Roughly 17% respondents believed that the faecal sludge was unscientifically disposed in the adjacent drain.

Figure 15: Septic tank in a household

6.4.5 EMPTYING AND TRANSPORTATION

The faecal sludge collected in septic tanks and pits are desludged through desludging vehicles. Faecal sludge needs to be safely emptied and transported to a treatment plant for scientific disposal. Based on the survey the team came across five desludging operators who were serving Bagru. But on more detailed discussions, it was found that three of them did desludging of chemical waste in the RIICO Industrial area. The other two desludging operators served the area in and around Bagru.

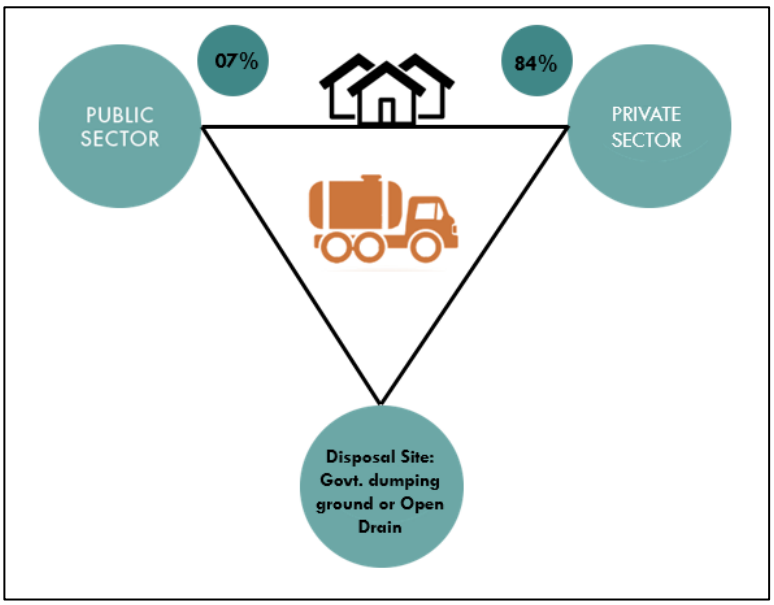


Figure 16: Desludging Requests and Disposal site

The entire operation of desludging can last for about 15-30 minutes, depending upon the accessibility and thickness of the sludge to be pumped out. After opening the access a crowbar or a stick is inserted into the pit/tank to get an understanding of the thickness of the sludge. If the sludge is thick, water is poured usually through the toilet pan and mixed with the crowbar till it can be pumped out. Vacuum suction is the most prevalent

means of desludging in Bagru; operators can empty 3 – 4 cum of sludge in 12– 15 minutes (this excludes the time in breaking open the access point). Solid waste such as polythene or stones present in the pits/tanks can choke or block the suction pipes, but no choking was observed during the desludging operation.

It was found that only in one particular instance in a Regar Basti in ward no 21, where HHs are very closely located to one another, that on failure of truck operator reaching the site, members of the HHs often have to resort to manual cleaning of the containment systems by hiring labors. The labors are usually from the same community.

The following table details out the operations of the two desludging operators:

Table 8: Desludging Operators Details

S.No.	Particulars	Desludging Operator #1	Desludging Operator #2
1.	Name	Jagdish Harijan	Hanuman Sahay
	Private /Public	Private	ULB Vehicle
2.	No. of Vehicles	2	1
3.	Capacity	3500 Liters	3500 Liters
4.	Company	Macidi 1035	Ensol
5.	Mounted On	Tractor	Tractor
6.	Length of the pipe	150 feet	50 Feet
7.	Area of Operation	Bagru, Jhag, Bhojmabag, Dudu, Palu, Savardha	Bagru
8.	No. of Staff	2	3 1 Driver and 2 Helpers
9.	Years of Operation	3	3 – 4 years
10.	Desludging Charges/trip	Bagru – Rs. 400 - 5000 Other Places – Rs. 1000 - 1500	Rs. 500 - 1000
11.	Number of Trips/month	Bagru – 10-15/month Other Places – 2/month	10 – 15 /month
12.	Disposal Location	Government Dumping Ground	Government Dumping Ground Open Drain Agricultural Fields

13.	CAPEX	Rs. 10 Lakh	Rs. 12 Lakh
14.	OPEX	Rs. 20,000	Rs. 30,000
15.	Time of Operations	Day time	Day time
16.	Time of Desludging	10 – 20 mins	10 mins – 2 Hours
17.	Time taken to reach the disposal location	Within Bagru – 20 Mins Other Places depends on the distance	Within 30 mins
18.	% area inaccessible by the Cesspool vehicle	- Regar Basti (Bagru)- Ward No. 21	-

Post collection, the private operator transported the faecal sludge to areas such as vacant land/ open drains present 2-4 km outside the city. To let out the sludge, the tank is vented and the same valve used for suction is opened, a small hose pipe is attached to this valve to dispose it away from the vehicle.

Figure 17: Nagar Palika Desludging Vehicle

The vacuum suction system and the collection tank are mounted on a tractor with an overall width of 3 meters. Trucks usually were defined based on the capacity of the tank. Suction in these systems is established through vacuum pumps which are powered by a separate arrangement (shaft) from the main vehicle engine. The most common problems associated with the system were that of vacuum pump breakdown which would lead to a few days of non-operation. The pumps usually breakdown once or twice a year and there is a locally available mechanic to repair these pumps.

The desludging vehicle owned by the Bagru Nagar Palika has been outsourced to a private operator named Hanuman Sahay for a period of 1 year from 1/04/2017 to 21/03/2018. As per the service agreement, the operators have to pay a sum of Rs. 96,000 to the Bagru Nagar Palika for this period. Further the service agreement mentions that the operator has to dispose the faecal sludge only at the designated spot. All the user fee collected from the households would be deposited at the Nagar Palika office. All repairs and maintenance regarding the desludging vehicle would be the responsibility of the desludging operators.

Figure 18: Cesspool vehicle stand near ULB in ward 10

6.4.5.1 OPERATION MODALITIES

The entire operation of desludging can last for about 15-30 minutes, depending upon the accessibility and thickness of the sludge to be pumped out. After opening the access a crowbar or a stick is inserted into the pit/tank to get an understanding of the thickness of the sludge. If the sludge is thick then water is poured usually through the toilet pan and mixed with the crowbar till it can be pumped out. Vacuum suction is the most prevalent means of desludging in Bagru; operators can empty 3 – 4 m^3 of sludge in 12– 15 minutes (this excludes the time in breaking open the access point). Solid waste such as polythene, condoms, stones was present in the pits/tanks can choke or block the suction pipes, but no choking was observed during the desludging operation.

Post collection, the private operator transported the faecal sludge to areas such as vacant land/ open drains present 2-4 km outside the city. To let out the sludge, the tank is vented and the same valve used for suction is opened, a small hose pipe is attached to this valve to dispose it away from the vehicle.

6.4.5.2 INFRASTRUCTURE

The vacuum suction system and the collection tank are mounted on a tractor with an overall width of 3 meters. Trucks usually were defined based on the capacity of the tank. Suction in these systems is established through vacuum pumps which are powered by a separate arrangement (shaft) from the main vehicle engine. The most common problems associated with the system were that of vacuum pump breakdown which would lead to a few days of non-operation. The pumps usually breakdown once or twice a year and there is a locally available mechanic to repair these pumps.

6.4.6 TREATMENT

Figure 19: Current Disposal of Faecal Sludge in the Dumping ground

Bagru Nagar Palika does not have any infrastructure for treatment of wastewater, faecal sludge or solid waste. It is primarily for this purpose the survey was embarked upon to understand the context specificities and thereby develop a treatment facility for the town.

6.4.7 DISPOSAL/ REUSE

The ULB has demarcated land and goes by the name of government dumping ground, away from the major settlement areas where all trucks go and dispose the faecal sludge. This includes both the private and the ULB desludging vehicle.

The government dumping ground spreads across an area of 6 acres. The site is used for the unscientific disposal of both solid waste and faecal sludge. Local rag pickers move around in this zone collecting rags. One zone (roughly 10 % of the total area) within this disposal site has been levelled by the Nagar Palika to contain sludge. The land allocated for disposal of solid waste and faecal sludge has been provided for a period of 99 years. Any kind of commercial establishment or an institutions for making profit has been prohibited by the Bagru Nagar Palika. This land will be subject to the Rajasthan improvement trust (Disposal of Urban Land) Rules, 1974 and any notifications issues by the Jaipur Development

Authority. Bagru Nagar Palika has allocated a land parcel of 22,250 Sq. m with Khasra number 415/4158 for solid waste and faecal sludge disposal. The part of this land parcel has been allocated by the Bagru Nagar Palika for the establishment of the Faecal Sludge Treatment Facility.

Figure 20: Wastewater being pumped for agriculture

Apart from this, there is an open drain where desludging operators dispose the faecal sludge. This drain also lines some portion of the RIICO Industrial area and hence flows with faecal sludge and Industrial waste. It majorly flows out of the Bagru.

Figure 21: Current Disposal Location

Farmers use FS on their farms primarily during the winter season for growing wheat and Bajra. These farmers also grow crops in the monsoon season like maize, pulses and beans which is primarily rain fed.

There is an underground water conveyance mechanism that channelizes the wastewater from the drain to the fields in ward no. 11. The farmers have installed pumps with trash cans that sifts out all the solid waste and allows only the liquid part to enter the field. This is done for irrigation during the winter seasons which is their only source of water for the season.

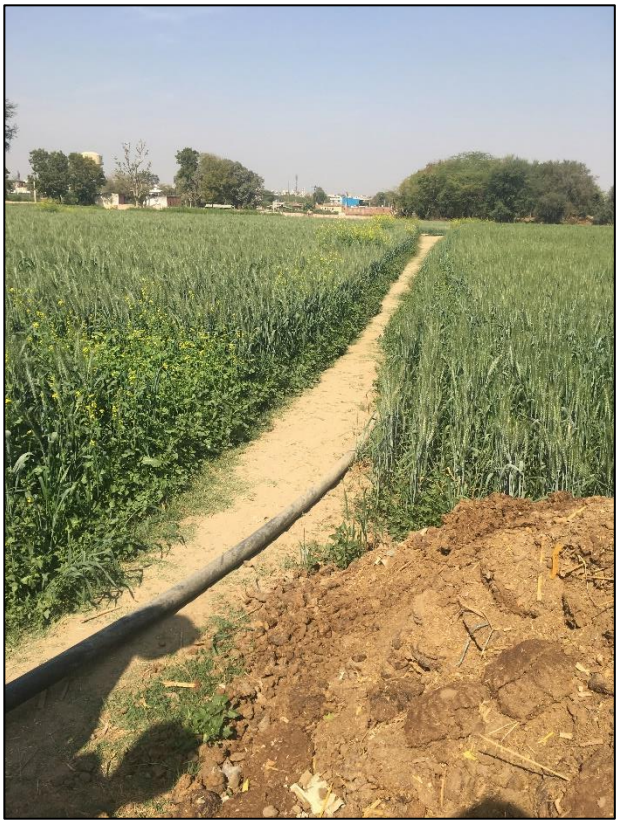


Figure 22: Farmlands that use Wastewater for agriculture

These HHs have parallel strong occupations and agriculture is practiced for subsistence purposes. The farmers do not use this water for growing any root crops. Only crops like wheat and bajra is grown. According to them the wastewater does not reach the eatable portions of the crop. They have been practicing this for the last eleven years and have not encountered any health hazards.

Apart from the sanitation value chain, it is also essential to understand the situation of the Urban Local Body (ULB) in terms of its financial health, governance mechanism in other spheres of its work. The following section discusses the other situational elements like: Bagru Nagar Palika's arrangement for Solid Waste Management, Financial health, organisation chart, policy and regulatory environment etc.

6.4.8 SOLID WASTE MANAGEMENT

Bagru Nagar Palika has made arrangements for HH level collection of waste which is disposed in the dumping ground. There is a rag pickers collective in Bagru, where there is a system for them to come and collect waste. The plastic waste is segregated and burnt off. Bagru Nagar Palika plans to formulate a document for solid waste management. Composting has been identified procedure to handle all the solid waste collected in Bagru. On finalization of the same, the construction of the treatment unit and operation and maintenance would be handed over to a third party.

Figure 23: Solid Waste Disposal Site

7 CRITERIA ADOPTED FOR TREATMENT PLANTDESIGN

7.1 QUANTIFICATION OF FAECAL SLUDGE

Accurate estimation of faecal sludge is important as it will determine the complete management mechanism right from desludging intervals, collection system, treatment modules, size of treatment unit, area required for treatment to the end-use of the treatment by-products. For the purpose of determining the quantity of faecal sludge receivable at the faecal sludge treatment facility, population based method for calculating faecal sludge generation in the city using sludge accumulation rate (CPHEEO Manual) has been used.

The total population of Bagru in the year 2011, as per census was 31229. Three different methods have been used to project the population to 10 years from current year of 2018. Considering previous growth rates and estimating population for the year 2028 which is 10 years from 2018, the population of the city would be 56925. This assumes a decadal growth rate of 23%.

a) Arithmetical Increase method

This method is suitable for large and old city with considerable development. If it is used for small, average or comparatively new cities, it will give lower population estimate than actual value. In this method the average increase in population per decade is calculated from the past census reports. This increase is added to the present population to find out the population of the next decade. Thus, it is assumed that the population is increasing at constant rate. Hence, dP/dt = C i.e., rate of change of population with respect to time is constant. Therefore, Population after nth decade will be Pn= P + n.C where, Pn is the population after 'n' decades and 'P' is present population.

Sl. No.	Year	Population - Bagru	Increment
1	1991	15509	-
2	2001	22092	6583
3	2011	31229	9137
		Average increment per decade ,C	7860
		Average increment per year	786.0
		No. of years from 2011 till 2028	17
		Population in 2028	44591

b) Geometrical Increase Method (Or Geometrical Progression Method)

In this method the percentage increase in population from decade to decade is assumed to remain constant. Geometric mean increase is used to find out the future increment in

population. Since this method gives higher values and hence should be applied for a new industrial town at the beginning of development for only few decades. The population at the end of nth decade 'Pn' can be estimated as: Pn = P (1+ IG/100) n Where, IG = geometric mean (%) P = Present population N = no. of decades.

Sl. No.	Year	Population - Bagru	Increment	Geometrical increase rate of growth
1	1991	15509		
2	2001	22092	6583	42%
3	2011	31229	9137	41%
Geometric mean I_G				41%
No. of years from 2011 till 2028				17
Population in 2028				**56614**

c) Incremental Increase Method

This method is modification of arithmetical increase method and it is suitable for an average size town under normal condition where the growth rate is found to be in increasing order. While adopting this method the increase in increment is considered for calculating future population. The incremental increase is determined for each decade from the past population and the average value is added to the present population along with the average rate of increase. Hence, population after nth decade is Pn = P+ n.X + {n (n+1)/2}.Y Where, Pn = Population after n^{th} decade X = Average increase Y = Incremental increase

Sl. No.	Year	Population - Bagru	Increment	Incremental Increase
1	1991	15509		
2	2001	22092	6583	
3	2011	31229	9137	2554
		Total	15720	2554
		Average	7860	2554
No. of years from 2011 till 2028				17
No. of decades until 2028				1.7
Population in 2028				50452

In the case of Bagru, the Population Method has been used to estimate the quantity of faecal sludge to be treated. Based on this method Bagru generates close to 12 cum /day.

Qualification of Faecal Sludge by Population Method

- 1991-15,509 (Census data)

- 2001-22,092 (Census data)
- 2011- 31,229 (Census data)
- 2017- 38,914 (Service Level Benchmark)

Faecal Sludge Generation- Population Based Method

- Bagru City Population (Census 2011) = 31,229
- Bagru City Population (Projected, 2018) = 40,270
- Bagru City Population (Projected, 2028) = 56,925
- Assume Floating Population of Bagru City 2028 (3% of population) = 1,708

Total Population of Bagru, 2017= 38,914

Population of Bagru in 2028 by Graphical Method = **56,925**

Assume Floating Population of Bagru, 2028 (3% of population) = 1,708

Total Population of Bagru City = 58,633

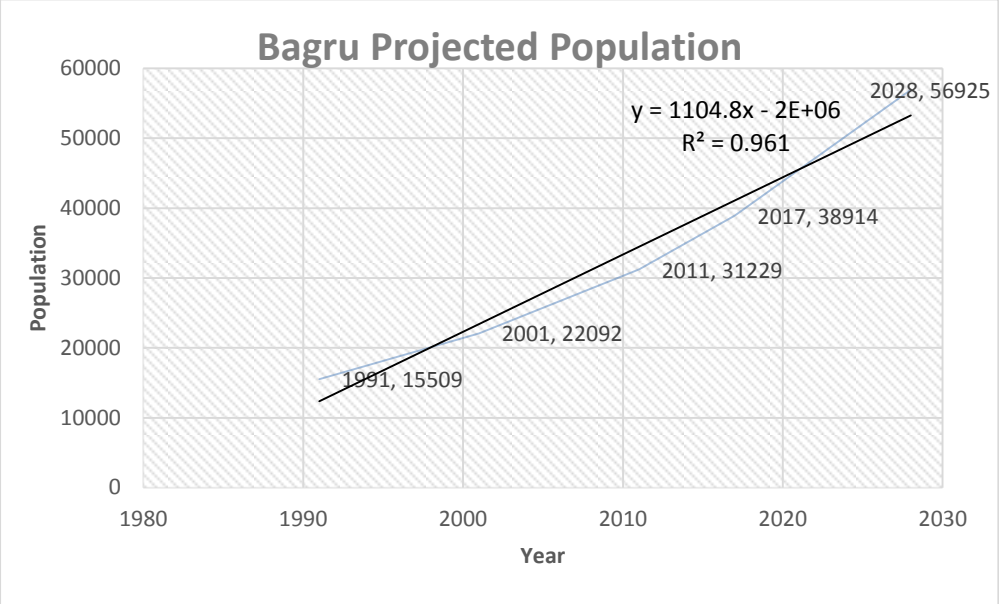


Figure 24: Bagru projected population

Sludge Accumulation Rate for septic tanks = 0.00021m^3/ca/d (CPHEEO Manual)

The town has reached the ODF status and also the targets for Swachh Bharat Mission and hence we consider only one type of containment systems and it is recommended to consider the sludge accumulation rate for the septic tanks which is also on higher side than the sludge accumulation rate for the pits.

Therefore in 2017 faecal sludge generated in a day = 41405 * .00021 = 8.69 m^3/day

In 2028 the population will be 58,633.

Therefore, faecal sludge generated in a day = 58,633 * .00021 = 12.31 m^3/day

Therefore total FS generated per day = 12.31 m^3/day

Considering one truck volume is 3 m^3/day, the total FS generated per day is rounded of to 12 m^3/day (4 trucks per day)

Faecal Sludge Quantity based on Collection Method

a) 3 trucks (2 Private+1 Government outsourced) which are 3.5 m^3 vehicle

Capacity * No of vehicles * no of trips per month

= 3[13] * 1 * 15= 45 m^3 per month (12-15 month, Government outsourced)

Therefore amount desludged per day = 45/30 = 1.5m^3 per day

= 3 * 1 * 20= 60 m^3 per month (15-20 month, for Private operator having 2 trucks together)

Therefore amount desludged per day = 60/30 = 2 m^3 per day

Therefore Total = 1.5+2 =3.5 m^3/day

Qualification of Faecal Sludge by Volume of Containment Method

For each type of containment unit (septic tanks & pits) the average volume for each desludging frequency were calculated:

The volumes for septic tanks and pits were calculated based on the data collected in the sample household survey:

- Average Volume of Septic Tanks – 13.48 cum[14]
- Average Volume of Pits – 4.14 cum

Total Volume of Septic tanks = Avg. Volume of S.T * No. of HHs having ST in 2028

= 13.48* (80% of 11,727 HHs)

=1, 26,464 cum

Total Volume of Pits = Avg. Volume of Pits * No. of HHs having Pits in 2028

=4.14 * (20% of 11,727 HHs)

=9,709.9 cum

Once the total volume (cum) is calculated, the volume/annum was calculated:

- Septic Tanks = 1,26,464/ 5 years = 25,293 cum/ annum
- Pits = 9,709.9/5 years = 1942 cum/annum

Total Volume Per annum = 25,293 + 1,942 = 27,235 cum

[13] 75% operational efficiency on an average(of the 3500 Lts)

[14] Based on the primary survey done in Bagru

Total FS /day = 27,235 / 365 = 74.6 = 75 cum

Quantification of FS: Summary

Table 9: FS Quantification

Method	Value
Population Method	12.31 cum
Collection Method	3.5 cum
Containment Method	75 cum

Under this project, it is proposed to consider population method for taking faecal sludge quantity to treat in a day. The volume of containment unit method does not hold good since the desludging frequency will vary from house to house and cannot be assumed properly. The collection based method also ignored since there is no proper collection is happening at this moment and it is impossible to project it for future years. With proper guidance and regulation it is estimated that a maximum of 12 KLD of faecal sludge every day will be generated based on population method. Further considering a modular plant design aspect and also of population growth discrepancy it was decided to design a faecal sludge treatment plant of 12 cum per day.

7.2 FAECAL SLUDGE CHARACTERISTICS

Faecal sludge characteristic are very variable even within one town as they depend on many factors such as the type of sanitation facility from which the sludge is removed, the interval of emptying, the techniques of emptying etc. Poor knowledge and lack of maintenance services often results in accumulation of organic sludge which reduces effective volume, lower retention times and affects the system performance.

The storage time in the pit or tank also determines the degree of digestion that would have occurred in the storage unit. In general faecal sludge from public toilets is found to be less digested or stabilized, whereas the sludge from households' pits or septic tanks is found to be more stabilized as it has been stored for a longer time. The sludge from pits is less stabilized than sludge from septic tanks as it has been stored for a shorter duration in a pit. The faecal sludge at the bottom of tanks or pits is also found to be more compact and better digested that the sludge at the top.

Faecal Sludge in general is much more concentrated that municipal wastewater (10-100 times higher contents of organic pollutants and suspended solids). Faecal sludge in pits or septic tanks with appreciable levels or organics, nitrogen and pathogens, disposed without

proper treatment are a cause of concern on account of the organic carbon, nitrogen, phosphorus and pathogens in the effluent.

The following table elucidates the differences in properties between faecal sludge and sewage (Udo Heinss, 1998).

Table 10: Differences in properties between faecal sludge and sewage (Udo Heinss, 1998)

Item	Type "A" – High Strength	Type "B" = Low Strength	Sewage
Example	Public Toilet	Septage/Faecal Sludge	Sewage
Characterization	Highly Concentrated, Mostly fresh FS, stored for days or weeks only	FS of low concentration, usually stored for several years, more stabilized that Type A	-
COD (mg/L)	20,000 – 50,000	<15,000	500 – 2,500
COD/BOD	2:1 – 5:1	5:1 – 10:1	2:1
NH4N (mg/L)	2,000 - 5000	<1,000	30 – 70
TS (mg/L)	>= 3.5%	<3%	<1%
SS (mg/L)	>=30,000	≈7,000	200 – 700
Helminth eggs (number/L)	20,000 – 60,000	≈4,000	300 – 2,000

7.3 FAECAL SLUDGE FEEDING (PEAK FLOW)

It is of utmost important to clearly define the rate at which the faecal sludge will be fed into the treatment system. The faecal sludge feeding into the treatment system depends on the capacity and discharge arrangement of the desludging trucks. The treatment modules are designed considering a flow rate generated by discharging 3.5 Kilo litres of faecal sludge being discharged from the truck into the treatment plant in 8-10 minutes time.

7.4 HYDRAULIC RETENTION TIME

In order to ensure the effective treatment of sludge as well as sludge water, it is necessary to provide adequate sludge and hydraulic retention time for each of the treatment module proposed. The proposed Solids and Hydraulic Retention Time for each of the treatment modules are explained in the next section.

7.5 CLIMATIC CONDITIONS

In order to ensure the effective treatment process, it is necessary to consider the climatic conditions for design of treatment modules, necessarily the temperature to ensure treatment efficiency, rainfall to ensure the drying of solids in the drying beds. The design and detailing of the treatment modules are carried out taking the aforementioned factors into consideration.

7.6 ODOURS

The odour problem has been associated with the handling of faecal sludge at the treatment facility. The most characteristic odour of faecal sludge is that of the rotten egg which indicates the presence of hydrogen sulphate and other gases. The real concern with odours is often not recognized during the design and only becomes apparent after the treatment plant becomes operational. Minimization of odour related issues should be addressed in the design details during the designing stage. The same has been considered for this project by providing proper ventilation for all modules of FSTP. It is also utmost necessary to develop good housekeeping practices in the facility operation.

7.7 SITE SELECTION

7.7.1 SITE SELECTION CRITERIA

Identification of septage treatment site is crucial for effective implementation of septage management plan. Following parameters taken into consideration before finalization of treatment sites and measures taken while planning of Faecal Sludge/Septage treatment facility[15]

Distance of treatment site: Distance from emptying to delivering and accessibility of the treatment site are major issues. The transport of relatively small faecal sludge volumes on congested roads over long distances in large urban areas is financially unfeasible. A site that is too far away implies fewer trips per day, less revenue and more fuel costs to private operators.

Reliability of electricity: It is also important to assess the availability and reliability of electricity if treatment technology has mechanical operated parts; as in case of fluctuations it will increase treatment time and will affect optimal utilization of treatment capacity.

Neighbourhood: A treatment site may generate nuisance, especially bad odors. For this reason it should be located at an appropriate distance from the residential areas.

[15] UDD,2016 Guidelines on Faecal Sludge and Septage Management

Land availability: Projects are often delayed because of non-availability or high price of land. ULB should identify the land bank for treatment facility. ULB should also explore the possibility of develop septage treatment facility at solid waste dumping or treatment site.

Geological Parameters: Assessment of existing geological conditions on site like groundwater table, type of soil, prone to flooding is always recommended as it may directly affect selection of technology option.

Below mentioned is the Indicative Decision making framework for Evaluation of Faecal Sludge/ Septage treatment site based on UDD, 2016 Guidelines on FSSM.

Table 11: Indicative list for selection of site for FSTP construction

No.			ment location 1	nt location 2	t location 3	Treatment location 4
Identification of treatment sites						
1	Distance of existing septage disposal site	km				
2	Distance of SWM treatment or disposal facility	Km				
3	Type of SWM treatment facility					
4	Average distance and duration of emptying trip	Km & mins.				
5	Electricity availability					
6	Neighborhood (Residential/ institutional/commercial/ irrigation/farming areas)					
Land availability						
7	Government or private land					
8	Available/ Non-available for developing site					
Geological parameters						
9	Water table	**mt**				
10	Type of soil					
11	Prone to flooding	**Yes/No**				

7.7.2 PROPOSED SITE

The site suggested from the Nagar Palika Bagru, is approximately 4.5 acre and is made available for FSTP construction which is located in ward no.3. There is compound wall all around the site and a land reserved for solid waste dumping. The site is approx. 2-3 km away from the town and is currently being used as faecal sludge dump site. Nice paved road passes nearby the site. **Refer Annexure 5** for detailed site checklist → GPS coordinates of the site.

8 PROPOSED CONCEPT FOR IMPLEMENTATION OF FAECAL SLUDGE TREATMENT SYSTEM

In the presence of only pits and septic tanks as a collection and treatment module for faecal sludge management and the absence of further treatment modules, the collected faecal sludge is disposed without treatment. The faecal sludge collected by the trucks is either disposed on farm lands, forest land, or water bodies. Treatment of faecal sludge is required before it can be safely disposed or used.

At present in Bagru there is no faecal sludge treatment facility available. Faecal sludge has several characteristics that make it difficult to handle. Faecal sludge cannot be discharged into surface waters or be treated like wastewater because its pollutant concentrations are too high. It cannot be used for direct land disposal or treated like solid waste because its moisture content is too high. It cannot be directly used for crop fertilizing because its pathogen content is too high. The first stage of faecal sludge treatment thus mostly involves Stabilization of the sludge and separation of the solid phase and the liquid phase. In this way the liquid part can be treated specifically, usually with wastewater treatment technologies. The solid part can further be treated to enhance its characteristics for reuse applications. Based on the characteristics of the faecal sludge from Bagru, the treatment objectives are listed as

i. Solid Liquid separation
ii. Dewatering
iii. Stabilization

iv. Reuse in agriculture

Sludge treatment involves different treatment steps where available techniques can be combined in various ways depending on the existing constraints and the treatment objectives.

8.1 INTERMEDIARY SOLUTION FOR FAECAL SLUDGE DISPOSAL

Faecal Sludge collected from the households in Bagru will be transported and disposed at the nearest DELAWAS Sewage Treatment Plant (STP) which is located in Sangner of Jaipur district and the decision has to be taken by the Nagar Palika until FSTP is commissioned at the town.

8.2 OPTIONS FOR FAECAL SLUDGE TREATMENT

Faecal sludge can be treated in a variety of ways and there is no single best option considering the widely varying conditions of urban areas. The criteria for short listing options are based on area requirement, treatment efficiency, simplicity in operation and maintenance, reliability and robustness of treatment modules, odour and public nuisance and cost effectiveness of the system at capex and opex levels.

Table 12: Options shortlisted for technologies

Sl. No.	Treatment Stages	Treatment Modules
1.	Pre Treatment	Screen and Grit Chamber
2.	Solid Liquid separation	Feeding Tank Sludge Drying Beds
3.	Solid Stabilization	Biogas Digester Sludge Stabilization Reactor Planted drying beds
4.	Liquid Wastewater Treatment	Settler + Anaerobic Filter Chamber
		Vertical Planted Gravel Filter
5.	Tertiary Treatment	Sand carbon filter and UV treatment

Table 13 below shows comparison between technologies considered. Out of these shortlisted technologies, the optimum combination of treatment technologies selected for Bagruis presented in the next section. The final detailed project report will have this treatment option along with final drawings and estimations for each module.

Table 13: Comparison of Technologies for Treatment of Sludge

Modu-les	Function	Area	Cost	Operation & Maintenance	Odour	Reuse
Un-plan-ted Drying Bed	Unplanted Drying beds are simple sealed shallow ponds filled with several drainage layers. Sludge is applied on the top and dried by percolation and evap oration	48 m^2/m^3	2.5 lacs/m^3	Trained staff is required for application of sludge, controlling drainage system and desludging Desludging is required every week	Very less chanc e of odours and flies	Dried slud ge cannot be directly used ,it requires further drying which can be done by storage or composting
Plan-ted Drying Bed	Planted Drying beds are simple sealed shallow ponds filled with several drainage layers and Plants. Sludge is applied on the top and dried by percolation and evaporation. The plants maintain the porosity of the soil and enhance the evaporation by tran spiration	105 m^2/m^3	5 lacs/m^3	Trained staff is required for application of sludge, controlling drainage system, desludging , maintaining the plant growth Desludging is required 1.5 to 3 years	Odour s and flies may be notice able	Dried slud ge can be used as bio solid in agriculture directly from the PDB

Bio Gas Di-gester	Wastewater and organic wastes are introduced in an airtight reactor, solids settle to the bottom, where they are decomposed by anaerobic digestion and transformed to biogas and fertilising slurry	1.5 m^2/m^3	50,000/ m^3	Trained staff is required for Checking gas-tightness regularly.	Odours may be noticeable	Bio gas can be used for the domestic chores directly from the digester.
Stabi-liza-tion Reac-tor	Stabilization Reactor has three chamber for mixing, stabilization and separation of solid and liquid of the faecal sludge	6.5 m^2/m^3	1.5 lacs/m^3	Trained staff is required to check the regular flow.	No odour is there	No option for reuse

8.3 TREATMENT CONCEPT

The treatment concept proposed for faecal sludge treatment in Bagru has been developed considering mainly

a) Area of treatment plant
b) Reusability of by-products
c) Implementation cost
d) Operations and Maintenance
e) Aesthetics

As manpower and electricity is limited in Bagru the design has taken into consideration minimum energy and minimum operation and maintenance requirement.

8.3.1 TREATMENT STAGES AND MODULES ADOPTED

Table 14: Different Faecal sludge Treatment Stages and Modules

Sl. No	Treatment Stages	Treatment modules
1	Pre-Treatment	Screen Chamber
2	Sludge Stabilization	Sludge stabilization Reactor and

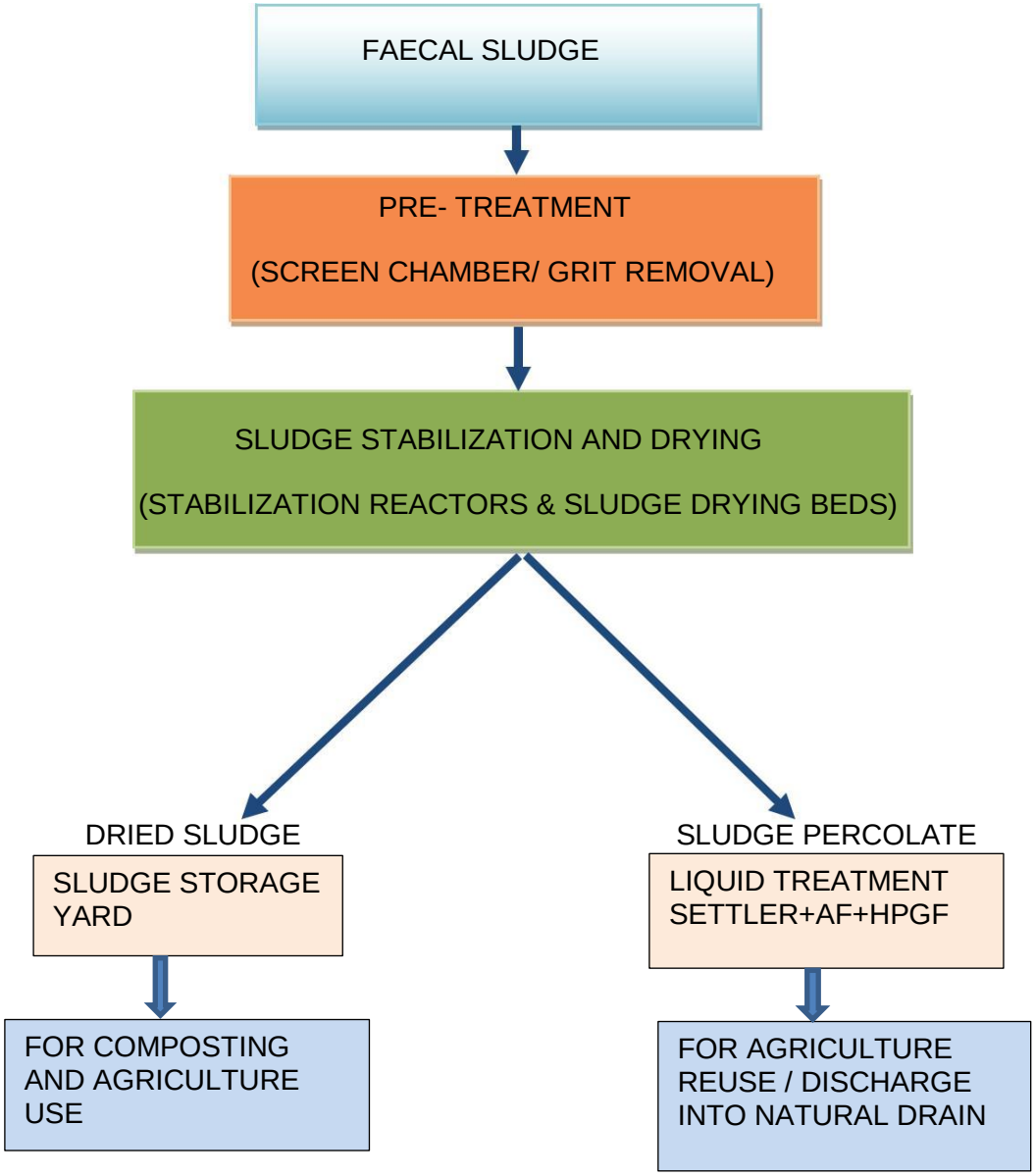
	Sludge Drying	Sludge Drying Bed Planted Drying Bed
3	Liquid Wastewater Treatment	Integrated Settler and Anaerobic Filter
		Horizontal Planted Gravel Filer
4	Tertiary Treatment	Polishing pond

8.3.2 FSTP CONCEPT PROPOSED FOR BAGRU

This feacal sludge treatment unit is designed for 12 cum capacity. The faecal sludge shall first be made to pass through the screening chambers for the retention of coarse materials/ solid waste present in the faecal sludge. The sludge would be conveyed to Stabilization Reactor where the soild liquid separation will take place and from there solid will be conveyed to Sludge Drying Beds (SDB), to remove the degradable organic substance and improve its dewatering ability and supernatant will conveyed to DEWATS. The solids collected at the bottom of the Stabilization reactor in the form of slurry flows to sludge drying beds by pump provided in the third chamber. The sludge drying beds are structures with sloped base for holding graded filter media. The sludge undergoes liquid-solid separation and also drying. The dried sludge from the drying beds are removed periodically and transferred to the sludge storage Yard located within the premises and the rest of the part which is the liquid percolate or effluent wastewater is conveyed to the collection tank after which it is pumped to the integrated settler and Anaerobic Filter.The effluent wastewater is then treated in two stages (primary and secondary stage) in DEWATS modules. The primary stages i.e. Settler is mainly meant for Sedimentation of any solids that have entered the modules along with the percolate. The secondary stage i.e. Anaerobic Filter is for the anaerobic degradation of any dissolved and suspended organic matter. The partially treated wastewater from the secondary treatment unit would be conveyed into the horizontal planted gravel filter takes place. The treated wastewater from the planted gravel filter is then conveyed to the polishing pond and it can be reused for agriculture. There is also inclusion of 2 beds of Planted Drying Beds as a contingency in case of the delay in the drying in the sludge drying beds

In future if the quantity of faecal sludge is expected to increase significantly the same system can be replicated in the selected location to accommodate the extra loads. The area available in the selected location for FSTP is **4.5 acres.**

8.3.3 LINE DIAGRAM SHOWING TREATMENT PROCESS



8.4 PROCESS FLOW DESCRIPTION

Screen chamber

It is a physical method for separation of solid waste and inorganic solids like plastic, cloth, sand, slit etc. from the faecal sludge to prevent clogging of subsequent treatment modules and also enhancing the value of treated end products. Screen chamber uses a series of vertical screens made from mild steel and coated with anti-corrosive elements for this purpose. In the screen chamber proposed for this treatment facility there is 1 vertical screen with has

Figure 25: Screening chamber

an opening of 25mm. The trash is collected by manually scrapping the screen with a rake or similar arrangement.

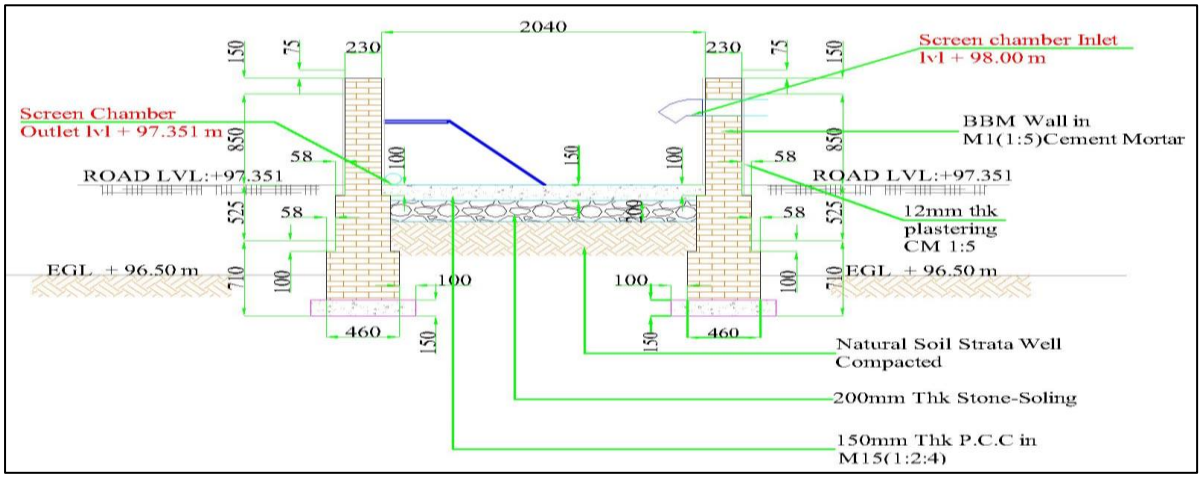


Figure 26: Screen Chamber

Table 15: Specifications for Screen chamber

Parameters	Unit	Values
Area required per screening chamber	m^2	2.7
Retention time	Seconds	30 Seconds
Number of screen chambers		1 numbers

Stabilization Reactor

The main objective of the stabilization reactor is to allow the sludge to digest anaerobically which leads to reduced organic load and better dewater-ability. The stabilization reactor has 4 chambers. The first chamber has a retention time of 2 days and assists in homogenization of sludge. During the discharge of sludge from the desludging vehicle high turbulence is created in the chamber with an up-flow velocity of 4-5 m/hr. The second and third chamber has a retention time of 7 days and is designed to stabilize the sludge through aiding the process of anaerobic digestion. The length of the chamber is kept low to prevent dead zones and liquid funnels that may be created at the outlet. A baffle wall is also designed for similar purpose. The up-flow velocity in this chamber is kept at 1.5 -2 m/hr., this is to disturb the sludge and help entrapped bio-gas to escape, thereby aiding liquid solid separation. The fourth chamber retains the sludge for 1 day; this is used as an intermediate collection tank to empty the contents into the drying bed every day.

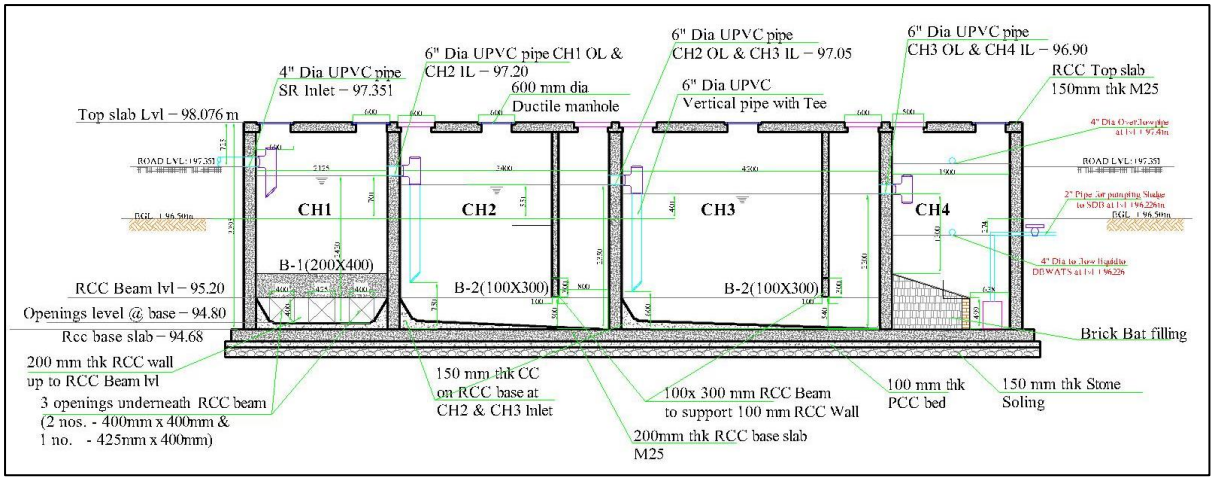


Figure 27: Cross Section of Stabilization Reactor

Table 16: Specification of Stabilization Reactor

Parameters	Unit	Values
Treatment capacity	m^3	12
Number of chambers	Nos	4
Sludge Retention time	Days	10
Area Required	m^2	72

Sludge Drying Beds

Unplanted Drying Bed is a simple, permeable bed filled with several drainage layers. When loaded with sludge, it collects percolated leachate and allows the sludge to dry by percolation and evaporation.

Approximately 50–80% of the sludge volume drains off as liquid or evaporates. This sludge needs additional treatment by composting before it can be safely disposed off or used as a nutrient-rich soil conditioner in agriculture. The percolate, however, still contains pathogens and needs to be further treated.

Figure 28: Sludge Drying Bed

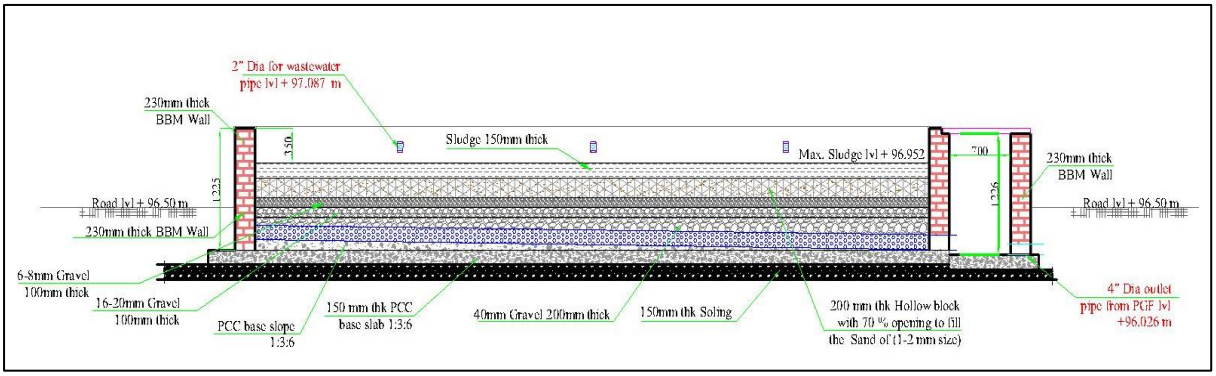


Figure 29: Sludge drying bed

Table 17: Specification of Sludge drying bed

Parameters	Unit	Values
Total number of beds	Nos	20(2 beds for contingency)
Treatment volume of each bed	m^3	4.8
Area required for each bed	m^2	40.5
Slurry feeding frequency	Days	19
Slurry drying period	Days	18
BOD outlet (percolate)	mg / L	250-300
COD outlet (percolate)	mg / L	500-1000
Dimension of Sludge Drying bed	m	8 x 4
Height of sludge layer	m	0.15
Dried sludge quantity per bed	Kgs	500 -900

Solar Sludge sterlisation:

Bio-solids from drying beds, can still have certain pathogens and microorganism which may be harmfull or pose risk of health hazards. It is therefore required that this sludge be sterlised before distributing to farmers or reused. In a solar sludge sterlisation unit, the dried bio solids are placed inside a solar heating chamber, where the temperate is raised to around 70 degree celsius, thereby killing or inactivating the pathogens. The design of the sterlisation unit ensures maximum capture and retaining of solar energy for raising the temperature. The sludge inside the unit is placed in trays and with applications of 10-15 cms per loading for a period of 2-3 hours.

Capacity per day	5 tons
Area required	100 m2
Temperature (max)	75 degree C

Figure 30: Sludge Sterilisation Unit

Planted Drying Bed (PDB)

The screened faecal sludge is applied on to Planted drying beds (PDBs), also sometimes referred to as planted dewatering beds, vertical-flow constructed wetlands and sludge drying reed beds, are beds of porous media (e.g. sand and gravel) that are planted with emergent macrophytes. PDBs are loaded with layers of sludge that are subsequently dewatered and Stabilized through multiple physical and biological mechanisms. FS is repeatedly loaded onto PDBs, with up to 10 cm of FS per loading where it accumulates for several years depending on the loading rate, the capacity of the system and mineralization rates and meanwhile the percolated water is treated separately in DEWATS modules. The volume of sludge on the PDB reduces continuously (through moisture loss and degradation), and the plants maintain porosity in the sludge layer thereby significantly reducing the need

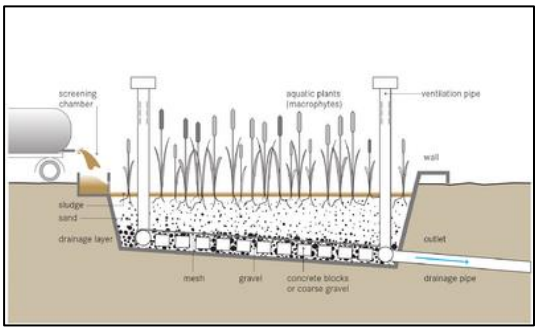


Figure 31: Planted Drying Bed

for sludge removal compared to unplanted drying beds (which require sludge removal every two to three weeks).

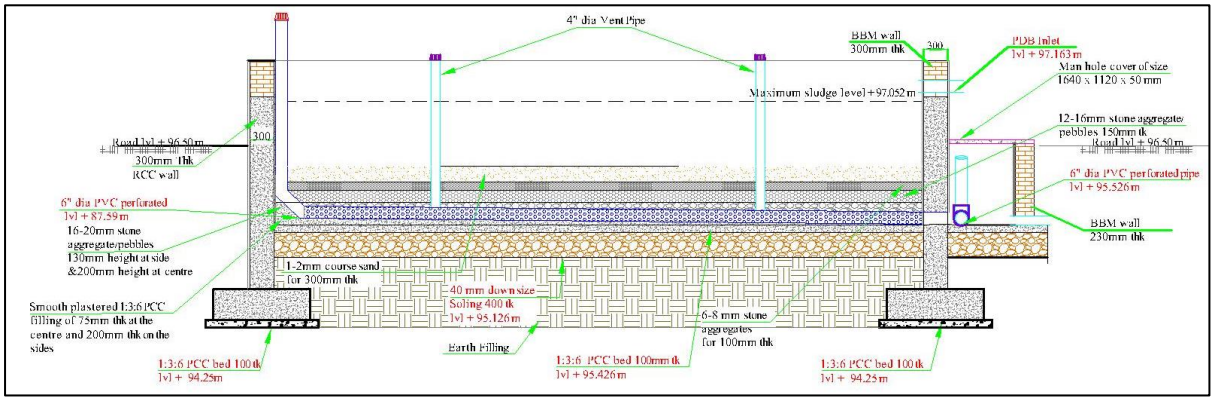


Figure 32: Cross Section of Planted Drying Bed

Table 18: Specifications of Planted Drying Bed

Parameters	Unit	Values
Total number of beds	No.	2
Treatment volume of each bed	m^3	10
Area required per bed	m^2	68
Slurry feeding frequency	days	1 load per week
Maximum sludge filling height	m	1
BOD outlet (percolate)	mg / L	300
COD outlet (percolate)	mg / L	900

Integrated settler and Anaerobic Filter (ISAF)

The percolate from the Sludge Drying Bed is further subjected to treatment in settler and Anaerobic Filter (AF). The incoming faecal sludge load has pretty high solids content, therefore it is proposed to provide a settler for sedimentation before it enters into the anaerobic filter. The anaerobic filter is provided with a series of chambered anaerobic fixed bed filters. As wastewater flows through the filter, particles are trapped and organic matter is decomposed by the biomass that is attached to the filter material.

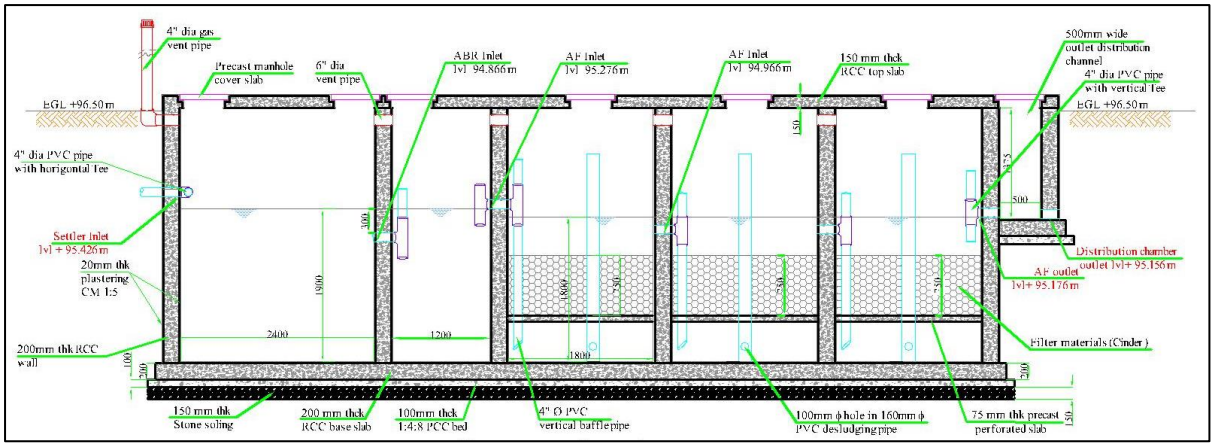


Figure 33: Cross section of Integrated Settler and Anaerobic Filter

Table 19: Specification for Settler Design

Sl No	Particulars	Unit	Values
1	Discharge (Q daily)	m^3/d	10
2	Time of peak flow (peak)	Hrs	4
3	Max. Chemical Oxygen Demand (COD in)	mg/l	900
4	Max. Biological Oxygen Demand (BOD in)	mg/l	300
5	Hydraulic Retention Time (HRT)	Hrs	4
6	Area required	m^2	10.6

Table 20: Specifications of Anaerobic filter design

Sl No	Particulars	Unit	Values
1	Discharge (Q daily)	m^3/d	10
2	Time of peak flow (t peak)	Hours	4
3	Chemical Oxygen Demand (COD in)	mg/l	626
4	Biological Oxygen Demand (BOD in)	mg/l	203
5	Min. Temperature (T minimal)	°C	28
6	Type of filter material	Construction Gravel, Cinder or corrugated pipes	
7	Volume of filter material	m^3	8.1
8	Area required	m^2	17.6
9	Chemical Oxygen Demand (COD out)	mg/l	144
10	Biological Oxygen Demand (BOD out)	mg/l	30

Horizontal Planted Gravel filter (PGF)

Organic load entering into the PGF is already within the required effluent (BOD < 30mg/L) requirement. In order to remove the odour and colour and to enrich the wastewater with oxygen it is necessary to allow the wastewater to pass through aerobic treatment. PGF is made of planted filter materials consisting of graded gravel. The bottom slope is 1% and the flow direction is horizontal. The main plants used in this filter bed are Canna Indica, Reed juncus, Papyrus and Phragmites. The plant selection is mainly based on their ability to grow in wastewater and have their roots spread wide. PGF also aids in reducing the nutrients such as Nitrogen, Phosphorous and potassium present in wastewater.

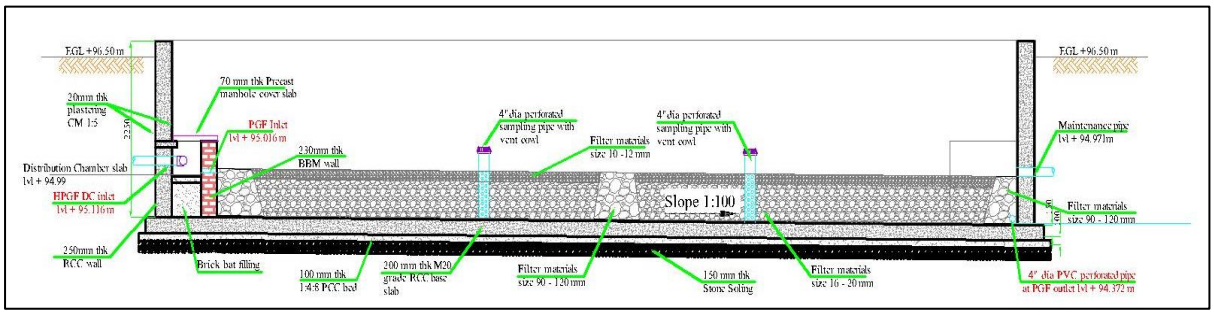


Figure 34: Cross section of Planted Gravel Filter

Table 21: Specifications of PGF

Parameters	Unit	Values
Percolate treatment quantity	m^3/Day	10
Total number of PGF	-No.	1
Hydraulic Retention Time per PGF	Days	4.31
Area required per PGF	m^2	87
BOD outlet	mg / l	10
COD outlet	mg / l	57

Polishing Pond Polishing ponds are used to improve the quality of effluents from efficient anaerobic sewage treatment plants, so that the final effluent quality becomes compatible with legal or desired standards. The residual organic material and suspended solids concentrations in the digested sewage are reduced, but often the main objective of polishing ponds is to improve the hygienic quality, measured by the concentration of two indicator organisms: helminthes eggs and faecal coliforms (FC). The FC removal is normally the slowest process and for that reason becomes the main design criterion for a polishing pond. The final effluent TSS and BOD concentrations were not very low for retention times of less than 1 week, but this could be attributed to the presence of algae in the final effluent. Filtered effluent BOD and TSS concentrations were very low. For retention times of more than 1 week algae were efficiently removed from the liquid phase by the action of predators and algae flocculation and settling, so that a final effluent with a very low BOD and TSS concentrations was produced. To maximize the FC removal efficiency, the polishing pond was constructed with the objective of approaching a plug flow regime.

Figure 35: Polishing Pond

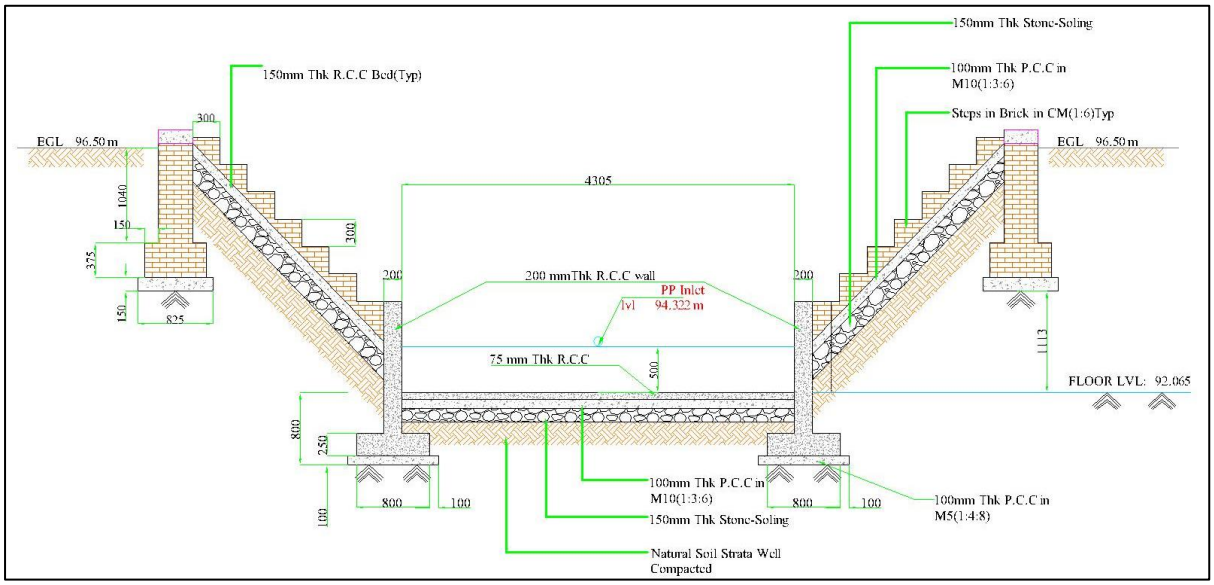


Figure 36: Cross section of the polishing pond

Table 22: Parameters for Polishing Pond

Parameters	Unit	Values
Area of Pond	m^2	52
Depth of the water in pond	m	0.5

8.5 AREA REQUIREMENT FOR PROPOSED FSTP

Table 23: Area Specifications of Treatment Modules

Sl.No	Modules	Nos	Area per module (sq.m)	Total Area (sq.m)
1	Screening Chamber	1	2.7	2.7
2	Stabilisation Reactor	1	72	72
3	Sludge Drying Bed	20	40.5	810
2	Planted Sludge Drying Bed	2	68	136
3	Settler+AF	1	27	27
4	Horizontal Planted Gravel Filter	1	87	87
5	Polishing Pond	1	52	52
Total area for treatment modules				**1187**
Total area for supporting structures(Road and Operator room)				**3813**
Total FSTP Area				**5000**

8.6 PLAN OF FSTP SITE

Figure 37: Plan of FSTP at Bagru

8.7 TIMELINES FOR IMPLEMENTATION OF FSTP

S.No	Item	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
1	Excavation											
2	Screen chamber SDB & PDB											
3	Settler and Anaerobic Filter											
4	Planted Gravel Filter											
5	Polishing Pond											
6	Road and Compound Wall											
7	Operators room											

9 END PRODUCT SPECIFICATIONS

The treatment system has two end products namely:

a) Bio solids
b) Treated Water

9.1 BIO SOLIDS

Bio solids are dried sludge from planted drying beds. Bio solids can be used as a soil conditioner for farming as they are a rich source of Nitrogen, carbon and phosphorous.

Table 24: Bio-solids characteristics

Parameters	Characteristics
P^H at 5% suspension	5- 7
Moisture %	10 - 30 %
Organic carbon %	10 – 25 %
Organic Nitrogen	2- 5 %
Phosphorous	0.2 – 1 %
Bulk Density (Specific gravity)	0.65 – 0.9

Source: Faecal sludge management systems approach for Implementation and Operation, IWA Publications, 2014

9.2 TREATED WATER

Water from liquid treatment modules are stored in a collection tank from where it can be reused for irrigating plantations in nearby farm lands and also can be discharged into a nearby drain. The characteristics of the treated water are as follows:

Table 25: Treated water characteristics

Parameters	Characteristics of treated water
P^H	6.5-9
Temperature	25 -35 degree
BOD at 5 days mg/L	~30
COD mg/L	~250
Total suspended solids mg/L	<100
Faecal coliform, MPN per 100 mL	<1000

Source: Based on lab test results from FSTP Devanahalli

10 PLUMBING SPECIFICATIONS

This Section includes the information on all the pipe material and sizes, registers and their sizes, slope provided for conveying the sludge and Supernatant /filtrate. Plug valves to be used in the conveyance and piping of sludge, i.e total solids in excess of 1%. For conveyance of treated water or percolate, ball valve to be used.

Pipe material and sizes

Table 26: Pipe material

Sl no	Pipe Material	Diameters used	Remarks
1	UPVC	110mm,160mm	None pressurized. i.e. gravity flow pipes
2	HDPE	110mm, 65 mm	For pipes below 1 metre ground filling
3	UPVC	50mm, 25mm	Pressurized Pipe for Pump.
4	Earthen Pipe	203mm	For making the channel for PVC pipe through road

Slope

The minimum gradient for the pipes conveying faecal sludge and treated wastewater is provided in Table 27.

Table 27: Slope Details

Sl No	Slope	Remarks
1	1: 100	All pipes Conveying wastewater (if not mentioned)
2	1: 100	Bottom slope in sludge drying bed and VPGF
3	1: 200	Storm water drain

Registers

The sizes of the register are based on the Depth of the sewer pipe and are provided in the table below:

Table 28: Register Details

Sl.No	Depth of the Sewer Pipe	Size of the Register
1	0m to 1m	0.7m x 0.7m
2	1m to 1.5m	1 m x 1 m
3	1.5m to 2m	1 m x 1m

11 QUALITY CONTROL DURING CONSTRUCTION OF MODULES

Table 29 below lists out the teste needed to be done during construction of FSTP Modules. An Implementation Plan is also provided which details out the construction activities with a timeline.

Table 29: Testing for quality control

Lists of tests		
Sl No	**Description**	**Frequency of the test**
A	**Cement**	Every Batch
i	Initial setting time	
ii	Final Setting Time	
iii	FINENESS BY DRY SEIVING % (90 MICRON)	
iv	COMPRESSIVE STRENGTH N/mm^2 at 3 days, 7 days and 28 days	

B	**Sand**	Every Load
i	Bulkage of sand	
ii	Silt and clay Content	
iii	Specific Gravity	
iv	Sieve Analysis	
C	**Coarse Aggregates**	Every Load
i	Bulk Density-12.5mm	
ii	Bulk Density-20mm	
iii	Specific Gravity-12.5mm	
iv	Specific Gravity-20mm	
v	Sieve Analysis-12.5mm	
vi	Sieve Analysis-20mm	
vii	Impact Value	
viii	Abrasion test	
ix	Flakiness and Elongation index	
D	**Cement Concrete**	Every Concrete Activity
i	Slump Test	
ii	Compressive Strength (7 days and 28 days in N/mm^2	
E	**Cement Concrete Block Test**	
i	Compressive Strength	Every Load
F	**Reinforcement Steel**	**Manufacturers Test Certificate**
G	**uPVC and PVC pipes**	**Manufacturers Test Certificate**
H	**Paver Blocks**	
i	Water absorption test	Every Load

ii	Compressive strength test	Every Load
iii	Abrasion Resistance Test	Every Load
iv	Breaking load/ flexural strength	Every Load
I	**Subgrade**	
i	Gradation or sand content	1 test
ii	Standard Proctor test	1 test
iii	Moisture Content	
iv	Density test after rolling	1 test/500 cum
K	**Wet Mix Macadam**	
i	Aggregate impact value	1 test/200 cum of aggregate
ii	Flakiness and Elongation Index	1 test/200 cum of aggregate
iii	Waterberg limit for binding material	1 test/25 cum of binding material
iv	Density of compacted layer	1 test/500 cum
L	**Water quality test for construction**	One time
M	**Water tightness test for structure**	Every Structure
N	**Soil test for foundation**	
i	Density test	all structures

12 OPERATIONS PLAN

The below section details out the proposed operational plan for the sustainable operation of the faecal sludge management system at the ULB level. The operational plan is divided into two components a) Collection and conveyance, b) treatment. Each component lists down the proposed plan, the agencies involved, their roles and responsibilities and other supporting systems to be established.

It is decided in consultation with the Department of Local Self-Government, Government of Rajasthan that the CAPEX and OPEX for 10 years including the cost of truck operations and treatment plant maintenance shall be provided as a grant from the state finance commission. The proposed plan below discusses the set up to be established at the ULB level during the period of 10 years and also measures to be taken to sustain the FSM operation over and after the 10 year grant period.

12.1 COLLECTION AND CONVEYANCE

12.1.1 PROPOSED PLAN: 10 YEAR PERIOD

General plan

- A new truck purchase is proposed under this DPR. The truck shall be registered under the name of the Urban Local body and shall be under the ownership of the same.
- The proposed truck operation shall be outsourced to a private operator, who in return shall desludge households in the ULB limits and also maintain the truck for its usage. The private operator shall pay to ULB as fixed rent for using this truck, in addition to an advance that shall be remitted at the beginning of the contract.
- The contract between the ULB and the private truck operator shall be for a period of 2 years. After 2 years, the ULB shall seek for fresh bidding from eligible and interested private participants.
- Households shall be charged a maximum fee of Rs.500 per desludging. This fee is tentatively fixed for 2 years to encourage the desludging practice by households. However, this fee shall be modified or changed by the ULB on the passing of relevant resolutions at the council meeting.
- Since the Households are to be encouraged to desludge once within 5 years, it is proposed that ULB shall provide a subsidy of Rs. 500 per desludging to the private operator. This subsidy shall be a part of the O&M estimation for FSM and shall be provided for a period of 5 years, till all households complete one cycle of desludging.
- The subsidy is only eligible per household for desludging once in the 5-year period. In case of demand from a household for desludging more than once in the 5-year cycle, then the private operator can charge a fee of Rs. 1000 per desludging.
- The ULB shall have a dedicated number for desludging services. Households shall call on this number to register for a desludging service. The number shall be owned by the ULB, but operated and serviced by the private desludging operator.

Role of the ULB

- The urban local body shall address any grievances raised by households with regards to pricing and quality of service provided by the empaneled private operator. The ULB shall be eligible to levy penalties on the private operator and in worst of cases, terminate the license to the operator, and thereby seek new operators.
- The urban local body shall on a periodic basis (proposed 6 months) inspect the truck and issue fitness certificate. Any damages or intentional wear and tear shall be brought to the notice of the private operator and relevant penalties and sanctions shall be imposed for its repair and upkeep.
- The Urban local body shall make it mandatory for every household in the town limits to desludge their onsite containment units once in 5 years. Failing which a penalty of Rs. 100 per month shall be levied to the household. Households shall submit the receipt of desludging as a proof in case of grievance redressal.
- The urban local body shall on a timely basis carry out any major maintenance work on the truck and if need be arranging for a new truck.
- Urban local bodies shall make it mandatory for all households within the administrative boundary to have an onsite containment system as per guidelines provided by the state government.
- Urban Local bodies shall monitor the operations of the desludging service with regards to the safety of operators, quality of service, financial transactions and disposal of the faecal sludge. If any violation is noted, the ULB shall appropriately penalize the private operator.
- In addition to the empaneled private operator, the ULB can provide a license to operate to other private operators who are interested. This shall be done to maintain competition and provide a better quality of service to the household. However, the licensing shall be regulated by certain conditions of the fee collected from household and discharge of faecal sludge.
- The ULB shall provide a subsidy of Rs. 500 per household per desludging (eligible only once per household). This subsidy shall be paid to the desludging operator on the provision of a receipt of the fee collected from the household.

Role of Private Operator

- Provide desludging service to households, at rates below the maximum prescribed rate by the ULB. The operator shall provide to the household a receipt of the fee collected using a point of sale machine. The operator shall provide proof of the receipt to the ULB on a timely basis and collect the subsidy allocated per household.
- Discharge the collected faecal sludge into treatment plants.
- Maintain a database of households, which have desludged and update the status to ULB on a quarterly basis.
- The operator shall maintain the truck for at least 95% of its availability. Any major repair works shall be upraised to concern official of the ULB and shall be borne by the ULB.
- The private operator shall maintain a vigil of other private operators in providing service in the administrative area and appraise the same to the ULB officials.

Financial forecasting

This section details a pro-forma income and expenditure statement (Year 1) for both the ULB and the Private operator with regards to the proposed model.

Private operator - finances

S.no	Particulars	Amount (per annum)	Remarks/Assumptions
	Income statement		
A	Revenue from desludging operations	Rs 8,05,400	Rs. 500 per household x 20% of 8054[16] households
B	Revenue from Tipping fee	Rs. 1,20,000	Rs. 100 for full load x 1200 loads per annum
C	Subsidy from ULB per household	Rs 8,05,400	Rs. 500 per household
D	Revenue from	Rs. 80,550	5% of all household

[16] Number of HHs based on the projected population of 40,270 for the year 2018

	nonscheduled desludging[17]		desludge per annum
1	**Total income (Sum A to D)**	**Rs. 18,11,350**	
	Expenses		
A	Rent to ULB	Rs. 1,20,000	Rs.10,000 per month
B	Labour	Rs. 3,60,000	Rs. 10,000 x 3 persons
C	Fuel expenses	Rs. 2,09,430	10 km per household desludged, Rs. 65 per liter of diesel. Fuel efficiency is 5 Km per liter
D	Miscellaneous costs for vehicle maintenance	Rs. 1,50,000	
E	Cost of safety equipment	Rs. 36000	Rs. 1000 per person per month
F	Database maintenance and GPS mapping of truck operations	Rs. 3,00,000	Rs. 25000 per month (included cost of computer operator, electricity, and misc. items related to database management)
2	**Total Expenditure (Sum A to F)**	**Rs. 11,75,430**	
	Gross Surplus (1-2)	**Rs. 6,35,920**	

ULB finances

S.no	Particulars	Amount	Remarks/assumptions
	Expenditure		
A	Maintenance of Truck	Rs. 1,80,000	10% of CAPEX per annum
B	Subsidy to households	Rs. 8,05,400	Rs. 500 per household
C	Salary of FSM inspector[18]	Rs. 2,40,000	Rs. 20000 per month
D	Admin overheads	Rs. 1,22,540	10% of total expenditure

[17] This is from household who demand desludging more than once in the 5 year period.

[18] Hired as a consultant by the ULB to monitor the FSM interventions and for awareness generation activities by the ULB

	Total Expenses	**Rs. 13,47,940**	
	Receipts		
A	Income from rent of vehicle	Rs. 1,20,000	
B	Receipt for truck operations and subsidy from State finance commission	Rs. 12,27,940	
	Total Receipts	**Rs. 13,47,940**	

After a period of 5 years, the ULB shall start charging Rs. 1000 per desludging from every household. Thus, from the 6 years onwards there shall be no receipt of subsidy from the state finance commission to ULB.

12.2 TREATMENT AND REUSE

12.2.1 PROPOSED PLAN: 10 YEAR PERIOD

General Plan

- The treatment plant of 12 KLD capacity shall be outsourced for construction, operation, and maintenance for a period of 5 years to a private plant operator.
- After a period of 5 years, the ULB can extend the contract with the existing operator or can call for new proposals.
- The CAPEX and the cost of 10 year OPEX shall be provided by the state finance commission grant.
- A subsidy of Rs. 100 shall be provided for a period of 5 years as a tipping fee to any desludging operator discharging faecal sludge in the treatment plant.
- The plant operator shall adhere to certain performance benchmarks as mentioned in the bid document. Payments shall be made on the basis of performance.
- The plant operator is permitted to sell the end products after certification from statutory bodies. The proceedings of the sale will be a bonus revenue source for the plant operator.

Role of the ULB

- ULB shall monitor the operations and infrastructure of the FSTP and shall rate the performance of the plant operator. The ULB shall thereby disburse funds for O&M of the treatment plant on the basis of the measured performance.

- The ULB shall document the performance of the treatment plant efficiency on a quarterly basis and send the same to state pollution control board for statutory filings.
- ULB shall timely carry out a technical evaluation of the plant performance and undertake changes in the design and operation as required for increasing the efficiency or capacity.

Role of the Plant Operator

- The plant operator in addition to creating the infrastructure shall operate and maintain the system as prescribed by the design consultant.
- The plant operator shall carry out testing of the end products every month and shall report the performance of the plant to ULB.
- The plant operator shall engage in creating awareness of the treatment plant to desludging operators and shall incentivize them to discharge in the facility. For every discharge a payment of Rs. 100 shall be made to the desludging operator. As an incentive to carry this out, an additional incentive of Rs 50 shall be provided to the plant operator.
- The plant operator shall get the required compliances for sale of end products and carry out the sales and marketing of the same to interested stakeholder groups.

Performance level measurement framework

The below framework can be used by the ULB to rate and provide suggestive penalties to the faecal sludge treatment plant operator. This framework is only indicative and can be modified after council discussion at the ULB. It is however suggested that this filled framework be sent to SFC (State finance commission to request for funding of O&M of FSTP)

S.no	Parameters	Unit of measurement	Benchmark	Financial implications
1	Treatment capacity	Average kilo liters treated per day (Total input of FS into treatment plant/ Number of operational days in a year)	1 year – 8 KLD 2 year onwards – 10 KLD and above	Less than benchmark – 75% of Operation expenses. Benchmark and more – 100% of budgeted O&M

				expenditure
2	Treatment efficiency	Number of samples where the results are satisfactory (out of 12 samples per annum)	12 /12	The penalty of Rs.10000 per month for 2 months in case of non-conformity. In case of more than 2 months, the penalty shall be Rs. 1000 per day.
3	Cleanliness of the facility	Independent observations carried by ULB staff	Compliant during every observation	Rs. 1000 fine per day
4	Safety during operations	Independent observations carried by ULB staff	Compliant during every observation	Rs. 1000 fine per day

Finance forecasting

The section forecasts the income and expenditure for the private faecal sludge plant operator for Year 1.

S.no	Particulars	Amount	Remarks
	Expenditure		
A	Operation and Maintenance cost of the Treatment Plant	INR 8,48,497	
B	Tipping fee to desludging operator	INR 1,20,000	Rs. 100 per load
1	**Expenses**	INR 9,68,497	
	Receipts		
A	Subsidy from ULB	INR 1,80,000	Rs. 150 per load
B	Operation and maintenance receipts from ULB	INR 8,48,497	
C	Sale of end products	INR 5,40,000	Rs. 1 per kg of bio-solids and Rs. 200 per KL of treated water. Sale efficiency: 75%
	Income receipts	**INR 15,68,497**	
	Surplus	**INR 6,00,000**	

12.2.2 PROPOSED PLAN – AFTER 10 YEARS

For the first 10 years after commissioning the sustainability of the FSM is financed by state finance commission (SFC). However post this period the following long-term action points are suggested for ensuring a sustainable and seamless transfer of O&M financing from SFC to ULB.

- The ULB from 6th year onwards can charge an FSM tax of Rs. 10 per month per household. The accumulated tax receipts for a period of 5 years can be used for enhancing the capacity of the treatment plant at the end of design period.
- The tax collected after 10th year onwards could be used for financing the operation and maintenance of the treatment plant.
- The quantum of tax collected per household, list of exclusions and method of collection can be further detailed by the ULB.

13 FAECAL SLUDGE MANAGEMENT REGULATIONS

After having successfully built and commissioned the FSTP, the municipality will have to work on making the plant operations self-sustainable.

There are 3 main components of FSM services:

1. Desludging Vehicles – they require regular scheduling, tracking and customer service, maintenance and optimized operations management.
2. Faecal Sludge Treatment Plant- They require technical management, operator training and monitoring
3. Reuse Facility – they require proper maintenance, technical assistance and monitoring.

To meet the costs incurred for maintenance of the FSTP and desludging vehicles, a strategy needs to be put in place which requires robust protocols and bylaws. This section focusses on the potential solutions and respective methodology for implementation of FSM in terms of 4 key policy resolutions that need to be passed by the Bagru municipality.

Table 30: 4 Key Policy Resolutions

Policy Resolution #1 **Tendering of O&M to 3rd Party** Outsourcing the O&M of FSTP and desludging vehicles to a 3rd party through tendering	**Policy Resolution #2** **Sanitation tariff part of the Tax being collected** Cost incurred by tendering the O&M, can be met by levying additional property/water tax/Solid waste collection at household level
Policy Resolution #3 **NOC for new property constructions** New OSS to be constructed as per CPHEEO standards & Municipality to validate the plan and certify with NOC before commencement of construction	**Policy Resolution #4** **Formalization of Private Operators** Private desludging service providers to be licensed and monitored by the municipality, formation of regulations for disposal at FSTP

13.1 TENDERING OF O&M TO 3RD PARTY

13.1.1 NEED FOR TENDERING/OUTSOURCING O&M

State Government and ULB must plan the entire FSM process effectively to achieve success. Procurement of the right desludging vehicles or building a FSTP is only part of the solution. Proper O&M is critical for success. The major problem in Faecal Sludge Management are as below:

1. Faecal sludge is disposed by the desludging operators at unsafe locations, typically into water bodies and open land instead of taking it to a treatment facility.
2. Either treatment facilities are non-existent or if present and not properly operated and are unable to adequately treat the FS.
3. Treatment plant particularly if close to urban centers creates nuisances like smell.
4. ULBs do not have the bandwidth or technical skills to run these operations efficiently both for the FSTP and desludging vehicles, which leads to financial losses.

Some of the best FSM systems in the world such as Manila Water in Philippines and Indah Water in Malaysia, operate integrated services including desludging, transport and treatment. Integrated services help address the severe problems mentioned above.

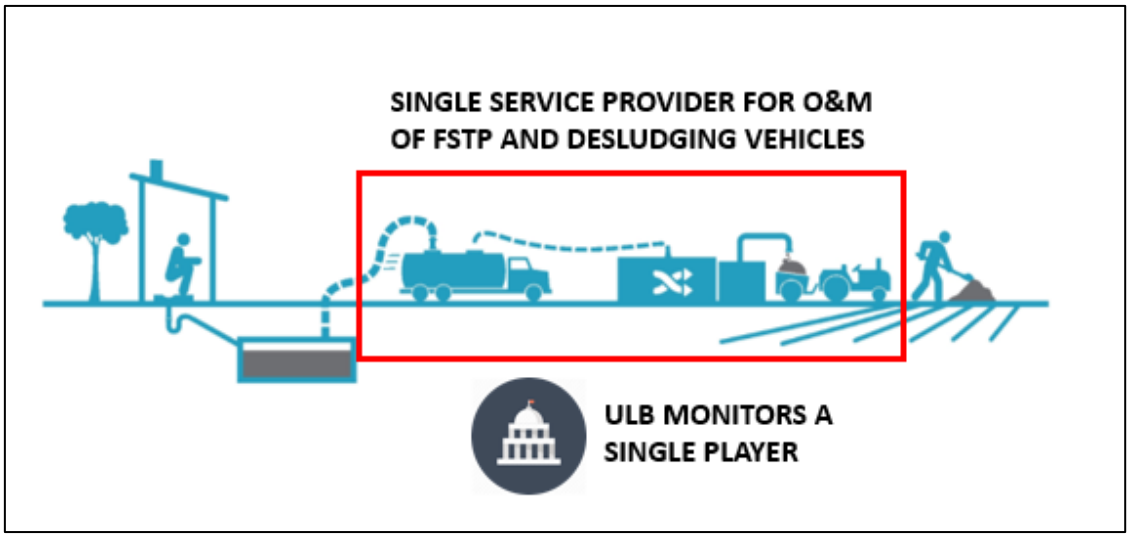


Figure 38: Work Bifurcation - Integrated service contract

Following are the salient features of the integrated service contract:

1. There will be a common service provider for the O&M of the FSTP and desludging vehicle operations.
2. Since the single entity has oversight of the entire system, they can invest in technology and monitoring/reporting systems.
3. If different entities operated the FSTP and the desludging vehicles, there can be disputes over whether all the sludge is being brought to the FSTP. The ULB will be arbitrating disputes while the environment may suffer.
4. ULB monitors only a single entity and can thus perform the task more effectively ensuring that service is provided as per standards.

13.1.2 OPERATIONAL DETAILS FOR THE RESOLUTION

This sections highlights the operational details of the resolution on tendering the O&M of the FSTP and Desludging vehicles to a single 3rd party.

1. Bagru should outsource the O&M of the entire FSM system to capable 3rd party and establish rigorous criteria for providing services:
   a. Selection of service providers based on technical capabilities and operations experience.
   b. Payment should be based on proper service being delivered to citizens.
2. Bagru Municipality and elected council should jointly determine the tender cost.
3. Tender to be a joint tender in which all the three elements of FSM to be covered.
4. Tendering to be done following the state government guidelines

5. Time frame of tendering is subject to the discretion of the Bagru municipality and council members.

13.2 TARIFF INCLUSION IN PROPERTY TAX/ WATER TAX/SOLID WASTE COLLECTION TAX

To meet the costs incurred and effective operation and maintenance of treatment facility, one viable option is to levy additional property tax to the existing tax rate.

Figure 39: Slab based Tariff structure in Property Tax/Water Tax/Solid Waste Collection Tax

13.2.1 OPERATIONAL DETAILS FOR THE RESOLUTION

This section highlights the operational details of the resolution on inclusion of FSM tariff in property tax/water tax.

1. Town council to levy additional tax at per capita household level.
2. Type of properties exempted from this taxation structure are as follows;
    a. Government offices/ Government run offices and institutions (schools, colleges, hospitals) for both central and state government also vacant lands and unspecified
    b. All residential, commercial, institutional (except government run) will come under this new property tax structure.
3. Calculation of property tax to be slab based.
4. Municipality is to ensure that the new slabs are disseminated to the residents of the town.
5. Municipality will be responsible for collection of these new taxes.

13.3 NOC (NO-OBJECTION CERTIFICATE) FOR NEW PROPERTY CONSTRUCTIONS

With new households coming up at a rapid pace, there is an immediate need for proper monitoring for these household units and ensure that the onsite sanitation systems are built as per the CPHEEO guidelines or the state specific norms. This section discusses the need and operational details for the introducing the system of NOC for new property constructions. The resolution is needed for the following reasons:

1. Pits and septic tanks are not built as per CPHEEO standards.
2. No existing guidelines or rules at the ULB level to ensure effective monitoring.
3. Threat to the environment since waste water directly enters the open drains or percolates into soil.

13.3.1 OPERATIONAL DETAILS FOR THE RESOLUTION

This section highlights the operational details of the resolution on the issuance of NOC for all new property constructions.

Figure 40: NOC for new property constructions

1. All new property to be constructed should have their sanitation systems designed as per CPHEEO guidelines.
2. If plan does not adhere to the standards suggested, Municipality to furbish the owners with the guidelines.
3. Municipality to issue an NOC certificate post proper validation of construction plan.
4. Municipality to track and monitor these new construction facilities by inspecting them on regular intervals.
5. The new resolution would be applicable to all properties irrespective of their type i.e. Commercial, institutional, residential, mixed, hostels, religious centers etc.

6. Bagru municipality shall strictly follow the standard guidelines issued by CEEPHO and NBC for construction standards of toilets and septic tanks/ pits.
7. Bagru Municipality to ensure these standards are well communicated to the relevant stakeholders.
8. Guidelines should be followed for both toilets and septic tanks/ pits construction and should be strictly sanitary in nature.
9. Post completion of construction, the residents despite of the type of household type would have to acquire a certificate of occupancy issued by Bagru Municipality, post inspection of the facility.
10. Any property or households building without proper approval will be subject to penalties.
11. Municipality may take support from external agencies whenever and as in required by Municipality
    a. Draft guidelines and procedures for successive implementation of the same.
    b. Training of staff and engineers in regards to the same.

13.4 FORMALISATION OF PRIVATE OPERATORS

Currently the excreta collected from households is dumped at farmlands and water bodies there by posing a potential threat to the health and wellbeing of the residents of Bagru. Under the directives to be prescribed on regulating disposal of faecal sludge and formalization of private desludging service providers in Bagru, Municipality should regulate the dumping of faecal sludge collected from pits and septic tanks across Bagru. The major problems are listed below:

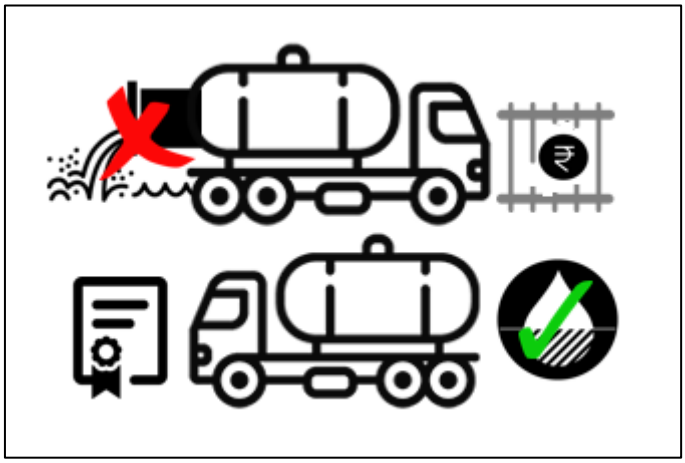


Figure 41: Formalization of Private desludging service providers

1. Municipality has no provisions for formalization of private desludging service providers.
2. Disposal of FS at undesignated locations and water bodies.

3. Low awareness amongst the residents on desludging of pits and septic tanks at regular intervals.
4. Health risks due to unsafe disposal practices.

13.4.1 OPERATIONAL DETAILS FOR THE RESOLUTION

This section highlights the operational details of the resolution on the formalisation of the private desludging service providers.

1. Disposal of faecal sludge in nay undesignated location will be considered illegal and calls for legal action and penalty or cancellation of operations license.
2. Prior notification to the municipality has to be done in case of disposal on farm land.
3. All sludge collected is to be dumped at the new FSTP facility.
4. Private desludging service providers to be identified and summoned to register/license with Bagru Municipality, by filling in a registration form **(Annexure 2)** and paying licensing fee.
5. Private desludging service providers to be provided with license **(Annexure 3)**, which would need renewal once in 3 years.
6. Private desludging service providers to be sensitized about the disposal of FS at the FSTP.
7. Any private player not registered with Bagru Municipality, or not holding the license to desludge will not be allowed to do any desludging at household/ property level within the premises of the Bagru town council wards.
8. Any private player having not registered with Municipality will attract penalty of Amount Rs 5000 which is again subject to discretion of Municipality.
9. Upon signing the registration the private operator will be given a manifesto from **(Annexure 4)** which will contain details of pits/ septic tanks and owner details, which they will submit at the Municipality office at a periodic time interval and any noncompliance to this will lead to cancellation of license.

14 CAPACITY BUILDING DEVELOPMENT PLAN

An important component for successfully implementing the above FSSM Plan would be augmenting existing capacities of various stakeholders. This would include workshops, trainings, live on-site demonstrations, interactive focus group discussions, continuous handholding assistance, education and awareness programs along with distribution of operative manuals and guidelines customized for target audience.

Following is the breakup of the target audience and the subject on which the capacities are supposed to be developed:

Table 31: Breakup of the target audience with referring developing subject

S.No.	Stakeholder	Subject	Modality
1.	**ULB Officials**	Concept and need of FSSM, FSSM Process across the sanitation value chain, Issues and Challenges, Statutory Provisions, Roles and Responsibilities, State level Operative Manuals and Guidelines, City FSSM Plan and regulations, scheduled desludging approach, post cleaning inspection, management of finances- revenue and expenditure, redressal of grievances, monitoring and evaluation of the work, maintaining records and database.	***Interactive Workshop***
2.	**Survey Team**	HH level Containment system data collection and database preparation	***On-on-one training***
3.	**Households**	Awareness regarding containment systems, scheduled desludging, health and safety hazards of open discharge, adverse impacts of open defecation, proper usage of public toilets and urinals, proper desludging services, incentives and penalties, payment of user charge, applying for emergency desludging request, registering complaints and grievances, filling up the records in the manifest forms with the desludging operators.	***Focus group discussions, public announcements and pamphlets***
4.	**Masons and plumbers**	Proper containment size, specifications and designs, Proper techniques to construct a septic tank, pit latrine, soak pit, toilet superstructure, various construction materials to be used and its sources	***On-site demonstrations***
5.	**Desludging Operator**	Safe procedure of desludging, importance of wearing safety gear, equipment maintenance, filling up the job card, penalties in case of non-compliance	***On-site demonstration***
6.	**Treatment Plant Supervisor and operator**	Treatment technology, detailed procedure of operations and maintenance, keeping records and manifests, storage and sale of compost generated from the plant	***Training***
7.	**Public and Community toilet operators**	Regular cleaning and maintenance of public toilets/urinals, keeping log of users, collection of user charges	***On-site demonstrations***
8.	**Farmers**	Adverse impacts of disposal of untreated sludge on farmlands, benefits of the	***Public announcements***

		compost generated from the treatment plant along with the ways to procure it.	***and pamphlets distribution***
9.	**Ward Councilors**	Concept and need of FSSM, FSSM Process across the sanitation value chain, Issues and Challenges, Statutory Provisions, Roles and Responsibilities, scheduled desludging approach, passing of town level resolutions for effective implementation of FSM.	***Interactive Workshop***

15 IEC CAMPAIGNS

IEC Campaigns play an important role in the strengthening of faecal sludge management and in the creation of awareness around faecal sludge management issues in the town.

The IEC Campaigns are necessary in bringing in the behaviour change among the stakeholders which would act in creating the sustainability of the project.

15.1 IEC FRAMEWORK

Recommendation on the IEC component required for FSM has been proposed in this section. The causal linkages of sanitation with public and environmental health need to be made more explicit to citizens, communities and institutions. In addition to the provision of facilities, sustained improvements in quality of life are possible when supplemented by hygiene behavior changes. Thus, it is recommended that the Sanitation Strategy provide strategies for sustained communication and behavior change. The aim of awareness and knowledge building is to establish the link between appropriate faecal sludge management with health and environment and also to clearly define the role of different stakeholders across the sanitation value chain. The time frame for the suggested IEC campaign should be during the planning and implementation stage followed with refresher campaigns after the implementation of the technology intervention. The framework may be developed as described in Table 32 below:

Table 32: IEC Framework for Bagru

Target audience	Needs	Communication elements	Method	Campaign stakeholder	Type of Approach
▪ **Local leaders** ▪ **Nagar Palika, EO**	▪ To sensitize all stakeholders towards appropriate faecal sludge collection and	▪ Video ▪ Power Point Presentations ▪ Information	▪ Workshop ▪ Exposure Visit	▪ Technical experts from local NGOs ▪ Local NGOs working in	▪ Advocacy ▪ Education

	treatment ▪ To provide information regarding benefits and business opportunities ▪ To inform the need of regular O&M of the sanitation infrastructure ▪ To ensure ownership, relevance and sustainability of the sanitation infrastructure	handouts		the sector	
▪ **Nagar Palika engineers** ▪ **Health Officers, engineers** ▪ **Social facilitators**	▪ To sensitize about technology options and design steps ▪ O&M procedures ▪ Monitoring tools	▪ Guidelines ▪ Standard Operating Procedures ▪ Manuals	▪ Training programmes ▪ Exposure visits	▪ Technical experts from local NGOs ▪ Local NGOs working in the sector	▪ Education and skill enhance-ment
▪ **Households or beneficiaries of the service of faecal sludge collection and treatment**	▪ To sensitize the beneficiary community towards appropriate faecal sludge collection and treatment • To sensitize the community about advantages of regular desludging • To highlight the cost savings from safety, health, time perspective • To create	▪ Leaflets ▪ Posters ▪ Local radio and television ▪ Mobile messaging	▪ Door-to-door campaigns ▪ Community meetings ▪ Mass communication	▪ Local leaders (political/ religious) ▪ Local NGOs ▪	▪ Personal and mass communication

	awareness about the process of FS collection and treatment				

16 NATIONAL POLICY ON FAECAL SLUDGE AND SEPTAGE MANAGEMENT

16.1 VISION

All Indian cities and towns become totally sanitized healthy and livable and ensure sustenance of good sanitation practices with improved on-site sanitation services together with faecal sludge and septage management to achieve optimum public health status and maintain clean environment with special focus on the poor.

16.2 SCOPE

Only on-site sanitation facilities and area served by such facilities would fall under the purview of this FSSM policy. It does not seek to cover network or conventional sewerage system of wastewater/sewage management. However it will address synergies between FSSM and sewerage systems or municipal solid waste management e.g., co-treatment of faecal sludge and septage at sewage treatment plants or co-treatment and management of faecal sludge and septage and MSW.

16.3 LEGISLATIVE AND REGULATORY CONTEXT

The legal context for FSSM includes the municipal acts, the Environment Protection Act 1986, the Water (Prevention and control of Pollution) Act 1974, the Solid Waste Management (SWM) Rules 2016, the Building Code of India, the Model Building Bylaws (MBBLs) 2016 and the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act 2013.

16.4 ROLES AND RESPONSIBILITIES

The Ministry of Urban Development (MoUD) Government of India (GoI) will be responsible for the overall guidance, coordination and interpretation of this policy. It will disseminate the Policy among the state and the ULB governments as well as dovetail it with the ministry's urban development programs and schemes. It will provide the necessary technical and planning support to the states and ULB's and will also design, lead and implement a national awareness campaign on this issue.

Each state will further need to formulate its own FSSM strategy and integrate the same in their respective state and city sanitation plans in overall conformity to the National Policy.
Several other stakeholders to have a critical role to play in the achievement pf safe and sustainable FSSM services for all.

16.5 IMPLEMENTATION STRATEGY

Currently FSSM Services are provided by a mix of formal public service providers, contractual operators and informal local service providers, but with very little supervision and control to ensure compliance with environment, health, safety and laws prohibiting manual scavenging. Rules, bylaws, regulations and operative guidelines for faecal sludge and septage management will address the following:

1. Design of septic tanks, pits etc. (adapted to local conditions) including siting and methods of approval of building plans, or retro fitting existing installations to comply with rules and byelaws.
2. Delineation of private (individual houses, group housing, institutions etc.) and public responsibilities (urban local bodies and other local authorities) in relation of faecal sludge and septage management.
3. Details of the planning and implementation process for carrying out safe and sustainable management of all faecal sludge and septage. This may be integrated with overall city land use planning, with the timelines for holistically addressing waste water management via onsite Decentralized or centralized systems.
4. Special provisions for medium and large format real estate developments.
5. Frequency of desludging, and O&M of installations and the responsibilities of householders (owner/occupant)
6. Operating procedures for desludging including safety procedures with an emphasis on the safety, health and dignity of sanitation workers.
7. Licensing, record keeping, monitoring and reporting arrangement for faecal sludge and septage service providers.
8. Methods and locations of transport (conveyance) treatment and safe disposal.
9. Tariffs or cess/ tax etc. for septage management in the city.
10. Penalty clauses for untreated discharge for households as well as desludging agents and unsafe emptying and handling of faecal waste.
11. Regular monitoring and evaluation of the entire process of FSSM.
12. Training, accreditation, education and awareness programs.

It is important that all ULB's make provision of land and other infrastructural facilities required for safe treatment and disposal/reuse of human waste generated in their areas.

This should go hand in hand with strict enforcement of disposal by cesspool operators as well as recognition and partnership with such service providers. Desludging should be carried out in an organized manner y taking into account of each and every septic tank and its cleaning frequency through a registered agency. Cesspool operators should be asked to register with the municipal bodies and there should be a string partnership and disincentive to unsafe disposal.

16.6 FINANCING PLAN

The Government of India may provide assistance for funding projects proposed as part of the FSM Plan through its ongoing urban development schemes. The state governments should prioritize funds to implement the FSSM plan at City level. They should promote engagement of private sector participation across sanitation service chain and should encourage ULB's to start levying sanitation tax/user charges to meet the O&M cost for effective FSSM operations at city level. They should also facilitate the involvement of private sector participation through and easy and amenable PPP relationship framework, to ensure financing and sustainability of FSSM Projects.

16.7 MONITORING AND EVALUATION

At the national level the GOI is adopting the Sanitation Benchmark Framework for the assessment of the performance of the city. State government will be responsible for monitoring and evaluation of the cities' performance and hence needs to devise data collections and reporting systems for the same. ULBs in turn need to develop database, registry of certified on-site sanitation systems, robust reporting format to track compliance of HHs with outcomes and process standards.

16.8 CAPACITY BUILDING AND TRAINING

GOI will make effort to integrate the FSSM components in ongoing capacity building programs. The State Government will identify agencies that will train its state level and ULB personnel and orientation of elected representatives on aspects related to FSSM. ULBs will need to provide training on sanitation to their own staff. They will need to utilize ongoing Government of India and State government schemes for training and capacity building in order to achieve this.

17 ANNEXURES

17.1 ANNEXURE 1: COLLECTION AND CONVEYANCE MECHANISM

17.1.1 OPERATION GUIDELINES - COLLECTION

The following steps are recommended for the operation of vacuum trucks:

1. Park the truck as close to the system as possible. The maximum distance is determined by the length of hose and elevation rise from the bottom of the pit or septic tank to the vacuum truck tank inlet. This should typically be no more than 25 meters in linear distance and 4 meters in elevation gain. Further distances or elevation differences may require intermediate pumps.

2. Inform the occupant of the pending service and note any concerns or issues.

3. Inspect the site for possible hazards, such as clearing the area of people, or identifying high groundwater that could cause a tank to 'float' if emptied.

4. Secure the truck using wheel chocks.

5. Lay out and connect the hoses from the truck to the tank or pit to be emptied.

6. Open the tank or pit by removing the access ports or covers over the storage system.

7. Engage the vacuum equipment by using a power take-off from the truck's transmission.

8. Increase the vacuum to the proper level with the valve closed by watching the vacuum gauge, then lowering the end of the hose into the storage system, and open the valve sufficiently such that the FS is drawn out of the tank or pit. Closing the valve periodically re-builds the vacuum to enable the removal of further FS.

9. Continue this process until the job is complete.

10. Break up FS that has agglomerated into a solid mass, either by making use of a long handle shovel and adding water when necessary to reduce the viscosity of the F8; or by reversing the direction of the flow and forcing the contents of the vacuum truck tank back through the hose and into the sanitation system in order to use the high pressure stream to

break up the sludge. The direction of the flow is then returned to normal and the contents removed. It is essential to ensure that the hose is in sound condition, and that the hose connections are locked into place prior to using this method;

11. Operators should remove between 90% and 95% of the contents. It is recommended that this is verified by management through periodic spot checks.

12. Identify any abnormal conditions, such as high concentration of non-biodegradable materials, oils and grease. The colour and odour of the FS can provide clues as to how the occupants are using the system, and if excessive chemicals are being discharged down the drain.

13. Inspect the system once empty. In the case of a septic tank, the following checks should be carried out by the operator:

a. Listen for water running back from the discharge pipe, which could indicate plugged leach lines (if present);

b. Check to make sure that inlet and outlet tees are properly in place. Frequently, these structures break off and can sometimes be found at the bottom of the tank;

c. Inspect the tank for cracks or damage;

d. Verify that the tank is properly vented;

e. Ensure that the tank lids are properly attached when the pumping is complete and that they are properly secured;

f. Prepare a written report indicating:

- how much waste was removed;
- the condition of the tank or pit;
- any recommendations for repairs or maintenance;
- any recommendations for proper use of the system.

14. Secure the tank lid and pack away the hoses;

15. Clean up any spillage using proper sorbent materials;

16. Inform the client that the work is complete, and give them the final report. In some instances, payment is received immediately for the service however, payment is often made directly to the service provider through some type of billing system. During this final interview, the operator informs the client of the findings and any recommendations;

17. Remove the wheel chocks and drive the truck to the next site or to the nearest approved disposal Site.

Figure 42: Correct and incorrect desludging method

17.1.2 OPERATIONS GUIDELINES – DISPOSAL AT TREATMENT PLANT

Independent of the delivery method of Faecal Sludge to the treatment plant or transfer station, operators should adhere to the following safety guidelines:

1. Check in with facility guard or operator.

2. Carefully following instructions regarding the sampling of FS. Some FSTPs have designated sites for residential septage, and others for commercial sludges. Plant operators may request samples of the FS prior to allowing discharge if it is suspected that the FS may contain materials hazardous to the plant.

3. Position the truck in the designated location for sludge removal, park and take the truck out of gear, apply the parking brake, and chock the wheels.

4. Remove the hose and make the connections.

5. Engage the power take-off or other mechanism for unloading the tank and complete the offloading process.

Figure 43: Unloading of tank

6. Obtain the necessary authorization and access to the transfer station prior to transporting FS, as some transfer stations have locked inlets.

7. Ensure sufficient water is available for washing the solids as some transfer stations have screens to remove non-biodegradable solids.

8. Store any screened non-biodegradable solids in a safe location to drain and dry prior to containment and/ or proper disposal either through incineration landfilling.

9. Use proper lifting techniques when discharging drums into a transfer station such as standing on a stable surface, and ensure all protective equipment is worn.

10. Clean up any spillage in the area around the inlet after completing the discharge of FS into the transfer station and re-seal the inlet.

11. Use personal protective equipment such as gloves and hard hats, and do not smoke during the entire collection and discharge operation.

12. Replace hoses and equipment, following adequate hygiene practices (e.g. hand washing), and completing the required paperwork.

17.2 ANNEXURE 2: REGISTRATION FORM FOR PRIVATE OPERATORS

Operator Registration Form Bagru Nagar Palika **Form Number:** **Date:**	
Owner Details:	
Name of the operator service:	
Name of owner:	
Address:	
Contact number details:	
Email ID	
Business Details:	
Year of starting business	
Number of vehicles in fleet	
Number of employees:	
Region of operation:*(localities where in you offer your services)*	
Driver details	
Name of driver:	
Age:	
DL number:	
Mobile number:	
Vehicle Details:	
Vehicle Registration Number:	
Vehicle type: (model description)	
Vehicle chassis number:	
Vehicle year of purchase:	
Vehicle of year of manufacture:	

Vehicle capacity:	
Insurance details: (vehicle insurance number, copy of the same to be submitted)	
Road tax paid : (Y/N)	
Signature of owner:	
Office purpose only	
Bagru Nagar Palika Authorised signatory	
Date:	

Along with the form following details need to be furbished to the Nagar Palika:

- *Copy of the vehicle registration with RTO:*
- *Copy of photograph of vehicle, operator and owner*
- *Insurance copy of the vehicle is to be submitted along with the form*

17.3 ANNEXURE 3: FORMAT FOR LICENSE FOR PRIVATE OPERATORS

Septage Transporter Permit , Bagru Nagar Palika

In accordance with all the terms and conditions of the current municipality rates, rules and regulations the special permit conditions accompanying this permit, and all applicable rules, laws or regulations of the Government of Rajasthan, permission is hereby granted to:

Name of Permit holder:

Address:

Permit Number issued:

For the disposal of septate/faecal sludge from domestic septic tank or commercial holding tank at the ----------STP/SWM site or agricultural fields.

This Permit is based on information provided in the **Septage/Faecal sludge Transporter Permit** application which constitutes the Septage/Faecal sludge Management Hauled Transporter Permit.

This Permit is effective for the period set forth below, which may be suspended or revoked for Permit Condition Non-Compliance and is not transferable. The original permit shall be kept on file in the Permit holder office. A copy of this Permit shall be carried in every registered vehicle used by the permit holder.

EFFECTIVE DATE:

EXPIRATION DATE:

__ CHECK IF RENEWED PERMIT

Permit is liable to be cancelled in case of violations of any Acts, Rules and Regulations relating to the operation of Septage/Faecal sludge System or in cases of safety protocols not being adhered to or in case of non-permitted disposals.

Bagru Nagar Palika Authorised Signatory

17.4 ANNEXURE 4: MANIFESTO FORM FORMAT FOR COLLATION OF HOUSEHOLD LEVEL DETAILS ON ONSITE SANITATION SYSTEMS

General Details	
1. Date	
2. Time of desludging	
3. Property type(mark ✓)	☐ Household ☐ Industry ☐ Institution ☐ Commercial ☐ Wastewater treatment plant
4. Volume of Sludge	
Details of Owner	
1. Name	
2. Property No.	
3. Address	
4. Ward No.	
5. Contact No.	
6. No of people in house/Institute	
Geographical data	
1. Type of soil in the area	
2. Ground water table	
Containment system details	
1. Age of sludge collected	
2. Is the containment system plastered on the inside?	
3. Type of containment system(mark ✓)	☐ Single pit ☐ Twin pit ☐ Septic tank
4. Type of construction(mark ✓)	☐ Ring ☐ Stone masonry ☐ Concrete structure
5. If rings,	No. of rings:

	Ring height: Ring diameter:
6. If not rings,	Length: Breadth: Depth:
7. Is vent pipe available?	
8. If sludge was hard, how did you dilute it?	☐ Water ☐ Crow Bar ☐ Detergent
9. Operator's name: Vehicle name: Vehicle no.: Contact no.: Operator's signature:	10. House Owner's signature:

17.5 ANNEXURE 5: FSTP SITE CHECK LIST

Date of site visit: 10-oct-18

GPS location of site: 26.807944, 75.524520

Location: Ward 3, Chitroli

Town/City/District: Bagru

State: Rajasthan

Proposed treatment capacity (m^3 per day): 12

Approach

1. What is the distance between the center of town/cluster (place around which most household that require desludging services are located) and the proposed site?
   2Km

2. Does the approach road to the site have a width of more than 3 meters? Can the desludging vehicle ply freely on the approach road?
   Yes

3. Condition of the approach road
   ☐ Concrete ☒ Tar road ☐ Mud ☐Stone/gravel
   ☐ Others (Please specify)

4. Can the road be used during rains?
   Yes

5. Does the approach road lead into the property?
   ☒ Yes ☐No, it stops at a distance of 2 km metres after which there is mud road

Property details

1. What is the total area available for construction of FSTP? (also mention the units)

   17,806 Sqm
2. Does the property have any other system/ infrastructure? If yes, what is it?) (Check if the manpower can be shared for FSTP operation)
   Facility of dump site for solid waste animal carcasses.
3. Does the property have a boundary wall? (to prevent trespassers and animals)
   Yes in all sides
4. What is the distance to nearest habitat (household where people live)?

   300 m
5. What is the terrain of the proposed site?

   ☐ Rocky ☐ Sandy ☐ Mud ☐ Wetland ☐Plantation – manmade

   ☒ Plantation natural ☐others,

   Specify _____
6. What is the depth of water table?

   350 – 450 m
7. Is there an open well/ bore well/hand pump/tube well nearby? If yes, at what distance from the property?

   None
8. Is there a natural drain/river/canal/pond nearby? If yes, at what distance from the property?

   No
9. Is portable water available at the property? If yes, what is the source and frequency?

   No
10. Does the property have access to electricity? If yes, please specify the number of hours in a day it is available and the phase (3 phase or single phase)

    Yes

11. Is there a provision for an operator room/house?

    Space available

12. Is the place located on the lower regions of natural drainage basin? Is the area flood prone?

    No

13. Details of neighbouring land parcels

Direction	Mention the usage of the land
North	Farm land
East	Farm land
West	Farm land
South	Road and Farm land

14. Does the land have a natural slope? (if yes please mention in the sketch)

    No

15. Does the land require felling of big trees for FSTP construction?

    No

Reuse

1. Is there a provision for reuse of Biogas? If yes, what and where?

   No

2. Is there a provision for reuse of treated water? If yes, what and where? If no, what are the means for disposal?

   Yes, for agriculture if neighbouring farmers are interested

3. Is there a provision for reuse of bio solids? If yes, what and where? If no, what are the means for disposal?

   As of now no possible usage in agriculture. More awareness among farmers needed.

General details

1. What is the size of desludging truck? (express in m^3 , capacity of sludge holding tank of the truck)

   3500 m^3

2. Distance between sludge outlet from the truck/vehicle and the ground level? (in meter)

   Minimum 0.3 m

3. Does the site have adequate incidence of sunlight? (check for shadow regions or regions covered under natural/man made cover)

   Yes

4. Is there a solid waste management yard in the vicinity? (If yes, please specify, the type of SWM, distance and quantity handled per day)

   Yes the site is within the solid waste dumping yard.

5. Who is the current owner of land? Is any transfer proposed? If yes, to whom and when?

   Nagar Palika, Bagru

6. What is the proposed development in the surrounding region for the next 10 years? (Are there any layouts, institutions, etc. planned)

   No big development expected

Schematic

In the next page make the following markings along with a detailed sketch of the site

a. Detailed boundary map
b. Topography details on the schematic map (mark slopes)
c. Wind direction
d. Location of other infrastructure (SWM centers, well, tank etc.)
e. Location of ponds, stream, river etc.
f. Location of surrounding human habitation.

Figure 44: Approach road

Figure 45: Existing compound wall at site

Figure 46: Landscape of the site

18 REFERENCES

Board, C. G. (2010). *Ground water quality in shallow aquifers of India.* Faridabad.

Board, C. G. (2014-15). *Ground water year book UTTAR PRADESH.* Uttar Pradesh.

CDD Society, & NIUA. (2017). *The faecal sludge and septage situation in 100 towns of Rajasthan.* Bangalore.

Climate-data.org. (2018). *climate-data.org.* Retrieved from Climate: Bagru: https://en.climate-data.org/location/963457/

MoHUA. (2017). *Guidelines for Swachch Bharat Mission-urban.* New Delhi: Ministry of Housing and Urban Affairs, Government of India.

Social Mobilisation Expert SBM PMU Cell, M. R. (2017, August 7). IHHL Estimation BMC. (C. S. Debisha Sharma, Interviewer)

Udo Heinss, S. A. (1998). *Solids Separation and Pond Systems for the Treatment of Faecal Sludges in the Tropics : Lessons learnt and Recommendations for Preliminary Design.* Switzerland: EAWAG.

ULB Bagru. (2017). Map of Bagru.

Watsan. (2012). *Wastewater solutions fordevelopment*. Retrieved June 27, 2013, from http://watsanexp.ning.com/page/cocopeat-gen

Survey No. 205 | (Opp. Beedi Workers Colony) | Kommaghatta Road Bandemath | Kengeri Satellite Town | Bengaluru 560060 |
Phone : +91-(0)80-28486700 | www.cddindia.org | banglore@cddindia.org

Consortium for DEWATS Dissemination Society

कार्यालय नगर पालिका बगरू, (जयपुर)

टेलिफोन नं. – 0141–2865360 ई–मेल – bagruulb.jaipur@gmail.com

क्रमांक : 17/1937 दिनांक 11/9/17

श्रीमान् निदेशक एवं संयुक्त सचिव महोदय,

निदेशालय स्थानीय निकाय राजस्थान,

जयपुर।

विषय - एफएसटीपी के सर्वेक्षण एवं निर्माण कार्य के लिए अनापत्ति बाबत्।

महोदय,

उपरोक्त विषयान्तर्गत निवेदन है कि आपके प्रॉजेक्ट सलाहकार द्वारा एफएसटीपी के लिए लगभग 1 एकड अविवादित सरकारी भूमि पर सर्वेक्षण एवं निर्माण कार्य करने की माँग की गयी है। पालिका के नाम खसरा नं 4157, 4158 में 22250 वर्गमीटर ज़मीन मौजूद है। पालिका इसमे से 1 एकड भूखंड पर एफएसटीपी परियोजना के सर्वेक्षण एवं निर्माण कार्य के लिए एतद द्वारा अनापत्ति दी जाती है।

उपरोक्तानुसार आप द्वारा किए जा रहे कार्य का पालिका के कनिष्ठ अभियंता एवं एसआई (स्वास्थ्य निरीक्षक) के निर्देशानुसार किया जाएगा। साथ ही आप द्वारा उक्त निर्माण किया जाकर पालिका को सूचित करना होगा एवं उक्त संपूर्ण 22250 वर्गमीटर भूमि का स्वामित्व नगर पालिका बगरू का ही रहेगा। भूखंड का खसरा जमाबंदी संलग्न है।

Santosh Chauhan

सन्तोष चौहान
अध्यक्ष
नगर पालिका बगरू

हेमा राम चौधरी
अधिशाषी अधिकारी
नगर पालिका बगरू

कार्यालय नगर पालिका बगरू, (जयपुर)

टेलिफोन नं. – 0141–2865360 ई–मेल – bagruulb.jaipur@gmail.com

क्रमांक :–न.पा.ब./17/2083 दिनांक :– 27/9/17

हम, बगरू नगरपालिका के सदस्य निम्नलिखित का पालन करने का संकल्प लेते है :–

1. बगरू, जिसकी आबादी 2016 में 38,914 थी, एक शहर के तौर पे उन्नत हो रही है। बढ़ती आबादी को ध्यान में रखते हुए, ना सिर्फ स्वच्छता को लेकर बल्कि सुधार कि आवश्यकता है। आने वाले दिनों में स्वच्छता के लिए हमें ऐसी नई प्रणाली लानी होगी जो छोटे शहरों में कम लागत में हि लागू हो सकें, जिसका परिचालन भी किफायती हो और जिससे नगर निवासियों को आपत्ति भी नहीं होगी। विकेंद्रित प्रदूषित जल प्रबंधन और मल गाद प्रबंधन ऐसी कुछ प्रणालियाँ हैं।
2. मल गाद प्रणाली के तहत, हम निम्नलिखित का पालन करेंगे :-
   - 2.1 बगरू को खुले में शौच से मुक्त घोषित किया जा चुका हैं।
   - 2.2 यह सुनिश्चित किया जाएगा कि हर नए शौचालय का सेप्टिक टैंक SBM में लिखित प्रणाली से बनाया जाए
   - 2.3 हर शौचालय का सेप्टिक टैंक या पिट कम से कम पांच साल में एक बार खाली कराया जाए
   - 2.4 यह सुनिश्चित किया जाएगा कि वैक्यूम ट्रक से खाली किया गया मल गाद केवल उपचार संयत्र में डाला जाएगा
   - 2.5 बगरू के लिए एक मल गाद उपचार संयत्र स्थापित किया जावेगा।
   - 2.6 हम प्रत्येक वार्षिक बजट में यूजर फीस के लिए प्रावधान और उपयुक्त आवंटन के जरिए उपचार प्रणाली की स्थिरता सुनिश्चित करेंगे।
3. एक मल गाद उपचार संयंत्र स्थापित करने के उद्देश्य के लिए, हम वार्ड संख्या 02 में 1 एकड़ भूमि चिन्हित कि है। इस संयंत्र का संचालन और रखरखाव जिम्मेदारी और लागत होगा, जिसके अतिरिक्त उपचार संयत्र दुर्गंध मुक्त और सौंदर्यशास्त्रिक रूप से आकर्षक होगा।
4. हम DPR तैयार करने के लिए डेटा प्रदान करने के लिए आवश्यक सभी प्रक्रियाएं करेंगे और पीएमसी को DPR को तैयारी के लिए समर्थन करेंगे।
5. राज्य वित्त आयोग से मल गाद उपचार संयंत्र के निर्माण के लिए राशि आवंटित की जावेगी।
6. इस तथ्य के बारे में जागरूकता रखते हुए, कि शहर के अपशिष्ट जल खुले नालों में शहर से से गुजरते हुए बगरू बीड मिलता में है, इस मुद्दे को हल करने के लिए हम एक व्यवहार्यता अध्ययन करने और उचित समाधान तलाशने का संकल्प करते हैं।
7. हम मल गाद और अपशिष्ट जल प्रबंधन के बारे में समुदाय में जागरूकता फैलाने के लिए आईईसी अभियानों को पूरा करने का संकल्प लें।

उपरोक्त प्रस्ताव नगरपालिका पालिका बगरू के अध्यक्ष, उपाध्यक्ष एवं सभी वार्ड पार्षद और अधिशाषी अधिकारी की उपस्थिति में लिया गया है और तत्काल प्रभाव से इसकी पुष्टि की जाती है।

Santosh Chaudhary
अध्यक्ष
नगर पालिका बगरू

अधिशाषी अधिकारी
नगर पालिका बगरू

D:\office Letter\LOI\Doc

क्र.स.	नाम	अध्यक्ष / उपाध्यक्ष / पार्षद	हस्ताक्षर
1	श्रीमती संतोष चौहान	अध्यक्ष	Santosh Chouhan
2	श्री शंकर चौधरी	उपाध्यक्ष	शंकर चौधरी
3	श्रीमती मंजू सैनी	पार्षद	मंजू देवी
4	श्रीमती सुप्रिया देवी कुमावत	पार्षद	सुप्रिया कुमावत
5	श्रीमती रतीष चौधरी	पार्षद	
6	श्री राजेन्द्र सिंह चौधरी	पार्षद	
7	श्रीमती गायत्री कँवर	पार्षद	गायत्री कँवर
8	श्री जगदीश प्रसाद जमो	पार्षद	जगदीश प्रसाद
9	श्री अकबर खट शेखो	पार्षद	अकबर
10	श्री मोहम्मद रफीक	पार्षद	
11	श्री अनिल कुमार संदधना	पार्षद	Anil Kumar
12	श्री भगवान सहाय टेपण	पार्षद	Bhagwan
13	श्रीमती कान्ता सोनवाल	पार्षद	
14	श्री ओमप्रकाश कुमावत	पार्षद	Omprakash
15	श्रीमती [illegible]	पार्षद	
16	श्रीमती ममता देवी कुमावत	पार्षद	ममता कुमावत
17	श्री विजय जांजपुरा	पार्षद	
18	श्री पुरुषोत्तम दीपा	पार्षद	पुरुषोत्तम दीपा
19	श्रीमती अनीता कासोटिया	पार्षद	अनीता कासोटिया
20	श्री रामावतार शर्मा	पार्षद	Ramavtar Sharma
21	श्रीमती आरती देवी नागर	पार्षद	आरती
22	श्री महेश कुमार रैगर	पार्षद	
23	श्रीमती सुमन चौधरी	पार्षद	Suman Choudhary
24	श्री अनिल कुमार मीना	पार्षद	
25	श्री हनुमान बुरी	पार्षद	हनुमान सहाय बुरी