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Town Level Assessment of major polluters and pollutants in Alappuzha Town

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WORKING PAPER - 4

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This is part of a Working Paper series that came out of studies and action done by CANALPY, an initiative of the collaboration between Indian Institute of Technology, Bombay and the Kerala Institute of Local Administration.

The major aim of CANALPY is the rejuvenation of canals through decentralised and participatory social and technological interventions. There have been two academic initiatives so far - a Winter School during November 2017 involving 36 students and a Summer School during May 2018 with 300+ students. Through a decentralised data collection process of the water and sanitation practices of Alappuzha, CANALPY was able to identify solid and liquid waste pollution in the sub-canals as the major impediment to the health of the canal system. During Kerala Floods 2018, CANALPY was also able to quickly deploy a student force to undertake a rapid impact assessment in Kuttanad, one of the worst affected regions. In December 2018, CANALPY organised a Winter School the output from which was an integrated solid and liquid waste management plan for Shadamani canal, one of the subcanals of Alappuzha.

This is a report of a town level assessment of major polluters and pollutants in Alappuzha, including management of organic and inorganic waste, and the waste chain cycle. These are abridged versions of the larger reports. The academic reports may be downloaded freely from the CANALPY website, www.canalpy.com

Working papers in this series:

1. Preliminary water and sanitation assessment for Alappuzha Town.
2. Comprehensive water and sanitation assessment for Alappuzha Town.
3. Rapid flood impact assessment in Kuttanad region.
4. Town level assessment of major polluters and pollutants in Alappuzha Town.

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Acronym	Definition
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ASCA	Alappuzha District Septic Tank Cleaning Contractors Association
CCTV	Cross Circuit Television
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
CPS	Centre for Policy Studies
CSE	Centre for Science and Environment
CTARA	Centre for Technological Alternatives in Rural Areas
CUCEK	Cochin University College of Engineering, Kuttanad
EPR	Extended Producer Responsibility
FSM	Fecal Sludge Management
FSTP	Fecal Sludge Treatment Plant
GAIA	Global Alternatives
HDPE	High Density Polyethylene
IEC	Information & Education Campaign
IIT	Indian Institute of Technology
IITB	Indian Institute of Technology, Bombay
INR	Indian Rupee
ISO	International Standards Organisation
KIEL	Kerala Enviro Infrastructure Ltd

KILA	Kerala Institute of Local Administration
KLD	Kilo Liters per Day
KSIDC	Kerala State Industrial Development Corporation
KSPCB	Kerala State Pollution Control Board
LDPE	Low Density Polyethylene
LSGD	Local Self Government Department
MCF	Material Collection Facility
MPN	Most Probable Number
MSW	Municipal Solid Waste
NEERI	National Environment Engineering Research Institute
OSS	Onsite Sanitation System
PCC	Plain Cement Concrete
PVC	Poly Vinyl Chloride
RCC	Reinforced Cement Concrete
SDG	Sustainable Development Goals
SPI	Society of the Plastics Industry
SWM	Solid Waste Management
WATSAN	Water and Sanitation
WTP	Willingness to Pay
YMCA	Young Men's Christian Association

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Town Level Assessment of Major Polluters and Pollutants in Alappuzha Town

ABSTRACT

CANALPY (read as CanAlleppey), an initiative by IIT Bombay and KILA (Kerala Institute of Local Administration) is aimed at the rejuvenation of the canal networks of Alappuzha through a participative, decentralised process and an integrated sanitation and waste management plan for the town. Through Winter School 2017, Summer School 2018 and Winter School 2018, more than 400 students have been trained in a protocol for participatory decentralised data collection on solid waste management practices, water and sanitation services and infrastructure. This has led to actionable recommendations on restoring the flow of canals, improving their water quality and upgradation of on-site systems at households across Alappuzha.

While progressing towards action plans for the major sub-canals, however, certain data was found lacking. There was a need for analysis of end-to-end cycle of several major pollutants, including plastic waste and faecal sludge. An assessment of the existing waste management (decentralised system) was also found lacking. This paper contains an assessment of specific major polluters & pollutants and includes plastic waste auditing, study of community aerobic units, waste water generation and waste management in commercial establishments, hotels, homestays, restaurants and industries and details on the faecal sludge management for Alappuzha. Major findings from this study include information about the brands contributing biggest quantities of plastic waste in the town, actionable recommendations for improving the aerobic bins and scrap shops, and a faecal sludge management plan for Alappuzha.

1. INTRODUCTION

The Small and Medium towns across India have shown a marked degradation of their natural environment, including pollution of their water resources. The main reasons for these include huge infrastructure deficit with respect to wastewater and solid waste management since they lack the technical, financial and institutional capacity for conventional sewerage management systems or centralised solid waste management with complete coverage. Decentralised technology options provide a viable alternative, the planning for which can be done through a participatory data collection system with student and citizen involvement. People's Plan Campaign for decentralised local level planning launched in Kerala in 1996 had focussed on this aspect in every aspect of development planning. This has been further proved in Alappuzha for the solid waste management project initiated under the leadership of Dr. Thomas Isaac, the local MLA who is also the Minister for Finance and Coir in Kerala.

The launch of the People's Plan Campaign in 1996 highlighted the need for local level solutions. However, it also requires building capacities in terms of technical, financial and institutional capacities. Kerala Institute of Local Administration (KILA), the nodal institution for capacity building for decentralisation and local governance in Kerala has been working towards this by providing training, hand holding, advisory services, research and establishing linkages with technical and academic institutions to support local self-governments.

In the meantime, Indian Institute of Technology, Bombay (IITB) has developed a protocol for participatory decentralised data collection of wastewater/sanitation infrastructure, services and practices through initiatives in Nedumangad (Kerala) and Alibag (Maharashtra). Since November 2017, a similar initiative has been taking place in Alappuzha.

1.1 SITUATION IN ALAPPUZHA

Alappuzha town which is on the western coast of Kerala, has been part of such an exercise since November 2017. Intertwined with a canal network and backwaters the town lacks a centralised sewerage system and relies on septic tanks. The partially treated and untreated wastewater either leaches to subsurface soil or drains into the canals. The town has had a successful decentralised system for managing solid waste (community aerobic composting units which accept plastic waste as well) but the canals still show a marked degradation and have turned into open drains. Rejuvenation of the canal network of Alappuzha then, requires a comprehensive assessment of its water, sanitation and waste management practices.

1.2 WINTER SCHOOL 2017 AND SUMMER SCHOOL 2018

Winter School 2017, an exercise with 36 students led to a database on parameters related to water supply, sanitation, solid waste management, public health, groundwater data etc. for more than 600 households and commercial establishments. In Summer School 2018, it was an exercise with 300 students from multi-disciplinary backgrounds, which covered more than 2000 households and 221 commercial/industrial establishments. Additionally, during the Summer School 2018, students collected and analyzed data on the willingness to pay of households for various toilet management options, to map quality of drinking water sources, establish linkages between septic tank-well distance and bacterial contamination and analyzed the fecal sludge management chain in Alappuzha. Through a comprehensive analysis of solid, liquid and fecal waste management practices in the town, the intention was to develop an integrated sanitation plan for rejuvenation of the canals of Alappuzha.

The comprehensive town level assessment, however, has had a few data gaps with respect to management of organic and inorganic waste - type and quantity of plastic waste generated, working of the existing decentralised system of managing organic waste (aerobic bins) and the faecal sludge chain in Alappuzha. This working paper is an effort to eliminate those gaps.

2. ASSESSMENT OF SOLID WASTE

The household level surveys undertaken by CANALPY during the Summer and Winter Schools point towards some clear trends of solid waste management practices: a) A majority (78%) of households practice waste segregation into wet and dry waste out of their own motivation. b) The utilisation of the decentralised waste management system (aerobic units) is unexpectedly low for both dry and wet waste management. c) This is leading to improper management of dry waste (burning, dumping on nearby ground or canals) for close to 50% of households, and d) There is a clear dissatisfaction with municipal services, specifically with the inability to provide door to door collection.

For developing an effective solid waste management strategy at household level and stop the degradation of canals, there needs to be a detailed assessment of the type and quantity of plastic waste generated from households, existing ways of managing organic waste generated, and the waste chain cycle through scrap shops. This section addresses these topics.

2.1 MANAGEMENT OF INORGANIC WASTE - HOUSEHOLD LEVEL PLASTICS

As per the government documents, of the total municipal waste in Alappuzha, plastic waste makes up 4-5 percent and the municipality conducts plastic collection drives once in 2-3 months (Suchitwa Mission, n.d)**.** Most of the plastic waste is collected by the representative of the Clean Kerala Company, formed under the LSGD of the Gov. of Kerala. The plastic is then sent to Erode in Tamil Nadu for recycling. Students from schools and colleges, where WATSAN clubs have been formed, have been roped in for collecting plastic Suchitwa Mission, n.d).

In order to characterize and quantify plastic waste generated in households, a plastic waste auditing and brand auditing exercise was carried out. The approach followed for the auditing is shown in a flow chart. With an objective of finding a way to manage plastic waste, CANALPY team decided to conduct a plastic collection drive. From the local colleges in Alappuzha, 50 volunteers were selected and trained for social campaigning along the canal stretch. Along with the awareness, bags were given to the households for storing cleaned plastic, which was later on collected after one month. These collected plastic waste was segregated as per The Society of the Plastics Industry Resin identification code (hereafter SPI code) and then quantified of each grade of plastic. Brand auditing was also conducted along with this. The market value of these graded plastic has also been found out.

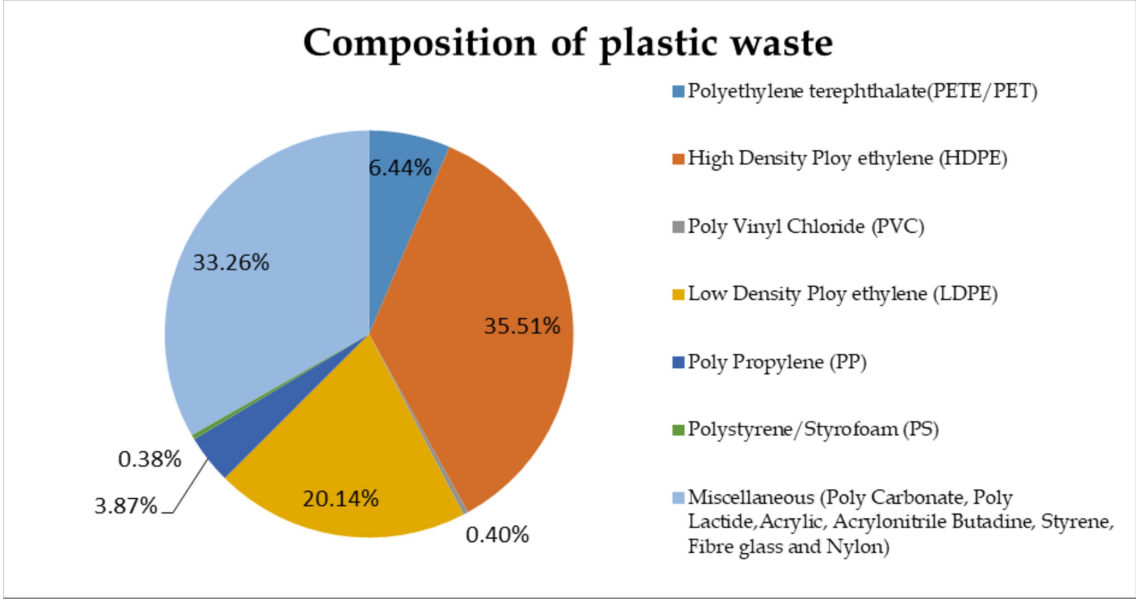

Figure1: Graphical representation of quantified segregated waste

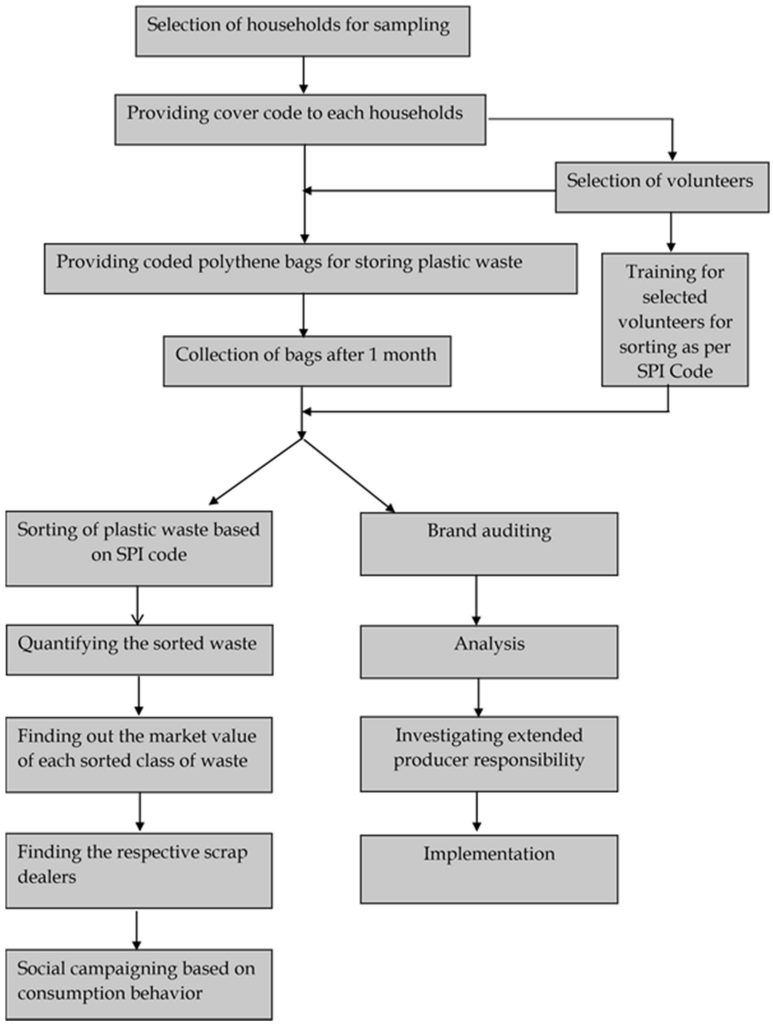

Figure2: Approach to plastic and brand auditing

2.1.1 Identification of major plastic waste contributors

Analysis of samples from 130 households showed that initially for every household, the quantity of plastic generation is almost uniform. However, the major chunk of wastes came from 14 households, who alone contributed one fourth of the total waste analyzed.

Out of the total plastic audited, 63% were recyclable and 37% were non-recyclable. Among the recyclable plastic waste Grade 2 (HDPE - High Density Polyethylene) contributes to 30% and Grade 4 (LDPE - Low Density Polyethylene) contributes to 26% of plastic waste. Among the non-recyclable plastic waste, 33% comes under Grade 7 (Miscellaneous), 4% comes under Grade 5 (Polypropylene) and 0.38% comes under Grade 6 (Polystyrene).

From the plastic waste auditing, information on the amount of plastic generated and the major contributors of plastic waste was collected. But in order to evaluate the reason for the high use of plastic by these families, further studies should be done.

2.1.2 Market value for segregated plastic based on SPI code

SPI Class	Market Value Per kg (Rs.)
Class 1	20
Class 2	6
Class 3	30
Class 4	11
Class 5	18
Class 6	Nil
Class 7	Nil

Table 1 Market value of plastic based on SPI classes

Out of 58.52kg of plastic waste collected, 36.6kg of plastic are recyclable and that can generate a market value of about Rs. 378.50. Among the different grades of plastic, grade 3 (PVC) has the highest market value i.e., Rs. 30 per Kg and grade 2 (HDPE) has the lowest value (Rs. 6 per Kg). Thus by collecting and segregating the plastic waste, an income can be generated. The market values of different grades of plastic has been obtained from primary data collected during interviews with the smart details.

2.1.3 Segregation based on brand

Brand auditing exercise was conducted to find out the brand that contributes more to the plastic waste generation in the pilot area. Aim of this audit was to investigate the possibility of the application of extended producer responsibility principle. Plastic waste collected from 130 households was considered for this exercise. In the analysis, ordering was based on the number of items identified through segregation of different brands, which was mentioned in the covers.

From the analysis, it was found that maximum number of items used in households is Milma, plastic carry bags, Malanadu, Ajmi and Ashirvad etc. Milma and Malanadu brands are under the plastic category of grade 4 (LDPE) as per SPI code and they come under the category of milk covers and thus are recyclable. Plastic carry bags are of grade 2 (HDPE) plastics and are recyclable. Ajmi, Ashirvad and Avees are flour brands coming under the miscellaneous plastic of grade 7 and are not recyclable.

2.1.4 Extended Producer's Responsibility

The central government has introduced an extended producer's responsibility (EPR) clause in the new SWM rules. According to this clause, the municipal authority may ask producers, importers and brand owners to provide the required finance to establish plastic waste collection centres either collectively or individually (Narain & Sambhyal ,2016).

A previous global study conducted by the Global Alliance for Incinerator Alternatives (GAIA) in June 2018 found similar composition of plastic waste in Thiruvananthapuram in Kerala (GAIA, 2018) with dry clean waste collected and audited from 135 households. Milma packets covers corresponded to the maximum percentage of the waste in the plastic collection in Alappuzha (60%). As per the Plastic Waste Management Rules 2016, "the primary responsibility for collection of used multi-layered plastic sachets, pouches or packaging is of Producers, Importers and Brand Owners who introduce the products in the market and they need to establish a system for collecting back the plastic waste generated due to their products."

2.2 MANAGEMENT OF ORGANIC WASTE - AEROBIC BINS

At present, Alappuzha Municipality has 23 aerobic composting units comprising 235 aerobic bins to process 15-16 tons/day of biodegradable waste.

Figure 3 Typical Aerobic Bin in Alappuzha

Aerobic bin composting units are eco-friendly methods to manage the biodegradable waste. The composting unit includes a box like structure with a ferro-cement floor. Layers of cow dung, carbon source and waste materials are subjected to composting in the presence of oxygen. The temperature rises rapidly in the waste to almost 70˚C, the peak temperature with pathogens. An aerobic compost bin, under optimum conditions, creates a lot of heat, which

can kill all sorts of seeds and pathogens. An efficient aerobic compost bin does not emit a foul smell like ammonia. An aerobic compost bin reduces the biomass to usable compost quicker than its anaerobic counterpart.

A unit with two aerobic bins can cost around INR 41,000. Providing an enclosed shed with a provision for drainage and soak pit for leachate, ramp for trolley etc. may cost INR 1,40,000. In order to understand the amount of waste managed in the aerobic bins, a seven day- study was conducted in six aerobic units in Alappuzha which were randomly selected. The data was collected through site visits, interviewing the workers and through observation. The key issues with the model are discussed hereunder. Figure 4 and Figure 5 below show the generation of biodegradable waste and plastic waste at each of the aerobic units surveyed, respectively.

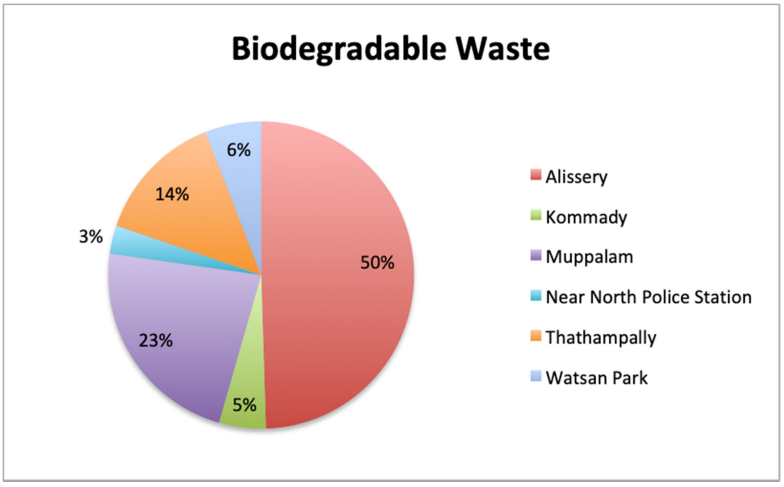

Figure:4 Generation of biodegradable waste

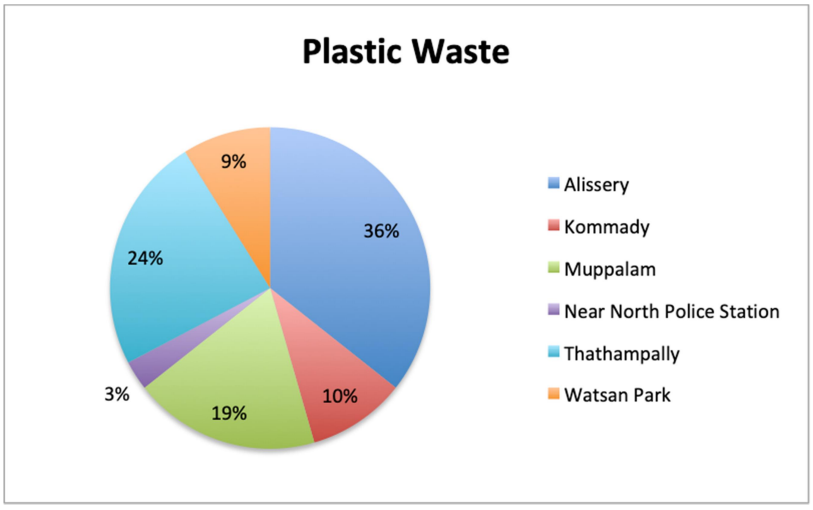

Figure :5 Generation of plastic waste

2.2.1 Supply-demand of units:

First and foremost, 6 units out of 23 units were found to be not working mainly due to flooding. Secondly, as indicated in the household survey there is lower utilization of the units. One of the crucial reasons for this is travel distance between the households and such units. Our analysis shows that to match the current population density and quantum of daily waste generated the city should have 720 bins instead of 235 bins. Similarly, some areas seem to have more number of bins such as Alissery unit (43 bins) while for some the number is as low as 4 bins (YMCA junction unit). To increase the utilization rate, units can be established within a distance of 500 meters (half a kilometer) as expressed in the survey.

2.2.2 Status of facilities at units:

In some units there is only a single shift for waste collection and for some units, two shifts. The critical facilities such as electricity and water are not available in 5 of the aerobic units. About 20 aerobic units fail to keep a log book for recording daily waste deposits.

1. **Leachates from waste:** The ground water table for Alappuzha is very high. Further, due to the flat terrain, most of the areas are waterlogged. If not managed properly, the leachate from the biodegradable waste can go into the subsurface soil and there is a possibility of contamination of groundwater. The issue can be resolved up to a certain extent if the aerobic compost bin has a gravel bed at the bottom. In this case, the bottom should be a bed of cover soil, drainage layer (i.e coarse aggregate and fine aggregate) and geo-membrane (coir pith, charcoal etc). The dimensions of each bed and the material size should consider pressure and soil type of the bin.

2. **Odour:** The issue of odour from the bins were found during the survey. This is largely due to lack of proper ventilation. An effective ventilation ensures oxygen supply to the bin thereby removing foul smell and gases. This can be achieved by leaving the sides of the bin open. Similarly, roof design needs to take such requirements into consideration.

3. **Rat infestation:** The issue of rat infestation was reported during the survey. The rats move inside the bin and dig out compost. It will increase the effort of workers. However, the positive side of this is the increase in the air circulation inside the bin, which fastens the process of composting. The issue could be due to soil foundation and thus can be managed to a certain extent by providing Reinforced Cement Concrete (RCC) or Plain Cement Concrete (PCC) foundation.

4. **Issues during monsoon season:** Since units are open from all sides, it allows rainwater to get inside. The higher water/moisture content reduces rate of composting

and quality of compost produced. The compost thus ends up dumped as waste. To curtail rainwater from entering the bins, slanting roofs can be provided. However, since the units are situated on the road side, beyond a stipulated limit it might cause disturbance to the traffic. Further studies are needed to find an appropriate solution for this problem.

5. **Shortage of dry leaves:** Another issue that is typically encountered during monsoon season is non-availability of dry leaves that help to reduce foul smell, maintain required temperature inside the bin and absorb water content. Thus, dry leaves play a crucial role in ensuring quality of the compost produced. One way is to store dry leaves when they are available. During the socio economic survey, many households conveyed they are ready to provide dry leaves to the aerobic units. However, most of the bins found to be lacking storage facility and space. Some units were found to be using alternative materials such as straw, saw dust etc. However, it might change the quality of the compost.

2.3 WASTE ENTERPRISES : STUDY OF SCRAP SHOPS

About 63% of the waste produced in Alappuzha is of recyclable quality. To cater to the recycling needs, the town has about 44 different types of scrap shops in Alappuzha (according to Alappuzha Municipality). About 70% of solid waste reaches various scrap shops. It is found that daily, 100 tonnes of scraps get exported from Alappuzha to different places. It contains 30 tonnes of plastic also (according to Alappuzha scrap dealers association).

However at household level, the utilization of such facilities is low (6% of the sampled households use such facilities). Whereas a considerable percentage (50%) dispose of dry waste in improper ways i.e. burn or dump in nearby land or canals. To further examine the role and economy of such facilities in the management of solid waste, a study was carried out. For this, few scrap shops in Alappuzha were selected randomly.

2.3.1 Waste chain

The study of scrap dealing in Alappuzha helped in identifying people involved in the movement of different types of waste from source to recycling/ disposal. At various stages of waste collection, storage and export different parties seemed to be involved in Alappuzha. For example, typically plastic waste from households is collected by a person or is directly given by the households to scrap shops. Such dealings are identified as the first party. After segregation, the waste/scrap is stored in the scrap shops and thus known as a second party. Such shops give segregated plastic waste to the third party and the third party gives it for recycling.

2.3.2 Rate, type and volume of waste handled

The daily rate of scrap material varies from shop to shop, whereas different materials have different rates. Among different materials, electronic waste (E-waste) seems to be fetching the highest price per kilogram. However, not many shops take or collect electronic waste. Metal scraps too get a good price/kilogram as compared to the plastic and paper wastes. Metal based scraps such as iron are exported to Palakkad for recycling purposes. Materials such as plastic and paper/cardboard get collected and exported in huge volumes to the neighbouring cities and states such as Changanassery, Thumboli (plastic bottle recycling unit), Perumbavoor, Muvattupuzha, and Tamil Nadu for recycling purpose.

The detailed data collected about the vendors are available in the main report, Town Level Assessment of Integrated Solid and Liquid waste management in Alappuzha available in the website.

2.3.3 Problems in scrap shops

Study helped in identifying following issues with the current system of scrap dealings in the town.

• The unsanitary conditions during waste collection and handling can lead to occupational hazards to workers.
• Daily log books are not maintained.
• There is no system for treating the waste generated in the shop itself.
• The rate of materials is different in each shop. The concerned government agencies can think of fixing the maximum and minimum prices of different material or must standardize it.
.• Provision of recycling units in the city can reduce the transportation cost.

2.4 RECOMMENDATIONS

- ***Data management:*** To design any policy, technical and social intervention the availability of data is crucial. Municipality currently lack data such as per capita solid waste production, characterisation, economy of informal recycling sector, etc. Efforts to maintain log books at various municipal facilities such as aerobic composting units, Material Collection Facility (MCF) and private scrap shops can be planned. It is important to maintain a logbook or to introduce a software system to identify the users of aerobic compost units.

- ***Creating infrastructure:*** At present Alappuzha municipality has 10 MCFs. Keeping current and future demand in mind the city might need more such facilities probably one for each ward. Institutions such as schools can also be targeted to install aerobic compost units and MCF centers. A comprehensive study to understand ways to enhance the efficiency of MCF, aerobic composting units and swap shops should be carried out.

- ***Ensuring public participation****:* Alappuzha municipality has been advocating 'your waste, your responsibility' for the last six years. For this to be successful, public awareness and participation is necessary. It is important to create awareness among people to reduce the

use of plastic, especially issues due to the burning of plastic etc. Further, to effectively utilize various civic infrastructure/services such as MCF and aerobic composting units, people's participation and commitment is an absolute must. Further, as part of the Green Protocol, school children can be taught about environmental conservation and waste management practices.

- It is important to install solar based cameras and surveillance systems (CCTV cameras) to monitor all the streets.
- Proper safety measures should be followed by the sanitation workers.

Social institutions for better regulation: There could be local collectives like canal-shed committees to collect the segregated and clean waste from the households and transport it to appropriate disposal sites. Thus the hybrid model of waste management can create local employment and green jobs. A group of technically skilled youth can work with such committees to ensure proper maintenance of household treatment systems like biogas plants and pipe compost units. Further, to overcome the financial burden, the municipality requires more public support, security and maintenance teams on a contract basis.

- Since water availability was not found to be an issue during a sample household survey, the Government can think of introducing cloth sanitary pads. A gradual process of cloth-based pads and napkins with an introductory subsidy to encourage usage of such products can be adopted.
- A study to understand the behavioural practices, user's perceptions, need and demand for sustainable projects is highly recommended. Meanwhile, households can be asked to segregate sanitary waste from other domestic waste and label/mark it for segregated collection and safe disposal.
- Redesign products and delivery systems to ensure that materials and packaging can be fully reused and are toxic free, and that the products and packaging are readily re-absorbed into existing production processes with little or no toxic by-products.
- Support and strengthen the existing, invisible, unsupported, and unregulated recycling sector that currently operates on the fringes with appropriate policy and financial instruments from the government and private sectors.
- For dealing with plastic waste, implement a comprehensive Extended Producer Responsibility (EPR) policy that will clearly identify accountability and responsibility all through the life of a product.

3. WASTE MANAGEMENT IN HOTELS, HOMESTAYS AND OTHER ESTABLISHMENTS – ALAPPUZHA MUNICIPALITY

3.1 TYPES OF ESTABLISHMENTS OTHER THAN COMMERCIAL/INDUSTRIAL

The data was analyzed to identify the different types of establishments in Alappuzha town. A total of 233 establishments were surveyed by the Joint Health Inspectors (JHIs) and KILA Research Associates. Different establishments in the town are hotels, home stays, halls, bakery etc.

3.2 PROXIMITY TO CANAL

Of the 233 establishments surveyed 139 were near the vicinity of canals. 42% of the establishments were observed to violate some form of waste management rules. The major canals arme the Commercial canal and the Vadai canal. Among the surveyed establishments, almost 35 establishments, dispose liquid waste into the Commercial canal and 26 establishments dispose waste into the Vadai canal.

3.3 LIQUID WASTE MANAGEMENT

The liquid waste is categorized into two - black water and grey water. Black water is primarily liquid waste containing faecal matter. The preferred way of black water disposal is by the use of septic tanks. Grey water refers to waste water from baths, kitchen and all other waste water streams, which is not contaminated by faecal matter. This could be disposed of in leach pits. It is better to segregate grey and black water for better efficiency of septic tanks.

3.3.1 Black water disposal

Out of the 233 surveyed establishments, only 80% of them had toilets. Among them, 41% disposed black water directly to the canals or nearby drains, although there were some form of filters installed at the discharge end. Only 21% had septic tanks. Majority of the rest were soak pits.

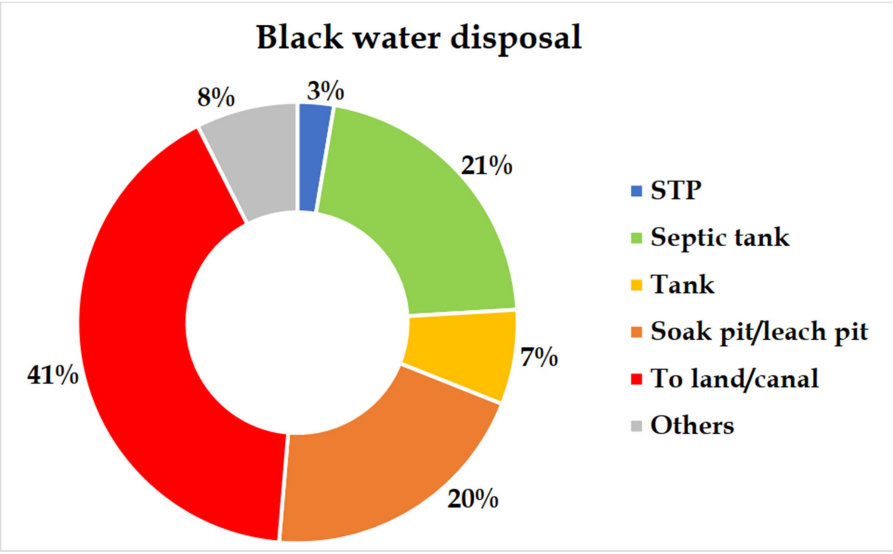

Figure 6 Black water disposal practice by commercial establishments

3.3.2 Grey water disposal

Close to 82% of establishments were found to produce grey water and 55% of them discharged grey water directly into the canals or drains. 24% dispose to the septic tanks. This practice of non-segregated disposal or mixed disposal of grey and black water is also not recommended as it may affect the efficiency of the septic tank.

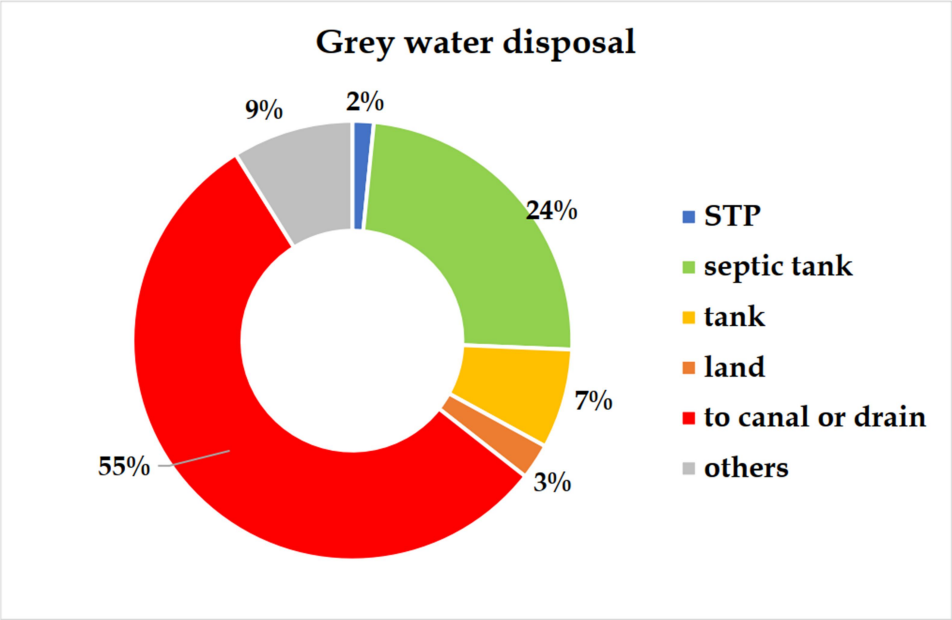

Figure 7: Grey water disposal practice by commercial establishments

3.4 SOLID WASTE MANAGEMENT

It is recommended to segregate solid waste into dry and wet waste. Wet waste usually contains all the organic matters such as kitchen waste, thus may be composted or used in biogas plants. Dry waste, further may be classified into plastic and non-plastic waste.

A majority, 73% of the establishments reported that they segregate the waste at the source itself.

3.4.1 Non-segregated waste disposal

There were 26% establishments which did not segregate their solid waste. Waste generated at 40% of these businesses were collected and treated somewhere else. The majority were depending on private agencies to dispose of their waste. Very few depended on the municipality. 19% practice dumping on land or the canals. They used either vacant land nearby or took the waste home. Another 18% burned the non-segregated waste, which is harmful as well.

3.4.2 Segregated wet waste disposal

73 % establishments surveyed segregated their waste and the wet waste mostly gets collected by private agencies. The onsite treatment practices adopted by the 20% include use of aerobic bin, biogas etc. Among them, biogas and community aerobic bins are the popular treatment methods.

3.4.3 Segregated dry waste disposal

54% of establishments depend on the waste being collected by private agencies or the municipality. But the second most popular practice is burning, which is observed to be more harmful due to partial burning.

3.5 FINDINGS

1. Liquid waste management is more critical than solid waste management in commercial establishments of Alappuzha. Majority are disposing both black and grey water directly to drains or canals nearby. Waste water dumping to canals and open drains can make them lose their appeal and eventually become a waste dumping point.
2. Solid waste is majorly collected by private agencies rather than by the municipality, this could make it difficult to track the waste after being collected. It is also noticed that the same agency collects both segregated and non-segregated waste.
3. Though aerobic units were initially planned to collect waste from households and small shops alone, the possibility of collecting the wet waste from the commercial establishments should be explored along with a tax from them. This can make some employment since many of these commercial establishments produce waste in a regular manner.

3.6 ENVIRONMENTAL REGULATION OF INDUSTRIES AND COMMERCIAL ESTABLISHMENTS

- Most of the Industries in Alappuzha are small firms falling in Orange category[1] and failure to comply with the environmental norms is mainly due to the involved high costs. As mandated in the Water Act (1974), Kerala State Pollution Control Board (KSPCB) must pro-actively demonstrate cost effective measures for fixing violations in return for a fee.
- Engagement with Industry Guilds and merchant (such as *Vyapari Vyavasayi*) associations is needed in order to understand the reasons for compliance failure and promote green practices.

[1] The typology used for categorisation of different institutions (commercial establishments and Industries) along the canal sides are according to the revised Classification of industries under Red, Orange, Green and White categories based on their respective pollution index. This is according to the notification no. B-29012/ESS/CPA/2015-16 dated 19/08/2015. Refer http://pib.nic.in/newsite/PrintRelease.aspx?relid=137373

- KSPCB must encourage industries to have an Environmental Management Plan along the lines of ISO 14001 and emulate Maharashtra State Pollution Control Board where this is a mandatory requirement for consent to operate.
- There is a need for a well-defined regulation for safe handling, transport, disposal and management of sludge from septic tanks and effluent treatment plants. KSPCB must mandate organizations like Kerala Enviro Infrastructure Limited (KIEL), a public limited company promoted by the Kerala State Industrial Development Corporation (KSIDC) to collect chemical waste sludge from industries periodically and also should ensure the release of water by the establishments are within the limits prescribed in Surface Water Quality Criteria of CPCB.
- In order to ensure compliance, there is a need to enhance capacity of KSPCB. Regulation by policing is a difficult option with limited staff. Here is the need for wider citizen participation to identify and monitor pollution points and report it through community institutions such as proposed canal-shed committees. This can formalise participation (with the strength of a collective) and also ensure transparency and accountability of state institutions for better regulation.
- Need for a system of citizen participation for social regulation – Formation of canal-shed committees is not feasible in the industrial belt as the population density is low. However, there is a need for an independent town level informal regulatory body, which will consist of members from the town. Community through this informal regulatory body can build pressure on violators and negotiate for clean-up and compensation
- Formalisation of the engagement between local government departments/agencies and academic institutions is recommended to fill the existing data gap and create a repository of data and information on pollution, water supply, sanitation issues, water quality etc. The data thus collected and collated can be shared with the citizen committees/groups and appropriate government departments for effective evidence-based policy advocacy and social regulation.

4. FAECAL SLUDGE MANAGEMENT FOR ALAPPUZHA TOWN

4.1 INTRODUCTION

Census Data 2011 for Alappuzha Municipality points towards nearly 100% household toilet coverage and the city has been declared open defecation free. However, the census data explains only part of the sanitation service chain.

The municipality decided to assess the current status of Faecal Sludge Management (FSM) in the town as the census data provides information only regarding access to toilets and types of OSS. Further, the city has not laid sewerage system in the town while the census reported nearly 13 percent houses are connected to such a system. Moreover, there is a suspicion that what people reported as septic tanks may actually be pits.

The following section explains FSM and its service chain followed by the methodology adopted to assess the current status. This is followed by an action plan based on an analysis of the existing status and finally the conclusion of the study.

4.2 WHAT IS FSM?

Faecal sludge refers to solids settled in on-site installation and its management refers to safe handling till it is treated and returned to the environment. It is partially digested and is a product of collection and storage of excreta and black water in OSS. Faecal Sludge Management (FSM) thus includes collection and storage, safe emptying from on-site system, conveyance, treatment and safe disposal of faecal sludge. As evident from the service chain (Figure 8) of FSM, the existing on-site systems are an essential part of the chain and it will help the existing toilets take the ultimate step in the new sanitation ladder that will be used by the Joint Monitoring Programme to monitor progress under SDG target 6.2.

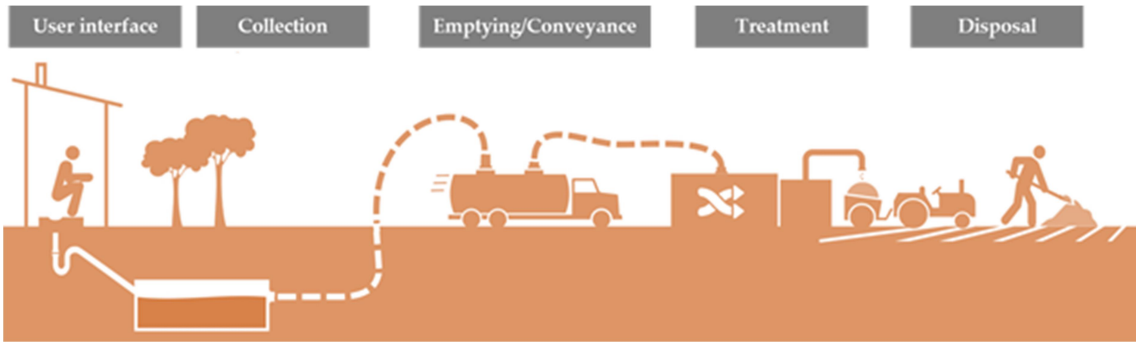

Figure 8: Service chain of FSM. Source: Adapted from http://www.wastewaterinfo.asia/sites/default/files/downloads/S9-01-Intro.pdf

4.3 STATUS OF FSM IN THE TOWN

This section presents the status of each component of the FSM service chain based on the data collected through household surveys and qualitative interviews of key informants. Of the 2155 households approached for surveys, 215 refused to participate while responses of 251 households were removed in the cleaning process which includes households that chose to end the participation mid-way, unavailability of decision maker in case of WTP study, or where the enumerators spent inadequate time.

4.3.1 Access to toilets

All the households have access to toilets and the municipality's claim of being 100 percent coverage of toilets stands vindicated. In the survey, only one household reported to not have their own toilet, they share the toilet of their neighbours.

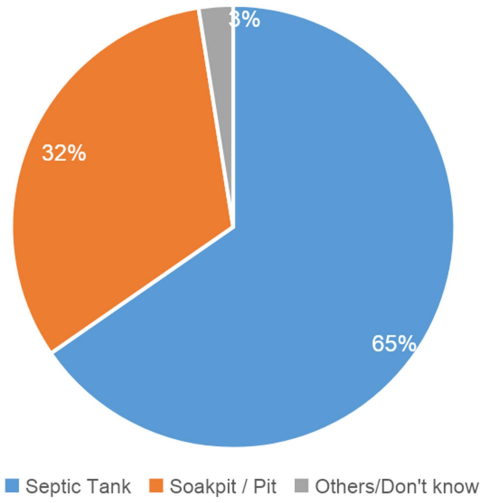

Figure 9 : Types of OSS as responded by households

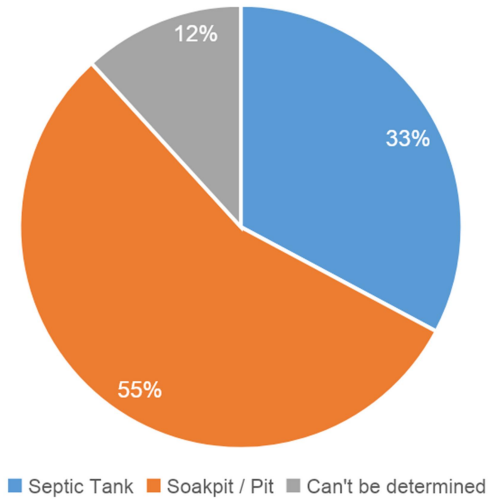

Figure 10: Types of OSS as deciphered by technical analysis of responses

4.3.2 Collection

Similar to Census 2011, most households reported that their toilets were connected to an on-site sanitation system (OSS). 65% reported that the OSS was the septic tank while 32% reported it being a variant of pit. However, as it is suspected that the OSS called septic tank locally is likely to be a pit, a technical analysis of the OSS was carried out based on the responses regarding the materials of the wall and bottom of the OSS as well as its outfall. The criteria used to decipher the OSS were based on literature and interviews of masons carried out before the questionnaires were formulated. 12 % OSS could not be conclusively deciphered either due to inadequate or inconsistent data or the respondents were unaware of the material of the wall or the bottom or both. The type of OSS determines the characteristics of faecal sludge (FS) emptied, which in turn influences the technology and capacity of the treatment system. This is particularly true for the state of Kerala as pits are inappropriate OSS in most cities due to high water table, and any meaningful plan for FSM will need them to be replaced. Further, the survey also found that one in two septic tanks are connected to soak pits while the remaining drain their effluent to a nearby drain or open land.

4.3.3 Emptying

The survey also found that 43 % of the on-site installations have never been emptied (see Figure 11). Almost 40 % of the unemptied on-site systems were less than 5 years old; but

more than 30 % were 10 years or older; the oldest was reported to be 50 years old. Of those emptied, the duration between successive emptying (frequency/cycle) ranged from 1 year to 20 years; 55 % observed an emptying cycle of less than 3 years (Figure 12) and the average emptying cycle of installation emptied was found to be 3.5 years. This is very close to the emptying cycle (2-3 years) suggested by the Central Public Health and Environmental Engineering Organisation (CPHEEO).

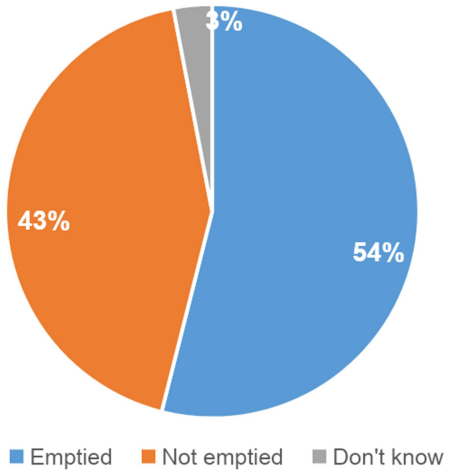

Figure 11 Emptying practice in Alappuzha

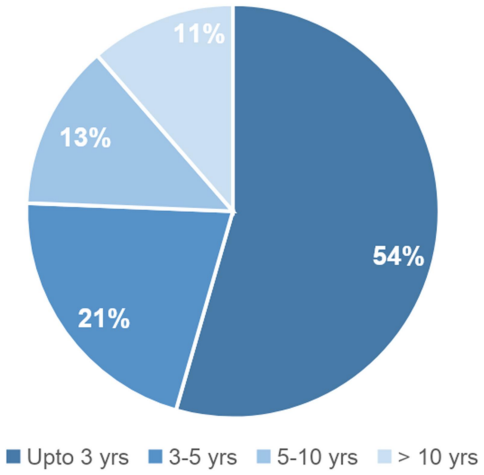

Figure 12: Duration between successive emptying (only of emptied systems)
Source of information for both charts: Primary survey

The municipality does not provide emptying service nor has it licensed any private service providers. Members of Alappuzha district Septic tank cleaning Contractors Association (ASCA)[2] provide emptying services to households and institutions like hotels, hospitals, etc. in the district as well as adjoining panchayats of the neighbouring districts. The members of the association collectively operate about 50 emptying trucks of 5,000 litres each. They provide service only in the night, often well past midnight as they perceive the business risky and fear action by law-enforcement agencies. Each truck makes about 5 trips each week (from all the areas they serve, not only the town). Though not permitted by law, manual emptying of on-site installations is practiced in the city. However, a preliminary finding of an ongoing research trying to study the lives of scavengers in the city has found that the people involved themselves do not want to be identified to be working with excreta for social reasons. The discussions also revealed that whether the tanks are emptied manually or through vacuum pumps, the personnel do not use personal protective equipment. The average charge paid by households for emptying of septic waste is demonstrated in figure 13. This practice poses many health risks for the personnel involved.

[2] Source of all information related to ASCA: Informal interview of the Coordinator of the Association on 04 December, 2018 by Ajith Krishnan AG, Research Associate, KILA

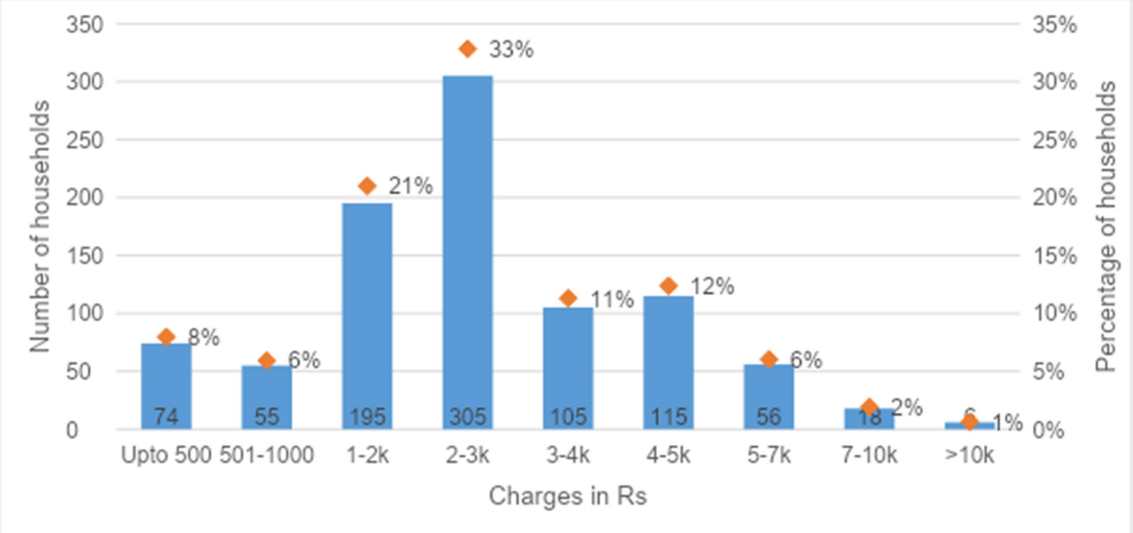

Figure 13: Distribution of charges paid by households for emptying OSS

4.3.4 Treatment

Alappuzha municipality currently does not have any faecal sludge treatment plant (FSTP). It has proposed following small plants to cater to institutions and 4 mobile treatment units under Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

1. General hospital (240 KLD)
2. Shatabdi Mandiram (100 KLD)
3. Mobile FSTPs (2 nos)

ASCA coordinator claims that the emptiers carry the emptied faecal sludge to a treatment plant at Info park in Cherthala some 25 km away from the town. The treatment plant operator charges Rs 1,000 for emptying each load. They are also aware that capacity of the treatment plant is insufficient. It is safe to assume that they dispose FS at the nearest convenient location. When manually emptied, the FS is either disposed of in a pit dug for the purpose or just spread around on the same property. Thus we can assume that FS from the town returns to the environment without any treatment.

4.4 RECOMMENDATIONS

The recommendations proposed for FSM in the town at different levels are described below.

Collection: All types of pits are unsuitable in Alappuzha due to its high-water table. It is therefore suggested that all the pits in the town gradually be replaced by watertight septic tanks. Considering that households are willing to pay for upgrades, the municipality only needs to encourage them through a strong information and education campaign (IEC) with

partial subsidies to incentivize less willing households to replace their pits. The municipality however needs to ensure that the new septic tanks are built according to the standards provided by the CPHEEO.

Emptying: The guidelines by the government of India require that an OSS be emptied every 2-3 years. At this rate, nearly 14,000 OSS need to be emptied annually. Assuming 300 working days and 3-4 emptying per truck per day, 14 emptying trucks will be needed. The municipality can get into a contractual arrangement with the association of emptiers and pay them based on the number of systems emptied and faecal sludge deposited at designated location/s. The municipality can begin with 'on-demand' emptying and should consider scheduled emptying, i.e. ensuring that an OSS is emptied on a pre-decided date/month.

Treatment: For selection of the treatment technology and to determine the required capacity of the FSTP, the characteristics and quantum of faecal sludge are needed. Further, demand for end-products for reuse of treated faecal sludge can also determine the choice of technology. The municipality therefore needs to conduct the following studies:

1. Characterisation and quantification of FS
2. Assessment of end-products of treated FS

Safe Disposal/ Reuse: Currently, there are no standard norms for re-using treated septage in India. GoI (p. 24, 2013)[3] suggests that we use the following norms for reuse of dewatered/treated septage in agriculture till CPCB notifies such norms.

- A faecal coliform density of less than 1000 MPN/g and Salmonella sp. density of less than 3 MPN per 4g total dry solids
- Helminth egg concentration of less than 1/g and E coli of less than 1000/g total solids in treated septage
- MSW Rules (2000) to check the concentration of arsenic, heavy metals and pH in the reusable water.

The planners should first assess the demand for products and choose a treatment system accordingly. Such an approach will need that the municipality and end-users collaborate and mutually decide the contours of the partnership.

Financially Sustaining the Service: Such an end-to-end service can remain functional only when it can recover costs of operations and maintenance. The municipality can raise demand from consumers at the time of emptying service or an annual tax against which the municipality will empty the OSS once based on the decided emptying cycle.

[3] Advisory Note on Septage Management in Urban India, MoUD, GoI, 24
http://cpheeo.gov.in/upload/uploadfiles/files/Advisory%20Note%20on%20Septage%20Management%20in%20Urban%20India.pdf

4.5 FINDINGS

This study presents a methodology to understand the current status of FSM in a town. It demonstrates the use of mobile based applications for carrying out household surveys. Further, qualitative interviews of key informants are needed not only to triangulate the data but to design the questionnaire itself. The study also demonstrates a methodology to decipher the type of OSS based on recall memory responses of the households. However, this is possible only because almost all houses in the town are built by the owners and not builder supplied.

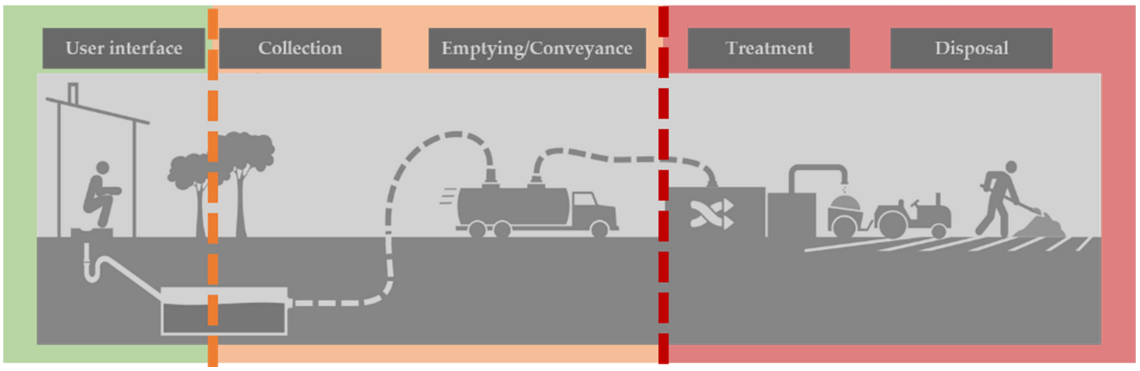

Figure 14: Status of the FSM service chain in Alappuzha Source: Adapted from http://www.wastewaterinfo.asia/sites/default/files/downloads/S9-01-Intro.pdf

The survey findings vindicate the city's claim of being open defecation free, as all the households have access to toilets. Most of the OSS in the town are pits that are inappropriate for the high-water table prevalent in the town. Further, 43% OSS have never been emptied and at least half of them are already older than the emptying cycle suggested by Indian standards. Though inappropriate and inadequate, collection and emptying are still being practiced, while treatment of FS and safe disposal or reuse components are totally absent. Finally, the study suggests that the municipality should encourage households to get their pits replaced with scientific septic tanks through an IEC and by incentivizing the replacement.

Developing a database will be needed to ensure that OSS are emptied within the emptying cycle, the municipality should use any existing mechanisms or devise new mechanisms to develop and keep the database updated. The emptying service providers active in the town should be licensed to legalise the service. This will enable them to operate openly without feeling any risk from law-enforcement agencies. This will also put an end to their practice of charging exorbitant prices for the service. To arrive at the capacity needed and to select the appropriate technology for treatment, characterization and quantification of FS and an assessment of demand for end products is suggested. Finally, to keep the service financially sustainable, the study recommends levying a tax that covers all the operational costs over the cleaning cycle.

5. CONCLUSIONS

The rejuvenation of Alappuzha's canal network requires a multi-pronged strategy. The required data for preparing such an action plan has been obtained through extensive studies and surveys by CANALPY since November 2017. While Winter School 2017 and Summer School 2018 have showed the importance of tackling solid and liquid waste generated at the household level, data on other aspects of waste management chain for the town as a whole was found lacking, including efficiency of existing decentralised waste management system and the faecal sludge chain for Alappuzha.

This paper has dealt with fine-grained understanding of major pollutants and polluters, including the type and quantity of plastic waste generation, waste management of hotels and homestays, faecal sludge management in the town among others. The analysis has shown that while citizen participation and mindset change is certainly important for a revival of the canal network, there needs to be regulatory oversight and investment from the local bodies for all aspects of waste management. This includes enforcing 'Extended Producer Responsibility' to deal with plastic waste, providing better facilities at aerobic composting units, environmental regulation of commercial & industrial establishments and investing in the faecal sludge management chain for safe disposal, among others.

Rejuvenation of the canal network can thus be realised only through a concerted action of the civil society and the state.

REFERENCES/BIBLIOGRAPHY

- Narain, Sunita and Sambhyal, Swati Singh. (2016). *Not In My Backyard,* Centre for Science and Environment (CSE).
- GAIA (Global Alliance for Incinerator Alternatives). (June 2018). *Pan-India Waste and Brand Auditing.*
- Suchitwa Mission (n.d.) *Clean Homes Clean City,* Local Self Government Department, Government of Kerala.

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Town Level Assessment of major polluters and pollutants in Alappuzha Town

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