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FAECAL SLUDGE AND SEPTAGE MANAGEMENT (FSSM)- A CASE OF DALHOUSIE, HIMACHAL PRADESH

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Abstract:

In an urban India, providing access to safe sanitation for every individual has become one of the key challenges for the governing authorities and under that Faecal sludge and septage management being very neglected topic still plays a crucial role in providing it. Scientific Collection and treatment of faecal sludge is not an easy task to do and it becomes more difficult when it comes to the areas where there is number of constraints related to slope, climatic conditions and settlement patterns are present.FSSM is one such approach towards such crucial topic since it follows the holistic approach to mitigate the issue and takes care of each and every step complimenting ground conditions.

Keywords:*Faecal sludge and septage management, Sanitation, Faecal sludge,Septage, Desludging, Disposal.*

1. Introduction

The management of safe containment, transportation, treatment, disposal and reuse of Faecal sludge and septage knew as Faecal Sludge and SeptageManagement(FSSM). As per census 2011, over 48% of Households in urban India area dependent upon onsite facilities and this proportion is increasing,especiallywiththerapidpaceofconstructionofindividualandcommunitytoiletsunderSBM(SwachhBharatMission). Most of these are based on on-site facilities such as pit latrines and septic tanks. [1]

Treatment capacity is available is only for "37% of the total 62,000MLD" (million litres per day) of human waste generated in urban India. Poor sanitation has significant health costs and untreated faecal sludge and septage from cities is the single biggest source of water resource pollution in India, causing number of diseases such as "diarrhoea, agricultural contamination, and environmental degradation".[1]

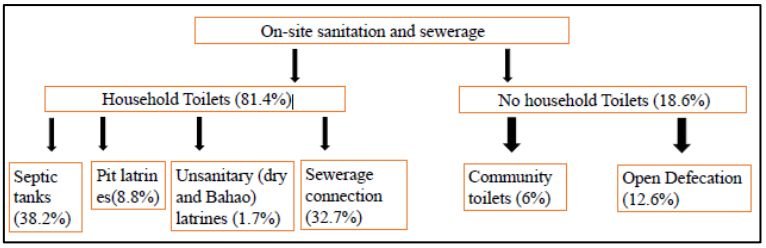

Figure 1. Sanitation Scenario at National Level[1]

Faecal sludge management process[2]:

1. **Access to the toilet**: Access to Hygienic Toilet to all households;

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2. **Emptying & transport**: Desludging of septic tanks by suction machines and transported to Treatment Plan;
3. **Treatment**: Treatment at centralized or decentralized treatment plants;
4. **Disposal**: Disposal at a designated site.

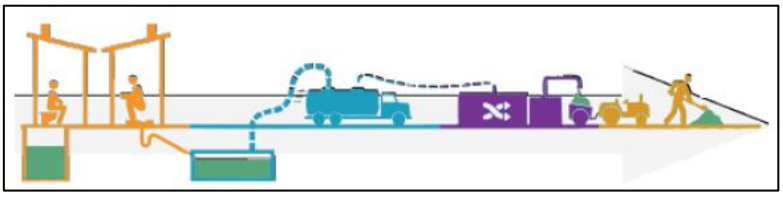

Figure 2. Process of FSSM[2]

India's urban population is 377 million or 31% of the total population (as in 2011) is expected to increase to 600 million by 2031. The Census 2011 also showed that in 4,041 statutory towns, 7.90 million households (HHs) do not have access to toilets and defecate in the open.[2]

It has been duly recognized by the Ministry of Urban Development that the objectives of the Swachh Bharat Mission cannot be fulfilled without a dedicated FSSM Policy. Management of faecal sludge in urban areas should go hand-in-hand with the installation of toilets before the gap between the production of sludge and its treatment becomes too wide to exist.

Dalhousie is a hill town in District Chamba,Himachal Pradesh. The population as per 2011census is 7051, it is ClassV town with 9 wards. It is located 56 Km from Chamba it is Important tourist destination in Himachal Pradesh as well as neighbouring states like Punjab. It is an important educational hub with the current student population of 4795 students. It is well connected by all weathered roads such as NH-49.

Site-specific need Dalhousie - There is no sewerage system in Dalhousie 51.73% houses have the flush latrines. Some of them have septic tanks and others dispose of the sewage in the Nallahs or in open drains. 48.17% have a dry latrine system.

2. Methodology

The methodology is the process in which the study has been conducted in a systematic manner. In the first step, objectives are set-up which is followed by the introduction of the study area, i.e., Dalhousie.

After that second step is the theoretical framework. It includes all the literature which is needed to understand the whole system of faecal sludge and septage management. In this, the National Urban Sanitation Policy (NUSP) of 2008 has been studied. Various sewerage treatment methods for on-site sanitation and off-site sanitation are studied as well. It also includes technologies which can be used for emptying the septic tanks safely so that they can be collected and safely transported to the treatment units.

Next step is Identification of Data- It includes the data which is to be collected from primary and secondary sources. It also includes preparation of questionnaires for various aspects like access to toilets, collection of faecal sludge and septage, emptying techniques, transport

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methods and final disposal and treatment of the septage. It also includes the involvement of public and various stakeholders at ULB level.

Data Collection Stage- Primary Data is collected from household surveys for sanitation facility, mode, frequency, etc. It also includes the data collected from the municipal council of Dalhousie, Irrigation and Public Health department, etc. Data is also collected from secondary sources like the reports which are obtained by various authorities, census handbooks, etc.

Data Analysis Stage- In this stage, the collected data from various sources is compiled and analysed. Data analysis for the use of various sanitation facilities is done at the city level as well as ward level. On the basis of the data, various observations are made and analysis is done which includes fact, cause and implication. Problems and potentials are also identified for sanitation facility in Dalhousie town.

The last step is the Proposals and Implementation Strategies. In this stage, proposals are given for various components of faecal sludge and septage management system. It includes proposals for emptying of septic tanks and safe transportation as well as disposal. Then the proposal for the treatment unit is also given. Various areas are also identified for which decentralised treatment units are given. This stage also includes implementation strategies like the involvement of various stakeholders, strengthening of ULBs through capacity building programs, generating awareness about the ill-effects of unhygienic conditions, etc.

3. Theoretical framework

As per Prohibition of Manual Scavenging Act, 2013 No person / local authority/agency engage or employee either directly or indirectly, any person for hazardous cleaning of a sewer or a septic tank**.**

In order to enhance the outcome and make people aware of this issues Policies Interventions through Central Level is also done and several states such as Rajasthan Government, Uttar Pradesh Government etc have also framed their state-level policy on FSSM specific for their Jurisdictions to implement this in an appropriate manner.

3.1.National Urban Sanitation Policy (NUSP) 2008[3]

With a vision to provide appropriate sanitation facilities in all cities/ towns,the government of India formulated the National Urban Sanitation Policy (NUSP)in 2008.

According to NUSP guidelines, state sanitation Strategies have to be prepared by all states of India and city Sanitation Plans (CSPs) needs to be formulated by Cities/ towns in which the following outcomes are expected[3]:

- ✓ ODF cities.
- ✓ Eliminate manual scavenging and provide safety for sanitary workers.
- ✓ Scientific disposal of municipal wastewater and stormwater drainage.
- ✓ Wastewater should be recycled and reused for non-potable applications after treatment.
- ✓ Proper collection and scientific disposal of solid waste.
- ✓ Serving the un-served with basic minimum services.

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- ✓ public health and environmental standards should improve through proper measures.

3.2.**National policy on faecal sludge and septage management (FSSM) 2017**[1]

With the objective to provide context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable Sanitation becomes a reality for all in each and every household, street, town, and city FSSM Policy was framed in the year 2017[1]

The Policy includesthe following provisions[1]

- ✓ All benefits of wide access to safe sanitation accrue to all citizens should be ensured by mainstreaming FSSM in urban India by the year 2019;
- ✓ The roles and responsibilities of various government entities and agencies, and of other key stakeholders such as the private sector, civil society organizations, and citizens should be defined for effective implementation of FSSM services throughout the country;
- ✓ Central Government programs such as SBM, AMRUT and the Smart Cities Mission enable and support to realize safe and sustainable sanitation.

4. Faecal sludge and septage Management Scenario in Dalhousie

4.1.Slope and Elevation

Dalhousie is comprising of steep slopes as well as fluctuations in the elevation also. Which actually resulting in making area very uneven in terms of topography and terrain.

Some of the areas such as Lohali a Kathlaj area are low – a lying area as compare to major settlement of the city, and there are predominantly steep slopes and stairs are in use to provide access to the HH. Ward 4 is the highest elevated area of city, as well as steeps slopes, are also present making the area most dispersed with respect to settlement pattern resulting lack of basic infrastructure availability in the area.

Lohali Area: The area is characterised with the steep slope as the lower Lohali is situated down the valley in the low elevation area as compare to the main settlement of the city.

Katlaj Area: The area is basically not having too much undulation in the terrain but it is situated in the low elevation area, it is the low- lying area of the city as shown in figure 3.

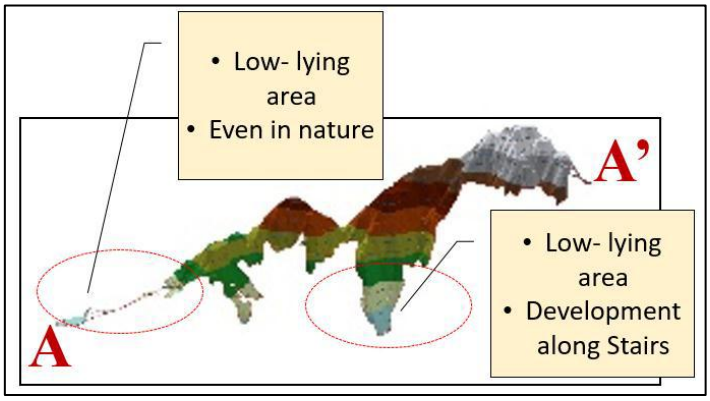

Figure 3. The terrain of Kathlag and Lohali

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In Dalhousie, Land is uneven in nature resulting in the dispersed kind of settlement within the area. Steep slopes and stairs are predominant within some of the areas to get access to the HH situated in the valleys. Built-up in the city is not evenly distributed as some of the areas are having major terrain constraints as shown in figure 4.

Figure 4. Undulations in terrain in Dalhousie

4.2.Existing Sewerage Network

67% of the households in Dalhousie town are using on-site sanitation facility, i.e septic tank because of terrain constraints and 26% of households are connected with the piped sewer system in ward number 4 and 5 because of compact development and rest of 7% households does not have latrine facility as shown in figure 5.

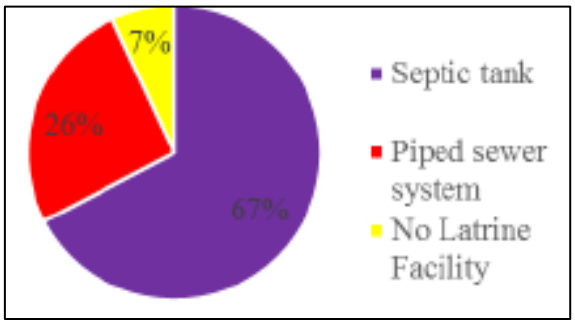

Figure 5. Current Sanitation Scenario of Dalhousie

Source: Primary Survey,2018

Figure 6. The existing sewer line in ward-4 Figure 7. Manholes at every 5m in ward number 4

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Under the on-going scheme for sewerage in Dalhousie, total 54 km of the sewer line is proposed to cover areas like upper Bakrota, Middle Bakrota, Lohali, etc. Till date, 22% of work is completed, i.e., 12km of sewer pipe has been laid.

4.3.Ward-Wise Sanitation Facility

Dalhousie has a total of 9 wards in its municipal limit. There is no equal distribution of ward area and its population resulting in variation of densities. Ward densities vary between 9pph to 200 pph, with ward-6 having the lowest density and ward-4 having the highest density.

Table no.1 Ward wise Sanitation facility
Source: Primary Survey,2018

Ward No.	No. of HH	Septic tank (%)	Piped sewer system (%)	No Latrine Facility (%)
1	292	73.1	2	24.9
2	102	81.4	3	15.6
3	132	74.8	24.1	1
4	121	6.1	93.9	0
5	95	32.4	65.6	2
6	150	79.8	4.9	15.3
7	141	56.9	39	4.1
8	136	9.	1.2	8.8
9	112	91.9	0.4	7.7

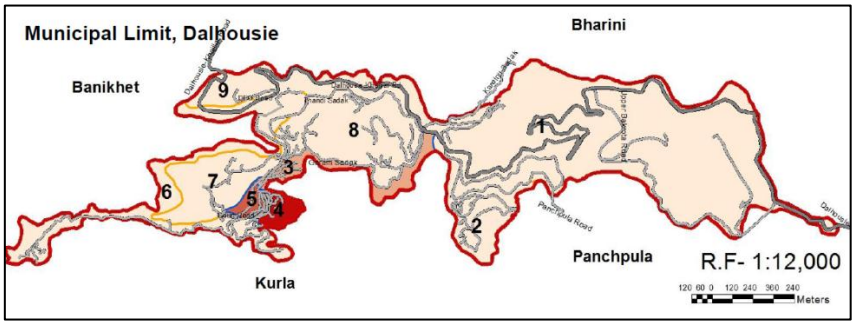

Figure 8. GIS Mapping of Dalhousie

Ward-1: This ward is having a density of 21 Person Per Hectare (pph) with the total household of 292 in number. The predominant landuse of this ward is residential land use. As per the filed survey conducted, out of total households (HH), 73% of HH are using septic tank as shown in table-3 above. Only 2% of HH has sewerage connection which is along the main road. 24.9% of HH is not connected to any kind of sanitation facility leading to the open defecation. These areas are unserved because of the terrain issues and people are not able to have access to basic facilities as well. There arealso secluded houses in Upper-Bakrota having terrain constraint. Because of this they are not using any kind of sanitation facility leading to open defecation.

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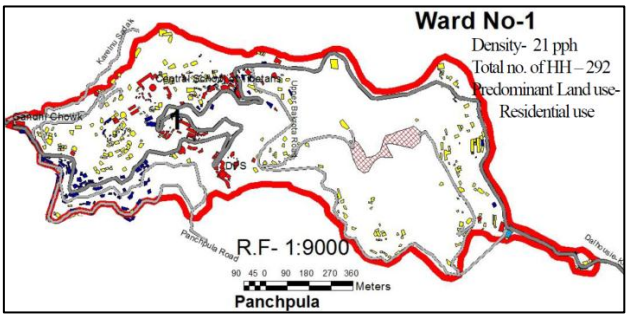

Figure 9. GIS Mapping of Ward 1, Dalhousie

Ward-2:- This ward is also known as Lohali and have agriculture as a dominant activity. People in this ward are involved in agricultural practices. It is having a density of 45PPH and has 102 HH. As per the filed survey conducted, out of all the HH, 81.4% are using septic tank facility. This area is fully developed on steps, which act as the major constraint in the development of this area as shown in figure 10. Houses at Lower-Lohali (ward no-2) area are sparsely developed due to steep slope, which makes it inefficient to give sewer system. So they are using septic tanks.

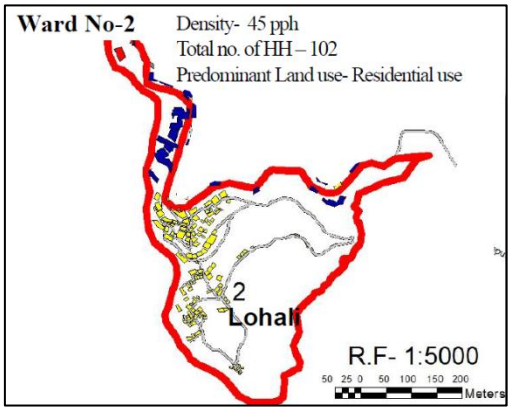

Figure 10. GIS Mapping of Ward 2, Dalhousie

Ward-3:- This was is unevenly distributed ward with a density of 62 PPH. As per the filed survey conducted, Ward no-3 is partially connected with sewer connection, (25%) below the SubhashChowk where it connects with ward-4. Other 74% of the HH inward use septic tank facility because of scattering development. The dominant land use in this ward is commercial and residential. Some of the public spaces are also present like gurudwara.

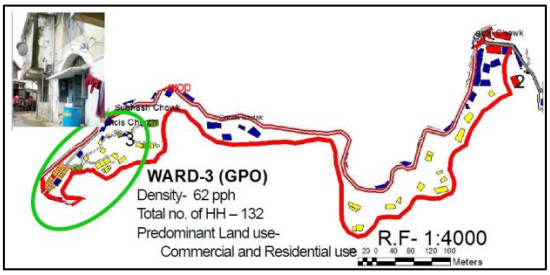

Figure 11. GIS Mapping of Ward 3, Dalhousie with Kathlaj area highlighted

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Ward-4:- This ward has compact development with the highest density of 201 PPH. It is dominantly a residential area, with narrow street widths. This ward having 121 HH, As per the filed survey conductedout of which 93% are connected to the sewer system. Compact development allows the laying of sewer lines as it was economically feasible. Manholes are also provided for the proper cleaning of sewer lines by Municipal Authorities. The sewer lines are connected to a containment unit, but no treatment is given to the wastewater and sewerage.

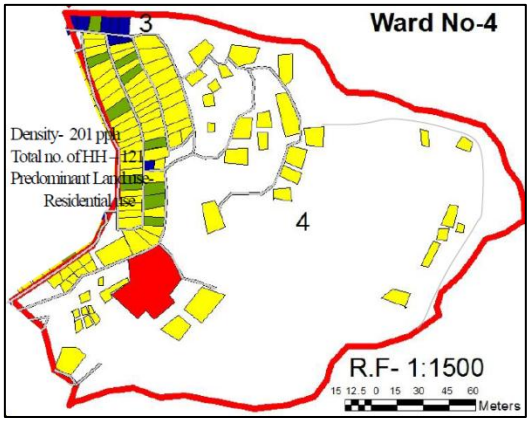

Figure 12. GIS Mapping of Ward 4, Dalhousie

Ward-5:- It has a total of 95HH with a density of 95 PPH. It has Police HQ of Dalhousie, which has its own septic tank for sewerage generated from HH in the police station premises. Residential HH in the ward is connected with sewer system.

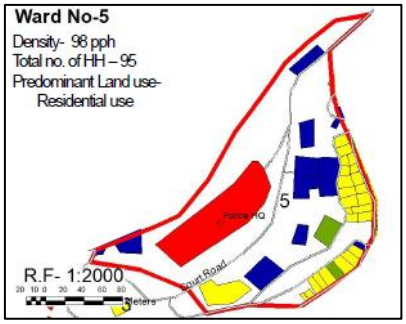

Figure 13. GIS Mapping of Ward 5, Dalhousie

Ward-6:- This ward has a village named Kathlag which is in a secluded area, away from the main town of Dalhousie. The road approaching this village is non-motorised making it inaccessible to provide any sewerage facility. So, people in the village use septic tanks as shown in table. They dispose their faecal sludge and septage in agricultural fields without treatment. Septic tank made at valley side in ward no-6 and making it inaccessible for desludging. It is also one of the factors that people construct septic tanks of varying sizes which are not acc. to standards.

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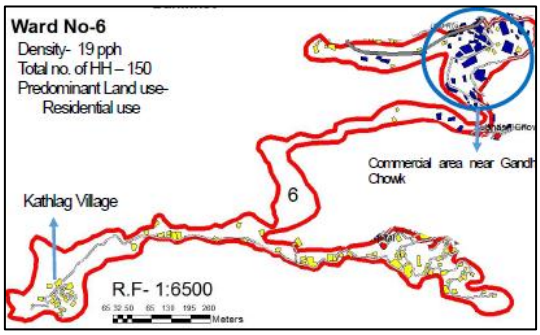

Figure 14. GIS Mapping of Ward 6, Dalhousie

Ward-7:- In this ward, there are 140 HH and out of which 57% use their own septic tank. It is because of the commercial landuse which includes hotels along the court road. These hotels have their own septic tank. As per the filed survey conducted,some of the HH (39%) are connected with the sewer lines. Hotels make sure to clean their septic tank at regular intervals. They are along the wide road which makes it easy to clean the septic tanks

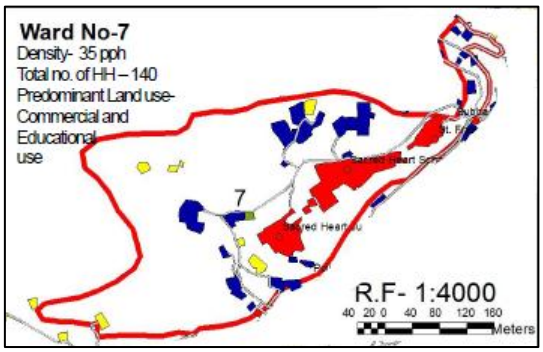

Figure 15. GIS Mapping of Ward 7, Dalhousie

Ward-8:- This ward has the density of 23PPH with HH of 136. It has dominant landuse of the commercial area.As per the filed survey conducted, 90% are using septic tanks and 9% does not have sanitation facility connected to them. There is provision of Public toilet in Gandhi Chowk at 500m of the commercial area. But condition of this is not good as they are not clean and foul smell is there.

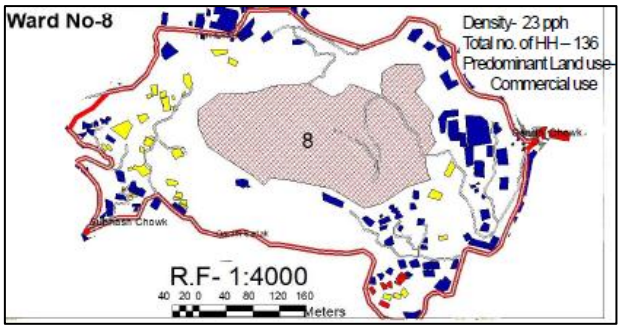

Figure 16. GIS Mapping of Ward 8, Dalhousie

4.4.Desludging of Septic Tank

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Predominantly septic tanks are being used in the whole area as there are topographical constraints due to that the development is dispersed/ scattered. Due to smaller width of roads and terrain constraints, 100% of the desludging work is done manually. They just use gloves and boots and no other protective measure is taken while performing desludging activity.

From govt's side, there are no specific guidelines given for construction of septic tanks. It has resulted in varying sizes of septic tanks. The frequency of desludging typically varies from 5 - 10 years as consumers build relatively large septic tanks in absence of design considerations from ULB in Dalhousie.

According to CPHEEO 2013, Desludging/Cleaning should be done in the interval of every 2-3 years but in Dalhousie and the height should not be more than 2 m[4] , Even though more than 50 % of the HH are getting cleaned their on-site sanitation facility after 3 years which goes to 10 to 15 years also as they are using septic tank with soak pit but the village areas such as Lohali village and Katlaj village they are having Septic tank without soak pits and they are disposing off the decomposed material into the valleys and the nallas.

Some Hotels and institutional; a building which is using septic tank at individual level are basically treated their sewage before disposing of it directly into the valleys then they dispose the water and use the manure generated from the faecal sludge for their fields.

As there is no proper policy, guidelines are present in the area regarding the desludging of septic tanks in terms of charges etc there is so much fluctuation is present in order of paying to the private sweepers for cleaning of the septic tank.

Graph representing the percentage of ranges of the amount usually residents pays in order to clean up/ desludging their respective septic tank.

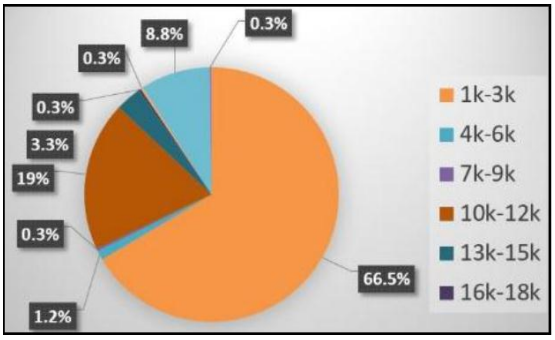

Figure 17. Charges paid by users for De-sludging in Dalhousie
Source: Primary Survey,2018

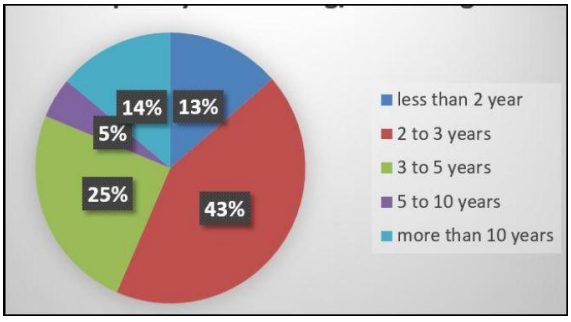

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Figure 18. Frequency of De-sludging in Dalhousie

Source: Primary Survey,2018

As there is less number of residents are present and also outmigration is happening in the city cleaning/ desludging of existing septic tank is not regular (due to lack of Government check and initiatives from the committee). As well as no proper guidelines regarding the dimensions of septic tank which should not degrade the environment.

Graph representing the percentage of ranges of the frequency of cleaning/desludging usually residents follow in the city. Graph representing the percentage of ranges of height of existing septic tank.

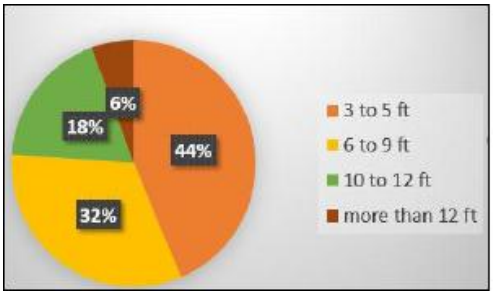

Figure 19. Depth of Septic Tanks in Dalhousie

Source: Primary Survey,2018

4.5 **Scenario of Dalhousie in light of National policy of FSSM, 2017**

Provision-1: 100% access to toilets with on-site or off-site sanitation facility[1]

According to data collected,67% of the HH in Dalhousie town are using on-site sanitation facilities, i.e Septic tanks because of terrain constraints; 26% of HH are connected with the piped sewer system inward no-4 and 5 because of compact development and rest 7% HH does not have latrine facility.

Figure 20. Septic Tank situated in the valleys of Lohali Village (Ward 2)

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Figure 21. Household connections to the septic tank at the cluster level.

Provision-2: Septage Collection and Conveyance[1]

According to data collected,14% of HH clean their septic tanks in less than 2 years; 42.9% HH have desludging frequency of 2 to 3 years which is permissible time for cleaning as per National policy of FSSM; 25% HH have a frequency between 3-5 years and 19% of HH use desludging facility after 5 years.

Due to the smaller width of roads and terrain constraints, 100% of the desludging work is done manually. They just use gloves and boots and no other protective measure is taken while performing desludging activity. From govt's side, there are no specific guidelines given for construction of septic tanks. It has resulted in varying sizes of septic tanks. There are informal desludging operators/sweepers are unregistered and there is a lack of necessary training to safely carry out these cleaning services.

Figure 22. Ongoing construction of septic tank with 2.5m dia and 5m height

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Figure 23. The undulation of land in ward-2

The frequency of desludging typically varies from 5 - 10 years as consumers build relatively large septic tanks in absence of design considerations from ULB in Dalhousie. Cleaning infrastructure such as "suction emptier trucks, trained human resources, safety equipment", etc is absent due to physical constraints in the town.

Provision-3: Treatment and Disposal of Waste[1]

As per the existing situations, there is no STP in the city, the collection of waste from sewer lines is done in the containment unit and no treatment is given to that waste. No scientific treatment is given to the waste and it is disposed of in "Khadd" that is in the valleys down the hills. It depicts degradation of land and environment.According to data collected, 17.5% of hotels use septic tanks, treat their waste and use it as manure. But they are unaware of the proper treatment. This kind of activity prevails inward no-7 and 2. There is no cost recovery done by ULBs.

Figure 24. Proper containment and disposal of sewerage at Ravi Hotel of Ward-4

Provision-4: Awareness about Sludge and septage management[1]

Municipal Authorities in Dalhousie is not aware of the management techniques about faecal sludge and septage. They do not have any capacity for building programs or training programs.According to data collected, 67% of HH are connected to Septic tank system but

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they are not aware of the proper treatment and disposal. It also put adverse impact on public health. 28% of people said that they face problem of over-flowing of septic tanks because they do not clean septic tank at proper frequency. It results in the degradation of land and groundwater. Many cases of water-borne diseases are also observed in the city.

Provision-5: Integrated Role of Institution at different levels[1]

Policy for FSSM is prepared only at the national level. Himachal Pradesh govt does not have prepared any State-level policy for FSSM. It depicts lack of integration at different institutional levels. This results in leisure approach of local bodies towards the management, treatment, and disposal of faecal sludge and septage.

Provision-6: Integrated Approach at City level[1]

Due to planning in a piece-meal (fragmented) manner, the full cycle of safe collection, treatment and safe disposal of the waste are not taken care of by ULB.

There is the availability of 5 community toilets which has been constructed by M. Council at locations of tourist interest like Gandhi Chowk, SubhashChowk, ThandiSadak, GaramSadak and Bus Stand, but these are on contract basis and there is no proper maintenance of it.

5. Implementation strategies

- Generating awareness about faecal sludge and septage management and its linkages with public and environmental health amongst communities and institutions including hazards from OSS liquid overflow by conducting awareness campaigns.
- It is also recommended that standards and norms documented and adequately use for design, construction and O&M of FSSM infrastructure such as On-Site Sanitation Facilities. Guidelines of CPHEEO to be followed in this light. These design considerations should be in line with the standards given by CPHEEO.
- Through the involvement of various public and private players which should be professionalized with standard operating procedures for desludging, operating and monitoring guidelines, etc. through appropriate training and capacity building of relevant service providers and regulators. Therefore, promoting the role of various stakeholders through PPP mode.
- Suction Emptier trucks & equipment, Treatment technologies (Sludge Drying Beds, DEWATS, FSTPs, Co- Treatment with STPs, etc.) and criteria for end-product disposal/reuse
- Encouraging a shift towards scheduled desludging of septic tanks, pit latrines, etc. (periodically within 2 – 3 years) in all ULBs, while generating awareness and incentivizing households for the same. The process would ensure complete containment of waste with no direct human contact with the waste under any circumstance.
- Increasing the funds for faecal sludge and septage management. This may through creating a dedicated fund for sanitation and FSSM, which would consolidate resources and funds from multiple sources – various central schemes and programs, state govt. grants under various schemes, ULB funds, etc.
- Ensuring “proper collection and disposa”l of the faecal sludge for “promoting proper functioning of faecal sludge and septage management systems”.

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- ❖ for non-potable applicationsPromoting recycle and reuse wherever possible after treatment of sewage.
- ❖ On-Site Sanitation facilities should be proper in design and construction.
- ❖ On the basis of issues faced in Dalhousie regarding the unsanitary conditions and disposal of faecal sludge management, 5 most problematic areas are identified where decentralized system can work efficiently:
- ✓ Upper and Lower Lohali
- ✓ Kathlag Village
- ✓ Balun
- ✓ Lower Bakrota
- ✓ Upper Bakrota

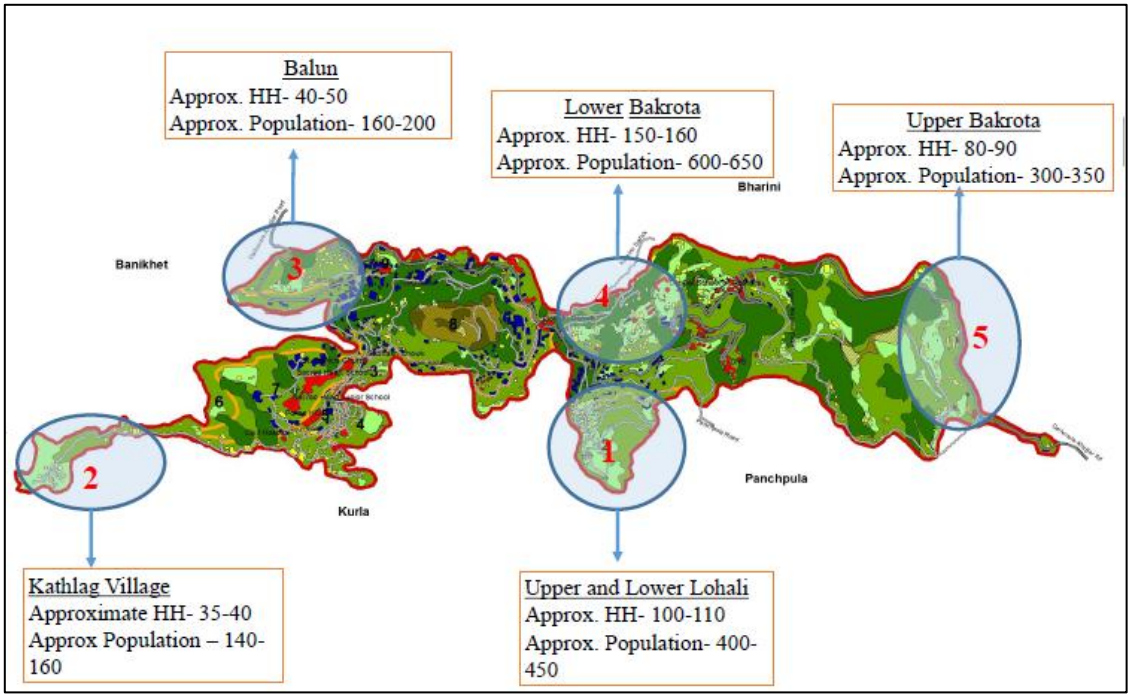

Figure 25. Identified five Priority areas of Dalhousie Town.

6. Proposals for safe evacuation and transportation of faecal sludge and septage

The proposal for evacuation and transportation in Dalhousie city is given using three different technologies. These technologies are proposed based on their technical feasibility and economic feasibility. These proposals are also based upon the terrain constraints.

Table no.2 Proposal for Evacuation and Transportation

Technology	Capacity (L)	Requirement	Cost (Rs)
VacuTug Mark I	200	1	2.2 Lac
MAPET System	500	2	3.75 Lac
Manual De-sludging Hand Pump	-	2	15000

Above table shows the technical feasibilities of all the technologies like MAPET system which is to be used in Kathlag village, VacuTugs for access roads and MDHP system for

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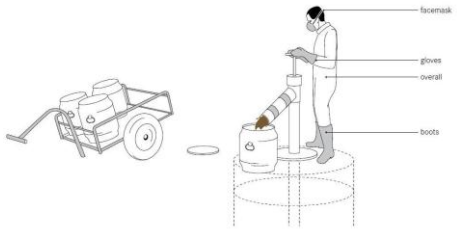
Lohali village. It also talks about economic feasibilities. Operation and maintenance of these technologies are also minimum. This will help in speedy cost recovery as well as generates employment as per the requirement.

Table no.3 Technical and Economic Feasibilities of Technologies

Technology Used	Technical Feasibility	Economic Viability and Cost Recovery	Man-Power Required	Concept
MAPET System (for Kathlag Village)	Overcomes the terrain constraint in areas like Kathlag Smaller in size and can reach narrow lanes with low sludge generation	Economically viable because 1 unit can cater tothe whole kathlag area.	3	 Figure 26. MAPET system [5]
VacuTug (for rest Dalhousie)	Feasible for de-sludging septic tanks along major roads Smaller width helps in easy manoeuvring and turning in hilly areas.	VacuTug can evacuate 500 Litre in one go, which will cater 80% of Dalhousie. The cost can be recovered easily using the proposed cost for desludging in 1 year	3	 Figure 27. VacuTug Machine [5]
MDHP (for Lohali Village)	Easy to carry and handle Feasible for areas like Lohali which is developed on stairs	Low operational and maintenance cost. Easy Cost recovery	2	 Figure 28. Working of MDHP[5]

On the basis of a public opinion survey, proposed cost for desludging is set in the range of Rs. 1000-1200 per visit. As it was observed that 58% of the people are willing to paying between 1000-1500 Rs per visit for the cleaning and emptying of septic tanks. Total cost for

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the equipment will be approximately 10 Lakh. It can be recovered over period of 2 years (excluding Operation and maintenance charges)

7. Proposal for treatment of faecal sludge and septage

7.1.Co-treatment of Faecal Sludge with Municipal Waste-Water in STP[6]

Working Principle	This is a "treatment of Faecal sludge and septage in Sewage Treatment Plant (STP)" with pre-treatment facilities for Faecal sludge.
Key features	Due to the similarity of the characteristics of the sewage and Faecal sludge co-treatment is considered option ▪ The two options for treating Faecal sludge in STP. It could be treated either as part of liquid stream or sludge handling stream ▪ Addition to either of the stream pre-treatment infrastructure in the STP and distribute the sludge into appropriated treatment unit in STP ▪ For addition to liquid stream in STP, Faecal sludge be added at multiple treatment points viz., screening, before primarytreatment (primary clarifier) or before secondary treatment (ASP) ▪ Faecal sludge addition to sludge stream may be made either at before sludge stabilization or dewatering stage. ▪ For co-treatment STP need to be equipped with Faecal receiving station, pre-treatment facilities and redistribution facilities in STP ▪ The influent quality requirements for the STP at both liquid and solids addition points must be met during the additions
Strengths	▪ Faecal sludge and sewage be treated at a single location minimizing the maintenance requirements ▪ No separate infrastructure required for Faecal sludge treatment with reduced capital cost
Challenges	▪ The Regulated flow to the STP needs to be engineered and changes

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	to this can affect the entire performance of the STP ▪ STP capability to handle Faecal sludge is governed by 1. quantity of Faecal sludge and 2. aeration capacity and solids handling the capacity of the plant ▪ The ability of the STP to co-treat Faecal sludge depends on STP type, design capacity and Faecal sludge pre-treatment facilities as Faecal sludge is 50 times higher strength than sewage

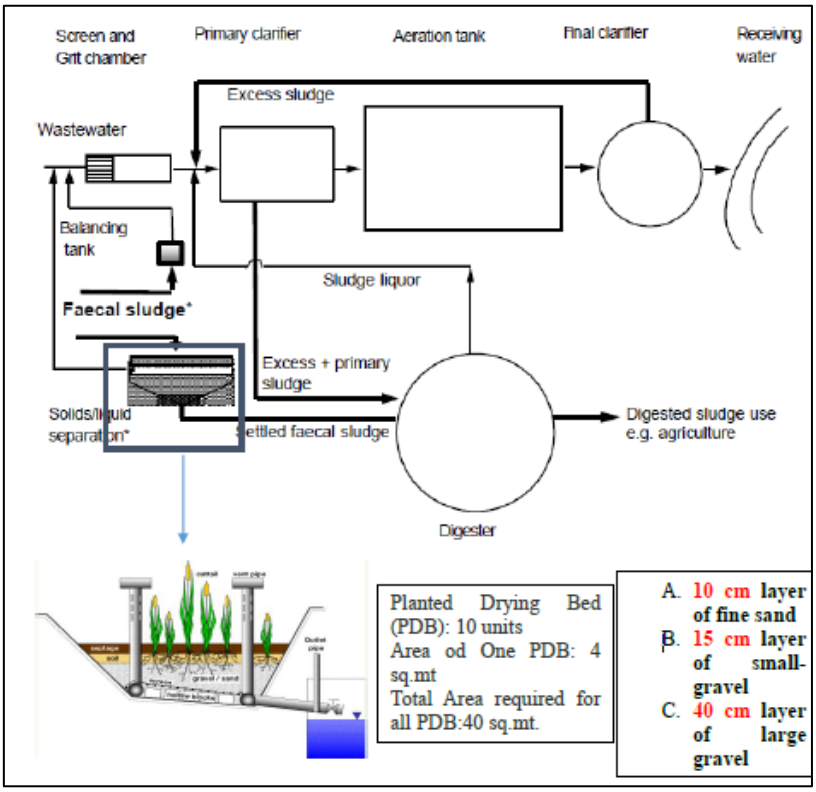

Figure 29. Co-treatment of Faecal Sludge and Wastewater (schematic)

7.2.For Kathlaj&Lohali: Planted sludge drying beds[6]

Planted sludge drying beds consist of a gravel/sand/soil filter planted with emergent plants, such as reeds, bulrushes or cattails. The applied sludge is dewatered by filtration and accumulates on the surface. The liquid fraction flows vertically through the filter media and is finally collected as percolate at the bottom (vertical flow).

The advantage of planted over unplanted sludge drying beds is that the root and rhizome system of the plants used in a constructed wetland (CW) creates a porous structure in the layer of accumulated solids, thus enabling to maintain the dewatering capacity of the filter for several years.

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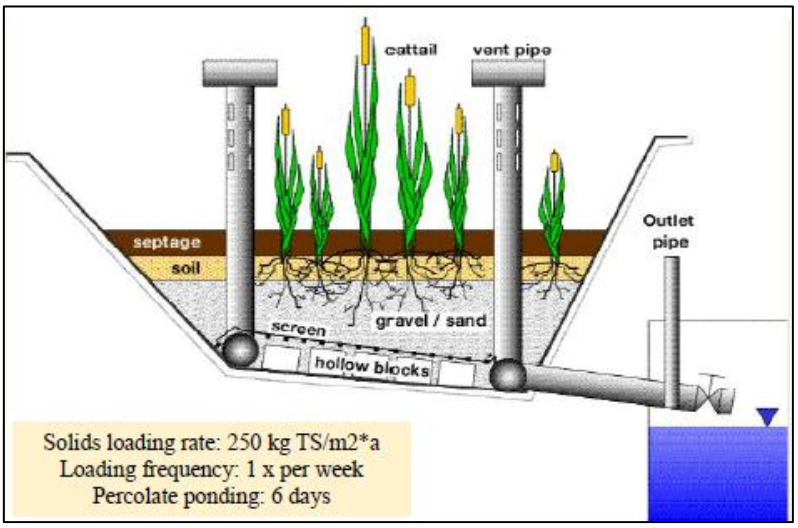

Figure 30. Planted sludge drying bed[6]

8. Conclusion

The issues related to sanitation is one of the major concern of urban India because with the Increase in Urbanisation it leads to pressure to the existing infrastructure of the Indian cities and town, FSSM is one of the major topic of debate nowadays as Govt. Of India also initiated several projects related to clean India such as Swachh Bharat, these project will only get success when holistic approach should be followed; FSSM is one such important task from that point of view. As Govt. Of India prescribed every states to work upon this issue, still several states have not initiated any of the measures related to it as also seen in the discussed case study of Dalhousie Himachal Pradesh. So it becomes important to get initiated from organisational level also and public level also, so that these issues can be solved in an appropriate manner. And for towns such as Dalhousie where settlement pattern and topography is the major constraint to perform such task The use of Co-treatment facility is most practical and can be adopted. It is most suitable and feasible in terms of economic feasibility as well. And also decentralisation of treatment and transportation technologies can be adopted with the incorporation of scientific innovations and research.

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