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Current Environmental Management Practices: A case study of unauthorized localities of Hisar city, India

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Abstract

This study is based on a visual inspection and questionnaire survey about water supply and sanitation pertaining to the status of environment management practices in different pre-identified localities of Hisar city, (Haryana) India. A total of 500 households from different localities were observed and interviewed regarding their perception about environment management practices at their household level. The main water source is ground water and its consumption in these areas is 60-100 litres per capita per day. One – fourth households living in unapproved localities were not connected to sewerage system for the disposal of wastewater and 65 percent households are using to pit latrine systems. Five percent households of surveyed area had no toilets facilities in their house. The public health department still using open channel for discharging domestic wastewater. People did not have idea about the potentials of the reuse of digested sludge. Private sanitation service providers of city sold the digested sludge to the farmers for agricultural use as manure, and they have no appropriate equipments for handling gas problem from pits. Almost half of the residents of the households dumped their household waste (HW) along the roadside whereas 56.4 percent collect it and do open burning. The problem in most of the government departments/organizations pertains to non availability of adequate funds for the treatment and disposal of wastewater and most of them do not have the future plan for wastewater management and sanitation facilities.

Key Words: Pit latrine, water consumption, unauthorized localities, sewerage network, Household Waste (HW)

Introduction

Hisar city (29^{o} 10’ N and 75^{o} 46’ E, 215.2 m above mean sea level) falls in a hot and semi-arid south western zone of Haryana State (India) and is an emerging educational and industrial centre. A number of residential localities have come up in the fringed area of the city in last two decades. These localities have planned street pattern but most of them are lacking basic civic amenities such as water supply, sewerage network etc. The authors have observed that these localities have emerged on agricultural land. Moreover, district records revealed that these are unauthorized localities and in recent past some of the localities have been approved by the government.

Environmental problems due to inadequate provision of urban liquid and solid waste management services in developing countries are a matter of concern for governmental agencies and scientists for over half-a-century now. Domestic wastewater may eventually pollute the precious water resources and cause environmental degradation unless properly collected, treated and safely disposed off. Since groundwater is the main source of water supply for the surveyed areas, on-site technologies are environmentally undesirable on long term basis for small households. Domestic wastewater management in Hisar city had been neglected for decades and no serious attempts have been made so far by the Public Health Department in Hisar city. The collected wastewater, without being subjected to any kind of treatment except natural ones, has been used by the local farmers to grow vegetables.

This study is concerned with knowledge about sanitation in the residents living in the surveyed areas and aims to examine the current environment management practices for unapproved localities around the Hisar city. The requirements for adequate sanitation system for sustainable society are given in table 1.

Table 1: Good requirement of sanitation system for sustainable society

Parameters	**Good requirement**
Disease prevention	Capable of destroying faecal pathogens.
Environment protection	Prevent pollution and conserve valuable water resources.
Nutrient recycling	Return nutrients to the soil.
Affordability	Affordable to poorest people of the worlds.
Acceptability	Aesthetically inoffensive, consistent with cultural and social values.
Simplicity	Easily maintained with the limited local technical capacity.

Source: Winblad et. al., 2004

Materials and Methods

Study Area and Survey

Twenty five pre-identified locations which are within and outside the municipality limits of city (Figure1) were selected for this study. The survey was conducted in three stages. The first stage of the survey was conducted to find out the water supply and sanitation conditions in terms of quality and quantity around the identified locations of the city among the general public. During this study 500 households were selected randomly. The second stage comprised of 20 different government organizations of city represented by municipality officer/public health officer and care takers of the organizations regarding water supply and sanitation system at organization level were studied. Fifteen private sanitation service providers of the city were also included in third survey regarding the sanitation system of the household and their problems. For the illiterate people, the questionnaires were filled by the researchers themselves. A simple visual examination of the surveyed areas and personal discussion with local people was also included as an optional environmental monitoring tool in addition to the collection of primary data using a questionnaire.

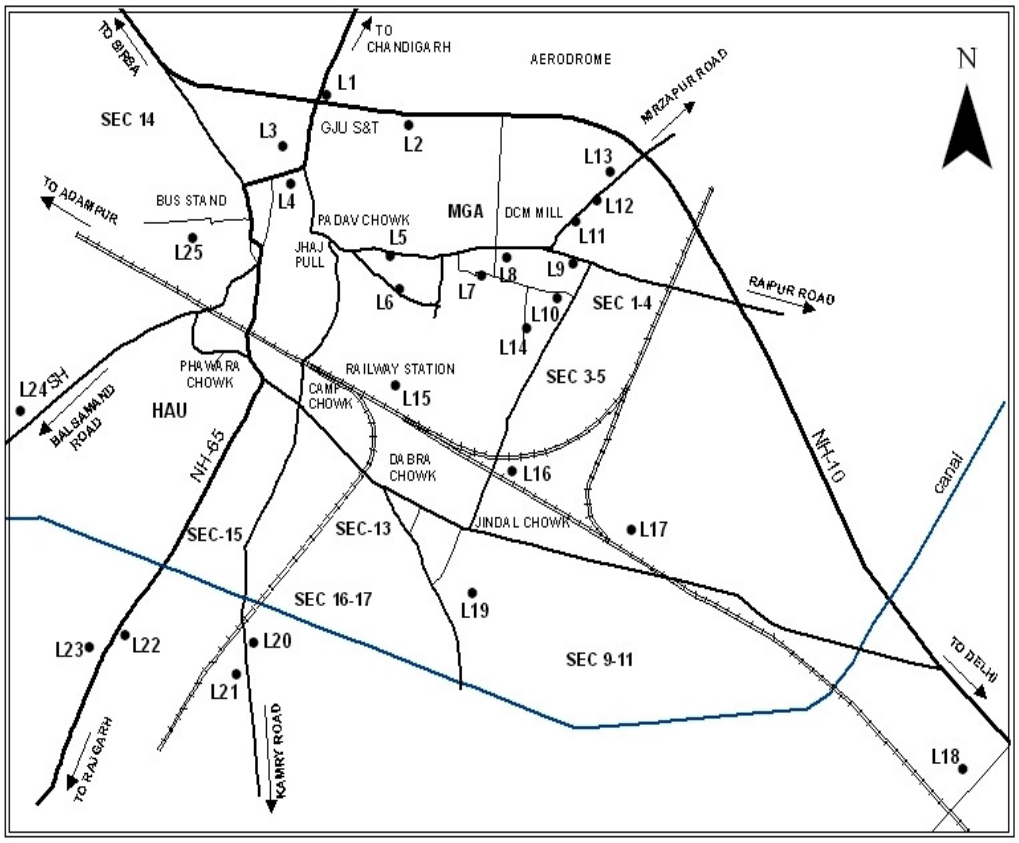

Figure 1 Location of different sampling sites

Questionnaire survey

The respondents were told about the good sanitation system first and then the responses were obtained and the data was collected after a random sample survey (RSS) with a questionnaire. The statements in first stage of the survey were as follows: (1) Size of the family and type of house. (2) Major sources of water. (3) Water consumption per house per day. (4) Discharge generated wastewater. (5) Sanitation facilities in your house. (6) Methods of cleaning of pit latrine. (7) Duration between emptying time. (8) Labour charges for cleaning of pit latrine. (9) Degree of satisfaction with the existing sewage sludge disposal method. (10) Household waste (HW) from the house.

For the second stage, the statements were: (1) Major sources of water supply. (2) Wastewater treatment facilities in the department or organization. (3) Wastewater management of department/organization. (4) Problems faced while handling the sewage sludge and its disposal. (5) Future plan for treatment of domestic wastewater.

The main statements for third stage of study include: (1) Average quantities of sewage sludge collected per household. (2) Household served per month. (3) Disposal of the collected sewage sludge. (4) Difficulties being faced in emptying and collected of sewage sludge.

Results and discussion

The literature available on low-cost sanitation for developing countries is not adequate to achieve desirable levels of sanitation for the commonly used on-site technologies. A proper wastewater collection system is a pre-requisite for consideration of the off-site wastewater disposal. While there is much information about off-site sewage treatment technologies, there are little published evidences on low cost schemes for sewage collection that may well suitable for smaller cities and towns.

Growth of Population

In 1901, the population of Hisar city was 17647 (Hisar District Gazetteers, 1915). During 1901 to 1961 the population increased by 97.2 percent (Census of India, 1961). The urban population has increased from 60222 in 1961 to 181255 in 1991 and it again increased to 263186 in 2001. The decadal growth rates of the population has been irregular, as it increased from 70.6 percent in 1961 to 53.59 percent in 1981 and 31.94 percent in 1991, which further increased to 45.2 % in 2001 (Census of India, 2001). If this decennial growth rate (45.2%) considered for projecting the population by 2031AD of Hisar city; keeping in view the various considerations i.e. increased industrial growth, rising standards of economic and educational activities, the estimated population can be approximately 15 Lacs by 2031AD as shown in figure 2. The urban growth leads to an increase in the pollution level and exposes population to serious environmental health hazards. According to survey, 62.8 percent people were living in the single family houses and 37.2 percent were in combined family houses were made of bricks and having permanent structures, the surveyed area was dominated by more than 7 members houses which occupied almost one-third of the population (33.6%) followed by the population (28.8%) of 5 member houses. Families with four members occupied as much as (17.4%), whereas six member houses in surveyed area covered (20.2%) of the total houses. The surveyed area has a literate population of 77 percent against a mere one-fourth illiterate of total population. The literate population consisted of 14.28 percent as post graduates, 16.10 percent were graduates, 55.9 percent were higher secondary and 15.84 percent were middle standard pass.

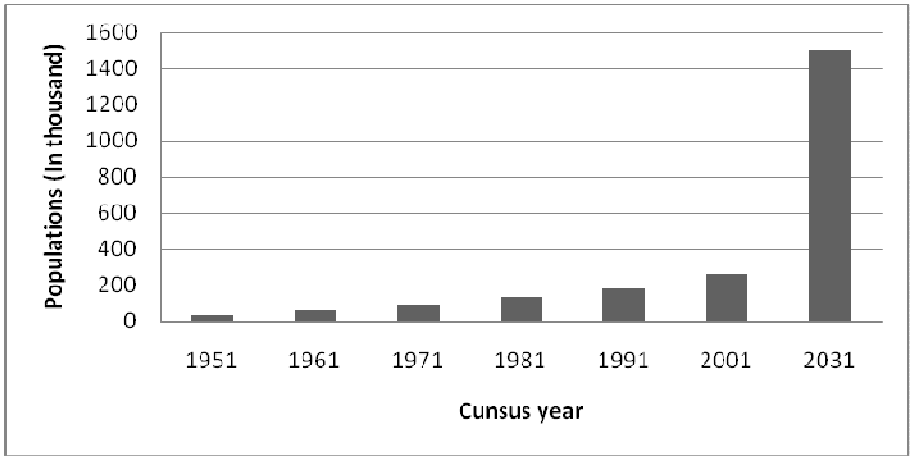

Figure 2 Future urbanization Trends in Hisar in 2031

Visual Monitoring

Each surveyed area was graded on a scale from 0 (lowest) up to 4 (excellent) for water supply and sanitation (Table 2). This scale is very similar to that presented by Fehr et al. (2004) for South American communities and also to that developed by Pradhan and Heinonen-Tanski (2010). The grades have been given to different localities on the basis of environmental condition with visual monitoring. The grades C was given to all pre-identified sites had the poorest sanitary conditions. Area in the vicinities of Guru Jambheshwar University of Science and Technology (GJUST) and Police Lines came under Grade B as shown in table 3.

Table 2: The study areas assessed by visual inspection

Study area	**Location**	**Drinking Water conditions**	**Sanitation conditions**
Police line	L_1	3	3
GJUST	L_2	3	3
Vikas Nagar	L_3	2	1
Auto Market	L_4	2	1
Dhani Sham Lal	L_5	2	1
12 Quater Area	L_6	1	1
Vinod Nagar	L_7	1	1
Shiv Nagar	L_8	1	1
New Jahwahar N	L_9	1	1
Tarshem Nagar	L_{10}	0	0
Viskarma Colony	L_{11}	0	0
Sree Nagar	L_{12}	0	0
Aman Nagar	L_{13}	0	0
Aadresh Nagar	L_{14}	0	0
Sant Nagar	L_{15}	0	0
Surya Nagar	L_{16}	1	0
Shiv Colony	L_{17}	0	0
Aadresh Colony	L_{18}	1	1
Model Town Ext.	L_{19}	1	0
Sham Enclave	L_{20}	0	0
Navdeep Colony	L_{21}	1	1
Azad Nagar	L_{23}	2	1
Shaket Colony	L_{22}	2	1
Chandan Nagar	L_{24}	0	0
New Rishi Nagar	L_{25}	1	0

The scale ranges from 0 to 4 (0 = very low, 1= low, 2= good, 3 = very good and 4 = excellent)

Table3: Grade for water supply and sanitation

Grade	For Water Supply	For Sanitation
A	Drinking water is available with very good quality water	All families have latrines and totally covered drainage system
B	Drinking water with some guarantee of its quality	Houses have flush and pit latrines and most are safe for the environment
C	Ground water available with unknown quality	Pit latrines, bad odor and signs of defecation along roadsides
D	No water supply	No sanitation

Water supplies System

The drinking water was a problem before the independence and continued even after it. The people used to draw water from 160 feet deep wells using ropes and buckets which were highly inconvenient. A moderate attempt was made by the municipality in 1950 to remove the problem by constructing of a tube well in Katra Ram Leela (local site) and added few more tube wells in subsequent years in different localities in central parts of the city. Water available from tube wells stored in public stand posts fixed in different parts had been the main source of drinking water (Census of India, 1961). To ensure clean drinking water a National Water Supply and Sanitation Programme was launched in 1954 and this scheme lasted till the formation of Haryana i.e. 1966. In 1969, the first waterworks was installed at Mahabir colony. Later, the water supply was augmented in 1977-78, the per capita supply was 91 liters per day and there were 370 public stand posts and 7,050 private water connections in the city (Haryana District Gazetteers Hisar, 1987). In surveyed area, now the main water resources are public water supply system, ground water taken via tube-well and hand pumps is shown in figure 3.

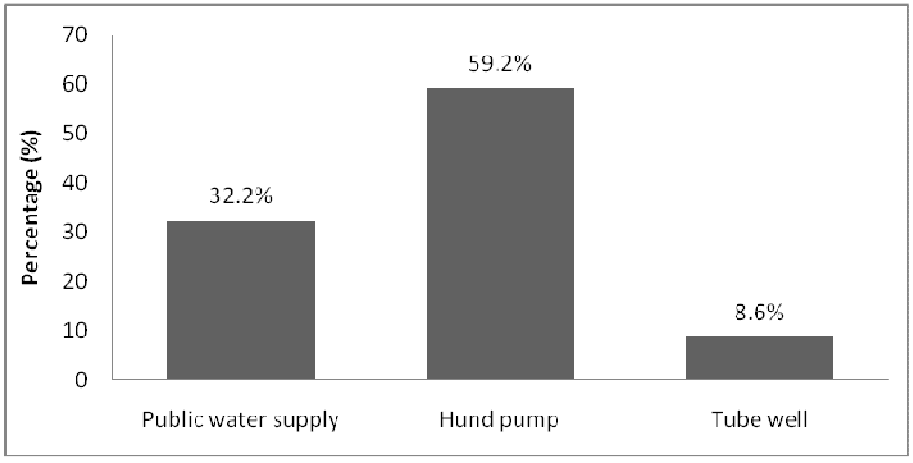

Figure 3 Sources of drinking water

According to survey, the water consumption in the study area was less than 500 (5.2%), 600-700 (64.4%), and less than 700 (30.4%) litres per day per household. The average per capita water consumption is approximately 100 l/d in the study area with a range of 60-100 L/capita/day depending on the season. Almost two-thirds households do not have water supply meters in their houses and only one-fourth

households are paying for drinking water in the study area. The level of the water tables is 40-60m in pre-identified locations of the study areas.

Wastewater Management

In city areas, the local bodies (Municipality) look after the removal and disposal of refuse, night soil and waste and cleanliness of the surroundings of the city. The underground sewerage has been commissioned in a central part of the city and the rest of the city is provided with surface drains before 1971. The construction of underground sewerage was undertaken in 1971. The residents are encouraged to have underground sewerage connection. By 1977-78, there were 1,654 private connections and 4 sets of public lavatories and are still under execution (Haryana District Gazetters Hisar, 1987).

It is estimated by the survey that about 75 percent of Hisar city population is served with sewage networks, and rest 25 percent population living in unapproved localities which have no connection of sewage disposal network so far. Black water containing feces is collected in pit latrines and sullage wastewater is generally discharged beside the street or open neighbouring plots in the study area. In the monsoon season, situation is further deteriorated due to mixing of sewage with rain water which flows on the street roads. In the surveyed area, about 65.6 percent of households have access to pit latrine systems, 27.8 percent have flush toilets connected to sewers, 1.6 percent have septic tanks and rest 5 percent are without any toilets facilities, People in houses without toilet facilities practiced open defecation, this may perhaps happen due to migration of labours from other places and old habits of the residents. Most of the pit latrines (84.6%) were constructed by the people from their own pocket and 15.4 percent are constructed by government scheme for Below Poverty Line (BPL) families. As per the discharge of wastewater is concerned from the different houses; 27.4 percent houses discharge their wastewater beside the house in open street channel; 41.8 percent in pits; 27.6 percent in sewers line and 3.2 percent use for gardening (shown in figure 4).

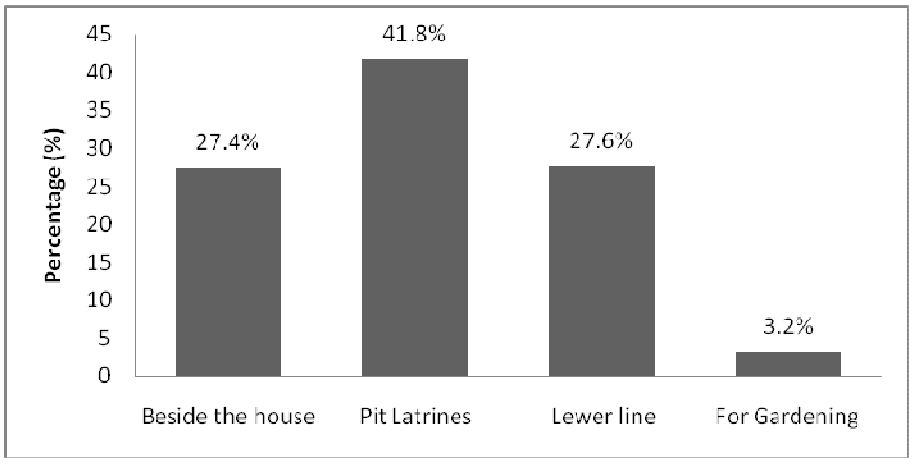

Figure 4 Discharge practices of domestic wastewater in Hisar city.

Sewage sludge Management

Since pit-latrines are an on-site treatment practices of sewage for long time in the city; most of the people using pit latrines in unapproved residential areas of city, and consists of one or two chambers each with a volume of about 2-4 cubic meters in general practice, depending upon the level of water table level. The pit latrines are built partially above ground level; the floor is built up to at least 25-50 cm above ground so that precipitation can not flood it. Pit latrines receive waste daily cumulatively as people use them for defecation and urination. This means, a slow accumulation of solids in the pit that requires periodic emptying (Mara, 1986). The settled solids accumulate at the bottom of the pit in the sludge bed. There is no liquid effluent outflow from these structures during use. The only outflow from these pits is the produced gas. The effluents (liquid or sludge) from these facilities are obtained only once during emptying of accumulated stabilized sludge. A portion of the sludge is left to act as an inoculum for the next cycle of use at emptying. In such systems, storage and digestion are combined together and part of the storage volume is always filled with seed sludge.

During the interviewed, it was revealed that 62.1 percent toilets were built more than three year ago; 22.6 percent were constructed between 2 to 3 years; 9.7 percent were built in between 1 to 2 years and 5.6 percent were constructed in less than one year's time. The time of emptying since pit latrine is in use, 57.4 percent responded not yet; 13.2 percent responded once; 18% percent responded twice and 17.6 percent responded more than thrice. The results reveal on the aspect of duration between emptying time of pit, 48.2 percent responded "once in 10 years"; 46.6 percent responded "once in five years" and 5.5 percent responded "I don't know", it might have owing to the new occupants of the house.

The vacuum machine (58%) has been using for pits cleaning; however, few respondents (13.6%) have also using manual methods. As far as price for cleaning is concerned, on an average it came out to be Rs. 500.00, through the amount is negotiable. In case of extent of satisfaction level regarding disposal methods, the meager number (12.6%) of respondents were found highly satisfied whereas majority of respondents (56.8%) were satisfied with the present system. However almost 1/5th respondents did not approve the ongoing methods and 10.4 percent were in the lot of highly dissatisfied respondents. The majority of respondents (65%) respondent, the municipality services is very poor whereas 23.5 percent respondents perceived it satisfactory. The level of satisfaction on higher side was found meager in case of municipality services.

Household Waste Management

According to the household survey, about 38.6 percent of the households dump their waste along the open roadside and 56.4 percent collect and burn the Household Waste (HW) at their own backyards. In addition, some households use alternative waste management techniques, with 5 percent segregating and composting their waste. The survey revealed that maximum households dispose of their waste along roads in open. When asked about the level of service provided by municipality, only 1.5 percent has responded it is very good; 10 percent have responded it is good; 23.5 percent have believed it is satisfactory and 65 percent have responded it is poor. Public surveys

revealed that the worst impacts of present solid waste disposal practices are related to social impacts such as odor, breeding of pests. Transport of the collected waste also appears to cause significant impact and caused odor while transporting the waste.

In surveyed area, HW collection varies from area to area within the city. In government organization, the daily collections of HW with the help of push carts and trailer-tractors shown in figure 5.

Figure 5 Current municipal solid waste management practice in Hisar city.

Whereas in some household areas HW is collected every day, in certain other areas waste is collected only about once in a week. But in unauthorized colonies, where accessibility is limited, solid waste collection is rather neglected. Often these householders dump their waste onto roadsides and neighbour open plot.

The results of second survey reveals that 60 percent government departments/organizations of city provided public water supply of cannel water to employees and 40 percent government departments/organizations said cannel water mixed with bore well water and then supply to their employee. In summer season it is common practice for water supply. When it comes to wastewater treatment system in the organization, 32 percent organizations agreed for the same while 68 percent claimed that they used septic tank for the same. The main problem in these departments/organizations to treat and disposal of wastewater are non availability of suitable treatment site (16%), Non availability of skilled workers (40%) and last but very important, non availability of suitable funds from the state and the central government. Regarding the future plans for wastewater management, 36% percent reported positive resonance but simultaneously 64 percent organizations do not have any specific plan in near feature. The Current sewage sludge management practice in Hisar city shown in figure 5.

Figure 5 Current sewage sludge management practice in Hisar city.

Third survey was conducted on15 different private sanitation service providers of the city regarding the sanitation system of the households. The results revealed that the average amount of sewage sludge collected per household 13.3 percent reported 2000litres; 26.7 percent reported 3000litres and 60 percent reported more than 3000litres. When asked about the numbers of household served per month, 6.7 percent said 14 household, 13.3 percent said 20 household; 26.3 percent said 25 household; and 53.3 percent said more than 25 household. When asked about the where you dispose off the collected sewage sludge; 25 percent said discharge on open Government land outside the city, if heavy order of cleaning pits and 75 percent sold to farmers as fertilizer in their fields, shown in figure 6.

Figure 6 Open dumping of sewage sludge on road side.

When asked about the problem in emptying and collection of sewage sludge, difficult to assess in Narrow Street (6.7%), gas problem (26.7%), Inappropriate equipments (53.3%) and skilled workers are not enough (13.3%). In this study, it was observed that many residents do not know the final disposal site of the collected sludge from their premises. They think "out of sight, out of mind". Most service provider said that, they are supposed to take out the liquid as well as sludge and transports it to places where it can be used as manure. They sell the digested sludge (manure) to the farmers for Rs.200.00/tanker having capacity 3000liters.

Conclusion

The knowledge about sanitation is associated with education level of the people. Sanitation problems in the city should be dealt with in an integrated manner; because even if an individual tries to improve the infrastructure within one's premises, still potential hazards could be imported from upstream or in neighbouring premises. The choice of suitable excreta disposal facility should as well look at seasonal and geographical distribution of diseases. Those seasons reflect the role of water as a transmission route of diseases and hence, avoiding contact between water and human waste by adequate provision of disposal facilities diminishes the problem.

In nut shell, it is evident from the study that people opted pit-latrines without understanding the pollution potentials to groundwater. However, they have a habit of building deep pits. People do not know enough about reuse potentials of digested sludge. Sewage sludge problems in the city are due to rapid population growth, pit flood risks, inadequate human and financial resources (poverty), cultural habits, and inaccessible settlements, serious lack of centralized data on sanitation of the city, no set places for sludge disposal, any sanitation policy and strong legislation. Disposal of sewage sludge facilities are not a priority of the departments/organizations. On the basis of the study results, the following recommendations are presented: Knowledgeable people should give health and educational campaigns for awareness. Guidance on proper way of handling the sludge should be developed. Improved pit-latrine technologies are important in order to reduce air pollution and reuse the sludge. Given the diversity nature of the city, application of different sewage sludge disposal systems needs to be given consideration. Subsidy must be given to all residents of the

city for construction of green toilets could assist in changing the current situation for better.

***Authors' contribution**:Er.* Jitender Pal, *(Assistant professor), Research scholar, contributed in experiment design and final editing of the manuscript; Dr.* Mukul S Bishnoi*, (Associate Professor), Supervisort, contributed in experiment design.*

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