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PUBLIC SPACES

OPEN DEFECATION ELIMINATION

SOLID WASTE MANAGEMENT

CLEANLINESS

Theme:

Swachh Bharat Mission

SHELTER

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FROM THE EDITOR–IN–CHIEF

On 2nd October 2014, Gandhi Jayanti day, the Government of India launched a pan-India campaign in the name of 'Swachh Bharat Abhiyan' or 'Swachh Bharat Mission' (SBM)both in rural as well as urban areas with the aim to eradicate open defecation by 2nd October 2019, the 150th birth anniversary of father of the nation Mahatma Gandhi. Besides the construction of household, public and community toilets, the Mission also aims at modern and scientific municipal solid waste management, eradication of manual scavenging, behavioural change and awareness regarding healthy-sanitation practices, capacity-augmentation of local bodies, and creating an enabling environment for private sector participation in Capex (capital expenditure) and Opex (operation and maintenance).

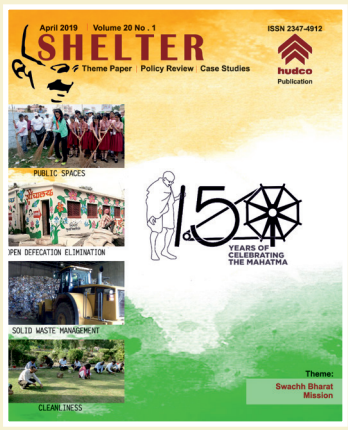
The success of the Mission is also expected to contribute to India achieving its international commitments in the form of the Sustainable Development Goals (SDGs) and the Habitat III New Urban Agenda (NUA). More particularly, the SDG6 aims at 'ensuring availability and sustainable management of water and sanitation for all' with the target that by 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open-defecation, paying special attention to the needs of women and girls and those in vulnerable situations. Further, Goal No. 12 of SDGs aims to 'ensure sustainable consumption and production patterns' and mandates that "by 2030, substantially reduce waste generation through Prevention, Reduction, Recycling and Reuse". The Habitat III 'New Urban Agenda (NUA)' also encourages member nations to commit themselves to promote adequate investments in protective, accessible and sustainable infrastructure and service provision systems for water, sanitation and hygiene, sewage, solid-waste management, urban drainage, reduction of air pollution and storm water management, in order to ensure universal and equitable access to safe and affordable drinking water for all, as well as access to adequate and equitable sanitation and hygiene for all; and end open-defecation, with special attention to the needs and safety of women and girls, and those in vulnerable situations.

After four and half years of its launch, the 'Swachh Bharat Mission' (SBM) has become a 'Jan Andolan' or 'people's movement'. Sustained efforts under SBM have yielded significant positive results. In the urban areas, as on 10th April 2019, 56.63 lakh individual toilets, 4.84 lakh community & public toilets have been constructed; 3558 cities have been declared open- defecation free; out of 84,358 wards, 75367(89%) now have 100% door-to-door waste collection; almost 88.4 megawatts (MW) of energy is generated from waste-to-energy (WTE) projects; and the waste-to-compost production stands at 15,06,501 metric tonnes. While all these are laudable achievements, much more needs to be done in order to make the motto of Swachh Bharat Mission 'Ek Kadam Swachhata ki Ore' (One step towards cleanliness) work. Effective urban governance, behavioural change, creating general awareness, involvement of civil society, NGOs and promoting PPP for fund raising are some of the critical challenges that need to be addressed for ensuring hygiene, waste management and sanitation across the nation.

The theme of this issue of 'Shelter' is 'Swachh Bharat Mission' (SBM), which aims to give wider coverage to the key issues involved for the further success of the Mission. The theme papers contributed by Akshaya Sen et al, A.K. Jain, Dakshayini Patil & Mamatha Raj, and Satpal Singh highlight progress, issues and challenges relating to different aspects of SBM such as Ecological Sanitation, Swachh Public Space, and Solid Waste Management. In the policy review section, articles by Mahavir Singh and Shalini Panigrahi review the policies related to urban flood and Right to Housing respectively. This volume also presents three case studies contributed by Vinita Yadav & Jyoti Ahlawat, Gopal Naik et al, and Abhilash Rawat & J. M. Vasudev on scientific management of solid waste and these efforts are worthy of emulation by other cities and towns. The efforts of Warangal Municipal Corporation presented in this volume have been recognized and selected for HUDCO award for Best Practices. This volume also contains a special article on Informalities of Formal Settlements in Guatemala by Joaquin Mario, who was one of our international participants under the MEA-ITEC Training Programme. The 'My Opinion' section contains my views on wide ranging issues relating to SBM and HUDCO's contribution towards this noble Mission.

The volume of Shelter presents a bouquet of thought-provoking articles, which are likely to sensitize all the urban stakeholders to make SWM truly a people's movement.

INSIDE



Theme

On 2nd October 2014, Gandhi Jayanti, the Government of India launched a pan-India campaign in the name of 'Swachh Bharat Mission' (SBM) with the aim to eradicate open defecation by 2nd October 2019. The 150th birth anniversary of father of the nation, Mahatma Gandhi, is being commemorated all over the nation and as a tribute to his ideals, India aspires to be a clean and green country. Besides the construction of household, public and community toilets, the Mission also aims at modern and scientific municipal solid waste management, eradication of manual scavenging, behavioural change and awareness regarding healthy-sanitation practices, capacity-augmentation of local bodies, and creating an enabling environment for private sector participation in Capex (capital expenditure) and Opex (operation and maintenance).

The theme of this issue of 'Shelter' is Swachh Bharat Mission'(SBM), which aims to give wider coverage to the key issues involved for the further success of the Mission. The success of the Mission apart from ensuring environmental hygiene, public health, ecological and cultural development, is also expected to contribute to India achieving its international commitments in the form of the Sustainable Development Goals (SDGs) and the Habitat III New Urban Agenda (NUA). More particularly, the SDG 6 aims at 'ensuring availability and sustainable management of water and sanitation for all' with the target that by 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open-defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

IN THE BOX

VARIOUS ACTIVITIES UNDERTAKEN BY HUDCO UNDER SWACHHTA ACTION PLAN

As part of Swachhta Action Plan (SAP), HUDCO has taken a number of steps to make the office space clean and green such as digitization of office records; steps towards making e-office with less use of papers; disposal of old files, vehicles, redundant computers/electrical/ electronic items; cleanliness and maintenance of all HUDCO office toilets on daily basis, waste collection & disposal linked to municipal waste collection Dhalaos; cleanliness and beautification of surrounding areas; organizing various Swachhta awareness activities, workshops, Pakhwada etc.

Recently, HUDCO had organized a Swachhta Mela in association with Aga Khan Foundation where awareness about using recycled products in place of plastics was raised among the participants. Further, as part of the 'Swachhata hi Seva' programme, various programmes such as Swachhta pledge by all HUDCO employees, Nukkad Natak, etc. were organized by HUDCO. All offices of HUDCO including Head Office, HSMI and Regional Offices were open on 16th September, 2018 for cleanliness drive around the respective office premises with the spirit to make each HUDCO office a "Zero-Waste Office". In addition, HUDCO also undertook tree plantation and cleanliness drive in the surrounding and nearby areas like Andrews Gunj, Aliganj, B.K. Dutt Colony, Nizzamuddin, Janpath, Nehru Park, etc.

Further, as part of Swachh Bharat Mission, Electronic Toilets with SHE accessories in 15 prominent locations of Hyderabad in GHMC limits was sanctioned CSR assistance of Rs 109.34 Lakh by HUDCO during 2017-18 to Greater Hyderabad Municipal Corporation (GHMC).

Swachhta Pakhwada at HUDCO during 1-15 February 2019

Dr. M. Ravi Kanth CMD, HUDCO inspecting the cleanliness in Office space

Installation of E toilets with SHE accessories in 15 locations in Greater Hyderabad Municipal Corporation (GHMC) limits, Hyderabad, Telangana State

CMD, HUDCO with officials on a Tree Plantation Drive in schools

SWACHH BHARAT MISSION

-ONE STEP TOWARDS CLEANLINESS

DR. AKSHAYA KUMAR SEN, MS. POOJA NANDY & MS. SANEERA DEV

In order to inculcate the spirit of Swachhta in everybody's life, at every place, and to bring behavioural change, the Government of India has been undertaking a number of initiatives, such as Star Rating Programme of Garbage-free cities, Swachh Survekshan, massive advertisements in print and electronic media, bringing in Swachhagrahis, programmes such as 'Swachhta Action Plan', etc.

Key Words: Sanitation, open defecation, SBM-Urban, SBM-Rural

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As a first step towards putting sanitation at the top of national agenda, the Government of India came up with its flagship programme Swachh Bharat Mission (SBM)– Clean India Mission- in both urban and rural areas on pan-India basis on 2nd October 2014. This paper analyses the progress of the Swachh Bharat Mission both in urban and rural areas, since inception. The paper also discusses the convergence amongst various flagship programmes of the Government of India and some of the unfinished agenda for making SBM sustainable.

"We must not tolerate the indignity of homes without toilets and public spaces littered with garbage. For ensuring hygiene, waste management and sanitation across the nation, a 'Swachh Bharat Mission' will be launched. This will be our tribute to Mahatma Gandhi on his 150th birth anniversary to be celebrated in the year 2019."

- Shri Pranab Mukherjee, Hon'ble former President of India in his address to the Joint Session of Parliament on 9th June 2014.

INTRODUCTION

Across the globe, sanitation needs are enormous. Improved sanitation facilities (facilities that separate human excreta from human contact) are used by less than two thirds of the world population. Developing countries lag behind developed countries, with only about half the population using improved sanitation. It is estimated that 2.6 billion people in the world do not have access to improved sanitation facilities, with high concentrations of these population in Southern Asia, Eastern Asia and Sub-Saharan Africa (WHO/UNICEF, 2010). Even though improvements have been made towards access to proper sanitation facilities, the progress has been rather slow owing to rapid population growth among the poorest sectors of society. In India too, the access to sanitation has remained a critical challenge. As per Census 2011, 7.90 million households in 4041 statutory towns did not have access to toilets leading to open defecation. Further, as per WHO/UNICEF (2013) Reports, the percentage of people residing in urban India with access to improved sanitation was 60% in 2011 and the same for rural areas was 24%, making the overall national figure of 35%. The open defecation was 60% in rural areas while 13% in urban India. It is well documented

that lack of proper sanitation has huge health cost as well as contributes to environmental degradation. Besides sanitation, huge solid waste generation and its scientific disposal is another concern area. As per CPCB (2016) estimates, the solid waste generation in India has increased significantly from 23.06 million tonnes per year in 1991 to 52 million tonnes per year in 2014.

THE INTERNATIONAL DIALOGUE

The issues of improved sanitation, elimination of open defecation and scientific management of solid waste have been in focus in many recent international discourses, be it United Nations Sustainable Development Goals (SDG), Habitat III New Urban Agenda (NUA), or the Paris Agreement on Climate Change. The 17 Sustainable Development Goals, also known as the global goals adopted by United Nations in September 2015, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The SDG 6 aims at 'ensuring availability and sustainable management of water and sanitation for all' with the target that by 2030, achieve access to safe and affordable drinking water for all, access to adequate and equitable sanitation and hygiene for all, and end open-defecation, paying special attention to the needs of women and girls and those in vulnerable situations. The SDG 6 also encourages countries to ensure support and strengthen the participation of local communities for improving water and sanitation management. Similarly, the target of SDG 11.6 is to reduce the adverse per capita environmental impact of cities, by paying special attention to air quality and municipal and other waste management, with indicator 11.6.1 being the proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated by cities. Further, SDG No. 12 aims to 'ensure sustainable consumption and production patterns' and mandates that "by 2030, substantially reduce waste generation through Prevention, Reduction, Recycling and Reuse".

The Habitat III New Urban Agenda (NUA), adopted in October 2016 in Quito, encourages member nations to commit themselves to promote adequate investments in protective, accessible and sustainable infrastructure and service provision systems for water, sanitation and hygiene, sewage, solid waste management, urban drainage, reduction of air pollution and storm water management, in order to improve safety in the event of water related disasters; improve health; ensure universal and equitable access to safe and affordable drinking water for all, as well as access to adequate and equitable sanitation and hygiene for all; and end open defecation, with special attention to the needs and safety of women and girls, and those in vulnerable situations. It also commits to promote environmentally sound waste management and to substantially minimise waste generation by 3Rs- reducing, reusing and recycling waste, minimising landfills and converting waste to energy. Under the Paris Agreement, Nationally Determined Commitments (NDCs) of many countries, include action on waste management to reduce greenhouse gas emissions.

INDIA RESPONSE – SWACHH BHARAT MISSION

Taking cognizance of the growing need for providing improved sanitation and solid waste management, as a first step towards putting sanitation at the top of national agenda, the Government of India came up with its flagship programme Swachh Bharat Mission (SBM)–Clean India Mission- in both urban and rural areas on pan-India basis on 2nd October 2014. The Swachh Bharat Mission (Urban), operated by the Ministry of Housing and Urban Affairs (MoHUA), Government of India, aims at making urban India free form open defecation,

by facilitating construction of 66.42 lakh individual household latrines (IHHL) and 5.08 lakh community & public toilets; and achieving 100% scientific management of municipal solid waste in all statutory towns in the country by October, 2019, the 150th birth anniversary of father of the nation, Mahatma Gandhi. It also envisages to: convert insanitary toilets to pour flush toilets; eradicate manual scavenging; generate awareness & bring about a behavioural change in people regarding healthy sanitation practices; strengthen urban local bodies (ULBs) to design, execute and operate systems; create an enabling environment for private sector participation in capital expenditure and Operation and Maintenance (O&M) costs.

The Swachh Bharat Mission (Gramin)-Rural, operated by the Ministry of Drinking Water and Sanitation (MoDWS), Government of India, aims at improving the levels of cleanliness in rural areas through Solid and Liquid Waste Management activities and making Gram Panchayats Open Defecation Free (ODF), clean and sanitised. 'Triggering' or 'Nudging' of Communities for Behaviour change leading to usage of toilets leading to an open defecation free environment shall be given priority.

PROGRESS OF SBM

SBM-Urban

Table 1: Physical Achievements vs. Target under SBM-Urban

Sl. No.	SBM-URBAN Components	Target (No. Lakh)	Achievement (No. Lakh)	Achievement (% of Target)
1	IHHL Construction	66.42	56.63	85.3
2	Community Toilet Seats and Public Toilet Seats	5.08	4.84	95.3
3	100% door-to-door collection and scientific management of municipal solid waste	0.84420	0.75367	89.8
4	ODF Cities (No.)	4041	3558	88.05
5	Waste-to-Energy Production (Mega Watts)	--	88.40	--
4	Waste-to-Compost Production (Metric Tonnes)	--	15.07	--

Source: SBM(Urban) Dashboards of MoHUA, GoI, accessed on 10th April 2019.

The financial and physical progress under SBM-Urban has been quite significant. The total cost for the SBM-Urban is estimated at Rs. 62,009 crore, of which Government of India's share is Rs. 14,623 crore. The balance funds is proposed to be generated through various other sources of fund such as: a) Private Sector Participation; b) Additional Resources from State Government/ULB; c) Beneficiary Share; d) User Charges; e) Land Leveraging; f) Innovative revenue streams; g) Swachh Bharat Kosh; h) Corporate Social Responsibility; i) Market Borrowing; and j) External Assistance. As against this targeted central share of Rs. 14623 crore, by April 2019, 100 % has been allocated and Rs. 5641 crore, amounting to 39 per cent, has been released. The physical achievement vs. target under various components of SBM-Urban is given in Table 1.

The Clean India Dashboard of MoHUA, GoI keeps track of the progress of the Mission components. As shown in Table 1, the progress has been very significant for all components. As against the targeted construction of 66.42 lakh individual household latrines (IHHL), 56.63 lakh (85%) IHHL have already been constructed by 10th April 2019. Similarly, out of 5.08 lakh target of community & public toilets, 4.84 lakh (95%) have been constructed. 88% of statutory towns are now open defecation free (ODF). Out of 84420 wards, 75367 wards (79%) now have 100% door-to-door waste collection and the Waste-to-Compost Production stands at 15,06,501 metric tonnes. All these figures indicate the magnitude of success of the Mission in 5th year of its implementation and the Mission is on right path to

fulfil its targets which would also contribute to India achieving its SDG commitments.

SBM-Rural

The performance under the SBM-Rural (Gramin) has been stupendous, as can be seen from Table 2. As per the Clean India Dashboard, accessed on 10th April 2019, more than 99% of the target for construction of 934.41 lakh individual household latrines (IHHL) has been achieved. 30 out of 35 States/UTs (86%) have been declared as open defecation free (ODF); 99% of the Gram Panchayats (2.47 lakh) are now ODF and around 86% villages (5.56 lakh) and districts (616) have declared themselves as ODF. Since its inception in October 2014, 500 million people have stopped defecating in the open, down from 550 million at the beginning of the programme to less than 50 million today.

These latest figures are also in line with the findings of the National Annual Rural Sanitation Survey (NARSS) 2018-19 Report, conducted by an Independent Verification Agency under the World Bank support project to the Swachh Bharat Mission Grameen (SBM-G). This survey found that 96.5% of the households in rural India who have access to a toilet use it. The survey has also re-confirmed the Open Defecation Free (ODF) status of 90.7% of villages which were previously declared and verified as ODF by various districts and states. Apart from IHHL, the survey also covered schools, anganwadis and public or community toilets in these villages.

VARIOUS SWACHHTA INITIATIVES UNDER SBM

In order to inculcate the spirit of Swachhta in everybody's life, at every place, and to bring behavioural change, the Government of India has been undertaking a number of initiatives, such as Star Rating Programme of Garbage-free cities, Swachh Survekshan, massive advertisements in print and electronic media, bringing in Swachhagrahis, programmes such as 'Swachhta Action Plan', 'Swachhata hi Seva', Swachhta Pakhwada, Seminars, Workshops, etc. These are briefly described below:

Star Rating of Garbage Free Cities. In order to incentivise the cities to take up solid waste management (SWM) in a scientific manner, the MoHUA, GoI has devised a 7-star rating system with multiple cleaning parameters for SWM, including source segregation, door-to-door collection, compliance by bulk waste generators, scientific land filling etc. all subsumed under a single metric.

As per the latest figures, out of 1295 ULBs considered under star rating system, 331 got 1-star rating, 908 received 2-star status, 53 got 3-star and 3 ULBs got 5-star rating. No ULB got 7-star rating.

'Swachh Survekshan' (Cleanliness Survey): The 'Swachh Survekshan' has been

Table 2: Physical Achievements vs. Target under SBM- Rural (Gramin)

Sl. No.	SBM:RURAL	Target (No. Lakh)	Achievement (No. Lakh)	Achievement (% of Target)
1	IHHL Construction	934.41	925.72	99.07
2	No. of ODF States/UTs	35	30	86
3	No. of ODF Districts (Self Declared)	712	616	86.51
4	No. of ODF Gram Panchayats	250000	247625	99
5	No. of ODF Villages	649481	556465	85.67

Source: SBM(Gramin) Dashboards of MoDWS, GoI, accessed on 10th April 2019.

used as an effective monitoring tool for measuring cleanliness in urban areas. Through the Swachh Survekshan guidebook, the cities get a self-assessment tool to help and rate themselves on their current status on the cleanliness. Four rounds of Swachh Survekshan (2016, 2017, 2018 & 2019) have been conducted by the MoHUA. As per the latest Swachh Survekshan 2019, Indore is the most clean city, followed by Ambikapur, Mysuru, Ujjain and New Delhi Municipal Council.

'Sankalp Se Siddhi' Campaign: The campaign envisages the emergence of a New India by 2022, the year of India's 75th anniversary of Independence, through a new kind of freedom movement. A portal www.newindia.in has been launched.

'Swachhta Action Plan: The Government of India has introduced 'Swachhta Action Plan' (SAP) which is very important in order to achieve the ultimate goal of cleanliness at all places, be it Government departments, Ministries, and other Institutions. SAP envisages that steps need to be taken to make the office space clean and green such as digitization of office records; steps towards making e-office with less use of papers; disposal of old files, vehicles, redundant computers/ electrical/electronic items; Swachhta awareness activities, workshops, Pakhwada, etc.

'Swachhta Hi Seva' Campaign: The campaign was launched with the aim to make cleanliness through multi-stakeholders 'Jan Andolan'. The campaign included the Sewa Diwas and Samagra Swachhata (over all cleanliness).

'Swachh Shauchalaya' Campaign: The campaign was focused on the behaviour change of citizens, especially public toilet users, towards proper usage of these toilets and aims to generate a sense of responsibility and ownership in ensuring that Public Toilets are treated in a similar manner as one's household toilets.

Source segregation campaign: Har Din Do Bin, i.e. Blue for dry waste and Green for wet waste, has been initiated to raise awareness among the households to segregate dry and wet waste at source, for proper disposal of wastes.

Swachhata app for citizen assistance. This app enables a citizen to post any civic related issues. Citizen can download the mobile application and use it to file complaints.

Multi-media campaign on Waste-to-Compost: 'Compost Banao, Compost Apnao' campaign has been started with the aim to encourage people to convert kitchen waste into compost for scientific disposal of solid waste. Government of India has been stepping up efforts to encourage conversion of biodegradable waste into compost, for use as fertilizer, and reduce the amount of waste going to landfill site.

City Compost Policy: To ensure effective utilization of municipal solid waste especially organic waste for more productive use, the Government of India approved the policy on promotion of city compost. It has a provision for Market Development Assistance (MDA) in the form of fixed amount of Rs.1500 per tonne of city compost, for scaling up production and consumption of the product.

Swachhagrahi – nameplate outside the house: The purpose of this initiative is to enforce the message of keeping one's house and surroundings clean amongst the residents of India and encourage the citizen to contribute towards cleanliness and green environment.

SBM CONVERGENCE WITH OTHER PROGRAMMES

The Swachh Bharat Mission is also designed to work in convergence with other

related flagship programmes being implemented by the Government of India in order to achieve its targets and objectives. For example, one of the mandated reforms (11th reform) under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) Programme is achieving Swachh Bharat Mission targets that pertains to Municipal Solid Waste Management, namely: elimination of open defecation; waste collection (100%); transportation of Waste (100%); and scientific Disposal of Waste (100%). Similarly, Smart Cities Mission (SCM) is another scheme under the MoHUA that has certain components pertaining to SBM agenda. The strategic components of area-based development in the Smart Cities Mission are city improvement (retrofitting), city renewal (redevelopment) and city extension (greenfield development) plus a pan-city initiative in which Smart Solutions are applied covering larger parts of the city which will help in achieving SBM objectives. Another flagship programme of the Government of India, HRIDAY which covers 12 cities, has the objective of implementation and enhancement of basic services delivery with focus on sanitation services like public conveniences, toilets, water taps, street lights with use of latest technologies in improving tourist facilities/ amenities.

UNFINISHED AGENDA

The progress of SBM in all its parameters and targets has been highly commendable so far. Nevertheless, maintaining the level of cleanliness sustainably over a long period of time is a critical challenge, given the population growth and rapid rate of urbanisation in India. Therefore, much more needs to be done in order to make the motto of Swachh Bharat Mission 'Ek Kadam Swachhata ki Ore' (One step towards cleanliness) a part of everybody's life, so as to make all places clean and green. Effective urban governance, behavioural changes, creating general awareness, involvement of civil society, NGOs and promoting PPP for fund raising are some of the critical challenges that need to be addressed for ensuring hygiene, waste management and sanitation across the nation. It has been reported that even though there are individual toilets, people are resorting to open defecation. Behavioural change through workshops and community engagements, as contained in SBM, is the key to sustain SBM projects and need to be imparted in a regular manner. Civil society and Urban Local Bodies will have to take more responsibilities for making SBM components achieve their targets and sustainably operate and maintain over a long period of time. Innovative financing mechanism including appropriate user charges, waste collection charges, land value charges, etc. need to be thought off to supplement the government finance and augment local finance for undertaking SBM projects.

CONCLUSION

Swachh Bharat Mission is a massive pan-India campaign to clean up urban and rural India which was launched in response to India's key challenges relating to sanitation and solid waste management. The response by all stakeholders including the citizens have been very encouraging but it needs to be inculcated in everybody's life through creating awareness and behavioural changes. If India becomes clean and green, it has the positive dividend in terms of employment generation particularly for informal sector people and overall economic growth. It is now everybody's responsibility to ensure the motto of Swachh Bharat Mission 'Ek Kadam Swachhata ki Ore' (one step towards cleanliness) works.

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SWACHHATA PAKHWADA BY HUDCO REGIONAL OFFICE - NCR

HUDCO has been undertaking various activities under the Swachhta Action Plan. As part of this programme, HUDCO Regional Office (NCR) organized Swachhata Pakhwada from 1st February to 15th February 2019. Regional Chief (NCR) administered the Pledge to all the employees. The employees were urged to keep their work-stations clean, work towards paperless e-office, disposal of old files, cleanliness and maintenance of toilets and target a "Zero-waste Office". An awareness programme on hygiene was also held on DOs and DONTs for house-keeping staff and HUDCO RO (NCR) officials. Hygiene kits were also distributed to the house-keeping staff of the office premises. HUDCO RO (NCR) also held an educative visit to the Manure Plant within the office premises where plant leaves, kitchen waste and wet waste is used to produce manure. Re-organisation of office furniture was taken up and unutilized, unserviceable items were disposed.

ECOLOGICAL SANITATION FOR HEALTHY AND HYGIENIC SETTLEMENTS

MR. A.K. JAIN

Conventional waterborne sewerage system have been unable to make a significant impact on the backlog of nearly half of the population. Even if sufficient investment could be made, so that conventional sanitation systems could be provided to people who lack access to adequate sanitation, the resulting sanitation systems would not be sustainable.

Keywords: Municipal Solid Waste, Swachh Bharat Mission, Technologies, Waste to Energy.

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Swachh Bharat Abhiyan can be a powerful mission in urban transformation and making human settlements cleaner, hygienic and environmentally sustainable. This requires some basic changes in the conventional practices of sanitation. The paper highlights various options to sanitation which are sustainable, ecological, healthy and hygienic. There is need to adopt sanitation practices which improve the socio-cultural and gender equity.

INTRODUCTION

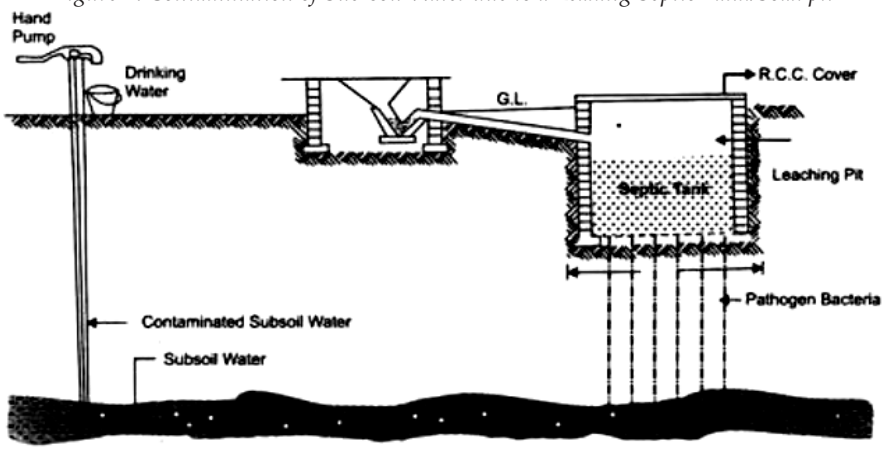
Sanitation and sewerage are the core elements of physical infrastructure that determine the environmental hygiene, public health, ecological and cultural development. The lack of sanitation reflects poor social, cultural and educational development. The situation is even worse for females, as 42 percent schools, markets and public buildings do not have toilets for them who face the problem of privacy and sexual violence. A United Nations (UN) report on sanitation says: ''Open defecation perpetuates the vicious cycle of disease and poverty and is an affront to personal dignity.'' Ingested bacteria and worms in the human faeces spread diseases, especially of the intestine, cause enteropathy and malnourishment. Open defecation is also linked to various other health problems such as stunted physical growth several water borne diseases, impaired cognitive function, and lowered IQ.

The Swachh Bharat Mission (Clean India Campaign) launched on 2nd October 2014, aims to achieve the vision of a 'Clean India' by October 2019. The Government of India along with State Governments have taken up various programs to make the urban and rural settlements open defecation free, clean and sanitary, with individual and public toilet facilities.

EXISTING SANITATION SYSTEMS

There are two basic types, *dry systems* (*pit toilets*) and *water-based systems* (*flush toilets*). The pit toilets have remained the principal means of excreta disposal in the areas with shortage of water and lack of municipal sewerage. However, these types of sanitation systems can be a threat to groundwater

Figure 1: Contamination of Sub-soil Water due to a Leaking Septic Tank/Soak pit



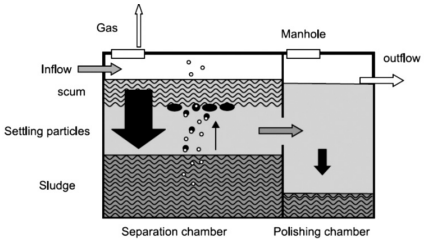
which is a major source of water for the population drinking and agricultural needs.

Septic Tank: The most popular on–site system is the age-old septic tank. The septic tank suffers from a number of problems, and periodically these have to be desludged. Because of spatial and financial constraints the septic effluent is allowed to flow into storm water drains or in open land. Another serious flaw is that if any crack occurs in the floor or wall of the tank then the hydraulic pressure inside leaks the liquid contents to the surrounding soil creating a no–flow situation in the tank which stops its functioning. The disposal of tank contents in insanitary manner contaminates subsoil water (Figure 1 & 2).

Single Pit Latrine: Single pit latrine consists of three main parts- the dug pit, the superstructure and the squatting pan. The liquids reach into the soil by way of the unlined pit while the solids are retained. The single pit contents endanger the health of the scavenger and final disposal of sludge is an environmental hazard.

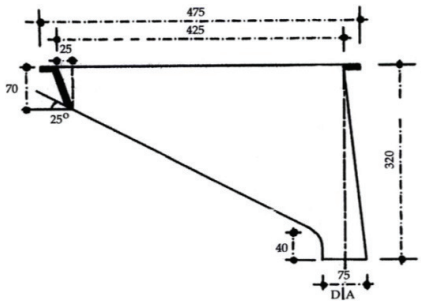
Two-Pit Latrine: The two–pit pour flush (TPPF) waterfall latrine provides an alternative and intermediate on–site sanitation system. It is comparatively easy to construct, operate and maintain, and is economical in quantity of water required. The pan has a steep bottom slope, a narrow neck and a waterfall trap set into the floor of the latrine make it amenable to complete flushing with only two litres of water. The junction box is connected through a pipe or drain to two–lined leaching pits (Figure 3 & 5).

Figure 2: Cross-section of a typical Septic Tank showing principle of sanitation



Borehole Latrine: A borehole latrine consists of a circular hole of 30-40 centimetre diameter and vertically dug into the ground to a depth of 4 to 8 metres. On the top of the hole, a reinforced cement concrete (RCC) slab with circular opening is placed (Figure 4).

Figure 3: Squatting pan and trap for pour flush toilet



Note: All measurements in millimetres

Figure 4: Borehole latrine

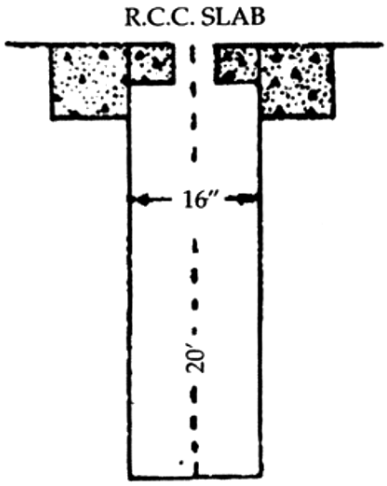
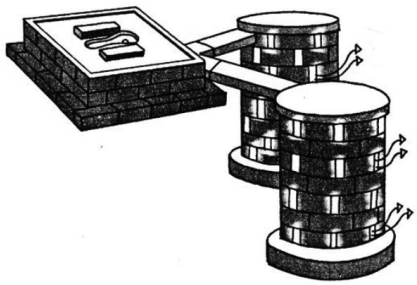


Figure 5: Double Pit-Brick Honeycomb



Source: UNICEF, 2007

SEWERAGE SYSTEM

Conventional waterborne sewerage system have been unable to make a significant impact on the backlog of nearly half of the population. Even if sufficient investment could be made, so that conventional sanitation systems could be provided to people who lack access to adequate sanitation, the resulting sanitation systems would not be sustainable. The idea of every family having access to a flush toilet would sharply increase drinking water consumption for flushing and lead to increased water pollution and health hazards. Problems to be addressed for sanitation include household motivation to invest in sanitation; household expectation from the system; and lack of awareness of hygienic risks and practices, which may arise or may pose severe health risks.

TOTAL SANITATION CAMPAIGN

The Government of India initiated Total Sanitation Campaign (TSC) in 1999, which was later named 'Nirmal Bharat Abhiyan' and now 'Swachh Bharat Abhiyan' (2014-19).

The backlog of toilets is linked with the sanitation and sewage facilities. In most cities, sewage lines do not cover all households, which usually exist only in the so-called planned colonies. Today the cities have expanded into surrounding peri-urban and rural areas, where underground drainage and sewerage infrastructure is absent. Putting up sewage lines in already-built, crowded, congested and haphazard urban areas is a difficult task. This challenge is compounded by the fact that even where sewage lines exist, they are broken, choked and are in a state of disrepair. Vast areas of city are without toilets, posing the problems of sanitation, hygiene, public health and ecological degradation. This poses a profound environmental, social and cultural challenge and implications thereof. Defecation is a private human activity and habits may largely differ between regions and cultures. In many cultures handling of excreta is subject to strong taboos related to aspects of human dignity. Knowledge and perception of the reuse of excreta largely varies between cultures and regions and sanitation practices differ.

NATIONAL URBAN SANITATION POLICY

The aim of the National Urban Sanitation Policy (NUSP 2008) was to transform urban India into community driven, totally sanitized, healthy, and liveable cities and towns.

The objective of public waste sanitation system is to ensure that sewage and sullage is properly discharged, collected, transported, treated to the required level of degree and finally disposed of without causing any health or environmental problems.

RECOMMENDED NORMS FOR SEWAGE AND ITS REUSE

As per Central Public & Environmental Engineering organization. (CPHEEO) manual, 80% of water supply may be expected to reach the sewers.It recommends designing the system by considering minimum wastewater flow of 100 litres per capita per day. As per the Manual of Sewerage and Sewage Treatment, the following provisions are to be followed:

a. Reuse of treated sewage should be taken up after discussions between ULB, water boards, Public Health Engineering Department PHEDs / Jal Nigams and the public, as the case may be, for possible reuse methods such as farm forestry, greenbelt development and lawns in road medians.

b. Utilization of sludge in public areas is not possible due to issues of public acceptance and hence it is best to focus on farm forestry.

c. Utilization of alternative energy, like energy harnessed from bio-methanation and to evaluate the ambient temperature suitability of sludge vs economics.

d. Reuse of treated sewage to a

Table 1: Recommended upper limits of treated Sewage quality for specified Reuse

S. No.	Parameter	Toilet Flushing	Fire Protection	Vehicle Exterior Washing	Non contact impoundments	Landscaping, Horticulture and Agriculture Crops which are eaten			
						Horticulture /Golf course	Non edible crops	Raw	Cooked
1	**Turbidity(NTU)**	<2	<2	<2	<2	<2	AA	<2	AA
2	**SS**	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
3	**TDS**	2100							
4	**pH**	6.5 to 8.3							
5	**Temperature(°C)**	Ambient							
6	**Oil and Grease**	10	Nil	Nil	Nil	10	10	Nil	Nil
7	**Minimum Residual Chlorine**	1	1	1	0.5	1	Nil	Nil	Nil
8	**Total Kjeldahl Nitrogen as N**	10	10	10	10	10	10	10	10
9	**BOD**	10	10	10	10	10	20	10	20
10	**COD**	AA	AA	AA	AA	AA	AA	AA	30
11	**Dissolved Phosphorous**	1	1	1	1	2	5	2	5
12	**Nitrate, Nitrogen as N**	10	10	10	5	10	10	10	10
13	**Faecal Coliform in 100ml**	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	**Helminthic Eggs/litre**	Nil	Nil	Nil	Nil	Nil	<1	<1	<1
15	**Colour**	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	**Odour**	Aseptic which means not septic and no foul odour							

Source: Manual on Sewerage and Sewage Treatment Systems, CPHEEO 2013.

minimum extent of 20% by volume shall be mandatorily explored and the proposed use for achieving this 20% target shall mandatorily form part of the Community Safety Partnership.

e. Utilization of sludge as a construction material (as porous pavement, bricks, etc.)

The recommended treated sewage quality, proposed to be reused, is given in the Table 1.

SEPTAGE DISPOSAL AND MANAGEMENT

For effective septage management plan, robust data on septage arrangements, their quantity and locations of its generation are required. It is advisable to divide the city into different sanitary zones (if not already done) and carry out the baseline surveys. The selection of zone could be based on availability of septage disposal sites – existing STPs could be potential septage disposal/ application sites. A two-step process is to be followed for selection of the treatment system:

i To determine the appropriate treatment option on the basis of size of town, land availability, proximity/ availability of existing sewage treatment plants and proximity to residential areas; and

ii To conduct a techno-economic feasibility to choose the most appropriate technology on the basis of capital, operations and maintenance costs.

The guidelines for selection of Septage Management Disposal System are summarized in Table 2.

DECENTRALISED SYSTEMS FOR SANITATION AND SEWERAGE

For remote areas, villages, townships, unauthorised colonies and suburbs which often lack the availability of municipal sewerage system, the decentralised sanitation systems

Table 2: Guidelines for selection of Septage Management and Disposal Systems

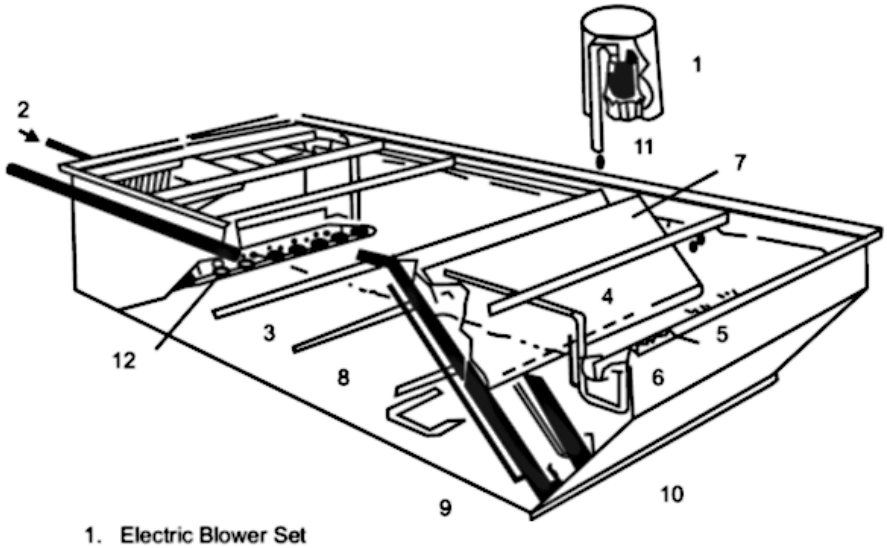
Town/Category	Conditions	Recommended Technologies	Capital Cost	O and M Cost	Management
Unserved Class-III, IV and V towns and rural communities	Remote land area available with suitable site and soil conditions	Sludge drying beds and waste stabilizing pond	Low	Low user fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract).
	Land available but close to settlement	Lime stabilization sludge drying beds and waste stabilization pond.	Low to Medium	Low to medium user fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)
	Inadequate land area with unsuitable site and soil condition, but available STP capacity within 20-30 km distance	Disposal at STP	Low to Medium	Low to medium user fees to recover O&M costs	Municipality.
Partially sewered medium size (Class-II towns)	Land area available with suitable site and soil condition but close to settlements	Lime stabilization sludge drying beds and waste stabilization pond.	Low to medium	Low to medium user fees to recover O&M costs	Municipality or private
	Inadequate land area, but available STP capacity	Disposal at STP	Medium	Medium user fees to recover O&M costs	Municipality or private
	Inadequate land area, no available STP capacity.	Disposal at independent mechanical treatment facility	High	High user fees to recover O&M costs	Municipality or private
Class I or Metro Cities	Available STP capacity	Disposal at STP	Medium	Medium, user fees to recover O&M costs	Municipality or private

Source: MOUD, Advisory Note – Septage Management in Urban India, MoUD 2012.

can be adopted. These include the following systems:

Extended Aeration Technique: The processing unit can be designed in the form of a compact, modular and a self-contained system. It can be installed independent of the overall city system and is suitable for sewerage needs of remote areas. The process is based upon the phenomenon of self-oxidation by the bacteria. When the bacterial cells reach their ageing stage, the consumption of organic matter is maximised. The bacterial cells draw their own oxygen for additional energy which they require. The process of self-oxidation leads to stabilization of sludge and purification of the effluents. A sequence of the treatment process, viz, screening, aeration, setting and thickening takes place within the package unit. Thus, open land can be saved from spill over of sullage and waste. The unit can be installed underground and the site can be landscaped from above. The package unit is attached with an adjacent motor to lift the sewage water to the inlet of the unit. Generally, the unit is buried and does not affect the appearance of the site where it is installed. Earthwork is usually started a

Figure 6: Extended Aeration Technique (Packaged Sanitary Unit)



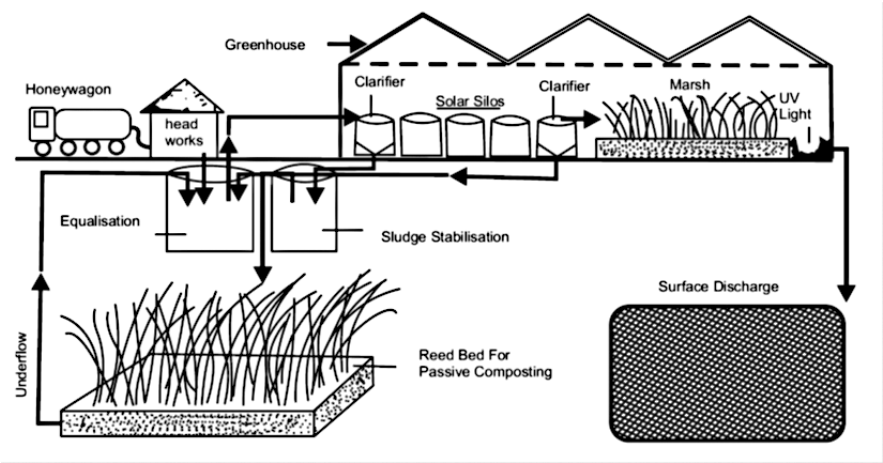
1. Electric Blower Set
2. Raw Water Inlet
3. Extended Aeration
4. Calcification
5. Treated Water Collection
6. Scum Collection
7. Baffle
8. Communication Port
9. Sludge Recirculation
10. Scum Pumping (Optional)
11. Air Feed
12. Air Diffuser

few days before delivery of the package unit so as to limit any risk of flooding (Figure 6).

Solar Aquatics Septage Treatment System: In this system, the effluent is discharged into a headworks from where it flows into an underground tank where the effluent is blended and preconditioned. Following equalization and preconditioning, effluent is pumped to a clarifier. From here sludge is pumped to the sludge stabilization tank where it is aerobically stabilized. It then flows to the reed bed for passive composting. Underflow from the reed bed is recycled by pumping it back into the equalization tank for further treatment. Liquid from the clarifier enters a series of solar silos that contain the plants and worms involved in the clean-up operation. Next, the liquid moves through a gravel-filled de-nitrifying marsh planted with grasses and is then sterilized with ultraviolet light before being discharged. Depending on total suspended solids limits, a sand filter may also be required at this point for final polishing before purified water is discharged (Figure 7).

Methanisation: Methanisation is a process of anaerobic biological treatment suitable for concentrated effluents. Methanisation is designed for treating effluents from industry and human settlements. Its advantages are small dimensions, low energy consumption (2 to 10 times less than conventional processes), low sludge production (3 times less than conventional processes), high BOD and COD treatment efficiency and production of a re-usable gas (heating, steam generation). Methanisation involves two main stages, each of which uses pacific bacteria, depending upon the nature of the effluent to be treated. These are suspended growth through contact and sludge blanket and attached growth through fixed bed and fluidized bed.

Figure 7: Solar Aquatic Septage Treatment System



Source: Ecological Engineering Associates, 13 Marcom Lane, Marion, MA, USA

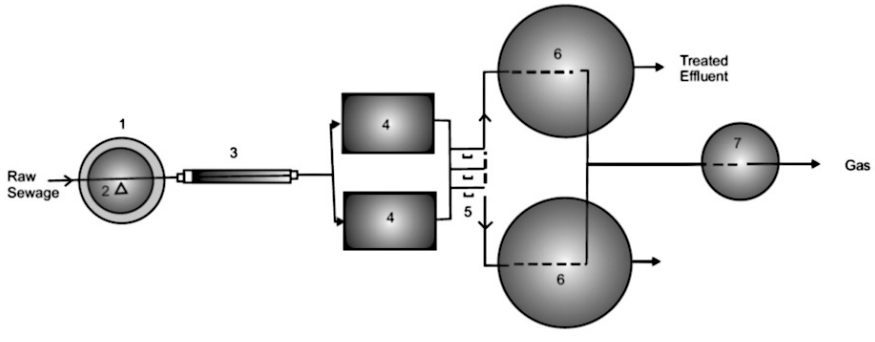
In Contact Suspended Growth, the contents of the digester are thoroughly mixed by stirring with effluent to be treated and recirculated, whereas in sludge blanket the effluent to be treated flows through a sludge blanket maintained at the bottom of the digester. The bacterial mass is attached to a solid support medium to obtain a higher concentration of active matter. The result is a more compact treatment unit. The volume obtained in relation to complete mixing can range from two times less with fixed bed and up to 10 times less with a fluidised bed.

In Fixed Bed, the effluent to be treated flows up through a filter medium on which the treatment bacteria develop; and in Fluidised Bed the effluent flows up through a mobile granular support medium kept in suspension and on which the treatment bacteria develop.

Fixed Film Reactor (FFR) Technology for Sewage Sludge Treatment: Based on National Environmental Engineering Research Institute's (NEERI) FFR technology, a demonstration project at Bhubaneshwar, an innovative system of sewage treatment cum- energy recovery has been developed (Figure 8). This technique has been in practice for several years and package plants are available for community sizes ranging from 10,000 population to over 250,000. The process provides cost effective alternative to the conventional aeration process.

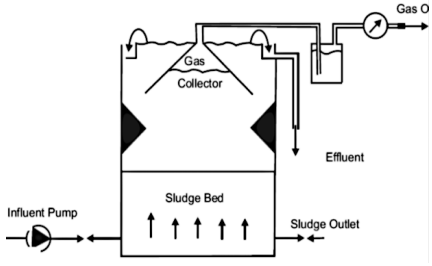
BIMA-Biogas Induced mixing Arrangement-Digesters: A commonly available version of UASB-Upflow anaerobic sludge blanket-(Figure 9) reactor is BIMA digester (Figure 10). The digester is divided into different functional compartments. By closing an automatic valve in the gas pipe between the two chambers, the gas produced is collected, which in turn displaces an equal amount of digested substrate into the upper chamber, building up a level difference and thus a gas pressure in the main chamber. When the required level difference is achieved, the gas pressure is suddenly released by opening the automatic valve in the gas connecting pipe. Thus, the substrate displaced into the upper chamber flows back to the main chamber with high velocity. On account of this reflux action and hydraulic design of the digester, fresh substrate, scum and sediments are remixed with the contents of the main chamber. The whole digester is completely automated.

Figure 8: Treatment and Biogas Recovery from Sewage, RRL Bhubaneshwar



1. Sump Well 2. Pumps 3. Screen & Grit Chamber 4. Holding Tank
5. Pumps 6. Fixed Film Reactor 7. Gas Holders

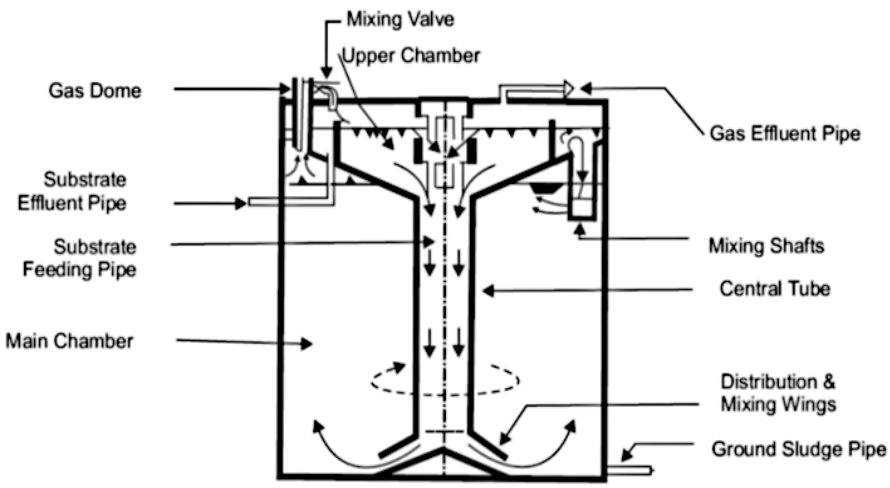
Figure 9: Upflow Anaerobic Sludge Blanket (UASB) Reactor System.



ECOLOGICAL SANITATION (ECOSAN)

"Ecological sanitation" or Ecosan works on the principle of separating the urine and faeces at source and putting both the urine and faeces back into the local nutrient cycle. The faeces drop straight down in a small storage chamber made of impervious materials. The urine goes to a tank. The faeces is stored and allowed to decompose by a process of aerobic digestion. Ash, or other organic absorbing

Figure 10: BIMA Digester



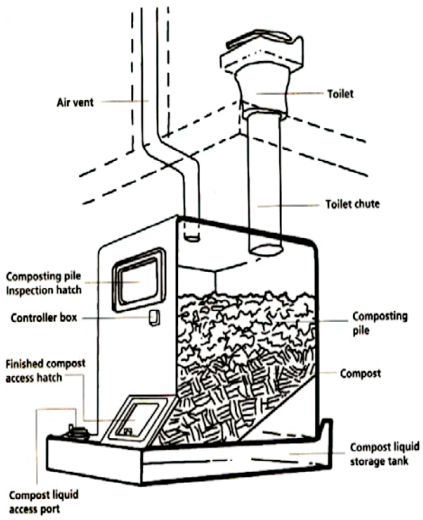
material like sawdust, is used to cover the faeces to aid in the drying out process. Time allows heat, given off by decomposition and normal soil bacteria to kill all the disease carrying organisms. Within six months the faeces is reduced to humus. Through the separate, undiluted collection of urine, the water demand for flushing toilets is significantly reduced. This not only saves water, but also the load of substances and nutrients from the urine on the water treatment facilities is reduced.

Ecosan systems have the overriding aim of improving public health and hygiene. However, the basic premise of ecosan of closing the nutrient loop between sanitation and agriculture, means that designers of ecosan systems must consider a much wider range of factors than those of conventional systems. This also leads to the soil conservation, increased long-term food security, and the sustainable use of resources in the form of nutrients, organics, water and energy. As ecosan aims to solve sanitation problems and ensure reuse at the lowest possible level, promoters of these systems also have to consider the active engagement of the local community and private sector, contributing to job creation and poverty reduction.

Modern ecosan toilets are already in use, the' 'Clivus Multrum Composting Toilet' is one of the most popular model (Figure 11). The Clivus Multrum is a single vault–composting toilet where urine, faeces and organic household wastes are combined and processed together. The model is available as a unit and consists of three main components—a composting vault with a slanting floor, air conduits and a liquid storage tank.

Dr. Vinod Tare[1] has developed an innovative toilet design for the segregation and recycling of human excreta and urine. When these toilets are flushed, the vortex movement of water cleans the pan surface and pushes the solid waste downwards into a tank at the centre.

Figure 11: Clivus Multrum Composting Toilet



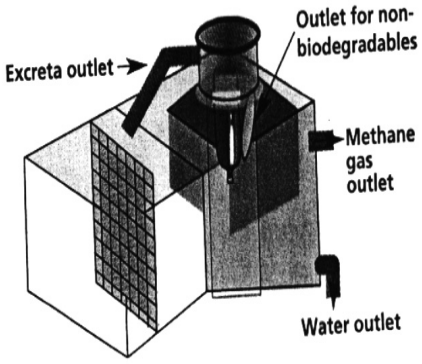
Source: New Age Approach, Down to Earth, February 28, 2002.

While the centrifugal force—acting outwards from a centre of rotation—presses water to the surface of the pan, the geometric design of the surface moves it through a circular path downwards towards the separator. At the separator, the water is guided into pipes in the sides that take it to another tank. The water is re–used for flushing the toilet, rather than discharging it along with the excreta. The

[1]Dr.V inod Tare is a scientist and Professor at IIT Kanpur with expertise and research interests in natural resource conservation and management; Biological nad ecological processes and water and waste water treatments.

eco–sanitation principles can be adopted for designing toilets for railways (Figure 12).

Figure 12: A Bio-digester Toilet for Railways Designed by DRDO



GREEN TOILETS

New generation green toilets remove water from human waste and vaporize it using a hand-operated vacuum pump turning the remaining solids into fuel fertilizer. A self-contained toilet disinfects liquid waste and turns solid waste into fuel or electricity.

Figure 13: An E-toilet

A **solar toilet** uses concentrated sunlight to disinfect liquid-solid waste and produce biological charcoal that can be used as replacement for wood charcoal or chemical fertilizers. These next-generation toilets won the ''*Reinvent the Toilet*'' challenge which was floated by Bill Gates. They are automatic and convert human waste to biological charcoal, mineral, clean water and even electricity.

India's first electronic portable public toilet uses GPRS controls and needs less than 40 sqft of space. Developed by Thiruvananthapuram based Eram Scientific Solutions Ltd, it is being widely used in Kerala and is akin to e-toilets in developed countries (Figure 13). Commercial production started in 2010 which have been installed under the aegis of various local bodies and various cities such as Noida, Delhi, Mumbai, Ahmedabad, Chennai and Bengaluru. The toilet infrastructure is connected through GPRS that connects all toilet units via web and mobile, making their use easier for the public and tourists. Built with stainless steel/fibre to withstand corrosion the closet is doused with 100 ml of water, post usage. If the usage is for less than three minutes, the system flushes with 1.5 litres of water. It also uses a bio-membrane reactor for its sewage treatment plant which uses nanotechnology to recycle used water. Solar panels generate electricity, while SMS alerts inform the control room about the status of the water tank and bio-gas plant. Modular and trendy, the e-toilet has revolving ad panels making it lucrative.

Vacuum Technology and Waterless Urinals

The Vacuum toilets originally designed for ships and airplanes are now being adapted for buildings also, where the faeces and urine mixture is dried by electric fans and then burnt. Buildings equipped with vacuum toilets and urinals are connected to the central vacuum pumping station in the basement. Blackwater from toilets and urinals is discharged to the communal sewerage system or processed by an on–site anaerobic treatment.

Grey water from hand washing, cleaning and kitchens can be collected in a separate gravity pipe system. It is treated using compact activate sludge reactors, membrane filtration and UV light. The treated greywater is used for toilet flushing and for cleaning.

PEEPOO – A SANITARY REVOLUTION

The PEEPOO story started with Anders Wilhelmson, a professor of architecture at the Royal Institute of Technology at Stockholm, who discovered that 40 percent of world's population

lack access to toilet. The result of his research was Peepoo, a bio-degradable, single use toilet in the form of a thin bag with an ammonia-based powder at the bottom. The producer, Peepoople, is now distributing it via schools and web retailers, 'micro entrepreneurs', in slum areas, but also via aid organisations to disaster areas and refugee camps in Africa and elsewhere. Peepoople has realised that besides basic hygienic needs, it is also vital to respect people's privacy, particularly that of women.

VACUUM SEWERAGE SYSTEMS

Vacuum sewerage systems developed by Subhash Deshpande, use an air stream generated by differential air pressure to drive the wastewater/sewage towards a vacuum station. In contrast to conventional gravity systems, the pressure within the system is maintained below atmospheric pressure (negative pressure). Vacuum sewerage systems have three elements, Collection chambers in each house/ building; Vacuum sewer lines; and Central vacuum station. Vacuum technology is based on differential air pressure. These sewers can be laid in flat terrain and up to certain limits may also be counter–sloped. Once sewage arrives in the vacuum storage tank at the vacuum station, it is pumped to the discharge point, which could be a gravity sewer or the treatment station directly. Discharge of Effluent in a Vacuum System takes place via a Collection Sump with an Interface Valve (Figure 14).

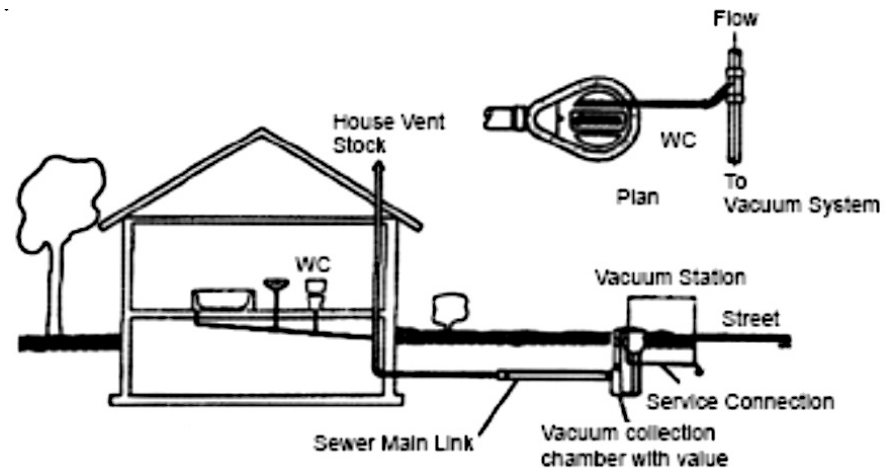
SUSTAINABILITY ASSESSMENT

The criteria for the assessment of the sustainability of sanitation systems can be grouped into five main categories: health, environment, economy, socio–culture, and the technical. The protection of human health is the main aim of providing sanitation. The technical function of the system is also an important criteria for sustainable operation. The criteria can provide a checklist to assist the planners, decision makers and other stakeholders to identify specific sustainability indicators for a suitable sanitation system.

Health: The sanitary system should minimize risks and safeguard public health by (i) reducing exposure to pathogens and risk of infection related to all system elements including collection, treatment reuse and final destination of products/ wastes; (ii) eliminating exposure to hazardous substance: heavy metals, medical residues, organic compounds; and (iii) the Health benefits accrue due to improved hygiene, food production, nutrition status and livelihoods.

Environmental: The sanitation systems aim to protect the environment against possible detrimental effects of the discharge. When considering the environmental sustainability, both emissions to different recipients (water, soil, and air), as well as resources used by different sanitation systems during the construction and operation phase must be accounted for. Moreover, it is important to consider the

Figure 14 Schematic Vacuum Sewerage Technology



Source: Subhash Deshpande, (2006) Vacuum Sewerage Systems, IPT Journal (p.32-45) January–February 2006

suitability of the treated product for possible reuse in agriculture or aquaculture.

Economy: The ability to pay for sanitation is a decisive factor in choosing the system. Among the users, the ability to pay is an important criterion for sustainability. However, in the end it may be their willingness to pay that will define within what range the costs (both for construction and O&M) can vary and services be sustained by the population

SOCIO-CULTURAL ASPECTS

The objective of sanitation is to improve socio-cultural, liveability and sustainability aspects. The system should be able to meet the cultural acceptance, institutional requirements, and perceptions of users. It is important to recognize that the prime driver for sanitation might be security, status, convenience (comfort, personal security, smell, noise, attractiveness, adaptability to different age, gender, and income groups) and appropriateness to cultural context.

WOMEN AND SANITATION

Women suffer disproportionately from inadequate sanitation facilities and face the risk of physical abuse. Public lavatories are few and far apart, besides being dirty and dark. The health and other risks associated with poor sanitation facilities are considerable for women in low-income areas. Therefore, appropriate financial system may be adopted keeping in view the reality that the tariffs do not cover the full cost of services, and poor women find it difficult to pay connection fees upfront, and also monthly bills. Physical and technical barriers should be overcome in extending sewerage networks into informal and unplanned settlements with guidelines for design, construction, operation and maintenance of the LCS programme. The technical reliability and performance of the system is the key to its success and ultimately its sustainability. The requirements of sustainability according to the context and time should be the basis of the planning process.

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EMERGING CHALLENGES IN MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA

DR. SATPAL SINGH

India has witnessed substantial growth both in production and consumption of plastic. In absence of appropriate waste collection and segregation processes, the plastic waste management has become a challenging task. About 25,000 tonnes of plastic waste is generated every year in India, of which 60 percent is recycled.

Keywords: Segregation of waste, Door to Door waste collection, Scientific disposal of waste, Recycled products, Landfill sites.

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Municipal Solid Waste Management (MSWM) in India has emerged as one of the greatest development challenges not only because of environmental and aesthetic concerns but also due to huge quantities generated annually. Cities across the country are struggling to deal with increasing volume of waste. Ensuring universal waste collection is still a big challenge for Urban Local Bodies (ULBs). Besides, segregation of waste at source, door to door collection, technologies for waste treatment, land resources and scientific disposal methods are some other major challenges. Segregation of waste at source is almost absent, although, door to door waste collection is improving in a few Indian cities and towns. In the absence of source segregation, the quality of recycled products is generally poor. It is a crucial matter that there is no specific regulation for the segregation and utilization of waste in India. Acknowledging the magnitude of the above mentioned challenges, the paper provides a comprehensive review of MSWM in India, discussing the government's policies and programmes to overcome the identified challenges as well as suggesting possible solutions.

INTRODUCTION

Ensuring sustainable MSWM has emerged as a major challenge not only because of the health and environmental concerns but also due to huge quantities of waste generated. Ensuring universal waste collection is still a big challenge for ULBs. It is to be noted that urbanization, industrialization and economic growth influence consumption rates that accelerate waste generation and change waste composition. The increasing trends in per capita waste generation puts immense pressure on ULBs who are mandated to provide this service in India. As a result, most ULBs are not capable in handling huge quantities of solid waste due to financial and institutional debilities. Moreover, they rarely have sufficient funds, resources, infrastructure and appropriate strategies which have resulted in poor collection, transportation, treatment and safe disposal of solid waste.

It is observed from the research documents that the segregation of waste, door to door collection, technologies for waste treatment, land resources and scientific disposal methods are some of

the key challenges. Segregation of waste at door steps is rare, although, door to door waste collection is improving in some Indian cities. Recycling of waste is mostly done by informal sector. It is a crucial matter that there is no specific regulation for the segregation and utilization of waste in India. Another significant challenge is to deal with corruption and lack of commitment in the solid waste transport sector. Moreover, finding new landfill sites is a major constraint in view of the 'not in my backyard' (NIMBY) phenomenon. This attitude of the people has made the task of waste storage difficult for ULBs. It is important to note that more than three-fourths of the municipal budget on MSWM is allocated for collection and transportation, which leaves very little for processing/ resource recovery and disposal (Ahluwalia, 2016).

Recognizing these challenges, the present paper provides a comprehensive review of the MSWM system in India and discusses the government's policies and programmes to overcome the identified challenges as well as suggesting measures for possible solutions.

REVIEW OF CURRENT MSWM IN INDIAN CITIES

MSWM includes managing activities associated with waste generation, collection, transportation, treatment and disposal with in an environmentally compatible manner. These activities of MSWM are briefly discussed below.

MSWM generation and composition: As per the Planning Commission Report entitled 'Task Force on Waste to Energy' (2014), India generates 62 million tonnes of waste annually, out of which 5.6 million tonnes is plastic waste, 0.17 million tonnes is biomedical waste, hazardous waste generation is 7.90 million tonnes per annum and 15 lakh tonne is e-waste. Whereas the waste generation is 1,43,449 metric tonnes per day with an average waste generation of 0.11 kg/capita/day as per the Central Pollution Control Board, (2015). It does not include waste picked up by Kabadiwalas from households and from the streets by rag pickers. The per capita waste generation in India ranges from 200 grams to 600 grams per day depending on the size of the city. The increase in waste quantities has been estimated at 5 percent per capita. The MSW generated in urban India is estimated to be 2,76,342 tonnes per day by 2021, 4,50,132 tonnes by 2030 and 11,95,000 tonnes per day by 2050. The estimations are based on an average per capita waste generation of 450 grams per person per day. However, there is conflicting data about the actual quantum of waste generation in urban India because there is no system of periodically collecting data on waste generation.

The composition of MSW includes different types of solid waste such as bio-degradable waste (food and kitchen waste, green waste-vegetables, flowers, leaves, fruits, paper, etc.), non-biodegradable waste, inert waste (construction and demolition waste (C&D), dirt, debris, etc.) and recyclable waste (plastic, paper, bottles, glasses, etc.). According to the report of the Planning Commission Report (2014), MSW constitutes 51 percent of bio-degradable waste, followed by the inert and non-degradable waste at 32 percent. Plastic, paper and glass constitute 17 percent of waste which are classified as recyclable wastes. It is observed that more than 50 percent of waste collected can be converted into compost and gas. Inorganic waste can be converted into energy.

India has witnessed substantial growth both in production and consumption of plastic. In absence of appropriate waste collection and segregation processes, the plastic waste management has become a challenging task. About 25,000 tonnes of plastic waste is generated every year in India, of which 60 percent is recycled. Management of plastic waste found in MSW is most critical sector because of continuous

increase in the share of plastic in MSW, its non-biodegradability and direct harmful effect to society.

In India, many states have banned fully or partial use of plastic carry bags, such as Andhra Pradesh, Assam, Chandigarh, Chhattisgarh, Goa, Gujarat, Jammu and Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Odisha, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal (CPCB, 2015-16). Several states have implemented further bans, such as Delhi NCR (National Green Tribunal's ban on disposable plastic), Maharashtra and Himachal Pradesh (government's ban on all single-use plastic) and Sikkim (first state to ban plastic bottles and disposable foam products).

Waste collection, transfer stations and transport: Waste collection, storage and transport are essential element of MSW and can be major challenges in Indian cities. According to the Ministry of Environment, Forest and Climate Change, about 75-80 percent of the municipal waste gets collected and only 22-28 percent of this waste is processed and treated. The collection efficiency of MSW in cities and towns is low due to non-uniformity in the collection system. Nearly 100 percent waste collection is observed in only those areas where the private contractors and NGOs are engaged in the waste collection activity. The uncollected waste often lies outside the designated bins in most of the urban areas due to inappropriate design, capacity, location and poor attitude of the community towards using bins. The mixed waste is being dumped in low-lying areas in and around towns. It is to be noted that the new 'Solid Waste Management Rules' 2016 recommends the need for segregations of waste at the door steps. Under these rules, the responsibility of waste generators is to segregate the waste into three categories i.e. Wet (biodegradable waste), Dry (recyclable waste) and domestic hazardous waste (disposable diapers, sanitary napkins, empty containers of cleanings, mosquito repellents, etc.). The generators have to pay 'User Fee' to the waste collector and a 'Spot Fine for littering and non-segregation. The Ministry of Housing and Urban Affairs (MoHUA) launched 'Source Segregation Campaign' on World Environment Day (5th June 2017) under the Swachh Bharat Mission (SBM) to motivate the waste generators to segregate waste at source. Under this campaign, two coloured coded dustbins (Green for wet waste and Blue for dry waste) were distributed to the waste generators. It is observed that the segregation of waste at source is rare. In the absence of segregation of waste, the quality of recycled products is generally poor. ULBs find difficult to comply with SWM rules, implement and sustain door to door collection, waste segregation, management, processing and safe disposal of MSW. There is no specific regulation for the segregation and utilization of waste in India.

It is a fact that the informal sector plays an important role in the waste collection, segregation and transportation. It is an integrated part of the MSWM and characterized by small-scale, labour-intensive largely unregulated and unregistered low technology manufacturing or provision of materials and services. Waste pickers collect household or commercial/industrial waste and they depend on waste for an income, despite the associated health and social issues. But they have not provided a legal status. These waste pickers are affected by occupational exposure and injuries. They save municipalities money by reducing the volume of waste (Krishna, 2017).

Transfer Stations are used where disposal sites are more than 15 km away from the collection area. It is economical to set up transfer stations as a tertiary collection system to save transportation time, equipment and fuel. In case of non-availability of suitable land for

a permanent station, the mobile compactor truck with primary collection vehicle can be used to improve the transportation efficiency of the system (MoUD, 2012). These stations are usually part of waste management system in large cities like Delhi, Mumbai, Bengaluru, Kolkata, Ahmedabad, Coimbatore, Chennai etc., (MOHUA, 2016).

Different types and sizes of vehicles are used for transportation of waste such as dumper places/Schiff loaders, refuse collector without compactors, refuse collection, mobile compactors, mini trucks with tipping floor, etc. Selection of right and suitable vehicles depend on quantity of waste, distance, road widths and conditions and process technologies. Many ULBs installed Global Positioning System (GPS), Geographic Information System (GIS), and Global system for Mobile Communication (GSM) system to save time, minimize human errors and improve the monitoring system. However, there is scope for covering all vehicles with appropriate designs for better results. Several cities in India have taken positive steps towards implementing the sustainable waste management practices by involvement the community in segregation, by enforcing better PPP contracts and by investing in modern technology for transportation, processing and disposal.

Processing, Treatment and Disposal of MSW: The processing technologies includes composting, bio-methanation, reuse and recycling, refuse derived fuel (RDF), gasification, incineration, pyrolysis, engineered landfills etc. Suitability of these technologies depend on what kinds of wastes are available – bio-degradable or non-biodegradable and its calorific value. Appropriate technologies also depend on the financial resource available and in-house capacity of local bodies. It is observed that there is a practice of dumping the waste in open areas in India. Waste dumps is a major contributor to global warming. It is important to note that the large quantity of organic waste must be processed either through bio-methanation or composting technology for generating bio-gas, electricity and compost for use as nutrient and prevent such waste from reaching the landfill site. The aerobic composting and vermi-composting are commonly adopted for the treatment of bio-degradable waste. The compost is used for growing vegetable and plants in their homesteads. The bio-gas has 55-60 percent methane that can be used as fuel for power generation. However, the current production of city compost from organic waste is lagging far behind its potential. The biggest constraints in composting lie in separating, collecting and transporting the waste to the location where decentralized or centralized large scale composting or bio-gas generation plus composting can be carried out. Bio-gas is a mixture of carbon dioxide and methane in varying proportions and a small quantity of hydrogen sulfide gas (Ahluwalia, 2016).

Recycling of waste is the reprocessing of used materials that would become waste. It is mostly undertaken by waste pickers, itinerant waste buyers (kabariwala), dealer and recycling units. The economics of recycling units encompasses a medley issues which includes collection cost for disposed materials, material demand for recycled product, landfill costs saved as a result of recycling the product and infrastructure and technology available. However, the recycling industries face a number of problems such as (i) labour intensive, and (ii) poor quality of recycled products are not compliant with regulatory requirements. From the economic perspective, recycling pays only when additional cost of collecting materials, sorting them for recycling and finally recycling and marketing them is substantially recovered from value of the recycled product.

Disposal of MSW: Disposal of MSW is at a critical stage of development of India. Most of cities and towns dispose of the waste by depositing it in low-lying areas outside the city

without taking precautions. Landfilling technology is frequently used for the disposal of waste in Indian cities. Almost 90 percent waste collected is disposed (Kumar, et.al., 2017) indiscriminately at dump yards in an unsatisfactory manner by the municipal authorities leading to health and environmental degradation. Finding new landfill sites is a major constraint in view of the 'not in my backyard' (NIMBY) phenomenon. People want a good facility for MSW but not in the vicinity of their households. This attitude of the people has made the task of waste storage difficult for ULBs. Innovative measures like use of 3-Rs (Reuse, Reduce, and Recycle), installation of waste-to-compost and bio-methanation plants would help to reduce the load of landfill sites.

EMERGING CHALLENGES FACED BY URBAN LOCAL BODIES

Increasing population in urban areas creates alarming level of challenges not in relation to the provision of basic needs alone but also on municipal solid waste generation and disposal. MSWM in most of cities and towns faces some typical challenges. These are:

- Ensuring the efficiency of 100 percent waste collection is a big challenge for ULBs.
- Lack of public awareness on segregation of solid waste at household level.
- Inability of ULBs to establish systems and technologies required for segregated collection and processing of different categories of solid waste and lack of coordination among different Government departments.
- Since no comprehensive studies have been conducted to cover almost all cities and towns to characterize the waste generated and disposed on landfill, it is difficult for the policy makers to make appropriate solutions for the kind of waste produced for a particular region because of limited resources of information available from few places.
- Due to financial crunch, ULBs do not have adequate infrastructure to provide suitable solutions and adopting innovative and appropriate technologies for the treatment of solid waste.
- Poor collection of user charges because of poor SWM services and hence cannot meet day to day expenses leading to a vicious cycle of poor performance.
- Lack of proper planning and indigenization of sophisticated waste processing facilities.
- Challenge of reducing land requirement of sanitary landfill for urban waste.

LEGISLATIONS AND POLICIES FOR MSWM

Solid Waste Management Rules, 2000 & 2016: The Municipal Solid Waste (Management & Handling) Rules, 2000 was framed under the Environment Protection Act, 1986 by the MoEFCC to protect the environment. The act assigns the responsibility of waste collection, transportation, treatment, disposal and segregation of waste to ULBs. But the rules did not succeed in ensuring sane management of MSW despite framed after a Supreme Court order (Krishan, 2017). The MoEFCC revised the previous rules after 16 years and notified new rules known as 'Solid Waste Management Rules, 2016. The new rules are applicable beyond municipal jurisdiction. The responsibility of waste generators has been made mandatory to segregate waste into three categories such as (i) bio-degradable or wet waste; (ii) non-biodegradable waste or dry waste; and (iii) Domestic hazardous waste (diapers, napkins, empty containers of cleaning agents, etc.). Bulk generators and Material Recovery Facility (MRF) were introduced. Bulk generators are those that generate 100 kg or more waste per day. The new rules have also made special provisions for Hilly areas. The rules have provided various provisions for hilly areas and suggested regional sanitary

landfills for the inert and residual waste. However, the new rules fail to provide exact criteria for the identification for landfill and waste processing facilities. It does not make any provision to eliminate the problem of NIMBY syndrome.

Plastic Waste Management Rules, 2016: MoEFCC has notified the Plastic Waste Management Rules, 2016 in supersession of the earlier Plastic Waste (Management and Handling) Rules, 2011. The recent plastic waste rules of 2016 is a part of the revamping all waste management. The new version of rules expanded its purview and applicability to rural areas and plastic importers in the supply chain. Further, it increases minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 microns plastic sheets used in packaging and wrapping commodities to facilitate collection and recycling of plastic waste. The rules also mandated the producers and brand owners to devise a plan in consultation with ULBs to take back plastic waste under Extended Producer Responsibility (EPR). The rules were revised further, to be known as the Plastic Waste Management (Amendment) Rules, 2018 in which three changes have been incorporated such as (i) the term 'non-recyclable multilayered plastic' substituted by multilayered plastic which is non-recyclable, non-energy recoverable or no alternate use; (ii) the pricing of carry bags omitted; and (iii) a centralized registration system to be established by mandating brand owners and producers. While the rules have been introduced with an attempt to mitigate the plastic menace, some concerns still remain (TERI, n.a.).

Other Ancillary Rules: In addition to the above key rules, following ancillary rules have also been introduced for managing waste:

a) Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016

b) E-Waste (Management) Rules, 2016

c) Construction & Demolition Waste Management Rules, 2016; and

d) Bio-medical Waste Management Rules, 2016

GOVERNMENT FLAGSHIP PROGRAMME: SWACHH BHARAT MISSION (SBM)

Swachh Bharat Mission (SBM) is the first landmark initiative of the Government of India (GoI). The launch of the Mission is an indication of the fact that the Central Government is assisting cities with the help of State Governments to improve sanitation conditions with target to 'Clean India' by October 2019, the 150th birth anniversary of father of the nation, Mahatma Gandhi. The focus of the Mission on solid waste management is seen as an important initiative as it highlights the cleanliness in India. Under this initiative, the Ministry of Housing and Urban Affairs (MoHUA) has been taking various steps to improve the MSWM system in India so that the goal of 'Clean India' is achieved by 2019. Amongst various schemes and campaigns, regular Swachh Survekshan is one of the important initiatives. It intends to foster a spirit of healthy competition among cities and towns to improve their service delivery to citizens, towards creating cleaner cities. Besides, the Ministry of Chemicals and Fertilizers (MoC&F) in collaboration with MoHUPA released operational guidelines to an amendment in the policy on the 'Promotion of City Compost'. Though the progress of the Mission in respect of waste segregation and recycling has been very significant, there is much room for improvement by addressing the manpower related problems. Also, in many cities, the door-to-door waste collection has failed to integrate the informal sector. Processing of MSW has also been a challenge for SBM.

Municipal Solid Waste Management Manual, 2016: The MoHUA, GoI has prepared the 'Municipal Solid Waste

Management Manual, 2016' in alignment with the latest Solid Waste Management Rules, 2016. It aims at guiding all cities towards sustainable solid waste management by addressing suitable measure for waste minimization at source, with an emphasis on the 3-R principle i.e. Reduce, Reuse and Recycle. It clearly defines the planning process to be adopted by ULBs for preparing, revising and implementation MSWM plans. The holistic approach adopted in the manual focuses on technical, institutional, financial and legal aspects. However, the existing literature on this subject underlines the need for the training workshop on this manual to all stakeholders to create better environmental conditions in India.

CONCLUSION AND WAY FORWARD

The preceding discussions clearly mention that MSWM is a critical service in India and has emerged as a big challenge not only because of the health and environmental concerns but also due to huge quantities of waste generated. The latest SWM Rules, 2016 would help to eliminate the challenges of SWM upto some extent. The provision for segregation of waste, penalty for non-segregation of waste, fines for littering and non-segregation - all these would be first action point of any agenda on MSWM. It is suggested that the community participation in MSWM system should be encouraged because it could deliver positive impact towards proper waste collection in ULBs. In addition to this, the waste reductions through proper waste segregation of valuable items help in reducing waste generation and could generate extra income. The people should be encouraged to realize the importance of source segregation at generation point. The policy agenda for sustainable solid waste management needs to drive behavioural change among citizens, elected representatives and decision makers to minimize wastage and littering and maximize reuse and recycling.

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SWACHH PUBLIC SPACES
-URBAN DESIGN & MANAGEMENT PERSPECTIVES

DR. DAKSHAYINI R. PATIL
DR. MAMATHA P. RAJ

Public spaces are successful when they are designed for place-making that welcome people who give life to the public spaces. Clean tidy public spaces positively enhance the quality of life; they are welcoming, encourage usage, provide safe environments for all users.

Keywords: Public space, Cleanliness & Management, Strategic framework, Integrated approach

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Swachh Bharat Mission (SBM) in urban areas has seen the light of the day in towns and cities across India. It's a break-through National movement foreseeing the image of Bharath as a progressive clean state. This mass movement of cleanliness well supported by the citizens, various organizations, celebrities and governmental bodies has diverse perspectives of cleanliness objectives. While, primary aim addresses provision of toilets (household and public) in all rural and urban areas along with overall cleanliness such as waste management, there are many aspects involved in achieving a wholesome clean ecosystem. One such aspect would be the public spaces or urban spaces in a neighborhood or city. Clean public spaces reflect the health of the city and its components. The success of SBM strives the path ahead for achieving cleaner public spaces in our cities but requiring an integrated approach to address the complexities involved.

INTRODUCTION

Urban public spaces comprise of people-centric zones that are the heart of the neighborhoods; where citizens come out of their abodes to access amenities, entertainment or to just socialize. They are the arenas of activity; diverse in terms of user groups from varied socio-cultural and economic backgrounds and form the life-lines of the society. Public spaces comprising mainly of streets, sidewalks, parks, plazas, community centers and civic centers are the peoples' domain; and the heart of any city worldwide. While cleanliness begins at home and the Swachh Bharat Mission (SBM) rightly starts off with the most basic and grass root level of sanitation & toilets for all, it needs to extend further on to the public realm completing the cyclic loop of cleanliness. The movement has initiated awareness on the same amongst government bodies and citizens. This paper deliberates on cleanliness of public spaces from perspectives of planning and design of the public spaces in the city. The aim is to understand the dynamics of public space system & management towards clean and safe zones.

The Swachh Bharat Mission components essentially include household toilets, community toilets, public toilets, solid waste management (SWM) & public awareness with capacity building. It encompasses the SWM in cities and neighborhoods to keep the environment clean, safe and comfortable for all. Hence, under this category

comes the aspect of public space cleanliness.

IMPLICATIONS OF CLEANLINESS OF PUBLIC SPACES

Clean public spaces reflect overall health of the city and are a reflection of its people and places. Public realm comprises not just the public space but extends into the zone of access to the private properties and buildings on either side of the street. Qualities of good public realm in the urban spaces include safety, comfort, diversity, accessibility and importantly cleanliness as a prime factor. Public realm comprises of all the amenities which help the community in addressing their needs of health, education and recreation, and also the space where they gather outside of the private zones and hence critical for an overall healthy society (Mammon & Paterson, 2005). There are certain characteristics that define good public realm-outdoor attractive spaces, high quality design and scope for people to spend quality time for several reasons. The degree of respect a public realm gets from its users, reflect the degree of its efficient design. Cleanliness is a pre-requisite of all urban spaces as Kevin Lynch points out. (Image of the city, 1990)

Public spaces when dirty & unkempt are unhygienic; have adverse impacts on the city in terms of health & well-being of its people causing epidemics & pollution while affecting the overall aesthetics as well. They majorly impact the quality of life and livability index. Public spaces are successful when they are designed for place-making that welcome people who give life to the public spaces. Clean tidy public spaces positively enhance the quality of life; they are welcoming, encourage usage, provide safe environments for all users.

As per CPHEEO Manual, 2016, the environmental impact of solid waste disposal on land in public spaces could be the following:

a. ground water & surface water contamination by the run-off from the waste dump;
b. bad odor, pests, rodents and wind-blown litter in and around the waste dump;
c. generation of inflammable gas (e.g. methane) within the waste dump;
d. fires within the waste dump;
e. epidemics through stray animals (Fig 1);
f. acidity to surrounding soil; and
g. release of greenhouse gases.

WHY DO PUBLIC SPACES BECOME DIRTY?

A simple question, but complex in its very nature. Would a one-time clearing or spot-fixing or facelift of the situation resolve the concern? Unlikely, as this kind of a recurring urban function needs a holistic long-term understanding and a built-in resolution system. When there is no ownership over the place, illicit & irresponsible usage of the space happens. Whereas,

Figure 1: Stray dogs and cattle near a garbage dump on a prominent public market street & square in Basavanagudi

if the people are awarded that attribute to control the space, they are likely to become responsible towards it. Natural surveillance on the street & public spaces becomes a critical necessity to achieve good quality spaces.

Public spaces include streets, sidewalks, plazas, squares, parks, playgrounds, civic centers, government complexes or amenities of various degrees. These are spaces that are frequented by people for accessing needs and entertainment. They are mostly Government-owned properties and considered as everyone's domain. Hence, stakeholders are many, ranging from the government to citizens who may be out there to shop, walk, jog, sell, work or socialize. Each person momentarily owns the space while being there. So, a person may use the space and later move out of it. Hence, he may or may not respect the space once out of it, leaving behind waste or debris. The public space essentially should be able to facilitate or demand the right usage of the space on part of the user. The awareness and response to the public space should become a parameter of analysis before planning or designing the space.

WHAT ARE THE WAYS IN WHICH A PUBLIC SPACE MAY GET DIRTY?

Throwing garbage, littering, creating nuisance, illicit dumping are ways in which public spaces may get contaminated. Illegal dumps along streets, sidewalks or open spaces are initiated by one person, and eventually becomes a habit amongst people to feed the dump. Once a garbage dump is created, stray animals enter the scene adding to further chaos and giving rise to health hazards.

Individual property occupants tend to keep their premises clean while dump the waste onto the public zones which due to lack of surveillance and check tend to be the easy targets to do so. Normally, these spots are those areas that are government property such as a park or street corner, which remains unmonitored or along large barricaded campuses (Figure 2). Shop owners or hawkers also tend to stow off the left-overs such as packaging material on the street.

Figure 2: Garbage dump alongside a high boundary wall of a government institution, Magadi Road, Bangalore

Cities host many public events or celebrate festivals or rejoice during elections etc.; such events normally end up with massive waste and debris strewn all over the street or public grounds. (Figure 3)

Figure 3: BEML Public Park, Bangalore as a party spot and the unattended leftovers (Bangalore mirror, Jan 4, 2019)

SOLID WASTE MANAGEMENT

Component 4 of SBM (urban) addresses SWM. ULB's are assisted by State governments in preparing DPR for SWM by empanelling/ shortlisting/ identifying private or government agencies for the same based on a reliable financial model in response to the needs identified in the City Sanitation Plan. These actions need to be based on GOI's goals as per NUSP 2008, SWM 2016, CPHEEO manuals. Street Sweeping, litter control interventions, and dumpsite remediation will be part of DPR which is essential for a clean city. The hierarchy usually adopted for waste management is (a) waste minimization/ reduction at source, (b)

recycling, (c) waste processing (with recovery of resources i.e. materials and energy), (d) waste transformation (without recovery of resources) and (e) disposal on land (landfilling).

Three main categories of SW on public spaces are: (CPHEEO manual)

Natural wastes: Includes dust and decaying vegetation such as fallen leaves from trees in the vicinity. Natural wastes cannot be avoided but may be suitably controlled by landscape design for selection of appropriate trees, placing and spacing of the trees and apt treatment of surfaces apart from the carriageway or sidewalks.

Road traffic wastes: Motor vehicles deposit oil, rubber and mud; accidental spillage of a vehicle's load such as from sand-carrying trucks, garbage trucks, construction waste etc. due to inappropriate transportation methods. Animal drawn vehicles deposit the excrement on the road surface. Traffic wastes are generally unavoidable but maybe controlled by regulatory mechanism on the mode and system of vehicle transportation.

Behavioral wastes: The main source of wastes is litter thrown by pedestrians, individual property occupants, shops, vendors (Figure 4). It includes human spittle and the excrement of domestic pets and together leads to health hazards. Behavioural wastes are largely avoidable, provided an efficient refuse collection service is in operation and litter bins are provided for the use of pedestrians. But success requires a continuing program of public education and awareness backed up by legislation and rapidly operating enforcement procedures.

STREET CLEANSING

Streets are the primary elements of public space network and involve many users. An important & everyday civic duty undertaken by the City Municipal Corporations is cleaning up of the streets. It is the most critical aspect of public space cleanliness management but highly understated and rarely a priority task. However, many cities spend between 30 to 50 percent of their solid waste (SW) budgets on street cleansing (CPHEEO) which reflects the criticality involved. Hence, need is to adopt a more efficient and reliable system to address this issue.

Figure 4: Construction debris on the public sidewalk alongside the construction site, Vijayanagar

The storm water drains channel also gets concentrated with solid waste leading to clogging and urban floods during rainy season. This results in unhygienic conditions, diseases and risks of pedestrian falls & injuries as well. Burning of waste is generally observed in garbage dumps.

A research survey conducted by the author in Bangalore on understanding barriers to pedestrian mobility of elderly citizens in their neighborhoods has shown that of the 14 inventory elements listed as barriers, garbage, debris and stray animals account for over 70%, adversely impacting a safe and comfortable walkability for elderly pedestrians. 80% elderly respondents listed 'cleanliness' as an essential parameter of good public spaces for them to venture out. Bangalore popularly known as Garden city has been mocked as Garbage city owing to the ever-growing garbage piles on every street and nook, polluted lakes and open spaces. Is there a solution to this? Many other cities are also facing the problem. While, the recent 2019 Kumbh mela saw a stupendous success on the Swachh Bharat front as an example of a larger scaled public event, it certainly proves the point that cities can impoverish their public spaces easily.

CONCERNS ON INDIAN STREETS

Streets in Indian context are

avenues of multiple users and urban functions. A typical street has users ranging from pedestrians walking to different destinations across all age groups, predominant informal-sector vendors or hawkers, adjacent property spill-overs from shops or residences, vehicles of all kinds, vehicle parking and others from the governmental offices undertaking their jobs plus the beggars and homeless. Activities hence range from walking, jogging, socializing, buying, selling, constant road and civic works, maintenance works, infrastructure works and much more. With so much of diversity, activity-laden streets and public spaces bear the stress of huge amount of waste and littering. *While each claims a stake, none takes the onus of the cleanliness of the public space*. The complexity is more and likewise solutions require a hierarchical approach. Cleanliness or *swachhata* in public spaces is a function of many parameters and not an independent aspect of functioning. There is a larger system in play, the factors of influence begin at planning and design level and come down to street-level cleanliness.

LEARNINGS FROM GLOBAL CITIES

Sometimes, it is essential to learn from other cities that have tackled the cleanliness aspect successfully though the city conditions might vary, yet small learnings give good leads. Singapore as a clean city since 1960s has undertaken steps to cultivate a healthy living environment for its citizens with the perspective that lack of cleanliness is a 'people-oriented problem' and that people-centric solutions should be applied to tackle it. Recently 'Keep Singapore Clean' campaign was kicked off to create awareness amongst its people on the extreme efforts involved from the Government in keeping the city clean. The city has an integrated approach of Master Planning and Governance with adoption of latest advancements. As rightly quoted- 'We want Singapore to be a clean place, not just a cleaned place…. need community participation, community leadership… to achieve this vision'- Mr. V Balakrishnan, Minister for the Environment and Water Resources, Govt. of Singapore (2010-2015). The city also pays attention to very small things in the big plan such as prohibition of gum sales in subway to avoid gum stuck to public subway stations or benches and high littering fines.

Adelaide city in Australia has totally gone the recycling way and given up landfills. City of Minneapolis has given up on graffiti & vandalism that add to city waste and mar the image. Oslo in Europe has literally no litter on streets or trash cans in public spaces; by adopting an automatic underground waste disposal system run by the city. Oslo citizens themselves gather up to clean public spaces. Kobe, Japan's sixth-largest city has taken efficient steps to retain its clean reputation by ways of establishing different waste collection days for different types of waste and if wrongly placed in a different bag, the city suspends the individual's trash collection privileges. Calgary's street sweepers are popular in making the Canadian city one of the cleanest in the world. Their annual Spring Clean-up program each year sees street sweepers scour over 14,000 kilometers of Calgary's roads & at the end of the process; the roads are pristine and beautiful.

STRATEGIC FRAMEWORK FOR *SWACHH* URBAN PUBLIC SPACES

To achieve Swachh public spaces in Indian cities in purview of the complexities involved and long term goals, it is essential to adopt an 'Integrated Plan of Action'. Many aspects are proposed and implemented by the Government to a certain extent but a wholesome approach is seemingly essential.

- To begin with 'city planning measures' must address the land use plan delineation and implementation to arrive at appropriate uses in city zones of residential, commercial,

public or institutional. This ensures compatible land uses to oversee a systematic development pattern.

- The 'street level design' is important as an immediate scope of 'public space management' policy. The planning must ensure a street-edge definition with active frontages with specified guidelines to control encroachment of the public space as a regulatory mechanism. In case of market zones in neighborhoods, retail commercial is recommended and for larger establishments such as institutional or government complexes, appropriate site boundary/ edge management is a must.
- 'Urban design guidelines' to ensure a natural surveillance and eyes-on-the street will mitigate illicit littering and dumps.
- A three-tiered 'Solid Waste Management Strategy' at the city level, neighborhood level, block level or street level to regulate waste generation and treatment towards achieving a smooth and sustainable system to resolve the impending waste management issues in most cities. Encouragement and awareness on the 3 R's of waste management – reduce, reuse, recycle shall control generation and inappropriate disposal of waste onto the public spaces. Legible bins provided at strategic points in the public spaces with attractive features shall encourage usage.
- A 'vendor management system' is needed to regulate the informal activities in public spaces under the purview of the existing norms but addressing the waste management norms as well for the vendors using streets for selling goods.
- 'Public space design strategy' to ensure aspects of street lighting, street landscape (trees/vegetation/elements), street clutter from activities or parking, pedestrian realm design for hassle-free safe mobility, street furniture and appropriate signage is recommended that provides safety and comfort with clean well-maintained streets.
- 'People responsive strategy' to involve citizens in taking charge, in decision-making activities, in taking onus for their neighborhoods. Neighborhood vigilance as an agenda may resolve many issues of safety and cleanliness.
- 'Awareness strategy' as already in place in the Component 5 of SBM (Urban) includes information, education and communication (IEC) & Public awareness with the objective of behavior change communication to ensure that sanitation as an issue is mainstreamed with the general public at large & and its related health and environmental consequences. M/o Information and Broadcasting, M/o Health & Family Welfare float the Communication material. Popular media may be adopted for spreading awareness but not under the financial plan. This to ensure grass-root level awareness on the critical implications amongst people involving schools or government organizations through organized camps or programs in neighborhoods shall invoke responsible attitudes.
- Incentives and strict punishments as enforcement tools shall be essential in the initial stages of public space management to envision long-term visions.
- Capacity building of the municipal personnel & contractors on the entire process of SWM in terms of collection, segregation, disposal, treatment and transportation is a must as the uninformed workers involved need to be educated precisely on the process. Adopting new technologies for the process is very essential as against putting the manual laborers' health at risk.

- 'Sustainable event waste management strategy' to outline the norms for public gathering events or festivals or celebrations to tackle and control illicit dirtying of the streets and public grounds. Also, to outline the same for private events that produces organic and plastic wastes.
- Lastly, resorting to surveillance and policing techniques with appointed personnel's in strategic places along the public spaces with frequent checks or installation of CCTV's to enforce the law.

CONCLUSION

Swachh Bharat Mission is a great unprecedented nationwide initiative by the Government of India to see Indian cities and towns as clean and safe havens; aimed to inspire the public to voluntarily clean public spaces as a service to the nation. There are many success stories from cities such as Mysuru, Chandigarh and Tiruchirappalli, with its clean Tourist places. Firstly, the social stigma on waste and its management is receding and people are themselves needed to take charge of the mammoth objective of clean public spaces in cities. Secondly, it is advisable for the Government to adopt latest technological advancements in the waste management process, equip the municipal personnel with the entire process of waste management cycle, train efficiently on handling the waste or equipment involved for a successful mission accomplishment.

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SEGREGATION OF DRY AND WET WASTE

MANAGING URBAN FLOODS

-A CRITICAL ANALYSIS

DR. MAHAVIR SINGH

The impacts of urban floods are more evident these days because of high densities, concentrated economic activities, poor drainage system, dwindling water bodies and frequent volatile weather conditions.

Key Words: Solid Waste Management, Service Level Benchmarking, Performance Assessment

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Water crisis is very severe in highly populated urban areas and it is going to be further aggravated with world becoming urban. As the open green spaces in the city act as the 'lungs' the water-bodies and natural drainage lines act as 'sponges' thereby reducing the impact of floods in the urban areas. The water-bodies/ lakes also help in recharging the aquifers. Uncontrolled urban sprawl and loss of natural drainage, inadequacy of storm-water drainage system and lack of a unified flood control mechanism in cities have led to devastating flood in cities. Therefore, city planners must map, conserve and develop these water bodies in cities.

INTRODUCTION

Adequate availability of water is pre-requisite for survival and quality of human life. It is estimated that about 1.2 billion people are without access to drinking water and about 2.4 billion lack basic sanitation. Further, it is projected that the population under water stress will rise from 450 million at present to 2.7 billion by 2025 and Indian subcontinent has been classified as the 'water stressed' which means that water needs exceed its availability.

Water crisis is very severe in highly populated urban areas and it is going to be further aggravated with world becoming urban. Today, most cities have become 'black holes' for water which is being brought from distant points to meet needs of growing urban population.

Water bodies/ Lakes have traditionally served the function of meeting water requirements for drinking, washing, irrigation, fishing and also for religious and cultural purposes. Urban Water Bodies including storm water drains, step wells (baoris), trenches around old forts, well and man-made Water Bodies like ponds within temples, gurudwaras, mosques etc. are commonly called as the "green architecture" of a city.

Apart from these functions, these water bodies are also known to recharge ground water, channelize water flow to prevent water logging and flooding. In the last half of 20th Century, urban water bodies underwent un-precedented environmental degradation on account of population explosion, large scale industrialization, chemical intensive agriculture and water intensive lifestyles.

Urban flood is a growing challenge to sustainable urban development as floods are more frequent amongst all natural disasters. The impacts of urban floods are more evident these days because of high densities, concentrated economic activities, poor drainage system, dwindling water bodies and frequent volatile weather conditions. Urban floods happen when natural and constructed drains fail to carry storm water for multiple reasons.

It is an undisputed fact that urbanization is inevitable and a continuous process. However, sometimes urbanization leads to adverse environmental impacts, if comprehensive approaches towards urban planning and flood management are not considered by the city planners. The recent example of urban floods in Gurugram stand in testimony to a similar situation when a modest amount of rainfall on 28th July, 2016 brought the city to a standstill.

The drainage problem in Gurugram has to be understood in its totality to solve it because as long as it remain invisible, it is guaranteed to remain insolvable. Further, to understand urban flooding and storm water drainage management, urban planning needs to be re-visited with emphasis on restoration of green areas, analysis of meteorological events and inter-departmental co-ordination etc. In this context, the experiences of Chennai deluge, mega Mumbai floods and drowning glory of Delhi would be of utmost importance.

EXPERIENCES OF URBAN FLOODING IN THREE METROS

Chennai

Chennai, sometimes referred to as the "Gateway to South India", is located on a flat coastal plain known as the Eastern Coastal Plains with average elevation of just 6.7 meters and traversed by the rivers namely Adyar, Cooum and Korralaiyar with their numerous estuaries. Several lakes of varying size are located on the western fringes of the city. Buckingham canal, originally a navigation channel and waterway till 1954, now serves only as a drainage channel. On the southern side of the city, there is vast fresh water swamp called as Pallikaranai wetland extending over 80 sq. kms, designated as reserve forest.

The city was jolted beyond imagination in the year 2015 when the devastating floods hit Chennai, causing loss of 400 precious lives, displacing of 18 lakh people and resulting into economic loss running in thousands of crores of Rupees.

The Cooum river flows through the core of the city, between the University of Madras and Fort St. George and drains in to the ocean. It accumulates excess from 75 tanks in its catchments within Chennai Metropolitan area. The Adyar river collects surplus from about 450 tanks in its catchments, apart from overflows from the Chembarambakkam tank. Today, the numbers of water bodies in Chennai have been reduced to a mere 46 due to onslaught of urban development. Geographically, Chennai is a flat topography and absences of natural slope cease unrestricted run off. The Corporation of Chennai has developed a storm water drain network of 855 km in the city. The sewage system in Chennai was originally designed for a population of 6.5 Lac at 114 litres per capita per day of water supply; it was further modified during 1989–1991, but is now much below the required capacity. Cooum and Adyar rivers in Chennai city are almost stagnant and do not carry enough water, except during the rains.

Haphazard town planning, chocked drains, poor garbage management, and the rampant destruction of mangroves, forests, and pastures have been identified as contributory factor to urban flood in Chennai. The unprecedented rain from northeast monsoon from November to December 2015 left vast portion of Chennai submerged. Most of the flood in Chennai are credited to depression over Bay of Bengal. However, on 8th November, 2015

Chennai flood was attributed to El Nino phenomenon which was recorded as an official disaster.

Since the beginning of the 20th century, Chennai has witnessed a steady deterioration of and decrease in water bodies and open spaces. It is estimated that in Chennai city, more than half of the wetlands have been converted for other uses. The green cover reduced rapidly across the city and in some wards almost 99% of the green cover has been replaced by non-vegetative development. As a result, the water-holding capacity of the city's surface has gone down drastically. The reduced city's surface water holding capacity combined with the augmented impermeable surface increased the peak flow up to 89% in some of the wards. Increased surface runoff and reduced retention capacity of the land cover almost stopped the groundwater recharging and thereby played havoc with the people of Chennai.

Mumbai

Mumbai is India's most populous and wealthiest city and is considered as the financial capital of the country. Mumbai comes under the administrative control of Municipal Corporation of Greater Mumbai (MCGM). Mumbai has the distinction of housing Asia's largest slum, Dharavi and it is estimated that more than 50% of Mumbai's population lives in slums. Mumbai has a tropical climate with seven months of dryness and peak of rains in July. Being a low lying and saucer shape area this city always gets flooded almost each and every year.

In the month of July 2005, 16 million people were affected by the Mega Mumbai floods due to absence of disaster management plans and series of development blunders. Once again in July 2015, the city encountered a similar tragedy costing thousands of crores to the financial capital of the country. Extreme weather conditions were projected as main reason for Mumbai floods but this was not the only reason.

Bandra-Kurla complex was the first to be affected by this calamity. Though the area had all the amenities of a self contained commercial hub, but there was one basic flaw. The complex was built on mangrove marshes that surround the mouth of the Mithi river near the Mahim bay. The Mithi river used to drain water from Mumbai City District area to the Arabian Sea. Construction rubble from Mumbai was used to fill the marshes and a shiny new business zone rose in almost record time to compete with south Mumbai's Nariman Point.

The choking of the Mithi river is considered as one of the major reasons for the water logging. For safety reasons, the banks of the river should have been kept clear but they were approved for slum development schemes. So, builders took over the slums, along with portions of the river. The storm water drainage of the river is encroached upon by a large number of hutments, storages, processing industries, workshops and scrap yards situated along its banks.

The storm water drainage system of Mumbai was built largely during the British Rule in 1860, when the population of Mumbai was merely one-tenth of what it is at present. The drainage system comprises of about 400 km of underground drains and laterals, built on the basis of the population and weather conditions. This antiquated storm water drainage system is capable of handling rain intensity of 25 mm per hour at low tide. If the rain intensity exceeds 25 mm per hour and a high tide occurs, there is always a possibility of inundation. Most of the drains throughout the city have been found to be occupied by a substantial amount of garbage and other solid deposits. The resulting decrease in the capacity of the city's storm water drainage system brought the disastrous inundation.

Every city has its share of dissipation spaces - wetlands, wastelands, mangroves and salt-pan lands. These act like sponges and take the pressure out of the high tide. In the past 10 years, each of these has been destroyed systematically in Mumbai. Mumbai had the advantage of

having excellent buffer zones in the form of 60,000 ha of wetland in Vasai-Virar and Bhayendar, just outside the northern outer limits of the city which used to absorb the effects of the sea. Permission was given to urbanise Vasai-Virar and 20,000 ha of wetlands were converted for urbanisation. In the Master Plan, land for gardens and playgrounds has been continuously de-reserved by successive Governments.

Delhi

Delhi, being the capital city of the country, is the seat of power in the country. Delhi is the largest commercial centre in northern India. It has a population of about 25 million, making it the second most populous city after Mumbai and most populous urban agglomeration in India. Delhi has the second largest slum population after Mumbai.

Two prominent features of the geography of Delhi are the Yamuna flood plains and the Delhi ridge. The summers in Delhi start from the month of April and continue till the month of July. The rainy season provides relief from searing heat, which is frequented by Northwesters till the month of October.

Delhi Jal Board is responsible for providing water supply and managing sewerage system in Delhi. Storm water drains are managed by the Municipal Corporation of Delhi, New Delhi, Municipal Council, Delhi Cantonment, Delhi Jal Board and Irrigation and Flood Control Department. Twenty-two drains including seven main drains take flood water to the river Yamuna. Total length of drains operating in Delhi is 1550 Kms. Besides, 100 pumping stations have been installed. It has been observed that on an average, Delhi experiences one major flood after every ten years.

Delhi is experiencing flooding due to depletion and encroachment of water bodies, deforestation, increase in concretization, and encroachment on the Yamuna catchment. Environmentalists have been raising hackles over rampant land use change of the Yamuna floodplains in Delhi. Construction of the Akshardham Temple and the Commonwealth Games (CWG) Village on the Yamuna riverbed are examples of construction being allowed through land-use change. Besides, the storm-water drainage network has been compromised through solid waste and sewage dumping, encroachment and concretization - a clear case of inviting disaster.

Delhi used to have a little over 800 water bodies but a majority of them either vanished or were encroached upon under the jurisdiction of different Departments/ Authorities/ Autonomous Bodies. There is no space for de-silting of drains due to encroachments. Drains separately designed to carry storm water, swell up primarily because they also carry sewage and solid waste. It is estimated that less than 50 per cent of Delhi is linked to sewers. The drains designed for carrying water of monsoon months are flooded even in dry season as they are clogged with solid waste. Only 60-70% solid waste is collected in Delhi and rest is visible in the drains of the city. Sewerage flows in the majority of the drains in Delhi, which has become a health hazard as almost all the slums and unauthorised colonies are along such drains. These drains are epidemic breeding lines.

The natural drainage systems/ courses are being given least importance in urban planning. Drains have been illegally encroached from all sides in such a way that access for maintenance has been blocked completely. The Drainage system in Delhi was designed in 1977 for an intake of 1 cusecs (28 liters) per acre of catchment area which is very conservative estimate. With increasing urbanisation and concretization, the runoff has increased considerably. Further, 1,642 unauthorised colonies, over 2,000 slums and 33,198 km of road are not linked with the existing drainage system in Delhi. Latest major flood seen in Delhi was in the year 2013.

ACASE OF GURUGRAM

According to the Irrigation Department, flash floods were never reported in Gurgaon till 1998 but the modest rainfall on July 28th 2016 led to massive waterlogging and traffic jams on the roads in Gurugram, and provided a brief peek at the urban nightmare. At the same time, it is estimated that Gurugram's groundwater is declining by 1.5 meters / year. Instead of recharging aquifers, rain is tormenting the citizens on roads. This single event caused huge loss to the economy of the millennium city, the estimates of which could vary. In comparison to other cases of urban floods, the extreme weather conditions were not responsible for floods in Gurugram. It was purely a man-made disaster which could easily have been managed with efficient drainage plan and routine exercise such as cleaning of drains and collection of solid waste.

The modest rainfall is an integral part of the sustainable ecosystem of a city which unfortunately resulted in perilous state in case of Gurugram putting a question mark on the resilience of the city.

Gurugram hasn't encountered any flood of the scale which Mumbai and Chennai experienced in 2005 and 2015 respectively. If at any point in time, flood happens in Gurugram of that scale, the impact will cost severely to the infrastructure and socio-economic life of the city. As per the report published in The Economic Times on 30th July 2016, the Multinational Companies are not comfortable with the level of infrastructure and its function particularly drainage system. If this state of affair continues, it would be difficult to stop shifting of business from Gurugram to the other competitive locations within National Capital Region.

WHAT LED TO THE CRISIS?

As the event recedes in our memory, it may be useful to examine how Gurugram's Master Plans have zoned forests, nallahs and water bodies which provide numerous benefits and comprise the natural infrastructure underpinning the built infrastructure.

Water bodies, big and small, johars, ponds, low lying areas and submergence areas of bunds act as natural sponges and cumulatively determine the natural water holding capacity of an area. Similarly, natural water channels and nallahs hold rainwater and help discharge excess runoff.

Recognizing their importance, the Regional Plan 2021 for the National Capital Region required water bodies, groundwater recharge areas, flood prone areas to be zoned as Natural Conservation Zone (NCZ), with strict limits on construction, thereby protecting Aravallis and forests. The Gurugram 2031 Master Plan, published in 2012 did include some Natural Conservation Areas in the Aravallis, but water bodies, ponds, Johars and nallaha were still ignored. This raises the question about the master planning process and the procedure adopted to incorporate forests, hydrology sustainability aspects and carrying capacity principles despite water bodies and groundwater recharge zones being an independent criteria in the terms of reference for declaration of NCZ.

Further, the submergence area of Ghata Lake, extending over 100 ha, and capable of holding around 1.5 billion litres of water was zoned as a residential sector. The natural nallah downstream was abandoned and a concrete, covered storm water drain was constructed along the highway. Similarly, the high flood level area of the Najafgarh jheel also include numerous sectors along the Dwarka Expressay. This shows disregard to the concept of sustainable development and principles of natural drainage.

THE STORY OF DIMINISHING URBAN LAKES

Ghata lake, a seasonal water body in Sector 58, was documented in the Gazette of India (1883). The

natural lake and the bund used to have enough water and was over 50 feet deep. Badshahpur drain that begins at Ghata, is the main carrier of storm water out of the city. Over the years, roads, housing projects and full-fledged HUDA sectors have come up in the catchment area of the drain. This is probably the single biggest factor behind the severe waterlogging that the city witnesses. Sometimes back, it was decided to build around 250 rainwater harvesting structure to hold the runoff from the Aravallis which usually leads to waterlogging in areas adjacent to Ghata. Unfortunately, such rainwater harvesting structures have not been built and water flows unabated from Ghata to Badshahpur flooding Gold Course Road.

Google Earth images between 2004 and 2015 reveal that over 60% of Badshahpur drain's catchment area has been taken over by real estate development around Gold Course extension road and Sohna road. The four major check dams in the city- Ghata (50ft deep), Nathupur (30ft deep), Chakarpur (12ft deep) and Jharsa (10ft deep)- that used to store rainwater and recharge groundwater while preventing waterlogging have long been encroached upon.

PRINCIPAL REASONS FOR INCREASED URBAN FLOODING

i. Uncontrolled urban sprawl and loss of natural drainage. Drainage channels have been blocked and urban water bodies lakes filled and encroached, canals degraded and polluted, heavily silted and narrowed. Further, waterways contamination and anaerobic digestion lead to sludge accumulation causing hydraulic hindrances.

ii. Inadequacy of storm-water drainage system and lack of maintenance. Plastic and polythene choke the storm-water streams aggravating the impact of urban flood.

iii. Increase in impervious surfaces on account of paving of roadsides, parks and open areas enhancing flood severity and conditions for drought to follow.

iv. Lack of coordination between agencies. Lack of a unified flood control implementing agency that integrates the functions of the Municipal Corporation, Development Authority, Public Works Department, Irrigation and Drainage Department, Public Health Engineering Department, Slum Clearance Board, Housing Board etc.

WAY FORWARD

As the open green spaces in the city act as the 'lungs' the water-bodies and natural drainage lines act as 'sponges', thereby reducing the impact of floods in the urban areas. These water-bodies/ lakes also help in recharging the aquifers. Therefore, Master Plans / Development plans of city should map, conserve and develop the water bodies in cities.

1. As per Advisory issued by Ministry of Urban Development on Conservation and Restoration of Water Bodies in Urban Areas (2013), the urban water bodies should be identified and designated as a separate land use classification that is legally tenable. It should be done in parallel with the Protected Areas as defined under the Environment Protection Act and the Forest Conservation Act to prevent their encroachment and destruction.
2. Land around the lake and at a certain distance from its shore should be declared as eco-sensitive area and dumping of any solid waste into these areas should be made a punishable offence.
3. The water bodies, big and small, ponds, johars, nallahs irrespective of current ownership and zoning along their 50/100 year high floods levels should be declared as Natural Conservation Zones (NCZ).
4. All the nallahas should be kept as kachha, wide and green avoiding concretization.

5. The urban forest (eg. Aravallis in Gurugram), being natural groundwater recharge area and home for wildlife, need to be protected permanently and no construction permissions should be given.
6. Wherever possible, water harvesting or recharging structures should be created and made operational.
7. The water holding capacity of the city should be increased by preserving natural water, retaining structures rather than having artificial lake (as proposed in the Gurugram master plan 2031).

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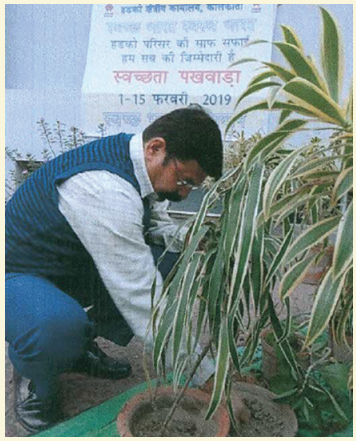
SWACHHATA PAKHWADA BY HUDCO REGIONAL OFFICE - KOLKATA

HUDCO Regional Office (Kolkata) observed Swachhta Pakhwada from 1st February to 15th February 2019. A number of activities were undertaken during the two weeks by Kolkata Regional Office. These include Swachhata Pledge taken by all employees and tree plantation programme. All employees had taken active role in the cleanliness drive at the office and surroundings. Old documents and files were weeded out during the Pakhwada.



STATUS OF RIGHT TO HOUSING IN INTERNATIONAL AND NATIONAL JURISPRUDENCE

MS. SHALINI R. PANIGRAHI

The Constitution of India is firmly grounded in the principles of liberty, fraternity, equality and justice. India also has certain constitutional provisions and laws that make it obligatory for the state to provide the right to adequate housing to all its citizens.

Housing is one of the fundamental human needs which is given prominence along with food and clothing. House does not mean simply a protected space with a roof overhead but it is integrally related to other elements constituting a series of services such as basic civic infrastructure and facilities concerning water, clean and healthy environment, health and education. Housing has also to be seen within a holistic and interdependent framework in terms of livelihood, security, personal safety, social and cultural settings. Ownership of a house, in fact, provides a person a sense of stability and belongingness in the community and helps in creating a physical, social and cultural identity. A right to adequate housing is therefore a prerequisite to meaningful living and socio-economic development. Housing is fundamentally important to an individual's physical welfare as well as one's sense of self dignity and role in the community. Housing is critically important to the well-being and health of children and families[1].

"...An equally basic essential to peace is a decent standard of living for all individual men and women and children in all nations. We have accepted, so to speak, a second Bill of Rights under which a new basis of security and prosperity can be established for all -regardless of station, race, or creed. Among these is...the right of every family to a decent home".

- Franklin D. Roosevelt

INTRODUCTION

A right, in simple form, may be defined as the valid claim of a person on society which is to be protected by the force of law or by that of education and opinion. Housing as a human right has been well established in the international community since its placement in the Universal Declaration of Human Right (UDHR) in 1948. Since the adoption of UDHR the notion that equality of access to affordable, secure, safe and healthy housing constitutes a fundamental human right. Housing Rights are viewed as an integral part of Economic, Social and Cultural Right within the United Nations. Human Right to Housing represents the law's most direct and overt protection of housing and home. Unlike other human rights, through which the home incidentally receives protection and attention, the right

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to housing raises housing itself to the position of primary importance.[2]

Further, at the national level at least 40% of the world's Constitutions refer to housing rights while some states have introduced legislation granting housing.[3] Housing rights have been established within international instruments and treaties, as well as national constitutions laws and curial jurisprudence. There is a growing corpus of law giving greater definition and clarification to state obligation and the nature and extent of housing rights.[4]

This article attempts to provide an insight on housing as a human right and socio economic right, with focus on the concept of right to housing as a human right and its interrelationship with socio economic and cultural rights. This paper also deals with important provisions of Indian Constitution which support the right to housing.

HUMAN RIGHT TO HOUSING AND HOUSING RIGHTS

There is a distinction between Right to Housing and Human Right to Housing. Right to housing is referred to human right as codified in or implied into international and regional rights treaties and declarations and into domestic constitutional orders through bills or declaration of rights as international or regional human rights. The rights to housing exist beyond the questions of citizenship. They are rights based on the recognition of human beings as human beings, not the rights one has by virtue of one's membership in a particular national political community or on one's status within the specific sovereign state. In the domestic constitutional context, questions of citizenship and jurisdiction may both be applicable. Nevertheless, the claim to a right to housing as a human right springs not from the question of citizenship but from the question of humanness or humanity and relates to the demand for the right that is audible beyond national borders and which seeks the attention of the international community as a whole.[5]

Housing rights, on the other hand, refer to legal rights codified into or arising from the domestic law of particular national states. These rights refer to entitlements under nationally conceived social welfare legislation for access to 'social' housing, or to support in relation to housing for tenants. That the rights of owners are discussed through the paradigm of property law, not through housing law, creates a significant distinction in rights that is questioned later in this work. Substantive constitutional socio-economic rights, as O'Connell argues, impose binding obligations over and above any moral obligations arising from welfare entitlements, which are in contrast 'essentially discretionary in nature'.[6]

The second point of distinction is based on the way the rights are claimed and invoked. In elucidating his right to the city, Henri Lefebvre, the French philosopher, recognized a crucial distinction between the demand for a right to housing, and the decision by the state to provide housing by taking control of pre-existing parts of the market economy, (although such a decision may give rise to legal rights and entitlements). The right to housing as a human right is motivated by such a distinction, which rests on the cry for recognition of the right as much as it does on the provision of the good.[7]

Human rights are interdependent, indivisible and interrelated. In other words, the violation of the right to adequate housing may affect the enjoyment of a wide range of other human rights and vice versa. Access to adequate housing can be a precondition for the enjoyment of several human rights, including the rights to work, health, social security, vote, privacy or education. The possibility of earning a living can be seriously impaired when a person has been relocated following a forced eviction to a place removed from employment

opportunities. Without proof of residency, homeless persons may not be able to vote, enjoy social services or receive health care.[8]

RIGHT TO HOUSING AS ECONOMIC, SOCIAL AND CULTURAL RIGHT

The right to housing traditionally falls within the category known as social, economic and cultural rights by virtue of its placement in International Covenant on Economic, Social and Cultural Right (ICESCR). This designation seems firmly entrenched, despite the official position adopted by the United Nations and endorsed by most human rights practitioners, activists and academics that all human rights are indivisible, interdependent and interrelated. Moreover, indivisibility often remains in the realm of rhetoric, rather than appearing as a commitment to equal realisation, enforcement or attention for all human rights.[9]

The social rights are rights which enable humans to exist in society at a certain minimum level. In Eide's definition, the right to housing is a social right. Constituting a necessary basis of subsistence, adequate housing facilitates human participation in the life of the community. However, the right to housing is also a cultural right. The form, location, arrangement and materials of the home are an expression of cultural practice and values. Both socio-economic and civil-political rights are designed to bring human beings into society.

The 'core' of social rights is the right to an adequate standard of living, which is embedded in Article 25 of the Universal Declaration of Human Rights 10 (UDHR), Article 11 of the ICESCR, and in the provisions of the Convention on the Rights of the Child 11 (CRC). This right to an adequate standard of living has a minimum basic content that ensures subsistence to all people in the form of food, clothing, housing and necessary conditions of care.[10]

The right to adequate standard of living has a minimum basic content that ensures subsistence to all people in the form of food, clothing, housing and necessary conditions of care. The economic rights are also instrumental to the provision of these social rights. Economic rights like right to property and right to work as codified in the UDHR and right to social security as included in UDHR, ICESR and CRC are instrumental as basics of independence and therefore of freedom. Alternatively, economic rights could be defined as rights to produce and to consume.[11]

The distinction between economic, social and cultural rights and other categories of rights remains highly relevant in a legal sense, due to differing obligations imposed on states through the ICESCR, for example, as opposed to the International Covenant on Civil and Political Rights (ICCPR), or through the Revised European Social Charter (RESC) as contrasted with the European Convention on Human Rights (ECHR). Such differing legal obligations illustrate Henry Shue's American Philosopher argument that it is not the normative or moral basis of various rights that differ, but in fact the correlative duties to fulfil those rights.[12]

THE LEGAL STATUS OF HOUSING RIGHTS IN THE INTERNATIONAL ARENA

The legal statue of Housing Right in the international arena is based on the following main relevant international Human Rights provisions[13].

Universal declaration on Human Rights (1948) adopted by almost all the States, recognizing right to housing in Article 25 which states that everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, and housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood

in circumstances beyond his control.

The International Covenant on Economic, Social and Cultural Rights (ICCPR) 1976 adopted by all states including United States in Article 17 provides that No one shall be subjected to arbitrary or unlawful interference with his (or her) privacy, family, home or correspondence nor to unlawful attacks on his (or her) honour and reputation. Everyone has the right to protection of the law against such interference or attacks.

The International Covenant on Economic, Social and Cultural Rights (ICCPR) 1966 adopted by 150 States recognizes the right to housing in Article 11.1: The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions. The States Parties will take appropriate steps to ensure the realization of this right, recognizing to this effect the essential importance of international co-operation based on free consent.

General Comment No. 4, of the Committee on Economic, Social and Cultural Rights, on the Right to Adequate Housing defines this right as being comprised of a variety of specific concerns namely.[14]

- **Security of tenure:** Housing is not adequate if its occupants do not have a degree of tenure security which guarantees legal protection against forced evictions, harassment and other threats.
- **Availability of services, materials and infrastructure:** Housing is not adequate if its occupants do not have a degree of which guarantees legal protection against forced evictions harassment and other threats.
- **Affordable housing:** Housing is not adequate if its costs threatens or compromises the occupant's enjoyment of other human rights.
- **Habitable housing:** Housing is not adequate if it doesn't guarantee physical safety or provide adequate space, as well as protection against the cold, damp, heat, rain, wind, other threats to health and structural hazards.
- **Accessible housing:** Housing is not adequate if the specific needs of disadvantaged and marginalized groups are not taken into account.
- **Location:** Housing is not adequate if it is cut off from employment opportunities, health-care services, schools childcare centres and other social facilities, or if located in polluted or dangerous areas.
- **Culturally adequate housing:** Housing is not adequate if it does not respect and take in account the expression of cultural identity.

The issues related to housing rights have also received wide attention over the last half century since the proclamation of the Universal Declaration of Human Rights in 1948, in a number of other international declaration and policy recommendations. These include:

(a) the Declaration of the Rights of the Child (1959), and the Convention on the Rights of the Child (1989) address the special housing rights of children. Article 27 of the Convention requires States parties to take appropriate measures to assist parents and others responsible for the child to implement the right to an adequate standard of living, and in case of need to provide material assistance and support programmes, particularly with regard to nutrition, clothing and housing.[15]

(b) *The International Convention on the Elimination of All Forms of Racial Discrimination:*[16] Article 5 (e) of this Convention includes the obligation of States parties to: prohibit and eliminate racial discrimination in all its forms and to guarantee the right of everyone, without distinction as to race, colour, or national or ethnic origin, to equality before the law, notably in

the enjoyment of economic, social and cultural rights in particular . . . the right to housing.

(c) *The Convention on the Elimination of All Forms of Discrimination against Women (1979):*[17] States parties are specifically required to eliminate discrimination against women in rural areas and to ensure to such women the right to enjoy adequate living conditions, particularly in relation to housing, sanitation, electricity and water supply.(Article 14).

(d) *The housing rights of migrant workers:*[18] The rights of migrant workers to equality of treatment with respect to housing is guaranteed in article 43 of the International Convention on the Protection of the Rights of All Migrant Workers and Members of their Families (1990). This article provides that: Migrant workers shall enjoy equality of treatment with nationals of the State of employment in relation to . . . (*d*) access to housing, including social housing schemes, and protection against exploitation in respect of rents.

(e) *The housing rights of refugees*[19] Under the 1951 Convention relating to the Status of Refugees, the Contracting States are required to accord refugees treatment as favourable as possible, and not less favourable than that accorded to aliens generally in the same circumstances with regard to housing.

Besides the above, the other instruments providing for Right to housing find place in various international legal instruments are: International Labour Organisation Recommendation No. 115 concerning Worker's Housing (1961), Declaration on Social Progress and Development (1969), Declaration on the Rights of Disabled Persons (1975) Vancouver Declaration on Human Settlements and Action Plan (1976), UNESCO Declaration on Race and Racial Prejudice (1978), ILO Recommendation No. 162 concerning Older Workers (1980), Declaration on the Right to Development (1986), the Global Strategy for Shelter to the Year 2000 (1988), Agenda 21 (1992), Vienna Declaration and Programme of Action (1993), Copenhagen Declaration and Programme of Action (1995), Beijing Declaration and Platform for Action (1995), and most importantly, the Istanbul Declaration on Human Settlements and the Habitat Agenda (1996).[20]

LEGAL BASIS OF RIGHT TO HOUSING

The right to adequate housing and land has been widely recognised and upheld in national and international law. This means that states have to take measures to protect, promote and guarantee the rights enshrined in law to all citizens. National Legal Obligations mainly national and municipal laws in a number of countries around the world provide for the guarantee of the human right to adequate housing and land.[21]

The Constitution of India is firmly grounded in the principles of liberty, fraternity, equality and justice. India also has certain constitutional provisions and laws that make it obligatory for the state to provide the right to adequate housing to all its citizens.

PROVISIONS IN THE INDIAN CONSTITUTION IN SUPPORT OF RIGHT TO HOUSING

The list of constitutional provisions that have a bearing on the right to adequate housing including women's and children's rights to adequate housing, are: Fundamental Rights.[22]

- Equality before the law (Article 14);
- Special provisions in favour of women and children based on the principle of protective discrimination (Article 15 (3));
- Freedom to reside and settle in any part of the territory of India (Article 19 (1) (e));

- Right of all citizens to practice any profession, or to carry on any occupation, trade or business (Article 19 (1) (g)); and
- Right to life and personal liberty (Article 21): No person shall be deprived of his life or personal liberty except according to procedure established by law.

The Constitution of India does not contain any provision for right to housing. However the Supreme Court of India, in several cases, has implied that such a right is within the compass of right to life within the meeting of article 21. The resulting jurisprudence has a deep, although ultimately unstable impact on the protection of housing, particularly in informal settlements in the Indian state.[23] Although the Supreme Court has widely employed international norms to inform its understanding of the Indian Human right systems, the Indian jurisprudence on the right to housing is analytically separate from the Right to housing as codified and interpreted in the international human rights Covenants; that is the jurisprudence of the Right to Housing has emerged from the Indian supreme court broad view of the right to life in article 21.[24] Although in early years the Supreme Court employed a literal interpretation of the constitution by the 1970's, the Court's stance had shifted to encompass a commitment to social justice through judicial activism. The Supreme Court has thus pioneered novel forms of litigation including public interest litigation to achieve the integration of socio economic goals though fundamental rights. The expansion of article 21 can be seen as judicial refusal to see the Indian constitution as lacking or inferior to any international document of human rights protection.

Indian Courts on Right to Housing

In 1981, the *Francis Coralie Mullin vs. Administrator, Union Territory of Delhi* [26] case provided an opportunity for the court to develop the meaning of Article 21. The Supreme Court held: "We think that the right to life includes the right to live with human dignity and all that goes along with it, namely, the bare necessaries of life such as adequate nutrition, clothing and shelter over the head and facilities for reading, writing and expressing oneself in diverse forms, freely moving about and mixing and commingling with fellow beings."

In 1985, **Olga Tellis v. Bombay Municipal Corporation**[27] case brought the question of housing and shelter squarely before the court in a petition on behalf of Mumbai slum and pavement dwellers. The Supreme Court held that Article 21 of the Constitution also encompassed the right to livelihood and that this right was indivisible from the right to shelter.

Olga Tellis has been followed by subsequent cases implying a right to housing and shelter into the right to life. The Supreme Court in the case **Shantistar Builders v. Narayan Khimalal Totame**[28] handed down in 1990 another group of pavement dwellers who approached the court, seeking enforcement of legislation that sought to prevent land accumulation by powerful interests and at the same time provide flats to house the weaker sections of the society. Court held that: ''The right to life would take within its sweep the right to food, the right to clothing, the right to decent environment and a reasonable accommodation to live in.''

The court provided further interpretation of the right to life in **Chameli Singh and others v. State of UP**[29] : In any organised society, the right to live as a human being is not ensured by meeting only the animal-needs of man. It is secured only when he is assured of all facilities for his self-development and is freed from restrictions inhibiting his growth. All human rights are designed to achieve this objective. Further, court also held that "in a democratic society... one should have permanent shelter so as to physically mentally and intellectually equip

oneself to improve his excellence as useful citizen as enjoined in the Fundamental Duties and to be useful citizen and equal participant in democracy. The ultimate object of making a man equipped with a right to dignity of person and equality of status is to enable him to develop himself into a cultured being.''

This has been established in numerous Supreme Court decisions, including **U.P. Avas Evam Vikas Parishad v. Friends Coop. Housing Society Ltd**[30] , where the Court held that: The right to shelter is a fundamental right, which springs from the right to residence under Article 19(1)(e) and the right to life under Article 21.

In **Ahmedabad Municipal Corporation v. Nawab Khan Gulab Khan and Others**[31] case, the Supreme Court observed that: Article 19 (1) (e) accords right to residence and settlement in any part of India as a fundamental right. In the same case, the Court also stressed special protection for Scheduled Castes and Tribes: ''The State and consequentially the local authorities are charged with the constitutional duty to provide the weaker sections, in particular the Scheduled Castes and Scheduled Tribes with socio-economic and political justice and to prevent their exploitation and to prevent them from injustice.'' The Union of India has evolved Indira Avas Yojna Scheme exclusively to provide housing accommodation to the Scheduled Castes and Scheduled Tribes and separate annual budgets are being allotted in that behalf by Parliament and the appropriate legislatures in allied matters.

The Supreme Court of India cases on right to housing have been welcomed across the world, revealing a perspective, profound and contextualized view of human life and the interconnected nature of all the human rights from equality to livelihood and from social inclusion to education.

Thus so far as the right to life is constitutionally guaranteed, anything that will assure the realization of this right ought and should be protected and guaranteed. The best example of the recognition of the right to adequate housing as a fundamental right is to be found in Section 26 of the constitution of South Africa, which provides that: 'Everyone has the right to have access to adequate housing, the state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of this right, and that no one may be evicted from their home, or have their home demolished, without an order of court made after considering all the relevant circumstances.' The South African constitution also provides that the government has the obligation to respect, to protect and to realize the right to adequate housing, which applies to the executive, legislative and judicial branches and to all levels of government.[32]

CONCLUSION

Housing is indeed a foundation from which other legal entitlements can also be achieved. The adequacy of one's housing and living condition is closely linked to the degree to which the right to environmental hygiene and the right to the highest attainable level of mental and physical health can be enjoyed. Housing rights forms an indispensable part of ensuring human dignity. Right to Housing as Human Right is well placed in international arena and jurisprudence, but still millions of people all over the world are forced to live in squatters and a condition that is not fit for decent living. The problem of housing is universal and its solution is complex and it has economic dimensions. State is considered as the protector of human dignity of the individual, though it is not expected of state, neither it is practically possible, to give a free home to every individual but still a lot could be done by the state to ensure a decent standard of living. Many states recognize Housing Rights as a Fundamental Right implicit in Directive Principles of State Policy but still it lacks the enforceability. Though it has persuasive value but still the

enforcement element is missing. However, as a result of judicial activism, the Supreme Court of India has very well established the Right to Housing as part of Right to Life.

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Expert Opinion of Dr. M. Ravi Kanth on

SWACHH BHARAT MISSION AND ROLE OF HUDCO

Dr. M Ravi Kanth, IAS (KL:86) is Chairman & Managing Director (CMD) of Housing and Urban Development Corporation Limited (HUDCO). Prior to this, he was CMD of Projects & Development India Limited (PDIL) and has held the positions of the Principal Secretary to Government of Kerala and Joint Secretary, Ministry of Power, Government of India, New Delhi. He is M.A. (Economics) and Ph.D. (Agri-Exports) from Andhra University, L.L.B from Delhi University and MBA (Finance) from Melbourne, Australia.

Dr. M. Ravi Kanth has served in various positions in Government of India including Dy. Chief Executive, Nuclear Fuel Complex, Dept. of Atomic Energy, Hyderabad, Director, APEDA in Ministry of Commerce & Industry, Chairman & Managing Director, National Handicapped Finance & Development Corporation in Ministry of Social Justice and Empowerment. He has also held several positions in the State Government of Kerala.

Q. With the kicking in of the slogan 'Swachhata hi Seva' on Gandhi 150th Birth anniversary in 2018 and as India has embarked on its 5th year of its 'Swachh Bharat Mission' (SBM) to achieve its targets by the year 2019, could you please shed some light on the need for launching SBM on an enormous scale in our country.

As per WHO/UNICEF (2013) Reports, the percentage of people residing in urban areas with access to improved sanitation was 60% in India in 2011 and the same for rural areas was 24%, making the overall national figure of 35%. The open defecation was 60% in rural areas while 13% in urban India. Every year, an estimated 0.4 million children died of water-borne diseases such as cholera, dysentery and suffered from stunted growth. Prior to the launch of 'Swachh Bharat Mission' (SBM) on 2nd October 2014, several other sanitation programmes were launched in the past, like the Nirmal Bharat Abhiyan in rural India and Basic Services for Urban Poor in urban India. But India's hope to be open defecation free (ODF) remained as bruised as its millions of toilets that were built but never used. Therefore, there was an urgent need to address the sanitation and waste management challenges in a massive scale which resulted in launching the Swachh Bharat Mission. It is in this context, the significance and breathtaking progress of SBM with the slogans like 'Swachhata hi Seva' need to be seen. As India has embarked on its 5th year of SBM, the target of achieving ODF by 2nd October 2019 is right on track.

Q. What is your opinion of the progress achieved through the Government of India initiatives such as Swachh Bharat Mission, Smart Cities Mission, AMRUT and their contribution towards addressing the problem of inadequate sanitation in urban areas?

I am of the opinion that the progress achieved under various flagship programmes of the Government of India has been excellent. On the SBM front, sustained efforts have yielded significant positive results, making it a 'Jan Andolan' or 'people's movement'. As per the SBM-Urban performance dashboard of MoHUA, GoI, in the urban areas, as on 10th April 2019, 56.63 lakh individual toilets, 4.84 lakh community & public toilets have been constructed; 3558 cities have been declared open defecation free; out of 84,358 wards, 75,267 (89%) now have 100% door-to-door waste collection; almost 88.4 megawatts (MW) of energy is generated from waste-to-energy (WTE) projects; and the waste-to-compost production stands at 15,06,501 metric tonnes. Similarly, in rural areas under SBM-Gramin, the sanitation coverage has been substantially increased to 99% as on 10.04.2019 from 38.70% as on 02.10.2014. 30 states have been declared ODF while the sanitation coverage in the lagging states of Uttar Pradesh, Bihar and Odisha has increased to 99.78%, 76.19% and 67.05% respectively. Similarly, significant progress has also been made under Smart Cities Mission as well as AMRUT. All these initiatives need to be complemented with effective urban governance, behavioural change, creating general awareness, involvement of civil society, NGOs and promoting PPP for fund raising which would help in addressing the sanitation concerns in urban areas, making the urban environment livable for all. Further, Information, Education and Communication (IEC) is an extremely important component for developing empowered, well aware and skilled stakeholders capable of planning, Operation & Maintenance and management of sanitation schemes.

So far, HUDCO has financed 2305 urban infrastructure projects involving project cost of Rs. 449,955 crore and loan sanction of Rs. 113,316 crore, out of which more than 30% are for water supply, solid waste management, sewerage, drainage and sanitation projects.

Q. Financing Urban Basic Services Projects such as Sanitation, Solid Waste Management, etc. is one of the key issues for making urban areas clean and green. What has been HUDCO's involvement and contribution in financing of such projects?

HUDCO entered urban infrastructure financing three decades ago and has since then emerged as a major player in the sector, through its support to a large number of core infrastructure and urban services projects such as water supply, sewerage, sanitation, and solid waste management all over the country, especially in small and medium towns which helps in attaining sustainable growth with improved quality of life and safe environment along with enhanced productivity of cities and towns. So far, HUDCO has financed 2305 urban infrastructure projects involving project cost of Rs. 449,955 crore and loan sanction of Rs. 113,316 crore, out of which more than 30% are for water supply, solid waste management, sewerage, drainage and sanitation projects. HUDCO's terms of financing is very competitive compared to other financing institutions for such projects.

Q. How is HUDCO supporting the Government of India flagship programme of

'Swachha Bharat Mission?

HUDCO has been an able ally not only to the Ministry of Housing & Urban Affairs but also to other line Ministries of the Government of India in performing key roles for nation building. Since inception, HUDCO has been assisting in the implementation of various flagship programmes of Government of India including 'Swachha Bharat Mission' in the best possible manner. Apart from providing techno-financing support to State Public Agencies under the Mission, HUDCO has also been providing Viability Gap Funding (VGF) to the State Governments and Urban Local Bodies, whenever required by them for funding their share of financial assistance. Besides, HUDCO has been actively participating in various SBM initiatives such as Swachhta Action Plan, Swachhata hi Seva, etc.

Q. With the introduction of Swachhta Action Plan (SAP) making swachhta everybody's business involving Govt. Departments, Ministries, and Institutions, 'behavioural change' in corporate culture has been a major challenge in the success of Swachh Bharat Mission Urban. Do you agree on this at an Organization and Institutional level with your experience at HUDCO? And what are your suggestions for improvements in the same? Also tell us about the activities taken up by HUDCO towards achieving SAP objectives.

Introduction of Swachhta Action Plan (SAP) is very important in order to achieve the ultimate goal of cleanliness at all places, be it Government departments, Ministries, and other Institutions. As father of the nation, Mahatma Gandhiji, said, "it is health that is real wealth and not pieces of gold and silver''. In order to maintain healthy office environment, cleanliness drive is very important and SAP brings in those common elements that need to be taken as first step to attain the goal of cleanliness. As part of SAP, HUDCO has taken a number of steps to make the office space clean and green such as digitization of office records; steps towards making e-office with less use of papers; disposal of old files, vehicles, redundant computers/ electrical/electronic items; cleanliness and maintenance of all HUDCO office toilets on daily basis, waste collection & disposal linked to municipal waste collection Dhalaos; cleanliness and beautification of surrounding areas; organizing various Swachhta awareness activities, workshops, Pakhwada, etc. Recently, HUDCO had organized a Swachhta Mela in association with Aga Khan Foundation where awareness about using recycled products in place of plastics was raised among the participants. Further, as part of the 'Swachhata hi Seva' programme, various programmes such as Swachhta pledge by all HUDCO employees, Nukkad Natak, etc. were organized by HUDCO. All offices of HUDCO including Head Office, HSMI and Regional Offices were open on 16th September, 2018 (Sunday) for cleanliness drive around the respective office premises with the spirit to make each HUDCO office a "Zero-Waste Office". In addition, HUDCO also undertook tree plantation and cleanliness drive in the surrounding and nearby areas like Andrews Gunj, Aliganj, B.K. Dutt Colony, Nizzamuddin, Janpath, Nehru Park, etc. Therefore, under the aegis of Ministry of Housing & Urban Affairs, HUDCO has been actively engaged in undertaking all the activities initiated by the Govt. of India under Swachh Bharat Mission. Yes, behavioural change in corporate culture has been a major challenge in

the success of Swachh Bharat Mission and such changes are happening and visible in corporate culture now.

Q. HUDCO has instituted 'Best Practice Award' for improving the living environment. Are there any Best Practice awards given by HUDCO in the field of Urban Sanitation and Waste Management? Do you think there is scope for further innovation and replication in this field?

Yes, since the year 2012, HUDCO has been giving 'Best Practice Award" to various agencies for contributing in the improvement in the living environment. HUDCO gives Best Practice Awards in 7 categories: (i) Urban Governance; (ii) Housing, Urban Poverty & Infrastructure; (iii) Urban Transport; (iv) Sanitation; (v) Environment Management, Energy Conservation & Green Building; (vi) Urban Design & Regional Planning, Inner City Revitalisation & Conservation; and (vii) Disaster Preparedness, Mitigation & Rehabilitation. During the last 7 years, HUDCO has awarded several urban local bodies and other stakeholders in the category of sanitation and waste management. Some of the awards include: Scientific Solid Waste Management by Warangal and Bhopal Municipal Corporations; Zero-Waste Management in Tamil Nadu by Directorate of Town Panchayats, Tamil Nadu; One- Home-One Toilet Program by Pune Municipal Corporation jointly with Shelter Associates, Pune; Sanitation through Public Participation by Directorate of Urban Development & Poverty Alleviation, Govt. of Mizoram jointly with Young Mizo Association; Underground Waste Bins by Haldwani Nagar Nigam, Nainital; 'Sabar Shouchagar' by Nadia District Administration, West Bengal; Waste to Energy initiatives by Jaipur Nagar Nigam as well as Pune Municipal Corporation. All these awards would go a long way in motivating other urban local bodies and concerned stakeholders to innovate and replicate suitably in their respective jurisdictions so as to further improve the quality of living environment.

Q. World Toilet Day is also celebrated worldwide on 19th November, which is about taking action to ensure everyone has a safe toilet by 2030. Do you see India achieving the SDG 6 targets on water and sanitation? What are the critical changes you envisage for effective and efficient transformation of current Urban India as 'Clean and Green Urban India' through SBM-Urban?

It is a matter of great concern that about 4.5 billion people in the world live without safely managed sanitation and 892 million people still practice open defecation. In this context, the World Toilet Day is very critical which focuses on building nature based ecological solutions to our sanitation needs. I am confident that the SBM would go a long way in India achieving the SDG6 aims at 'ensuring availability and sustainable management of water and sanitation for all' with the target that by 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. The results of SBM, so far, are quite staggering and I am sure in addition to SDG6, India will also reach the targets of SDG12 which aims to 'ensure sustainable consumption and production patterns' and mandates that "by 2030, substantially reduce waste generation through Prevention, Reduction, Recycling and Reuse".

Expert Opinion of Shri Vinod Kumar Jindal on

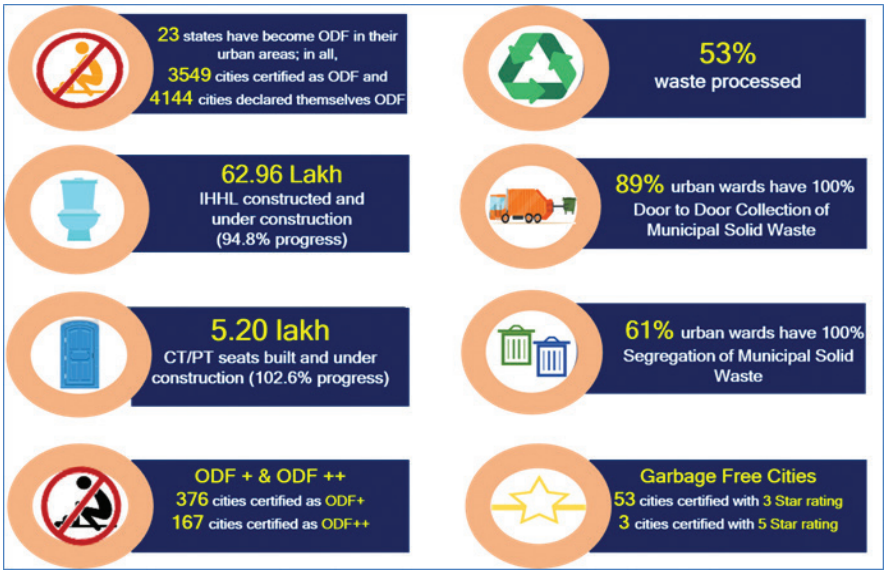
SWACHH BHARAT MISSION

Shri Vinod Kumar Jindal is an officer of Indian Cost Accounts Services of 1988 batch. Presently, Shri Jindal is working as Joint Secretary in the Ministry of Housing and Urban Affairs, Govt. of India and is looking after the Swachh Bharat Mission division. Shri Jindal has worked in the Department of Economic Affairs, Ministry of Petroleum and Natural Gas, Department of Agriculture, Department of Public Enterprises and Department of Expenditure in various capacities from 1988 till 13th August, 2017. Shri Jindal by profession is a Chartered Accountant and Company Secretary.

Q. The Government of India's flagship programme of 'Swachh Bharat Mission' started in October 2014 and has entered its 5th year of implementation. Could you please shed some light on the background of launching this Mission and the achievements so far?

Prior to 2014, Swachhata had no place in the dictionary or the imagination of the citizen of the country. Despite Gandhiji's claim in the early 20th century that "swachhata is more important than political freedom" urban sanitation and solid waste management did not find its rightful place in the socio-political discourses. In 2014, while launching the Swachh Bharat Mission, the Hon'ble Prime Minister gave a clarion call to the citizens of the country to join hands to achieve a Clean India by October 2019, to coincide with Mahatma Gandhi's 150th birth anniversary. The Swachh Bharat Mission – Urban has two broad objectives: creating all cities and towns in India Open Defecation Free (dovetailing with SDG 6.2 catering to Sanitation and Hygiene), and ensuring 100% scientific management of municipal solid waste in all towns and cities (in line with SDG 12.5 promising to reduce, reuse, recycle solid waste). The achievements under the Mission are summarized in the box below. The Mission has been able to bring about a change in the mindset of people in the way they view Swachhata and I am proud to say, the Mission is no longer a government project, but has become a '*jan andolan*'.

The Mission has been able to foster a spirit of healthy competition among its cities and towns, through its annual cleanliness survey, Swachh Survekshan and in 2019 it covered 4,237 cities and garnered citizen participation of 64 lakhs! – Proof of the extent to which the Mission has captured the mind-space of citizens. There has also been a paradigmatic shift in the way SBM is being implemented: the focus is now on sustaining Open Defecation Free (ODF) towns/ cities, rather than counting toilets alone. The *ODF+ and ODF++ Protocols* issued



by MoHUA emphasize on cleanliness and maintenance of community and public toilets and addressing the sanitation value chain in its entirety through faecal sludge management. The same holds true for solid waste management (SWM) as well.

The Mission is also committed to ensuring holistic transformation of cities through its *Star Rating Protocol for Garbage Free Cities*. Till date, 3 cities – Indore, Ambikapur and Mysuru have already been certified as 5-star cities, while 53 cities have been certified as 3-star.

Q. The other Government of India initiatives such as, Smart Cities Mission and AMRUT have strong linkages with the success of Swachh Bharat Mission'. Do you agree with this and could you please elaborate their contribution towards addressing the problem of inadequate sanitation in urban areas?

Cleanliness or Swachhata is at the core of the Government's development agenda. All other programmatic and technical aspects of urban development are centered around this idea of creating a cleaner, healthier, smarter and thereby a more livable India. At MoHUA, other Missions such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT) which addresses the issue of waste water and faecal sludge management, the Smart Cities Mission (SCM) which has Solid Waste Management as one of its development parameters - are complementing the SBM (Urban)'s efforts in taking forward the mandate of sanitation and waste management. SBM – Urban is also driving convergence with the National Urban Livelihood Mission whereby the Self-help groups registered with NULM are increasingly finding up livelihood opportunities in the sanitation and waste management sector (as is exemplified in Ambikapur and Pune). Moreover, other Ministries such as the Ministry of Environment, Forest & Climate Change, Ministry of Women and Child Development, Ministry of Health and Family Welfare, Ministry of Skill Development and Entrepreneurship and Ministry of Tourism have strong linkages with SBM-U. Coordination, cooperation and convergence with these different Ministries holds the key towards the attainment of a Swachh India.

Q. Financing Urban Basic Services Projects such as Sanitation, Solid Waste Management, etc. is one of the key issues for making urban areas clean and green. In this context, PPP has been seen as a potential financing mechanism for financing of such projects. What are the steps taken by the Government of India for promoting PPP in SBM?

The estimated cost of implementation of SBM (Urban) is INR. 62,009 Crore. The Government of India

share as per approved funding pattern amounts to INR. 14,623 Crore. In addition, a minimum additional amount equivalent to 25% of GoI funding, amounting to Rs. 4,874 Crore is contributed by the States as State/ULB share. The balance funds is to be generated through various other sources of fund which are, but not limited to private sector participation, corporate social responsibility initiatives, etc. In fact, one of the stated objectives under the mission is encouraging private sector participation. The Ministry, under the aegis of the Mission, is continually working on creating an enabling environment for the participation of the private sector. A few of these include: (i) Policy on Market Development Assistance to private compost manufacturers; (ii) Guidelines on Use of Refuse Derived Fuel (RDF) as alternate fuel in various Industries; and (iii) Policy for mandatory purchase of power by DISCOMS at stipulated tariff for power produced from waste.

Q. With the introduction of Swachhta Action Plan (SAP) making swachhta everybody's business involving Govt. departments, Ministries, and Institutions, 'behavioural change' in corporate culture has been a major challenge in the success of Swachh Bharat Urban. What steps are being taken to bring in behavioral changes for success of the Mission?

The Swachh Bharat Mission is the largest behavior change programme attempted by any government till date. In its final year, the Mission is on its way to achieving the objective it set out to deliver and the credit for this must go to the people of our nation. The Mission has launched several innovative communication campaigns on television, radio, print and social media to bring about and sustain behavioural change in people. For example, (i) *'Har Din Do Bin Campaign'* launched on World Environment Day in 2017 focused on source segregation of waste; and (ii) '*Asli Tarakki campaign*' focused on safe sanitation and toilet usage - a true reflection of how children are our greatest brand ambassadors when it comes to disseminating messages on Swachhata and getting people to act upon it.

We are also using a variety of methods to engage with the people on the ground. For example, we tied up with the Bureau of Outreach Communication (BOC) to conduct 1000 direct outreach programs in 250 cities. The monthly thematic drives conducted by the Mission across all its ULBs has met with great success when it comes to engaging communities and key stakeholders in the Swachhata of our cities. To cite a few examples of successful citizen engagement, more than 40,000 students had participated in a Swachhata walkathon in Navi Mumbai, an event which has found place in the Limca Book of Records. Citizens of Ahmedabad, through their commitment, ensured source segregation of 100% of the city's waste in a single day. Today, we are proud to say that we have over 150 national level brand ambassadors such as Amitabh Bachchhan, Sachin Tendulkar, Shah Rukh Khan, etc. to name a few, who have joined hands to take the message of Swachhata to the people of the country.

However, the real Swachhata ambassadors of this movement are the people of this country, aptly evidenced by the participation of over 1 crore people from thousands of urban Indian towns in over 63,000 events and cities during the Swachhata hi Sewa fortnight last year.

Q. Do you think instituting 'Best Practice Award' for innovative methods for implementing SBM would motivate the agencies for working toward continuity of the Swachhata culture? Do you think there is scope

for further innovation and replication in this field?

I truly believe that innovation is the cornerstone for the success and sustainability of any program and the Swachh Bharat Mission is no different. The Mission therefore has been focusing increasingly on identifying and recognizing innovations and best practices from both Urban Local Bodies (ULBs) and citizens in the area of sanitation and solid waste management. Parallely, cities are being encouraged to replicate these innovations and scale them up, to bring about significant improvement in the lives of citizens. This year, the Mission, during the Swachh Survekshan Award Ceremony held in March 2019 awarded some of these initiatives – for example, the Bohras and the Maratha communities in Indore have created a model of Zero Waste Public events which is now being followed across Indore, the cleanest city of India. Similarly, Panchgani, a small hill station in Maharashtra has converted a stinking garbage dumping yard to Swachh Bharat Point –a place where people come to take selfies and enjoy a meal or two, through a locally developed and financially viable model, which is replicable throughout the country. Be it the making of plastic to paver blocks in Korba or using flower waste to make value added products (Ujjain) – organizations and citizens are coming up with models that truly embody the philosophy of creating "Wealth out of Waste" through innovations and best practices.

Q. Do you foresee the Urban India transforming soon into 'Clean and Green Urban India' through SBM-Urban? What are the critical changes needed for this to happen?

The momentum built up under the Swachh Bharat Mission has helped to lay a strong foundation on which the 'Swachhata' movement now rests. The key focus during this period has been on building the necessary infrastructure, especially for sanitation, while simultaneously creating an enabling environment for policy changes and bringing about behavioural change in citizens. While significant progress has been made in these areas, the challenge now lies in sustaining the results achieved during this phase and targeting that all cities achieve ODF+ and ODF++ status and addressing the entire sanitation value chain through end-to-end faecal sludge management.

In Solid Waste Management, source segregation of waste has entered the mainstream vocabulary. While there are lighthouse cities doing noteworthy work on SWM such as Indore (Madhya Pradesh), Panchgani (Maharashtra), Nawanshahr (Punjab), Ahmedabad (Gujarat), etc, the idea of source segregations needs to be implemented completely in every city across the country. The next step, however, is to ensure minimization of the amount of waste generated by citizens within their homes through home composting, recycling of dry waste and practising the 3R (reduce, reuse, recycle) principle as a way of life. Going forward, the Mission will focus on the management of construction and demolition (C&D) waste, remediation of legacy waste, and blue economy through effective plastic waste management, for greater resource utilization and contributing to the principles of circular economy. The SBM- U will focus on building capacities of ULB officials, explore synergies with other ministries and most importantly, motivate a million more to join the Jan Andolan. I sincerely believe that a Swachh Bharat indeed holds the key to a Swasth (healthy), Samarth (empowered) and Samridhh (prosperous) Bharat and we are well on our way to seeing this transformation happen.

DEVELOPMENT AND ENVIRONMENTAL CONFLICTS

-CASE OF SOLID WASTE MANAGEMENT IN GURUGRAM

DR. VINITA YADAV
MS. JYOTI AHLAWAT

Development cannot happen without environmental resources and such resources are the foundation for development. Thus, development and environment are interdependent. Solid waste generation and transportation is one such environmental issue, which is related to economic development. For bringing improvement in environmental quality, human resources require know-how of advanced technologies as well as fund allocation for management of waste.

Key Words: Solid Waste Management, Environment quality, Landfill sites

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The management of solid waste is not restricted to municipal jurisdiction, but has regional implications, as waste generated from municipal areas is exported out of the region for processing and treatment. The waste associated issues are not limited to single jurisdiction but have regional linkages. The dynamics of economic development, waste management and environment are interlinked with each other but are often in conflict as one factor tries to overshadow the other. This paper examines the inter-relationship of economic development, solid waste generation and environment quality at a regional scale by assessing the waste generation, transportation of waste, waste disposal and waste management at solid waste dumping site in Gurugram case. The paper provides an insight into how solid waste generated within Gurugram municipal area affects the surrounding region as well as ecological sensitive region of Aravali ranges. The paper also analyses the initiatives taken by authorities and suggests strategies for scientific waste management.

INTRODUCTION

Environmental resources are the foundation of economic growth. Whenever the demand for resources increases more than the resource availability, a conflict occurs between the environment and economic development. The adverse effect of anthropogenic activities is also observed on environment when quantum of waste becomes more than the replenishing limit of environment. Solid waste generation is related to economic development. It's composition and quantum is dependent on the economic condition of the region. The pace of economic growth depends on the urbanization level of the region, which in turn affects the overall waste generation. The solid waste management process is also inter-linked with the environmental and social dimension in a region. The waste generated in municipal areas is often exported out of the municipal boundaries for processing and treatment at landfill sites. At times, regional delineation for waste management goes beyond the boundaries of a single region, as in the case of Gurugram and Faridabad, where waste dumping site is common for both the cities and this site is located beyond the city boundary. A single circle is formed for the purpose of waste management for two of the metropolitan city circles. The distance between waste generation sources to

solid waste-dumping site and cost of transporting the waste is positively correlated. The latter generates air pollution as well as impairs the aesthetic value of the natural environment. It justifies the need to focus on waste management while preparing plans at regional scale.

Such an impact of waste related activities are not limited to waste generating areas, but are spread from the neighborhood up to a regional scale. From waste generation to its management, the process of solid waste management is linked with social, economic and environment aspects. Thus, inefficient management of solid waste has an adverse impact on these aspects in a region. Regional planners' understanding of such linkages helps to plan an efficient waste management system at different scales. This paper examines the solid waste generation, impact on environment and economic development and regional linkages with the help of Gurugram case study.

RELATIONSHIP BETWEEN ENVIRONMENT AND DEVELOPMENT

Development cannot happen without environmental resources and such resources are the foundation for development. Thus, development and environment are interdependent. Solid waste generation and transportation is one such environmental issue, which is related to economic development. For bringing improvement in environmental quality, human resources require know-how of advanced technologies as well as fund allocation for management of waste.

People migrate to regional centers in search of employment opportunities. With economic growth, purchasing power of people increases, resulting in an increase in per capita consumption and waste generation. With rising urbanization, there is a change in lifestyle and food habits, and not only has the quantum of solid waste increased but its composition has also changed. As per Basel Convention Secretariat, per capita waste generation will increase from 0.46 kilogram in 1995 to 0.7 kilogram in 2025 in India (Ray 2008). It establishes the direct relationship between economic growth, urbanization and solid waste generation. Models such as Kuznets curve also describe the relationship between economic development and environment. The economic development initially leads to deterioration of environment but after a certain level of economic growth (per capita income), the society begins to improve its relationship with environment and levels of environment degradation reduce. This model is also studied in terms of income waste relationship.

There are various arguments regarding the curve and its application. Firstly, economic growth implies a negative scale effect on the environment. According to the hypothesis of scale effect, the amount of waste generated increases when economic activity expands. However, this trend can be reversed via technological progress and changes in the production structure. Similarly, in the composition effect phenomenon, the continuous increases in income drives the transition from manufacturing based heavy industry activities to a service economy, which generates comparatively less waste. The economic composition also affects the characteristics of waste generated. The second line of arguments relates to the elasticity of demand for environmental quality. It suggests that the growth of GDP per capita leads to further deterioration of environment in early stages of economic development. However, income growth stimulates demand for a cleaner environment by increasing the resources available to combat pollution. The willingness to pay for bringing improvements in environmental quality increases in greater proportion after arriving at a certain income threshold (Bandyopadhyay 2013). The third argument

analyses the role of state, institution and regulation policies. When the basic needs of people are met, their concern for the environment increases. The environmental quality is considered a luxury good for certain income levels. Institutions improve the regulatory framework and effectiveness of the enforcing agencies. Weak policy regulations and their reduced enforcement lead to intensive waste generation activities. Thus, the three categories indicate the relationship of waste generation with environment, economic growth and change in technology. With increase in income, environmental resources become a compulsory good for quality of life as compared to a source of production.

IMPACTS OF SOLID WASTE MANAGEMENT AND ECONOMICS INVOLVED

Solid waste management in a region is related to the economic condition of the region. In the process of solid waste management from collection to disposal, economics plays an important role. The first step in solid waste management is the collection of waste. There are different types of solid waste generated in the region depending on their sources, which can be further classified as household waste (municipal waste), industrial waste (hazardous waste), biomedical waste (hospital waste) and electronic waste. As per MSW Rules 2016, municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. The garbage is generated mainly from residential and commercial complexes. Increase in population at a faster rate accelerates the solid waste generation. With a higher quantum of waste generation, infrastructure availability such as vehicle to transport the waste, etc. as well as appointment of workers for solid waste related activities and site allocation for dumping the waste will happen within a region. In case of a mismatch between waste generation and availability of associated infrastructure for its transportation, disposal and management, environmental deterioration occurs.

The type and amount of waste generated in a region depends on its economic composition, whether it is an industry, agriculture or service sector based economy. The collection process depends on the collection system introduced by handling agencies and community awareness. The collected waste goes through various transformation processes including recycling, energy recovery, compost, biogas production, alternative fuels and other transformation processes. When such processes are not possible, waste is disposed off in landfills.

The uncollected solid waste thrown into storm water drains leads to clogging of drains and obstructs storm water runoff. It also finds its way into streams and rivers, resulting in flooding. The solid waste thrown into streams and rivers deteriorates their water quality, resulting in loss of biodiversity inside the drain. The uncollected solid waste consists of plastic waste which gets fragmented into microscopic pieces and leaches the toxin Bisphenol A and other toxins in the river and ponds (Gall and Thompson 2015). In turn, it disturbs the local ecosystem. The collected waste harms the environment in other ways too, as landfill sites are a breeder of diseases due to air pollution and leaching lead to soil quality degradation. Although it is difficult to quantify all the above impacts economically, they do impact the economy indirectly at a global scale.

For collected waste disposal, landfills are a common practice. The selection, construction and use of landfill sites are important steps in solid waste management. In habitated areas, land uses compete with each other due to high land values. The landfill sites have negative externalities leading to property value depreciation in surrounding areas. The trade off happens between transportation

cost and land value at the waste disposal site. If land value is lower in the periphery, municipal authorities export the waste out of their jurisdictional boundaries in order to save the cost of land. The waste management is not restricted to municipal boundaries. Waste generated in municipal areas is often exported out of the region for processing and treatment at landfill sites. The impact of waste disposal activities is not limited to the waste generating areas, but also pass on to other areas. Such sites are located either in the outskirts or in neighbouring jurisdictions. The process of waste collection and its transportation to the landfill sites harm environment in one way or another.

Sanitary landfill sites are provided far from the settlement, mainly in areas located in villages. During transportation, waste spillover happens. The Green House Gas (henceforth GHG) emissions from burning the fuel add to the environmental pollution. The decomposition of waste at landfill sites releases toxic gases and chemicals in air and water. Waste decomposition creates leachate, and in the process of matter decomposition, methane gas is released. Methane is a major contributor of GHG arising out of the waste sector. Thus, the inefficient waste management in a region affects the regional environment as well as contributes to environment related issues at global scale.

Economics is involved, in terms of environment as well as health and socio-economic benefits, in the whole process of solid waste management. Migrants, who belong to economically weaker section, see solid waste as an opportunity for livelihood generation. In the absence of other employment opportunities, such migrants find waste collection as an unrestricted livelihood-generating means and indulge in informal waste collection. The informal sector plays an important role in solid waste recycling and disposal at no extra cost to public, municipalities or waste management authority of the area. The rag pickers remain in direct contact with the waste, leading to health hazards. Such rag pickers along with other workers at landfill sites are the most vulnerable group.

Solid waste directly or indirectly impacts the health of people. For the residents, the major hazards to health are indirect and come from the breeding of disease vectors, elementary flies and rats (Ray 2008). Thus, inefficient solid waste management affects the environment, people's health and society. Environment deterioration is an indirect economic loss, which affects health of region's inhabitants. Health implications reduce human resource potential, productive working man-hours and increases health infrastructure demand in the region.

Thus, effects of inefficient solid waste management can be seen in terms of both environment and socio-economic losses. Such impacts are not limited to a particular area but have regional linkages too. With development, solid waste is a challenge faced by all regions irrespective of their population, size and area across the country. On one hand, highest percentage of authorities budget is devoted to manage the growing burden of solid waste. On the other, solid waste acts as an opportunity for economic development for people indulged informally in solid waste management process. Thus, solid waste management provides a challenge as well as opportunity for the region's development.

NEED OF STUDY

Solid waste management provides an opportunity to planners for transforming the waste management practice from a cost intensive challenge to a long-term economic development strategy. This will be achieved by formulating solid waste management strategies that address the economic, health and environmental concerns and work out the land use relationship connected with the inappropriate disposal of waste at regional level. There is a need to undertake a

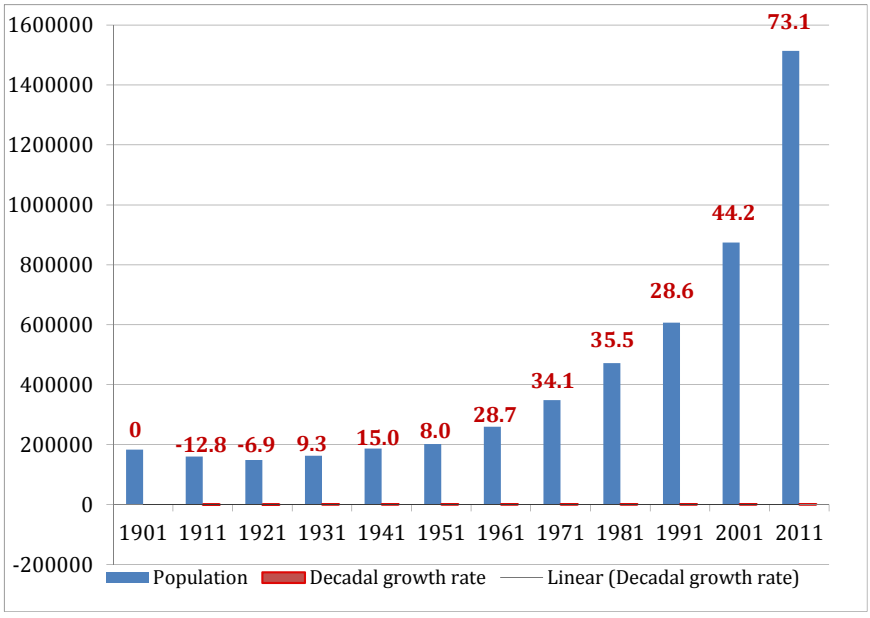
regional level study to formulate strategies for waste management by understanding the relationship between economic development, solid waste generation and environmental quality. Keeping this in mind, the aim is to understand the inter-relationship of economic development, solid waste generation and environmental quality as well as formulating waste management strategies for Gurugram. The study objectives are to understand the linkage of development, solid waste and environment with planning; to study the regional demography, employment characteristics, economic structure and environment related solid waste dynamics; to understand the reasons for inefficient solid waste management; to understand the impact of landfill sites on communities residing near such sites; and to formulate community region- specific waste management strategies.

The case study of Gurugram is taken to understand the relationship between solid waste, development and environment. The population and GDP statistics for Gurugram have been collected and analyzed. The issues pertaining to solid waste have been studied from various available published researches and newspapers. The projects taken up by authorities for solid waste management such as landfill site and waste to energy plants have been studied for their impact on environment and communities. The role of different agencies and organizations involved in solid waste management has been studied for comprehending their roles and future potentials. Based on the above study and analysis, reasons for inefficient solid waste management are identified and strategies formulated for improving that the waste management.

POPULATION GROWTH AND WASTE GENERATION: CASE OF GURUGRAM

Gurugram took the upward trajectory of growth around 1966, when it came under the administration of Haryana state. The growth of the city started with the setting up of Maruti Udyog in 1980s. From 1990 to 2000, the population increased at a rate of 44 percent. In 2000s, the city experienced population explosion, accompanied by real estate and IT sector boom. Gurugram is one of the fastest growing centres in NCR region. From 2001 to 2011, the population increased at the rate of 73 percent (Figure 1). The exponential population growth of Gurugram has caused a manifold increase in the generation of solid waste. In 2014-15, Union Ministry of Urban Development conducted a survey and has given a Swachh Bharat ranking in 476 class-I size cities. Each city has been awarded a Swachh Bharat rank based on 42 indicators out of which 20 indicators are related to open defecation practices and 22 pertaining to solid waste

Figure 1 Population Growth of Gurugram, 1901-2011



Source- Census of India 2011 and Gurugram District Fact Book

management system. In this survey, Gurugram ranked 466 out of 476 cities. Despite being the fastest growing centre in India, Gurugram received a rating of 36 out of 73 cities in the Swachh Sarvekshan 2016 under the Swachh Bharat Mission. Such ranking indicates the condition of solid waste management in Gurugram and confirms the direct relationship with economic growth of Gurugram. Since the last 40 years, strong economic growth of Gurugram has resulted in the corresponding increase in waste generation in the region.

Gurugram's District Domestic Product (henceforth DDP) has increased from 1,669 crore for the year 2004-05 to 2,699 crore for year 2009-10, an increase of around 62 percent in 5 years. The per capita income for Gurugram district has increased from 81,478 rupees in 2004-05 to 2,29,208 rupees in 2009-10. Waste generation in Gurugram is growing at 5 percent annually (Table 1). According to the DG Environment News Alert Service (2010), the amount of solid waste has a positive and causal relationship with Gross Domestic Product (henceforth GDP). With the increase in GDP, solid waste generated in the Gurugram region also increases. (Table 1)

Table I Per capita Waste Generation for Gurugram

Year	Population	Per capita waste (Gram per day)	Total waste generated
2006	1,250,000	320	400
2011	1,514,085	350	525
2021 (Proposed)	2,600,000	400	1040

Source- Municipal Corporation of Gurugram 2013 Report on Solid Waste Management

COMPOSITION OF SOLID WASTE

Gurugram was envisioned as a satellite town for Delhi where people from Delhi travel for work related activities. Over the years, it has developed as a land of a mix of different land uses developed by private sector players and government without any integration. Gurugram is presently a hub of industrial, corporate and medical facilities in the NCR region. The isolated land use planning is clearly visible in the spatial plan. The mix of land use dictates the waste composition of the region, as well as guides the waste management strategies dependent upon the waste composition for future. Gurugram has been developed in parcels. Apart from municipal solid waste, e- waste is also generated in large quantities, due to huge corporate sector, bio-medical waste due to growing hospital sector and industrial waste due to growing industrial base within the region. Due to rapid real estate sector development, it generates 700 ton of construction and demolition waste. Around 161 big construction sites and more than 1,000 small and midsized construction sites exist in and around Gurugram. Bio-medical waste is also an important constituent of waste. Gurugram has only a single facility for treating biomedical waste at Bhondsi where waste from hospitals, and nursing homes is being processed (Naveen 2018).

CURATIVE VS. PREVENTIVE APPROACH FOR SOLID WASTE MANAGEMENT

Since 1980s, when Gurugram started growing, there was no solid waste treatment plant planned. The only solid waste treatment plant of Gurugram was set up in 2007, which became operational in 2008 (The Indian Express 2015). Since land values in the region were high due to real estate development, availability of land in proximity of the urbanized area for waste disposal was the major area of concern for authorities. This is considering the quantity of waste generated and price of land. Thus, the waste disposal sites were selected in villages far away from urbanized area.

Water accumulation at Bandhwari

Source: Yogendra Kumar for Hindustan Times photos, 29 June, 2018 (left picture), 1 July, 2018 (Right picture)

In Haryana, cluster based Municipal Solis Waste (henceforth MSW) plants have been adopted. Gurugram comes under the Faridabad cluster that consists of Gurugram and Faridabad. The 30-acre site of 1000 ton per day capacity is developed in Bandhwari village. The combined solid waste management facility plant started functioning at Bhandwari for processing the MSW for Faridabad and Gurugram Municipal Corporation in 2008. The plant reached its limit in 2013 and stopped functioning since then (Sumedha 2019). In case of Gurugram, the increase in waste generation is comparatively higher as compared to projections and development of landfill sites. The non-segregated waste reaching the landfill site is also accountable for reaching its limit. The prime issue is of waste segregation at collection stage in the waste management process. The waste from source is collected at transit sites. Rag pickers informally sort out some amount of waste at the transit sites. Three different types of transit points i.e. community bins, refuse containers and the dumper placer containers are found. From these sites, large dumpers carry the waste to the Bandhwari solid waste treatment plant and the landfill site. About 90 percent of the waste (in mixed form) reaches the Bandhwari landfill site. Thus, recyclable and biodegradable waste also reaches landfill sites. The waste generation, which is more than the projected quantum, non-segregation of collected waste and entire collected waste not reaching the landfill site are some of the factors leading to malfunctioning of the only landfill site at Gurugram.

In the cluster, the estimated MSW generation is 1165 ton per day in 2012, which is expected to reach 2100 ton per day by 2035 (Municipal Corporation of Gurugram, 2016). Identification of landfill site and planning for required capacity is one of the challenges in front of authorities. In 2016, Municipal Corporation of Faridabad proposed an integrated solid waste facility of 1100 ton per day capacity on Faridabad-Gurugram road for processing 600 tons of waste from Faridabad and 400 tons of waste from Gurugram. The per capita total waste generated in Gurugram was more than 529 tons per day in 2011. This quantum was more than the proposed waste to be generated in 2016. A curative approach is followed for waste management in Gurugram instead of a preventive approach. Waste management

Defunct Bandhwari Waste Treatment Plant

Source- Parveen Kumar for Hindustan Times Photos , April 12,

becomes a challenge when the dumping site gets saturated and effect of improper waste starts impacting the environment. Due to application of unscientific disposal technique and faulty waste projection, the dumping site becomes a mountain of waste and waste pilferage deteriorates the surrounding environment. Then, project proposals are made for rejuvenation of such sites as happened in case of Okhla and Bhlaswa landfill site.

This requires a preventive measure of proper site selection and maintenance. The criteria and method followed for the Bandhwari dumping site selection are not provided in the project proposal reports. The site is located in close proximity to residential areas and water bodies, which is against the guidelines laid out by Solid Waste Rules 2005. Further, the site is located on the foothills of Aravalli Hills. Therefore, the undulating topography of the dumping site has potential for polluting underground water. Site location indicates that the parameters such as underground water quality, slope of the area, nearness to the residential areas, and presence of water bodies have been not considered for site selection.

Other than this, the plant has impacted the residents of neighboring villages in different ways. Residents of Bandhwari, Pali, Mangar and Gwal Pahari villages held protests demanding shifting of the plant citing health concerns and contamination of water resources (Pati 2017). The contamination of water and soil has also been proven by many state and central surveys.

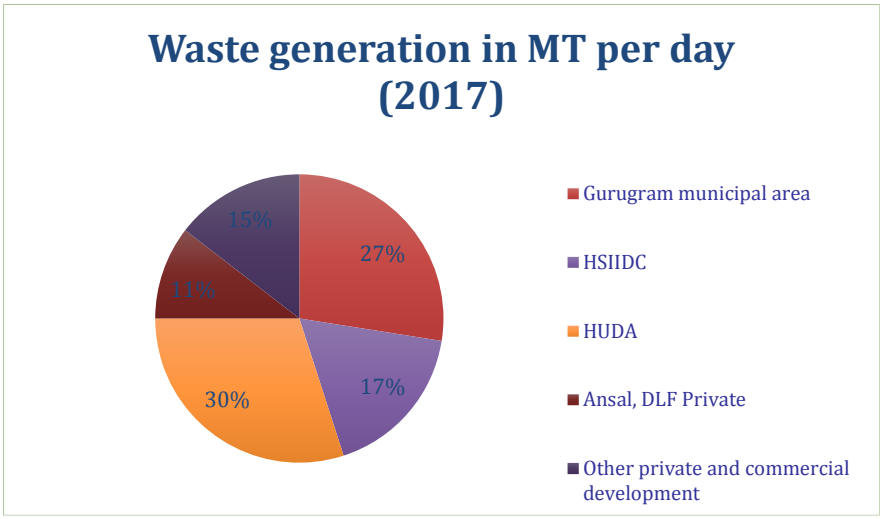
ROLE OF ORGANIZATIONS IN SOLID WASTE MANAGEMENT

Municipal solid waste is being managed by number of organizations. Both municipal bodies and private contractors manage it. Municipal Corporation Gurugram (MCG) is responsible for collection, transportation and disposal of waste generated within the municipal limit. Haryana Shehri Vikas Pradhikaran (HSVP), erstwhile Haryana Urban Development Authority (HUDA), manages the waste generated in HSVP sectors. Private developers manage solid waste in their respective colonies whereas village panchayat takes care of waste in the urban villages. Around 400 metric ton of municipal waste is collected every day within the controlled area out of which about 75-80 metric ton is generated within the municipal area and rest in HSVP sectors, private developers' area, and urban villages.

As per MCG study conducted in 2009, waste management in different areas of Gurugram is as follows:

HSVP Area: In this area, waste collection is being undertaken by private contractors, Resident Welfare Association (henceforth RWAs) as well as by permanent employees of HSVP. RWAs with financial assistance from HSVP manage the waste generated in these sectors. The infrastructure for solid waste includes bins placed in different sectors for

Figure 2: Waste generation in Gurugram



Source- Gurugram Handbook on Waste Management, 2017

collection; with refuse collectors owned by HSVP and tractor-trailer deployed by private contractor. About 30 sanitary staffs are regular employee of HSVP and RWAs, and private contractors provide the balance employees.

MCG Area: Municipal Corporation of Gurugram (henceforth MCG) manages the waste only in the municipal area i.e. Gurugram Town, with an operational staff strength of 387 sanitary workers, under the overall supervision of Chief Sanitary Inspector. Three different types of waste storage points exist in MCG area i.e. *Dhalao* (hindi term used for community bin), refuse container and dumper placer containers. The system of waste collection is predominantly manual, with only 25-30 percent of the waste being collected mechanically using dumper placer container, loader and trucks. Municipal and private operator collectively transport the waste (Pant 2018).

Private Developer's Area: Private developers have engaged private contractors for door-to-door collection, street sweeping, transportation, and disposal of waste. Cycle rickshaws do door-to-door collection. Tractors trolley or dump trucks are used for transportation of waste. In the absence of any designated site, collected waste is disposed off in the vacant land. In few societies, the community waste disposal system for biodegradable waste has been adopted.

Urban Villages: There is no system of waste management in the urban villages located within the controlled area boundary. Waste is thrown in the vacant land within or outside the village limit.

ISSUES AND STRATEGIES

The quantum of per capita waste generation has increased from 320 to 400 gram per person i.e. 5 percent rate of annual growth from 2006 to 2011. It has increased far beyond the envisioned waste calculation. This is the reason why the selected landfill site of Bhandwari ran out of its capacity before time. It requires two measures i.e. segregation and handling of different types of waste (Bio-medical and industrial) separately. The pressure on a single landfill site is comparatively less, if processing of different types of waste is planned separately. With the segregation and recycling of waste, quantity of waste reaching landfill site automatically reduces. Hence, the process requires initiatives at source level of waste generation.

Another issue with waste management in Gurugram is multifarious institutions functioning independently to handle the waste. None of the institutions handle the system of waste management alone. Different institutions are managing the waste in different parts of the region, which makes the operation and strategy formulation difficult for the future.

For handling solid waste, solid waste dumping site is one requirement. In a cluster based approach, environmental aspects are not considered during site selection. The authority has not considered the parameters of cost and area at existing site. The dumping site is low cost but open, non-useable and has potential for polluting underground water and air quality. The organised segregation and door-to-door collection system is being practiced only in private developer's area. Such a practice should be implemented in the whole of Gurugram. Streamlining the institutions for collection, transportation and disposal shall be the intervention for solid waste management in Gurugram.

CONCLUSION

The economic growth has resulted in an increase of production of solid waste, and a direct relationship exists between economic growth and solid waste production. The population of Gurugram has grown at a fast rate and disposal of municipal solid waste of the city has increased as a by-product of economic activities. The waste management process

has followed a curative approach of solving the problem, after an issue has erupted. The solid waste generation has increased more than the quantum that can be handled at city scale. Such an increase requires an emphasis on policy and technological interventions at regional scale. This should be done keeping in mind that solutions cannot be found within city boundary. The waste is related with population size and requires pre-planning and initiatives both at authority and regional level. There are many problems related to solid waste management but there are also best practice examples of waste handling in Gurugram.

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CSR ACTIVITIES OF HUDCO : CLEAN INDIA MISSION

SOLID WASTE MANAGEMENT IN BANGALORE

-A FIELD STUDY OF PRIMARY COLLECTION

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BBMP has taken up several initiatives to encourage waste segregation in Bangalore. Some of the initiatives include, setting up of Dry Waste Collection Centers (DWCCs) in each ward; launching of Kasa Mukhta (garbage free) Programme; registration of waste pickers as formal recognition of their role; and revival of Karnataka Compost Development Corporation.

Keywords: Solod waste mangement, source quality, dry risk

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Solid waste management (SWM) is an emerging multidimensional challenge to manage cities in India particularly in rapidly growing large cities like Bangalore where exponentially growing migrant population as well as consumerism is posing considerable challenges. Timely collection, proper handling and disposal of solid waste require scientific and systematic approach. The current procedure of handling solid waste incentivises handlers to aggravate the problem and requires a large amount of land for waste disposal. Finding adequate land for disposal in a rapidly growing city like Bangalore has posed serious challenges as the landfills create huge negative externality in terms of polluting air, water and causing substantial health risk. The data inadequacies and absence of proper understanding of the actual practices are making it difficult to arrive at appropriate solutions. In this context, this paper tries to capture the primary waste generation practices, the gaps in collection process, and estimation of the waste generated at primary level for the Bangalore city.

INTRODUCTION

Bangalore, the capital of Karnataka State, is one of India's fast growing cities with an average annual population growth rate of 3.25 % and with a population of 8.4 million (census 2011). It has an area of 800sq km and is situated at an altitude of 920 m above mean sea level. It is the third most populous city in India. The city is divided into 8 zones that are further divided into 198 wards. This paper is based on the findings of a research study sponsored by HUDCO on 'Solid Waste Management in Bangalore'. The paper discusses the waste generation as well as the waste collection practices in Bangalore and provides recommendations for efficient SWM practices. The objectives of the study were to: (i) assess the quantum and the composition of Municipal Solid Waste (MSW) taking select wards of Bangalore as samples; (ii) undertake due diligence of the primary collection systems of MSW in selected wards, and identify the key issues and gaps in collection process; (iii) study the behaviour of the citizen and identify their concerns and issues in storage, segregation and disposal of solid wastes; and (iv) recommend model collection system and best practices to be followed during the collection system.

STUDY AREA & METHODOLOGY

The study collected the secondary data from official sources and primary data from a sample of 10 wards which constituted 5% of total wards numbering 198. There are in total 8 zones under BBMP (Bruhat Bengaluru Mahanagara Pallike) and at least one ward per zone was selected taking into consideration that the selected wards had the following categories of waste generators: residential population; slums / areas around slums; commercial establishments (hoteliers / marriage halls / convention centers/shopping malls); markets (vegetables, fruits, meat); institutions (hospitals, schools, colleges, etc.); and industries (including IT Parks).

Out of the remaining two wards, one ward was selected from old areas of the city where there is maximum floating population, high density commercial areas and haphazard/unplanned dense development and the other ward was selected based on the best practices currently adopted in segregation, storage and disposal of waste. Table 1 gives the area and population of the wards selected for the survey.

Mapping the collection process right from generation of municipal solid waste from various groups to storage - segregation, door-to-door collection, transportation, treatment and disposal of MSW - was undertaken and process flow charts were developed for all the selected wards.

An important contribution of the study is the determination of the quantum and composition of household waste through the measurement of the waste. This was done in a sample of 5 wards out of 10 wards at household level. The selected households in the sample were a mix of various socio-economic backgrounds. The data on waste generated was collected from 270 households for 3 days (810 samples). In the selected households, 7 disposable covers with labels for different types of disposable items were placed and the residents were explained to dispose solid waste in each

Table 1: Ward Characteristics

Sl. No.	Ward Number	Ward Name	Zone	Area (sq.km)	Population (2011 census)	Remarks
1	110	Sampangiram Nagar	East	4.45	27,504	Old city & Shivajinagar market
2	91	Bharathi Nagar	East	0.78	32,689	Russell Market
3	65	KaduMalleshwaram	West	11.36	35,609	Planned area
4	94	Gandhi Nagar	West	1.93	31,208	Old city
5	178	Sarakki	South	1.34	31,063	New area
6	160	Rajarajeshwari Nagar	Rajarajeshwari Nagar	11.35	56,897	New area
7	174	HSR Layout	Bommanahalli	6.98	63,033	Apartments dominated
8	3	Atturu	Yelahanka/ Bytrayanapura	10.13	58,129	New area
9	15	T.Dasarahalli	Dasarahalli	0.88	33,042	Apartments dominated
10	85	Doddanekkundi	Mahadevpura Zone	12.12	63,083	Apartments dominated

Source: BBMP

cover as per the label. The seven categories of waste include: wet / organic waste; paper; plastic; other dry waste (metal, glass, tetrapacks, tin, rubber, leather, rexin, etc.); sanitary / biomedical waste; hazardous; and other rejects (thermocol, e-waste, broken sanitary ware, etc.).

Survey of citizens was conducted in the 10 wards with objectives of understanding the primary collection systems of municipal solid waste, and identifying key issues and gaps hindering the collection process. Stratified sampling was done in order to ensure different categories of citizens were captured. The categories included those living in individual houses (general & slums) and apartments, restaurants owners, marriage hall owners, nursing homes/ clinics owners, schools and shop owners. From each ward 100 samples were randomly selected. Thus, total 1000 households and establishments were surveyed from the 10 selected wards. The shops and bulk waste generators were covered as part of the citizen's survey.

WASTE MANAGEMENT IN BANGALORE

Under the current practice of solid waste management at BBMP about 70% of the MSW activity starting from primary collection to disposal has been outsourced and 30% is managed by BBMP. The primary collection is performed using pushcarts & auto tippers which are used for door-to-door collection. The door-to-door collection & sweeping is performed by sweepers of BBMP and contractors. The service contracts which have a maximum period of 3 years include segregation of waste as one of the important aspects.

BBMP has taken up several initiatives to encourage waste segregation in Bangalore. Some of the initiatives include setting up of Dry Waste Collection Centers (DWCCs) in each ward; launching of Kasa Mukhta (garbage free) Programme; registration of waste pickers as formal recognition of their role and; revival of Karnataka Compost Development Corporation.

The idea behind establishing DWCCs was to facilitate the streamlining of the entire process of waste management in the city, by concentrating exclusively on Dry Waste. The DWCCs are equipped with appropriate infrastructure capable of purchasing, collecting, aggregating and processing both high value and low value dry waste like plastics, papers, glass, tetrapaks etc.

There is a plan to set up dry waste collection centers in all the 198 wards. Till 2013, dry waste collection centers have been set up in 148 wards of which 100 are functional, out of which working of 57 DWCCs have been entrusted to NGOs.

FINDINGS OF THE STUDY

The system level findings of the study are presented first followed by the analysis of primary survey conducted.

Policy Level

The due diligence of the Policy of Integrated Solid Waste Management 2012 for BBMP, prepared by the Department of Environmental Cell showed that it lacks the ways of incentivizing/ dis-incentivizing the citizens and other stakeholders to segregate the waste. It lacks the means of effective mechanism and role of citizens in monitoring the service delivery on a regular basis. It does not contain the standards for evaluating and monitoring the performance of the service providers.

Organizational Level

The responsibility of day-to-day monitoring of solid waste services is decentralized and entrusted to supervisory staff (junior or senior health inspectors) working at the ward level. However, roles are not clearly defined for staff above Junior Health Inspectors. The Junior Health Inspector with his/her limited knowledge at the bottom of the organizational structure, is the only one completely in charge of solid

waste management for the ward. Posts of Environmental Engineers have been created for improving skills to carry out the municipal services of solid waste management; however, BBMP did not have the desired number of Environmental Engineers. Hence in most of the wards, the civil engineers are given additional charge of solid waste management. Environmental engineers / specialized / trained staff were not interested in this job due to inadequacy in their career growth avenues.

Contract Effectiveness

System of giving small and multiple contracts has made it easy and quick to implement. The private entrepreneurs are willing to invest in collection and transportation equipment, as well as providing labour, tools, equipment, etc. The normative standards stated in the SWM Policy for Bangalore for segregated storage of waste on premises, door-to-door collection, street sweeping, secondary storage are rarely cross-checked with the on-ground performance of the contractors / workers. This is due to the lack of proper data at ward level to measure the performance of the service provider using standard norms.

Monitoring at each ward depends upon individual supervisory staff (junior or senior health inspectors) and the success in implementation of Solid Waste Management Rules also depend upon his/her extraordinary championship. Technology such as smart phones, social networking sites, etc. for quick reporting and monitoring has not been adequately utilized. In case of default or non-performance, the tendency is to pass the blame between the contractors / multiple staff. Role of NGOs / SHGs / RWAs is limited due to the current system of contracts. The biometric system suggested in contract document to monitor the punctuality and regularity of the workers/staff is yet to be implemented.

The mode of payment is based on quantity of waste brought to the landfill. This acts as a disincentive towards waste segregation and waste reduction. Weak monitoring leads to higher payment for the contractors.

Process Inadequacies

Primary Collection: Segregation of waste and awareness creation are an important aspect of SWM. Though lots of initiatives have been taken in terms of creating awareness about waste segregation, none of them is carried out on a regular basis. Segregation of waste is not taking place in an organized manner and is taking place in only those areas where citizen's groups or RWAs/NGOs are active. The workers while collecting the waste from such households pick up the recyclable materials and sell them at junk shops and bring the left over to the DWCCs. They dump the remaining mixed waste at the collection points from where it goes to the landfill on compactor/lorry. Even though the contract suggests no Garbage on Ground (nGoG) method, the transfer of waste at each stage is done manually at temporary depots. These are mainly vacant plots or road sides which necessitates multiple handling of waste. Waste is often spilled over which is unsightly and unhygienic. The waste collectors are either not given the required tools and equipment or they have not been educated enough to use them. As a result, they handle the waste without the use of safety gear like boots, uniform, gloves, etc.

Dry waste collection centers are one of the unique initiatives by BBMP and if properly administered, can help in segregating almost 30% of waste produced every day. However, due to lack of proper waste segregation, the centers are not very effective.

Secondary collection and transportation: Most of the autos are old, ill-maintained, open and without hydraulic system. There are insufficient workshop facilities for regular cleaning and vehicle maintenance. The waste is mostly transported in open lorries or trucks with bags of segregated waste hanging on the sides. Availability of compactors for transportation of

Table 2: Average per capita waste generation (grams/day)

S.No.	Waste Components	Ward 65 Kadu Mallesh-waram	Ward 110 Sampangiram-nagar	Ward 160 Raja-rajeshwarinagar	Ward 15 T. Dasarahalli	Ward 85 Doddanek-kundi	Average of 5 wards
1	**Organic**	210.48	208.42	219.71	209.59	235.06	**216.65**
2	**Paper**	22.04	18.97	22.45	17.77	23.48	**20.94**
3	**Plastic**	33.35	24.02	27.76	20.58	27.02	**26.55**
4	**Other Dry waste**	25.93	25.01	16.96	20.02	13.39	**20.26**
5	**Sanitary**	36.41	5.01	8.15	2.85	28.12	**16.11**
6	**Hazardous**	2.69	2.76	1.43	0.52	5.11	**2.50**
7	**Rejects**	15.81	0.00	5.01	1.73	7.73	**6.06**
	Total quantity (gpcd)	**346.69**	**284.19**	**301.45**	**273.06**	**339.91**	**309.06**

Source: Household survey for quantity and composition of waste generation

waste to the landfills is limited to few wards. This is mainly due to the contractors sharing this facility between various areas awarded to them. There is lack of synchronization of primary and secondary collection of waste which results in multiple waste handling or waste remaining at points of generation.

Quantum and composition of waste: An important contribution of the current study is the estimation of waste generated at primary level. Based on the sample household survey for quantum and composition of waste, it was found that the quantity of waste generation in Bangalore is about 309.06 grams per capita per day (Table 2).

The physical composition of the household waste based on the survey is: Organic waste generated from the households is 2022 tpd (70.57%); Recyclable component is 629 tpd (21.97%); and Non-usable inorganic including sanitary, hazardous and rejects is 214 tpd (7.47%). The breakup of physical quantity of household waste generated based on the household survey is given in Table 3.

As per the SWM Policy document prepared by the Department of Environmental Cell, BBMP in year 2012, the household waste forms 54% of the total waste generated in the city. Considering total household waste of 2,865 tpd as 54%; the remaining 46% i.e. 2,440 tpd is the waste from commercial establishments, markets and function halls, institutions and others. Therefore, the total waste generated in the city is 5,305 tpd.

Observations from the household survey

Table 3: Quantity of organic and inorganic waste generated at household level

S.No.	Waste Components	Percentage waste composition (%)	Quantity of waste (tonnes)
I	**Biodegradable waste**	**70.57**	**2021.79**
1	Organic	70.57	2021.79
II	**Inorganic (Recyclable)**	**21.97**	**629.35**
2	Paper	6.78	194.18
3	Plastic	8.55	245.05
4	Other Dry waste	6.64	190.11
III	**Inorganic (Landfill, Sanitary, Hazardous)**	**7.47**	**213.89**
5	Sanitary	4.86	139.15
6	Hazardous	0.78	22.43
7	Rejects	1.83	52.31
	TOTAL	**100.00**	**2865.03**

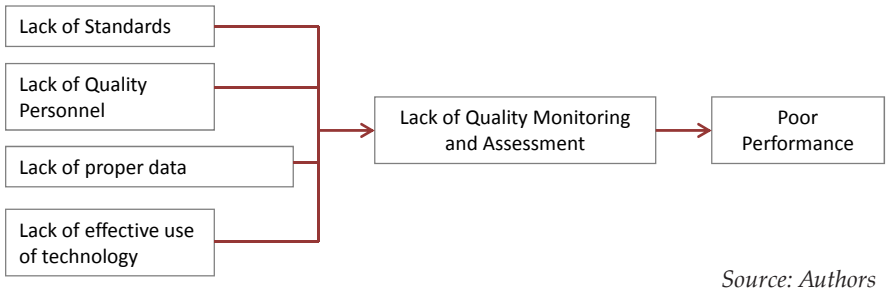
Source: Household survey for quantity and composition of waste generation

The system of door-to-door collection and segregation are not standardized across wards. Only 56.5% respondents reported daily cleaning of the street in their locality. On an average, 75% of the waste is collected directly from the households, and the remaining 25% of waste comes on the streets, vacant plots, etc. Also most of the waste collection and street cleaning is over by noon and any waste that comes on the road after noon gets cleaned up only the next day. . Just 40% households segregate the waste out of which 70% say that the waste gets collected in a segregated manner by the worker. This indicates that only 28% of the waste enters the waste stream in a segregated manner. More than 60% respondents are ready to pay for solid waste management services and 28% are neutral about the payment for the services. The wards that are cleaner than the others are the ones where Citizen's groups are active in SWM.

Observations from the survey of bulk generators

Overall service delivery and waste segregation in case of shops and bulk waste generators is better than that of households but has scope for improvement. Even in areas dominated by shops & restaurants, most of the doorstep waste collection and street cleaning is over by noon. In commercial areas, collection of waste and street cleaning twice a day is preferred. Segregation of waste is performed by more than 60% of respondents in both cases. However, some of this segregated waste is mixed up by the workers and only 44%, in case of shops and 54%, in case of bulk generators, enters the waste stream in a segregated manner.

Figure 1: Service quality gap



Source: Authors

Service Quality Gap

The performance in case of primary collection of solid waste management at Bangalore can be improved by quality monitoring and assessment with the help of proper standards, by appointing quality personnel, by generating regular data, and by using the available technology effectively. As shown in Figure 1, lack of standards, lack of quality personnel, lack of proper data and lack of effective use of technology leads to lack of quality monitoring and assessment. The current poor performance is the result of lack of quality monitoring and assessment.

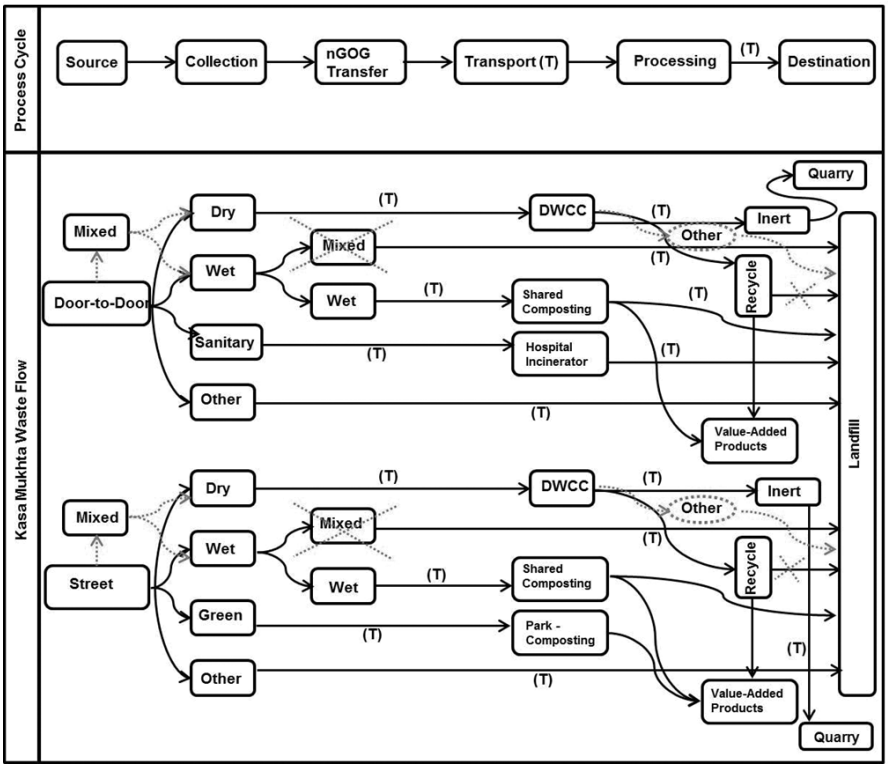
RECOMMENDATIONS

It would be difficult to bring in expensive high-technology solutions of managing waste in India and Bangalore is no exception. The city is already moving towards the system of segregation for handling the large quantity of waste produced and the infrastructure for the same is already in place or in the process. Hence, it would be wise to incorporate segregation of the waste as the solution to the waste management problems. To achieve this, all the stakeholders i.e., the residents, the Corporation, the contractors, the pourakarmikas (workers), rag pickers and the NGOs/RWA's /CBOs/SHGs have to play an important role. The suggestions made below are based on the discussions we had with officials and operators, and deliberations of the workshop.

Policy level: The Policy of Integrated Solid Waste Management 2012 for BBMP is to be modified. A suggested model is presented in Figure 2. Changes to be made are in dashed lines.

As per the figure of the waste process flow in the Contract document shown above, the wet waste will be further segregated into mixed and wet waste, which

Figure 2: Recommended change (dotted line) in waste process flow in Contract document



Source: Municipal SWM Contract agreement between BBMP and private party

may not be practically possible. Hence recommendation has been made (shown in dotted line) to segregate the mixed waste which is being collected during door-to-door collection and street sweeping. Another additional step recommended to the flow of waste is to separate the 'other' waste component from the DWCCs. The 'other' waste would be those articles which are neither inert nor recyclable, for example, thermocol, plastic packets with metal lining, multilayered plastics, etc. and hence would need to be sent directly to the landfill. This change in the process flow is to ensure that the waste reaching the landfill site is minimum, achieved after segregation of waste at-source or segregation of mixed waste at the next level. It emerged from the deliberations in workshop that strict laws should be framed to enforce the Extended Producers Responsibility (EPR), which should take care of large amount of unmanageable waste from this stream. The companies should be made responsible for reducing the large quantity of waste generated by the products they sell.

Organizational Intervention: BBMP should have a separate MSWM department with staff dedicated solely for SWM related work. Environmental Engineers / Public Health Engineers / Sanitation experts of requisite number should be appointed and given effective training related to Municipal Solid Waste Management. Environmental Engineers should have similar career growth opportunities like Civil Engineers. Career growth of Environmental Engineers can be linked to increase in area of operation and /or assigning advisory role in environmental related aspects of BBMP.

DWCC be converted to Clean Bangalore Centers (CBCs): Dry Waste Collection Centers need to be converted to SWM solution centers for activities related to solid waste management at a community level. These can be called as Clean Bangalore Centers (CBC) that shall run in collaboration with BBMP. BBMP should provide land & building and supervision; NGOs/SHGs should be take care of day-to-day functioning and; Industry (private players) should bring-in the managerial skills for running the centers and to make them economically sustainable.

Segregation at-source to be mandatory responsibility of the generator: Clean Bangalore Centers can help ensure strict enforcement of segregation at-source with the help of citizen's awareness programs. Waste should not be accepted free of cost by those who give mixed waste to the pourakarmikas. Mixed waste can be collected by

the pourakarmikas by charging a fee for segregating the mixed waste. The pourakarmikas should have the right to reject the mixed waste. Segregated waste is to be collected by the pourakarmika without any charge. Whenever someone misses giving waste to the pourakarmikas collecting waste from door to-door, it shall be the responsibility of the generator to drop the mixed waste (on-charge) at the Clean Bangalore Centre (CBC).

Three bin system of waste segregation

Introduction of segregation of waste into 3 broad categories need to be brought about. The 3 categories are: wet waste (organic waste) approx. 60%; dry waste (recyclable waste) approx. 30%; and other inorganic waste (sanitary / hazardous / inert waste) approx. 10%.

Tackling wet waste (60%) at household / community / city level: Composting of waste at household / community level should be encouraged. Service can be provided by BBMP pourakarmikas / NGOs to those who are willing to treat the wet waste at household / local level using various technologies to convert it into compost. The pourakarmikas collecting the waste from the doorstep can be equipped for hand-holding such an activity and also supply the material for the same. This service is to be charged to the household and done without affecting primary collection. NGOs can also link up this process with a buy-back system of the compost generated. The Clean Bangalore Centers in each ward should assist the residents in this regard.

Tackling dry waste (30%) at Self Sustainable Dry Waste Collection Centers/ Clean Bangalore Centers (CBC): The service provider should collect/buy the dry waste once a week from various generators within the ward using their own vehicle/s. The dry waste can also be collected by the door to door Pourakarmikas and sold at CBCs. Citizens can also bring their dry waste and sell it at the center at their convenient time. The service provider will earn by selling the segregated dry waste at the wholesale market.

Collection and Transportation of other inorganic waste (10%): Inorganic waste (sanitary / hazardous / inert) from all the generators and organic waste from those who are not processing the wet waste should be collected in separate containers. Hazardous waste needs to be handled separately and only the wet waste should be taken to composting units (within 24 hours). Certain portion of waste like sanitary waste and biomedical waste needs to be sent to the designated treatment centers. The remaining inorganic waste (< 10%) should be sent to landfill sites. If the amount of this waste increases above certain benchmarks, the contractors should pay a penalty. A target time should be set to achieve this.

Professional Management of the whole system: Improvement of SWM systems is important to upgrade the profession of those working with waste. Professionalizing the solid waste sector means building the capacity of workers to perform more effectively and efficiently, given the existing conditions. It also means that workers perform their duties without any occupational health hazards through use of proper clothing, proper equipment, etc.

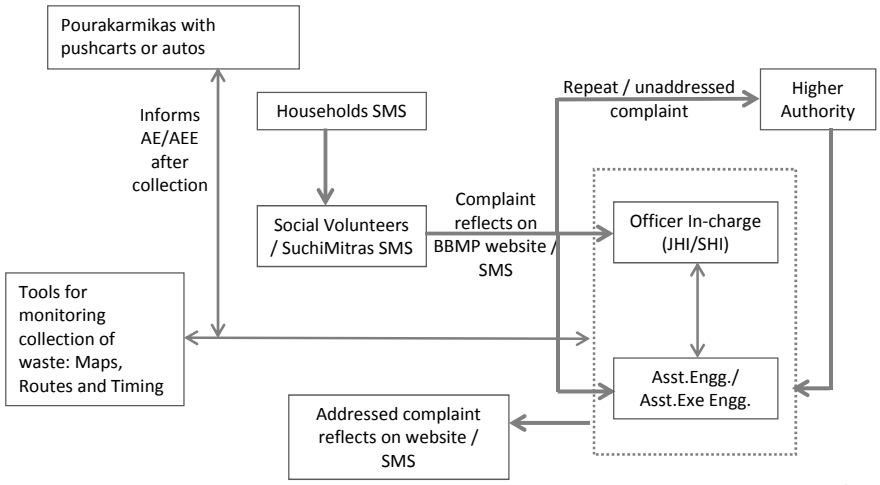
Synchronizing primary and secondary collection: BBMP has done away with the system of storage of waste in road side bins. This calls for efficient synchronization of the primary and secondary collection systems. Such synchronization can be achieved by: assigning proper time to both primary and secondary waste collectors and adherence to this time schedule, which can be done effectively using mobile applications; linking the payment mechanism to the contractors or Pourakarmikas for effective synchronization of primary and secondary waste collection; and institutionalizing monitoring and reporting system of the same to BBMP.

Enhance role of Citizens and NGOs/SHGs: The role of citizens and NGOs/SHGs need to be enhanced. The contractors role can be limited to collection and transportation of wet waste to processing units (wherever local composting does not happen), collection and transportation of sanitary waste and biomedical waste to the designated treatment centers and collection and transportation of rejects to designated landfill sites.

Citizen Monitoring and Supervision: Modern concepts of social volunteers can be introduced to harness citizen's voice as a resource to solve real life problems on such civic issues. Preparing citizen's report cards would involve them to bring about a positive change in each ward. Modern day technologies like smart phones, social networking sites, etc. should be used for quick reporting and generation of MIS reports. Involvement of citizens through regular report card system & its effectiveness will keep the interest of the citizens alive and also keep the authorities on its toes for performing. A strict monitoring and redressal mechanism at BBMP is needed (Figure 3).

Strict Monitoring and Penalty System by BBMP: Monitoring Information System (MIS) for Solid Waste Management in each ward should include ward maps, route maps, and timing

Figure 3: Suggested monitoring and redressal mechanism



Source: Authors

of services. Use of technology (smart phones, internet, etc.), media (television, newspaper), signage, and websites should be done for awareness creation, achieving standardization and monitoring. Services provided by the contractors / SHGs / NGOs should be monitored by the Citizen Volunteers and SWM department officials. Penalty system as suggested in the Policy for Integrated Solid Waste Management 2012 for BBMP should be enforced. The composting units should stop accepting the waste if the contractor continues to send mixed waste.

CONCLUSION

This study was conducted in Bangalore to understand the current practices and status of initiatives taken up for collection and segregation of waste, and to assess the quantum and composition of waste produced in the city as well as the system of waste collection. Around 70 per cent of the city's solid waste management is handled by private contractors. The study recommends making segregation at-source a mandatory responsibility of the generator by empowering pourakarmikas to refuse mixed waste or charge for it; fixing responsibility on those who miss the door-to-door collection to drop the waste (on-charge basis) at the Clean Bangalore Centre (CBC); and doing away with contract to transport mixed waste. Strict laws need to be framed to implement Extended Producers Responsibility, which should take care of large amount of unmanageable waste from this stream. Infrastructure for waste segregation like Dry Waste Collection Centers has been set up in almost all the wards. However, it is not very effective due to lack of proper waste segregation. Dry Waste Collection Centers should be

converted to SWM facilitation centers for activities related to solid waste management at a community level. They can be called as Clean Bangalore Centers (CBCs) and should run in collaboration with BBMP which provides the land & building and supervision; NGOs/SHGs for day-to-day functioning and; Industry (private players) to bring-in the managerial skills of running the centers and to make them economically sustainable. The Clean Bangalore Centers should be a role model for maintaining cleanliness in the locality and can act as one-stop solutions for any activity related to solid waste management of a particular ward.

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WORLD HABITAT DAY-2018 CELEBRATION AT NEW DELHI

The 'World Habitat Day (WHD)-2018' was celebrated in India in a function organized by the Ministry of Housing and Urban Affairs, Govt. of India on 5th October 2018 at New Delhi. The theme of WHD-2018 was '*Municipal Solid Waste Management*' which aimed to raise global awareness and promote sustainable development policies that ensure appropriate disposal and management of municipal solid waste.

Speaking on the occasion, Shri Hardeep Singh Puri, Hon'ble Minister of State (I/C), Ministry of Housing and Urban Affairs (MoHUA), Government of India complemented UN-HABITAT for choosing the theme and said that the choice of this year's theme is particularly relevant at a time when the Government of India has made this a 'Jan Andolan' or 'people's movement' through its flagship programme of 'Swachh Bharat Mission', which was announced by the Hon'ble Prime Minister on 15th August 2014 from the ramparts of Red fort, to fulfil the Mahatma's unfinished dream of clean India by his 150th birth anniversary.

Shri Durga Shanker Mishra, Secretary, MoHUA, stated that after open defecation free (ODF), the biggest challenge was faecal matter (sludge) management, for which the guidelines were issued to all states in 2017. He informed that 21 states such as Andhra Pradesh, Telangana, Maharastra, Karnataka and Odisha have already taken initiatives towards this challenge and come out with plans and programmes for effective sludge management. Bhubaneswar is the leading city in faecal sludge management.

To mark the occasion, the Hon'ble Minister released special publications brought out by the MoHUA, HUDCO, NHB, BMTPC and NCHF as well as gave away prizes to award winners in the various painting competitions organized by HUDCO, NHB and BMTPC. Three publications of HUDCO, including the October 2018 issue of SHELTER, were released by the Hon'ble Minister in the presence of Dr. M. Ravi kanth, Chairman & Managing Director, HUDCO.

Hon'be Minister releasing HUDCO HSMI's Publication "Shelter" in the presence of Shri D.S. Mishra, Secretary (MoHUA), Dr. M Ravi Kanth, CMD-HUDCO and other dignitaries

SUSTAINABLE STRATEGIES TO MANAGE SOLID WASTE IN A HILLY REGION

-A CASE OF SHILLONG, MEGHALAYA

AR. ABHILASH RAWAT

AR. AWALE MADHURI VASUDEV

Most Waste to energy processes generate electricity and/or heat directly through combustion, or produce combustible fuel commodity, such as ethanol, methane, methanol, or synthetic fuels. This process is climate resilient process & is used as an alternative to conventional land filling methods.

Key word: Solid waste Management, Methane Emission, Traditional Governance, Sustainability, community Participation

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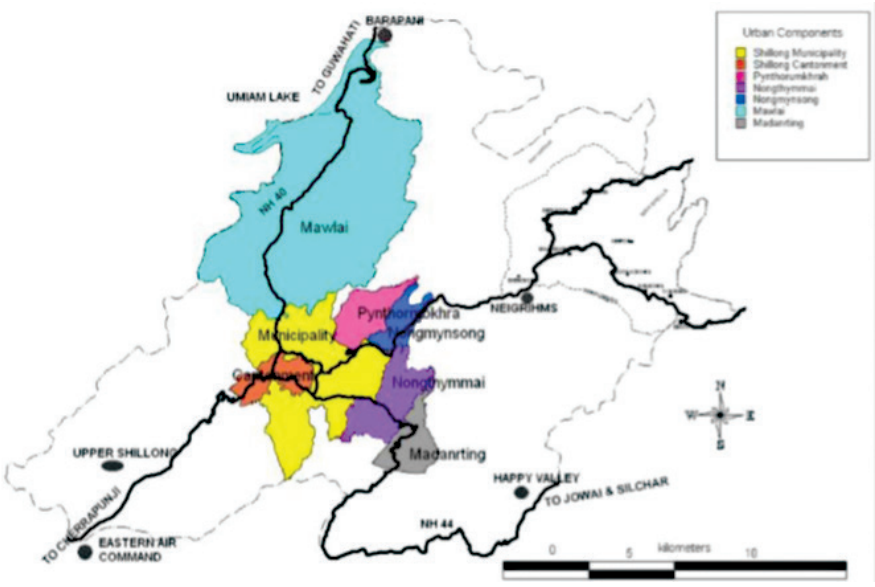
Solid waste management has emerged as one of the most challenging issues in the urban setup. Shillong, the capital of Meghalaya, is one of the populated hill stations in North-East India . There has been an increase in waste generation due to the increasing infrastructure and urban growth which is imposing pressure on existing waste management practices. Shillong Municipal Board has taken up many sustainable approaches such as zero litter campaign, use of local bamboo bins which are well supported by traditional governance system & waste to energy, recycling & Segregation at source level, which establish this place as a good example of waste management practices. This paper is an attempt to evaluate present solid waste management practices, Methane gas emission, environment concerns and successful implementation of sustainable interventions with the help of community participation

INTRODUCTION

Shillong is the capital of Meghalaya and located in the East Khasi Hills District, popularly known as "The Scotland of the East". Shillong is the creation of the British Raj and established as a hill-station. This tiny settlement has now grown into a flourishing city with a population of 1,43,229 according to the 2011 Census. A large number of developmental sectors of the city have given rise to increasing population and results in expansion of the city. The expanding urban sprawl is gradually affecting and putting pressure on various sectors like transportation, water, energy, environment & waste management. Due to continuous increase in population and urban growth, there has been continuous increase in waste generation which is imposing pressure on existing waste management practices. Indeed, various sustainable practices have been followed by the residents of the city introduced by the local government through its local administrative setup. Shillong (Cantonment Board) and Shillong (Municipal Board) are statutory towns and Mawlai, Nongthymmai, Madanrting, Pynthorumkhrah, Nongmynsong, Mawpat, Nongkseh, Umpling, Umlyngka, Lawsohtun, Cherrapunjee are census towns.

Map 1: GSPA(Greater Shillong Planning Area) Source: BCEOM,2007



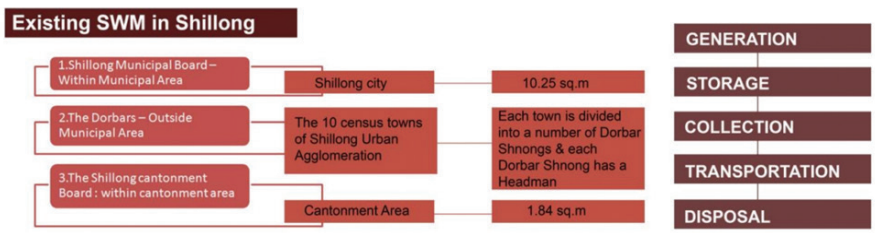
SOLID WASTE MANAGEMENT IN SHILLONG

Present Scenario

With the increasing population and demand in various development sectors, the waste management in Shillong is characterized by tons of generation of wastes per day which occupy the dumping ground of the city. The Meghalaya State Pollution Control Board (MSPCB), has reported that Greater Shillong Planning Area(GSPA) (Map 1) generates about 150 metric tons per day (MTPD) of solid waste of which 120 MTPD (80%) of waste is generated within the Shillong Municipal Board(SMB) area (Table 1), while the remaining 30 MTPD of waste is collected and transported to the landfill disposal site at Mawiong(*SEMAC,2009*).

It is estimated that only about 45-47% of waste is collected and transported to the landfill disposal site at Mawiong. Shillong is the only city in North-Eastern Region wherein a compost plant with a 100 MTPD capacity had been installed under Private - Sector-Partnership, but due to some technical problems relating to incoming waste; it is not fully operational for some time (Figure 1). However, State government is making efforts to revive the plant and put it into full operation at the earliest.

Figure 1: SWM managed by different Authorities



Waste Characteristic

Solid waste generation is highest from households which accounts for 59% share, (Figure 2) followed by market (24%) coming largely from the CBD area Police Bazar and least generation is from construction related (2%). The composition of commercial waste in Shillong is given at Figure 3. Percentage of Composting Waste is higher in Shillong as per Indian standards, which is ideal for conversion into organic fertilizer by composting (SMB Report, Shillong).

Figure 2: Domestic waste

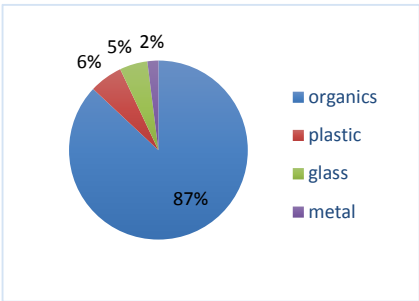


Figure 3: Commercial Waste

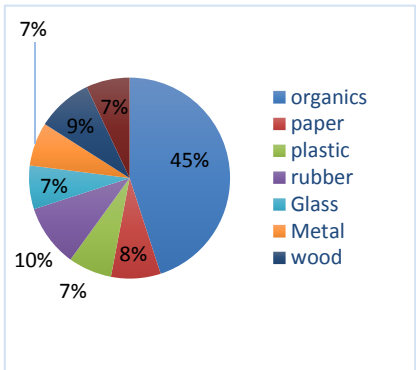


Table 1 Waste Generation and collection from each Town

Towns	Class	Generated / Day(MT)	Collection per Day (MT)	Gap
Shillong Municipal Board	I	120	11	20
Shillong Cantonment	IV	6	5.5	0.5
Madanriting	III	8	6.4	1.6
Mawlai	III	18	14.4	3.6
Nongthymmai	III	16	12.8	3.2
Pynthorumkhrah	IV	10	8	2
Nongmysong	IV	5.3	4.2	1.1

(Source: The state of Environment of Shillong city, MSPCB)

Source: SMB Report, Shillong Year 2007

Solid Waste Generation

The quantity of municipal solid waste generated from a town or city is a very important criterion in planning of collection, transportation and ultimately disposal systems to be adopted for a definite time frame or the design period. Segregation of solid waste at source is not practiced and generally the community is not aware of the need and its importance at source. The recycling market is ruled by middlemen who pay a very small sum and therefore the householder is not encouraged to store recyclables and dispose to the recyclables market (Map 2).

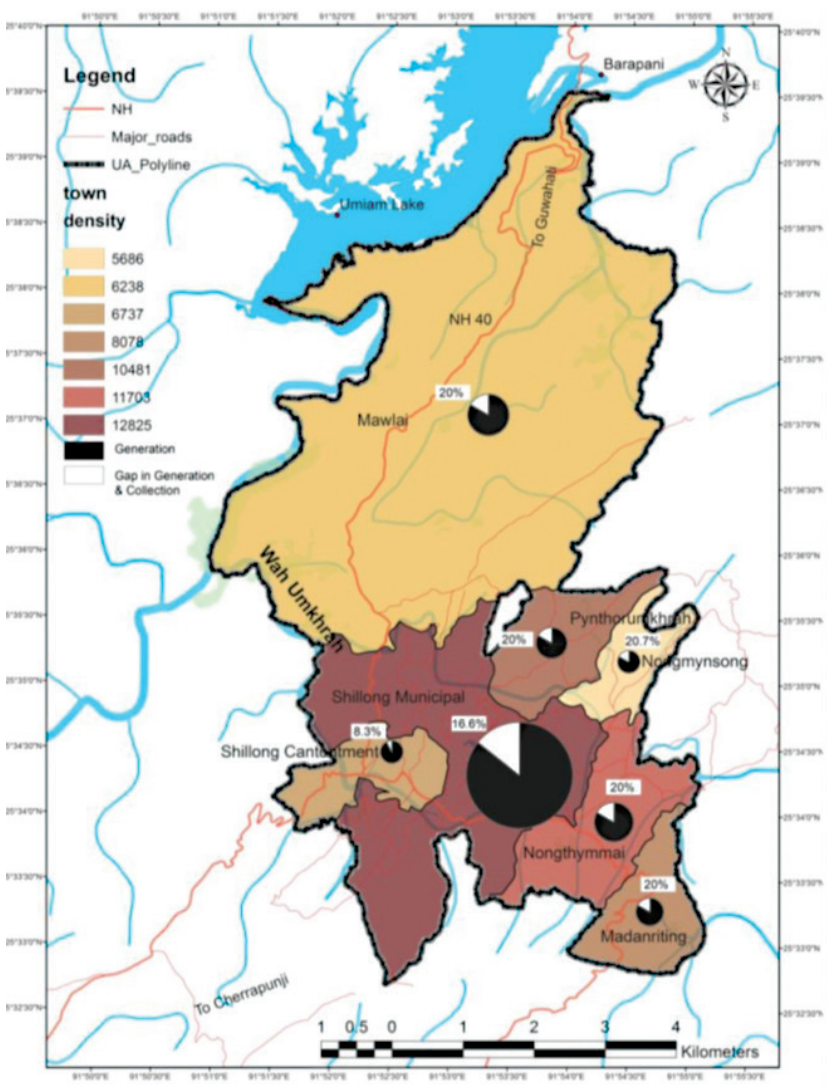
Solid Waste Collection

In Shillong Municipal Board (SMB) area, the collection method is door-to-door collection; outside SMB, the collection is managed on ad-hoc basis and operated along the lines of the system established by the respective Darbar Shnongs & transported to Mawiong (Land fill site).

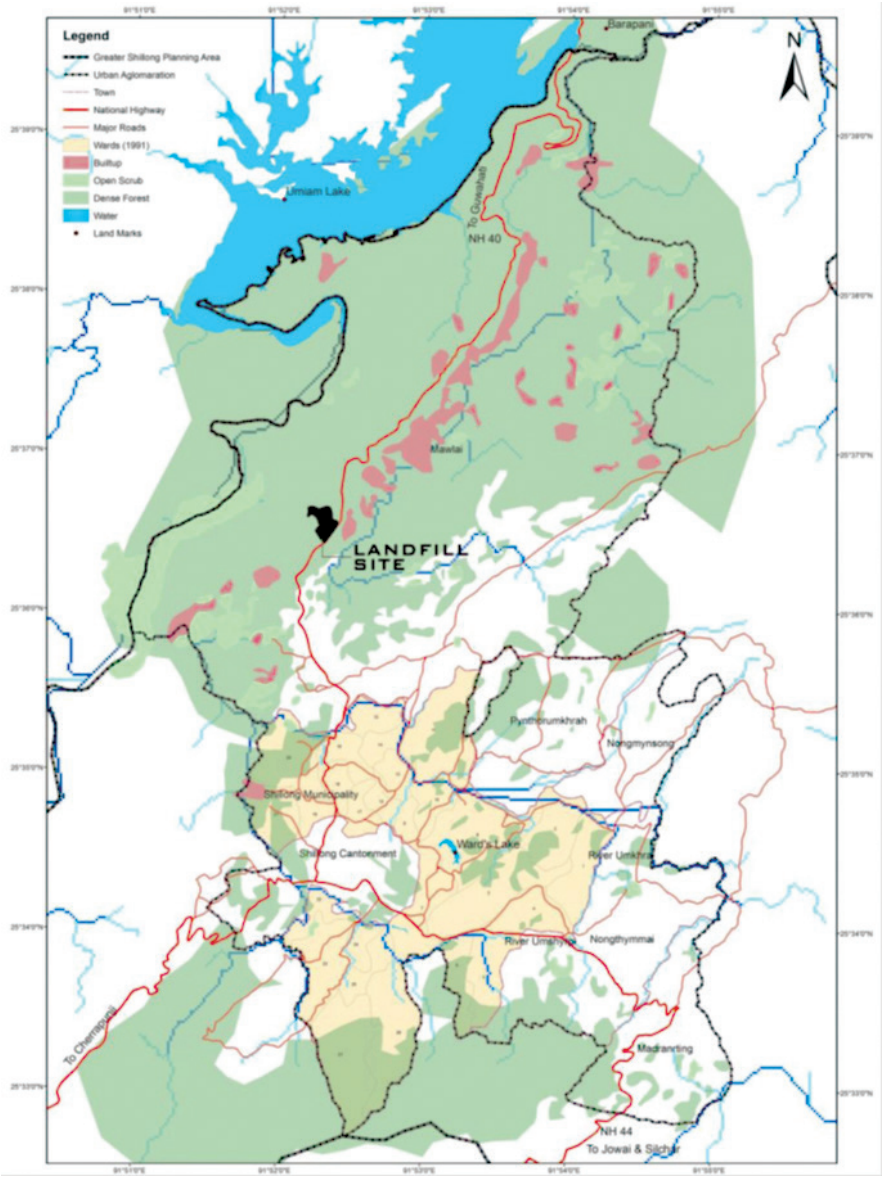
Solid Waste Transportation

Transportation of solid waste is usually done by trucks and dumpers at wide roads and junctions but for small roads small vehicles and hand pulled carts are used to collect and transport it to the large vehicles. The Shillong Municipal

Map 2: Comparison of Solid waste generation in SMB areas



Map 3 Map showing Location of Dumping Ground



Board has 6 LCVs, 4 trucks, 4 dumpers and 3 tractors which are in operation presently for transportation of garbage to disposal site at Mawiong. These are being manned by 17 drivers and 60 attendants.

Solid Waste Disposal

Waste collected from GSPA dumped at Mawiong disposal site, 7km away from the city and adjacent to NH-40 (the Shillong Guwahati Road). The site (area of 4.706 hectares) is located within the Riat Khwan forest with hills on one side and presence of deep valley on other side (Map 3). The site is being operating since 1938 (SIPMU,2009).

CALCULATION OF GHG (METHANE) EMISSION PRODUCED FROM WASTE

Waste is also one of the critical sectors in contributing green house gases. Globally, 3% of the GHG emission is from Waste sector, hence Waste Management should be emphasized while preparing low carbon & carbon resilient development plan. Methane emissions from landfill represent the major source of climate impact in the waste sector (which are quantified in later section).The potential to save GHG through improved materials management, methane recovery are considered in later proposals. In Shillong, Waste contains organic material, such as food, paper, wood etc. Once waste is deposited in a dumping site, microbes begin to consume the carbon in organic material, which causes decomposition resulting into methane & carbon dioxide gas emissions. The microbial communities contain methane-producing bacteria under the anaerobic conditions which is prevalent in landfills. As the microbes gradually decompose organic matter over time, methane which is approximately 50%, carbon dioxide (approximately 50%), and other trace amounts of gaseous compounds (< 1%) are generated and form landfill gas (UNEP, 2010).

Waste generation (WG) projections are made considering WG as 448 gram/capita/day. Methane Emissions are calculated using Intergovernmental Panel on Climate Change (IPCC) Default calculation Method. Using IPCC Default Formula, methane emission is calculated as follows:

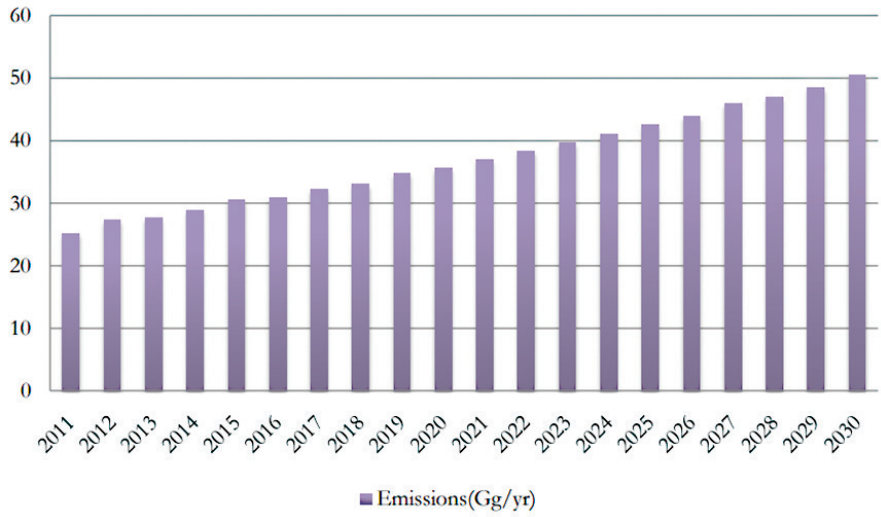
Methane Emission (Gigagrams/ Year)= (MSWT x MSWF x MCF x DOC x DOCF x F x 16/12-R) x (1=OX)

Where in Shillong

- MSWT: Total MSW generated in Gg/yr = 136TPD = 9.64 Gg/ yr
- MSWF: Collection of disposal site 47% of total MSW = 23.33 Gg/ yr
- MCF: Methane correction Factor = 0.4
- DOC: Degradable organic carban (Fraction) (Kg C/ kg SW) = 0.4(18) + 0.17(0) + 0.15(46) + 0.3(4) = 0.153 by weight
- DOCF: Fraction DOC dissimilated = 0.014(18) + 0.28 = 0.532
- F: fraction of CH4 in landfill gas = 0.5
- 16/12 : conversion of C to CH4
- R: recovered CH4 (Gg/yr) = 0
- OX: oxidation factor = 0
- Using IPCC default method

CH4 Emission: 49.64 x 23.3 x 0.4 x 0.153 x 0.532 x 0.5 x (16/12-0) x (1-0) = 25.04 Gg/yr

Figure 4: Methane Emission Projections



- Methane Emission = 25.04 Gg/ yr for 2011

As per the above calculations, total methane emission would increase from 25.04 Gg/year in 2011 to around 50 Gg/year by 2030 in the business as usual scenario(Figure 4).

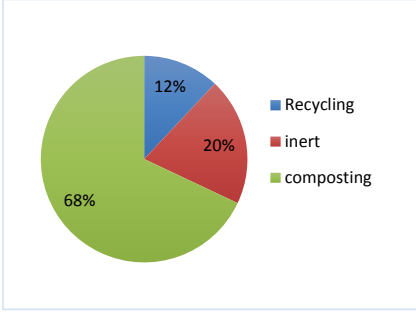
SUSTAINABLE APPROACH TO MANAGE SOLID WASTE

To reduce GHG's, 3 waste reduction methods have been proposed: (i) Waste Recycling: For reducing the amount of waste by recycling the waste into usable end products; (ii) Waste Reduction: For reducing the amount of waste at Source level; and (iii) Waste to Energy: By efficiently generating & recovering energy from treatment processes.

Waste Recycling

In Shillong, out of the total waste generated, 68% of the total waste is biodegradable waste, 20% of the waste is inert waste and 12% of the waste is recycling waste i.e in Shillong, 33 tonnes of the total waste can be recycled per day (Figure 5). Waste Recycling and reduction it will help to minimize net GHG emissions.

Figure 5: Percentage of Waste Generated in Shillong



Source: The state of Environment of Shillong city, MSPCB

Two qualitative scenarios have been proposed a) the business as usual scenario; b) probability of recycling, to show how it reduces the amount of green house gases (Figures 6).

Figure 6: Scenario for Waste Recycling: Scenario for Waste Recycling

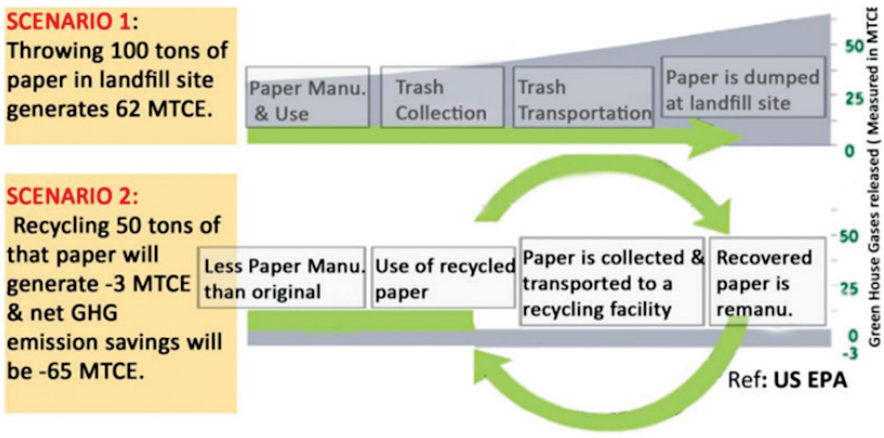


Figure 7: Waste Segregation at Household Level

Waste Reduction by segragation

at source: Waste reduction is an efficient way to reduce pressure on landfill site, which eventually helps to minimize the GHG emissions. Started in Few localities of Shillong & is segregated as Bio-degradable and Non Biodegradable waste at household level (Figure 7).

Waste to Energy: Waste-to-energy (WtE) is the process to generate electricity and/or heat from the primary treatment of waste, basically, Waste to Energy (WtE) is another form of Energy recovery. Most Waste to energy processes generate electricity and/or heat directly through combustion, or produce combustible fuel commodity, such as ethanol, methane, methanol, or synthetic fuels. This process is climate resilient process & is used as an alternative to conventional land filling methods. Moisture content present in waste, % of organic/ volatile matter, fixed carbon, total inert & most importantly, its calorific value are the major parameters for the selection of technology. Appropriate technology is selected on the basis of these parameters (Table 2).

Table 2 shows that in case of Shillong, technology selected on the basis of selection parameters & their desirable range is: Thermo-chemical Conversion Technology & 150 tonnes of

Table 2: Comparison of Technology

No.	Waste Treatment Method	Basic Principle	Important Waset Parameters	Desirable Range	Shillong
1	**Thermo chemical Conversion** Incineration Pyrolysis Gasification	Decomposotion of organic matter by action of heat	Moisture content	<45%	44.80%
			Organic/ Volatile matter	>40%	61%
			Fixed Carbon	<15%	35-40%
			Total inerts	<35%	30%
			Calorific Value	>1200 Lcal/kg	2704.80%
2	Bio chemical Conversion Anaerobic Digestion/ Bio methanation	Decomposition of organic matter by microbial action	Moisture Content	>50%	
			Organic / volatile matter	40%	
			C/N Ratio	25-30	

Source: CPHEEO(2000)

MSW with 60% of organic matter can generate around 2.25 MW.

Other Innovative measures

Promoting Zero Littering Lifestyle in Shillong

Meghalaya Urban Affairs Deptt. has set up an example of zero-littering lifestyle in which, stakeholders from different backgrounds such as taxi drivers, school children joined their hand to create awareness regarding segregation and disposal of waste. The goal of this campaign is 'for the people, with the people, by the people'. To reduce tourism waste, major tourist spots and parks are kept free from litter by prohibiting plastic waste inside public parks and banning hawkers (Elets Technomedia , 2017).

Bamboo-made waste bins - Khoh

Khasi tribe of Meghalaya used to carry goods with multi-purpose basket i.e Khoh . It is shaped like cone made up of tightly woven bamboo strips but government use this type of Khoh as Green Dustbins. These bins are also promoting the sustainability of raw material (Jagyasi, 2018).

In Shillong, *Indigenous Compost technology* from collected bio-degradable waste has been developed by government and is known as 'Garbage to Gold'. A good quality of compost is prepared through this technique and sold to local citizens at a very nominal price. (Clean Shillong Committe, 2018)

Capital Punishment

In order to keep the spirit of 'Clean & Green Shillong', the East Khasi Hills district police also have adopted a stringent approach to deal with pollution and littering in public places and tourist spots and violators are liable to pay fine of around Rs. 5,000.

CONCLUSION

This paper has examined strategies to manage the solid waste in sustainable manner. It also examined the role government is taking in various initiatives that can help in minimizing environmental degradation occurring due to improper waste management practices. Methane Gas Emission from landfill site is responsible for climate change. It can be reduced by using various sustainable approaches like waste recycling, waste to energy, zero litter campaign, use of green bins made up of local materials, Indigenous Compost Technology (ICT) and public participation. The findings and suggestions in this papers will help other hilly areas in managing solid waste.With the help of Public participation and integration of modern & traditional technologies, Shillong is setting an example for other hilly cities to achieve sustainability in hilly region.

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THE INFORMALITIES OF FORMAL SETTLEMENTS IN GUATEMALA

MR. MARIO JOAQUÍN LÓPEZ HUERTAS

Despite a list of different efforts to avoid the informalities in these settlements the solution should focus on a wide holistic vision that integrates different variables in the urban landscape, as well as its interactions with the rest of the city and the region.

Formal Settlements consider criteria such as access to basic services, housing conditions (design, structure and materials), security of land tenure and proper zones approved by the local or municipal government. This study assesses the informality of Guatemalan settlements in the case of Zone 2 & 5 in the City of Quetzaltenango. Although the criteria for these areas to be considered "formal" are fulfilled, the region faces recurrent flooding problems during rainy season, revealing a lack of urban governance and management. This study contemplates two timelines, one that implements land-use planning policies and a second that considers an institutional response against threat of floods. As a contribution of this study, a sustainable approach (social, economic, environmental and institutional) to the problem has been presented as a guide to a long-term solution. Overall, two scenarios were proposed, which demand an involvement of different sectors and variables of the regional planning in the urban landscape.

Keywords : Informal Settlements, Quetzaltenango Floods, Regional Planning

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INTRODUCTION

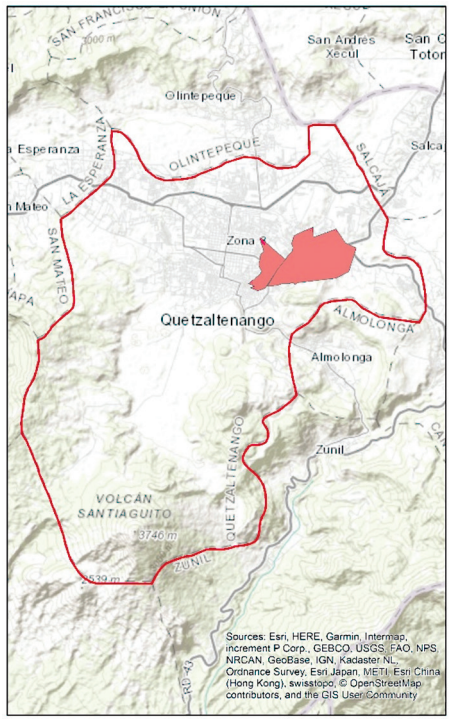
Quetzaltenango is located in the Western highlands of Guatemala (2,333 meters above sea level) in a fertile valley that witnessed one of the last Mayan resistances against the Spanish conquest in the 16th century. The landscape invited the attention of the Europeans due to its strategic position for the control of both transit and of the indigenous population. After defeating the Mayan Caciques, the Spanish settled close to the water sources, using the "Colonial Checkboard"[2] as the only urban pattern to shape the landscape for the following centuries, leading to the urban sprawl, as land and natural conditions would allow. Currently, Quetzaltenango is considered the second most important city in Guatemala (after the capital, Guatemala City); it represents a regional commercial hub and due to the educational opportunities, it has become a university city for the Western part of the country. With a population of 175,000 (municipal limit0073), Quetzaltenango holds a density of 1,250 inhabitants/km^2, an extension of 120 km^2, where the urban area represents 61% of the whole territory. The population is estimated to reach 95% in 2034 (Alvarado, 2010) due to the failure of adequate planning mechanisms.

[2]Better known as Grid Plan. In Urban Planning the streets are distributed at right angles, forming a grid.

Map 1: Area of Analysis. Source: Prepared by the author.

Map 2: Guatemala

Map 3: Quetzaltenango



The growth of Quetzaltenango is driven by three main factors: urban-rural migration, migration from other urban centers and physical expansion. It is estimated that by 2030 the population will be 627,000 and will reach 1,000,000 by 2050 (IDB, 2014). However, there are many challenges that the city has not been able to overcome since decades ago. In 2015 the Millennium Development Goals revealed that Quetzaltenango failed to improve its indicators regarding malnutrition (increasing of 5.7 points between 2009 and in 2014) schooling opportunities for children (63% in 2014 vs 94.7% in 2000) and the loss of forest cover (Loss of 3,597 Ha in the entire Department). Currently, regarding the Sustainable Development Goals (SDG), Quetzaltenango has worsened its Multidimensional Poverty Index, from 0.242 (2006), to 0.326 (2011) and with a low improvement in 2014 to 0.304. Moreover, there is a low coverage of basic services: sanitation (56% of the Whole Population - WP), water (28% WP), housing conditions such as ground floor (25.1% - WP) and overcrowding (49.5%[3]), affecting a significant portion of the population. Therefore, the objective image that Quetzaltenango wants to achieve both short and long term, has to be linked to different variables in the sense of promoting a more resilient, inclusive, fair, compact, participatory, safe and sustainable city (UN, 2016).

The official urban distribution of cities (*or Municipios*) in Guatemala is called a Zone. As a concept of agglomeration of a specific kind of activities such as residence, commerce, industry, etc. Quetzaltenango has 12 urban zones. This study assesses the case of Zones 2 and 5.

RESEARCH METHODOLOGY

This paper analyzes information provided by documents from public and private institutions, academic research, scientific and legal documents to systematize them and propose a future approach. The methodology was divided into three different steps.

The first step consists of the analysis of two timelines: one regarding the policies applied to the Quetzaltenango Territory since the city's foundation, and

[3]Municipal statistics based in PNUD, 2017

another describing the problem of the floods that occur during rainy season in Zone 2 and 5 (affecting more than 35,000 residents). This particular step includes an analysis of the institutional response to reduce this impact, as well as the failure to acknowledge historical reality in an effort to allow for urban growth. The second step explores the informalities of these "formal settlements" from a sustainable approach, identifying different landscape variables that would allow for a more holistic vision of the problem. In third and final step, two possible scenarios are proposed and justified by an inductive analysis.

POLICIES FOCUSED IN FORMAL SETTLEMENTS

After the implementation of the "Colonial Checkboard," Quetzaltenango grew and developed in a disorganized manner, the only restriction set by the government being the landscape morphology (topography, forest expansion, rivers and streams) and risk areas. In 1961, the "Urban Land Policy" was created as an answer to the lack of housing in the country (CRG, 1961). Its main purpose was to give land to families in urban areas for the construction of housing, but it was not defined as a subsidy program, and the local Municipality was not given the responsibility to enforce the policy[4]. Furthermore, at that time, Quetzaltenango did not have an ordinance to define uses of land.

In 1983, an "Urban-rural Development Regulatory Plan for the Metropolitan Valley of Quetzaltenango" was created with the support of the IDB (Interamerican Development Bank). Despite the plan's potential, it unfortunately did not demonstrate the desired implementation nor the expected results, and it was not implemented due to low political will and the lack of the civil society's involvement. Decades later in 2009, the "Departmental Developed Plan" was released by Quetzaltenango Municipality. This plan focused on socio-economic indicators without a territorial, housing or financial focus, but had an emphasis on the lack of a Land Policy. In 2012, the Guatemalan government announced the Housing Policy, demanding municipal governments "to harmonize land-use planning" in order to achieve a dignified,

Figure 1: Quetzalteanngo City Policies Timeline. Source: Prepared by the author.

[4]In 1961, there was no Municipal Code in Guatemala. This was implemented until 2002 (after the 1996 Peace Accords) which included in the Article 22 (territorial division) to set guidelines for the land-use planning, urban and rural development.

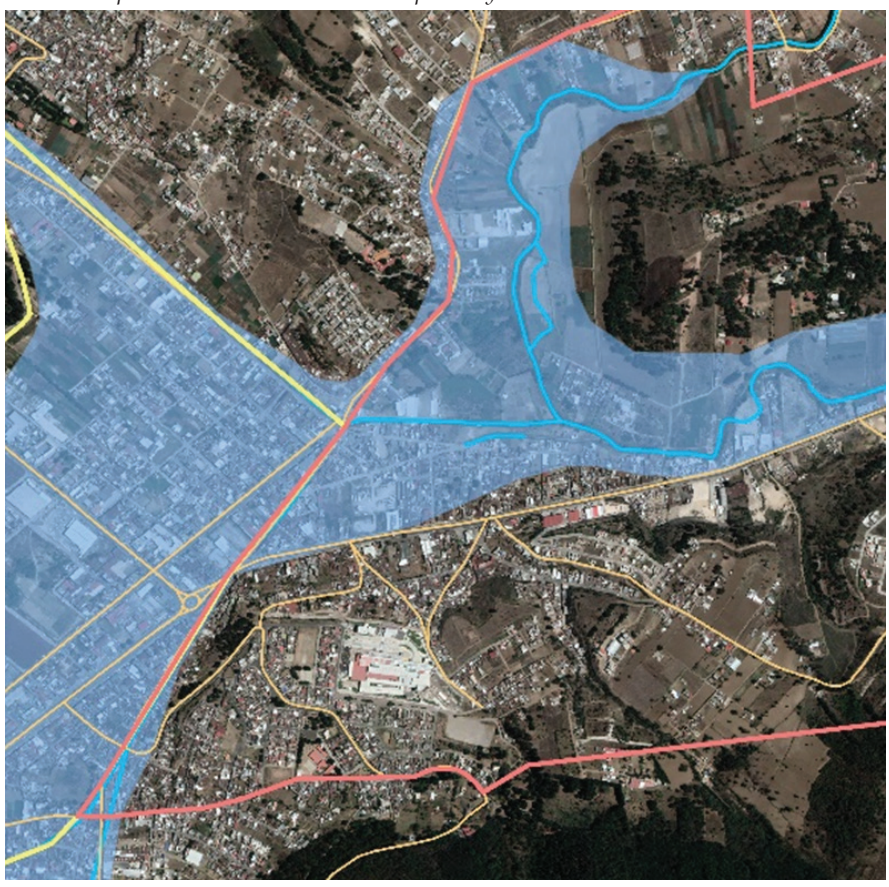
adequate and healthy home as a fundamental human right.

With the pressure of several national laws and research papers published from different institutions (Alvarado, 2010; IDB, 2014; Hermesse *et al.*, 2015; PNUD, 2017), the Land Use Policy for the City of Quetzaltenango (**POT**), was released in 2017. The purpose of this instrument has been to regulate the urban growth patterns and the occupation and transformation of physical space to influence the quality of life of the population in a meaningful way. Nevertheless, since its release, it has not been well received by the population, due to inconsistencies in the planning process and a low rate of community inclusion. These actions have caused different representatives of civil society to reject the plan, demanding reformations that have not been implemented to this day[5].

FLOODS IN QUETZALTENANGO IN ZONE 2 & 5

In Zone 2 & 5, two large rivers, the Seco and the Xequijel, converge. The Xequijel River has a greater flow, and due to the meander formed where the two rivers merge the water overflows towards the Western zone, flooding all of Zone 2. Furthermore, the watercourse that come from the southwest

Map 4: Meander area. Source: Prepared by the author. Based in IDB 2014.



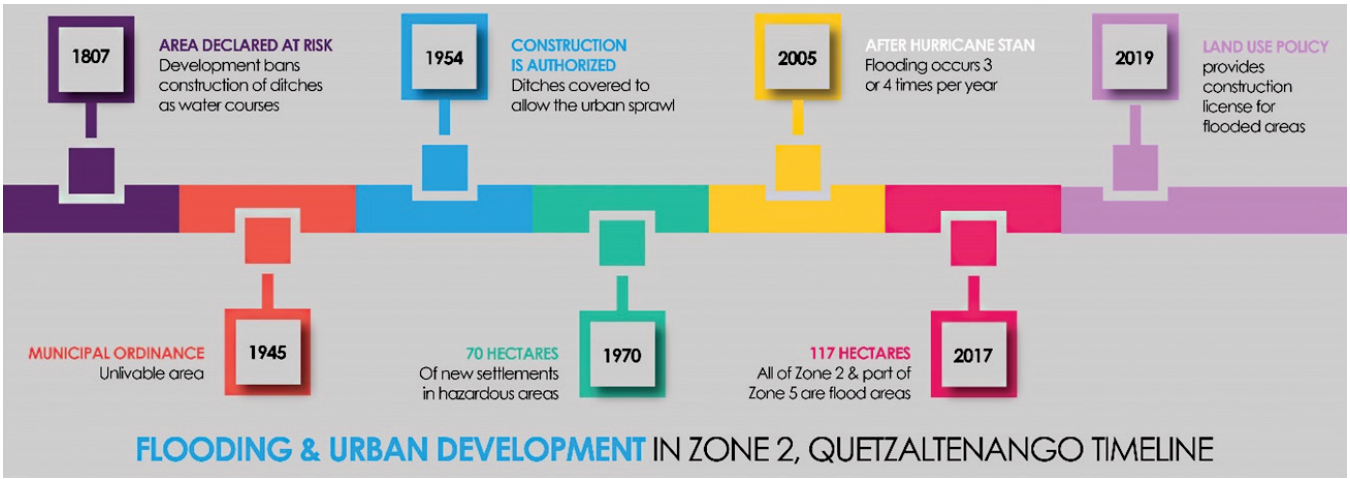
overflows because the water level exceeds its capacity. This typically occurs during the rainy season (May to November with an average of 264 mm on a monthly basis) due to the saturation of the soils.

Historical records shows that the first floods of Zone 2 & 5 date back to 1807 (Merida, 2010), and that officials took the precautionary steps such as prohibiting the development of settlements, agricultural allocations and the construction of storm water drainage ditches, despite that there was no land use policy (Rivas, 2015).

Yet this did not impede individuals from occupying at-risk sectors, so in 1945, due to a Municipal agreement, the sector was declared as uninhabitable (Méndez, 2014). The ordinance was followed, but the city was expanding towards this area at a higher rate. In 1954, a new administration took over the Municipality and the agreement of *Unlivable Area* was abolished due to a lack of coherent order and a misunderstanding of the hydrological cycle in these watersheds (Rivas, 2015). The ditches (watercourses) were then covered by streets, which

[5]Recovered in Prensa Libre News: https://www.prensalibre.com/ciudades/quetzaltenango/luis-grijalva-y-su-concejo-son-denunciados-en-el-ministerio-publico-por-dos-delitos/

Image 2: Flooding and Urban Development. Source: Prepared by the author.



decreased the water flow and fractioned the agricultural land, and intensive construction was undergone, introducing potable water services, drainage, electricity and the recollection of solid waste. At that time, the families had the security of land tenure.

By 1970, more than 70 hectares were developed in the at-risk area due to the urban expansion, which meant the historical memory was left aside. In 1983, when the Urban-Rural Development Regulatory Plan for the Metropolitan Valley of Quetzaltenango was released, the flood areas were categorized as COR Areas (retail, office and business, and residential).

In 2005, the vulnerability of the Zones were recognized again due to the rainwater of tropical storm, Hurricane Stan. More than 15,000 individuals were affected by the floodwaters that were created from the natural disaster. Since then, roughly two to four times per year there is recurrent flooding in these areas.

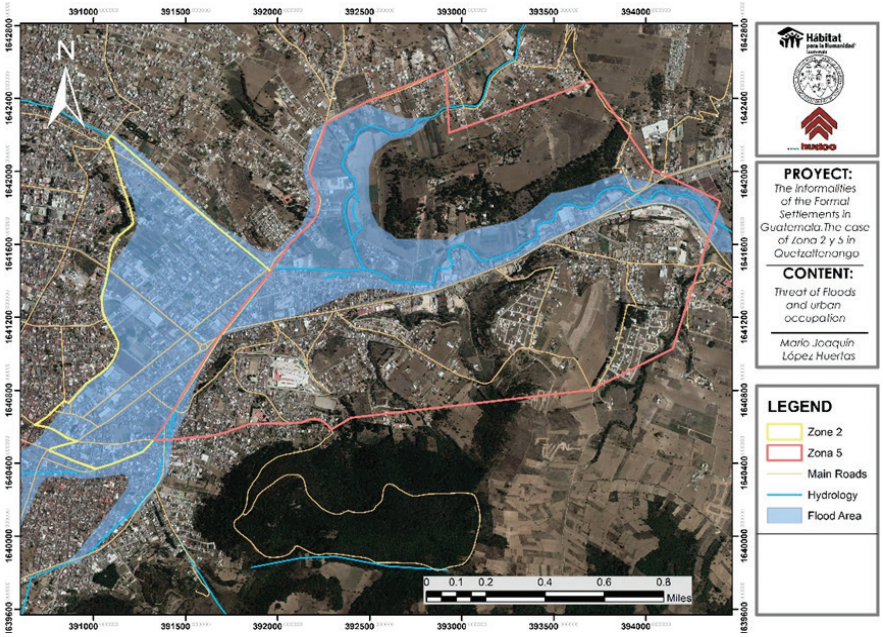
By 2017, more than 117 hectares of the at-risk zone were occupied by the urban sprawl; the majority of the area considered susceptible to flooding. Currently, 35,000 inhabitants live in the two sectors holding a density of 4,070 inhabitant/km^2. Even though the **POT** (2017) attempts to reduce the density of the zone (<13,000 inhabitants/km^2) the municipality still continues to enable construction and the authorization of licenses.

Photos 1 & 2: Floods in Zone 2. Source: Prensa Libre Newspaper

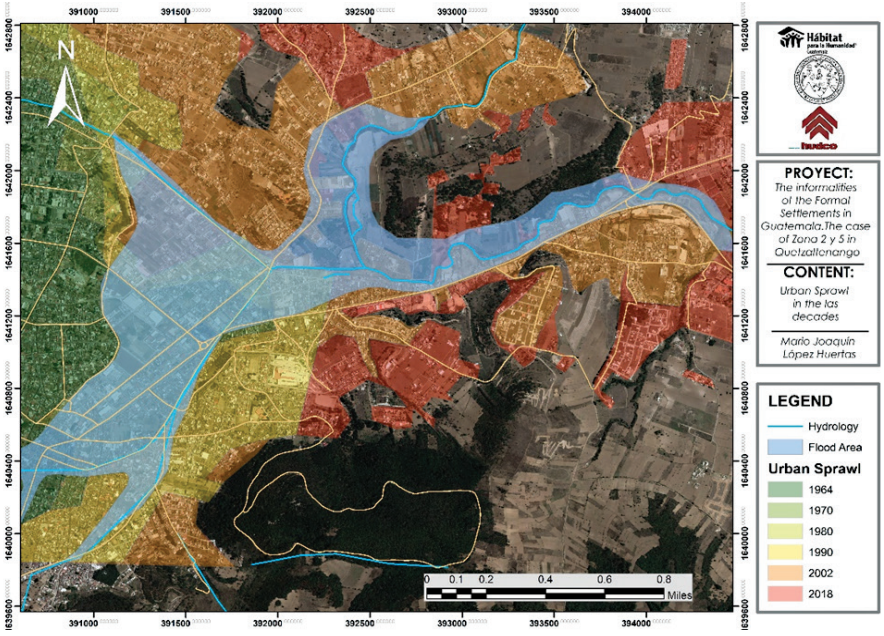
Photos 3 & 4: Floods in Zone 2 and 5. Source: El Quetzalteco Newspaper

THE INFORMALITY OF FORMAL SETTLEMENTS

Map 5: Threat of floods & Urban Occupation



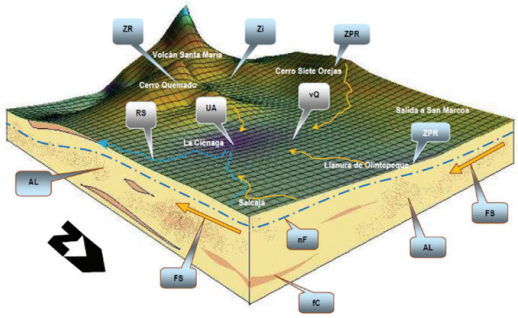
Map 6: Urban Sprawl



The concept of Informal Settlements stems from different conditions; such as the occupation of private or state lands, the lack of basic services (waste collection, water, sanitation, electricity), lack of land tenure, or the existence of homes in precarious states (due to construction in zones that have not been approved by municipal authorities – (Nassar & Elsayed, 2017).

Nevertheless, not one of these characteristics seems to describe the case of Zone 2 & Zone 5 in Quetzaltenango. Rather, this sector consists of formal construction in design and materials, access to all the basic services and security of land tenure. In fact, the buildings here were constructed by the approval and promotion of the municipal authorities. Locally known as "the swamp", this area suffers from flooding during the rainy season on an annual basis. This climatic situation generates economic, physical, and human loss and questions the formality of the settlement. Image 4 represents a hydrogeological model of Quetzaltenango, created by Tacam in 2011. The image shows the formation of an impermeable geological formation, in the form of a *vessel*, and the location of the nearby slopes and clay deposits, which reaches six meters deep.

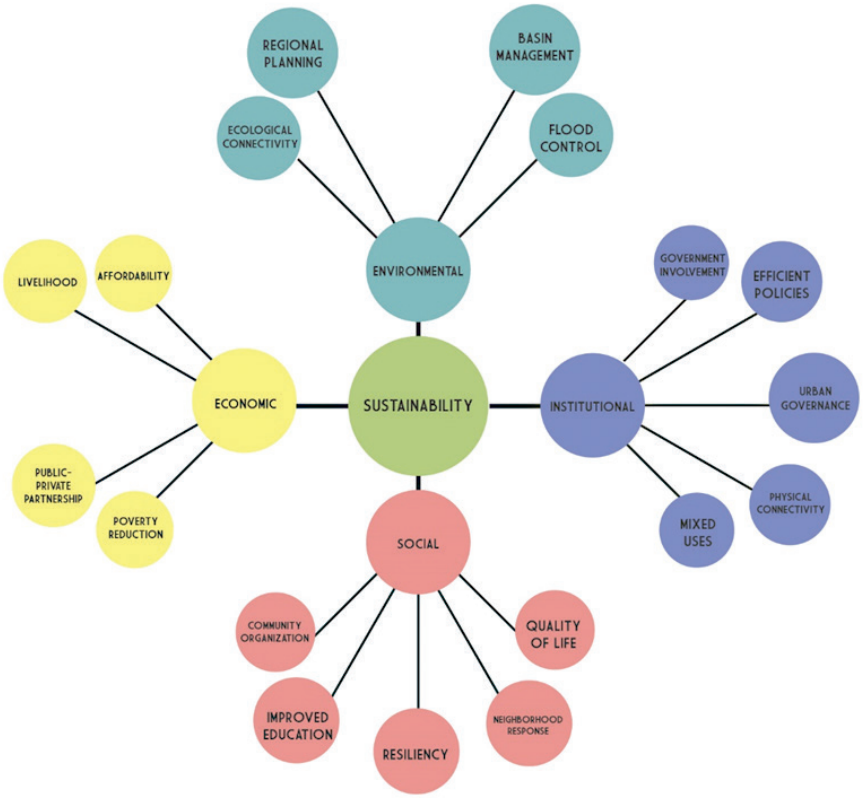
Image 4: Hydrogeological model of Quetzaltenango. Source: Tacam, 2011



TOWARDS A FORMAL SETTLEMENT FROM A SUSTAINABLE APPROACH

Despite a list of different efforts to avoid the informalities in these settlements the solution should

Image 5: Sustainable approach to flooding scenarios. Source: Prepared by the author.



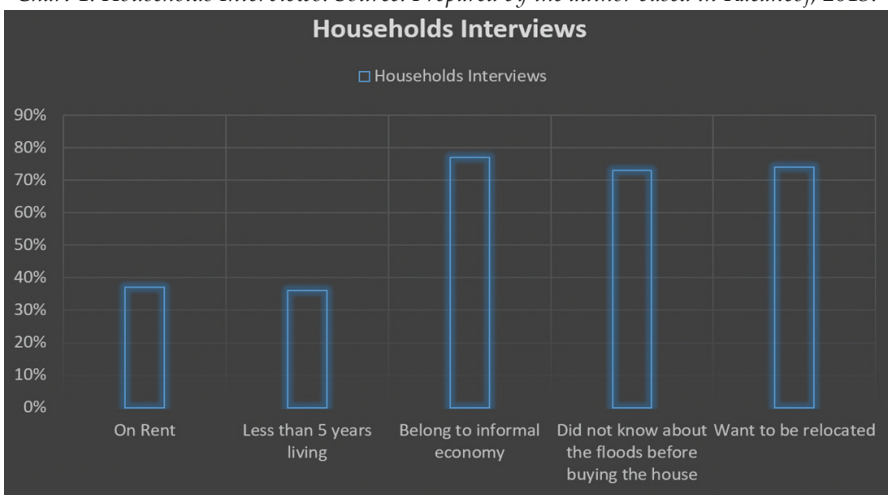
focus on a wide holistic vision that integrates different variables in the urban landscape, as well as its interactions with the rest of the city and the region. According to Sharify & Murayama it is necessary to design a planning process in order to achieve sustainability on an adequate scale, which is based upon four fundamental pillars: Social, Environmental, Institutional and Economic (2012). The sustainable approach to flooding scenarios is depicted in image -5. This structure would allow for prioritization of work areas and the definition of proposals that could be measured from a multidimensional perspective (Lopez *et al.*, 2017).

Social

From the social perspective, the participation of the entire community is essential to avoiding informalities in settlements. In order to improve the quality of life of the community and to obtain neighborhood resiliency, local needs focused on common welfare must be expressed and understood (Nassar & Elsayed Op. Cit., 2017). However, community organization in the sector is weak due to lack of involvement (38% residents are renting which decreases participation). In addition, there is no implementation of a Municipal plan to gather stakeholders and civil society to socialize the problem with the hope of finding the best solutions.

According to risk perception in the zone, a recent survey reveals information of the settlement's behavior (Racancoj, 2013). 35% of the population has lived in the area for less than five years. 70% of the owners did not know about the flood threats before buying the land; demonstrating that there is no local or municipal effort to socialize the constrains of the urban land. Furthermore,

Chart 1: Households Interviews. Source: Prepared by the author based in Racancoj, 2013.

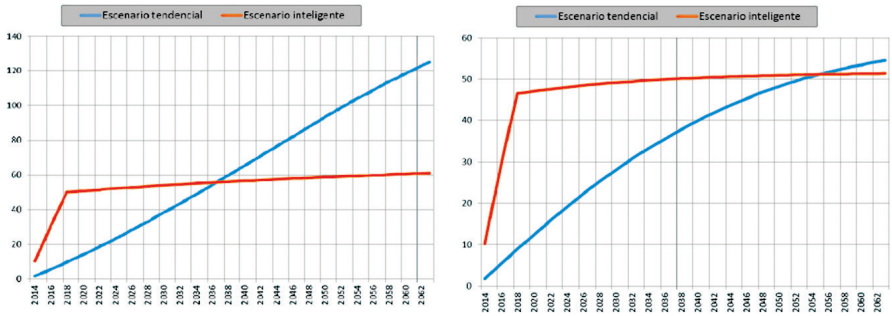


38% of the inhabitants rent their homes, and 78% of the population belongs to the informal economy, evidence that they belong to a vulnerable sector. The study continues to reveal that more than 70% of the population is willing to relocate to a safe area. In addition, some individuals invest on an annual basis in home improvements (trying to adapt their homes to the floods, which yields ineffective results), and the area continues losing surplus value.

Economic:

Without efficient land use policies, territorial issues present even more of a challenge for the 30.4% of Quetzaltenango's population living in multidimensional (PNUD, Op. Cit., 2017). For the solution to adapt to the social situation, it must be linked to strategies such as land exchange and land use changes to promote investment (Deininger, 2003), or subsidies to relocate families from at-risk areas to places with access to affordable social housing that is close to their livelihoods (Aldrich & Sandhu, 2015). On the other hand, the Central Government of Guatemala is not performing well in the administration of public resources. This also applies to the Quetzaltenango Municipality, which faces several crises, including the lack

Chart 2 & 3. Investment scenarios comparison. Source: IDB, 2014



of qualified personnel, lack of execution of the annual budget (in 2018, the Municipality did not implement US$ 15,000,000 of their designated budget[6]) and the presence of debt with central institutions (US$ 180,000,000 of debt with an electricity provider[7]). The projects and interventions to reduce the impacts of flooding in recent years have been more reactive and isolated than efficient and effective. The chart generated by IDB (2014), shows two types of investments scenarios. With a small investment (such as the current scenario), the problem can be addressed short-term, (chart 2 & 3) while with a greater investment, there would be a more long-term solution.

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Environmental

The preparation of a city to face environmental conditions is key in guaranteeing an optimal performance against any threat. The relationship between the constructed components and the natural environment is crucial as it becomes more ecological. This ensures that its services are ecosystemic, defining buffer zones to any climatic event such as the regulation of watercourses in urban zones to reduce flooding (Hough, 1995; Register, 2005).

In Quetzaltenango, the land use and the urban sprawl model reveals a carelessness towards the city's natural elements. Today, the rivers and streams of Quetzaltenango are used as drainage and solid waste dumps. In addition, the understanding of the natural cycles has not been socialized. Regional planning or basin management concepts have not been introduced, leaving

[6]Recovered in https://www.prensalibre.com/ciudades/quetzaltenango/comuna-de-xela-preve-plan-de-gastos-2018-con-q1038-millones-menos-que-el-del-presente-ao

[7]Recovered by https://www.prensalibre.com/economia/economia/eemq-reconoce-solo-11-de-deuda

historical memory to one side and allowing for construction of housing in saturated soils and flood areas.

Institutional

Urban governance in Quetzaltenango has been implemented in an informal manner (Suhartini & Jones, 2019). This can be demonstrated not with a specific statement made by the Quetzaltenango municipality, but rather with their actions: lack of land management, the authorization of plots of land, and the distribution of basic services (such as drainage, electricity, water and garbage collection) in Zones 2 & 5. These actions are cohesive with the development of any formal settlement.

The Drainage Department of the Quetzaltenango Municipality has proposed to dredge (or reroute) the Xequijel River. Even if they were to carry out these actions, environmental impact conditions and climate change could exceed the capacity limit of the dredging flow (Jain & Sigh, 2003; Manap & Voulvolis, 2016; Wasim & Nine, 2017) and consequently flood the affected areas again.

Therefore, it is necessary to not only solely consider the institutional factor when making decisions, but also consider the other three aspects necessary when seeking a sustainable approach; the support of the community, the economic feasibility and the environmental concerns (ecological solutions that adapt to their natural surroundings instead of being invasive) (McHarg, 1969; Margulis, 1998). Additionally, the modification or eradication of the settlement to a safe area has to be discussed and assessed by the neighbors, stakeholders and civil society to promote a positive impact (Chardon, 2010).

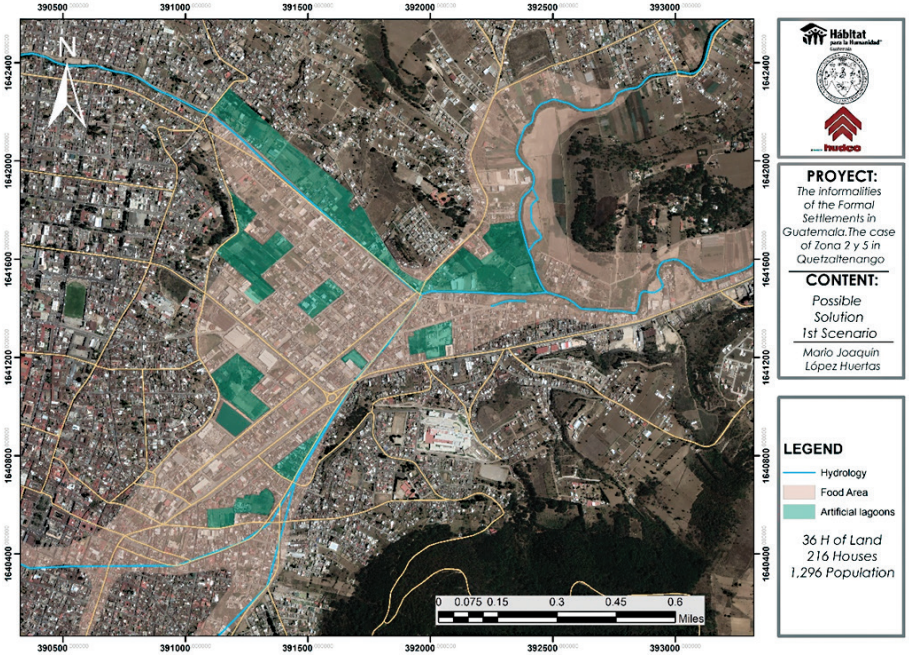
PROPOSED SOLUTIONS

For the purpose of this study, two scenarios have been designed as possible solutions to reduce flooding probabilities and to improve the living conditions for residents the Zones 2 & 5. The proposals have the intention to open a discussion about urban metabolism concepts. This could enhance the understanding of the city behavior: 1. Horizontal flows of the hydrological cycle, ecological and soils connectivity. 2. Vertical flows with climatic exchange and rainwater runoff. 3. Urban energy transformation cycles about the inputs and the outputs in the city (Rogers, 2000).

The First Scenario

The first approach focuses on seeking out the plots of land in the at-risk zones that are not currently being used or have a low density of occupation, to be used as small reservoirs that can retain runoff during the peak hour of the flow coming from the Xequijel River. These spaces could be used as public space to increase the inflow of people in the sector and would help to increase the surplus value.

Map 7: First Scenario. Source: Prepared by the author.



1ˢ Scenario: **Artificial Lagoons**

Total area: **36 Ha.**

Houses displaced: **216 Units**

Population Affected: **1,296**

Beneficiaries: > **35,000**

The Second Scenario

The second scenario proposes a long-term and more efficient solution, with mitigation and protection from the water runoff and flow intermittence, through the implementation of buffer zones. It would be necessary to locate different native canopies as biologic corridors to reduce the water speed and effects against residential and commercial zones. The intervention considers widening the river and watercourses, opening underground streams and eradication of housing in the threatened zones. The socioeconomic impact is larger in this scenario, as compared to the first scenario, due to the relocation of a larger number of families.

2nd Scenario: **Auxiliary Streams**

Total area: **67 Ha.**

Houses displaced: **460 Units**

Population Affected: **2,530**

Beneficiaries: > **35,000**

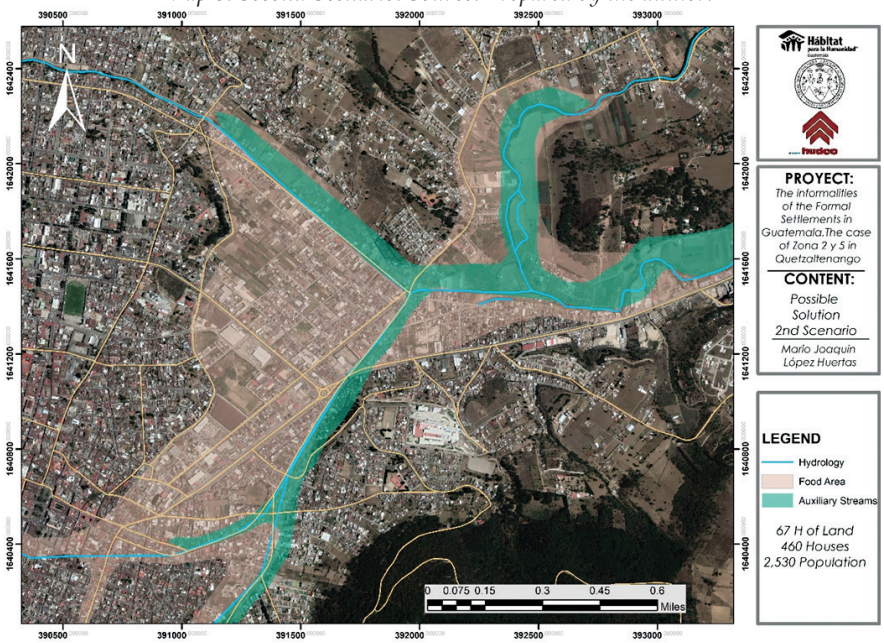
CONCLUSIONS

This paper has been prepared with the intention of creating an analysis that contemplates the opinions of different actors and implements elements of various reports elaborated in previous years. The study seeks to present evidence regarding the failure to implement policies, as well as the lack of political will to improve the urban metabolism and the condition of Quetzaltenango´s settlements.

The proposals were presented with the aim to open up a discussion regarding the future adaptation that the city should ponder for the long-term. Both of the proposed solutions have socioeconomic impacts that need to be assessed and faced at some point in the near future, considering the urban growth rate in Quetzaltenango. The proposed actions include eradication from hazard zones, resettling, and land use changes.

The expansion of Zones 2 and 5 has created an urban pressure from the continued occupation of at-risk areas, and demonstrates that historical memory has not impacted the environmental conditions and restrictions as it should. The perception of a formal settlement has to reach a definition from different perspectives. This study seeks a sustainable approach on an economic, institutional, environmental and social scale, whereas the analysis allows for an understanding of the definition of "formality" beyond the access of basic services, housing design and structure, security of land tenure and zones as defined by the municipality. Therefore, it is necessary to anticipate long-term conditions in a changing natural-cultural landscape, while focusing on regional planning, presenting possible solutions and other elements so that the formality of

Map 8: Second Scenario. Source: Prepared by the author.



urban settlements in Guatemala are no longer jeopardized.

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SANITATION MANAGEMENT

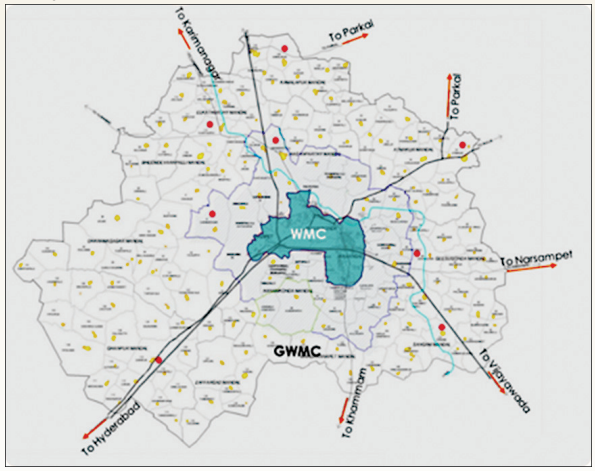
NON-SEWERED SANITATION AND FAECAL SLUDGE AND SEPTAGE MANAGEMENT IN WARANGAL CITY

Implemented by: Greater Warangal Municipal Corporation (GWMC)

Warangal is the first city to introduce Faecal Sludge Management (FSM) regulation in the country. Extensive use of Information and Communications Technology (ICT) tools, citizen awareness campaigns, engaging and capacity building of key stakeholders played an important role in operationalizing regulation. The project focuses beyond Open Defecation Free (ODF) to bring sanitation innovations across the sanitation value chain from containment, emptying, transportation, treatment and reuse to benefit the poor and vulnerable (ODF plus). Its focus is Operationalizing the Faecal Sludge Septage Management (FSSM) regulations including establishing Faecal Sludge Treatment Plant (FSTP – Sanitation Resource Park). Mode of implementation is through Public Private Partnerships (PPP) in provision of public conveniences. Throughout the planning and implementation of the project, public participation in awareness creation, decision making and monitoring is engaged. The project is monitored by ICT based application. A unique aspect of this project is the gender aspects in sanitation. Warangal is the first city in India to have introduced 9 SHE toilets - Exclusive toilets for women (4 PPP and 5 funded by GWMC) at GWMC premises operational since November 2017 as a pilot. The toilets are designed to have menstrual hygiene kits (dispenser, incinerator), woman caretaker, CCTV surveillance.

BACKGROUND

Warangal, the second largest city of the newly formed state of Telangana is spread over 407 sq.km and has a population of 8,19,000 as per 2011 census and the estimated population as on 2017 is about 10,00,000. The city does not have an underground sewerage system and depends only on on-site sanitation. Lack of adequate individual, community and public toilets has been a key issue. As of 2015, 30% of the city's population was reported to be practicing open defecation and this was particularly high in areas having water bodies and slums. The sanitation service delivery in the city was suboptimal with issues such as low level of awareness and understanding about the linkage between health and sanitation; difficulties in accessing subsidy for individual household toilets (some of the 180 slums had 100% open defecation); poor maintenance of public toilets lead to lack of usage particularly by women and children; lack of sanitation facilities in schools; presence of many insanitary toilets polluting the environment; unscientific emptying and transportation of faecal sludge from septic tanks and twin pits; lack of use of personal protective equipment by emptier; indiscriminate disposal of faecal waste in water bodies and open areas due to lack of availability of treatment systems. All these issues have affected the public health status of citizens of Warangal city particularly the urban poor. The current insanitary sanitation situation has also led to severe environmental degradation.



Warangal City Profile:
Second largest city in Telangana after Hyderabad, located at a distance of 145 km from Hyderabad. Covered under Smart City, AMRUT and HRIDAY

- Area : 407 sq.km,
- Population : 0.81 million
- No. of HH : 0.19 million
- Number of Slums: 183
- Slum Population : 30%

(Census, 2011)

PROCESS

Scientific evidence on the city's sanitation situation collected by ASCI (Administrative Staff College of India) helped GWMC to prioritize steps and interventions to bring comprehensive sanitation improvements with support and participation from multiple stakeholders - citizens, civic groups, Community based organizations (CBOs), traders, corporate sector (private and public), private operators, international foundations.

Table 1 List of priorities formulated and implemented on the basis of issues identified

1. Stakeholder Alignment	• Building Identity : logo, crowd sourcing ideas and funds for school sanitation • Political Ownership • Consultations with Community, Media and Private sector
2. Enhanced Access to Sanitation	• Process re-engineering to hasten application process and subsidy flow for Individual Household Toilets • Establishment of Sanitation Help-Line (S-Line) • Construction of Public Toilets (PTs) on PPP mode • Introduction of exclusive toilets for women (SHE toilets) • General Public access to toilets in Fuel Stations • Enhanced quality of existing PTs • Construction of Community Toilets and toilets in schools • Use of ICT tools for monitoring
3. Septage Management and Decentralized Waste Water Management	• Passing Faecal Sludge Management (FSM) Regulations • Decentralised STP to treat waste water in low-income localities • Training of operators on safe emptying practices and use of personal protective equipment • Identifying suitable technology options • Developing PPP structures
4. Strengthening Institutions	• Reviewing City Sanitation Plan • Organisation Development & Capacity building for FSM • Establishing a dedicated sanitation helpline • Implementation of Monitoring & Evaluation Framework • Developing Sustainability plan
5. Creating Platform for Citizen Engagement and Dialogue	• Establishing City Sanitation Taskforce • Slum Level Federation (SLF) & Resident Welfare association (RWA) networks • Developing Sanitation Markets & Social Entrepreneurship models

The process of achieving the aim of the Sanitation project can also be divided into six targeted interventions:

Intervention I	**Intervention II**
Detailed diagnostics study.	Evidence based advocacy for political will, stakeholder support and alignment.
Intervention III	**Intervention IV**
Initiatives to increase access to toilets: PT, Schools, IHHLS.	Regulating faecal sludge and septage management.
Intervention V	**Intervention VI**
Grey water management through decentralized approaches.	Use of ICT for monitoring and sustaining sanitation interventions.

RESOURCE MOBILISATION

ASCI & BMGF have extended technical & knowledge and financial support to GWMC.

Corporates such as OICL, SBH and REL and organizations such as Rotary and Vasavi club have lent financial support to infrastructure and capacity building for school sanitation. RWAs, SLFs and MEPMA were deeply involved in IHHL demand creation, funding support and monitoring the progress of construction greatly assisting GWMC in achieving ODF status. The city has invested time, human, financial resources and land for building its capacities and bringing sanitation service provision. The State has also invested, particularly in school sanitation.

RESULTS ACHIEVED

GWMC has made substantial progress on all the indicators of sanitation. Following are some the strides made in augmentation of sanitation infrastructure in the city:

- City declared Open Defecation Free in September 2017 and Quality Control of India certified city as OD free on December 21, 2017
- Public toilets on PPP and DBFOT increased from 28 to 45. Demand assessment and locations earmarked for another 10.
- 5 Electronic toilets (e-toilets) introduced and operationalized.
- SHE toilets - Exclusive toilets for women (4 PPP and 5 funded by GWMC) in advanced stages construction. One SHE toilet inaugurated in November 2017.
- All the 47 fuel stations allow general public to access the toilet facilities in their premises.
- Branding of Public toilets introduced by way of standardized signage board on the PTs for easy recognition and four direction boards per PT for enhancing visibility installed.
- Improved designs of PTs to increase the usage rate by children and differently abled form an average of 15 and zero respectively in 2015 to 412 and 192 in 2017.
- 4 community toilets under construction to be inaugurated by end of February 2018
- Septage collection is regularized
- FSM data captured and monitored regularly
- Country's first thermal based FSTP inaugurated in November 2017.
- GWMC and other stakeholders capacitated to take on the city's sanitation challenges.
- Warangal is the first city in the country to establish a dedicated non-sewered sanitation (NSS) unit.

Figure 1 Public Toilet at Warangal

Figure 2 FSTP at Warangal

Figure 3 Sanitation messages inside the FSTP to understand the FSM value chain

TRANSFERABILITY

The experience and outputs of Warangal are replicable and scalable.

- The successful initiative of toilets at fuel stations available for use by citizens has been incorporated in the Swachh Survekshan guidelines and is replicated in many towns in the country.
- SHE toilets - Exclusive toilets for women (have been replicated throughout the state of Telangana and it has become mandatory for each city to have at least 10 She toilets)
- Feedback machines introduced in PTs in Warangal have led to national government asking all cities to follow suit.
- ICT applications developed are freely available and can be readily introduced by any city for enhancing the quality.
- FSM Policy: after the formulation of FSM rules in Warangal, resolution has been passed at state level in which Warangal has set an example
- Mason training and operator training modules are standardized and available for scale up.
- The innovative thermal technology based FSTP and the sanitation resource park can be replicated to achieve health outcomes.
- Sanitation funding model through a combination of city, private sector and CSR investment can be tested for replication elsewhere.
- Process reengineering approaches, institutional frameworks, and capacity building initiatives are replicable
- Stakeholder engagement platforms and initiatives can be initiated for enhanced participation and ownership.

To summarize, Warangal City has introduced several innovative processes and solutions. The response from stakeholders is encouraging. Public Private Partnerships (PPP) models are also considered. Lessons from Warangal are being scaled up across the State of Telangana through introduction of State level FSM policy and operational guidelines. Several national and international professionals have visited Warangal to witness success and learnt lessons for mutual benefit.

KEY TAKEAWAYS

The importance of a defined institutional arrangement for FSM is evident as most cities do not have clear assignment of roles and responsibilities of stakeholders for safe management of faecal sludge. State government could play an enabling role and define upfront responsibilities of citizens, GWMC, Pollution Control Board, civil society groups etc. It also highlights the need for strengthening data systems at municipal level with regards to toilet coverage, toilet typology, property numbers are disorganized hindering effective planning of FSM. In addition, the need to establish Faecal Sludge Treatment Plant: Technology selection process, Detailed Project Report (DPR) preparation and earmarking of land for FSTP should begin early on in the project cycle. Capacity building of elected representatives, administrators including civil society organizations is a condition precedent for success of innovations in urban sanitation.

Figure 4: Greater Warangal Municipal Corporation receiving award for Best Practice

HUDCO WELCOMES ITS NEW DIRECTOR (CORPORATE PLANNING) SHRI M. NAGARAJ

Shri M Nagaraj, has joined as Director, Corporate Planning of Housing and Urban Development Corporation Limited (HUDCO) on 1st February 2019.

Prior to joining HUDCO, he was Chairman-cum-Managing Director of PEC Limited (formerly Projects and Equipment's Corporation of India Limited) under the Ministry of Commerce and Industry. Prior to that, he was Managing Director in National SafaiKarmacharis Finance and Development Corporation (NSKFDC) under the aegis of Ministry of Social Justice and Empowerment. He has also served as Director in IIFCL Projects Limited, General Manager in IIFCL (India Infrastructure Finance Company Limited) under Ministry of Finance, Government of India. He had started his career with HUDCO as Management Trainee and worked in various capacities up to Deputy General Manager for about 20 years before joining IIFCL.

Shri M. Nagaraj is a qualified Cost Accountant & Company Secretary and is also a certified Banker having qualification of CAIIB. He holds Post Graduate degree in Management i.e., MBA with Specialisation in Finance. He has varied experience of around 28 years in multitude of sectors such as Housing, Infrastructure Finance, Skill Development & Micro Finance in Social Sector, and International Trading. He has strong fundamentals in Managerial Capabilities and e-governance for corporate sector.

GENERAL GUIDELINES: CHECKLIST FOR SUBMISSION OF ARTICLES

The following checklist should be used when preparing an article for submission Please be sure to follow the specifications exactly and completely to ensure that your article is reviewed a timely manner and any delays avoided further along in the publishing process should your article be accepted for publication.

1. The paper should be created using a word-processing program (such as Microsoft Word) and should be between 3,000 and 5,000 words in length. The file may be in .docx or .doc format.
2. The paper should be typewritten, double-spaced, and formatted to print on 8.5" x 11" (or A4) size paper. It is written in the third person in a clear style, free of jargon.
3. The first page of the article includes the following:
   i. the paper's title and
   ii. an approximately 200-word abstract that emphasizes the paper's contribution to the field and its practical architectural/ planning social/ economic implications.
   iii. the name(s), position(s), professional or academic affiliation(s), and email address(es) of the author(s), as well as the full postal address of the corresponding author;
4. The body of the paper should include the following:
   i. an introduction to the subject,
   ii. background information,
   iii. discussion of procedure,
   iv. results,
   v. conclusions,
   vi. implications for practice and advancement of research,
   vii. references,
   viii. acknowledgments (optional; if funding for the research was received from non-personal sources, the sources must be identified in this section), and
   ix. an autobiographical sketch.
5. Please ensure that:
   i. References are complete, have been arranged alphabetically by author surname and checked for accuracy.
   ii. Reference citations in the text are referred to by author name and year. If there are more than two authors, the name of the first author followed by "et al." has been used.
   iii. References contain the following information, in the order shown: names of all contributing authors (last name followed by first initial), date of publication, title of article, names of editors (edited books only), title of journal or book, volume and issue numbers (journals only), location and name of publishing company (books only), and inclusive pages (journals and articles in edited books).
   iv. Figures/ pictures/ graphs submitted are:
      a. Large enough to be readable when reduced to fit the journal page size (approximately 5.25" x 8.25").
      b. A brief caption is provided for each figure/ picture/ graph.
      c. The figure is cited in the text.
      d. Please ensure that scanned images are of a high resolution to ensure good quality printing (not less than 640 x 480)
   v. All tables are included either in the original manuscript file or as a separate Microsoft Word document and have been checked to ensure that they can be easily reproduced on the journal page (size approximately 5.25" x 8.25").
      a. A brief caption is provided for each table.
      b. The table is cited in the text
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7. The manuscript and any table/picture files should be sent via email to hsmishelter@gmail.com ONLY original works neither published nor under review elsewhere will be considered.

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