Waste management scenario in Bangalore: Scope for in-situ valorisation of biowaste

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SUMMARY: Due to unplanned rapid urbanisation since the last two decades, the municipality of Bangalore (Bengaluru) struggles to provide adequate waste management (WM) services in the city. In December 2015, as a measure to facilitate semi-centralised treatment, the Karnataka High Court ordered the Bengalureans to segregate waste at source. This study unveils the status quo of solid WM in Bengaluru and investigates the scope for treatment of biowaste at household level. Public awareness on and their contentedness with the existing WM situation, and their willingness to treat biowaste within the household was assessed using online questionnaires. The chosen sample population included Bengalureans mainly belonging to middle class and age group 22-34. Parallelly, experts from different stakeholder groups (in Bengaluru) were interviewed to triangulate data. Despite establishing semi-centralised waste processing centres and other efforts by the municipality; the city still faces a waste crisis, as acknowledged by both groups. Lack of involvement of the public (apathy towards segregation) and non-cooperation of the pourakarmikas or waste collectors (irregular collection, dumping and burning waste within the neighbourhoods, etc.) were found to be the main reasons for the failure of the schemes. Currently, most of the waste processing centres are not functioning and the collected waste still gets dumped inappropriately. The interviewed experts and the survey respondents equally welcome solutions (household digester/composter) for in-situ treatment of biowaste. The price ranges found out in this study shows the expectations of middle class Bengalureans for such systems.

1. INTRODUCTION

With more than 90% of the generated municipal solid waste (MSW), containing about 50% bio-waste, disposed inappropriately in open dumps (Kumar et al., 2009; Sharholy et al., 2008; Srivastava et al., 2015), the status quo of solid waste management (WM) in Indian cities is similar to that in cities of other low-income developing countries around the world. Unplanned rapid urbanisation and the associated steady increase in solid waste generation, and lack of source segregation, financial resources and technical expertise makes it challenging for the urban local bodies (ULBs) or municipalities to achieve a sustainable centralised scheme. Attempts for centralised composting or energy recovery could not succeed due to reasons like inability to market the produced compost (due to lack of purity), low quantity (than design capacity) and/or calorific value of the Indian MSW and technical/financial problems (Narayana, 2009; Planning Commission - Government of India, 2014; Sharholy et al., 2008). Besides, after expending most (70 to 95%) of the available budget on collection and transportation (Ghose et

al., 2006; Hazra and Goel, 2009; Sharholy et al., 2008), the ULBs are mostly forced to resort to open dumping, which is the cheapest option available.

It is essential that WM situation in Indian cities takes a leap from open dumping, which causes immense environmental and health problems, to sustainable solutions emphasising on circular economy. Participation of civilians and source segregation have pivotal roles in resource-centric WM. Generally, Indian households are sensible in contributing to the recycling of paper and cardboard, metals, glass and plastic; due to the monetary returns from doing so (Gupta et al., 1998; Kumar and Goel, 2009; Mukherji et al., 2016). The author of this study opines that a model based on in-situ handling of biowaste at households (via anaerobic digestion and/or composting) might see success; since it would offer material/financial benefits (in the form of biogas and/or compost) thereby motivating an active involvement of the public.

The aim of this study is to assess the awareness of the middle class Bengalureans on the current WM scenario in the city (using online questionnaires) and their willingness to treat biowaste within households. Parallelly, some experts (from different stakeholder groups), involved with WM in Bengaluru, were interviewed to get their views on the status quo, to identify prevalent problems or challenges (if any) and measures for improvement. This paper discusses the present status of WM in Bengaluru and the scope for household treatment of biowaste, based on the findings from the online survey and personal interviews.

2. REASONS FOR CHOOSING BENGALURU

- Bengaluru is one of the megacities in India, whose population is steadily soaring. Its urban population saw an increase of about 52% from 2001 reaching about 8.75 million in 2011 (CensusIndia, 2011). Being the base for multinational IT companies (popularly known as the ‘Silicon valley of India) causing a very high population influx, the municipality (Bruhath Bengaluru Mahanagara Palike - BBMP) struggles to cater adequate municipal solid waste management (MSWM) services to the city.

- With the intervention from the High Court of Karnataka; Bengaluru is the first Indian metropolitan city where segregation of waste at source was mandated, so as to enable decentralised composting of wet waste (Environment Support Group, 2012). Based on the outcry in media (Adivarekar, 2016; AFP, 2017; Chaturvedi, 2016), the city still seems to face a waste crisis because of which Bengaluru once termed as ‘Garden city’ has also acquired its name ‘Garbage city’.

- Compared to other Indian megacities like Delhi, Mumbai and Kolkata, there is hardly any study reporting the WM scenario in Bengaluru.

2. METHODS

2.1 Online Survey

To asses:

- public awareness on and their contentedness with the current MSWM practices in Bengaluru, and
- the willingness of the public to invest in a solution to treat biowaste within the household,

online survey was conducted. The questionnaire was divided into three parts: (1) to evaluate the current MSWM system; (2) to estimate consumer demand and price for a household system, and (3) to gather demographic data of the respondent. The second part of the survey offered two hypothetical products, viz. digester-composter (which would offer biogas and compost) and composter (only compost), to treat the biowaste at the household level explaining the benefits of biogas and compost briefly. The respondents were asked to choose a fair market price (from a given set of values) for each variant and to specify as to which product he/she would likely buy. All questions in the survey were closed-ended with response-options being of nominal, ordinal or interval nature. An adapted version of the questionnaire can be found elsewhere (Ramaswami, 2017).

The questionnaire (having desktop and mobile versions) was created using Typeform. It was desired that the survey addresses a particular section of the society, namely the middle class people belonging to the age group 22 to 34. This was an attempt to focus on the 'new middle class' (Upadhya, 2009) in Bengaluru. Various social media platforms like WhatsApp, Facebook Messenger, etc. were used to reach the sample population. More respondents were obtained also with the help from three local NGOs and through exchange with potential strangers (sharing the link using smartphones and inviting participation) at strategic public places in the city. A combination of convenience and snowball sampling was used in the study. The possible occurrence of the error - 'multiple submissions' (due to slow internet connection or other reasons); was prevented by filtering the data using Network ID (as recommended by Typeform). A total of 412 responses, mostly from smartphones or tablets, were collected over a period of 15 days. On an average, the respondents required 4 minutes to complete the survey.

2.2 Expert interviews

To facilitate triangulation of data, hand-picked individuals with experience in MSWM activities in Bengaluru were interviewed. A total of 11 potential interviewees from different stakeholder groups were identified and contacted, of which 5 consented to participate in the personal interviews. Table 1 lists the experts who were interviewed in this research work. The individuals were presidents, top level executives or persons actively involved (for e.g. in campaigns, voluntary clean-ups, training sessions, etc.) in MSWM activities in Bengaluru.

A questionnaire, with open-ended questions, was prepared and used to conduct the interviews in December 2016. The questions were aimed at getting the perspectives of the

Table 1. Experts interviewed in the study

Individual (from)	Category	Abbreviation
Bengaluru municipality	Policymaker	BBMP
Environmental activist	Environmentalist	ENV
Let's be the change	NGO	LBTC
Rotary Club of Bangalore	NGO	RCOB
A residents' welfare association	Public / activist	RWA

experts on: the current MSWM scenario in Bengaluru; the success of or challenges faced with the adopted 'two bins and one bag' system; possible measures for betterment; and the scope for treatment of biowaste at households. The questions can be found elsewhere (Ramaswami, 2017). The interviews were recorded and transcribed, which after verification by the interviewees; were used for comparison and evaluation of the experts' ideas.

3. RESULTS AND DISCUSSION

3.1 Summary from expert interviews

Table 2 shows an overview of the experts' perspectives on the current MSWM scenario in Bengaluru, challenges faced and some measures for improving it. The responses in the table are interpretations of the author (based on the interview transcripts); to be able to group, compare and analyse the answers of the interviewed experts.

Table 2. Interpretation of experts' responses to the interview questionnaire

	BBMP	ENV	LBTC	RCOB	RWA
Does Bengaluru face a waste crisis currently?	No	Yes	Yes	Yes	Yes
Is the 'two bins and one bag' system currently successful?	No	No	No	No	No
Are the adopted WM measures sufficient?	No	No	No	No	No
What are the reasons for failure?	1	1	1	1	1
1. Lack of segregation at source or apathy of the public	2	4	2	2	3
2. Non-awareness and lack of dedication in pourakarmikas	3		4	3	4
3. Pourakarmikas and/or contractors not cooperating				4	
4. Ineffective scheme or implementation by the municipality					
Current MSWM scenario:	4	2	2	1	1
1. Piled in neighbourhoods 2. Disposed in open dumps				2	2
3. Open burning 4. Treated at processing centres					3
Measures for improvement:	1	1	1	1	1
1. Creating awareness and winning the involvement of public	2	6	2	2	3
2. Training pourakarmikas and increasing their motivation	4		5	3	4
3. More dedication and involvement from the municipality	5			5	5
4. Municipality should work together with NGOs and RWAs	6			6	
5. Strict enforcement of littering prohibition and other penalties					
6. Decentralisation of MSWM					
Can treatment of biowaste at households be a solution?	Yes	Yes	Yes	Yes	Yes
Factors determining its success	3	2	1	2	2
1. Price of the system 2. Governmental subsidy			2	3	
3. Other forms of incentives			3		

3.2 Status quo of MSWM in Bengaluru

Figure 1 shows the public perspectives on the existing MSWM scheme in Bengaluru. About 63% of the participants have voiced that the collected waste gets dumped inappropriately. With about 92% stating that they are disturbed (of which 61% being bothered a lot) by the garbage issue, it can be inferred that the municipality is facing challenges in handling the generated waste satisfactorily. The existence of a waste crisis in the city was acknowledged by 4 out of 5 interviewed experts, which is also affirmed by the headlines (Bandyopadhyay, 2017; Bharadwaj, 2017; DH News Service, 2017; Shukla, 2017; The New Indian Express, 2017).

The 'two bins and one bag' system, ruled by the Karnataka High Court in December 2015 mandating the segregation of waste into dry, wet and hazardous at source (Krishnaprasad, 2015), has not been implemented successfully. As remarked by the interviewed experts and congruently raised by media sources (Bharadwaj, 2016; Chaturvedi, 2016; Joshi, 2017; Nirupama, 2016), lack of involvement of the public is one of the main reasons for the failure of the schemes introduced by the municipality.

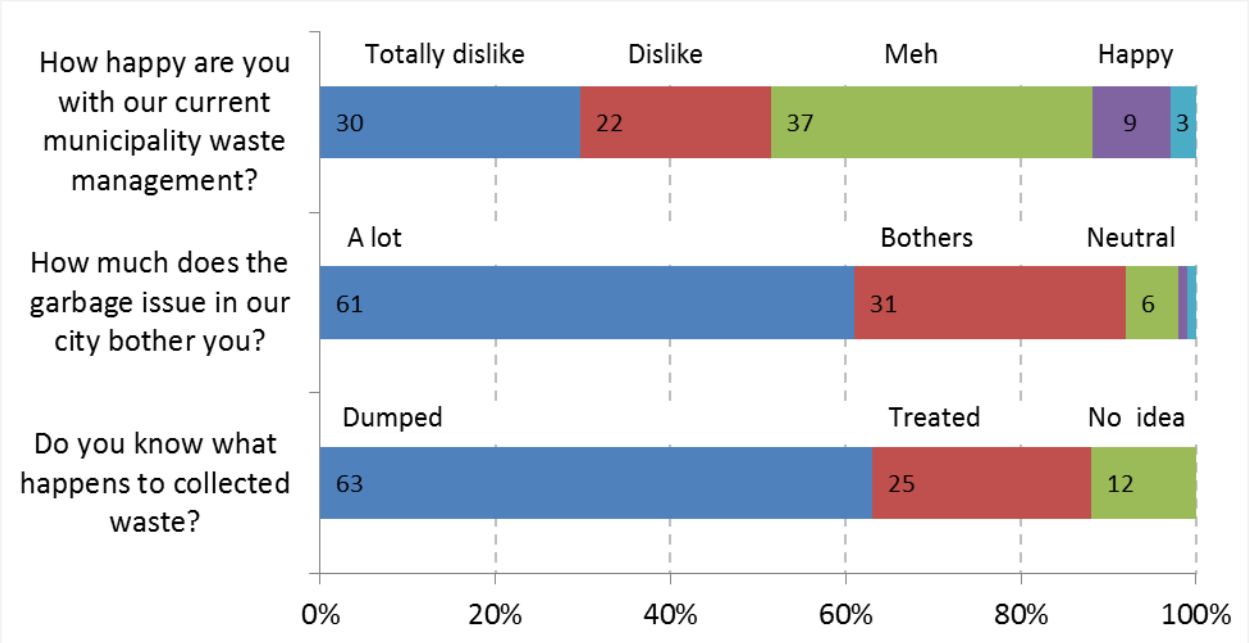

Figure 1. Opinion of the online survey respondents on the current MSWM system in Bengaluru

Surprisingly, 79% of the online-survey respondents reported that they segregate their waste, although the observed segregation efficiency in the city is less than 40% currently. Two possible reasons for this outcome can be that: some respondents could have lied so as to portray a good self-image or to make the researcher happy, or the survey reached only a particular section (age, education, income group, etc.) of the society. Besides, 3 out 5 interviewed experts mentioned that some regions in the city are segregating their waste better (60-80% efficiency) than others; however, the enthusiasm and dedication for segregation (after a campaign or training) is short-lived.

And even if the households play their part in segregation, the stakeholders in the collection (pourakarmikas or waste collectors) and transportation (truck drivers and contractors) system do not do their job well. The actions of the municipality are further impeded by the following shortcomings (which were expressed by the experts and are equally claimed by the media):

- Irregular door-to-door collection, due to which the civilians discard their garbage in nearby vacant plots or along roadside (Shukla, 2017).
- The pourakarmikas mix the waste during primary collection or dump the collected waste in open spaces in the same neighbourhood and burn them (Bandyopadhyay, 2017; Nirupama, 2016).

Creating awareness through trainings and winning the dedication of Pourakarmikas was emphasised by all five experts. However, it is to be noted that they are not paid well and are

made to segregate mixed waste without protective gear (Ramani, 2015; Staff reporter, 2017).

Ultimately, owing to the failure of segregation at source and subsequent closedown of most of the waste processing plants (Bandyopadhyay, 2017; Bharadwaj, 2017); the municipality is in search of quarries and empty lands for dumping (Joshi, 2017; Ram, 2017), and the trucks and contractors dump the waste illegally on highways, nearby canals, in lakebeds, etc. in and around Bengaluru (DH News Service, 2017; DHNS, 2017; Gopal, 2016; TNM Staff, 2017).

3.3 Opinion on a system for treating the biowaste at household level

All the interviewed experts applauded the idea of treating biowaste at household level, wherein two of them remarked the possibility for scaling up such a system for commercial buildings or residential complexes. The price of such a product, after possible subsidies or other incentives, will indeed be one of the driving forces for its success.

In order to gauge a prospective price for such a solution, which would be affordable for the middle class; the respondents of the online survey were asked to choose what they thought to be a fair cost for each projected variant - (1) Composter, and (2) Digester-composter. Figures 2a and b show the prices (in Indian Rupee ₹, 1 EUR ≈ ₹ 72 in June 2016) opted by the respondents for composter and digester-composter, respectively. The data can be used during various stages of design and development of such products (household digester and/or composter) so as to meet the price expectations of a middle class family in Indian cities.

When asked, which product are you likely to buy; 53% of the respondents decided on composter and the rest (47%) showed interest for digester-composter. Furthermore, to facilitate a basic assessment of public acceptance for such a solution, the respondents had to rate the relevance (on a Likert scale from 1-‘not at all’ to 3-‘can’t say’ to 5-‘very important’) of these products for Bengaluru. About 81% of the respondents (56% - very important and 25% - important) agreed that such solutions are need of the hour for Bengaluru and the rest stated ‘can’t say’.

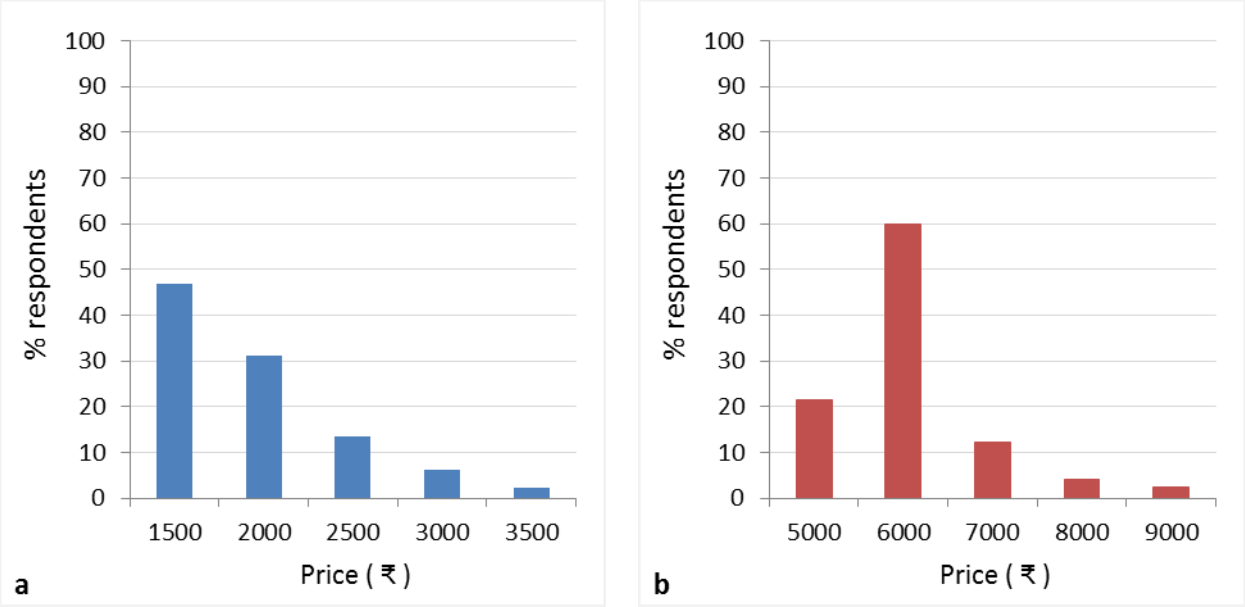

Figure 2. Distribution of prices opted by the respondents for the product which offers: (a) only compost, (b) biogas and compost.

Although 4 out of 5 experts emphasised that a provision of governmental subsidy can be favourable for the success of such a product, the expert from BBMP pointed out another attractive incentive – i.e. a waiver on the garbage cess for individuals undertaking such initiatives, which has been recently proclaimed for invocation (Moudgal, 2017).

3.4 Demographic data of online survey respondents

Figure 3 shows the demographic data of the survey respondents. It was possible to attain the desired goal of having middle class belonging to age group 22-34 as sample population.

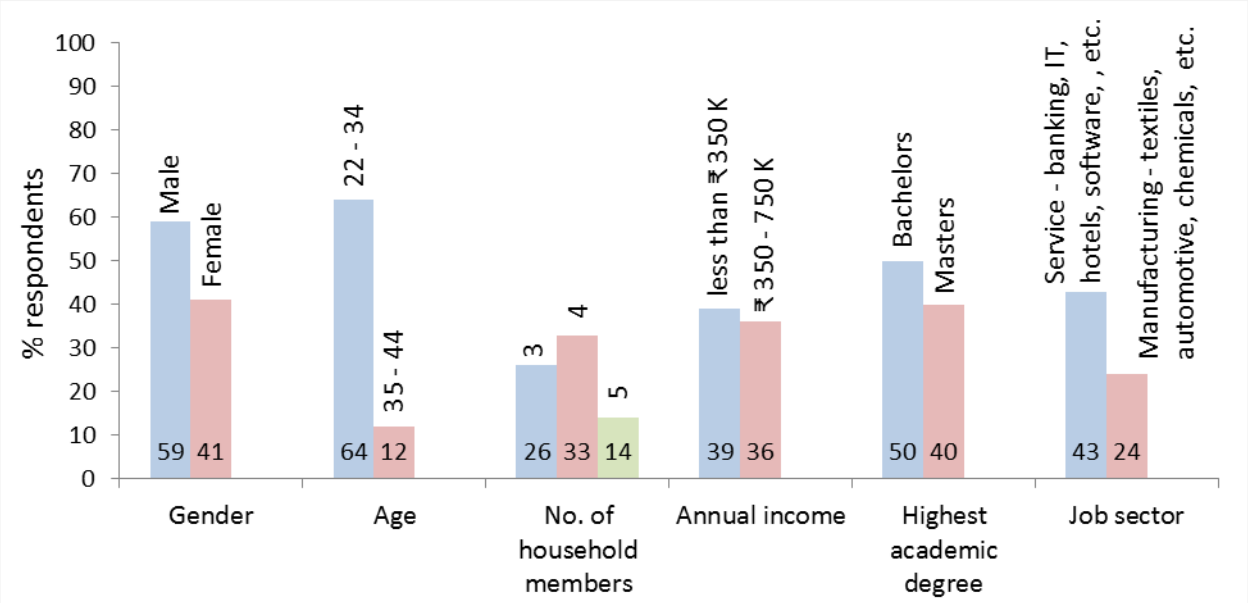

Figure 3. Demographic data of survey respondents

4. CONCLUSIONS

- Despite the verdict of the Karnataka High Court mandating segregation of waste at source for tackling the garbage crisis in Bengaluru, segregation efficiency in the city is quite low due to lack of awareness and involvement of the public. Even if the households exhibit enthusiasm for segregation, the pourakarmikas (responsible for door-to-door collection) do not execute their task as expected.

- Due to these reasons, the semi-centralised treatment schemes planned by the municipality do not get realised. Most of the established waste processing centres are not functioning well and the collected mixed waste gets inappropriately dumped.

- Solutions for treatment of biowaste at household level were appreciated equally by the interviewed experts and the residents of Bengaluru belonging to middle class and age group 22-34 years.

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