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SOURCE OF WASTE AND ITS DISPOSAL PRACTICES AT FOOD SUPPLYING CENTRES IN MYSORE CITY, KARNATAKA – A CASE STUDY

Megha T. R. and S. Basavarajappa*

DOS in Zoology, University of Mysore, Manasagangotri, Mysore-570 006, Karnataka, India.

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Corresponding author: Dr. S. Basavarajappa

Manasagangothri, Mysore -570 006, Karnataka, India.

ABSTRACT

Solid waste management is a worldwide phenomenon; it is challenging human existence amidst urban centers. In India, Mysore is tourist's hub, facing municipal solid waste management especially generated from food supplying centers (FSCs). Therefore, present study was under taken by collecting data from 233 respondents who were met personally at 35 areas. FSCs viz., hotels, street vendors, fruit stalls, cool drink shops, sweet stalls, choultries, conventional halls, slaughter houses, hot chips making centers etc, were randomly selected to record the information on source, quantity of waste produced, collection, transport, storage and disposal with the help of pre-tested questionnaire and also by interacting with people at FSCs. Majority (30.7%) of FSCs produced 5 to 9.9 kilograms of waste per day and that included different types of wet and dried wastes form edible and non-edible items. Altogether 177.23 kilogram wet waste and 42.10 kilogram dry waste produced per day from different FSCs. Produced wastes are stored temporarily in plastic bins, steel bins, hard card board boxes, gunny bags and disposed largely (51.1%) through municipal city corporation units. However, wet waste is used for piggery farm (16.7%), cattle farm (10.3%), gardening (34.9%) and biogas production (9.4%). Despite the recycling and proper disposal practices followed in Mysore, still more opportunities prevailed to make use effectively the produced solid waste from FSCs to retain and maintain clean city status. Details are discussed to a greater length in this communication.

KEYWORDS: Source of waste, disposal, food supplying centers, Mysore.

INTRODUCTION

Solid waste means 'any garbage, trash, refuse, abandoned material, bye-products, scrap, ash, solid, liquid, semisolid or contaminated gaseous material resulting from industrial, commercial, agricultural operations and from man-made activities'.[1-2] It is an unwanted or useless material generated from various man-made activities, caused pollution in two ways viz., direct or indirect ways. In direct way, the pollution is land pollution and in an indirect way pollution is an air pollution and water pollution. The Municipal Solid Waste (MSW) is one of the commonly produced wastes, requires routine collection and transport to a processing or disposal site away from a city, town or village. It contains a wide variety of unwanted materials namely: food waste, vegetable and meat waste, leftover food, eggshells etc, which is called 'wet garbage' and the paper, plastics, tetra-pack, plastic cans, newspaper, glass bottles, cardboard boxes, aluminum foil, wood items etc, as dry garbage. These wastes causes harm to human beings and the environment. Hence, solid waste becomes one of the burning issues, common problem around the world. Several researchers have studied the solid waste and its management at different parts of the world.[3] have provided an overview of waste disposal and landfills/dumps in Asian countries.[4] have explained the current situation of solid waste management in China.[5] has reported the municipal solid waste characteristics and management in Nigeria. The status, problems and challenges of municipal solid waste management in China has been studied by.[6] [7] have proposed the analysis techniques for solid waste management in European countries.[8] has assessed the current status of solid waste management of Gondar town in Ethiopia.

However, In India,[9] has reported the perspectives for municipal solid waste management. The current status and future challenges of municipal solid waste management in India has been investigated by.[10] Moreover, the metropolitan domestic solid waste generation analysis was made by.[11] Hence, all urban

centers have the solid waste management systems.[12-14] Further,[15] have reviewed the solid waste management for smart cities in India.[16] has provided a plan for solid waste management for Indian megacities.[17] Have provided an insight on the status of municipal solid waste management in metro cities like class I and class II towns in India. Thus, options and opportunities for solid waste management in India are enormous.[18] In this regard, perspectives of municipal solid waste management, solid waste assessment and management, eco-friendly approach for solid waste management, evaluation of municipal solid waste management, characteristics of municipal solid waste, scientific information on management of municipal solid waste and decentralized solid waste management were investigated by various researchers at different parts of India.[19-24,14,25-31] However, such types of published reports in Karnataka with special reference to Mysore are sparse excepting the reports of.[32-36]

Since, Mysore is the second most populous city in Karnataka after Bangalore.[33] Moreover, it is considered as one of the fast growing cities in Karnataka, densely populated with more than one million populations.[37] Mysore is housed with wide and spacious streets with cleanliness and obtained 'clean city' status three times from Union Government of India.[37] Further, Mysore is a tourist's hub, floating population is very high and thousands of people visiting Mysore every day from different parts of Karnataka, India and world also. As a result, more demand for different types of instant food supply is created. To address this issue, many food supplying centers (FSC's) are established at various public places in Mysore. Various FSCs such as hotels, restaurants, cool drink shops, food selling street vendors, chat centers, ice cream shops, convention halls and recreation halls are serving to the people around the clock at various public places. FSCs are playing a pivotal role by supplying different type of food to the floating population and tourists every day. Accordingly, more garbage/solid waste is produced from these centers and it is not properly disposed instead thrown on the streets and nearby public places. This has led to the increase in municipal waste both garbage and sewage generation.[33] This has created nuisance and bad smell that becomes hazardous to man and his surrounding environment. Despite its clean city status, presently, Mysore is facing problem for its waste disposal due to various reasons. Several researchers have reported the solid waste and its management in Mysore.[33-36] Although, these researchers have provided the information on solid waste and its management in Mysore city, published reports specifically on FSCs in Mysore is poor.[38-39] Moreover, reports on the FSCs and their solid waste production and disposal are required to maintain cleanliness and hygiene at public places. To retain the clean city status in Mysore, in depth studies are required to know the source and types of waste produced at public places. Information on type waste produced, disposal practices followed by the FSCs should be generated so as to help undertake proper waste management measures. In this regard, an attempt was made to collect information on source of waste and its disposal practices followed at FSCs in Mysore. As, FSCs are back bone of the cities, their existence is very essential to cater the need of different type of food to various class of people who visit tourist places like Mysore. Hence, the present study has necessitated.

MATERIALS AND METHODS

Study Area: Mysore city is located in the southern maiden (southern plateau) of Mysore District in the southern part of Karnataka State and lies between 11°45' to 12°40' N. Latitude and 75°57' to 77°15' E. Longitude with an elevation of 770 meters mean sea level.[40] As per 2001 population census data of India, 7, 85, 800 inhabitants were recorded in Mysore and it is raised to 9, 14, 819 in 2011. The literacy rate of urban Mysore is extensively higher than that of the State average i.e., 82.8%. The population is increasing every year at the rate of 2.5% in recent years.[38] The city experiences tropical monsoon climate which is a product of the interplay of two opposing air masses of the south-west and the north-east monsoons. Summer is languorously warm and winter is bracingly cool. By and large, Mysore city climate is agreeable, cool with equable temperature and exhibit salubrious climate around the year. Hence, people from different parts of India and the world are visiting Mysore city regularly.

Methodology: Present work was conducted in between January to April, 2018 by visiting study sites two times per week. Out of 65 wards in Mysore city, 35 places were randomly selected. Around 10 types of FSCs were identified at each place and total 233 study sites along with local residents were met personally to collect the data pertaining to the source of waste and its disposal practices followed at FSCs in Mysore. To record the solid waste produced at different FSCs, the data was collected from primary and secondary sources, where FSCs are functioning and people working at these centers were interacted by using pre-tested questionnaire. Details regarding sources of solid waste, waste storage, collection, transportation, disposal methods and solid waste management practices followed were collected. Information on waste segregation and disposal was collected as per.[41] In pre-tested questionnaire various parameters were included. Collected data was complied systematically and analyzed by following standard methods. Per cent occurrence of different solid wastes was calculated by following standard methods.[42]

RESULTS

Food supplying centers (FSCs): Table 1 shows the number of FSCs selected and their per cent contribution towards the instant food supply to different people in Mysore. Vegetarian hotels and street vendors have served highest (21.5% each) food supply and it was followed by sweet stalls and bakery shops (14.6%), fruit stalls and cool drink shops (10.7% each), non-vegetarian

hotels (8.2%) and hot chips making centers (6.5%). However, slaughter houses, convention halls and choultries contribution was just 2.1% each (Table 1).

Per cent waste production: Table 2 shows the quantity of waste produced at different FSCs in Mysore. Based on the quantity of waste produced in kilograms per day, FSCs were grouped into 1 to 4.9, 5 to 9.9, 10 to 14.9, 15 to 19.9, 20 and above and their per cent waste production was assessed. Majority (30.7%) of FSCs have produced 5 to 9.9 kilograms of waste per day and it was followed by one to 4.9, 10 to 14.9, 20 and above and 15 to 19.9 kilograms waste per day respectively 22.4, 17.4, 15.6 and 13.9% by different FSCs in Mysore (Table 2).

Types and quantity of waste produced: Commonly producing different wastes at vegetarian hotels and non-vegetarian hotels in Mysore are depicted in Table 3. Around 30 items from vegetarian hotels and 20 items from non-vegetarian hotels have produced different type of wastes and their quantity is given in Table 3. Interestingly, vegetarian hotels have contributed highest (33.93 kilograms) waste per day compared to non-vegetarian hotels, 8.09 kilogram waste produced per day. Yearly 12, 384.45 and 2, 953.22 kilograms of waste produced per year from vegetarian and non-vegetarian hotels respectively in Mysore (Table 3). Moreover, the quantity of waste produced from street vendors, sweet stalls, fruit stalls, cool drink shops, hot chips making centers and slaughter houses, choultries and convention halls are shown in Tables 4, 5, 6 and 7. Street vendors produce 24 items as waste, sweet stalls produced 16 items as waste during food preparation and production daily. Quantity of different waste items produced per day and year is shown in Table 4. Similarly, fruit stalls and cool drink shops produced 19 and 15 waste items respectively (Table 5). However, from hot chips making centers and slaughter houses seven types of waste items were recorded (Table 6). Quantity of these waste items produced per day and year is shown in Tables 5 and 6. Moreover, the choultries and convention halls also produced respectively 15 and seven types of waste items every day. The quantity of different wastes produced every day and year is shown in Table 7.

Isolation of wastes from edible items: Waste from edible items at different food supplying centers was grouped into vegetables, fruits and cooked food items. Around 15 vegetable items have commonly contributed waste every day and their per cent occurrence is given in Table 8. Similarly, 13 waste items from fruits, 12 from cooked food items were recorded and their per cent occurrence is depicted in Table 8. Further, considerable amount of waste appeared from 18 vegetable items, which were used at different FSCs are depicted in Table 9. On an average, vegetarian hotel, street vendor shop, non-vegetarian hotel, sweet stall, choultry, convention hall, hot chips making center, fruit stall have produced good amount of waste and that makes 49.72 kilograms of wet waste from vegetables, 12.6 kilograms of non-vegetarian spoiled items from slaughtered house (Table 9). Details about amount of waste produced from different vegetables are given in Table 9. Total 12 fruits have produced different quantity of waste every day at vegetarian hotels, fruit stalls and cool drinks shops. Quantity of waste produced from each fruits is given in Table 10. Altogether, 61.8 kilogram of waste produced from different FSCs (Table 10). Further, from 17 cooked food items, considerable amount of waste was recorded from different FSCs (Table 11).

Isolation of wastes from non-edible items: Waste from non-edible items at different FSCs were grouped into plastics, paper and non-vegetarian waste (Table 12). Plastic waste produced from 12 different items, paper waste from six items and five items from slaughter houses. Per cent occurrence of these waste are shown in Table 12. Total nine plastic items were commonly appeared as waste (Table 13). Altogether, 11.37 kilogram of plastic waste produced every day from different FSCs. Similarly, from seven items, paper waste is produced and their quantity is shown in Table 13. Total 22.07 kilogram paper waste appeared at different FSCs (Table 13). Moreover, small amount of other items viz., tooth picks (0.06Kg) and grass (0.4Kg) also produced every day from FSCs (Table 13). Thus, altogether 177.23 kilogram of wet waste and 42.10 kilogram of dry waste produced per day from different FSCs in Mysore (Table 14).

Waste collection: Time of waste collection for disposal by different FSCs is shown in Table 15. Usually, generated/appeared wastes from the premises of FSCs are assembled more (50.2%) during evening hours and only 49.8% FSCs have collected the waste for disposal during morning hours (Table 15).

Storage of waste: Different types of wastes are stored temporarily in various devices such as plastic bin, steel bin, hard card board box, gunny bags and crate at FSCs in Mysore. Per cent use of these devices to store produced waste from edible and non-edible items was not same but it varied considerably. Table 16 shows the different devices used to store waste at FSCs. Plastic bins were used maximum (55.7%) to store waste. However, gunny bags, steel bins, hard card board boxes and crate were used to store waste respectively 10.3, 7.5, 17.5 and 7% (Table 16).

Disposal of waste: FSCs depended largely (51.1%) on MCC for waste disposal in Mysore (Table 17). However, wet waste is used for piggery farm (16.7%), cattle farm (10.3%) and gardening (34.9%) also. Moreover, 9.4% waste is used for biogas production. Further, 7.6% excess food items considered as waste from cooked food items were supplied to orphan centers (Table 17).

Table 1: Type of food supplying centers selected during the study in Mysore city.

Sl. No.	Food supplying centers	Sample size (n)	%
1.	Vegetarian Hotels	50	21.5
2.	Non-Vegetarian Hotels	19	8.2
3.	Street Vendors	50	21.5
4.	Slaughtered Houses	05	2.1
5.	Sweet Stalls & Bakeries	34	14.6
6.	Choultry	05	2.1
7.	Conventional Halls	05	2.1
8.	Fruit Stalls	25	10.7
9.	Hot Chips Making Centers	15	6.5
10.	Cool Drink Shops	25	10.7
Total		233	100.0

Table 2: Per cent quantity of waste produced at different food supplying centers in Mysore city.

Sl. No.	Food supplying centers	Quantity of waste produced per day (in Kg.)					
		1 to 4.9	5 to 9.9	10 to 14.9	15 to 19.9	20 & above	Total
1.	Vegetarian Hotels	13.7	13.5	33.5	16.3	23.0	100.0
2.	Non-Vegetarian Hotels	14.8	18.5	19.0	14.3	33.4	100.0
3.	Street Vendors	12.0	80.0	8.0	-	-	100.0
4.	Slaughter Houses	60.0	40.0	-	-	-	100.0
5.	Sweet Stalls & Bakeries	20.6	5.9	29.4	44.1	-	100.0
6.	Choultries	-	-	-	-	100*	100.0
7.	Conventional Halls	40.0	20.0	40.0	-	-	100.0
8.	Fruit Stalls	12.0	28.0	4.0	56.0	-	100.0
9.	Hot Chips Making Centers	26.7	53.3	20.0	-	-	100.0
10.	Cool Drink Shops	24.0	48.0	20.0	8.0	-	100.0
Mean		22.4	30.7	17.4	13.9	15.6	100.0

Table 3: Quantity of different type of waste produced at vegetarian and non-vegetarian hotels in Mysore.

Quantity of waste produced at							
Vegetarian Hotels				Non-vegetarian Hotels			
Sl. No.	Items	Quantity (in Kg.) per		Sl. No.	Items	Quantity (in Kg.) per	
		Day	Year			Day	Year
1.	Idli	0.2	73.0	1.	Bone pieces	3.0	1,095.0
2.	Vada	0.08	29.2	2.	Egg shell	0.5	182.5
3.	Chatni	0.3	109.5	3.	Tooth sticks	0.06	21.9
4.	Dosa	0.2	73.0	4.	Banana leaves	0.6	219.0
5.	Rice	0.2	73.0	5.	Areca cups/sheets	0.9	328.5
6.	Sambar	0.3	109.5	6.	Tissue paper	0.1	36.5
7.	Poori	0.1	36.5	7.	Ice cream cups	0.1	36.5
8.	Curry/sagu	0.2	73.0	8.	Juice packets	0.2	73.0
9.	Sweet	0.2	73.0	9.	Plastic water bottles	0.5	182.5
10.	Soup	0.2	73.0	10.	Juice bottles	0.6	219.0
11.	Beans	0.8	292.0	11.	Onion peelings	0.03	10.9
12.	Onion peeling	0.03	10.9	12.	Ginger	0.05	18.25
13.	Chilly	0.3	109.5	13.	Garlic	0.05	18.25
14.	Carrot	0.8	292.0	14.	Chilly	0.03	10.9
15.	Tomato	0.5	182.5	15.	Tomato	0.4	146.0
16.	Potato	0.2	73.0	16.	Green pea	0.02	7.3
17.	Capsicum	0.2	73.0	17.	Cucumber	0.3	109.5
18.	Cucumber	0.8	292.0	18.	Lemon	0.4	146.0
19.	Beetroot	1.3	474.5	19.	Capsicum	0.03	10.9
20.	GLVs	2.8	1,022.0	20.	Empty milk packets	0.3	109.5
21.	Banana leaves	0.3	109.5				
22.	Watermelon	17.5	6387.5				

23.	Strawberry	0.4	146.0				
24.	Sapota	1.2	438.0				
25.	Orange	1.5	547.5				
26.	Plastic sachets	0.1	36.5				
27.	Empty milk packets	0.2	73.0				
28.	Tissue paper	0.02	7.3				
29.	Water bottles	2.5	912.5				
30.	Ice cream cups	0.5	182.5				
Total		33.93	12,384.45	Total		8.09	2,953.22

Table 4: Quantity of different types of waste produced at street vendors and sweet stalls in Mysore.

Quantity of waste produced at							
Street Vendors				**Sweet Stalls**			
Sl. No.	**Items**	**Quantity (in Kg.) per**		**Sl. No.**	**Items**	**Quantity (in Kg.) per**	
		Day	**Year**			**Day**	**Year**
1.	Idli	0.02	7.3	1.	Onion peelings	0.02	7.3
2.	Vada	0.02	7.3	2.	Chilly	0.01	3.7
3.	Chatni	0.03	10.9	3.	Carrot	0.07	25.6
4.	Dosa	0.03	10.9	4.	Tomato	0.04	14.6
5.	Rice	0.03	10.9	5.	Potato	0.03	10.9
6.	Sambar	0.06	21.9	6.	Capsicum	0.03	10.9
7.	Poori	0.04	14.6	7.	Cucumber	0.04	14.6
8.	Curry/sagu	0.05	18.3	8.	Beetroot	0.01	3.7
9.	Onion peelings	0.04	14.6	9.	GLVs	0.07	25.6
10.	Chilly	0.03	10.9	10.	Bakery items	0.7	255.5
11.	Carrot	0.07	25.6	11.	Ice cream cups	0.08	29.2
12.	Tomato	0.07	25.6	12.	Plastic spoons	0.01	3.7
13.	Potato	0.02	7.3	13.	Newspapers	0.02	7.3
14.	Capsicum	0.01	3.65	14.	Tissue paper	0.005	1.8
15.	Beetroot	0.04	14.6	15.	Butter papers	0.002	0.73
16.	GLVs	0.07	25.6				
17.	Banana leaves	0.3	109.5				
18.	Drum stick	0.06	21.9				
19.	Coffee/tea extract	0.4	146.0				
20.	Paper cups	0.4	146.0	16.	Paper plates	0.03	10.9
21.	Straw	0.02	7.3				
22.	Plastic sachets	0.1	36.5				
23.	Milk packets	0.2	73				
24.	Tissue papers	0.02	7.3				
Total		2.13	777.45	Total		1.17	426.03

Note: GLVs: Green Leafy Vegetables

Table 5: Quantity of different types of waste produced at fruit stalls and cool drinks shops in Mysore.

Quantity of waste produced at							
Fruit Stalls				**Cool Drinks Shops**			
Sl. No.	**Items**	**Quantity (in Kg.) per**		**Sl. No.**	**Items**	**Quantity (in Kg.) per**	
		Day	**Year**			**Day**	**Year**
1.	Watermelon	0.9	328.5	1.	Peelings of watermelon	15.5	5,657.5
2.	Banana and its frond	0.9	328.5	2.	Muskmelon	9.0	3,285.0
3.	Sapota	0.3	109.5	3.	Banana	0.4	146.0
4.	Apple	0.3	109.5	4.	Apple	0.3	109.5
5.	Grapes	0.5	182.5	5.	Orange	2.5	912.5
6.	Green lemon	0.8	292.0	6.	Lemon	1.0	365.0
7.	Onion	0.3	109.5	7.	Sweet lemon	2.5	912.5
8.	Tomato	0.4	146.0	8.	Strawberry	0.2	73.0
9.	Brinjal	0.3	109.5	9.	Papaya	4.8	1,752.0
10.	Chilly	0.1	36.5	10.	Butter fruit	0.7	255.5

11.	Capsicum	0.2	73.0	11.	Pomegranate	1.4	511.0
12.	Cucumber	0.8	292.0	12.	Straw	0.009	3.28
13.	Carrot	0.3	109.5	13.	Sapota	0.7	255.5
14.	Drumstick	0.2	73.0	14.	Paper cups	0.3	109.5
15.	Ash guard	0.2	73.0	15.	Plastic cups	0.2	73.0
16.	Beans	0.2	73.0				
17.	Eggshell	0.05	18.3				
18.	Dry grass	0.4	146.0				
19.	Un used news Papers	0.3	109.5				
Total		7.45	2,719.93	Total		39.509	14,420.78

Table 6: Quantity of different types of waste produced at hot chips making centers and slaughter houses in Mysore.

Quantity of waste produced							
Hot Chips Making Centers				Slaughter Houses			
Sl. No.	Items	Quantity (in Kg.) per		Sl. No.	Items	Quantity (in Kg.) per	
		Day	Year			Day	Year
1.	Onion peelings	0.05	18.3	1.	Feathers	3.0	1,095.0
2.	Carrot peelings	0.2	73.0	2.	Skin pieces	1.0	365.0
3.	Potato peelings	0.6	219.0	3.	Bone pieces	2.0	730.0
4.	Chips covers	0.05	18.3	4.	Blood	9.0	3,285.0
5.	Oil covers	0.2	73.0	5.	Chicken fecal matter	0.2	73.0
6.	Expired items and pieces of chips	0.4	146.0	6.	Mutton fecal matter	0.4	146.0
7.	Used newspaper	0.2	73.0	7.	Plastic cover	0.2	73.0
Total		1.70	620.6	Total		15.8	5,767.0

Table 7: Quantity of different types of waste produced at choultries and convention halls in Mysore.

Quantity of waste produced at							
Choultries				Convention Halls			
Sl. No.	Items	Quantity (in Kg.) per		Sl. No.	Items	Quantity (in Kg.) per	
		Day	Year			Day	Year
1.	Food items	25.0	9,125.0	1.	Dry flowers	5.0	1,825.0
2.	Plastic bottles	5.0	1,825.0	2.	Plastic covers	0.9	328.5
3.	Tissue paper	0.3	109.5	3.	Ashes	5.0	1,825.0
4.	Onion peelings	0.5	182.5	4.	Food items	10.0	3,650.0
5.	Chilly	0.4	146.0	5.	Paper plates	0.8	292.0
6.	Carrot	0.2	73.0	6.	Lemon peelings	1.0	365.0
7.	Tomato	0.3	109.5	7.	Dyes	0.5	182.5
8.	Potato	0.2	73.0				
9.	Capsicum	0.2	73.0				
10.	Cucumber	0.6	219.0				
11.	Beetroot	0.8	292.0				
12.	Green leafy vegetables	0.5	182.5				
13.	Banana leaves	30.0	10,950.0				
14.	Dining table paper	8.0	2,920.0				
15.	Ice cream cups	0.4	146.0				
Total		72.4	26,426.0	Total		23.2	8,468.0

Table 8: Isolation of wastes produced from edible items at food supplying centers in Mysore.

Sl. No.	Waste produced from							
	Vegetables	%	Sl. No.	Fruits	%	Sl. No.	Cooked food	%
1.	Onion peelings	10.7	1.	Watermelon	10.6	1.	Idli	8.0
2.	Chilly	9.7	2.	Muskmelon	10.6	2.	Vada	8.0
3.	Carrot	9.1	3.	Strawberry	9.1	3.	Chatni	10.1
4.	Tomato	9.5	4.	Sapota	9.4	4.	Dosa	8.0
5.	Beans	6.5	5.	Orange	5.7	5.	Rice	10.7

6.	Potato	9.0	6.	Banana	10.5	6.	Sambar	10.7
7.	Capsicum	4.7	7.	Apple	9.6	7.	Poori	4.1
8.	Cucumber	7.0	8.	Grapes	9.7	8.	Curry	10.7
9.	Beetroot	2.8	9.	Sweet lemon (Moosambi)	10.5	9.	Sweet	11.8
10.	Green leafy vegetables	6.2	10.	Papaya	6.4	10.	Soup	4.8
11.	Drumstick	4.2	11.	Jackfruit	0.9	11.	Ice cream	8.5
12.	Brinjal	3.9	12.	Butter fruit	2.1	12.	Bakery items	4.0
13.	Lemon	8.6	13.	Pomegranate	4.9			
14.	Ash guard	3.7						
15.	Mangalore cucumber	4.2						
Total		100.0	Total		100.0	Total		100.0

Table 9: Raw food items waste recorded from food supplying centers in Mysore.

Sl. No.	Items	Raw vegetables waste recorded per day (in Kg.)									Raw NV items (in Kg.)
		VH	SV	NVH	SS	C	CH	HCMC	FS	Total	NVH
1.	Onion & its peelings	0.03	0.04	0.03	0.02	0.5	-	0.05	0.3	0.97	-
2.	Beans	0.8	-	-	-	-	-	-	0.2	1.00	-
3.	Chilly	0.3	0.03	0.03	0.01	0.4	-	-	0.1	0.87	-
4.	Carrot	0.8	0.07	-	0.07	0.2	-	0.2	0.3	1.64	-
5.	Tomato	0.5	0.07	0.4	0.04	0.3	-	-	0.4	1.71	-
6.	Potato	0.2	0.02	-	0.03	0.2	-	0.6	-	1.05	-
7.	Capsicum	0.2	0.01	0.03	0.03	0.2	-	-	0.2	0.67	-
8.	Cucumber	0.8	-	0.3	0.04	0.6	-	-	0.8	2.54	-
9.	Beetroot	1.3	0.04	-	0.01	0.8	-	-	-	2.15	-
10.	GLVs	2.8	0.07	-	0.07	0.5	-	-	-	3.44	-
11.	Drumsticks	-	0.06	-	-	-	-	-	0.2	0.26	-
12.	Green pea	-	-	0.02	-	-	-	-	-	0.02	-
13.	Garlic	-	-	0.05	-	-	-	-	-	0.05	-
14.	Ginger	-	-	0.05	-	-	-	-	-	0.05	-
15.	Lemon	-	-	0.4	-	-	1.0	-	0.8	2.20	-
16.	Brinjal	-	-	-	-	-	-	-	0.3	0.30	-
17.	Ash Guard	-	-	-	-	-	-	-	0.2	0.20	-
18.	Others (BLs)	0.3	0.3	-	-	30.0	-	-	-	30.6	-
19.	Skin pieces	-	-	-	-	-	-	-	-	-	1.0
20.	Bone pieces with tendon	-	-	-	-	-	-	-	-	-	2.0
21.	Blood	-	-	-	-	-	-	-	-	-	9.0
22.	Chicken waste	-	-	-	-	-	-	-	-	-	0.2
23.	Mutton waste	-	-	-	-	-	-	-	-	-	0.4
Total		8.03	0.71	1.31	0.32	33.70	1.00	0.85	3.80	49.72	12.60

Note: Data is based on Tables 4 to 7.
VH: Vegetarian Hotel; SV: Street Vendors; NVH: Non-vegetarian Hotel; SS: Sweet Stalls; C: Choultries; CH: Convention Halls; HCMC: Hot Chips Making Centers; FS: Fruit Stalls; NV: Non-vegetarian; GLVs: Green Leafy Vegetables and BLs: Banana Leaves.

Table 10: Fruits waste recorded from few food supplying centers in Mysore.

Sl. No.	Items	Raw fruits waste recorded per day (in Kg.)			Total
		VH	FS	CDS	
1.	Watermelon	17.5	0.9	15.5	33.9
2.	Strawberry	0.4	-	0.2	0.60
3.	Sapota	1.2	0.3	-	1.50
4.	Orange	1.5	-	2.5	4.00
5.	Apple	-	0.3	0.3	0.60
6.	Grapes	-	0.5	-	0.50
7.	Banana & its fronds	-	0.9	0.4	1.30
8.	Musk melon	-	-	9.0	9.00

9.	Lemon	-	-	3.5	3.50
10.	Papaya	-	-	4.8	4.80
11.	Butter fruit	-	-	0.7	0.70
12.	Pomegranates	-	-	1.4	1.40
Total		20.60	2.90	38.30	61.8

Note: Data is based on Tables 4 to 7.
VH: Vegetarian Hotel; FS: Fruit Stalls and CDS: Cool Drink Shops.

Table 11: Cooked food items waste recorded from food supplying centers in Mysore.

Sl. No.	Items	Cooked food waste recorded per day (in Kg.)								Total
		VH	SV	NVH	SS	C	CH	HCMC	FS	
1.	Idli	0.2	0.02	-	-	-	-	-	-	0.22
2.	Vada	0.08	0.02	-	-	-	-	-	-	0.10
3.	Chatni	0.3	0.03	-	-	-	-	-	-	0.33
4.	Dosa	0.2	0.03	-	-	-	-	-	-	0.23
5.	Rice	0.2	0.03	-	-	-	-	-	-	0.23
6.	Sambar	0.3	0.06	-	-	-	-	-	-	0.36
7.	Poori	0.1	0.04	-	-	-	-	-	-	0.14
8.	Curry/Sagu	0.2	0.05	-	-	-	-	-	-	0.25
9.	Sweet	0.2	-	-	-	-	-	-	-	0.20
10.	Soup	0.2	-	-	-	-	-	-	-	0.20
11.	Coffee/Tea extract	-	0.4	-	-	-	-	-	-	0.40
12.	Bone pieces	-	-	3.0	-	-	-	-	-	3.00
13.	Boiled egg & its shell	-	-	0.5	-	-	-	-	0.05	0.55
14.	Bakery items	-	-	-	0.7	-	-	-	-	0.70
15.	Sevu & Kara	-	-	-	0.6	-	-	-	-	0.60
16.	Food items	-	-	-	-	25.0	10.0	-	-	35.00
17.	Pieces of chips	-	-	-	-	-	-	0.4	-	0.40
18.	others	-	-	0.2	-	5.0	5.0	-	-	10.20
Total		1.98	0.68	3.70	1.30	30.00	15.00	0.40	0.05	53.11

Note: Data is based on Tables 4 to 7.
VH: Vegetarian Hotel; SV: Street Vendors; NVH: Non-vegetarian Hotel; SS: Sweet Stalls; C: Choultries; CH: Convention Halls; HCMC: Hot Chips Making Centers and FS: Fruit Stalls.

Table 12: Isolation of waste from non-edible items at food supplying centers in Mysore.

Sl. No.	Non-edible waste							
	Plastic waste	% Occurrence	Sl. No.	Paper waste	% Occurrence	Sl. No.	Non-vegetarian waste	% Occurrence
1.	Milk packets	12.0	1.	Tissue paper	29.3	1.	Bone pieces	14.4
2.	Chips covers	3.7	2.	News paper	33.5	2.	Egg shell	51.1
3.	Oil covers	14.4	3.	Paper plates	16.9	3.	Unused mutton food items	11.5
4.	Water bottles	6.1	4.	Paper cups	10.5	4.	Unused chicken food items	11.5
5.	Ice cream cups	12.3	5.	Butter paper	7.0	5.	Unused fish food items	11.5
6.	Plastic cups	0.8	6.	Dining paper roll	2.8			
7.	Plastic straw	3.9						
8.	Plastic covers	10.8						
9.	Polythene terephthalate sheets	8.8						
10.	High density polythene covers	8.9						
11.	Low density polythene covers	8.8						
12.	Plastic spoons	9.5						
Total		100.0	Total		100.0	Total		100.0

Table 13: Plastic, paper and other solid waste recorded from food supplying centers in Mysore.

Sl. No.	Items	Plastic and paper waste recorded per day (in Kg.)										Total
		VH	SV	NVH	SS	C	CH	HCMC	FS	CDS	SH	
	Plastic											
1.	Plastic sachets	0.1	0.1	-	-	-	-	-	-	-	-	0.20
2.	Empty milk pockets	0.2	0.2	0.3	-	-	-	-	-	-	-	0.70
3.	Empty water bottles	2.5	-	0.5	-	5.0	-	-	-	-	-	8.00
4.	Plastic straw	-	0.02	-	-	-	-	-	-	0.09	-	0.11
5.	Empty plastic covers	-	-	0.2	-	-	0.9	0.05	-	-	0.2	1.35
6.	Juice plastic bottles	-	-	0.6	-	-	-	-	-	-	-	0.60
7.	Plastic spoons	-	-	-	0.01	-	-	-	-	-	-	0.01
8.	Plastic cups	-	-	-	-	-	-	-	-	0.2	-	0.20
9.	Oil plastic covers	-	-	-	-	-	-	0.2	-	-	-	0.20
Total		2.80	0.32	1.60	0.01	5.00	0.90	0.25	-	0.29	0.20	11.37
	II. Paper											
1.	Tissue paper	0.02	0.02	0.1	0.005	0.3	5.0	-	-	-	-	5.44
2.	Dining Table paper	-	-	-	-	8.0	5.0	-	-	-	-	13.00
3.	Butter paper	-	-	-	0.002	-	-	-	-	-	-	0.002
4.	Paper plates	-	-	-	0.03	-	0.8	-	-	-	-	0.83
5.	Paper cups	-	0.4	-	-	-	-	-	-	0.3	-	0.70
6.	Ice cream cups	0.5	-	0.1	0.08	0.4	0.5	-	-	-	-	1.58
7.	News paper	-	-	-	0.02	-	5.0	0.2	0.3	-	-	0.52
Total		0.52	0.42	0.20	0.14	8.70	11.30	0.20	0.30	0.30	-	22.07
	Others											
1.	Tooth picks/sticks	-	-	0.06	-	-	-	-	-	-	-	0.06
2.	Dry grass	-	-	-	-	-	-	-	0.4	-	-	0.40
Total		-	-	0.06	-	-	-	-	0.40	-	-	0.46
(I + II + III) Total		3.32	0.74	1.86	0.15	13.70	12.20	0.45	0.70	0.59	0.20	33.90

Note: Data is based on Tables 4 to 7.
VH: Vegetarian Hotel; SV: Street Vendors; NVH: Non-vegetarian Hotel; SS: Sweet Stalls; C: Choultries; CH: Convention Halls; HCMC: Hot Chips Making Centers; FS: Fruit Stalls; CDS: Cool Drink Shops and SH: Slaughter House.

Table 14: Overall waste produced in Mysore city.

Sl. No.	Waste produced from FSCs			Quantity (in Kg)	
				Wet waste	Dry waste
I.	Edible items	1.	Vegetable items	49.72	-
		2.	Non-vegetarian items	12.60	8.2
		3.	Cooked food items	53.11	-
		4.	Fruit items	61.80	-
II.	Non-edible items	.	Plastics	-	11.37
		2.	Paper	-	22.07
		3.	Others	-	0.46
Total				177.23	42.10

Note: Data is based on Tables 9, 10, 11 and 13.

Table 15: Time of waste collection for disposal at food supplying centers in Mysore.

Sl. No.	Food supplying centre	Collection of waste during		
		Early morning	Late evening	Total
1.	Vegetarian Hotels	84.0	16.0	100.0
2.	Non-vegetarian Hotels	78.9	21.1	100.0
3.	Street Vendors	42.0	58.0	100.0
4.	Slaughtered Houses	80.0	20.0	100.0
5.	Sweet Stalls & Bakeries	29.4	70.6	100.0
6.	Choultry	-	100.0	100.0
7.	Conventional Halls	-	100.0	100.0

8.	Fruit Stalls	24.0	76.0	100.0
9.	Hot chips Making Centers	80.0	20.0	100.0
10.	Cool Drink Shops	80.0	20.0	100.0
Mean		49.8	50.2	100.0

Table 16: Devices used to store waste at food supplying centers in Mysore.

Sl. No.	Food supplying centers	Devices used to store (%)						
		PB	GB	SB	HCBB	C	Others	Total
1.	Vegetarian Hotels	89.0	-	11.0	-	-	-	100.0
2.	Non-vegetarian Hotels	81.0	19.0	-	-	-	-	100.0
3.	Street Vendors	50.2	11.1	-	38.7	-	-	100.0
4.	Slaughtered Houses	80.0	20.0	-	-	-	-	100.0
5.	Sweet Stalls & Bakeries	35.9	-	64.1	-	-	-	100.0
6.	Choultry	80.0	-	-	-	-	20.0	100.0
7.	Conventional Halls	60.0	40.0	-	-	-	-	100.0
8.	Fruit Stalls	24.4	-	-	17.8	57.8	-	100.0
9.	Hot Chips Making Centers	-	13.3	-	86.7	-	-	100.0
10.	Cool Drink Shops	56.0	-	-	32.0	12.0	-	100.0
Mean		55.7	10.3	7.5	17.5	7.0	2.0	100.0

Note: PB: Plastic bin; GB: Gunny bags; SB: Steel bin; HCBB: Hard Card Board Box and C: Crate.

Table 17: Mode of waste disposal at food supplying centers in Mysore.

Sl. No.	Food supplying centre	Waste disposal (%)						
		MCC	PF	CF	G	BG	Others	Total
1.	Vegetarian Hotels	60.0	40.0	-	-	-	-	100.0
2.	Non-vegetarian Hotels	36.8	47.4	-	-	-	15.8	10.00
3.	Street Vendors	60.0	-	10.0	-	30.0	-	100.0
4.	Slaughter Houses	40.0	40.0	-	-	-	20.0*	100.0
5.	Sweet Stalls & Bakeries	70.6	-	20.6	8.8	-	-	100.0
6.	Choultry	20.0	40.0	-	-	-	40.0*	100.0
7.	Conventional Halls	40.0	-	-	40.0	20.0	-	100.0
8.	Fruit Stalls	24.0	-	52.0	-	24.0	-	100.0
9.	Hot Chips Making Centers	80.0	-	-	-	20.0	-	100.0
10.	Cool Drink Shops	80.0	-	20.0	-	-	-	100.0
Mean		51.1	16.7	10.3	4.9	9.4	7.6	100.0

Note: MCC: Mysore City Corporation; PF: Piggery Farm; CF: Cattle Farm; G: Gardening and BG: Biogas. *Orphan centers and Hostels.

DISCUSSION

Majority of Indian mega cities are suffocating due to the generation of large quantity of wet and dry garbage/waste.[15,16,17] The municipal solid waste contains 'wet garbage' (e.g. food waste, vegetable and meat waste, leftover food, eggshells etc.), dry garbage (e.g. paper, plastics, tetra-pack, plastic cans, newspaper, glass bottles, cardboard boxes, aluminum foil, wood items etc.). These wastes cause pollution if not proper action is taken for their proper disposal. Therefore, regular investigations are required to evaluate the status, options and opportunities for solid waste management in India.[18][32-36] have reported the solid waste management practices in Karnataka in general and Mysore in particular. However, during the present study, detailed investigations have been made exclusively on the source of waste and its disposal practices at FSCs in Mysore city. Mysore is the second most populous city,[33] attained 'clean city' status three times from Union Government of India.[37] Floating population is very high in Mysore, because of its tourist attraction. Due to more demand for instant food supply, many FSC's are established at various public places and produced altogether 177.23 kilogram of wet waste and 33.90 kilogram of dry waste per day. From 15 vegetables, 13 fruits and 12 cooked food items, 49.72 kilograms of wet waste and 12.6 kilograms of non-vegetarian spoiled items from slaughtered house appeared every day. Moreover, from nine plastic items, 11.37 kilogram of plastic waste, seven paper wastes produced 22.07 kilogram waste. Thus, altogether 177.23 kilogram of wet waste and 33.90 kilogram dry waste produced per day from different FSCs. This type of detailed reports is first of its kind collected during the present study in Mysore. Various researchers[9-15,17,19,20-26,28,30,31] have investigated the different aspects of solid waste management and suggested the techniques for safe disposal at different

parts of India. However, certain urban centers are located at unique geographical locations, need specific strategies for waste disposal. On this line intensive research is going on in recent years.[43] have explored the possibilities of resource recovery potentials of municipal solid waste and its composting in developing countries. Since, solid waste causes environmental pollution,[44,45] management systems are augmenting at a faster rate in India.[45] Various alternative methods are followed to control the solid waste burning in India.[46] However, solid waste management becomes a challenge in India[47] and it includes the sources, collection, transportation, recycling and management.[48] Urban centers should adopt alternative approaches with geographical location specific strategies for better solid waste management.[49,50] Accordingly, integrated solid waste management approaches are suggested by various researchers. To achieve this task, a critical operational research framework for effective solid waste management is need of the day.[51] Obviously, specific solid waste management strategies should be adopted to obtain good success.[52-53] Further, solid waste recycling should be taken up as an environment friendly and income generating activity.[54] This type of activities yielded good success in foreign countries.[4,55] Furthermore, there should be a partnerships for solid waste management between developed and developing countries. [3 & 56] After realizing the solid wastes generation and recycling potential[57] accordingly, waste recycling should be undertaken to help conserve local/regional environment.[58] By this hazards and impact of solid waste on human health and environment is avoided/reduced.[53] Thus, sustainable recycling and integrated management for solid waste in developing countries[59] like India in general and smart city like Mysore in particular is need of the day. This has to be achieved at a greater speed in smart cities which possess clean city status in the years to come.

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