

**REPORT ON THE SOLID WASTE SOURCE AND DISPOSAL PRACTICES IN
COMMERCIAL AREAS AND PUBLIC PLACES OF MYSORE CITY, KARNATAKA,
INDIA – A CASE STUDY**

Mamatha M. C. and Dr. S. Basavarajappa*

Department of Studies in Zoology, University of Mysore, Manasagangothri, Mysore -570 006, Karnataka, India.

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*Corresponding author: Dr. S. Basavarajappa

Department of Studies in Zoology, University of Mysore, Manasagangothri, Mysore -570 006, Karnataka, India.

ABSTRACT

Mysore is a third most populous city in Karnataka, has vibrant history, heritage and attracting tourists around the world every day. It is trying hard to maintain clean environment at places of tourist importance. To record the solid waste produced at commercial areas and public places, 63 wards were selected randomly in 20 different places and visited those places personally during January to April, 2018. The solid waste origin, source, production, collection, storage, isolation, transportation and disposal were collected at various commercial areas and public places by using pre-tested questionnaire. Waste from edible items included 13 vegetables, 11 fruits and six bakery shops and waste from non-edible items consists of 10 plastic items, four metals, three each rubber and cloth and paper items appeared at commercial areas and public places and this varied considerably. Overall, 63.7% bio-degradable and 36.3% non-biodegradable waste appeared at commercial areas and public places in Mysore. Further, collection, isolation and disposal practices are varied considerably. Mysore has already crowned with the clean city status three times, still more scope is prevailed to manage solid waste and demanding regular update of the solid waste management practices, for that innovative and economically viable strategies are needed to control solid waste at places of tourist interest amidst commercial areas and public places in Mysore.

KEYWORDS: Source of solid waste, disposal, commercial areas, public places, Mysore.

INTRODUCTION

The waste appears commonly in human inhabited places due to various domestic and non-domestic activities. The kind of waste produced and the chemical nature of waste greatly varies depending upon the type of man-made activities conducted at different ecosystems. In human inhabited places both solid and liquid wastes are produced and which causes pollution in air, water and soil.^[1] Now-a-days, solid and liquid wastes have created havoc in urban areas, becomes problematic to residents of metro cities and fast growing cities.^[2] Hence, waste management is very essential.^[3] to have clean environment for normal survival. In the present paper, only solid waste and its management especially in commercial areas and public places is reported.

There are published reports available on the solid waste management and its control at urban areas of Tanzania,^[4] The Netherlands,^[5] Kuwait,^[6] China,^[7-8] Ghana,^[9] Nigeria^[10] and in Ethiopia.^[11] In India,^[12-18] have studied

the solid waste management in urban centers. Moreover, the municipal solid waste and its management practices undertaken have been reported in Dhanbad, Delhi, Indore, Mumbai and Pondicherry by.^[19-23] In Karnataka, the solid waste management in sub-urban areas of Bangalore was reported by.^[24-25,26-28] have reported the municipal solid waste management in Mysore city. All these reports are emphasized on various aspects of solid waste and management in different places of India and abroad. However, specific reports on the source, collection, isolation, storage and disposal practices employed for solid waste removal from different sectors of urban areas are poor. Recently,^[2, 29-31] have reported the solid waste source, collection, isolation, storage and disposal practices followed from different sectors namely: food supplying centers (FCSs), health care centers (HCCs), residential areas (RAs) and educational institutes (EIs) in Mysore. However, reports from commercial areas and public places in Mysore are wanting. Hence, the present study was undertaken.

MATERIALS AND METHODS

Study area: Mysore lies between 11°40' to 12°40' N. latitude and 75°57' to 77°15' E. longitude with an elevation 770 meters mean sea level.^[32] It possesses more than one million populations^[33] and attained the status of one of the clean cities in Karnataka. The city experiences tropical climate with warm summer and cool winter with equable temperatures due to salubrious weather. Being a tourists paradise, it has a rich, vibrant history and heritage, attracting good number of tourists around the world every day. As a result thousands of people from different parts of the world are visiting Mysore every day. Because of floating population and intensive human activities at commercial places, huge quantity of garbage is produced in the public places of tourist interest and led to the accumulation of huge quantity of waste at various places in Mysore city.

Methodology: To record the different types of solid waste produced from commercial areas, 20 places were selected and 63 sites were visited personally to collect information on the origin, source, production, collection, storage, isolation, transportation and disposal of waste at commercial areas and public places in Mysore city as shown in Table 1. Interested residents and the commercial shop owners who are enthusiastic to share their views were met in the study sites and interviewed by using pre-tested questionnaire during January to April, 2018 to collect the data on municipal solid waste and its disposal as per.^[2,29-31,34] Information on solid waste produced, segregated and disposed was collected as per.^[35] Collected data was compiled systematically and analyzed by following standard methods as per.^[36]

RESULTS

Per cent occurrence of waste from edible items: Commonly occurring waste from edible items is depicted in Table 2. Bio-degradable waste from 13 vegetables, 11 fruits, six from bakery shops and four from other places have recorded and per cent occurrence of these entire waste items is given in Table 2.

Per cent occurrence of waste from non-edible items: Around 26 non-edible items were commonly appeared as waste at commercial areas and public places. Of all, 10, 3 each and 4 items from plastic, paper, metal and cloth, rubber and cloth respectively contributed waste at commercial areas and public places. Per cent occurrence of these entire waste items is given in Table 3. In addition, glass waste and other waste included coconut coir, old batteries and piston kit also appeared as non-bio-degradable waste at commercial areas and public places (Table 3).

Waste collection and isolation: Time of waste collection and methods followed while isolating the waste was not alike at different commercial areas and public places. Table 4 shows the collection and isolation of waste amidst commercial areas and public places.

Majority (92.1%) i.e., 68.5% dry waste and 23.6% wet waste was isolated as bio-degradable waste and only 7.9% waste that included 7.6% non-biodegradable waste and 0.3% other waste was isolated as non-biodegradable waste at commercial areas and public places (Table 4). Further, 58.3% waste was collected during beginning of the day i.e., morning hours and 41.7% waste was collected during end of the day i.e., evening hours of the day at commercial areas and public places (Table 4).

Quantity of waste produced: Quantity of waste produced per day was considerably varied amidst commercial areas and public places. Majority (31.8%) of the commercial areas and public places, only one to two kilogram of waste is produced every day and it was followed by 19.7, 16.7 and 10.6% of the commercial areas and public places, where 3 to 6, 15 to 18 and 7 to 8 kilograms of waste produced every day respectively (Table 5). Moreover, 6.1% each have produced respectively 25 to 30 and 40 to 50 kilograms of waste every day (Table 5). However, 3% each of few commercial areas and public places, where minimum 0.2, 0.5 and maximum 70 to 80 kilograms of waste was produced every day respectively (Table 5).

Quantity of waste recorded from edible items: Commonly used 13 vegetable items have contributed 45.510 kg waste per day at commercial areas and public places (Table 6). Similarly, from 13 fruit items have produced 34.110 kg waste per day. Further, from seven bakery items, which included unused/spoiled food items has generated considerable quantity (3.550 kg) of bio-degradable waste every day at commercial areas and public places (Table 6).

Quantity of waste produced from non-edible items: The commonly used commodities made with different raw materials such as cellulose, cotton/fabric (cloth), coconut coir, plastic, metal, rubber and glass as non-edible waste and their quantity produced per day is given in Table 7. However, other items which were difficult to isolate separately either as edible or non-edible items were recorded separately as other waste and those included old batteries and piston kit, which were commonly appeared as waste every day at commercial area and public places. Quantity of these waste items produced per day is depicted in Table 7. Overall, six items such as three from edible items (i.e., vegetables, fruits and bakery shop), three from non-edible items (i.e., clothes, paper and others) have contributed 63.7% bio-degradable waste amidst commercial areas and public places in Mysore (Table 8). Similarly, five items from non-edible items such glass, metal, plastic, rubber and other have contributed 36.3% non-biodegradable waste amidst commercial areas and public places in Mysore (Table 8). Per cent occurrence of both bio-degradable and non-biodegradable waste items is shown in Table 8.

Storage and disposal of waste: Table 5 shows the storage and disposal of waste produced amidst

commercial areas and public places. Interestingly, 74.6% of the collected waste was stored in dust bins and it was followed by gunny bags, where 22.4% of the collected waste was stored every day. However, only 3% of the collected waste was stored in plastic covers (Table 5). Interestingly, highest (72.7%) collected waste was disposed every day at commercial areas and public

places (Table 5). Around 7.6% of the collected waste is disposed twice a day. Around 6.1 and 3% each of the collected waste is disposed once in a month and once in four months respectively. Surprisingly, 7.6% of the collected waste is disposed once in a year (Table 5). Thus, storage and disposal of waste produced at commercial areas and public places varied considerably.

Table 1: Commercial areas and public places selected during the survey in Mysore city.

Sl. No.	Places	No.	% age
1.	Aishwarya Petrol Bunk	01	1.6
2.	Basappa Memorial Hospital Area	02	3.2
3.	Danvantri Road	02	3.2
4.	Devaraj Urs Road	01	1.6
5.	Devaraj Mohalla	02	3.2
6.	Fountain Circle, Bangalore Road	09	14.3
7.	Ghandhi Squar	01	1.6
8.	Hanumantha Rao Street	01	1.6
9.	Ittigegudu	01	1.6
10.	Jayalaxmipuram	03	4.8
11.	Kalidasa Raod	02	3.2
12.	Kuvempu Nagara	11	17.4
13.	Lashkar Mohalla	05	7.9
14.	Nazarabad	04	6.3
15.	Paduvrahalli	01	1.6
16.	Saraswathipuram	09	14.2
17.	Sayaji Rao Raod	01	1.6
18.	Sub-urban Bus Stand	03	4.8
19.	Vijayanagar	01	1.6
20.	V.V. Mohalla	03	4.7
Total		63	100.0

Table 2: Per cent waste produced from edible items at commercial areas and public places.

Sl. No.	Type of waste	% age	
I.	Bakery Shop	1. Unused bread	0.9
		2. Unused cake	0.9
		3. Unused chips	0.9
		4. Unused ketchup	0.9
		5. Used ice cream cups	2.6
		6. Unused pickle	0.9
Total		7.1	
II.	Fruit Stall	1. Custard apple waste	0.9
		2. Lemon peelings	1.8
		3. Musk melon	0.9
		4. Spoiled/unused Apple fruit	3.5
		5. Spoiled/unused Grapes	2.6
		6. Spoiled/unused Jack fruit	1.8
		7. Spoiled/unused Pomegranate	0.9
		8. Spoiled/unused Orange fruits	3.5
		9. Spoiled/unused Guava fruit	0.9
		10. Spoiled/unused Papaya fruit	1.8
		11. Spoiled/unused Watermelon	3.8
Total		22.4	
III.	Vegetable Market	1. Spoiled/unused Beans	8.8
		2. Spoiled/unused Bitter guard	1.8
		3. Spoiled/unused Brinjal	5.9
		4. Spoiled/unused cabbage	9.4
		5. Spoiled/unused carrot	1.8

		6. Spoiled/unused cauliflower	3.5
		7. Spoiled/unused capsicum	6.4
		8. Spoiled/unused garlic	1.8
		9. Spoiled/unused green leafy vegetables	5.8
		10. Spoiled/unused Lady finger	2.9
		11. Spoiled/unused Onion	5.8
		12. Spoiled/unused Potato	2.6
		13. Spoiled/unused Tomato	6.1
Total			62.6
IV.	Others	1. Coconut coir	0.9
		2. Spoiled/unused Banana	5.2
		3. Spoiled/unused Banana frond	0.9
		4. Unused Banana leaves	0.9
Total			7.9
Over all			100.0

Table 3: Per cent occurrence of waste from non-edible items at commercial areas and public places.

Sl. No.	Different type of waste	% age
I.	Plastic waste	
	1. Hand wash refills, vials etc.	0.5
	2. Oil sachets	6.4
	3. Old/unused plastic items	1.5
	4. Old cable	2.3
	5. Polythene covers	17.3
	6. Unused chocolate	0.5
	7. Used juice bottles	2.4
	8. Used shampoo bottles	0.5
	9. Used soap covers	5.4
	10. Used water plastic bottles	5.4
Total		42.2
II.	Paper waste	
	1. Hard Card Board Sheet Boxes	11.9
	2. Papers	12.3
	3. Used ice cream cups	1.4
Total		25.6
III.	Metal waste	
	1. Old/unused metal bracelets	3.2
	2. Timing chain	0.9
	3. Unused/rusted steel or iron items	6.0
	4. Unused/rusted aluminum items	5.0
Total		15.1
IV.	Rubber waste	
	1. Old/unused tyres	2.3
	2. Old/unused leather shoes	2.3
	3. Used/unused rubber items	1.8
Total		6.4
V	Cloth waste	
	1. Unused cloths	0.4
	2. Used/unused different fabrics	1.4
Total		1.8
VI.	Glass waste	
	1. Broken glass items	3.1
VII.	Other waste	
	1. Coconut coir	0.4
	2. Old batteries	4.5
	3. Piston kit	0.9
Total		5.8
Overall Total		100.0

Table 4: Isolation and collection of waste at commercial areas and public places.

Sl. No.	Isolation of waste		% age	Sl. No.	Collection of waste	% age
1.	Bio-degradable waste	Dry waste	68.5	1.	Beginning of the day	58.3
		Wet waste	23.6			
2.	Non-biodegradable waste	Plastic/glass/rubber/mixed with metal waste	7.6	2.	End of the day	41.7
3.	Other waste		0.3			
Total			100.0	Total		100.0

Table 5: Storage, disposal practices and quantity of waste produced at commercial areas and public places.

Sl. No.	Storage	% age	Sl. No.	Frequency of waste disposal	% age	Sl. No.	Quantity of waste (in Kg)	% age
1.	Dust Bins	74.6	1.	Every day	72.7	1.	0.2	3.0
2.	Gunny Bags	22.4	2.	Once in two days	7.6	2.	0.5	3.0
3.	Plastic Covers	3.0	3.	Once in a week	6.1	3.	1 to 2	31.8
			4.	Once in a month	3.0	4.	3 to 6	19.7
			5.	Once in four months	3.0	5.	7 to 8	10.6
			6.	Once in a year		6.	15 to 18	16.7
			-	-	7.6	7.	25 to 30	6.1
			-	-		8.	40 to 50	6.1
						9.	70 to 80	3.0
Total	100.0		Total		100.0	Total		100.0

Table 6: Quantity of waste recorded from edible items at commercial areas and public places.

Quantity of waste produced (in Kg)					
Vegetables	Per day	Fruits	Per day	Food items	Per day
1. Beans (n=8)	3.525	1. Apple (n=4)	2.620	1. Bread (n=3)	0.500
2. Bitter Guard (n=2)	4.000	2. Banana (n=5)	2.900	2. Cake (n=3)	0.500
3. Brinjal (n=5)	2.500	3. Custard apple (n=5)	2.000	3. Chips (n=2)	0.200
4. Cabbage (n=5)	2.800	4. Grapes (n=5)	2.700	4. Chocolate (n=5)	0.100
5. Carrot (n=2)	5.500	5. Guava (n=2)	1.000	5. Jam (n=4)	1.000
6. Capsicum (n=3)	2.660	6. Jack fruit (n=2)	4.250	6. Ketchup (n=3)	1.000
7. Cauliflower (n=4)	4.820	7. Lemon (n=2)	1.250	7. Pickle (n=5)	0.250
8. Lady's Finger (n=3)	2.500	8. Musambi (n=2)	1.000		
9. Leafy vegetables (n=6)	3.080	9. Muskmelon (n=2)	3.000		
10. Garlic (n=2)	3.500	10. Orange (n=3)	2.830		
11. Onion (n=5)	1.550	11. Papaya (n=3)	2.560		
12. Potato (n=3)	4.160	12. Pomegranate (n=2)	2.000		
13. Tomato (n=7)	3.210	13. Watermelon (n=2)	6.000		
Total	47.060	Total	34.110	Total	3.550

Table 7: Waste recorded from non-edible items at commercial areas and public places.

Waste produced from							
Bio-degradable waste (in Kg)			Per Day	Non-biodegradable waste (in Kg)		Per Day	
I.	Cellulose items	1. Empty Ice cream cups (n=3)	6.000	I.	Plastic	1. Chocolate covers (n=10)	0.005
		2. Hard Card Board Sheets (n=30)	1.920			2. Damaged shampoo bottles (n=10)	0.050
		3. Waste paper (n=44)	0.850			3. Oil Sachets (n=12)	1.016
	Total	7,920.85	4. Polythene covers (n=44)			1.125	
II.	Cloth	1. Fabrics (Fiber & its allied fabrics) (n=6)	1.116			5. Used/unused cable wire(n=7)	1.142

		2. Old/unused clothes (n=3)	0.500			6. Used juice bottles (n=2)	0.350
		3. Waste cotton(n=12)	1.330			7. Used water bottles (n=11)	0.757
		Total	2,946			8. Shampoo sachets & soap covers (n=12)	0.433
					Total		4.878
III.	Coconut coir	1. Coir waste (n=10)	1.500	II.	Metal	1. Chain bracelets (n=6)	1.500
						2. Old piston ring (n=4)	1.125
						3. Rusted Iron (n=9)	1.500
						4. Trimming chain (n=6)	1.000
						5. Unused Aluminum (n=10)	1.700
					Total	6.825	
				III.	Rubber	1. Rubber items (n=3)	2.000
						2. Tyres (n=7)	2.850
					Total	4.850	
				IV.	Glass	1. Broken glass items (n=6)	0.400
V.	Others	2. Old Batteries (n=5)	1.100				
		3. Piston kit (n=5)	0.500				
		Total	2.000				
Over all Total (I +II + III)			9,423.796	Over all Total (I +II + III + IV + V)			18.953

Table 8: Bio-degradable and non-biodegradable waste produced at commercial areas and public places.

Sl. No.	Waste	Waste from	% age	Total %
I	Bio-degradable	1. Bakery Shop	3.5	63.7
		2. Clothes	0.9	
		3. Fruit Stall	11.2	
		4. Others	7.9	
		5. Paper	12.8	
		6. Vegetables	31.3	
II	Non-biodegradable	1. Glass	1.5	36.3
		2. Metals	7.5	
		3. Others	3.0	
		4. Plastic	21.1	
		5. Rubber	3.2	
Overall Total			100.0	100.0

DISCUSSION

Every day huge quantity of solid waste is produced due to various man-made activities amidst urban areas. Hence, the waste management is being regularly practiced to achieve good sanitation and cleanliness in human inhabited places. In Mysore city, municipality and other non-governmental organizations are making good efforts to remove waste produced at food producing centers,^[2] health care centers,^[29] residential areas^[34] and educational institutes.^[30] Similar types of efforts were made to remove the waste in commercial areas and public places of Mysore. Since, Mysore is one of the fast growing cities in Karnataka,^[2] and it is a tourist's paradise,^[34] offered good sanitation and cleanliness in commercial areas and public places also. Otherwise, commercial areas and public places becomes stinking with bad smell due to the accumulation of solid waste produced by various man-made activities at few places of tourist interest and commercially important areas amidst public places. The solid waste production was ranged in between minimum 0.2 to maximum 70 to 80 kilograms every day. Accumulated solid waste was

collected two times i.e., morning and evening hours. However, waste collection and isolation was not uniformly attended and there was a considerably variation existed. Further, collected waste was classified into dry waste (68.5%) and wet waste (23.6%) and both were put together as bio-degradable waste (92.1%) and non-biodegradable waste (7.9%). The waste from edible items such as 13 vegetables, 11 fruits, six waste items from bakery shops and waste from non-edible items namely: plastic, paper, metal, rubber, cloth (cellulose, cotton/fabric), broken/unused glass, old batteries and piston kit have recorded. Altogether, 63.7% bio-degradable waste and 36.3% non-biodegradable waste appeared amidst commercial areas and public places. This entire accumulated waste could cause pollution,^[1] hence its disposal is necessitated every day to maintain sanitation and cleanliness.^[3] Unfortunately, waste storage and disposal was not alike in commercial areas and public places. Similar type of observations were recorded at food producing centers, health care centers, residential areas and educational institutes by.^[2,29,34,30] Again, there was a variation in storage of waste. Total, 74.6% of the

collected waste was stored in dust bins and 22.4% waste was stored in gunny bags. Altogether, 72.7% waste was disposed from the overall collected waste every day. Thus, storage and disposal of waste produced at commercial areas and public places varied considerably and need critical attention by the concerned municipality authority. Obviously, specific waste management practices for waste from edible items and non-edible items are required for better management in urban centers. Similar types of approaches were made by^[21,17] for metro cities, class I cities and class II towns at different states in India.^[12-18, 37] Even in urban centers of developing and under developed countries such as Tanzania, The Netherlands, Kuwait, China, Ghana, Nigeria and Ethiopia, where critical approaches were made for the better management of solid waste.^[5-11] Hence, solid waste management should be attended every day^[14,12,3,15] to remove accumulated municipal and domestic waste in urban areas. The solid waste generation is a continuous process due to various domestic activities in metropolitan cities,^[15] its regular analysis help assess the current status in turn specific strategies can be developed^[13,21] for future to attend solid waste disposal in a better way.^[14,7,16,11] Because, the solid waste is characterized by specific chemical contents and exhibit unique properties^[37] especially solid wastes from metal, rubber, glass and plastic materials need specific treatment for their recycling and reuse.^[9,38] In this direction, scientifically sound plans are required to recycle non-edible waste. This could help solve the burning issues of solid waste management^[8] in fast growing cities like Mysore. On this line, in depth research is necessitated in the years to come. Interestingly, solid waste recycling activities are already in practices in The Netherlands,^[5] in Canada,^[39] in Kenya.^[40] Scientific investigations are necessitated in Mysore to initiate solid waste recycling activities as remunerative income generating occupation. Further, bio-degradable waste could be used for composting,^[41] making livestock feed^[2] and others. Thus, integrated approach for sustainable solid waste management is need of the day^[42] for fast developing cities like Mysore. Similar type of approaches were made by^[12-16,3,5,7-8,40,41] at different parts of India and abroad. Our observations are in agreement with the previously published reports of.^[10-11,13-21,23-28,5-9,37,42]

SUMMARY

The solid waste production was ranged in between 0.2 to 80 kilograms. The time of waste collection, storage and disposal of different wastes produced in commercial areas and public places varied considerably. Total 74.6% of the collected waste was stored in dust bins. Around 72.7% of the waste was properly disposed every day. Total 63.7% bio-degradable waste and 36.3% non-biodegradable waste was recorded in commercial areas and public places. The vegetables, fruits, spoiled bakery items, paper and clothes made with cotton becomes important sources for bio-degradable waste can be used to produce organic manure. The plastic, metal, glass,

rubber items are non-biodegradable waste can be recycled for reuse.

RECOMMENDATIONS

The solid waste must be isolated into bio-degradable and non-biodegradable waste at its place of occurrence at every place of tourist interest amidst commercial areas and public places. Tourists who are visiting places of tourist interest and people living at commercial areas and public places should be properly educated by providing time to time information regarding the follow of rules and regulations. At every tourist place and public place of commercial importance, colour coded dustbins which is placard with the bio-hazard mark should be kept for safe disposal of waste. In this regard, municipality, area councilor, Archeology department and other concerned government officials must take proper care on top priority basis every day for solid waste management. The municipalities and other agencies involved in waste disposal must collect waste every day from the areas of tourist interest and place of commercial importance and dispose regularly.

CONCLUSION

Although this type of study is general in their appearance, lot of science is involved in this work. While classifying the edible and non-edible items, segregating them into bio-degradable and non-biodegradable waste, more scientific knowledge is required to suggest for their effective and safe disposal. Moreover, scientific innovation is very much required to make use the available bio-degradable and non-biodegradable wastes for reuse and recycle for economic gains. Hence, this study seems to be simple, but it provides scientific insight that could help develop skills to attend solid waste management practices meticulously for human advantage and in turn to have contamination free ecosystem.

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