Chapter - II

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GROWTH AND PATTERN OF SOLID WASTE IN BELGAUM CITY

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2.1 Introduction

The purpose of this chapter is to overview the profile of the study area. To study the issues which generates the solid waste, in view of global scenario and the scenario of India. In this chapter we are going to study the factors that affecting the solid waste generation and management in Belgaum Municipal Corporation area. The different issues related to it.

The city of Belgaum has an area of 94 square km. There is cantonment and defence area. This city has grown around there four corners of area. The older areas of the city are very densely populated in comparison to the outlaying areas, but even the newer are well populated. It has been estimated that the current population of the city is 431 lakh and its would increase to 4.7 lakh by 2010 and 5.10 lakh by 2015. By 2015, the density of population is expected to reach to 5400 persons per square km.

According to Sudhakar Reddy and S. Gulab – Solid Waste Management (SWM) involves managing activities associated with generation, storage, collection, transfer, and transport, processing and disposal of solid wastes which are environmentally compatible adopting principles of economy, aesthetics, energy and conservation.

2.2 Generation of Solid Waste

The literature on generation of solid waste examines solid waste generation and related issues are as follows :

1. How much solid waste is generated?
2. What is the composition of solid waste generated?
3. Whether there is a correlation between the solid waste generated and population growth and class background of the household?
4. What are the implications of the characteristics of solid waste generated for its management?

Waste generation encompasses activities in which materials are identified as no longer of value and are either thrown away or gathered together for disposal.[1]

The waste generation is at present, an activity that is at controlable. In the future, however more control will be exercised over the generation of wastes. In the states where waste diversion goals are set by law and must be met under threat of economic penalty, it is necessary to put in place of a manifest system to monitor waste diversion, source reduction, although not controlled by solid waste managers, is now included in system evaluation as method of limiting the quantity of solid waste generated.[2]

2.3 Generation of Solid Waste : A Global Scenario

Growing population, fast urbanisation rising incomes and changing consumption pattern continue to complicate the waste

management problems, and have global dimension. Waste is produced throughout the world. But the ability to manage these wastes lags behind the rates of their production and accumulation. Further, throw away has become a way of life in both the developed and developing countries.

Table No. 2.1 shows solid waste per person per day in selected cities of the world. The table shows the solid waste generation in some selected cities of developed and developing countries of the world.

The cities of different countries of the world are classified as industrialised countries (high income countries), middle income countries and developing countries (low income countries). Their per capita generation of solid waste is –

Table No. 2.1

Solid Waste Generated Per Person in Selected Cities

The Countries	Name of the Cities	Per Capita Solid Waste Generation (in Kg) per day
Industrialised Countries	1. New York	1.800
	2. Tokyo	1.400
	3. Paris	1.000
	4. Hamburg	0.800
	5. Rome	0.600
Middle Income Countries	6. Singapore	0.800
	7. Hong Kong	0.800
	8. Tunis	0.500
	9. Medallion (in Columbia)	0.500
	10. Cairo	0.460
	11. Manila	0.460
	12. Kani (in Nigeria)	0.450
Low Income Countries	13. Lahore (Pakistan)	0.600
	14. Jakarta	0.600
	15. Calcutta	0.454

Source : Times of India, January 2nd, 1989, p. 41

From the above table No. 2.1 it is observed that the highest per capita solid waste generation was in New York city (1.8 kg), followed by Tokyo (1.4 kg), Paris (1.0 kg.), Hamburg (0.8 kg), Rome (0.6 kg.) cities under the industrialised countries. In the middle income countries group, the highest solid waste generation was in Singapore and Hong Kong (0.8 kg) each followed by Tunis (0.5 kg), Medallion (in Columbia) (0.5 kg), Manila (0.46 kg), Cairo (0.46 kg) and Kani (in Nigeria) (0.45 kg). The highest per capita per day solid waste generation in low income group was in Lahore in Pakistan (i. e. 0.6 kg.) and Jakarta (0.6 kg) followed by Calcutta (India) (0.45 kg). The per capita per day solid waste generation seems to be low in Calcutta city, not because of efficient management of municipal solid waste.

The foregoing analysis reveals that developed countries generate solid waste in greater extent than middle income and low income countries of the world. Hence, they should undertake more efforts for management of solid waste compared to others. But there are also some cities in middle income and low income countries which have greater magnitude than developed counties.

2.4 A Scenario of Solid Waste Generation in India

India is a major developing country. It has 16% of world population, but only two percent of land area, simultaneous increase in population and economic growth is placing severe pressure on its natural resources and environment. It is facing cruel dilemma of balancing the environmental imperatives and developmental

requirements. The problems like air and water pollution, waste disposal are caused due to inadequate environmental safeguards adopted in development projects.[3]

Urbanisation is one of the important factors affecting the generation of solid waste. The number of urban population is increasing rapidly. Out of 844 million people, 217 million people of India live in urban areas (1991 census). The process of urbanisation is very rapid as compared to the growth of rural population, whereas the decimal growth of rural area has been 19.17% during 1981-91, the urban population growth was as high as 36.19%. A net increase of 56.44 million people has been registered during the decade, with the current growth rate, the urban population of the country is likely to be 30% million (2001), which will be 30.5% of the total population and 2011 it will be 395 million.

The number of urban area is also increasing rapidly. In 1951, there were 3060 towns in 1981. They turned to 4029 and as per 1991 census, the figure has gone to 4689 million, similarly the number of urban agglomeration towns which were 3378 in 1981, have gone upto 3768 in 1991 it is interesting to note that as much as 65.20% of urban population was living in 300 class-I cities in 1999.[4]

Table No. 2.2

Nutrient Supply from Urban Solid Waste in India

Sr. No.	Details	Quantity
1	Total Urban Population	217 million
2	Total Number of Towns in India	3768
3	Total Solid Waste Generated	24 million tonne per annum
4	Nutrient Quantity (Annual Total Tonnes)	
	i) Nitrogen	1,45,000
	ii) Phosphorus	70,000
	iii) Potash	70,000
	iv) Total NPK	2,85,000

Source : 1) NEERI, 1996 2) Jeevan Rao, 1992

Map of Belgaum District

2.5 A Profile of Belgaum City

Belgaum is an important industrial, commercial and education hub of region, adequate water and a very good climate characterise the city of Belgaum. The extent of the city has not increased, but the population has been steadily increasing at the average rate of population, about 2% annually over the past two decade. The city is expected to maintain its steady growth status.

The city of Belgaum has an area of 94 square km. There is a cantonment and defence area distributed into four corners within the city. The older areas of the city are very densely populated in comparison to the outlay areas, but even the newer are well populated. The city does not have any rural pockets. It has been estimated that the current population of the city is 4.31 lakh and it would increase to 4.71 lakh by 2010 and 5.11 lakh by 2015.

2.6 Solid Waste in Belgaum City

Solid waste is the term used to describe non liquid waste materials arising from domestic, trade and commerce, industries, public services and agricultural activities. It is a combination of various heterogeneous waste materials. It is commonly known as garbage, refuse, rubbish or trash.

2.7 Projection of Waste Generation in Belgaum City

The waste generation for Belgaum has been project over a planning period of 8 years with population growth rate of 2% and a waste growth rate of 1%.

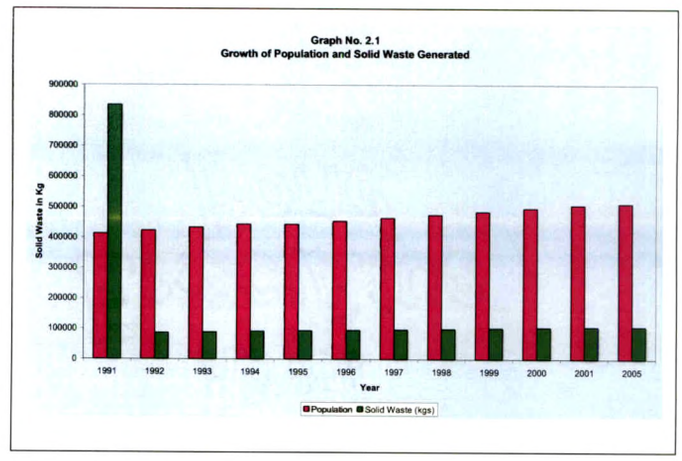
Table No. 2.3 shows the growth of population and solid waste generation in Belgaum City from 1991-2005

Table No. 2.3

Growth of Population and Solid Waste Generated

Year	Population	Solid Waste (kgs)	Quantity of Waste Generated per day
1991	412794	834506	0.204
1992	423176	86686	0.204
1993	433558	88866	0.204
1994	443941	91047	0.205
1995	443941	93227	0.209
1996	454323	95407	0.209
1997	464705	97588	0.209
1998	475088	99768	0.209
1999	485470	101948	0.209
2000	495853	104129	0.209
2001	506235	106309	0.210
2005	511488	107400	0.280
CGR	9.63	2.25	

Source : Census 2001



From the Table No. 2.3 it is observed that the population of Belgaum city increased, the solid waste collected also increased. The highest population is in 2005 (511488) and solid waste collected was 107400 kg and quantity of waste generated per day is 0.280 grams.

Thus, it is observed that wit the growth in population of the city, its solid waste generating also has been increased significantly in absolute as well as per capita terms. This demands an increased need and attention for the management of the solid waste by the Belgaum Municipal Corporation as an urban local government of its jurisdiction.

2.8 Composition of Solid Waste in Belgaum City

Composition term is used to describe the individual components that make up a solid waste and their relative distribution. The solid waste generated in Belgaum city is 140 tonnes per day, out of this quantity 108 tonnes is collected and transported at present. It consists of various materials discarded by human, commercial and industrial, social, activities like most cities in India. The municipal solid waste in Belgaum comprise of organic food and vegetable wastes, paper and cardboard products, plastic waste, rubber, rags and textile materials, broken glass and crockery, dead animals, bones, stones, etc.

Table No. 2.4 shows the composition of municipal solid waste from Indian cities.

Table No. 2.4

Composition of Municipal Solid Waste in India

Parameter	Composition as % of MSW (w/w basis)
Dry matter	45 – 60
Moisture	40 – 55
Paper and cardboard	5 – 25
Plastics	0.6 – 0.9
Glass and ceramics	0.1 – 0.7
Sand and fine earth	30 – 40
Ferrous metals	0.6 – 1.0
Total compostable matter	30 – 45
Organic matter	25 – 40
Ash	15
c/co ratio	20 – 30
Calorific value (in J/g wet weight)	1000 - 2500

Source : Technical Literature of Municipal Solid Waste[5] (Management treatment and disposal project detailed project report AIC Western Consultant Ltd., p. 3, Chapter-4.)

2.9 Waste Characterization for Belgaum City

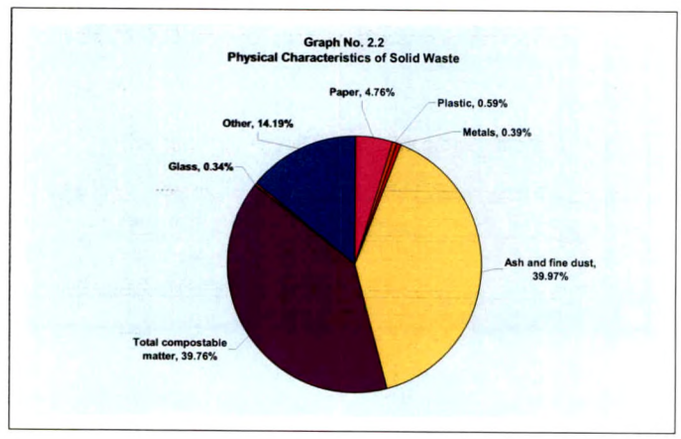
The specific data on the composition of municipal solid waste in Belgaum was available with Belgaum Municipal Corporation and the results of the analysis are given in the Table No. 2.5.

Table No. 2.5

Physical Characteristics of Solid Waste

Item	Percentage (%)
Paper	4.76%
Plastic	0.59%
Metals	0.39%
Ash and fine dust	39.97%
Total compostable matter	39.76%
Glass	0.34%
Other	14.19%
Total	100%

Source : Action Plan for SWM (2006)



2.10 Chemical Characters of Solid Waste

The study of Indian citifies has shown the chemical composition of solid waste as under.

Table No. 2.6

Chemical Composition of Solid Waste

Population (million)	Nitrogen as total Nitrogen	Phosphorus P_2os	Potassium K_2oF	C/N Ratio
0.1 to 0.05	0.71	0.63	0.83	30.94
0.5 to 1.00	0.66	0.56	0.69	21.13
1.0 to 2.0	0.64	0.82	0.72	23.68
2.0 to 5.0	0.56	0.69	0.8	22.45
5.0 & above	0.56	0.52	0.52	30.11

Source : NEERI Strategy Paper of Solid Waste Management in India, August 1995

Chemical characters of Indian wastes have shown that total Nitrogen varies from 0.56% to 0.71%, Phosphorus from 0.52% to 0.82%, Potassium from 0.52% to 0.83% and C/N ratio is between 330 and 560 kg.

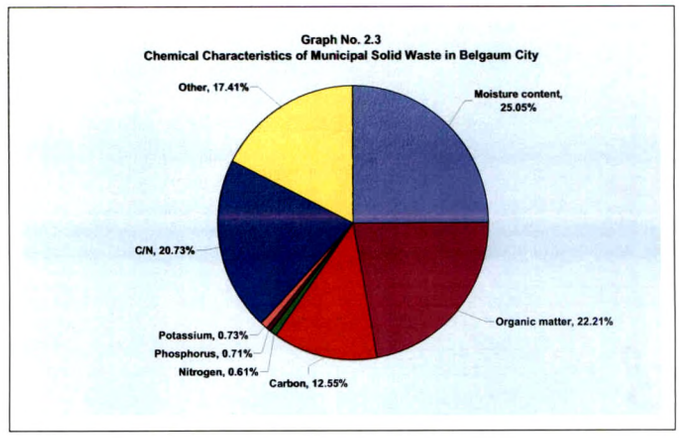
Table No. 2.7

Chemical Characteristics of Municipal Solid Waste in Belgaum City

Item	Percentage (Average)
Moisture content	25.05%
Organic matter	22.21%
Carbon	12.55%
Nitrogen	0.61%
Phosphorus	0.71%
Potassium	0.73%
C/N	20.73%
Other	17.41%
Total	100%

Source : Action Plan Report, 2006

Graph No. 2.3
Chemical Characteristics of Municipal Solid Waste in Belgaum City



The table shows that moisture content is high than other contents about 25.05% and organic content is 22.21%. the maximum carbon content was of 12.55% in Belgaum. So far as the C/N ratio is concerned, it is 0.73%. It means that C/N ratio is less than which indicates that there is least scope for recycling of organic waste in Belgaum Municipal Corporation.

2.11 Demography

The knowledge of basic demography trends is very essential to sort out the problems and exact needs of the area to be planned. It provides the ideas regarding habitation of people and basic requirements.

The city of Belgaum has an area of 94 square km. There is a cantonment and defence areas distributed in 4 corners of the city. The city has been growing steadily and table No. 2.8 gives

the details of population overtime. It has been estimated that the current population of the city is 4.31 lakh and this would increase to 4.71 lakh by 2010 and 5.11 lakh by 2015. The growth of the city has been steady and progressively the various areas within the city are growing.

Table No. 2.8

Population of Belgaum City Past and Projected

Year	Population	Growth Rate
1981	274430	-
1991	326399	18.93%
2001	399600	22.42%
2005	431568	*
2010	471528	*
2015	511488	*
CGR	- 37.80	*

Source : Census data.

Note : *Estimated using projected growth rate of 2% per annum over 2001 population.

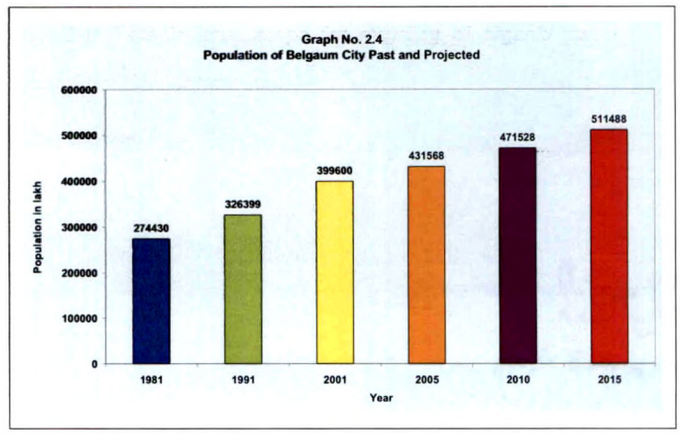


Table No. 2.8 gives the growth in the population/density of the city. The area of the city has remained stagnant over the last 3 census periods, which population has been growing. This has resulted in population density is increasing. There are no immediate proposals to merge the neighbouring areas into the city area and progressively the density of city is expected to increase with further population increase. But by 2015 the density of the population is expected to reach to 5400 persons per square km.

Table No. 2.9

Population Density of Belgaum City

Year	Population	Area within town city limits	Density	Growth in density
1981	274430	94	2919	-
1991	326399	94	3472	18.9
2001	399600	94	4251	22.4
CGR	20.669	-	20.678	-

Source : Action Plan Report, 2006

A Ward Profile

The civil area of Belgaum have been subdivided into 58 wards. The ward wise data on the population estimated for 2002 along with the data on the number of household classified at non slum and slum households is presented in Table No. 2.10. The total number of households in the city was about 91609 at an average family size of 4.4, 24 of the wards have slum population, only about 5.6 of the households are slum households. The two ward having the major clusters are the ward numbers 35 and 48.

Table No. 2.10

Wardwise Population, Slum and Non Slum Households

Ward No.	Population	Non Slum Households	Slum Households	Total Households
1	8921	1781 (100%)	0	1781 (100%)
2	11486	2119 (77.16%)	27 (22.84%)	2746 (100%)
3	5762	978 (86.16%)	157 (13.83%)	1135 (100%)
4	7431	1100 (79.0%)	292 (20.97%)	1392 (100%)
5	6936	987 (93.28%)	71 (6.7%)	1058 (100%)
6	8237	2752 (100%)	0	2752 (100%)
7	5413	2691 (100%)	0	2691 (100%)
8	6920	1543 (100%)	0	1543 (100%)
9	9320	3006 (97.62%)	73 (2.3%)	3079 (100%)
10	6447	1443 (100%)	0	1443 (100%)
11	9238	1597 (100%)	0	1597 (100%)
12	8368	1312 (100%)	0	1312 (100%)
13	6371	995 82.36%)	213 (17.63%)	1208 (100%)
14	4770	1141 (100%)	0	1141 (100%)
15	10315	3868 (98.62%)	54 (1.3%)	3922 (100%)
16	7069	2063 (90.80%)	209 (9.1%)	2272 (100%)
17	7219	3298 (100%)	0	3298 (100%)
18	6560	1183 (100%)	-	1183 (100%)
19	5060	1072 (100%)	-	1072 (100%)
20	6451	1150 (76%)	362 (23.94%)	1512 (100%)

Ward No.	Population	Non Slum Households	Slum Households	Total Households
21	7853	2015 (100%)	0	2015 (100%)
22	5484	1140 (100%)	0	1140 (100%)
23	6300	956 (100%)	0	956 (100%)
24	6403	1360 (100%)	0	1360 (100%)
25	6666	2144 (100%)	0	2144 (100%)
26	6427	1312 (100%)	0	1312 (100%)
27	4860	1207 (95.86%)	52 (4.1%)	1259 (100%)
28	5260	983 (100%)	0	983 (100%)
29	4386	1191 (100%)	0	1191 (100%)
30	5656	873 (94%)	55 (5.9%)	928 (100%)
31	5697	943 (100%)	0	943 (100%)
32	4588	501 (100%)	0	501 (100%)
33	5337	1146 (88.76%)	73 (5.6%)	1291 (100%)
34	4860	1021 (100%)	0	1021 (100%)
35	8193	978 (46.61%)	1120 (53.38%)	2098 (100%)
36	8120	1052 (100%)	0	1052 (100%)
37	5860	618 (85.59%)	104 (9.8%)	722 (100%)
38	4474	756 (94.02%)	48 (5.9%)	804 (100%)
39	5834	864 (100%)	0	864 (100%)
40	6274	728 (90.43%)	77 (9.5%)	805 (100%)
41	4130	592 (100%)	0	592 (100%)

Ward No.	Population	Non Slum Households	Slum Households	Total Households
42	5050	728 (66.60%)	365 (33.39%)	1093 (100%)
43	12240	2262 (100%)	0	2262 (100%)
44	11240	2435 (98.30%)	42 (1.6%)	2477 (100%)
45	8190	861 (94%)	54 (5.9%)	915 (100%)
46	6907	1328 (96.37%)	51 (3.7%)	1378 (100%)
47	7540	1736 (100%)	0	1736 (100%)
48	5944	1402 (59.83%)	941 (40.16%)	2343 (100%)
49	8924	1826 (100%)	0	1826 (100%)
50	6984	1293 (100%)	0	1293 (100%)
51	5687	1361 (100%)	0	1361 (100%)
52	10800	2545 (100%)	0	2545 (100%)
53	9844	2760 (100%)	0	2760 (100%)
54	10154	2529 (76.58%)	773 (23.41%)	3302 (100%)
55	6854	976 (100%)	0	976 (100%)
56	8764	1154 (78.82%)	310 (21.17%)	1464 (100%)
57	3890	764 (100%)	0	764 (100%)
58	6876	675 (63.26%)	392 (36.73%)	1067 (100%)

Source : Solid Waste Action Plan Report, 2006

Note : Figure in bracket indicate percentage to total households.

The table No. 2.10 gives the list of slums of Belgaum. There are totally 58 slum areas in the city. The total slum population is about 23000 accounting, which stands at 6% of the total population.

The Kasai galli and Ganganwadi are two major clusters of slum population.

Table No. 2.11

Slums in Belgaum City

Ward No.	Slum Name	Slum Household	Slum Population	Identified Declared
2	Rohidas Nagar Angol	21	96	D
3	Nathpai Nagar, Angol	219	820	I
5	Harijanwada, Angol	170	840	D
8	Nayar Camp	81	349	D
9	Naddar Chavani, Sambhajinagar	87	449	I
10	Vaddar Galli	143	688	D
11	Malaprabha Nagar	199	826	I + D
13	Gollar Colony, Laxmi Nagar	198	949	I + D
14	Savodaya Colony	107	518	I
15	Hindwadi Vaddar Chavani	55	314	D
17	Godrewadi, Goodshed Road	129	638	I
18	Alvan Galli, Shapur	191	1018	I
19	Harijanwada	61	237	I
20	Khasbag Vaddar Chavani	128	672	I
21	Gayathri Nagar	91	467	I
23	Bhandur Galli	71	362	I
27	Kapileshwar Backside	29	142	I
30	Fulbagh Galli	58	324	I
33	Bapat Galli	67	334	I
35	Kaqai Galli & Howdad	146	880	I
42	Matang Colony	77	325	I
43	Hanuman Nagar	269	1199	I
45	Bedar Colony	70	2524	I
44	Vedyagiri Colony	25	91	I
45	Bedar Chavani	148	591	I
46	Bedar Colony	70	2526	I
47	Ahsok Nagar	268	667	I
48	Gangavadi	374	1792	I
50	Veerabhadranagar	129	645	I
54	Kanchi Koravar Colony	57	233	I
52	Gandhi Nagar	133	525	I
55	Campus Extension	32	108	I
56	Kanabargi Extension	83	284	I
	Total	3906	19917	I

Source : Action Plan Report, 2006

A detailed database on the wardwise road has been prepared giving the length of the road and its width. This data has been used for making sweeping plans. The table No. 2.12 below gives the consolidated information on the road wardwise. The total road length in Belgaum is about 458 kms.

Table No. 2.12

Wardwise Data on Different Waste Generating Establishment

Ward No.	Households	No. of Shops	Commercial	Hospitals & Nursing Homes	No. of Industries
1	1781	-	-	0	90
2	2719	65	65	1	1495
3	978	-	-	0	10
4	1100	-	-	0	15
5	987	-	-	1	17
6	2652	-	-	0	15
7	2691	298	298	8	105
8	1543	259	259	5	97
9	3006	338	338	1	168
10	1443	262	262	5	143
11	1597	557	557	10	458
12	1312	727	727	5	270
13	995	243	243	6	155
14	1141	241	241	4	20
15	3868	381	381	15	13
16	2063	22	22	11	5
17	3298	171	171	6	15
18	1183	167	167	0	38
19	1072	234	234	3	57
20	1150	366	366	5	241
21	2015	372	372	9	172
22	1140	150	150	3	34
23	956	59	59	1	31
24	1360	115	115	2	9
25	2144	171	171	2	45

Ward No.	Households	No. of Shops	Commercial	Hospitals & Nursing Homes	No. of Industries
26	1312	300	300	5	62
27	1207	229	229	2	28
28	983	250	250	1	2
29	1191	100	100	0	3
30	873	682	682	0	17
31	943	422	422	7	2
32	501	413	413	3	1
33	1146	639	639	12	0
34	1021	682	682	0	0
35	978	267	267	0	0
36	1052	544	544	0	0
37	618	229	229	4	6
38	756	167	167	30	9
39	864	74	74	5	1
40	728	90	90	0	0
41	592	217	217	1	8
42	728	208	208	27	4
43	2262	210	210	8	1
44	2435	185	185	6	3
45	861	220	200	19	4
46	1328	316	316	7	1
47	1736	121	121	10	1
48	1402	89	89	4	5
49	1826	89	89	6	3
50	1293	69	69	7	0
51	1361	64	64	6	3
52	2545	280	280	14	53
53	2760	152	152	12	13
54	2529	127	127	11	1
55	976	-	-	4	0
56	1154	-	-	5	1
57	764	-	-	5	0
58	675	-	-	7	2
Total	85694	12633	12633	331	3951

Source : Action Plan of Solid Waste Management, 2006

Salient Data about the City

The salient data about the city is presented in Table No. 2.12. The population of the city as per 2001 census was 399600 in the 58 wards of the city. In addition to the population in the cantonment area was about 550. The total area of the city including the cantonment and defence area in 94 square km. There are 15 fruit and vegetable markets and 15 major centres for sale of meat and fish. There are 509 hotels and restaurants and 3951 major offices and industries. The municipal budget for the year 2003-04 was Rs. 37.03 crores of which Rs. 6.57 crores was spent on solid waste management.

Table No. 2.13

Salient Data about Belgaum City

Sr. No.	Item	Details
1	Population (2001 Census)	399600
2	Area	94 Sq. km.
3	Number of Wards and Councilors	58
4	Total length of the roads	458 km.
5	Markets	15
6	Biomedical establishments	331
7	Hotels and Restaurants	509
8	Offices and Industries	3951
9	Budget of City Corporation (Estimates 2003-04 Rs. In crores)	3703

Source : Annual Budget Reports of Belgaum Municipal Corporation

2.12 Concluding Remarks

In this chapter a profile of the study area and generation of solid waste are studied. The projection of waste generation in Belgaum city shows that 140 tonnes municipal solid waste is generate per day,

out of this quantity of 108 tonnes is collected and transported at present. The population of the city has increased from 326399 in 1991 to 399600 in 2001. Increased population housing, slum generates most solid waste. The official slum population was 19917 in 2001. It generates more solid waste. The total developed area in Belgaum city increased by 21.4%, the residential households area 3.16% increase in commercial area and 3.16% increase in area of shops. This chapter also shows the functional area of Belgaum city, where more and more solid waste is generated. It is observed that Belgaum Municipal Corporation has failed in collecting of all the solid waste generated in the city, which demands the need for promoting expansion of solid waste collection not of the Corporation.

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