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Generation, Characterization and Collection of Solid Waste - A Case Study

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Abstract:

The study deals with generation and characterization of solid waste in class II town of district Ambedkar Nagar, Uttar Pradesh. With an average waste generation rate of 0.350 kg/head/day, the town generates about 28.672 ton of waste daily. As per our estimates nearly 63.95 per cent population generates 75.38 per cent waste at the rate of more than 0.300 kg/head/day and only 11.77 per cent population generates less than 0.25 kg/head/day. The share of organic waste is well below 50 per cent. The average organic waste generation rate is 0.158 kg/head/day, whereas average inorganic waste generation is 0.198 kg. Only 35 per cent waste is collected.

Keywords: SWM, Waste, Generation, Characterization, Organic, Inorganic, Collection, Tanda.

1. Introduction:

Solid Waste Management (SWM) is a matter of concern in the urban areas of developing countries particularly in the developing Asian countries where uncontrolled growth of population and its urban shift further adds to waste generations. The changes in consumption patterns with alterations in the waste characteristics have resulted in a

quantum jump in solid waste generation. The volume and characteristics of MSW generated in developing countries depend on the standard of living, consumption patterns, cultural traditions, commercial and institutional activities and the geographical location. Waste composition in urban areas is changing with increasing use of packaging material and plastics (CPCB, 2003). The quantity and magnitude of different categories of waste vary often within the country (Al-Khatib et al. 2010). In developing countries a large part of the municipal waste flow is organic and biodegradable, originating from households largely peelings from fruits and vegetables, food ruminates and leaves (Cointreau, 2006).The composition of waste is generally compared on the basis of weight. The density sometimes also varies between seasons, where the rainy season generally results in even higher density of MSW (Philippe and Culot, 2009).

Municipal solid waste generation rate is over riding the population rate not only in mega cities but also in small towns and cities of India. The daily per capita solid waste generated in small, medium and large cities and towns in India varies from the minimum of 0.2 to 0.5 kg/ capita/ day with the recyclable content varying from 13 per cent to 20 per cent. (CPCB 2001 a). However, Sharholy *et al. (*2008) estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 - 0.4 kg and 0.5 kg capita-1 day-1, respectively. The per capita generation even reaches to 1.0 kg capita-1 day-1 in high income households in metros of developing countries especially India (World Bank 1999). The Central Pollution Control Board (CPCB, 2000a) estimated the generation rate for the selected cities of India and concluded that the national average of waste generation is about 0.376 kg/capita/day. The International Solid Waste Expert Committee has estimated an average generation rate of 0.4 to 0.6 kg/capita/day for low income countries. However, the World Bank uses the figure of 0.460 kg/capita/day for India.

Though, it is not comparable with the developed countries where per capita waste generation rate is well above 2.5 kg, yet the actual quantum is large owing to the large population size in India. In spite of sharp increase in the generation of waste, the organic component of waste has remained almost stable at 40 per cent over the last many years, but the percentage of recyclable waste gone up from 9.5 per cent in 1971-73 to 17.2 per cent in 1995, adding to the problem of scientific disposal of waste and technological development of safe recycling as in the case of e-waste.

2. Objectives:

The objectives of the study are to determine the quantitative and qualitative characteristics of MSW in Tanda.

3. Data and Methods:

The town does not maintain any data for waste generation, collection and disposal hence it had been generated through field survey. One hundred fifty households were randomly selected to assess MSW quantity, collection frequency, satisfaction level, etc. Besides, samples have been randomly collected from various locations and analyzed to determine the characteristics of MSW. Spatial information was obtained from Google image, Survey of India topo sheet, and Nazri Naqsha of the town.

4. The Study Area:

The town is situated at 26° 33' 00" N and 82° 39' 00" E longitude on the right bank of river *Gaghara* .The town spreads over an area of *10.45* sq. km., population of 83467 with an average density of 7983 persons per square km.
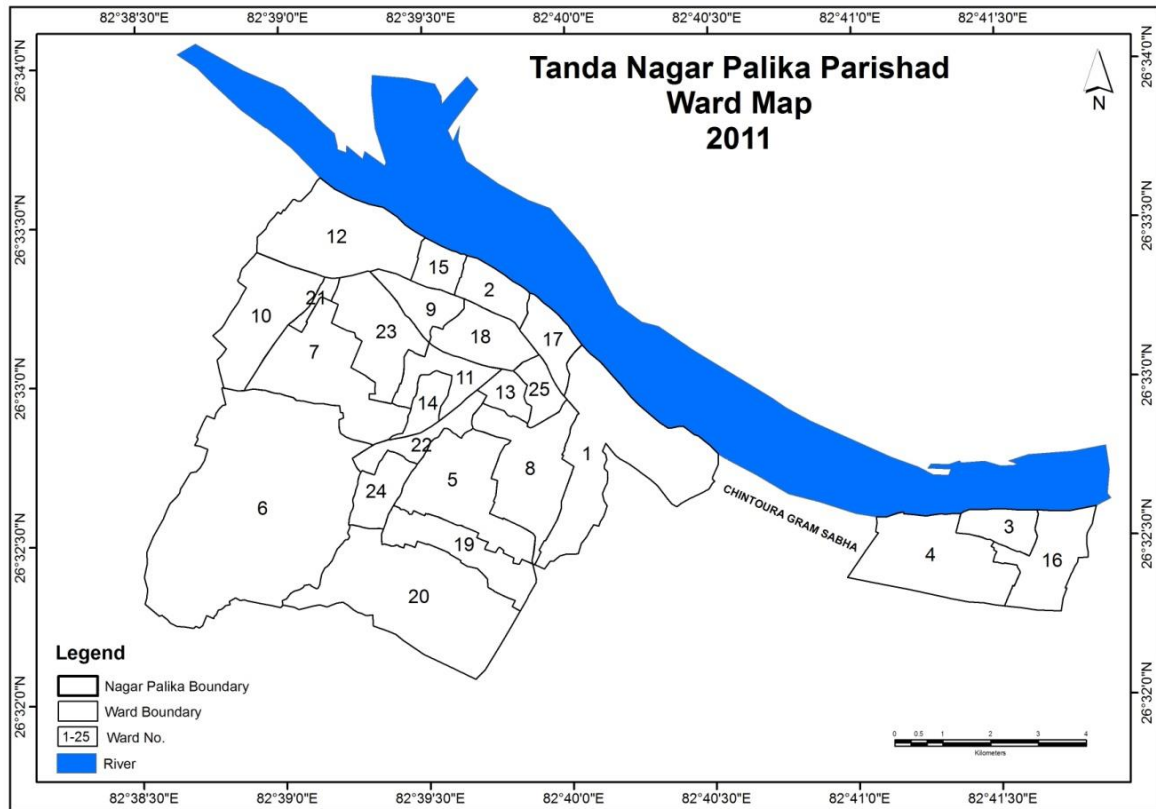
Figure 1: Tanda: Wards

Tanda is the business centre and famous for power loom industry. It has emerged as household industry. More than 80 per cent population is directly or indirectly engaged in power looms industry. Recently the industrial character has reported a significant shift. As a result number of rice mills, brick kilns, and agricultural machinery manufacturing units has come up in the periphery of the town. Tanda which was once famous for *Tanda terricott* is now known for agricultural machinery.

5. Waste Generation:

Tanda municipality is an industrial town with high population density and narrow lanes and bye-lanes. The industrial character dominated by power loom and congestion have posed a serious threat to the waste management. This is one of the richest Nagar Palika of Ambedkar Nagar even then in most the wards the heaps of garbage can be seen everywhere.

Table 1: Waste Generation Rate

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Ward No.	Ward Name	kg/person/day
1	Nehru Nagar	0.319
2	Chajjapur	0.400
3	Mubarakpur Uttari	0.225
4	Mubarakpur Dakshani	0.235
5	Sakrawal Uttari	0.400
6	Kashmiriya	0.350
7	Kazzipura	0.256
8	Sikandrabad	0.240
9	Chajjapur Dakshani	0.380
10	Alhadadpur	0.420
11	Kasba Uttari	0.270
12	Aliganj Uttari	0.430
13	Hayatganj Purvi	0.400
14	Kasba Paschimi	0.260
15	Chajjapur Uttari	0.380
16	Mubarakpur Purvi	0.270
17	Hayatganj Uttari	0.430
18	Hayatganj Paschimi	0.410
19	Sakrawal Purvi	0.340
20	Sakrawal Dakshini	0.425
21	Aliganj Dakshini	0.410
22	Kasba Purvi	0.310
23	Futtupatti	0.290
24	Sakrawal Paschimi	0.450
25	Hayat Ganj Purvi	0.340
Average		**0.345**

Source: Field Survey

The dustbins are cleared in the morning hours only. The empty bins are filled again in a short time and the garbage remains there till the next day morning. The town had one dumping site and a slaughter house in Sikandarabd ward. The dump site is presently non functional as it is surrounded by dense settlement and number of power looms. Further, about 50 per cent area of the site has been earmarked for the construction of residential

houses for the low income group under the Ambedkar Awas Yojana of the State government. The Nagar Palika Parishad adopted the same collection and disposal system as in the other towns of the district.

With an average waste generation rate of 0.350 kg/head/day, the town generates about 28.672 ton of waste daily. About 63.95 per cent population accounts for about 75.38 per cent waste at the rate of more than 0.300 kg/head/day and only 11.77 per cent population generates less than 0.25 kg/head/day and majority of them at the borderline (Table 1).
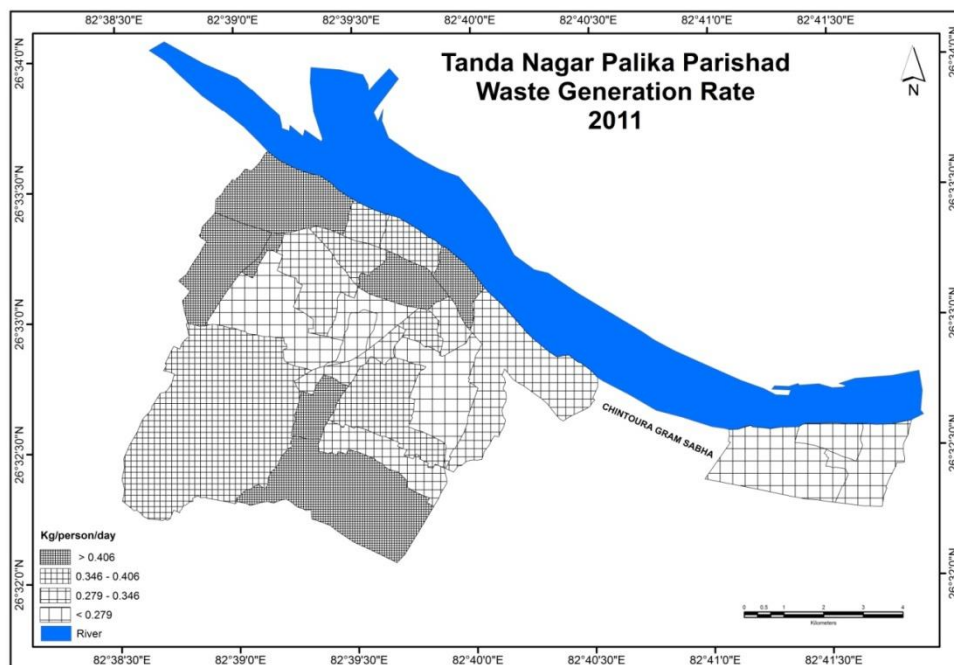

Figure 2: Tanda: Waste Generation - 2011

This pattern indicates the gravity of the problem and needs care full consideration. It was found that though the rate of waste generation increases with the increase of income but the difference in the rate of generation among different income groups is insignificant. About 65 per cent population earning less than Rs.3000/ pm reported waste generation rate of 0.311 kg/head/day, whereas those earning between 3000 and 5000 reported generation rate of 0.397 kg/head/day i.e. a difference of only 0.086 kg. In spite of being power loom

centre, only 7.38 per cent population earns more than Rs.5000/ a month. This category includes even the big businessmen whose income is far above. The average generation of 0.425 kg/head/day is not true picture of the generation rate.

6. Waste Composition:

The general classification of waste is based on composition of the waste in terms of physical characteristics because no data are made available on chemical characteristics of urban wastes. For analysis purpose the waste is broadly classified as organic and inorganic. Most of the organic waste originates from households but commercial, institutional and industrial waste also contains significant proportions of organic waste. It comprises foodstuffs and litters etc. and can be processed in the presence of oxygen by composting or in the absence of oxygen using anaerobic digestion. Both methods produce a soil conditioner, which can be used as a valuable source of nutrients in urban agriculture. Anaerobic digestion also produces methane gas an important source of bio-energy. Decomposed organic wastes produce biogas (predominantly methane, a significant greenhouse gas) and leachate that contains nutrients and soluble organics. The leachate may pollute groundwater and may release and mobilize heavy metals from landfills (Waste, 2001). Some organic wastes such as sludge and bio solids can contain heavy metals or nutrient pollutants. Uncontrolled disposal of bio -solids may lead to site contamination or water pollution. Open burning of organic wastes pollutes the air and contributes to the smoke haze problem in cities and may contribute to global warning by releasing green house gases. If these wastes are properly managed they can be converted into resource and can be processed into various useful products. Potential products and markets include mulch, compost, vermi-compost, soil conditioners, and recycled timber, firewood and energy recovery.

Rapid industrialization and concomitant urbanization during last two decades has led to the generation of huge quantities of inorganic wastes, which have aggravated the environmental problems in the country by depleting and polluting natural resources. Therefore, rational and sustainable utilization of natural resources and its protection from toxic releases is vital for sustainable socio-economic development and wholesome living environment in town and cities. The hazardous waste generation in the country is estimated to be around 4.4 million tonnes annually while, as per the estimates of Organization for Economic Cooperation and Development (OECD), nearly five million tonnes of hazardous waste is being produced in the country. About 38.3 per cent of this is recyclable, 4.3 per cent is incinerable and the remaining 57.4 per cent is disposable in secured landfills. Twelve states of the country namely Maharashtra, Gujarat, Tamil Nadu, Orissa, Madhya Pradesh, Assam, Uttar Pradesh, West Bengal, Kerala, Andhra Pradesh, Karnataka and Rajasthan account for 97 per cent of the total hazardous inorganic waste generation. The top four waste generating states are Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu. On the other hand, states such as Himachal Pradesh, Jammu & Kashmir, and all the North Eastern States except Assam generate less than 20,000 tonnes per annum. Given the wide variations in quantity and nature of inorganic waste generated across states and union territories and also considering the wide variations in climatic as well as hydro-geological conditions in different regions of the country, the approach to waste management has to be essentially state/ town specific.
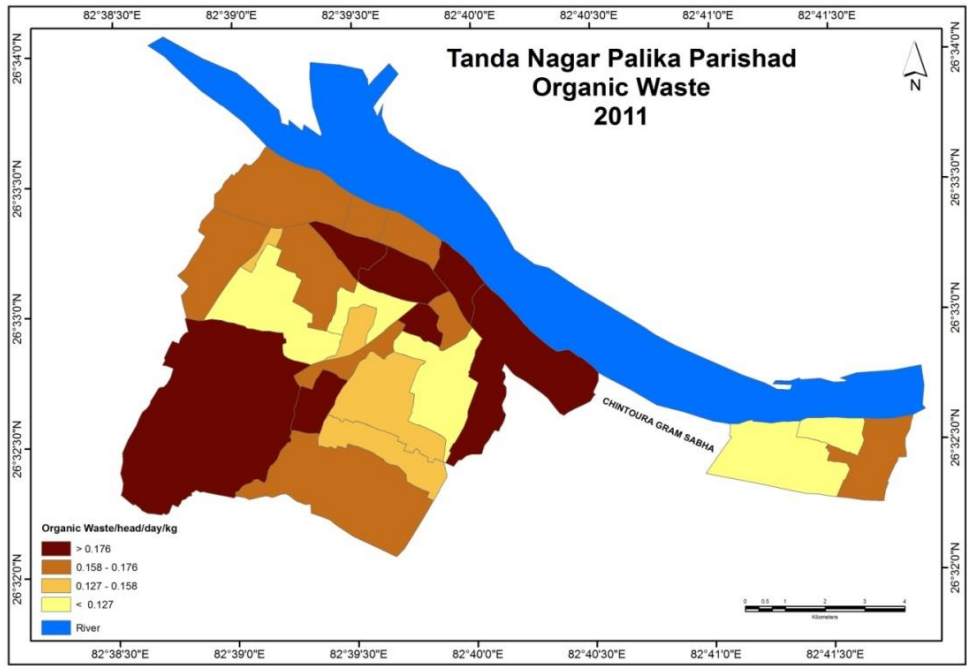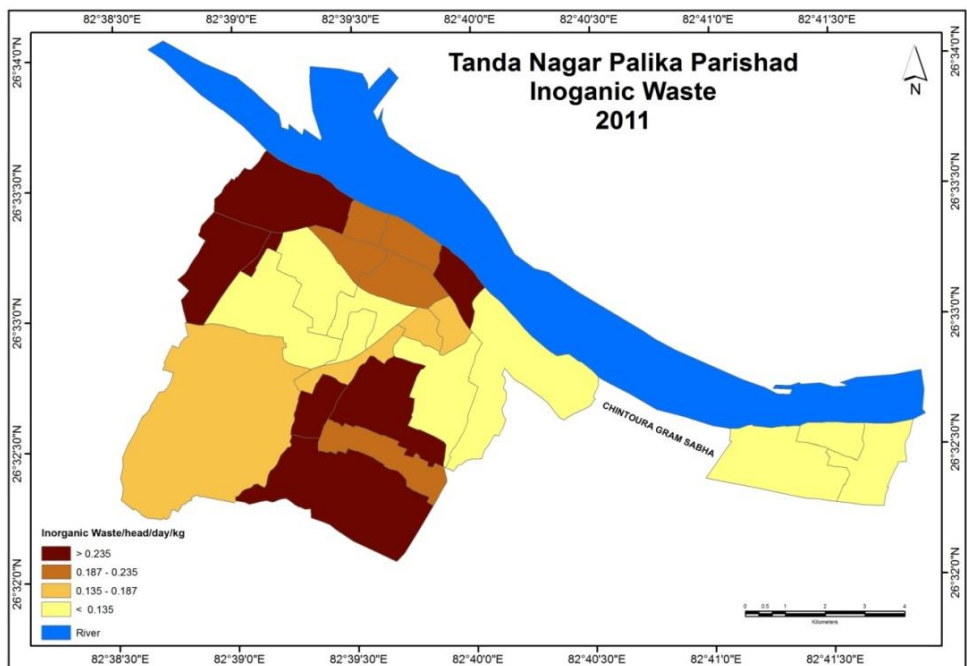
Figure 3: Tanda: Organic Waste

Figure 4: Tanda: Inorganic Waste

7. Solid waste collection system:

Communal storage and community bin system of waste collection practiced in Tanda *Nagar*

Palika. Door to door collection is not in practice. Waste formed out of domestic,

commercial and industrial activities is called communal waste. Such wastes are thrown out

from the premises into the bins. These bins are generally open spaces. There are no built up enclosures (*Kudaghar*) in the town. Only those wastes which are thrown along the road side are collected by the *safai karamchari*. The waste thrown in the private lands is left uncollected. It causes accumulation of waste and leads to unhygienic conditions. Open depot is probably the most common communal storage method. An open depot is an open space without specific boundaries which is treated as an official storage point for waste. These are usually sited along the road side, streams or at the boundary of open space.

In community bin system the generator of the waste himself is responsible for depositing the waste. The existing collection system in the towns is community bin system. The community bins system exists but because of shortage of dust bins sufficient number of dust bins is not placed particularly in the outer parts of the towns. As a result people are throwing their waste in open and road sides. In community bin system, municipality put the metallic bins in which residents dump their waste. The location and size of dustbin is not governed by municipality rather by the residents. The sweeper or crew of waste collection visit these localities, collect the waste and transport it to municipal disposal site. It has been observed that the waste is not disposed of at all. It remains accumulating in the residential area. Generally sweepers or householders collect the waste from the house and dump it in open plot or in front of their houses. Municipality collection vehicle do not visit these areas. In door to door system the waste is collected from door to door and deposited in the nearby community bins. The dustbin is kept permanently outside the house. In this system, generally private sweeper municipal sweeper or servants of the houses collect the waste from the house and dump it in the nearest, community bin. In some cases, the municipality sweepers are also assigned the duty of sweeping of road. In such cases depending upon the street, generally a road length of 400 meters is allowed to each sanitation worker for street sweeping. In few cases it has been observed that sweeper dump the waste on the road or

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burnt it. Temporary road picking is one of the important collection systems observed as the installation of dustbins is not found everywhere. In this system of waste collection, the waste is heaped by the municipal workers usually at a difference of 40 meters between two heaps. Tanda could collect and dump only 10 tones (35.7 %) waste. This is the ground reality in a situation where the volume is very low. The way the consumerism is on rise, it is expected that if the agencies don't wake up, the solid waste will emerge a serious challenge. In the management of solid waste the sanitary workers (sweepers) play an important role. Their strength is an indicator of collection efficiency and shows concern of the *Nagar Palika Parishad* towards the clean city environment. The sweeper-population ratio, the sweeper-road length ratio, bin-population ratio and spacing of dustbins are important parameters for assessing the efficacy of waste collection system.

As far as the sweeper-population ratio is concerned, the average ratio for the town is 405.18 which is close to the recommendation of CPCB. It is noted that the wards situated in the southern part of the town have poor ratio in comparison to the wards of northern part. Sweeper-road length ratio is another criterion to assess the efficiency of collection system. The average ratio for is 1120.4 meters which is very poor as per the norms. There is sharp variation among the wards. The ratio in the inner part of the town is satisfactory but moving away it declines. Worst ratio is recorded in the outer wards.

Table 2: Tanda: Sweeper - Population Ratio, Sweeper- Road length Ratio, Bin-Population Ratio

S. No.	Ward	Ratio	Ratio (in meters)	Ratio
1	Nehru Nagar	421.48	1470	1157.66
2	Chajjapur	355.46	560	976.33
3	Mubarakpur Uttari	425.24	590	1168.0
4	Mubarakpur Dakshini	428.88	1070	1178
5	Sakrawal Uttari	462.13	1470	1269.33
6	Kashmiriya	463.95	2220	1274.33
7	Kazzipura	462.86	2150	1271.33
8	Sikandrabad	396.60	1490	1089.33

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9	Chajjapur Dakshini	346.11	760	950.66
10	Alhadadpur	348.78	1510	958.00
11	Kasba Uttari	450.48	1260	1237.33
12	Aliganj Uttari	373.65	1510	1026.33
13	Hayatganj Purvi	346.48	390	1094.66
14	Kasba Paschimi	358.0	520	983.33
15	Chajjapur Uttari	360.67	610	990.66
16	Mubarakpur Purvi	375.12	1230	1030.33
17	Hayatganj Uttari	398.54	560	1094.66
18	Hayatganj Paschimi	373.90	810	1027.00
19	Sakrawal Purvi	380.33	1050	1044.66
20	Sakrawal Dakshini	417.71	2020	1147.33
21	Aliganj Dakshini	396.23	450	1080.33
22	Kasba Purvi	463.47	820	1273.00
23	Futtupatti	437.86	1830	1202.66
24	Sakrawal Paschimi	450.84	1190	1238.33
25	Hayat Ganj Purvi	434.58	480	1193.66
Total/Average		**405.18**		**1120.84**

Source: Field Survey, 2011

There are only 75 dustbins for a population of about 87,000. It means only three dust bins per ward. Though the sanitary staffs clear the waste in the morning hours but soon these are filled and therefore the residents under compulsion put the waste along the roads in the form of heaps. These are occasionally burnt particularly in the market centres. There is no problem of fund but the local authorities failed to increase the number as there is little or no space for putting the bins particularly in the densely populated wards and the market centres. Small number of dust bins has adversely affected the waste management plans of the Nagar Palika. It is reflected in a poor ratio of 1: 1112.89. Best ratio of 950.66 is found in Chajjapur Dakshini followed by Alhadadpur, and Chajjapur. Whereas, the worst ratio of 1: 1274.33 is found in Kashmiriya, followed by Kazipura, Sakrawal and Kasba etc. It is notable that the best ratio is found in the wards located either along the river or occupied by rich people. Wards with worst ratio are largely found in the southern part of the town. These are dominated by Ansari community engaged in weaving business.

8. Conclusions:

The study finds that the waste generation in Tanda is 0.350, kg/head/day, whereas the state

average is 0.381 kg/capita/day and the national average is 0.376 kg/capita/day. As far as the status of organic and inorganic in the study area is concerned it is such that the share of organic waste is well below 50 per cent. The average organic waste generation rate is 0.158 kg/head/day, whereas average inorganic waste generation is 0.198 kg. It is found that the wards with high per capita waste generation have also recorded high per capita inorganic waste and vice versa. Communal storage and community bin system of waste collection practiced in Tanda *Nagar Palika*. Door to door collection is not in practice. Tanda could collect and dump only 10 tones (35.7 %) waste. This is the ground reality in a situation where the volume is very low. The way the consumerism is on rise, it is expected that if the agencies don't wake up, the solid waste will emerge a serious challenge.

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