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Characterization of municipal solid waste in Sunder Nagar, Himachal Pradesh, India.

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ABSTRACT

The characterisation of Municipal Solid Waste is mandatory aspect for the evaluation of its suitability for different waste processing techniques. The paper presents physical characterisation of municipal solid waste for Sunder Nagar town of Himachal Pradesh and evaluation of the existing sanitation setup of town. The population of town is approximately 26,000. The total waste generation of the town is 20 tonnes per day and the waste generation rate for individual person in the town is 0.54 kg/day/capita. Physical characterisation of the study area revealed that the town is rich in organic waste and biomass resources hence prove advantageous for composting and incineration processes. It is revealed from the evaluation of existing sanitation setup of the town that solid waste management is very inadequate. Source segregation of waste is still not in process in the town. Various waste processing techniques such as recycling, composting, vermin composting are totally absent in the town. It is perceived from the study that a considerable amount of effort is required by the municipal corporation of the town and public to obtain remarkable outcomes in this direction.

Keywords: Household waste, physical characterization, Sanitation setup, Sunder Nagar, Himachal Pradesh.

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INTRODUCTION

Increased population along with urbanization and industrialization leads to economic development and improved living standards of people contributes increase in the municipal solid waste production around the world. Due to urbanization, industrialization, population growth and economic growth, the tendency of increase in waste generation has been marked worldwide in most of the cities (Punjab Pollution Control Board (PPCB), 2010). The living standards of people, increased income sources, consumption of goods and services results into the higher amount of waste generation. The annual production of waste in India is more than 42.0 million tones. In this context, it has been found that the rate of solid waste generation in India varies from 0.2-0.87 kg/day which is depending upon the population and the economic potential of the city (Sharholy etal.,2008;Kumaretal.,2009). The increase in generation of waste in India is around 5% annually (Sharholy et al., 2008; Kumar et al., 2009). Interestingly, based on the literature survey and Himachal Pradesh State Pollution Board Report (SPCB), it is reported that the generation of municipal solid waste (MSW) in Himachal Pradesh was estimated to be 360 tonnes per day (TPD) in the year 2015 (Communication with the authority of State Pollution Control Board). The hazardous waste in Himachal Pradesh is 84.27% landfillable, 5.33% is incinerable and 10.30% is recyclable (Dr. Omesh Kumar Bharti, Health office State Pollution Control Board (H.P.). The per capita generation of waste in Himachal Pradesh is around 0.413 kg/capita/day. Based on current annual MSW increase rate of 1-1.33% annually, the urban projected population in the year 2011, 2021, 2031 and 2041 for the State is listed below in Table1**.**

Table 1: Estimated waste generation in Himachal Pradesh (State Pollution Control Board Report, 2011)

Sr. No.	Year	Per capita waste generation	Urban Population	Waste Generated
1.	2011	0.413	736.3369	304.3
2.	2021	0.472	883.3212	416.6
3.	2031	0.538	1023.429	550.9
4.	2041	0.614	1155.249	709.6

Further, existing research showed that about 70% of the solid waste produced in India is dumped off directly in the landfills in an unsatisfactory and unplanned manner especially in metro cities and towns (Hazra and Goel, 2009). The capacity to produce a sustainable and efficient waste management practices in developing countries has been limited by insufficient documentation of the volume and characterization of solid waste generation (Ogwueleka., 2009; Olukanni., 2013; Olukanni et al., 2014). The scope of the studies range from existing generation, collection and disposal techniques (Rana et al., 2015)and characterization of solid wastes (Rawat et al., 2013).In Indian Scenario, waste management is not so much adequate and in proper manner. Open dumping of waste is promoted most of the cities and towns in Indian context. The predominance of open dumping and the absence of reliable data regarding generation and characterisation of waste has created the difficult situation for urban local bodies responsible for managing MSW generated in the city (Sethi S. et al., 2013). The present study focuses on the determination of physical characterisation of municipal solid waste and evaluation of existing sanitation setup of the study area (Sunder Nagar, Himachal Pradesh).

STUDY AREA AND SANITATION SETUP

Sunder Nagar, a name derived from the name of Sukdev Rishi, become the fast progressive town of Himachal Pradesh. Sunder Nagar is widely known for the B.S.L. project of hydro electric generation. The area of this municipal council is 12.47 square meter. Sunder Nagar lies within the coordinates of 31.5332˚N and 76.8923˚E having a population of 24,344 as per National Census Report (Census report 2011). Figure 1 showed the location map of the study area. The general view of dumpsite where the waste is disposed off openly in land is shown in Figure 2.

MSW generation: The major sources of municipal solid waste in Sundernagar municipal council areas are residential areas, offices, commercial areas and institutions. The generation of solid waste in the town is around 20 tons/day. The municipal solid waste arising from Sunder Nagar town also consists of high proportion of organic waste, paper, plastic and metals.

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Figure 1: Site location of Sunder Nagar (Himachal Pradesh)

Figure 2: View of dumpsite in Sunder Nagar (Himachal Pradesh)

MSW collection: The solid waste arising from human activities in Sundernagar has become on the major environmental pollutants causing extensive damage to local ecology, and threat to human health because of non- appropriate way of collection of waste. The collection of solid waste areas on daily basis from the household is totally absent in the town. There is no management of different dustbins for biodegradable and

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non- biodegradable waste. There is no storage stations of waste in the town where the solid waste collected from domestic households can be stored temporarily before being transported to the disposal sites.

MSW transportation: For the transportation of municipal solid waste from storage container to the disposal site, Sunder Nagar Municipal Corporation has provided a total of 11 vehicles (Personal communication with Sundernagar Municipal Corporation), which include trucks (2), Dumper placer (1), compactor (1), tractor (2) and three wheelers. The capacity of these vehicles varies from 2 tonnes. The routes used by drivers for transferring wastes are haphazard and depend on the existing traffic of that particular day. Further, the wastes are neither cleaned nor given any treatment with sprays so as to avoid any contamination or spread of disease.

MSW Disposal: The dumping of the solid waste at this site started back in 1994. The total available land area for dumping the waste at the Sunder Nagar dumpsite is about 5 acres (Personal communication with the authority of Sundernagar MC). In practice, the municipal solid waste dumped at the dumpsite in an open dumping manner without providing any prior treatment increasing the potential environmental and health risks. The flow sheet of municipal solid waste management including (generation, collection, transportation and disposal of waste) is shown in Figure 3.

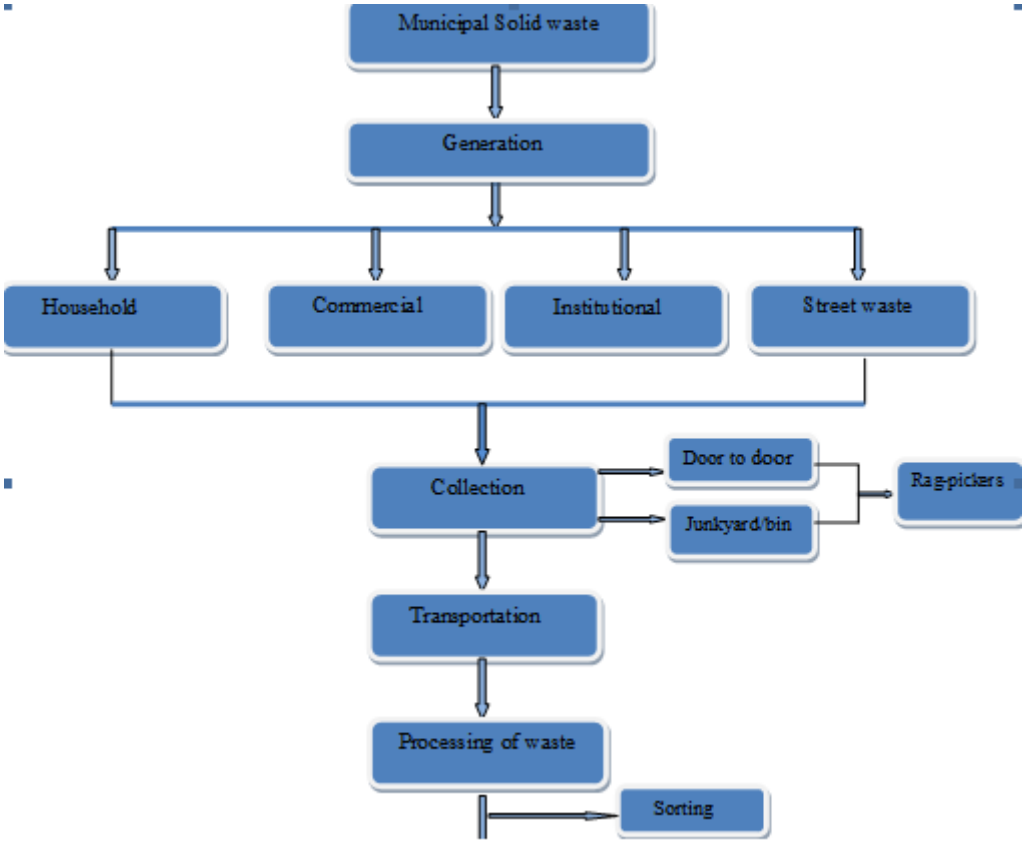

Figure 3: Flow chart of municipal solid waste management in study area

METHODOLOGY

The sampling process for physical characterisation of waste was performed in according to ASTM D5231-92 (ASTM 2008). In this method, vehicles from identified zones reaching at the respective dumpsite of the town and were selected at random during each day of the one week sampling period to have representative waste samples. The gravimetric profiling method (conventional method) was adopted for the physical characterization of waste. The entire vehicle contents were emptying out on a plastic sheet to avoid the intermixing of underlying soil with waste. The quartering technique was used to collect 1,000 kg of sample of the entire vehicle content which was further reduced to 100 kg in the second iteration. The waste samples were sorted and segregated manually in the dumpsite with the help of rag pickers. The waste components

were weighed after sorting and segregation process. The mean waste composition was determined by using the result of waste composition of each of the sorting samples (Sethi et al., 2013).

RESULTS AND DISCUSSIONS

The percentage of various physical components of Municipal solid waste sorted in the dumpsite of study area (Sunder Nagar, Himachal Pradesh) is shown in Table 2.

Table 2: Physical composition of MSW in percentage

S. No.	Components	Composition
1.	Organic waste	40%
2.	Paper	14%
3.	Plastic	12%
4.	Glass	10%
5.	Metal	11%
6.	Textiles/leathers	0-2%
7.	Wooden matter	0-5%
8.	Other waste	0-6%

Organic (40%):

The organic waste constituted on average the highest (40%) fraction of the total municipal solid waste generated from urban areas. Organic waste is mainly composed of kitchen wastes including vegetables, food remains, fruits etc were observed. The average organic fraction of MSW would be higher if waste generated from the weekly markets were included.

Paper & paperboard: (14%): Paper and paperboard formed the second highest (17%) fraction of the municipal solid waste. This category of waste included all paper products (printed or plain paper, notebooks, newspapers and magazines), all types of corrugated and non-corrugated carton boxes and packages. Carton boxes were sourced mainly from commercial establishments, offices and although household also produced some quantities.

Plastics (12%)**:** Although the uses of plastics for pouches, carry bags have been banned in Sunder Nagar (Himachal Pradesh) since 2003.The waste generated from plastics formed up to 12% of the total waste generation in the study area (Sunder Nagar). Plastic waste composed of packaging, plastic product, PET bottles etc. Plastic waste is not decomposable and compactable hence affects transportation cost and the life of landfill.

Textiles/leathers (2%)**:** The textiles and leather component formed the fewer fractions (2%) of the total municipal solid waste generation. Textiles components consist of cotton, jute; wrappers, bags etc. and leather components mainly consist of leather shoes, bags, belts, and other leather items.

Glass(10%)**:** Glass materials made up 10% of the total municipal solid waste. Glass mainly consists of beer bottles, liquor bottles, juice bottles and other beverage. Intact glass bottles were also observed in the municipal solid waste, most of the glasses were either broken bottles or household utensils and containers.

Metals (11%)**:** The composition of metals was identified merely 11% out of the total municipal solid waste. Most residents prefer storing metal scraps at home for later sale to scrap dealers because metal scraps can have high resale values.

Wooden Matter(0-5%): The composition of wooden matter was observed (0-5%) indicating the quantity of wood, pulp, and rice hulls etc. The composition of wooden matter in Sunder Nagar town is average because of moderate temperature.

Others (0-6%)**:** This category including the waste components such as ash, dust, construction and demolition waste such as timber, sand and gravel, household hazardous wastes such as household chemicals, dry batteries, or any other wastes that cannot be classified under any of the above categories were all classified as Others waste. The fraction of other waste formed 0-6% of the total municipal solid wastes.

SUGGESIONS AND RECOMMENDATIONS

It is exhibit from the study that at present, there is no treatment facility present in Sunder Nagar (Himachal Pradesh) except for a small scale recycling of items including (Paper, paperboard and plastic). Municipal solid waste management is a tedious task consists of generation of waste, collection of waste, transportation of waste and the final disposal of waste. If waste is not managed in proper and adequate manner, it may cause many health hazards and environmental problems including water, air and soil quality deterioration. Some of the recommendations are reported that would be helpful for the proper management of solid waste:

(i) Underground waste collection bins should be constructed and used for collection of waste in a segregated manner from the individual houses and transported further to the processing facilities such as recycling units/biogas plants.

(ii) Unscientific way of waste disposal must be stopped as may cause contamination of both the ground water and surface water sources due to runoff from hills during precipitation. Heavy rainfall may carry the waste with the flood water. Water pollution may create health hazards to the residents and the tourists as well. This may hamper the tourism potential of the Himachal Pradesh and ecology in general.

(iii) The biodegradable and wet portion of the waste such as garden waste, food and vegetable waste should be sent to the biogas plant wherein its organic fraction can be utilized as a substrate, for microorganisms converting it to biogas.

(iv) The non-biodegradable and dry waste such as paper, plastic, rubber, metal and glass should be sent to the authorized recyclers; for its use in manufacturing.

(v) The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes. The inert and non-biodegradable waste shall be used for building roads or filling up of appropriate areas on hills.

CONCLUSION

The study provides an overview of the existing sanitation setup and determination of physical characterization of municipal solid waste in Sunder Nagar town of Himachal Pradesh. Physical characterization of solid waste indicates that the waste is rich in organic waste that is good for composting. The resources of bio-energy in municipal solid waste are paper and plastic. The percentage of paper and paperboard varies from 10-14% therefore incineration method can be adopted for the burning of paper and other combustible materials such as clothes, leafs, jute etc. Municipal solid waste can be converted into energy by combustion process and by natural decomposition of municipal solid waste. These processes are very advantageous for waste to energy conversion and moreover the burden of waste on landfill will also reduce. From the existing sanitation setup of the town, it is concluded that solid waste management in the study area of Himachal Pradesh is very uncertain and inadequate. The arena showed that there is no daily door to door collection from the households. Delay in waste collection leads to degradation of waste. The quantity of municipality dustbins is not sufficient in the respective towns. It leads to littering of waste everywhere that is the major cause of environment degradation. The segregation and sorting of waste is done in informal way. No proper machines are available for the segregation of waste. The present scenario of the existing technique of waste management in the town of Himachal Pradesh (H.P.) has demanding major improvements for the proper management of waste. The study convey suitability to choose the best technologies for the processing of municipal solid waste to local decision makers on the basis of physical characterization of solid waste.

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