COMPOSITION, GENERATION AND CURRENT PRACTICES OF MUNICIPAL SOLID WASTE IN LUKLA, SOLUKHUMBU

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ABSTRACT

Solid Waste Management (SWM) in remote areas such as Mt. Everest region in Nepal is being increasing difficult due to the cold climate, complex topography and extreme environmental factors. The study was carried out in KPLRM-2, Lukla, Solukhumbu to quantify and seasonal comparison of the composition, generation and current management practices of Municipal Solid Waste (MSW) of an autumn and winter season. The representative samples were carried out by systematic random sampling method from 40 residential households and 20 commercial lodges out of total 211 households for 24 hours in each four weeks of October 2022 and January 2023 by collecting & segregating manually for the composition and weighing the waste components for generation as well as questionnaires for the current practices. The MSW was categorized into six components such as organic waste, plastics, paper & paper products, glass, metals and cloth where organic waste had highest percentage in both residential households (70%) & commercial lodge (60%) which was followed by plastics and other wastes were found in low percentage. Waste generation was found to be 0.237 kg/capita/day from residential households and 0.719 kg/capita/day from commercial lodges. Among the waste composition in the residential household & commercial lodge found that organic waste reveals highest percentage in the autumn season and winter season where cloth had lowest percentage for both seasons. Majority of the people were followed segregation of MSW into biodegradable and non-biodegradable waste respectively. The non-biodegradable wastes were disposed through burning in the waste pit, incinerating and a few wastes was reusing for different purposes. Most of the local people and local organization is actively seeking way to collaborate with KPLRM to improve the waste management system.

Keywords: Composition, Segregation, Municipal Solid Waste, Recycling

INTRODUCTION

Any garbage, refuse, sludge from waste treatment plants, water supply treatment plants, or pollution control facilities, industrial waste and other discarded or unwanted materials, including solid, semisolid, liquid or contained gaseous materials, as a result of industrial, commercial, mining, agricultural, hospital, and community activities are all considered to be solid waste (ADEM, 2016). Municipal solid waste (MSW) is commonly known as domestic refuse along with non-hazardous waste that is mainly produced by households, commercial and institutions. Generally, MSW is majorly composed of organic waste, paper, plastic, glass along with hazardous household waste such as batteries, light bulbs, medicines, etc. (Magutu & Onsongo, 2010).

The rapid population growth, urbanization, together with the constantly changing in technologies, and rising standards of living and development activities which is considered a burden to the society and hazardous to the environment (APHA, 2010). Additionally, this problem is also increasing due to the frequent use of disposable or single use products in contemporary societies (Katiyar, 2016). So, the study with local bodies such as locality, municipality and corporation is an important area for solid waste management (Tuladhar, 2003).

Solid waste management (SWM) is an important tool of sustainable development for any nation so prioritizing of SWM is greatly supported by global initiates (UNDESA, 2005).

According to University of West of England, "Solid Waste Management (SWM) is the discipline associated with the control of generation, storage, collection, transfer, processing and disposal of solid waste minimization of the production, the re-conceptualizing of waste as an economic resource, mobilizing the communities in the process, and protection of human health and environment (Nyachhyon, 2006).

Similarly, mountain regions in developing countries experience significant challenges in handling in the increasing quantity of solid waste due to the pressure of expanding tourism activities and lack of proper waste management facilities, the pollution of the land and water bodies in the proximity of human

settlements in Nepal (Byers et al., 2020). Environmental degradation due to open dumping, open burning and poor collection schemes in many mountain regions in Nepal is associated with tourism activities and the regions' waste management practices (Byers et al., 2020). The economic growth from tourism in the Everest region, there arise challenges of waste handling as a large volume of solid waste is generated along the trekking routes in every year. Currently, Nepal is experiencing the landfill problem becoming more serious in the high mountain regions and urban areas. The growing presence of landfill poses a serious public health issues and environmental hazard due to the routine burning of waste materials which release of toxic chemicals, and contamination of local and downstream groundwater supply (Ghimire et al., 2013). Most of the solid waste deposited in landfills is composed mainly of tin, steel, aluminum cans, glass bottles, plastic bottles and its other products, electronic waste such as batteries, computer parts, and old household appliances is increasing found in the landfills, as well as medical waste in the health clinics and hospitals (Posch et al., 2015). Most of the kitchen scraps from household is fed to livestock and practices compost which does not present any sort of disposal problem at present time (Maharjan et al., 2019).

Waste management is all the activities and actions required to manage waste from its generation to its final disposal (UNSD, 2017). Wastes management is now seen at the part of the broad globe concern for sustainability and it clearly overflows national boundaries in terms of problems and possible solutions (Fagan et al., 2001). The current waste management in the Everest region is based on the displacement of waste from one place to another (Byers et al., 2020). The stakeholders such as Local Government and NGOs dedicated to waste management are trying to develop environment-friendly, cost effective, and feasible solutions. Among them, SPCC seems to be the most active as it is a community-based organization established and run by the local community of Khumbu. SPCC is responsible for collecting, separating, and treating solid waste in the Everest region. Currently, SPCC is actively seeking ways to collaborate with the Khumbu Pasang Lhamu Rural Municipality (KPLRM) to best achieve mutually beneficial goals for waste management. SPCC is collaborating with Sagarmatha Next and Blue Waste to Value, which is moving towards in innovative SWM approach. The solid waste generated by households, lodges and trekkers is transported to dumping or collection sites designated by SPCC and the number of incinerators running in the areas (SPCC, 2020).

As per the Government of Nepal Rules 2012, the Ministry of Federal Affairs and Local

Development (MOFALD) is responsible for the formulation, implementation, monitoring and evaluation of policy, plan and program relating to sewage and sanitation, and the Ministry of Urban Development (MOUD) is responsible for the sanitation and drainage (APHA, 2010).

MATERIALS AND METHODS

Study area

The study area was carried out at Lukla, Khumbu Pasang Lhamu Rural Municipality (KPLRM). Lukla is a small Himalayan town in the Solukhumbu District, Koshi Province of Nepal. It is a popular place for the main gateway to the Mount Everest and situated at 2860 meters (9,383 Ft). The area is bounded between the latitudes 27°41'20" E and longitudes of 86°43'50" N respectively occupying a total area of 1538 km^2. It contains a small airport servicing the Everest region, and a variety of shops and lodges catering to tourists and trekkers.

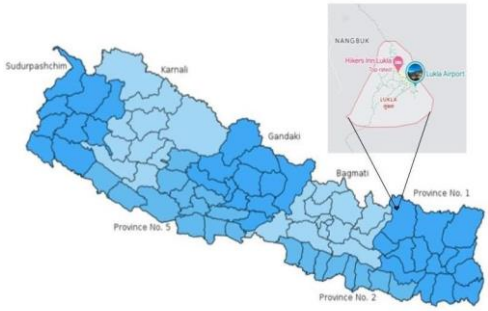

Figure 1: Map of Nepal showing study area

Materials

All the materials required for measuring the quantity of Municipal Solid Waste are listed below:

- Weighing machines
- Polythene bags
- Gloves
- Mask
- Note book and Pencil

Methods

There are five wards in KPLRM where Lukla lies in ward no.2. Out of 211 households, 163 residential households and 48 commercial lodges were found where among these households, 40 residential households and 20 commercial lodges were selected. In October 2022, a two day preliminary survey was conducted in the study area. Each household was randomly selected for sample collection and residents were informed that the waste generated in a 24-hour would be analyzed to quantify waste composition and generation. The polythene bags of 10 kg waste carrying capacity were provided to every selected household for the quantification of the composition and generation of waste. Waste collected from the sampling site was segregated manually by handpicking and the waste components were categorized as organic waste, plastics, papers, metals, glass and cloth. The weight of wastes component was calculated by using a weighing machine to analyze the waste generation within an autumn season and winter season.

The samples were taken four times in the month of October 2022 and January 2023 during autumn season (trekking peak season) and winter season (trekking off- season).
analyzed through categorizing into six components of waste (organic waste, plastics, papers, metals, glass and cloth) through collecting and segregating the waste. The generation of waste was measured by using a weighing machine and later analysed using Microsoft Excel.
The survey involved collecting crucial information through semi-structured questionnaires and interviews with the local government and residents to understand waste management practices.

RESULT

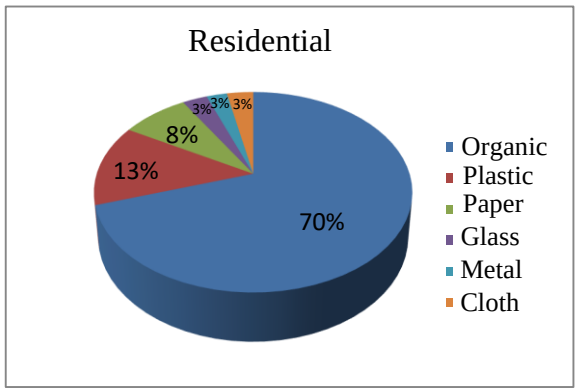

Figure 2: Composition of Residential Household Waste in Lukla, Solukhumbu

The residential household waste was classified into six categories such as organic matter, plastics, paper and paper products, glass, metal and cloth. The result shows that the highest quantity of organic waste (70%) was followed by plastic (13%) and paper waste (8%) as compared to others (glass, metal and cloth). The rest of the waste composition such as glass, metal and cloth were found in negligible amount.

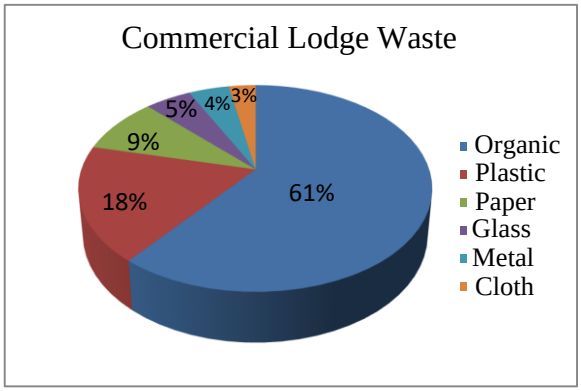

Figure 3: Composition of Commercial Lodge Waste in Lukla, Solukhumbu

The results shows that 61% total waste was organic which was the highest among the other types of waste. The organic waste was followed by plastics waste (18%) and cloth (3%) was found in lowest percentage.

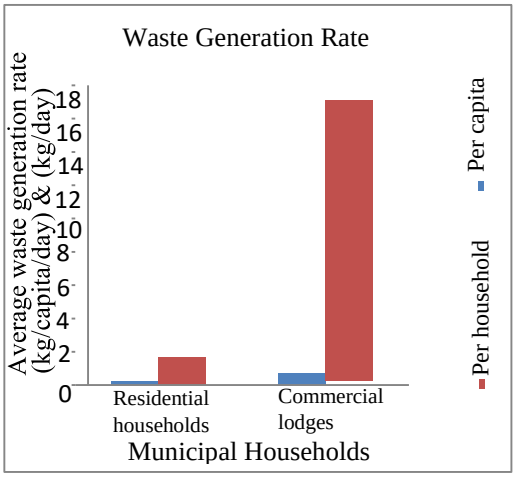

Figure 4: Municipal Waste generation from residential households and commercial lodges in Lukla, Solukhumbu

The result shows that, per capita generation of waste from selected residential households and commercial lodges were 0.237 kg/capita/day and 0.719 kg/capita/day respectively. The average waste generation rate of per household from selected residential household and commercial lodges were 1.64 kg/day and 16.86 kg/day respectively.

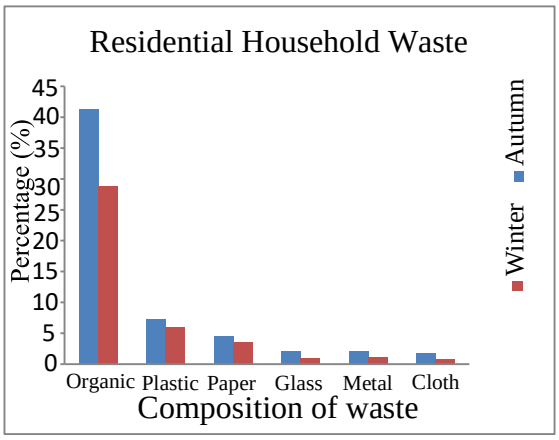

Figure 5: Comparison of Residential Household Waste between autumn season and winter season of Lukla, Solukhumbu

The result shows that the organic matter was found to be the highest percentage in both autumn (41.20%) and winter (28.85%) season. The rest of the household wastes were remained relatively constant throughout the seasons.

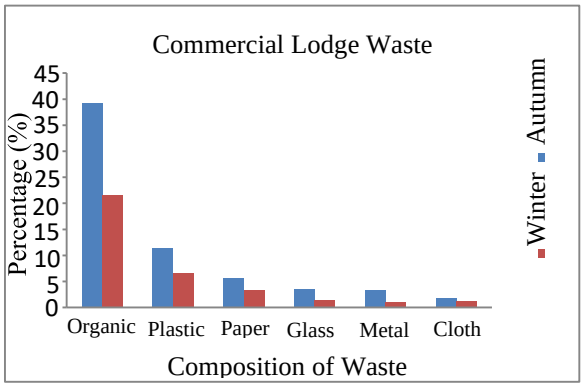

Figure 6: Comparison of Commercial Lodge Waste between autumn season and winter season of Lukla, Solukhumbu

The result reveals that the organic fraction of the waste was observed to be highest amount. About 39.12% of total waste were organic in the autumn season while 21.54 % in winter. The other categories of waste such as plastic, paper, glass, metal and cloth were higher in autumn season than winter season.

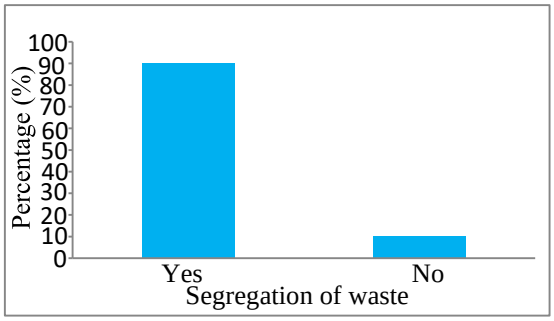

Figure 7: Segregation of waste

The result shows that highest percentage (90%) of the respondents had the habit of segregating organic and inorganic waste while 10% did not adopt segregation method.

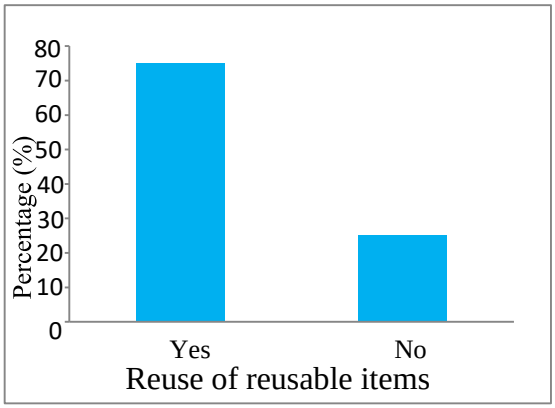

Figure 8: Reuse of reusable items

The result shows that 75% of the sampled households wer reusing the reusable items such as plastic bottles and wine bottles, cloth and metal etc whereas 25 % were not.

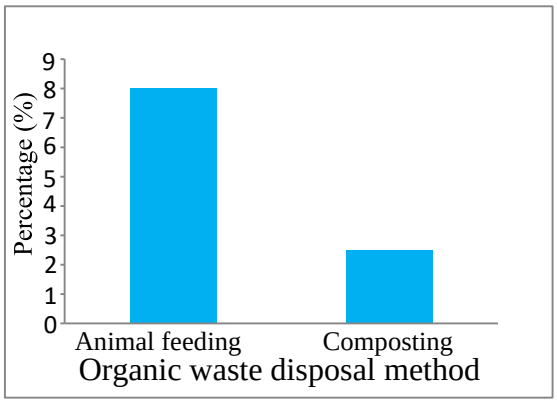

Figure 9: Organic waste disposal method

The result shows that 80% of the respondents were feeding their organic waste to animals and 20 % were composting as a disposal method. Organic waste was found as the highest percentage among the MSW composition but a huge volume of organic waste did not create any impacts on the environment due to these disposal methods.

DISCUSSIONS

MSW composition & generation

The statistical analysis of the composition and generation of MSW from systematic randomly selected households among 40 residential households and 20 commercial lodges of Lukla, KPLRM, Solukhumbu. The total waste produced from the selected household was found to be 1076.11 kg where residential households generate 266.77 kg and lodge generate 809.34 kg respectively. The result indicated that waste generation rate of commercial lodge was three times more than residential households. The study showed that percentage of organic waste from residential households and commercial lodges was 70% and 60% respectively. The organic waste was highest as compared to other types of waste as kitchen waste was the major contributor in terms of volume and quantity. A higher percentage of plastics, paper and paper products were increased due to the rising number of tourists in lodge as compared to residential households. The result also shows that the quantity of plastic and paper also more as compare to others (glass, metal and cloth) as goods, such as food containers, water bottles and household items are made from plastic and paper. The paper and paper products waste were also increasing because it is an ecofriendly alternative to plastic for transporting and storing goods as well as used for toilet paper, tissues and paper towels. Similarly, the quantity of glass and metal waste was much more in lodge than in households, indicating the presence of wine bottles, beer bottles and other drinking items.

According to Diaz et al., (2011), the key constituents of household waste included 71% organic wastes, 12% plastics, 7.5% paper products, 5% dirt and construction debris and 1% hazardous wastes in USA. ADB (2013) reported that the composition of commercial waste comprises 43% organic wastes, 22% plastics, 23% paper and paper products, 4% glass, 2% metals, 2% textiles, 1% rubber and leather and 4% others.

Seasonal comparison of the composition of MSW

The statistical analysis of the result of seasonal comparison of MSW generation from the randomly selected households of Lukla, KPLRM, Solukhumbu as shown in the figure 5 and figure 6. The total waste produced from the residential households and commercial lodges were found to be 156.8 kg and 525.62 kg in the autumn season while 109.97 kg and 283.72 kg were found in the winter respectively.

The seasonal variations in the MSW composition were found more in commercial lodges in compared to residential households where as there was not a large significant seasonal variation in household waste. However, the most obvious difference in the seasons found in commercial lodge because of the fluctuating number of tourists in the Everest region. The Everest region, also known as the Khumbu region, is a popular tourist destination in Nepal which is famous for mountain landscapes, Sherpa culture and numerous trekking opportunities. So, large number of tourists visits the Khumbu region in the autumn and spring season. As result shows that, huge amounts of waste compositions were produced in the autumn season while around 30% of wastes were reduced in the winter season due to decrease the number of tourists.

The maximum amount of organic matter was found among the others waste while organic waste collected during autumn season was much more than winter season. The percentage of plastics and paper was found to be much more than others because of the increasing number of tourists in Everest region. While higher percentage of plastics was found because it is used for packing and other consumer goods. The waste of paper and paper products also increasing stage because it is an eco-friendly alternative to plastic for transporting and storing goods as well as used for toilet paper, tissues and

paper towels. There was a significant variation on the composition of commercial waste between autumn season and winter season. In Everest region, autumn season is known as trekking peak season which falls in the months of September, October and November while as winter season is known as trekking off season due to decreased the number of tourists. The waste generation rates can be depended on the various factors such as population size, socio-economic factors, lifestyle and consumption patterns, urbanization and residential density, seasonal variations, cultural and behaviors, infrastructure and waste management systems etc.

Waste management practices

The household questionnaire survey was conducted among the selected respondents to collect information about MSW in Lukla, Solukhumbu where most of the respondents (90%) had practiced of segregating waste into biodegradable and non-biodegradable waste. Organic waste (kitchen waste) was found in huge amounts which generally used for cattle feeding and a few people used to compost. The amount of non-biodegradable waste including plastics, glass and metal generated is low as compared to organic waste. These non-biodegradable wastes create a great visual pollution problem on the landscape which caused an environmental and human health issues. Currently, the generated MSW in Lukla dispose by burning, burying, incinerating, transporting and applying 3Rs principle of waste management. The import of glass bottles (mainly beer) was banned in the Everest region initiated by the Buffer Zone Management Committee to reduce the problem of glass.

SPCC is the lead organization working in waste management activities including waste collection, segregation and disposal in the Khumbu region. SPCC has been continuously working to keep Khumbu clean through developing appropriate waste management infrastructures and integrating sustainable waste management approaches, such as setting up a system for waste segregation, strengthening community participation, public education, and finding opportunities for waste reducing, reusing and recycling.

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