Awareness on Plastic Related Household Waste Production in Pokhara Metropolitan City, Ward-12

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***Abstract*—This research investigates the levels of awareness and knowledge among residents of Ward-12 in Pokhara Metropolitan City regarding plastic-related household waste production. Through a comprehensive examination of waste management practices, plastic waste types, and socio-economic factors such as education and income, the study aims to elucidate the correlation between awareness and waste production. The findings from this research contribute to the understanding of plastic waste behaviors and provide insights into the effectiveness of awareness campaigns in promoting responsible waste management practices within the specified urban context.**

***Keywords*—plastic waste, solid waste management, waste management**

I. Introduction

A. Background of the Study

The escalating issue of plastic pollution has emerged as a significant concern on the global environmental agenda, precipitating adverse consequences for ecological systems, human well-being, and the overarching health of the planet. Over the recent years, the exponential proliferation of plastic production, coupled with inefficient practices in waste management, has led to an alarming proliferation of plastic waste accumulation across terrestrial and marine environments, extending even to domestic habitats. Effectively addressing this multifaceted challenge necessitates a comprehensive approach, which encompasses both heightening individual awareness of their role in plastic waste generation within households and instituting transformative actions to mitigate its environmental repercussions.

The escalating production of plastics, driven by industrial and commercial demands, has contributed substantially to the escalating environmental burden of plastic waste. This surge in plastic usage, combined with the absence of adequate waste management infrastructure, has precipitated the persistent and pervasive accumulation of plastic waste in landfills, aquatic ecosystems, and terrestrial habitats. The harmful ecological implications of this phenomenon, including compromised marine life, disrupted ecosystems, and long-lasting environmental degradation, underscore the urgency of this predicament.

The household waste composition analysis conducted by the Asian Development Bank (ADB) in 2013 highlighted the prominence of organic waste at 66%, with plastics accounting for 12% of the waste category. On a broader scale, municipal solid waste is composed of 16% plastics, underlining the substantial contribution of plastics to waste streams. A pertinent case in point is Nepal, where the daily production of plastic waste approximates 600 tons, with a mere 8% recycling rate, as documented by the World Bank in 2019. Within the confines of Pokhara Municipality, a substantial 200 tons of waste are generated daily, of which nearly 20% (equivalent to approximately 40 tons) comprises plastic waste. Regrettably, only a limited 20% of plastic waste within the municipality is subject to recycling or retrieval, leaving the remaining 80% (approximately 32 tons) to amass and exacerbate the issue [1].

The findings of this research endeavor will bear far-reaching implications for environmental policy formulation, waste management strategies, and public awareness campaigns. The identification of gaps in awareness and understanding among individuals will enable policymakers to tailor interventions to address specific knowledge deficits. Moreover, enhancing waste management systems based on identified barriers to recycling and waste reduction will lead to the development of more robust and accessible waste infrastructure.

In conclusion, this research initiative aims to contribute substantively to the evolving body of knowledge concerning plastic pollution and household waste dynamics. By gauging the awareness levels of individuals, households can be empowered to make informed choices and effect meaningful actions, thus catalyzing a paradigm shift toward diminished plastic footprints and a more ecologically conscious society.

B. Objectives of the Study

- To assess the level of awareness among households regarding plastic waste generation: The study aims to measure the knowledge and understanding of individuals regarding the production, usage, and disposal of plastic in their households.
- To explore household behaviors and practices related to plastic waste management: The study will investigate the recycling habits, waste disposal methods, and overall behaviors of households in relation to plastic waste.
- To examine the perception of environmental impacts associated with plastic pollution: Seeks to understand how households perceive the environmental consequences of plastic waste.
- To identify motivations and barriers to reducing plastic waste: By conducting qualitative interviews, the study aims to uncover the underlying motivations, attitudes, and challenges faced by households in adopting more sustainable practices.
- To provide recommendations for promoting awareness and reducing plastic waste: Based on the research findings, the study will offer practical recommendations for policymakers, waste management systems, and public awareness campaigns.

C. Significance of the Study

The significance of this study lies in its potential to catalyze substantial positive changes in the realm of plastic waste management and environmental consciousness. As plastic pollution continues to exert its detrimental effects on ecosystems and human well-being, comprehending household awareness, attitudes, and behaviors pertaining to plastic waste assumes paramount importance. By shedding light on knowledge gaps and misconceptions, the study can serve as a compass for crafting targeted awareness campaigns and educational initiatives that empower households to make informed decisions about plastic consumption and waste disposal. Furthermore, the identification of barriers to recycling and sustainable practices will guide the enhancement of waste management systems, optimizing infrastructure and logistics. Ultimately, the study's findings hold the promise of fostering a more environmentally aware and responsible society, thereby contributing substantively to the broader endeavor of curbing plastic pollution and advancing global sustainability objectives.

D. Limitations of the Study

Two potential limitations of this study include the reliance on self-reported data, which could introduce response bias and inaccuracies, and the geographical specificity of the research location, which may limit the generalizability of findings to broader contexts.

II. Literature Review

A. Theoretical Review

Last 20 decades, plastics are used for many purposes and become an important part of our daily life. In many developing countries, people use the bags, bottles, utensils, furniture made up of plastics and for many more domestic purposes without considering the fact that it will create a lot of waste which is impossible to manage. Due to this fact, it recently has become a common and serious issue for the worldwide. It harms not only environment but also the human beings. Along with this, tons of plastics exist in oceans which causes loss of marine animals every year. Looking at this serious issue, there is a need to manage the plastic wastes by different methodologies like recycling and reusing, landfill, incineration, gasification and hydrogenation, etc. In this review paper, we are going to look towards the current procedures of use of plastic waste in current situation as well as to look for all the possibilities to minimize these wastes. [2].

In Singapore, 822,200 tons of plastic waste were generated in 2016, with only 7% recycled. Due to the complex nature of plastic waste mixtures, mechanical recycling is often inefficient, leading to a majority of waste being incinerated. In this article, alternative solutions are introduced to address the waste problem, such as recovering valuable fuels from plastics via thermochemical methods. Life Cycle Assessment (LCA) was adopted to investigate 8 scenarios of plastic waste management options. In a nation with land scarcity, the scales and sizes of each plastic waste recycling/recovery method is also taken into consideration. The results demonstrated how different combinations of four plastics valorization technologies, and associated capacities, affected the potential environmental benefits and drawbacks of plastic waste treatment systems. In order to enable selecting the best option among the 8 scenarios, normalization and weighting was carried out [3].

Implication People are using plastic items because of availability and being cheap, but regarding plastic waste and solid waste management, there is a marked difference in study areas about education, facilities, and concern [4]. Waste management is practiced more in rural areas, as is the case in Lohdraan. 99 of people managed their waste in one or the other way and satisfied on their own. 100 of people do not manage their waste even there is the provision of necessary facilities and waste management facilities. Regarding their concern for waste management, people in the village all 100 do not want to pay for waste management because they are managing independently even though there is no government intervention regarding waste management, even no necessary facilities [5].

Bearing in mind that only 42% of plastic packaging post-consumer waste is recycled in Europe, the European Directive 2018/852 established the key target of a 55% plastic packaging waste recycling rate by 2030. For this reason, PlastiCircle, funded by the European Union's Horizon 2020 research and innovation program project, aims to foster the recycling of packaging, improve all stages of the waste collection, and promote responsible consumption. Three European cities have been selected as locations for pilot implementation: Valencia (Spain), Utrecht (The Netherlands) and Alba Iulia (Romania). The main objective of the present study has been to evaluate the participants' opinion and attitudes on plastic recycling. This paper presents the results from the district of San Marcelino in the city of Valencia, the first PlastiCircle pilot to face the challenges of encouraging households to participate more in plastic waste sorting and recycling [6].

A study was undertaken to evaluate the quantity and composition of household solid waste to identify opportunities for waste recycling in Can Tho city, the capital city of the Mekong Delta region in southern Vietnam. Two-stage survey of 100 households was conducted for dry season and rainy season in 2009. Household solid waste was collected from each household and classified into 10 physical categories and 83 subcategories. The average household solid waste generation rate was 285.28 g per capita per day. The compostable and recyclable shares respectively accounted for 80.02% and 11.73%. The authors also analyzed the relations between some socioeconomic factors and household solid waste generation rates by physical categories and subcategories. The household solid waste generation rate per capita per day was positively correlated with the population density and urbanization level, although it was negatively correlated with the household size. The authors also developed mathematical models of correlations between the waste generation rates of main physical categories and relevant factors, such as household size and household income. The models were proposed by linear models with three variables to predict household solid waste generation of total waste, food waste, and plastic waste. It was shown that these correlations were weak and a relationship among variables existed. Comparisons of waste generation by physical compositions associated with different factors, such

as seasonal and daily variation were conducted. Results presented that the significant average differences were found by the different seasons and by the different days in a week; although these correlations were weak. The greenhouse gas baseline emission was also calculated as 292.25 g (CO_2 eq.) per capita per day from biodegradable components [7].

Municipal Solid Waste (MSW) quantity and composition analysis is fundamental for the planning of municipal waste management services. The purpose of this paper is to report the results and experiences of sampling household waste at the source of generation in Gaborone, Botswana. The average generation rate, in kg capita −1 day −1, and percentages of various components of waste in Gaborone were determined using a statistically designed household sampling survey. The survey covered 47 households with different socio-economic characteristics over 21 days with 893 samples obtained. The results showed that the average waste generation rate for Gaborone was 0.33 kg capita −1 day −1. Contrary to common belief, the waste generation rate measured as in weight units was found not be directly related to household income. However, the packaging fractions of plastic and paper measured as volume had a direct relationship with household income. Across all income groups, the putrescible waste fraction constituted the highest proportion of the waste stream at approximately 68%. The main general conclusion is on the importance of practical considerations. As much as statistically designed sampling procedures provide a useful means of estimating the quantity and composition of household waste at source of generation, there are some practical issues that should be carefully considered during sampling to improve the accuracy and relevance of the results [8].

B. Empirical Review

Managing the solid waste produced in Nepalese cities, including tasks like collecting, transporting, treating, and disposing of it safely, poses a significant challenge, similar to countries at a comparable level of development. Nepal has a total of 753 local governments, out of which 293 are considered urban, encompassing metropolitan/sub-metropolitan cities and municipalities. The remaining local governments are classified as rural municipalities. The urban areas are home to around 16 million people, with approximately 10.5 million residing in the southeastern plains (referred to as the 'terai' region) and the rest in the northwestern hills.

It is estimated that urban areas in Nepal produce about 4,900 tons of solid waste every day, which accumulates to around 1.8 million tons annually. Out of this waste, about 63% is generated in the Terai region, while the remaining 37% comes from the hills. On a daily basis, each person in Nepal generates approximately 0.30 kg of solid waste, a slightly lower amount compared to neighboring countries such as India (0.52 kg), Bhutan (0.52 kg), and Sri Lanka (0.34 kg). This waste generation rate is similar to that of Bangladesh (0.28 kg). Around 56% of the total waste produced in urban Nepal consists of organic materials, with glass contributing to 16%, plastic to 13%, and paper waste to 8%.

The study conducted a one-month survey of 130 households in Can Tho City, Vietnam, to assess the quantity and composition of household solid waste, with a particular focus on plastic waste. The findings revealed an average household solid waste generation rate of 281.27 g/cap/day. Plastic waste had an average generation rate of 17.24 g/cap/day, with plastic packaging and containers being the dominant types, comprising 95.64% of the plastic waste. Plastic shopping bags were identified as the major component, constituting 45.72% of the total plastic waste. The study also examined factors such as household income and size, which were found to correlate with plastic waste generation. Additionally, household habits, behaviors, and environmental impacts of plastic waste disposal alternatives were evaluated.

The intricate interplay between household solid waste generation and socioeconomic factors forms a focal point of investigation in the present literature review. The research demonstrates a noteworthy variability in household solid waste generation and composition, reflecting the diversity inherent in individual households. Through the implementation of the Kendall test, the study establishes a clear linkage between socioeconomic parameters and both the reduction of household solid waste generation and the modulation of waste composition. Notably, household income and educational attainment emerge as the most influential factors in this regard, underscoring the potential avenues for waste reduction in the studied areas. Of significance, this research signifies Iran's inaugural exploration into household solid waste analysis and its intricate connections with pertinent parameters. This underscores the importance of subsequent studies that encompass a broader spectrum of socioeconomic and cultural variables, thereby enriching the understanding of the intricate dynamics at play in household solid waste generation and composition. Hence, it is imperative to undertake future inquiries that embrace a holistic perspective to pave the way for effective waste management policies and practices [9].

A study focused on assessing the composition of solid waste, specifically plastic waste, in Peshawar City, Pakistan. The findings revealed that food waste accounted for the highest proportion of municipal solid waste (52%), followed by plastic waste (16%). The study estimated the daily volume of plastic waste to be 330 tons. Establishing a plastic waste refinery for this amount of plastic waste was found to have significant benefits, including cost savings of 66,725,340 rupees/annum, generation of 551 MW of energy per month, and a reduction of 41.08 GHGT/year in greenhouse gas emissions. These findings can guide decision-makers in implementing sustainable plastic waste management practices [10].

The COVID-19 pandemic has led to an increase in the usage and consumption of Personal Protective Equipment (PPE) and other Single-Use Plastic (SUP) products, which has contributed to the surge in plastic waste production. The management of household plastic waste has been affected by changes in community behavioral patterns during the pandemic in Sri Lanka. Disposable face masks and hand sanitizers were popular plastic products during this time. The frequency of handing over waste to collectors and recycling centers slightly decreased, while the preference for burning plastic waste increased after the pandemic. The disposal methods of plastic waste before and after the pandemic were significantly associated with income level, employment

status, and education level of respondents. The public fear of contracting the COVID-19 virus, along with government-implemented lockdowns, has led to changes in lifestyles, such as increased online shopping and takeaway food orders, resulting in a shift of waste from commercial sectors to households. To minimize plastic waste production, it is important for the general public to follow mitigation behaviors such as handwashing, sanitation, and mask use, in addition to using plastic-based items as a hygienic barrier against the virus [11].

Plastic pollution is a planetary threat, affecting nearly every marine and freshwater ecosystem globally. In response, multilevel mitigation strategies are being adopted but with a lack of quantitative assessment of how such strategies reduce plastic emissions. We assessed the impact of three broad management strategies, plastic waste reduction, waste management, and environmental recovery, at different levels of effort to estimate plastic emissions to 2030 for 173 countries. We estimate that 19 to 23 million metric tons, or 11%, of plastic waste generated globally in 2016 entered aquatic ecosystems. Considering the ambitious commitments currently set by governments, annual emissions may reach up to 53 million metric tons per year by 2030. To reduce emissions to a level well below this prediction, extraordinary efforts to transform the global plastics economy are needed [12].

III. Research Methodology

A. Study Area

The study area of the research is located as per the Fig. 1 in Ward No. 12, Pokhara Metropolitan City. The area includes a small portion of hill area, Karki Danda, Matepani Gumba Danda and rest of all is plain land.

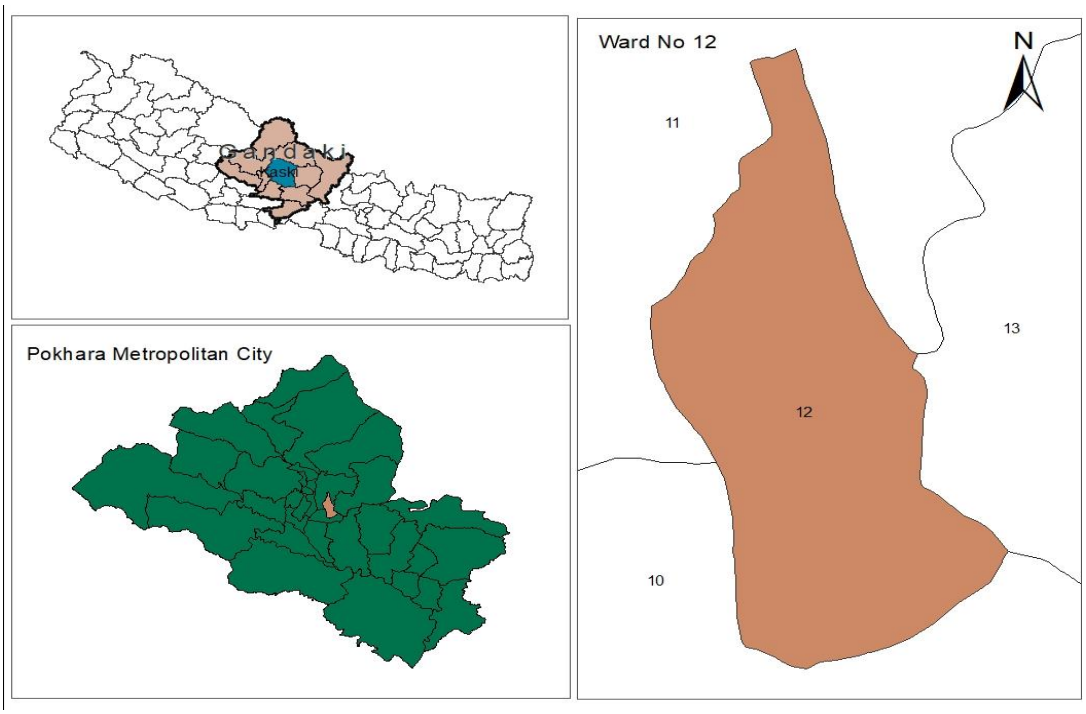

Fig. 1. Map of Pokhara Metropolitan City, Ward No.-12.

B. Study Design

The research mainly aims to identify the level of awareness of the people on the study area about the usage of Plastic Related Household Waste. The study data will be collected from a sample survey as well as FGD & KII. The study is expected to be cross-sectional survey where the analysis of the awareness of Plastic Related Household Groups among the household of the population composition of different age groups, genders, religions and occupations.

C. Nature and Sources of Data

The study will be using the primary source of data from direct respondents. The data collected is expected to be both qualitative & quantitative.

D. Study Population, Sample Size and Sampling Procedure

The demographics of Ward no. 12 of Pokhara Metropolitan City according to population (Table 1) preliminary report, 2078 is as follows:

Table 1. Population composition of Ward No. 12

Demographics	Total
Household	3014
Population	11613
Female	6172
Male	5441

The sample size has been calculated from the method below:

Total Population (N) = 3014
Margin of Error (e) = 10% = 0.1
Confidence Level = 90% = 1.28 (z-value)
Population Proportion (P) = 50%
We have:

$$\textbf{Sample Size (n)} = \mathbf{N} \times \frac{\frac{z^2 \times \rho(1-\rho)}{e^2}}{\mathbf{N}-1+\frac{z^2 \times \rho(1-\rho)}{e^2}} = \mathbf{67}$$

Therefore, the sample size for the collection of data is from 67 households.

E. Methods of Data Collection

The methods of data collection for the research are Observation, Focus Group Discussion (FGD), Key Informant Interview (KII), Personal Interviews, and so on.

F. Methods of Data Analysis

The collected sample data has been analyzed and formulated using SPSS Version 25.

IV. Presentation and Analysis of Data

A. Process of the Study

With the close co-ordination with the ward office, the survey's first step was the selection of the households. There were 23 Tole Sudhar Committee/Clusters (TSC) registered officially in the ward. The ward office helped us gather the information of the spokesperson of those samitis. We performed the Key Informant Interview (KII) with the ward President, Mr. Santosh Banstola & Focus Group Discussion (FGD) with all those spokespersons of the TSCs around the study area.

B. Selection of the Title

The title "Awareness on Plastic-Related Household Waste Production in Pokhara Metropolitan City, Ward-12" was chosen through a process that began with defining the study's focus on plastic waste awareness, specifically within the context of household waste production. A review of existing literature and engagement with local stakeholders revealed a gap in knowledge regarding residents' understanding of their role in plastic-related waste generation. By incorporating the geographical specificity of Pokhara Metropolitan City and Ward-12, the title effectively conveys the study's aim to assess awareness levels within a specific locale, aligning with both local relevance and the global concern over plastic pollution.

C. Special Findings

1) Education level of the respondents

The education level of the respondents was divided into Basic, Secondary, and Higher Level (Fig. 2).

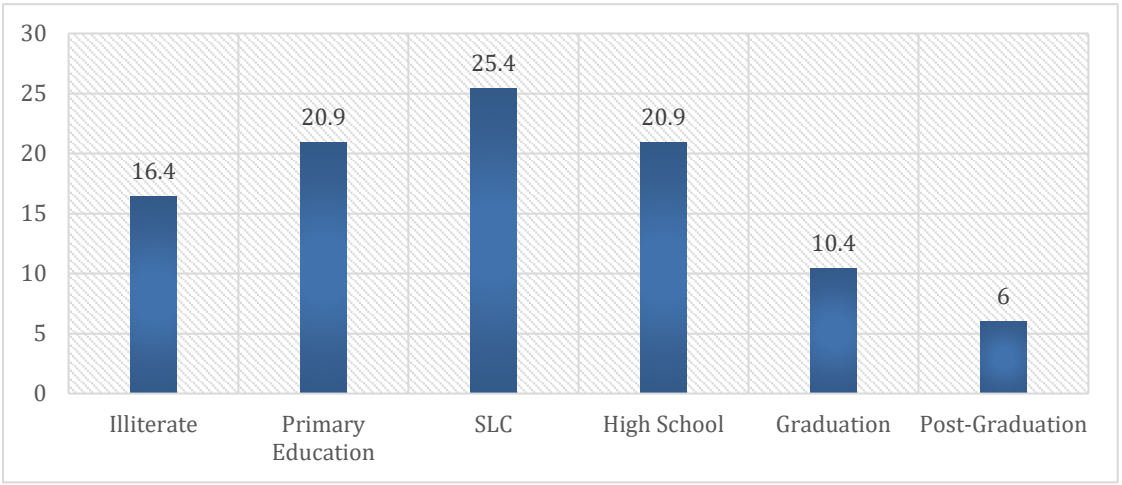

Fig. 2. Respondents' education level.

The data illustrates the educational attainment levels of a group consisting of 67 individuals. The distribution reveals a diverse range of educational backgrounds within the group. The largest segment, comprising 25.4% of the sample, has completed their School Leaving Certificate (SLC), indicating a significant proportion with at least a secondary education. Additionally, 20.9% have attained primary education and high school completion, respectively, further underlining the emphasis on foundational education. Beyond that, 10.4% of the group holds a degree, while 6.0% have pursued postgraduate studies, indicating a smaller but notable contingent of highly educated individuals. Notably, illiterate individuals constitute 16.4% of the group.

2) Main family income source of the respondents

The Occupations of the respondents were divided into Government Job, Private Job, Business, Labor, Agriculture, Politics, Pension, and Remittance categories (Fig. 3).

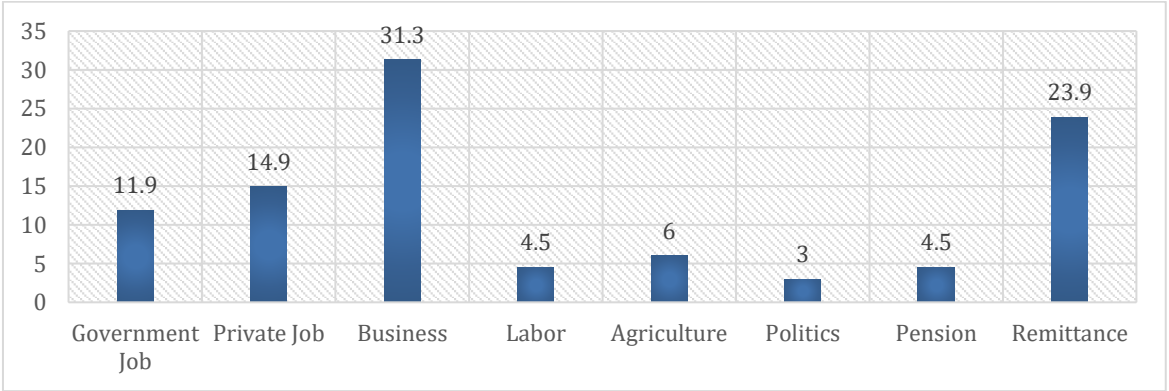

Fig. 3. Respondents' family income source.

According to the recorded data, Business emerges as the most prominent livelihood option, with 31.3% of individuals engaged in entrepreneurial endeavors. This underlines the entrepreneurial spirit within the group. Private jobs and remittances account for significant livelihoods as well, with 14.9% and 23.9% respectively. This potentially suggests a blend of local and international economic engagements. Moreover, government jobs and business are nearly equally popular, constituting 11.9% and 14.9% respectively, indicating a balance between public sector stability and private sector opportunities. Interestingly, a smaller fraction, around 6.0%, is involved in agriculture, showcasing a continued connection to traditional vocations. A minority of individuals are engaged in labor (4.5%), politics (3.0%), and pension-related activities (4.5%), reflecting additional dimensions of the livelihood landscape.

3) Yearly income level of the respondents

The Income Level of the respondents were divided into the classes of 240001 to 360000, 360001 to 480000, 480001 to 600000, and more than 600000 (Fig. 4).

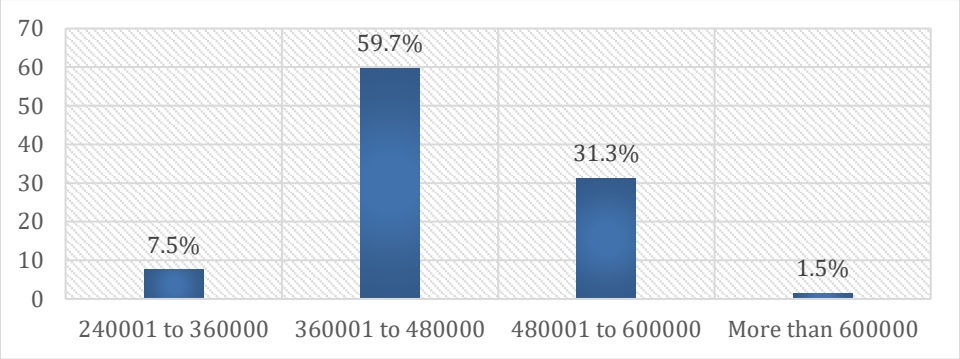

Fig. 4. Respondents' yearly income level.

Notably, the largest portion, accounting for 59.7% of the individuals, falls within the income range of 360,001 to 480,000. This concentration suggests that a significant majority of the sampled individuals have incomes within this middle range. Moreover, 31.3% of the individuals earn between 480,001 and 600,000 annually, further emphasizing the prominence of the middle-income brackets. A smaller proportion, 7.5%, falls into the 240,001 to 360,000 income range, signifying a segment with slightly lower earnings. Interestingly, only 1.5% of the group reports an income exceeding 600,000, indicating a limited number of higher-income individuals within the sample.

4) Household size of the family members of the respondents

The Household Size of the Family Members of the Respondents have been divided into 0 to 4 members, 5 to 8 members, 9 to 12 members & 13 to 16 members. This directly contributes to the amount of waste produced by the household (Fig. 5).

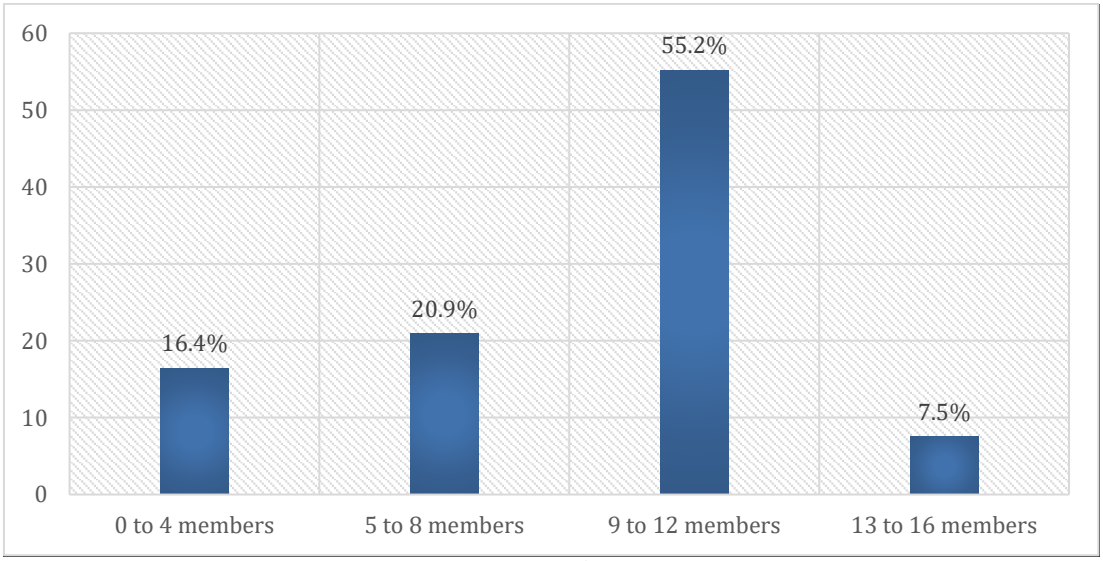

Fig. 5. Household size of the respondents.

Notably, the majority of households, accounting for 55.2% of the sample, fall within the range of 9 to 12 members, indicating a prevalent pattern of larger families. The next most common household size is within the range of 5 to 8 members, constituting 20.9% of the sample. Relatively smaller households, with 0 to 4 members, comprise 16.4% of the group. Additionally, there is a smaller subset of households with even larger family sizes, as 7.5% fall within the 13 to 16 members' range.

5) Amount of the waste produced in the household of the respondents

When asked about amount of waste produced in the household, the respondents had varying answers (Fig. 6).

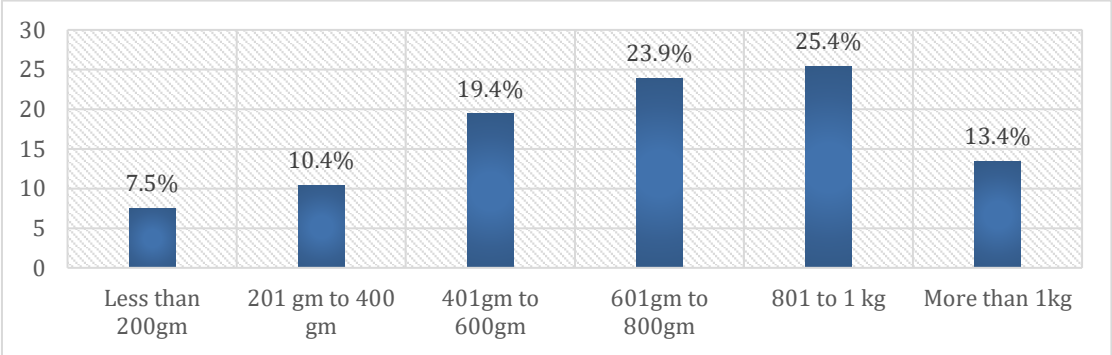

Fig. 6. Waste production amount at the household of the respondents.

Starting with smaller waste quantities, 7.5% of the sample generates less than 200 grams of waste. Moving up the spectrum, 10.4% produce waste ranging from 201 to 400 grams, followed by 19.4% generating waste between 401 and 600 grams. The distribution shows a trend towards larger waste production as the categories progress. The largest portion of waste production falls within the range of 601 grams to 800 grams, encompassing 23.9% of the sample. Following closely, 25.4% produce waste in the range of 801 grams to 1 kilogram. Notably, 13.4% of the sample generates more substantial waste quantities, exceeding 1 kilogram.

6) Monthly waste management fees

The Monthly Waste Management Fees paid by the respondents were divided into the classes of Rs. 101 to Rs. 200, Rs. 201 to Rs. 300, and More than Rs. 300 (Fig. 7).

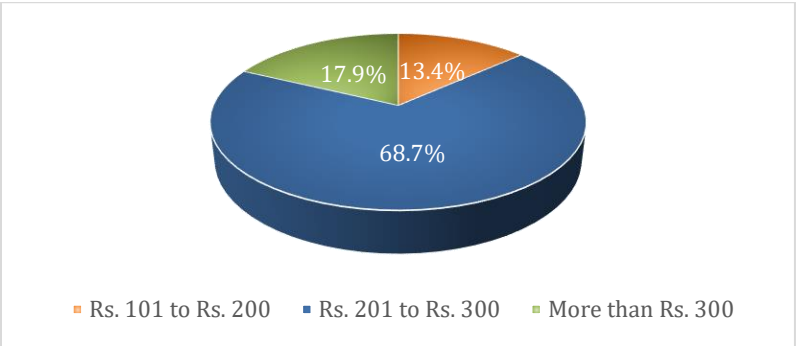

Fig. 7. Waste management fees paid monthly by the respondents.

Among the respondents, 13.4% are paying a monthly fee ranging from Rs. 101 to Rs. 200. The majority, comprising 68.7% of the sample, falls within the range of Rs. 201 to Rs. 300, indicating that a significant proportion is paying fees at this level. Moreover, 17.9% of respondents are paying fees exceeding Rs. 300 per month for waste management services. This breakdown showcases the varying levels of financial commitment for waste management among the respondents.

7) Type of produced waste at the household

The questionnaire for the respondents included the types of wastes as Degradable Waste, Non-degradable Waste, Hazardous Waste, Recyclable Waste, Non-recyclable Waste and Other Waste (Fig. 8). The responses were as follows:

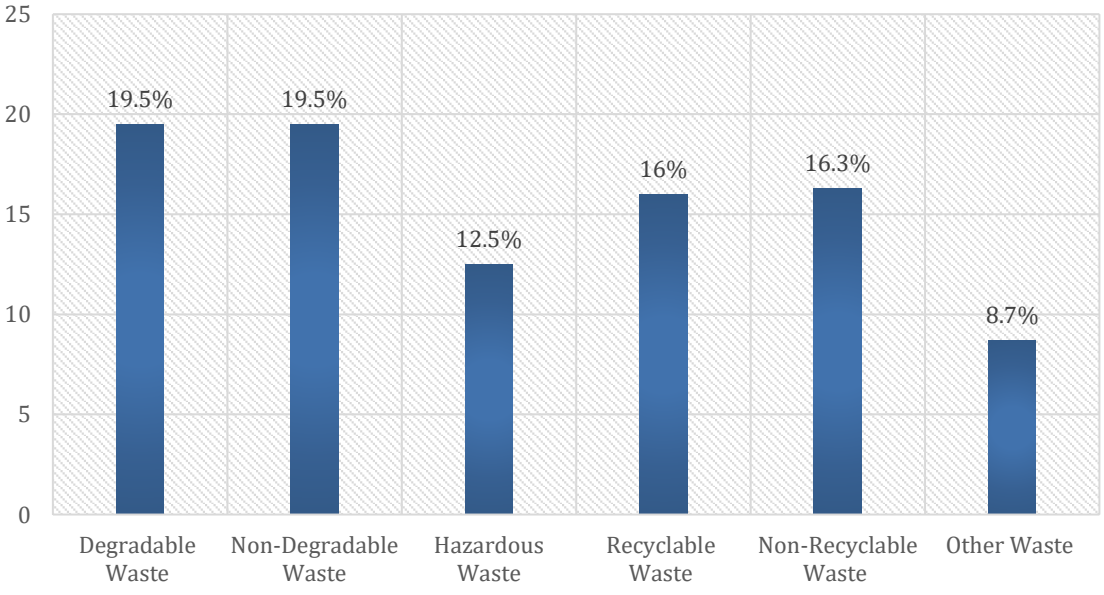

Fig. 8. Type of waste produced at household.

According to the respondents, Degradable Waste and Non-Degradable Waste are equally generated by all 67 households, each accounting for 19.5% of the sample. This indicates that a balanced distribution of both degradable and non-degradable waste exists across the households. Hazardous Waste is produced by 43 of the households, making up 12.5% of the sample. This suggests that hazardous waste is a notable concern for a portion of households, potentially pointing to the need for proper disposal methods and awareness. Recyclable Waste is generated by 55 households, comprising 16.0% of the sample, while Non-Recyclable Waste is produced by 56 households, representing 16.3% of the sample. This near-equivalent production of recyclable and non-recyclable waste indicates a certain level of waste segregation or recycling practices within the group.

8) Known type of waste by the respondents

The questionnaire included what types of wastes the respondents knew about and the options were Degradable Waste, Non-Degradable Waste, Hazardous Waste, Recyclable Waste, Non-Recyclable Waste and Other Waste (Fig. 9). The responses were as follows:

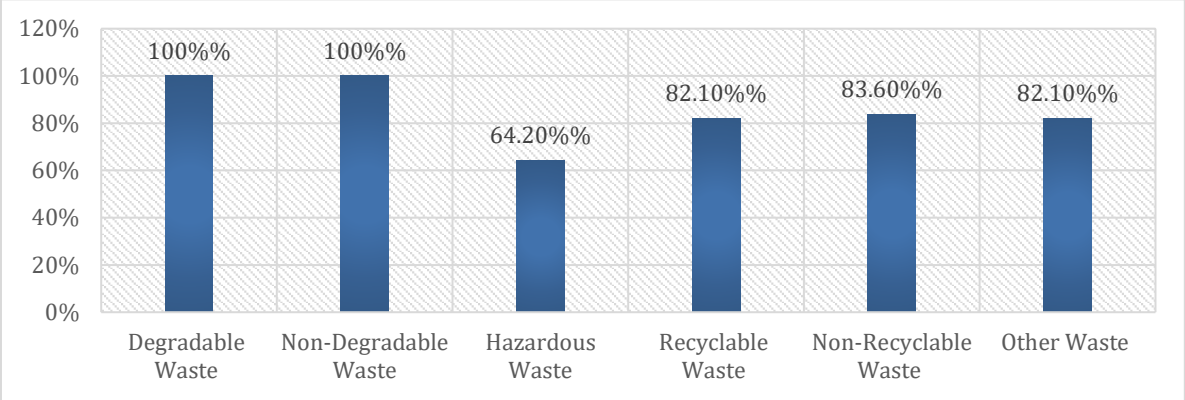

Fig. 9. Known type of waste by the respondents.

Across the respondents, 19.5% are familiar with the concept of degradable waste, indicating that this category holds a notable level of recognition. Similarly, the term non-degradable waste is also familiar to 19.5% of the respondents, suggesting that they understand the distinction between waste that breaks down naturally and waste that does not. Hazardous waste is recognized by 12.5% of the respondents, demonstrating a lower level of awareness. This could indicate a potential gap in understanding concerning waste materials that pose risks to human health and the environment. Recyclable waste is familiar to 16.0% of respondents, and the term non-recyclable waste is recognized by a slightly higher percentage, at 16.3%. This balance in awareness of recyclable and non-recyclable waste suggests a moderate level of understanding about the potential for reusing certain waste materials and the limitations of others. Furthermore, 16.0% of respondents are aware of other waste categories beyond those specified in the data. This category's presence might indicate respondents' recognition of specialized waste types not explicitly mentioned in the options provided.

9) Waste management techniques used by the respondents

The questionnaire for the respondents included the Waste Management Techniques as Segregate waste, Keep in Mixed form, throw during collection service, Burn, Bury, Composting, Feed animal livestock and Sell to Recyclers (Fig. 9). The responses were as follows:

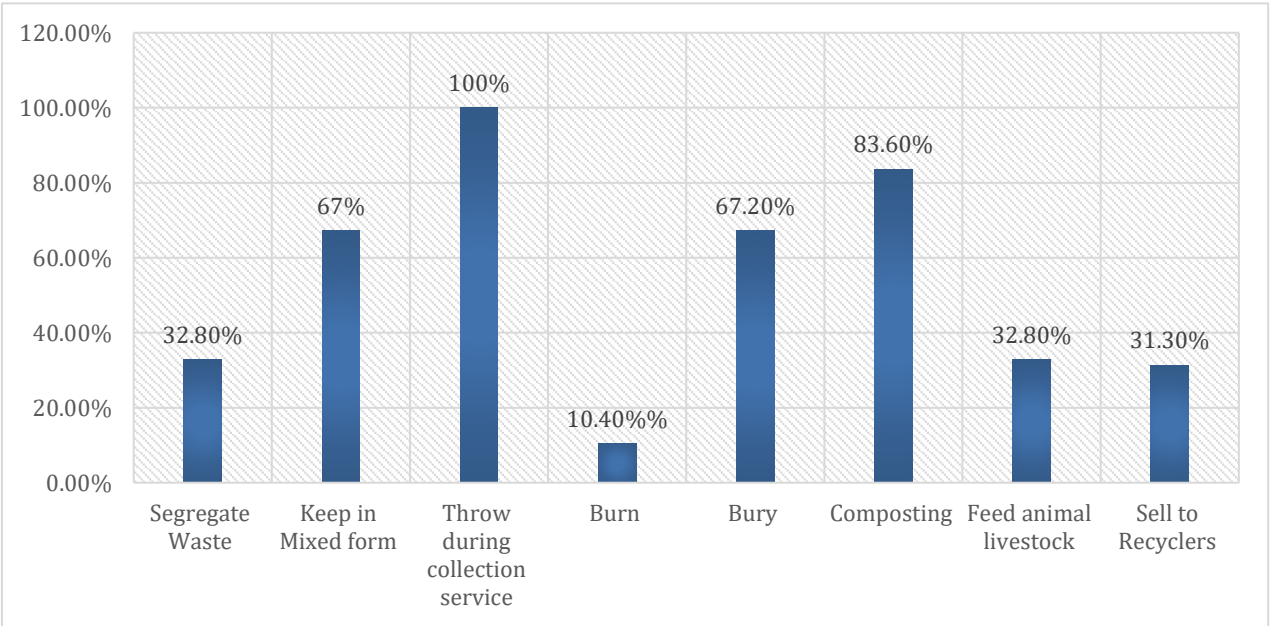

Fig. 10. Techniques for waste management used by the respondents.

Among the techniques, the most prevalent approach is "Throw during collection service", with 23.5% of respondents using this method. This suggests a common reliance on formal waste collection services as the primary means of waste disposal. "Composting" is also widely practiced, being adopted by 19.6% of respondents, reflecting an environmentally conscious effort to recycle organic waste. A significant portion of respondents, 15.8%, "Keep in Mixed form", and another 15.8% "Bury" waste. This may indicate a mix of waste management practices or a lack of consistent approaches, potentially influenced by factors such as location or available resources. "Feed animal livestock" and "Send Sell to Recyclers" are less commonly utilized methods, chosen by 7.7% and 7.4% of respondents respectively, showcasing efforts to repurpose waste through animal consumption or recycling. It's notable that a small percentage, 2.5%, resort to burning waste, a practice that can have negative environmental consequences. This underlines the need for increased awareness about more sustainable waste management alternatives. Overall, the data illustrates a range of waste management techniques, reflecting the diversity of approaches employed by the respondents in their efforts to handle waste responsibly.

10) Types of plastic waste produced at the households

The questionnaire for the respondents included the types of Plastic Waste produced as PET, HDPE, PVC, LDPE, PP, PS, MLP & Tetra Pack (Fig. 11). The responses were as follows:

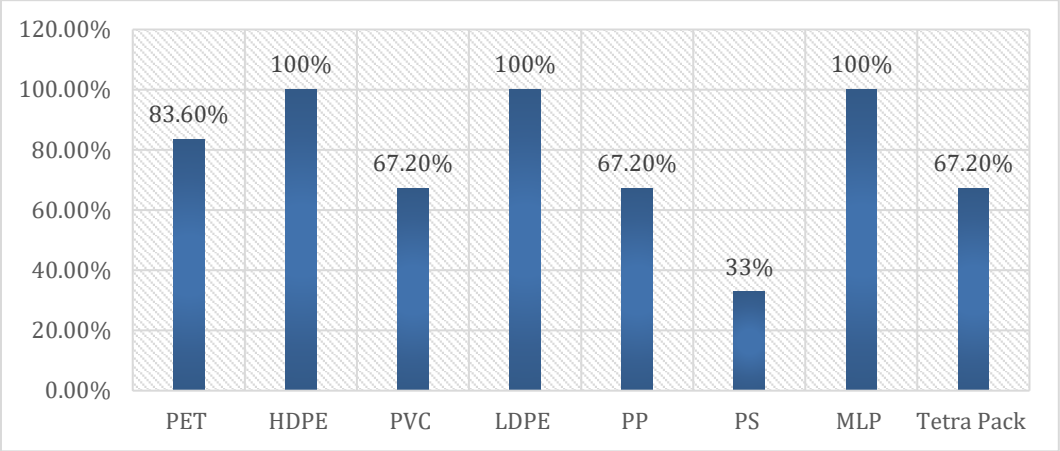

Fig. 11. Types of plastic waste at respondents' household.

The data presented outlines the types of plastic waste produced, along with their respective frequencies, within a sample. High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE) are the two most common plastic waste types in the sample, each accounting for 16.2% of the occurrences. This suggests that these types of plastic, known for their versatility and applications in various products, are widely consumed and disposed of by the group.

Polyethylene Terephthalate (PET) and Modified Low-Density Polyethylene (MLP) also make up a substantial portion, with each constituting 13.5% and 16.2% of the occurrences, respectively. This highlights the prevalent use of PET bottles and MLP packaging materials, possibly indicating the prominence of beverages and consumer products that utilize these materials within the group's consumption patterns. Polypropylene (PP) and Tetra Pack are each represented at 10.9% of the occurrences. PP, often used in packaging and containers, and Tetra Pack, commonly found in liquid food packaging, reflect the diverse sources of plastic waste generated by the group. Polystyrene (PS) constitutes 5.3% of the occurrences, signifying a lesser prevalence within the plastic waste stream. PVC, accounting for 10.9% of occurrences, completes the spectrum of plastic waste types identified.

11) Waste management stakeholders as per the respondents

When asked, whose responsibility is it to manage the household waste, the respondents had mixed opinion (Fig. 12).

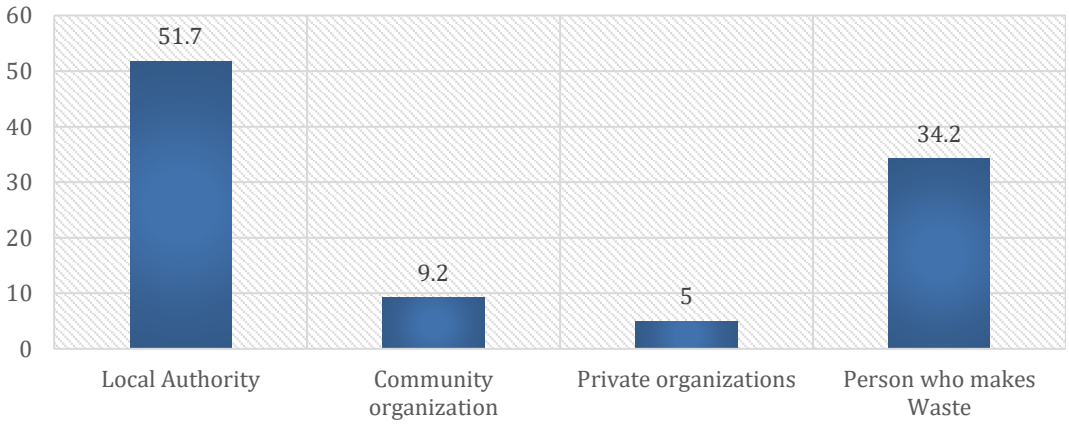

Fig. 12. Waste management stakeholders as per the respondents.

The majority of respondents, accounting for 51.7% of the total, identify the local authority as a significant stakeholder in waste management. This indicates a strong recognition of the role that local governmental bodies play in overseeing and managing waste within the community. Moreover, 34.2% of respondents attribute waste generation to individuals who produce waste, emphasizing the responsibility that citizens hold in the waste management process. Community organizations are seen as waste management stakeholders by 9.2% of the respondents, suggesting a smaller but notable presence of non-governmental entities involved in waste management efforts. Private organizations are identified as stakeholders by 5.0% of respondents, indicating the role of businesses and commercial entities in waste-related initiatives.

D. Cross-Analysis & Interpretations

Here in this section, the cross-analysis between different topic responses is done in order to relate them with each other. This will help us understand the co-relation & associate factors that influence different actions of plastic waste management.

1) Knowledge on type of waste by different academic backgrounds

Education plays a very crucial role in defining the knowledge on waste production of the family. To analyze the situation, the analysis of connection between knowledge of type of waste & academic backgrounds of the respondents is here (Table 2):

Table 2. Knowledge on type of waste vs academic backgrounds of the respondents

1	Illiterate		Primary		SLC		High School		Graduation		Masters	
Segregate Waste	5	18.5%	3	11.1%	9	33.3%	6	22.2%	2	7.4%	2	7.4%
Keep in Mixed form	11	16.4%	14	20.9%	17	25.4%	14	20.9%	7	10.4%	4	6.0%
Throw during collection	11	16.4%	14	20.9%	17	25.4%	14	20.9%	7	10.4%	4	6.0%
Reduce	5	11.6%	11	25.6%	12	27.9%	9	20.9%	4	9.3%	2	4.7%
Reuse	8	17.8%	11	24.4%	10	22.2%	8	17.8%	5	11.1%	3	6.7%
Recycle	4	19.0%	6	28.6%	3	14.3%	4	19.0%	3	14.3%	1	4.8%

When it comes to the type of waste, the data shows that the largest proportion of waste generated falls into the categories of “Degradable Waste” and “Non-degradable Waste”, each accounting for 19.5% of the total waste. This suggests that a significant portion of the waste generated consists of materials that could potentially be managed more effectively through composting and other eco-friendly methods. On the other hand, “Hazardous Waste” constitutes 12.5% of the waste, indicating a need for specialized and careful disposal methods to prevent environmental and health risks. “Recyclable Waste” and “Non-Recyclable Waste” make up 16.0% and 16.3% of the waste respectively, highlighting the importance of promoting recycling practices and reducing the use of non-recyclable materials. The category “Other Waste” also accounts for 16.0% of the waste, implying a need for clearer classification and understanding of waste types to implement suitable disposal strategies.

Shifting the focus to education qualifications, the data suggests that respondents with varying levels of education engage in waste management differently. Those with “Primary Education” and “SLC” backgrounds constitute the largest segments at 20.9% each. This might indicate that individuals with basic to intermediate education levels are collectively responsible for a significant portion of waste generation and management. Additionally, the proportion of “Illiterate” respondents at 16.4% implies a need for targeted awareness and educational campaigns to improve waste management practices within this group.

Interestingly, individuals with “Graduation” and “Post-Graduation” degrees form smaller proportions of the respondents, at 10.4% and 6.0% respectively. This might suggest that higher levels of education are not necessarily directly correlated with more responsible waste management behaviors. However, these individuals could potentially play a role in influencing positive waste management practices within their communities due to their education backgrounds.

2) Education qualification in reference to plastic waste produced

The research examined the relationship between education qualification and plastic waste production, revealing that individuals with higher education qualifications tend to produce relatively lower amounts of plastic waste compared to those with lower education levels. This finding underscores the potential influence of education in fostering awareness and responsible behaviors towards plastic waste reduction (Table 3).

Table 3. Education qualification vs plastic waste produced

	Illiterate		Primary Education		SLC		High School		Graduation		Post-Graduation	
	N	%	N	%	N	%	N	%	N	%	N	%
PET	11	16.4%	14	20.9%	14	20.9%	12	17.9%	3	4.5%	2	3.0%
HDPE	11	16.4%	14	20.9%	17	25.4%	14	20.9%	7	10.4%	4	6.0%
PVC	8	11.9%	11	16.4%	10	14.9%	8	11.9%	5	7.5%	3	4.5%
LDPE	11	16.4%	14	20.9%	17	25.4%	14	20.9%	7	10.4%	4	6.0%
PP	8	11.9%	11	16.4%	10	14.9%	8	11.9%	5	7.5%	3	4.5%
PS	3	4.5%	3	4.5%	7	10.4%	6	9.0%	2	3.0%	1	1.5%
MLP	11	16.4%	14	20.9%	17	25.4%	14	20.9%	7	10.4%	4	6.0%
Tetra Pack	8	11.9%	11	16.4%	10	14.9%	8	11.9%	5	7.5%	3	4.5%

The provided data offers insights into the correlation between education qualifications and the types of plastic waste generated. By examining the distribution of plastic waste types across different education backgrounds, we can gain valuable insights into how education might influence plastic consumption and disposal habits.

The data showcases a breakdown of plastic waste types, with "HDPE" and "LDPE" constituting the largest proportions at 16.2% each, followed by "PET", "PP", "PVC", "Tetra Pack", and "MLP", each accounting for 10.9% to 13.5% of the plastic waste. This distribution highlights the prevalence of various plastic materials in the waste stream, ranging from single-use plastics like "PET" and "Tetra Pack" to more durable plastics like "HDPE" and "LDPE".

Analyzing the relationship between education qualification and plastic waste, we observe that individuals with different levels of education contribute differently to the plastic waste generated. Notably, respondents with "SLC" (School Leaving Certificate) and "High School" education backgrounds constitute the largest segments at 25.4% and 20.9% respectively. This might suggest that individuals with basic to intermediate education levels are contributing significantly to the plastic waste stream. Conversely, respondents with "Graduation" and "Post-Graduation" degrees, forming 10.4% and 6.0% of the sample respectively, seem to produce relatively lower amounts of plastic waste. Interestingly, "Illiterate" and "Primary Education" groups make up 16.4% and 20.9% of the respondents respectively, implying that individuals with limited formal education also contribute significantly to plastic waste. This underscores the importance of targeted awareness campaigns and educational initiatives to address plastic consumption patterns within these segments.

In conclusion, the data suggests that education qualification might play a role in influencing plastic waste production. Higher education levels appear to correlate with a tendency to produce relatively lower amounts of plastic waste, while individuals with lower education levels contribute prominently to plastic waste generation. Addressing plastic waste challenges should involve tailored strategies that raise awareness and promote responsible plastic consumption across all education backgrounds.

3) Knowledge of waste in reference to main family income source

The research explored the connection between family income levels and knowledge regarding plastic waste, revealing that higher family income tends to correlate with a greater understanding of plastic waste issues, potentially due to increased access to education and information resources. This finding underscores the importance of targeting awareness campaigns and educational initiatives across income groups to enhance overall plastic waste awareness (Table 4).

Table 4. Knowledge of waste vs main family income source

	Gov. Job		Private Job		Business		Labor		Agro		Politics		Pension		Remittance	
Degradable Waste	8	11.9%	10	14.9%	21	31.3%	3	4.5%	4	6.0%	2	3.0%	3	4.5%	16	23.9%
Non-Degradable Waste	8	11.9%	10	14.9%	21	31.3%	3	4.5%	4	6.0%	2	3.0%	3	4.5%	16	23.9%
Hazardous Waste	4	9.3%	7	16.3%	11	25.6%	2	4.7%	4	9.3%	2	4.7%	3	7.0%	10	23.3%
Recyclable Waste	5	9.1%	9	16.4%	17	30.9%	3	5.5%	2	3.6%	2	3.6%	2	3.6%	15	27.3%
Non-Recyclable Waste	6	10.7%	8	14.3%	17	30.4%	3	5.4%	3	5.4%	2	3.6%	3	5.4%	14	25.0%
Other Waste	5	9.1%	9	16.4%	17	30.9%	3	5.5%	2	3.6%	2	3.6%	2	3.6%	15	27.3%

The income distribution reveals that the majority of respondents fall within the "360001 to 480000" income range, constituting 59.7% of the total. This might suggest that a significant portion of the sample belongs to a middle-income bracket. The "480001 to 600000" category represents 31.3% of the respondents, while the "240001 to 360000" and "More than 600000" groups make up 7.5% and 1.5% respectively, indicating a smaller proportion of individuals in higher income ranges.

Analyzing the knowledge levels about plastic waste, the data shows relatively consistent percentages across the different waste types, with "Degradable Waste", "Non-degradable Waste", and "Other Waste" each accounting for 19.5% of the knowledge. "Recyclable Waste" and "Non-recyclable Waste" both represent 16% and 16.3% respectively, while "Hazardous Waste" knowledge is at 12.5%. When considering the relationship between family income and knowledge on plastic waste, it's notable that there isn't a clear linear correlation between income levels and knowledge percentages. While higher income levels might be associated with better access to educational resources and information, the data doesn't strongly reflect this trend. This could indicate that awareness about plastic waste is not solely determined by income, but rather influenced by various factors including education, media exposure, and cultural awareness.

In conclusion, the data does not strongly suggest that higher family income directly correlates with greater knowledge about plastic waste. To promote better plastic waste awareness across all income groups, targeted awareness campaigns and educational initiatives are essential. These efforts should aim to engage individuals from diverse income backgrounds, ensuring that the understanding of plastic waste and its environmental implications is accessible to everyone.

E. Major Problems and Issues

There are several issues and problems in Solid waste management of the Pokhara Metropolitan City. The Ward 12 community has also numerous of issues in management. They are listed here below:

- Untimely schedule of waste collection
- Waste disposal at water canals
- Animal excreta on the roads from street animals and haphazardly by the actions of animal owners
- Mixed waste collection

- All the community members (landlord and renters) have not taken SWM membership cards.
- Community members still need awareness programs and bring out behavioral change towards waste management and perception towards waste workers.
- PMC has not made efforts to get the community members to get the SWM membership cards and monitor the waste segregation or other bad practices on SWM as per the PMC SWM Regulations, 2075.
- The SWM monthly fee rate list requires revised service fees, which is very low.
- The dumping site is temporary with possibility of closures due to community protest, road damaged roads which leads to stop of waste collection services.
- There are no composting centers, Material Recovery Facilities of PMC nor private waste collection companies.
- The collected waste goes to landfill directly after the vehicle is full without segregation or recovery of valuable items in the waste.

V. Conclusion and Recommendation

A. Conclusion

In addressing the critical issue of plastic-related household waste production in Pokhara Metropolitan City, Ward-12, this research has shed light on several key aspects that influence waste generation, management, and awareness. The findings provide valuable insights into the intricate dynamics of waste behaviors within different demographic contexts. Education levels emerged as a determinant of waste management practices, with higher education levels potentially fostering more responsible waste behaviors. Notably, family income did not consistently correlate with increased awareness of plastic waste, highlighting the importance of targeted awareness campaigns across all income groups. The study also unveiled prevalent waste management practices, such as relying on formal waste collection services and composting, while also revealing areas that require improvement, including hazardous waste disposal and reducing waste production in household.

The research identified various challenges and issues in solid waste management within the community, including untimely waste collection, improper disposal practices, and the need for more effective waste management infrastructure. The data underscored the importance of community-wide engagement and awareness programs to foster behavioral changes towards waste management. Moreover, it emphasized the role of local authorities, community organizations, and private entities in collectively addressing waste-related challenges. These findings collectively contribute to the knowledge base on plastic pollution and waste management, providing a foundation for informed policymaking, strategic interventions, and targeted public awareness campaigns. Ultimately, the research underscores the urgent need for collaborative efforts and proactive initiatives to alleviate plastic pollution and promote sustainable waste management practices for a cleaner, healthier environment in Pokhara Metropolitan City, Ward-12, and beyond.

B. Recommendations

1) Recommendations for community members

- Actively participate in meetings and training sessions focused on Solid Waste Management (SWM).
- Embrace responsible SWM practices at the source of waste generation.
- Effectively segregate waste and hand it over separately to collection vehicles.
- Obtain SWM membership cards to ensure proper waste collection and disposal.
- Cease the practice of discarding waste in drains, which contributes to sewer blockages and river pollution.

2) Recommendations for private waste collectors

- Provide comprehensive training to community members under their purview to facilitate waste segregation and proper handling.
- Implement a structured waste collection schedule to enhance efficiency.
- Engage in community meetings to promptly address concerns and challenges.
- Strategize resource recovery initiatives to extract value from waste, minimizing landfill contributions and the frequency of trips to dumping sites.
- Collaborate with local organizations, Tole Sudhar Committees (TSC), clubs, or like-minded entities sharing a common vision for SWM in the ward.

3) Recommendations for Metropolitan City office/ward office

- Enforce the implementation of the SWM Regulations of 2075 formulated by the Pokhara Metropolitan City (PMC).
- Consider the insights and solutions provided by the World Bank's study titled "Strategic Assessment of Solid Waste Management Services and Systems in Nepal" for enhancing SWM practices in Pokhara Metropolitan City.
- Organize regular cleanup campaigns within each tole to maintain cleanliness.
- Install designated sets of dustbins exclusively for pedestrians in public spaces.
- Distribute compost bins and deliver training sessions to ensure comprehensive community coverage.

Conflict of Interest

The author declares no conflict of interest.

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