An Analysis of Solid Waste Management in Gangtok Municipal Corporation – A Behavioural Approach

A Dissertation Submitted

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Degree of Master of Philosophy

By

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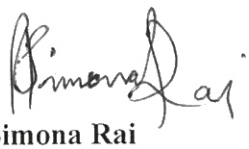
DECLARATION

I, **Simona Rai**, hereby declare that the research work embodied in the dissertation titled **"An Analysis of Solid Waste Management in Gangtok Municipal Corporation – A Behavioural Approach"** submitted to Sikkim University for the award of the degree **of Master of Philosophy**, is my original work. The dissertation has not been submitted earlier for any other degree to this University or any other University.



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CERTIFICATE

This is to certify that the dissertation titled **"An Analysis of Solid Waste Management in Gangtok Municipal Corporation – A Behavioural Approach"** submitted to Sikkim University for the partial fulfilment of the degree of **Master of Philosophy** in the Department of Geography, embodies the result of bonafide research work carried out by **Simona Rai** under my guidance and supervision. No part of the dissertation has been submitted for any other degree, diploma, associateship and fellowship.

All the assistance and the help received during the course of investigation have been duly acknowledge by her.

We recommend this dissertation to be placed before the examiners for evaluation.

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"An Analysis of Solid Waste Management in Gangtok Municipal Corporation – A Behavioural Approach"

Submitted by **Simona Rai** under the supervision of **Dr. Ishwarjit E. Singh (Assistant Professor, Department of Geography, School of Human Sciences, Sikkim University)**.

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Simona Rai

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ABBREVIATIONS

- AFR - Africa
- ALERT - Anti-Littering Enforcement Team
- CAB - Community Advisory Board
- CDP - City Development Plan
- CH4 - Methane
- CO - Carbon monoxide
- CO2 - Carbon dioxide
- CPCP - Central Pollution Control Board
- DPH - Diesel Power House
- EAC - Eastern and Central Asia
- EAP - East-Asia Pacific
- ECOSS - Eco-tourism and Conservation Society of Sikkim
- ENVIS - Environmental Information System
- EU - European Union
- GHG - Green House Gases
- GMC - Gangtok Municipal Corporation
- GPRS - General Packet Radio Service
- GPS - Global Positioning System
- GSDP - Gross State Domestic Product
- ICAR - Indian Council of Agricultural Research
- IPCC - Intergovernmental Panel on Climate Change
- ISWA - Integrated Solid Waste Association

- ITF - Intermediate Treatment Facilities
- JNNURM - Jawaharlal Nehru National Urban Renewal Mission
- KKKP - Kagad Kach Patra Khastakari Panchayat
- KMC - Kolkata Municipal Corporation
- LAC - Latin America and the Caribbean
- MENA - Middle Eastern and North Africa
- MSW - Municipal Solid Waste
- MT - Metric Tonne
- MW - Mega Watt
- NEERI - National Environmental Engineering Research Institute
- NERCCDIP - North Eastern Region Capital Cities Development Investment Program
- NGO - Non-Governmental Organization
- NH - National Highway
- NIMBY - Not in My Backyard Syndrome
- NSWAI - National Solid Waste Association of India
- OECD - Organization for Economic Co-operation and Development
- OEH - Occupational and Environmental Health
- PET - Polyethylene Terephthalate
- PP - Polypropylene Bags
- PPP - Public-Private Partnership
- RDF - Refused Derived Fuel
- SAR - South-Asia
- SBM - Swachh Bharat Mission
- SEHB - Shimla Environment, Heritage Conservation and Beautification

- SIPMUI - State Investment Program Management and Implementation Unit
- SNT - Sikkim National Transport
- SSEC - State Socio Economic Census
- STNM - Sir Thutop Namgyal Memorial
- SWaCH - Solid Waste Collection and Handling
- SWM - Solid Waste Management
- TMC – Thiruvananthapuram Municipal Corporation
- TPD - Tonne per day
- UD&HD - Urban Development and Housing Department
- UNEP - United Nations
- UNEP - United Nations Environmental Programme
- VIP - Very Important Person
- WEEE - Waste from Electrical and Electronic Equipment
- WTE - Waste-to-energy

CHAPTER I

INTRODUCTION

1.1. Introduction

The history of waste has been related to the histories of the largest cities; especially the Western Hemisphere who faced the challenges arising from wastes in the beginning. However, shifting to an epoch of Anthropocene, where the world is growing towards its urbanized future, one of the urban lifestyles' by-products, solid waste, is growing even faster than the rate of urbanization. Thus, for the last two centuries, waste has become an integral part of the study of Urban and Behavioural Geography, which is the sub-field of Human Geography. Ten years ago, there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day. Today these amounts have increased to about 3 billion urban residents generating 1.2 kg/capita/day globally. By 2025, this will likely increase to 4.3 billion urban residents generating about 1.42 kg/capita/day of municipal solid waste as per World Bank Report (2012). Currently, the global waste management is collectively managed by International Solid Waste Association with strong partnerships with various NGO's, financial institutions and conference inputs like the Basel Convention of 1989, Climate & Clean Air Coalition, the German Biogas Association, UNEP, the World Bank, World Health Organization, Global Methane Initiative, Green Climate Fund and many more to meet the Sustainable Development Goals.

Around the world, various regions have depicted differing types and amount of waste generation, mainly because of the spatial and temporal variations. However, the trend that has evolved is that of, wealthier the country, more varied and complex is the composition of the waste. Even though, the developed countries have been quite successful in managing its municipal wastes. After the commitments made at the Earth Summit in Rio de Janeiro, 1992, the European Council in 2001 adopted the first EU sustainable Development Strategy. Implementation of the Thematic Strategy on the

Prevention and Recycling of Waste, Strategic Environmental Assessment Directive, Waste Framework Directive, Landfill Directive, Packaging and Packaging Waste Directive, End of Life Vehicles Directive, Hazardous Waste Directive and Potential Social Directive of Not in My Backyard Syndrome (NIMBY) has aided the European Union countries to some extent to have a good waste management. Through these systematic modelling practices there has been an improvement in the existing legislation with simplification and modernization effects on waste definition, end-of-waste criteria, recycling, recovery and disposal activities with an overall policy change. Strategic Environmental Assessment directive and NIMBY syndrome takes into account the social aspects where there is active public participation to draw up scale effective plans and programs relevant to the environmental directives. However, due to differing geo-political scenario among the member countries of EU, more integrative solid waste management systems and developing measures has to be implemented in countries like Portugal, Greece, and Spain to meet the objectives of the EU directives (Pires, et al., 2011).

On the other hand, EU member, Sweden has become very successful in implementing zero waste management. The Environment Protection Act 1969 gave a push to prioritize the importance of waste as resource in Sweden. In 1980's the focus shifted towards reducing the quantity, hazard and environmental impact of waste. In 1992's bill, the concept of eco-cycles gained importance of reusing and recycling waste using minimum resources and without harming the nature. This protocol imposes management of waste as the producer's responsibility. Likewise, the bill of 1997 focused on reducing landfilling of organic waste. Environmental Code and tax going to landfill were enacted by 2000. Accession of Sweden to European Union in 1995 has given greater impact on the waste management. Their Framework Directive, Landfill

Directive and Waste Incineration Directive have formed the core of the policy of *"waste hierarchy"* which has led Sweden to achieve zero waste management (Swedish Environmental Protection Agency ,2005).

Municipal Solid Waste Management has not been as successful in the developing countries as the developed ones. This is mainly because of rapidly growing urbanization, industrialization and lack of proper urban planning. The lack of ability to understand the threat caused by the waste generation in developing countries has also led to mismanagement of the solid waste to some extent. India is also facing the various challenges imposed on environment, economy and social activities by the waste's proliferation. The rise of mega-cities since the 1990's has definitely contributed to the growing problems of waste in India. Today, an urban dweller in India generates wastes between 0.21kg/day to 0.5kg/day. However, the quantity and nature of the waste generated vary with the activities performed in a country. The central government of India under Ministry of Urban Development has provided an impetus with the state government to improve the urban areas under various schemes. The Jawaharlal Nehru National Urban Renewal Mission funded 49 SWM projects in various cities during 2006 to 2009. According to the Central Pollution Control Board, 2018-2019, the quantity of solid waste generated by the 23 large cities in India is 30,058 tonnes/day. Mumbai produces the maximum with 5,335 tonnes/day and Vishakhapatnam generates the least at 300 tonnes/day. Nevertheless, the growing problem of waste is also prevalent in smaller cities which have become open bins and overloaded dumping site. Similarly, Sikkim is one of the fast-urbanizing tourist stations in India. In 2017, tourism sector contributed 7.68% to its GSDP (2018). However, over the next two years, there has been a phenomenal growth of tourism in Sikkim accounting for more than 16 lakhs of tourist in 2019 which is sixteen times the population size of Gangtok. Within almost

a decade, tourist influx has raised from 5 lakhs in 2011 to triple its size by the end of the decade. Unfortunately, along with the tourism comes a challenge of waste management. Sikkim produces 75.1 tonne per day out of which 67.1tonnes per day is collected, 51.4 tonnes/day is dumped in the various landfills around Sikkim and only 13.05 tonnes/day is treated (CPCB ,2018-2019) . However, only Martam landfill and Mangan in North Sikkim has composting plant which attends to their partial amount of bio-degradable waste.

Gangtok has shown the highest influx of intra-state and inter-state migration as well as tourist influx. Ministry of Urban Development, Government of India has projected that Gangtok's waste generation will rise up to 59.7 metric tonne per day by 2025 (UD&HD, Part II : Environmental Infrastructure ,2008). Since majority of the grass-root population is dependent upon tourism for livelihood, the influx of tourist will only grow as years go by as denoted by the past decadal data. On top of that, the various institutional opportunities and globalized lifestyle has attracted unplanned growth of population and consumerism in the capital. However, the high altitudinal destination is ecologically fragile and rampant growth has created environmental and urban management issues like water scarcity and waste proliferation. Furthermore, garbage accumulation and disposal in the nearby *jhoras* have caused drainage blockage which has led to landslides in many areas in the city during monsoon before.

Events as such has encouraged the solid waste management to be in an immediate need of attention and it can be made possible only if one pays attention to the new geographies of waste which is qualitative and social in its approach. The transition from the traditional system of non-compliant landfills to integrated waste management aiming the prevention, reuse, recycling and recovery of waste involves behavioural

changes by the social subjects. This behavioural change of communities towards the waste system, however, involves social and territorial implications.

Thus, taking mind-set into consideration for an efficient solid waste management from a behavioural standpoint is mandatory. Behavioural approach simply takes a human being as a dynamic person whose behaviour influences his action. A human makes choice and those choices are governed by the pre-owned knowledge built from churned perception that the person has. Therefore, the present study is an attempt to approach waste management not only from the technical and economic reasons but rather, from a holistic approach.

1.2. Locating the Problem: Literatures' Context & Concepts

1.2.1. Municipal Solid Waste in India and Sikkim

1.2.1.1. Positivist Approach

The positivist approach in studying waste has always been predominant and it relies on accurate measurement and accounts. The traditional positivist approach in social studies of waste has been concerned with generating technologically appropriate models to tackle the upheaving waste and sees people who, only as numbers vary spatially, contribute to the rising waste.

Kumar (2016) also analyses the importance of spatial and temporal variability for implementing efficient waste management. The result shows that borrowing Western technologies to tackle waste in India has now become its flaw because the developed countries had different development pattern as compared to India. Their technologies are bringing little to no difference in India as those replicated technologies are inappropriate in the present conditions here. He further states that the developing countries are spending 20%-80% of their available funds on solid waste management.

However, open dumping and open burning is quite a normal phenomenon in such countries: 30%-60% of urban solid waste is not collected. High income countries, on the other hand, spent less than 10% of their total budget enabling significant funds to be used for different treatment facilities.

Kumar and Chakrabarti (2010) further provides an in-depth study of waste management in India and it highlights that Indian urban dweller generates 0.2-0.6 kg per person per day. 70-90% of total wastes generated by the largest cities of India are collected whereas only less than 50% of the total solid wastes generated by the smaller cities and towns are collected. Their work also reflects that the socio-economic variation among the urban dwellers has an immense hand to play in the type of waste generated and managed. They highlight that there is sporadic or no waste collecting facilities in the low-income community which influences their eco-unfriendly behaviour towards waste management.

Sharma (2019) has worked on the challenges of waste management in Gangtok and states that only 40% of the waste is collected here and sent to Martam landfill and the rest is disposed into the natural water systems and valleys. The proper segregation of the waste is also not done and toxic wastes from the power plants and the hospitals are not disposed mechanically. She suggests that implementation of 4 R's should be done efficiently improving the waste management system with supporting statistical figure.

Chettri (2019) also states that the enforcement of the Sikkim Non-Biodegradable Garbage Act-1997 has been of quite a use until now. Banning of the use of plastic bags by the Sikkim Trade License and Miscellaneous Provisions Rules, 1985 with charges of fine has encouraged the people in Gangtok to avoid the non-biodegradable product to quite some extent.

Rai and Goswami (2019) have studied urbanization and tourism induced challenges in Gangtok. Their result shows that only 20% out of the surveyed commercial community follows segregating practices of waste. They highlight the discontentment among the people with regards to irregular waste collection and open dumping of the waste. When GMC officials were interviewed, they observed issues of lack of man-power and financial constraints.

1.2.2. Attitudes and Behaviours in waste management

1.2.2.1. Post-positivist Approach

With the growing concern about the waste proliferation, studies under various disciplines including Geography have gone past the objectivity of waste and tried to examine the attitudes and behaviours of the citizen in relation to waste generation and its management but to successfully examine this activity, first relationship between attitudes and behaviour calls for an understanding. Social psychology has provided many studies which statistically measures public attitudes and the relationship between attitudes and behaviour. The assumption underlying this research is that attitudes predetermine individuals to behave in a certain manner.

"Attitude is the evaluative feeling evoked by a given object (Fazio and Zanna, 1981)*"* and behaviour is simply the way one acts. There has been a growing focus in establishing attitude-behaviour relationships. This has been studied by Fazio and Zanna (1981) where they have done extensive research on attitude towards the housing storage within the campus. The result shows that the students who are temporarily accommodated just in a cot in lounge takes more active actions by raising petitions against the housing department of the campus and is more in contact with the administrative officials pressurizing them to change the housing policies whereas the permanently accommodated students show concern regarding this issue but are less

likely to participate in the action. Hence, the structural conditions and lived experience are likely to affect the attitudes that are clearly defined and certain of behaviours of the subjects.

Research done by Crespi (1971) suggests when there is a choice provided attitudes of the subject can also predict the behaviour as well, meaning, how likely a person will choose to purchase a specific brand of food, watch a certain movie in a cinema hall or voting is dependent upon the expectation they want to meet at the end. For example, the motive behind purchasing certain food brand can be physiological or a matter of social prestige. Likewise, it would depend upon the temporal situation or the perceived image of the manufacturing brand and so on. Thus, showing *"attitudes were treated as highly specific combinations of beliefs, preferences, and intentions, each held with varying degrees of intensity* (Crespi, 1971)*."* However, in loose structured situations where no role expectation is there, attitude is least likely to predict the behaviour. This would also be the case in analysing and understanding the attitude-action landscape of the waste management system.

After the World War-II, the industrialized agriculture brought along many environmental problems but it was not until the energy crisis of 1973, the people felt the need to conserve their source of energy which eventually led to conservation behaviour. Thereafter came Brundtland Report in 1987 with sustainable development which focused on recycling behaviour. Recently, researchers have grown interested in examining the relationship attitudes of conservation with recycling activity. It was from late twentieth century that researchers started looking into recycling attitudes with empirical research. McGuinness, Jones and Cole (1977) found out from their study that the participants who held ecological attitudes were more actively participating in the paper recycling program of the city. However, the conservation attitudes are directly

proportionate to recycling; the same is unsaid about the behaviour and can be better understood only by analysing the many factors that builds up an attitude towards management behaviour.

Steel (1996) empirically investigates the link between attitudes and self-reported behaviours regarding the environment from the data collected from 1992 American national survey. The results show that environmentally protective attitude predicts self-reported environmental behaviour and political activism with regards to environmental issues. Thus, reporting that citizen participating in environmental issues "think globally and act locally".

Ebreo and Vining (2000) provides quantitative research and conclude that ecological attitudes were seen as a great predisposing factor for recycling and social reasons representing motives relating to other people's influence on their own recycling behaviour were not given much importance. However, economic incentives due to inconvenient structure were viewed as an important factor influencing recycling by non-recyclers as compared to recyclers. They differed in the level of perceived difficulty of recycling like the time required for the activity and the storage space estimation for it. They suggest that educating the people on how to recycle, how to prepare the materials for recycling and where to go for the assistance required would be more encouraging to have recycling behaviour.

1.2.2.2. Social Constructivist Approach

Young (1986) on the other hand, researched recycling attitudes based on intrinsic motive (self-satisfaction) and found little variation between the well-off population and grassroots population. With this methodology he tries to reflect on how people carry out conservation behaviour not for rewards but simply for their personal satisfaction. Another study by Young (1990) suggests that people are more influenced by

conservation attitudes from the data collected which showed 85% of the respondents of the six studied areas in Michigan thought that recycling was a vital activity for environment conservation. Finally, he concludes that conservation attitudes can turn into pro-recycling behaviour even without any monetary incentives.

There are some researchers who oppose the core attitude-behaviour consistency theory. As cited by Wicker (1969), La Piere conducted a study with his Chinese companions in 1930's when United States of America grew anti-sentiments against Chinese. During his study, their accommodation was only once denied and the treatment was welcoming above 40% of the hotels visited by them. Nevertheless, when he wrote to those 250 hotels inquiring whether they would accommodate Chinese guests or not, above 90% of them indicated that they would not entertain Chinese guest despite their contrary actions earlier. Wicker (1969) himself suggests that behaviour is unrelated or rarely predicted by the attitude itself but more so by the knowledge of the situations. The strategy of pre-assuming and generalizing the study of attitude and behaviour of waste practices is strongly felt in the positivist approach of research.

To study such a subjective natured topic like behaviour with only verification and falsification of the earlier assumption makes the research stiff and monotonous. The make-believe by testifying that positivist method of studying behaviour will result in the ultimate truth and reality in itself reflects a gap of knowledge where in reality; the behaviour is flexible and dynamic. In addition, only falsifying the presumptions shows that there is a lack of connection between the generalized theory and reality.

Majority of the literature reviewed reflects those attitudes and behaviour has tended to utilize quantitative approaches derived from psychology. Nevertheless, the use of quantitative research methods to quantify and measure attitude-action relationship of a human being is contested.

Barr (2002) says that the post-positivism examines and generalizes the trends in behaviour which cannot be undertaken if there is an assumption that all humans are dynamic. Blake (1999) states that the use of quantitative methods is very deterministic to study human behaviour as it demands the respondent to comment on complex enquiry in a simplistic manner. “These researchers have called for the adoption of more diverse research methodologies including qualitative techniques such as interviews and focus groups in order to elucidate nuanced information from participants (Fahy and Davies, 2007).” Henceforth, new waste studies in geography inclines toward behavioural geography under the sub-discipline of human geography which emphasizes on the subjectivity and the meaning waste holds among each individual.

The antecedent of Behaviouralism goes back to early twentieth century when maps were of focused interest. In 1907 and 1913, F.P. Gulliver and C.C. Trowbridge, accordingly, found that children and students recognized home as an anchoring point rather than the actual compass point on maps showing egocentric-imaginative reference system. Likewise, American Geographer, Carl Sauer explained how landscapes were shaped accordingly by human beings and their culture. His compatriot John Kirtland Wright emphasized the importance of the imagination and intellectual curiosity in structuring views of the world and recommended that geographers should concern themselves with the study of geographical knowledge from any or all points of view (Gold ,2019). The ultimate rise of behavioural geography came in mid-twentieth century when axiom of economic man or rational man was denied and challenged by Wolpert where he concludes that farmers are not profit maximisers but sub-optimal satisfiers. Hence, human behaviour was seen to be a product of decision-making and it was a human tendency to not have proper information, to make imperfect choices and yet be content with sub-optimal options. Basically, it came into origin against the result

of the developments that were made in positivism and quantitative revolution. Similarly, behaviouralism is inevitable for a systematic and in-depth understanding of the processes that governs the garbage proliferation.

Boulding in 1956 suggested that over time, individuals' developmental impressions of the world (here, waste) are formed through their everyday contacts with the environment and that these images act as the basis of their behaviour. Bringing forth the work of Acuto (2014) where she talks of neglected "Everyday" in "International Relation" with her study in Sydney. Every day is *"the spatiality of situated, mundane and habitual practice often little appreciated in IR* (Acuto, 2014)*"* because of the routinized globalist thinking of the contemporary world. For instance, as cited by Acuto (2014) is the work by a feminist, *"Enloe in Bananas, Beaches and Bases (1989), where she describes the palindrome-like nature of this approach in relation to the state. 'Personal is political' and 'the political is personal,' it suggests that politics is not shaped merely by what happens in legislative debates, voting booths, or war rooms but rather it prompts one to investigate the politics of marriage, venereal disease, and homosexuality not as marginal issues, but as matters central to the state* (Acuto, 2014)*."*

Sydney's study aware us about the embeddedness of lived experiences in the global relations. The application of Zero-Waste by the city council has urged citizens to not only be aware of their environmental governance responsibilities but also urged them to lead a morale homemaking. Today, the waste management is not merely a quantified system where the waste disposed is technically fixed but is a holistic mechanism which changed the notion of waste to the subject that reimagined Sydney. The Waste and Recycling Guide enacted by the mayor in Sydney has made the urban dweller a forceful agent to keep up the image it has achieved. This is where "home" or the mundane

practices of everyday interaction with the environment become central to the behaviour. It hereafter demands research to explore and unfold the attitude-action landscape of the waste management system.

Likewise, Davies, Fahy and Taylor (2005) conducted a qualitative study of publications and attitudes towards waste in Ireland. The research revealed a complex landscape of attitude-action relationships influenced by factors ranging from personality characteristics (intrinsic motives. e.g., no time due to work or pro-active behaviour based on the attitude of "right thing to do") to cultural context (with regards to the historical background of colonization, passivity towards waste management was used as a resistance against authority) and institutional contexts (lack of accessibility to the disposal or proper awareness in the school encouraged more of household waste management behaviour).

Davies' (2003) qualitative study concludes with the contesting political issue between the local government and the local people regarding waste management bringing forth the interdisciplinary approach to the study of waste in geography. The Act of 2001 implemented by the Minister of Environment crippled the public' democratic right to speak against the incineration plant set-up in the locality as the local body feared confrontation with Europe due to its lack of progress in waste management plans in Ireland. She suggests that marginalization of public with regards to waste management is problematic. Implementing Civic-model of public participation will bring out more transparency and public views on the system of waste governance. Thus, decreases the occurrence of waste wars by creating a healthy communicative relationship between citizens and the waste sector.

Fahy and Davies (2007) applies the action research practice in qualitative research to study the household waste management behaviour. With this method they conclude that

waste management behaviour is the culmination of various social, cultural and contextual factors' interaction in the day-to-day life of the participants. They further suggest that this approach brings theoretical account of behaviour closer to studies of actual practice unlike quantitative approach which *"is abstracted from the realities of waste management as practiced within the home."*

Barr (2007) has used a qualitative approach to study the waste attitudes and behaviours in Exeter, United Kingdom. His main focus is in finding out the factors that influences the environmental consciousness in particular. The result shows that the reducing and reusing practices or behaviours are driven by environmental values, knowledge and concern-based variables whereas the recycling behaviour is strongly based upon normative behaviour of the individual.

Graham-Rowe, et al. (2014) have provided in-depth research in identifying the motivations and barriers in minimizing food waste using qualitative approach. They find that there are two core reasons to not waste the food which are waste concern and doing the 'right thing' whereas there are four core reasons barring the generation of food waste which are a 'good' provider identity, minimizing inconvenience, lack of priority and exemption from responsibility. The ultimate findings show that there is a conflicting personal goal that limits the food waste minimization practices.

Chen, et al. (2019) have provided a qualitative study of exploring the driving mechanism of waste separation behaviour of urban residents in three provinces of China. The research reveals that factors of individual psychology, perception of separation empowerment, policy and standards, products and facilities, group norms, link trustworthiness, and social demography variables affects the waste separation behaviour which can be habitual and decisional linked with relationship and citizenship.

1. 3. Statement of Problem

On an average, the urban population of Sikkim's capital, Gangtok produces 53 metric tons of waste per day accounting for 524 gm/capita/day and 60 percent of it is contributed by the households alone (NERCCDIP ,2011). The recent estimates show that the Martam landfill designed to last for 15 to 20 years may not sustain that long. The existing literatures on waste management in Gangtok have certainly refined the broad picture of the system. However, the positivist approach on the waste studies has been overemphasized and fails to go beyond the lens of managerial techniques and growing quantification of the waste. Rigidity is observed in the existing literature of waste in Gangtok where only verification of the pre-assumption is reflected. The waste study demands an elaborative and comprehensive understanding at the source of generation for it to be efficiently managed; which can be achieved only by exploring the participant's knowledge of lived-experience. For the same, attitude and behaviour landscape of household respondents towards waste should be taken as a key tool of research. Without having a deeper knowledge of elements influencing attitudes and behaviour of participants' waste practices, the void in efficient waste management will always prevail.

1. 4. Objectives of the study

i. To evaluate the spatio-temporal variation of municipal solid waste in Gangtok Municipal Corporation.

ii. To examine the various factors that influences attitude-action consistency towards solid waste management at household level.

iii. To comparatively analyse solid waste management among the population of the residential, mixed and commercial society from behavioural perspective.

1. 5. Research Questions

i. Does the nature of the waste change with the spatial variation?

ii. Why is it important to view waste based on attitudes and behaviour?

iii. Is there a consistency in attitude and action/practice on solid waste management?

iv. What are the factors that determines suitable attitude towards solid waste management?

v. How varied is the waste management practice of the populations in the different locations?

1. 6. Database and Methodology

The study is based on mixed methods, including both quantitative and qualitative methods. Data used for the study is collected from both the primary and secondary sources. The sources of data and methods applied is given below.

Table No. 1. 1. Sources of data and method applied

Objectives	Methods	Sources	Target Groups
i) To evaluate the spatio-temporal variation of municipal solid waste in Gangtok Municipal Corporation.	Secondary data on the government publications and reports and research articles, publications, Resource sat I and II imageries and Google Earth imageries. Primary data from interview with driver and NGOs for the data of waste generated from the wardwise.	Census of India, Asian Development Bank, Central Pollution Control Board, Urban Department & Housing Department, Gangtok Municipal Corporation, State's Pollution Control Board, Forest and Environment Department, Government of Sikkim, Bhuvan ISRO geoportal, USGS Earth Explorer, Google Earth Pro and Field Survey	Non-Governmental Organizations, GMC waste truck drivers. (Table No.1.5 and Table No. 1.6)
ii)To examine the various factors that influences attitude-action consistency towards solid waste management at household level.	Random and stratified sampling, scheduled questionnaire, in-depth interviews and focus group discussion.	Field Survey	Households in residential, mixed and commercial wards (Table No.1.3)
iii) To comparatively analyze solid waste management among the population of the residential, mixed and commercial society from behavioral perspective.	~Do-	~Do-	~Do-

The sources of secondary data are given below:

Table No. 1. 2. Sources of Secondary Data

Sl No.	Source
1	Census of India, 2011
2	Asian Development Bank
3	Central Pollution Control Board, Government of India
4	State Pollution Control Board, Government of Sikkim
5	Urban Development and Housing Department, Government of Sikkim
6	Gangtok Municipal Corporation
7	Forest and Environment Department, Government of Sikkim
8	The Ecotourism Conservation Society of Sikkim
9	The World Bank
10	Integrated Solid Waste Association (ISWA)
11	United Nations Environment Programme (UNEP)
12	The Intergovernmental Panel on Climate Change (IPCC)
13	Resourcesat-1 LISS III , Resourcesat-2 LISS-III data - Bhuvan ISRO geoportal
14	Sentinel 2 - USGS Earth Explorer
15	Satellite imagery - Google Earth Pro

Landuse-landcover map and Google Earth imagery have been prepared to primarily show the changes in the built-up area within Gangtok Municipal Corporation to comparatively analyse the growth of urbanization and waste generation. For the same, the land-use landcover maps have been prepared by taking the imageries from Resourcesat-1 LISS III data of 2005-06, Resourcesat-2 LISS-III data of 2015-2016 and Sentinel-2 while the imageries of November, 2007; November, 2015 and December, 2020 of Gangtok Municipal Corporation have been acquired on 12th October, 2021 from Google Earth Pro imagery.

The primary data were collected through household survey with the help of schedule questionnaire from households, focus group discussion of the officials and workers of GMC, interviews of the households and drivers and the outsourced NGOs' which are given in detail below.

There are fifteen wards in GMC; Syari-Tathangchen, Development Area, Lower Sichey and Chandmari are highly residential, Burtuk, Arithang, Tadong, Daragaon, Upper

Sichey and Diesel Power house are mixed used and highly commercial wards are Lower M.G. Marg, Upper M.G. Marg, Deorali, Ranipool and Tibet Road. To make sure that the study is not limited and confined with interpretations of lived experiences of only one particular characteristic location, households in three different settings have been purposively stratified and surveyed, keeping a possibility to venture into interpretations that can be more reflexive and diverse. These wards have been selected from the data on City Plan Report as well as with the technique of pilot survey where the land-use description is strongly observed. Likewise, Tibet Road is one of the most important commercial centres in Gangtok, most densely developed with public. Tadong is one of the swiftly growing wards with fast emerging commercial and institutional hub despite many households settled here and finally, Syari is the ward where no traffic pressure is felt and the buildings are predominantly residential type. (UD&HD ,2010)

Table No. 1.3. Types of location and number of households surveyed

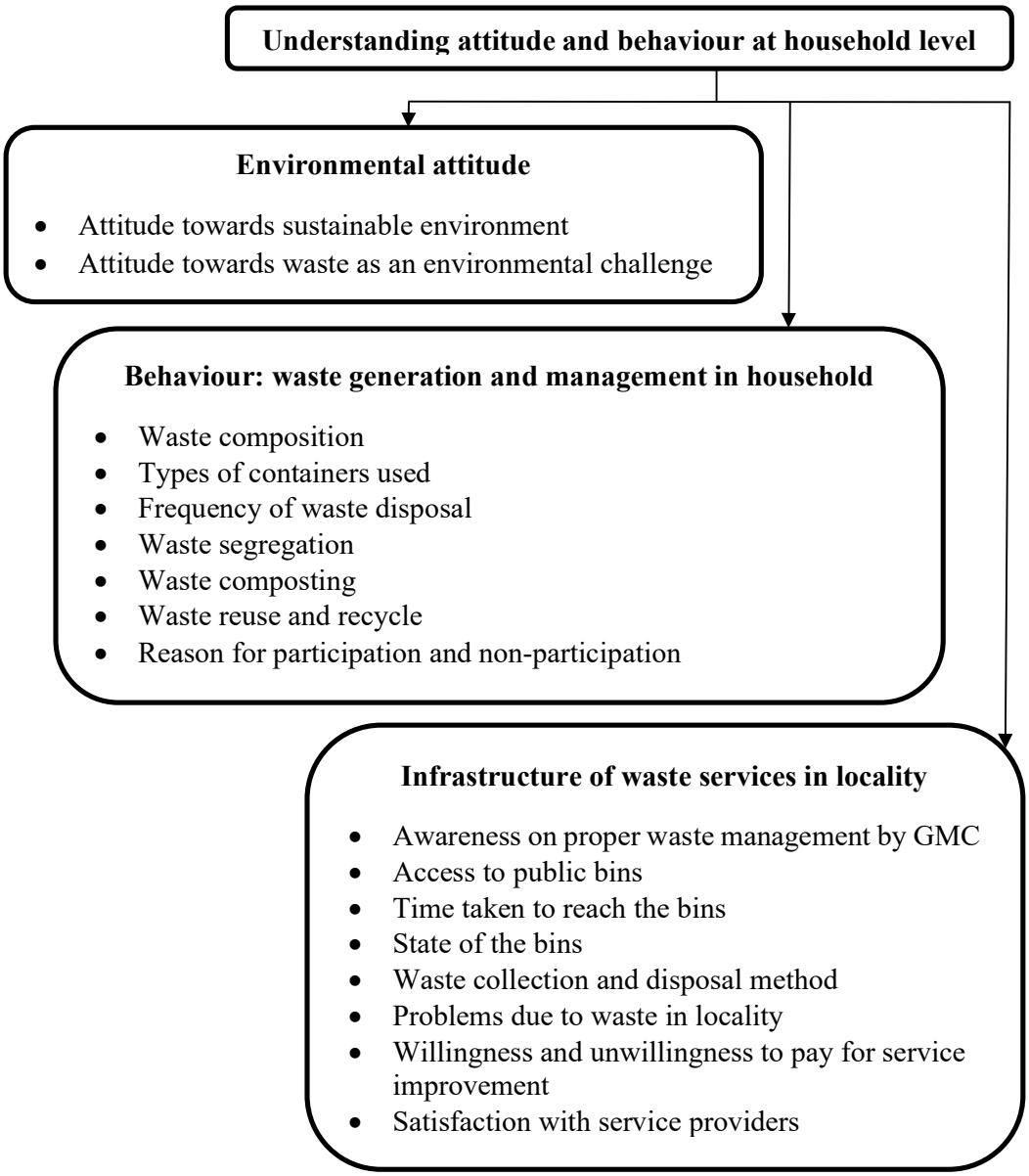
Sl. No.	**Residential Location**	**Ward with residential use**	**No. of HH. surveyed**
1	Syari - Tathangchen	Syari	47
2	Development Area		
3	Lower Sichey		
4	Chandmari		
	Mixed-used Location	**Ward with mixed-use**	
1	Burtuk	Tadong	46
2	Arithang		
3	Tadong		
4	Daragaon		
5	Upper Sichey		
6	Diesel Power House		
	Commercial Location	**Ward with commercial use**	
1	Lower MG marg	Tibet Road	15
2	UpperMG Marg		
3	Deorali		
4	Ranipool		
5	Tibet Road		
	TOTAL		108

Source: (Gangtok Municipal Corporation ,2011)

The households surveyed have been further stratified by income level: High income above 75,000 rupees/month, low income below 15,000 rupees/month and middle income ranging between these levels of income. The households are also stratified by gender, education level, occupation and age. Hence, forty-seven households have been

surveyed in Syari, forty-six households in Tadong and fifteen in Tibet Road. Since attempting to examine and churn the possible factors that shapeup an individual's waste practices is an extensive space of interest which cannot easily be apprehended at once, the study draws from theory of *cognitive maps and spatial behaviour* of (Downs and Stea ,1973) and the attributes that has been taken to evaluate the waste management attitude and behaviour of the household is framed in Fig. 1.1.

Fig. 1.1. Framework of understanding attitude and behaviour at household level



Source: Field Survey, Gangtok, 2020

A schedule questionnaire method is used to obtain the socio-demographic attributes and infrastructural and situational attributes related to waste services and facilities and their respective waste knowledge and practices. This method provides the data of socio-demographic factors that can or cannot possibly influence the waste practices of the household for initial analysis.

An in-depth interview of household respondent was done to elaborate the reasons why the respondents opt for their way of waste practices at the source. An in-depth interview of government officers was also done who have provided detailed information of waste management system in the study area before and after the introduction of GMC with limitations and future proposals of managerial prospects (Table No.1.4)

Table No. 1.4. List of government officials inquired.

Sl. No.	Designation
1	Member Secretary, SPCB, Forest Environment &Wildlife Management Department, Government of Sikkim.
2	Divisional Engineer, GMC, Urban Development and Housing Department, Government of Sikkim.
3	Deputy Chief Inspector (then Assistant Councillor of Gangtok), GMC, Government of Sikkim

Source: Field Survey, Gangtok, 2020.

Furthermore, it also used for collection of data on waste composition and its quantity from the landfill contractor and 32 Mile waste trader. Also, quantity of collected waste per day and details of places and routes where the collection service is delivered is collected from the GMC truck drivers (Table No.1.5).

Table No. 1.5. List of GMC vehicles whose drivers are surveyed

Sl No.	Vehicle No. of GMC truck drivers surveyed
1	SK/01/D3912
2	SK/01/D1823
3	SK/01/D3269
4	SK/01/D3971
5	SK/01/D6639
6	SK/01/D4083
7	SK/01/D2654
8	SK/01/D0511
9	SK/01/D3029
10	SK/01/D3252
11	SK/01/D1167
12	SK/01/D3913
13	SK/01/D2807
14	SK/01/D3254
15	SK/01/D3862
16	SK/01/D0184
17	SK/01/D3257
18	SK/01/D1514
19	SK/01/D2807
20	SK/01/D1168
21	SK/01/D3254
22	SK/01/D3268
23	SK/01/D3260
24	SK/01/D0401
25	SK/01/D3258
26	SK/01/D3262
27	SK/01/D3270

Source: Field Survey, Gangtok, July-December,2020.

The outsourced organizations (Table No.1.6) of Gangtok Municipal Corporation have also been surveyed for the same. The data collected through this method has formed general idea of waste generation and management in the study area.

Table No. 1.6. List of NGOs surveyed

Designation	Names of outsourced organizations
Manager	Megalink
Manager	United Educated Unemployed
Manager	Upper Sichey Educated Unemployed Cooperative Society Ltd.
Manager	Solid Waste Management Team
Manager	Genesis Educated Unemployed Cooperative Society Pvt. Ltd.
CEO	Watson Committee
CEO	Golden Circle (no longer active)
Manager	Mahila Sangaj Sanjeevani Cop. Society
CEO	United Arithang Development Society
Manager	Chandmari Youth
CEO	Deorali Samaj Kalyan Sangh
CEO	Multi-Purpose Cooperative Society Ltd.
CEO	Burtuk Youth Association
CEO	Eco-Tourism and Conservation Society of Sikkim

Source: Field Survey, Gangtok, 2020.

The method of focus group discussion is used with the GMC employees, householders (18-60 years old) of Syari ward, Tadong ward and Tibet Road ward to understand the

management issues. It is also used to derive the perspective of the young generation to understand the role of institutions in waste management, how they look into current waste scenario and their opinion on future prospects and suggestions, population in the age group below 18 have been surveyed.

Table No. 1.7. Focus-group discussion in Gangtok Municipal Corporation

Location and Date of FGD	Rationale for selection	Ideas of FGD
Syari, Gangtok. 04/11/2020	i) To elaboratively understand the issues of waste management. ii) To examine the perception of school-aged children on waste	Meaning of waste
Tadong, Gangtok. 03/11/2020		Role of institutions
		Current situation
Tibet Road, Gangtok. 02/11/2020		Future prospects and suggestions

Source: Field Survey, Gangtok, 2020

1. 7. Limitation of the study

The limitation of the study is felt when the sampling of the household is done because of the emergence of the Covid-19 pandemic and the lockdown the nation went from 24th March,2020. Since Tibet Road is the heart of the city, a complete lockdown of the commercial area was done and due to the growing intensity of the pandemic, the participation in the household survey in the main town was strongly alienated by the residents here. However, since Syari and Tadong is quite a far from the centre hub, the survey wasn't as reluctantly taken by the households than in the Tibet Road. Hence, only about two percent of the households have been taken into consideration for the survey; irrespective of which the varied perception of the householders is still fully absorbed in the study. Also, while in the field survey, the acute data acquisition of the waste generation was a huge issue too since there is no weighing bridge operational till date in the landfill and the data is based upon the verbal analysis of the ground workers.

CHAPTER II

A SCENARIO OF GLOBAL SOLID WASTE MANAGEMENT

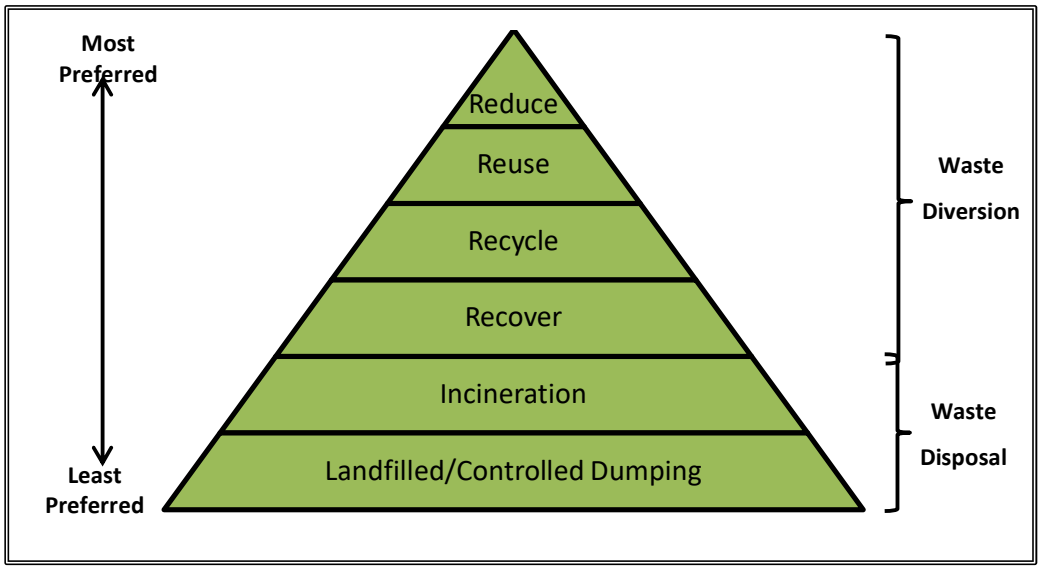
2.1. Waste Management Hierarchy - Routine and Merit:

Municipal Solid Waste have become a herculean task for the waste managers as it has to be tackled in the most environmentally, socially and economically suitable manner possible. Solid waste management today has become one of the most important parts of the respective local body's responsibilities and is almost, always an enormous responsibility of theirs and theirs alone. In most of the developing countries', municipal solid waste management has become their largest budget item. Beside an increasing pressure to work with the integrated international direction of solid waste management, the local management officials have to deal with the changing demographics of work force, employment creation and management of both formal and informal staff. As of today, municipal solid waste management have gained a very comprehensive supervision which inculcates not only the contract professionals, finance expertise and organized labour force but also demands a strong social cohesion between the municipality and their immediate community.

Solid waste is very much considered an "urban" problem of the more urbanized and industrialized country. Their standard of living increases with the rise in income which eventually leads to increase in consumption of goods and services. Hereafter, contributing to the growth in waste generated. On a contrary, the rural populations have lower income level and mostly have subsistence livelihood which leads to lower purchases of globalized products and lesser waste generation with simple composition which is easily degradable. As per the World Bank (2012), 1.3 billion tonnes MSW is generated per year globally by 3 billion urban residents alone which have been estimated to grow to 2.2 billion tonnes MSW per year by the year 2025 by the estimated 4.2 billion urban residents globally (The World Bank, 2012). Even though given the

global average estimates, it differs drastically by region, country, city and even within cities. Keeping in mind that there is no single waste management approach that is suitable for managing the various waste types, given all the circumstances, a waste hierarchy has been adopted which is the most environmentally suitable strategy for municipal solid waste management.

Fig.2.1. Waste Management Hierarchy



Source: The World Bank (2012)

Ontario's Pollution Probe, one of the first environmental non-governmental organizations of Canada is known to first use the waste management hierarchy in the early 1970's. However, earlier, only 3R's – reduce, reuse and recycle were used (The World Bank, 2012). Now, there has been an addition of the fourth R.i.e, recover. The hierarchy represents a pyramid of most preferred to least preferred activities for systematic management of the waste. This strategy has been generally accepted because of its environmental, economic, social, and administrative considerations. This method starts at the source of waste generation. Hence, source reduction initiates prevention and minimization routine. Overall, this method seeks to redesign the production and

consumption patterns of consumers at the origin. Conservation of the natural resources, sustainability of energy, and reduction of greenhouse gases emission by avoiding product manufacturing and waste management processing are the sole benefits of this routine.

Other strongly preferred routines are reusing and recycling. These two routines go hand in hand where there is collection of the used items and it is put to use again. In this process, the consumed materials replace the untouched raw materials which would have, or else, been in use for manufacturing a product. Altogether, recycling routine is a circular system where the materials are flowed back to the economy for the same use or similar purpose. For example, bulk of glass bottles used for selling liquor in the first hand is returned to a distillery for a reuse after processing. The key advantage of this strategy is that it decreases the amount of disposed waste.

Recovery is the middle strategy which is generally accepted and used as the waste generation is inevitable. This routine applies initiatives like composting and digestion of organic leftovers. With aerobic (with oxygen) composting, the vital merit is not only the recovery of organic waste from being disposed in the landfill but also little to no emission of methane which is the one of the most potent GHG. Furthermore, this routine provides an eco-friendly fertilizer for agriculture, replacing the chemically infused fertilizers which eventually contaminate the ground water supplies. Anaerobic digestion, on the other hand, is very much suitable for intended generation of methane which is combusted for production of fuels. However, this technique is costly and can be afforded by selective managing authorities only. Overall, recovery with composting process is a better alternative than disposing the organic waste in the landfill.

The second least preferred routine is incineration of *"the very high amounts of packaging materials, paper, cardboard, plastics and horticultural waste* (The World Bank, (2012)*"* for the generation of energy. It is preferred to direct landfilling. Nevertheless, only energy recovery incineration is suitable and not an open burning as this routine emits harmful pollutants in the air which is harmful for both humans and the environment. The estimated global emission of CO2 is 1.4 trillion kg/year, CH4 is 3.6 billion kg/year and CO is 37 billion kg/year due to open burning (Cogut ,2016). As per World Bank (2012), it reduces volume of waste being disposed by 90 percent.

At the most least preferred end is uncontrolled dumping in the landfill. It is the most common form of waste disposal and is a vital part of integrated solid waste management. This routine is the final management option which has to be operated in the most environmentally suitable manner. If operated sensibly, the methane gas released from the anaerobic breakdown from landfills can be recovered as energy. However, the level of methane released from the landfill varies by country, depending upon the waste management practices, climatic conditions and composition of the waste. In 2010, of the entire municipal waste sector, landfills were responsible for emitting almost half of the methane and the MSW accounts for 5 percent of the total GHG emissions (The World Bank, (2012) which are of great concern at present. Nevertheless, the ultimate benefit of the waste management hierarchy is the minimization of the GHG which is a pivotal factor pushing the climate change ahead at a very concerned rate. Due to increased methane recovery from the landfills, the rate of GHG emissions from waste sector has decreased from 69 mtCO2 e per year in 1990 to 32 million tCO2 e per year by 2007 (ISWA ,2009).

2.2. Waste Generation, Composition and Management by Global Regions:

As the study of Geography, it is only a matter of time to bring about space into consideration for the analysis of the waste system. Regional variation plays a very important role in the composition of waste, waste generation and the practices that are applied in the management of the waste streams. As a matter of fact, the world is divided into the following seven regions based on the administrative purposes by the World Bank:

- Organization for Economic Co-operation and Development (OECD).
- East Asia and Pacific (EAP).
- Eastern and Central Asia (ECA).
- Latin America and the Caribbean (LAC)
- Middle East and North Africa (MENA).
- Africa (AFR).
- South-Asia (SAR).

2.2.1. Waste Generation by Global Regions:

Out of all the countries around the globe, only 161 countries have provided the data for the analysis of the Municipal Solid Waste (MSW) generation. Annexure – I shows that the total urban population of all the seven regions is 2,982 million from the total population of all these regions.

East Asia Pacific have the most urban population from China and the least urban population is in Middle East and North Africa. The total MSW generation from the entire region accounts 3.5 million tonnes per day. Despite EAP having the highest total urban population, the largest contributor to the total MSW generation is Organization for Economic Co-operation and Development. OECD alone generates 1.5 million tonnes of MSW per day.

Organization for Economic Co-operation and Development generates almost half of the total MSW per day i.e., 44 percent. This is mainly because the countries of OECD region have high income level and have reached the maximum development and technological advancement. Annexure – II shows that the MSW generation ranges between 1.10 kg/capita/day and 3.68 kg/capita/day.

Africa generates second least MSW with 0.65 kg/capita/day as an average making up only 5 percent share in the total MSW generation of the entire regions. The reason for the low waste generation rate is specifically due to the majority of the countries of AFR being a low income and low middle income economies. However, Annexure – II highlights that there is a wide span of range from 0.3kg/capita/day to 2.98 kg/capita/day. Seychelles shares the largest contribution of MSW generation mainly because the islands of this country are famously run by tourism industries.

The East Asia and Pacific 21 percent of the total MSW generation and has an average urban MSW generation of 0.95 kg/capita/day. The per capita generation ranges from 0.44 kg/capita/day to 4.29 kg/capita/day. Being an economic hub, China has the highest urban population with more than 73 percent of total MSW contribution within the region. On the contrary, the daily average MSW generation is not the highest here as it

is lower middle income countries which reflect that the composition of waste is mainly organic in nature.

Middle East and North Africa includes high income economies and middle income economies, respectively. Annexure- II shows that Iran has the lowest daily per capita MSW generation at 0.16 even with the highest urban population contribution and the highest daily per capita MSW generation is by Kuwait at 5.72 kg/capita/day. The average regional urban MSW generation is 1.07 kg/capita/day which contribute the overall waste generation of 5 percent.

Latin America and Caribbean shows the widest span of range of MSW generation from 0.11 kg/capita/day to 14.39 kg/capita/day in Annexure - II. This is due to the fact that Trinidad and Tobago is a high income economy and the generation of waste is proportional to per capita income. However, the regional average MSW generation is 1.09 kg/capita/day bagging its way to the top three distributors of total MSW generation in the world with 12 percent share.

Eastern and Central Asia generates 1.12 kg/capita/day on an average. The countries falling in this region have upper middle income level in majority, high income level and lower middle income level. Annexure – II accounts for the highest MSW generation at 2.09 kg/capita/day and the lowest at 0.29 kg/capita/day. Cyprus is the highest daily MSW generator simply because it is a high income economy.

The least of the regional generator is South Asia at only 0.45kg/capita/day. Here, the countries are mainly in low income level and lower middle income level. The MSW generation rate ranges from 0.12 kg/capita/day in Nepal to 5.10 kg/capita/day in Sri Lanka. Even in the developing countries like Sri Lanka the per day generation rate is very high because of the intensive tourism industries whereas in low income level

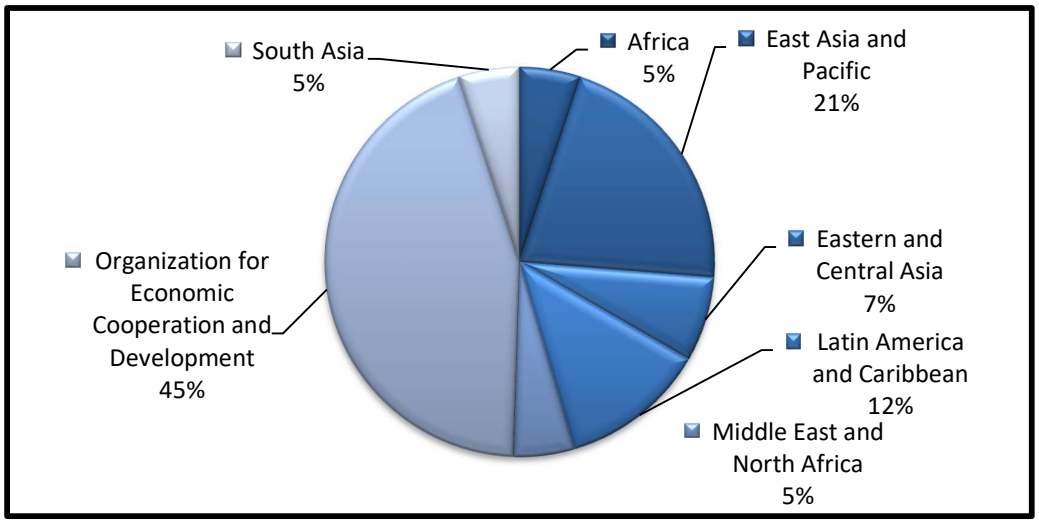
countries like Nepal the waste generated is mainly organic composition. Nevertheless, SAR shares 6 percent of the total regional MSW generation and India alone contributes 57 percent of the total MSW generation within this region due to very rapid expansion of urbanization within the country.

Table No. 2.1. Generation of MSW by global regions:

Region	Number of countries included	Total Urban Pop. in millions	Urban MSW Generation (kg/capita/day)	Total MSW Generation (tonnes/day)	Total MSW Generation (in %)
AFR	42	261	0.65	1,69,120	5
EAP	17	777	0.95	7,38,959	21
ECA	19	227	1.12	2,54,389	7
LAC	33	400	1.09	4,37,545	12
MENA	16	162	1.07	1,73,545	5
OECD	27	729	2.15	15,66,286	44
SAR	7	426	0.45	1,92,411	5
Total	161	2982	7.48	35,32,255	100

*Source:*The World Bank (2012)

Fig.2.2. Percentage of Generation of MSW by Global Regions



Source: The World Bank (2012)

2.2.2. Waste Composition by Global Regions:

Waste composition refers to the ingredient nature of the total volume of waste. Basically, it is organic (easily succumbed by environment) and inorganic (too complex

for the environment to breakdown) in nature. Additionally, the composition of waste generated is influenced by various factors like geographical location, climate, cultural practices, economic advancement, energy sources and the standard of living. As there is a development in an economy, the urbanization grows eventually with an increase in the per capita income of the country. Due to this, there is usually a shift in the consumption pattern towards the inorganic and globalised products. Table 2.1 shows the various compositions of waste streams as provided by the World Bank (2012). Here, the composition of the waste is solely based on the household waste that is considered sufficient for MSW analysis. The waste composition has been divided into organic, paper, plastic, glass, metal and others which includes textiles, rubbers, ashes, dirt, household e-waste and multi-packaging such as tetra packs.

Table No. 2.2. Composition of Waste by Global Regions:

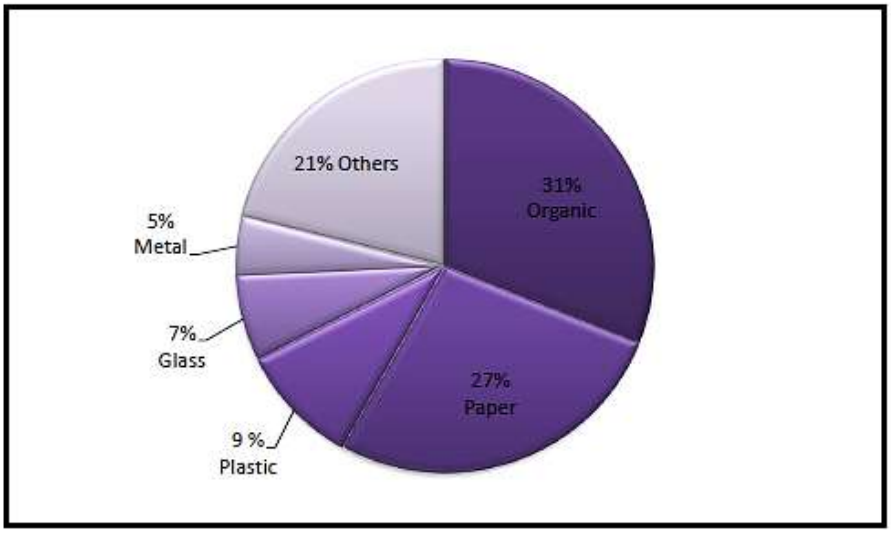
Region	Organic (%)	Paper (%)	Plastic(%)	Glass(%)	Metal(%)	Other(%)
OECD	31	27	9	7	5	21
LAC	47	18	13	4	4	13
EAP	49	13	12	5	7	14
ECA	38	19	8	7	5	23
MENA	60	15	10	3	3	9
AFR	54	7	6	2	2	23
SAR	65	8	8	2	1	17

Source: The World Bank (2012)

Table No.2.2 highlights that Organization for Economic and Cooperative Development produces the MSW with the organic composition in the least amount of 31 percent and highest amount of paper composition of 27 percent among all the other regions. This is because all the countries are high income level economy and there is a consumption preference of more packaged goods and inorganic materials. Annexure – III provides a detailed account where Germany has shown the lowest composition of organic matter within this region at only 14 percent, whereas holding the highest composition of plastic

waste at 22 percent. The highest organic composition of waste of 56 percent is contributed by New Zealand. Countries like Sweden, Denmark and Luxemburg account for not more than 2 percent of plastic composition in the waste stream. Majorly, this is due to the successful practice of Zero Waste Management. (Annexure - III)

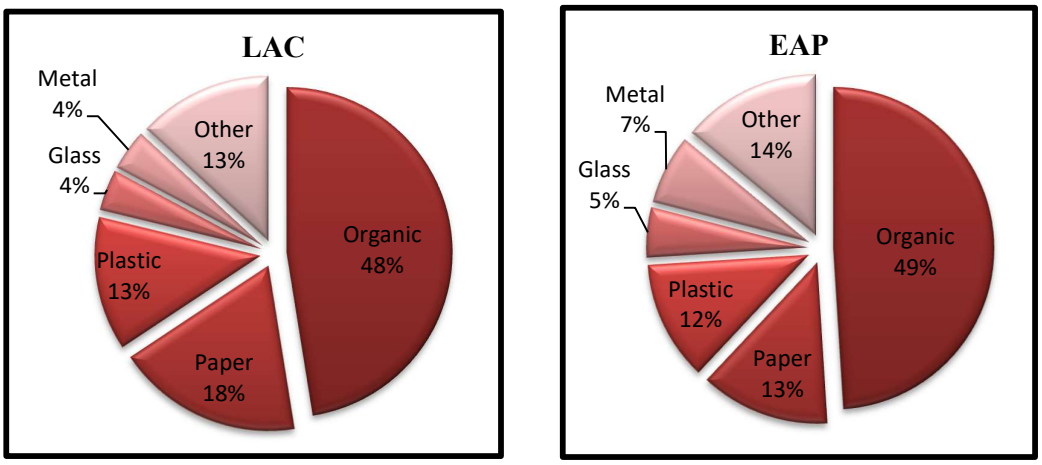
Fig.2.3. Percentage of Waste Composition of OECD



Source: The World Bank (2012)

Latin America and Caribbean includes countries that have middle income level with the exception of only one high income level i.e., Trinidad and Tobago. It is because of this, Trinidad and Tobago has the least organic composition share of 14 percent and highest paper and plastic composition of 32 percent and 24 percent respectively. Furthermore, the metal composition share within this region is also highest at 16 percent by Trinidad and Tobago. Countries like Belize, Jamaica and Peru have the top three organic compositions in their waste stream at 60 percent, 57 percent and 55 percent, respectively. Peru is the least contributor of plastic composition waste at 4 percent within LAC. (Annexure - III)

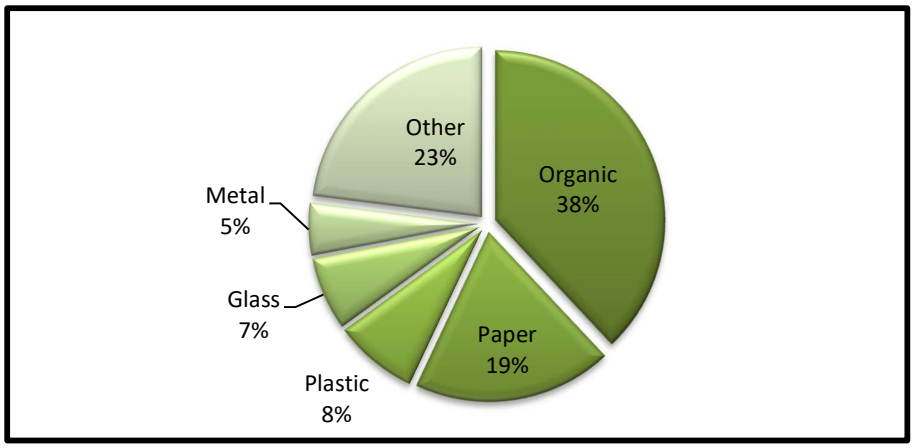
Fig. 2.4. Percentage of Waste Composition of LAC and EAP



Source: The World Bank (2012)

Annexure – III shows East Asia and Pacific (EAP) has the highest percentage of contribution in the global metal composition of MSW at 7 percent. Macao, China has the least percent of organic composition in the MSW of 4 percent and highest plastic composition of 24 percent within EAP. It is because Macao is one of the high income level economies where tourism is the backbone of the country. Vanuatu, a nation of many islands contributes the highest organic composition of MSW within the region at more than 70 percent. The main reason lies in the fact that this innumerous islands nation is a developing country with lower middle income.

Fig. 2.5. Percentage of Waste Composition of ECA

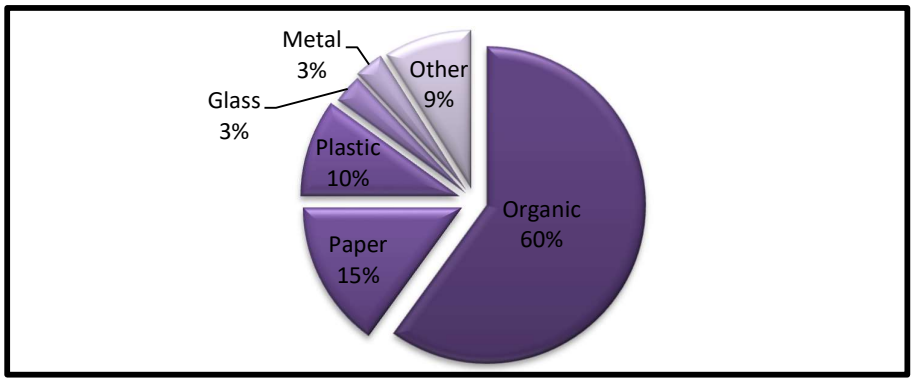


Source: The World Bank (2012)

Table No.2.2 illustrates that Eastern and Central Asia has the highest share of glass at 7 percent and the second highest contribution of paper at 19 percent in comparison to other regions' composition of the MSW. High income countries like Croatia and Cyprus and upper middle income countries like Belarus, Turkey and Serbia have higher share of plastic and paper composition.

Middle East and North Africa has 60 percent organic composition in its waste stream. Majority of the countries like Syria, Morocco, Jordan, Iran and Egypt, Tunisia and West Bank and Gaza are lower middle income countries and each puts up huge share of organic waste in the MSW stream. On the contrary, Israel is the only high income country whose waste composition accounts the least of organic matter of 40 percent and highest paper composition – 25 percent among the other countries.

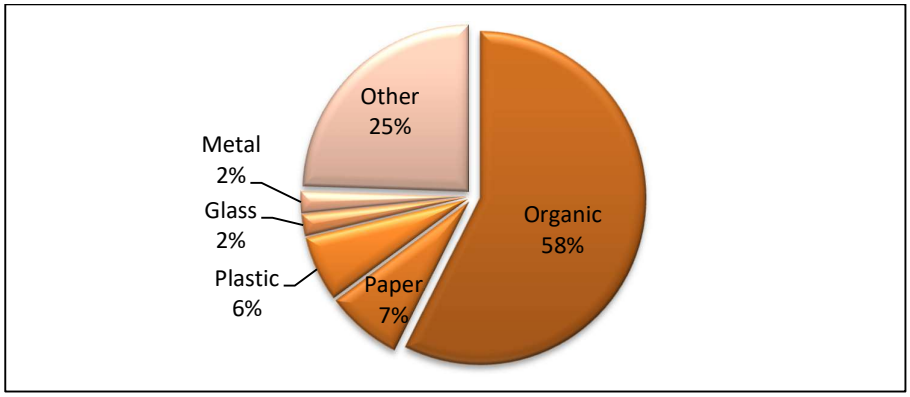
Fig. 2.6. Percentage of Waste Composition of MENA



Source: The World Bank (2012)

Africa have countries of low income level. Ethiopia has the highest organic composition of 88 percent in its waste stream. However, Zimbabwe has high plastic and paper composition in its MSW as compared to other countries at 20 percent and 21 percent, each. Overall, the glass composition and metal composition in Africa region is 2 percent each. The organic composition of waste stands at 54 percent in this region.

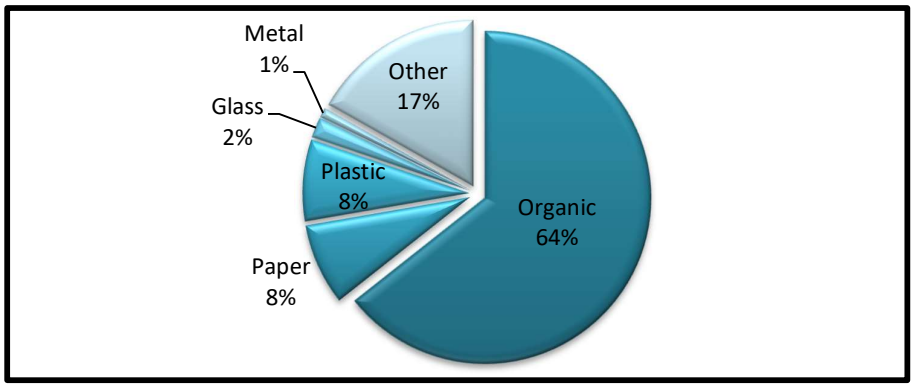
Fig.2.7. Percentage of Waste Composition of AFR



Source: The World Bank (2012)

South Asia have the highest composition of organic components in its waste. Nepal has 80 percent of its waste in organic matter and India has only 35 percent of its waste in organic materials. However, Annexure – III suggests that the majority of percentage of waste in India is of other composition at 59 percent. This is mainly because the majority of population in India uses coal and woods for domestic chores as well as for the heating purposes which leaves behind the ash as the other residue. Another reason for this is that there has been an expanding preference of packaged junk foods in the majority of urban population which not only increases the per capita waste but also makes the waste stream more complex because of the multi-packaging composition. Thus, it ends up in the others category.

Fig.2.8. Percentage of Waste Composition of SAR



Source: The World Bank (2012)

2.2.3. Waste Collection and Disposal by Global Regions:

The collection of the waste is done by different ways like door to door collection where the service providers visit the households and collects the waste, curbside collection where the households leaves the waste by the roadside at the allotted time of waste truck, community bins where public bins are provided for the community for temporary disposal of the household waste and in some case, self delivered by the waste generators. The waste collection department has the highest budget allotment among the waste management system. However, out of the total waste management budget, waste collection alone takes up around 80 percent to 90 percent in the developing countries whereas it takes less than 10 percent in the developed countries (The World Bank, (2012). Nevertheless, the frequency and efficiency of collection facilities is still lower in the developing regions as compared to the developed regions around the world. The highest rate of collection is found in the high-income countries of OECD at 98 percent and the lowest collection is at 46 percent in the countries of Africa region. Annexure – III shows that most of the countries in OECD have 100 percent of collection rate. The only country who has the lowest collection rate at 76 percent is Ireland. This is basically due to the 'public attitudes and politics of a place in the waste management strategies'; there is a 'cultural waste-wars' between the public and authority where the previously colonized people in Ireland do not follow the rules as a symbol of resistance against the authority (Davies, 2003). In Africa, the lowest collection rate is at 20 percent in Comoros, this is mainly because it is one of the least developed countries around the world whose 80 percent working population is dependent upon primary activity. Being an insufficient country, it majorly imports basic food products, especially rice which is the staple food of the country (UNEP, 2007). Since majority of its budget goes in such

basic needs, waste management is unsurprisingly, a luxury for them. Hence, there is little to no collection in the country.

The disposal of waste is the ultimate part of the waste management which signifies how the region or country will contribute to the environment. Unfortunately, as there is a vast variation in various variables among, and even, within the regions, the distribution of disposal of waste is no different than the generation and composition of waste. Therefore, it is procured that the waste disposal methods in majority of developing and under-developed countries practice the least favourable methods of the waste hierarchy. The high-income countries sort to recycling and incineration, 129 million tonnes and 122 million, respectively (The World Bank, (2012). The advanced countries have proper treatment and disposal system of waste. OECD produces hundred times the waste than AFR though the population is almost the same between these two regions. However, it is to be noted that 60 percent of this waste stream is 'diverted from landfills' in OECD (The World Bank, (2012). On the contrary, the disparities between the developed countries and developing countries are felt severely in the waste economy. The trade of e-waste and plastics from the Global North to Global South is one of the methods incorporated by the high income countries to dispose the rapidly increasing waste in their countries.

It is procured that only 20 percent of the global waste from electrical and electronic equipments (WEEE) collected and treated is accounted (Baldé, et al. ,2017), the majority of which is produced by the developed countries. It is perceived from Annexure – II that Canada produces 13 percent of metal waste followed by United States of America with 8 percent. There is an outsourcing of the e-waste collected from EU to the Global South by the recycling companies as charity donations but charge collection fees for the responsibilities of recycling and treatment (Krikke ,2008) and

often mislabels the shipment of hazardous waste to African countries like Kenya, Ghana and Nigeria illegally (Oswald and Reller ,2011). Since these wastes imported in African countries are 'broken, unrepairable or cannot be reused' (Cotta ,2020) to great amount, they either disposed it in the landfill without proper treatment or open-burning is used to get rid of it which is unsafe for both the unskilled labours in these countries and the environment. Despite the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal enforced by the Global North to help the Global South in 1989, the effort is not efficiently working.

The trade of plastic from United Kingdom to China is another case of disposal tactics used with the help of an economical trade between two regions. Currently there are strategies like 'extended producer responsibility' to control and prevent the pollution caused by the generation of wastes like plastics. However, the generation of plastic waste is rooted in the system which is efficiently marketed with the help of circular economy by big companies. The permanent ban on import of plastic waste in China in 2018 has tried to break the salient disposal mechanism of Global North to the Global South. However, now it has been shifted to different South-East Asian countries, particularly, Indonesia and Malaysia (Cotta ,2020).

Globally, United States is the second largest exporter of plastic scrap (Cotta ,2020). Majority of the plastic generated are shipped to countries having high mismanaged waste. China is the leading country who imports the plastic waste from the high income region including United States. Until 2018, China imported 12.3 million metric tonnes (Mt) of plastic waste from United States followed by 0.9 million metric tonnes by India, Vietnam imported 0.4 Mt, 0.4 Mt by Indonesia, 0.5 Mt by Malaysia and Thailand imported 0.2 Mt (Dell ,2019). The reflection of which can be observed in Table No. 2.5 where Macao, China have a plastic composition of 25 percent followed by Hong Kong

with 19 percent and even Vietnam have 16 percent of plastic composition in the waste stream. Irrespective of the plastic waste exported from the Global North to the ill-equipped low income countries, the international multi-national companies blame five Asian countries, namely, China, Indonesia, Philippines, Thailand and Vietnam for 'over half of land-based plastic-waste leakage' in ocean pollution (Merkl and Stuchtey ,2015).

The export of plastic as recyclables to Asian countries is contributed from many other countries like Japan, New Zealand, European Union and Australia apart from United Kingdom and United States. Australia in particular exports 60 percent of the plastic waste collected as 'recyclables' to Vietnam. However, 'more than half of the plastic imported into the country is sold to "craft villages", where it is processed informally, mainly at a household scale (Retamal, et al. ,2019)' where majority of the imports is manually handled and the residue is eventually burned or disposed in the ocean. Apart from the trading of waste as recyclables, the big developed countries dispose the waste illegally. Since the waste quantification is usually abstracted, the exact figures are unaccounted yet it is illustrated in existing studies. The United States Geological Survey has identified large scale military dumping of radioactive and chemical weapons in the coastline and international waters. All of these are unrecorded and unmonitored (A. R. Davies ,2011). Likewise, an incident of Koko, Nigeria of 1988 illustrates how an Italian firm illegally dumped '8000 leaking barrels of chemical waste' in the backyard of a farmer who was told that the barrels contained fertilizers. Many of the barrels were stolen by the neighbourhood residents for storing water which later accounted for their death due to consumption of toxic polychlorinated biphenyl. Similar incident of Guinea, West Africa where a Norwegian firm dumped toxic ash labelling it as 'raw materials' (Clapp ,1994) also illustrates the disposal tactics used by the OECD countries

towards the economically deprived regions. However, Bamako Convention of 1991 in Africa have bridged the scope of regional imbalance by widening the scope of application of the Basel Convention though its own application is very limited (Pratt ,2011).

The systematic trade of obsolete ships from the Global North to South-Asia is one of the most discreet disposal mechanisms in the world. Earlier, the ship-breaking and recycling activity was based in industrialized OECD countries like United Kingdom, United States, Germany and Italy only (Hossain and Islam ,2006). However, due to increased environmental and safety regulations and labour cost, a result of *"economic modernization"* (Frey ,2013) , there has been shift of ship-breaking industry to countries in SAR. Starting from early 1980's till date, the ship-breaking and recycling in Alang, Gulf of Khambhat, India and Chittagong, Bangladesh have grown into the largest and second-largest ship-breaking hotspots, respectively where steel and scraps are extracted for rematerialisation. This trade is one peculiar asymmetric core-periphery relation where the regional imbalance is strongly felt. Occupational and environmental health (OEH) risks are very significant in the developing nations where the lack of safety equipments and risk management training, manual labour of 12 working hours with no overtime leave and low wage rate is pervasive. On international level, the International Maritime Organization, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), the Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matters and the International Chamber of Shipping Industry Code of Practice on Ship Recycling have some instrumental guidelines for pre-checking the ships at the owner nation for safety measures in the destination location. Nevertheless, only European

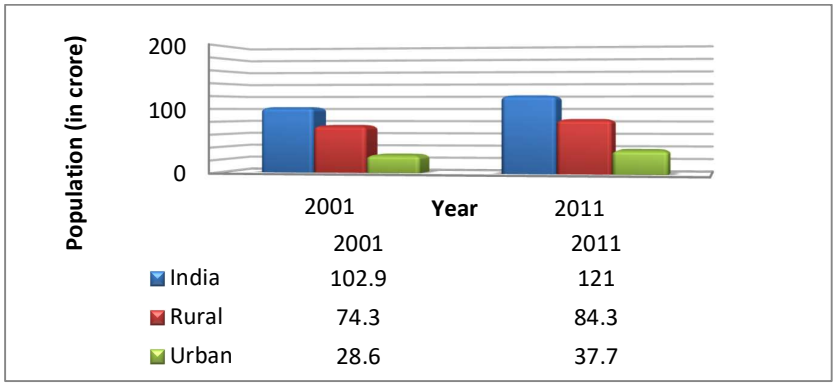
Union is the only signatory among the major shipping powers globally (Rousmaniere and Raj ,2007).

Given the disposal mechanism of waste across the globe, an overtone of space and time is strongly felt which the quantification of waste fails to overview as resource recovery and recycling activities are 'corporeally vulnerable' (Gregson ,2011). The regional disparities bring forth the politics of environment and social injustice which Global South faces with the trade of hazardous waste trade. These wastes are often socially and culturally embodied. For instance, the ship-breaking industry and plastic-recycling industry attracts only the low income and underprivileged population in the countries of South Asia. The consumers of this waste trade, like in Vietnam, are either primarily household based population or, like in India, are migrant labours that are ready to work irrespective of any working condition due to rampant unemployment, who are entangled in the macro-scaled global waste mobility though micro-scaled and locally active. The manifestation of world system processes is strongly felt in this displacement of hazardous waste to the peripheral countries (Frey ,2013) where "unethical behaviour" (Cotta ,2020) of Global North not only burdens the Global South with their responsibilities of waste recovery but also with "spatial injustice" (Gregson ,2011). It is thus, perceivable that waste does not flow. Rather, waste is "pushed, carted, trucked and shipped wherever it is ultimately buried or burned" (Lindner and Meissner ,2016). Henceforth, waste though seen as a resource overshadowed with the connotation of circular economy of globalization is ultimately a major problem because the majority of the waste stream traded end up with individually, locally, socially and environmentally unsuitable management practices.

2.3. Scenario of Solid Waste Management in India:

India is one of the developing countries and the waste management here remains a humongous challenge with the developing standard of living and growing urban population which at present remains 31.6 percent of the total population in 2011 (MoHUA ,2011). The urban population grew from 28.6 crores in 2001 to 37.7 crores in 2011 (Census of India, 2011). It is also observed for the first time since independence in India that the absolute increase in population is more in urban areas than in the rural areas. With 1.02 billion populations, India is the second most populous country after China. This growing rate of population in urban areas is one of the direct factors influencing the generation of the municipal solid waste in India.

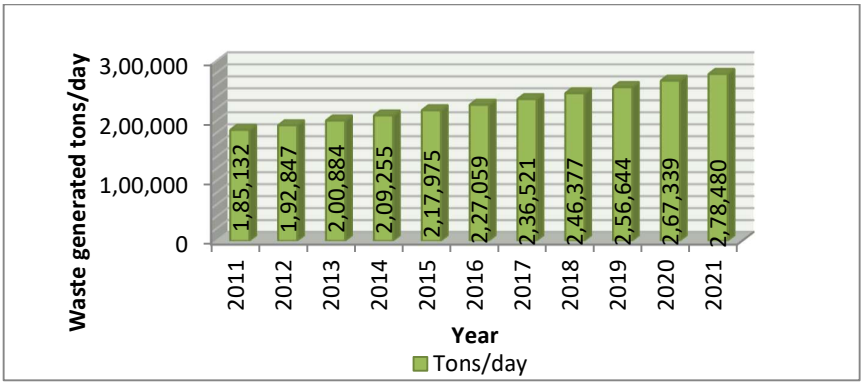
Fig. No. 2.9. Distribution of rural-urban population in India



Source: (Census of India, 2011)

Due to these rapidly industrializing and urbanizing factors, the generation of waste in India has steepened to 145,133 tonne/day where 48 percent of segregation have been achieved with 82 percent of door-to-door collection and 37.23 percent of waste processing (MoHUA ,2018-2019). At present, the composition of municipal solid waste consists of 50 percent compostable, 17 percent recyclables and 33 percent of inert wastes (CPCB ,2005). However, the quantity and quality of waste generation varies from place to place for various reasons.

Fig. No. 2.10. Cumulative estimation of generation of MSW in entire urban India



Source: (Annepu ,2012)

2.3.1. Policies, Rules and Schemes of Solid Waste Management

The Environmental Protection Act, enacted in 1986 aims in protecting the environment and development of the waste management system; it follows the 'Polluter Pays Principle' where a person/firm, if found guilty of harming the environment in contrary to the obliged duty of alleviating and minimizing the pollution, will be held responsible and served the needful punishment by the law (UN ,1972). Fining an umbrella in this Act, in India, various Ministries are now responsible for implementing and monitoring the policies, rules and schemes for the management of waste. (Table No.2.3)

The management of solid waste in India is guided by the following rules at present:

- Solid Waste Management Rules,2016
- Plastic Waste Management Rules,2011
- E-Waste Management Rules,2011
- Bio-Medical Waste Management Rule, 1998
- Hazardous Waste Management Rules, 1989

Table No. 2.3. Various roles of Ministries in Solid Waste Management

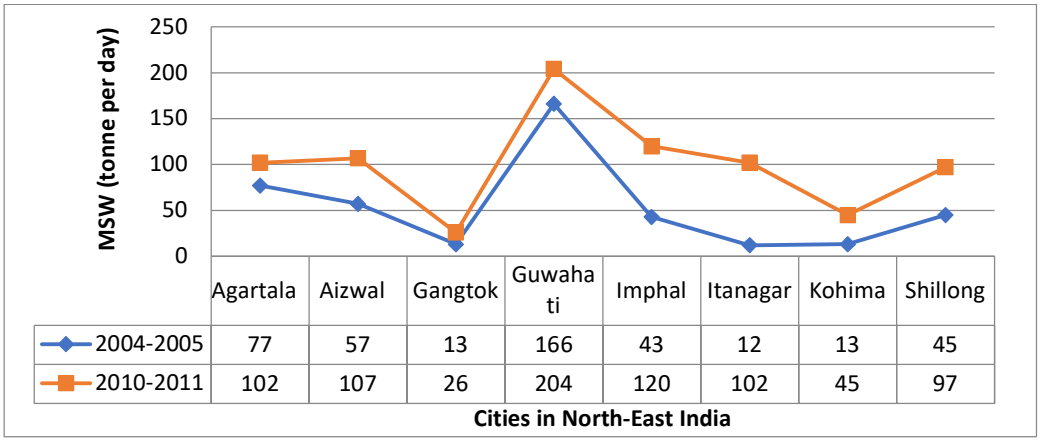
Ministry	Role
Ministry of Environment, Forest and Climate Change	i) Overall implementation and monitoring the management.
Ministry of Housing and Urban Affairs	i) To formulate National Policy/Strategies for waste management. ii) To facilitate, promote, provide technical and financial assistance to state/ULBs and stakeholders with research, training and development of efficient waste management. iii) To have a yearly review of the project execution on solid waste management.
Department of Fertilizers, Ministry of Chemical and Fertilizers	i) To provide assistance in co-marketing the compost generated.
Ministry of Agricultura & Farmers Welfare	i) To promote the use of composts in farm lands and set up testing labs for quality check with local authorities.
Department of Power	i) To provide technical and infrastructural assistance in plant set-up and provide subsidies for such plants to state/ULBs. ii) To allot tariffs on the energy generated from the waste. iii) To promote the use of energy generated from the waste plant.

Of the various schemes, Swachh Bharat Mission (SBM) and Jawaharlal Nehru National Urban Renewal Mission (JnNURM) are the biggest contribution in developing the urban areas and efficiently driving a cleanliness mechanism in India. JnNURM launched in 2005 is an urban city development mission for seven years which SBM, initiated in October 2nd, 2014 to make the country open-defecation free by 2019 also ensures door-to-door collection of solid waste and create awareness among the citizens with public participation. These schemes and rules have assisted the states to run a systematic waste management and the same has been resulted in various cities in India.

2.3.2. Solid Waste Management - India in Regions:

Along with NEERI, Central Pollution Control Board (CPCB) has conducted survey in 59 cities for solid waste management; all of which have been categorized into various regions for exploring the regional variation in waste study.

Fig. No. 2.11. Generation of MSW in North-East India



Source: CPCB (2004-2005, 2010-2011)

Figure No. 2.11 shows that among all the north-eastern cities surveyed, Guwahati produces the highest amount of municipal solid waste and the least generation is in Gangtok as of 2011. In Guwahati, the bigger corporative units like Indian Oil, Guwahati refinery and other corporation have their own waste treatment system. Despite this, Guwahati has the per capita waste generation of 606 gm/day. West Boragaon being the only disposal ground in the city, it is not efficient for the generated municipal solid waste. Furthermore, the open dumping in the roadside and drainage system is rampant here (Gogoi ,2013).

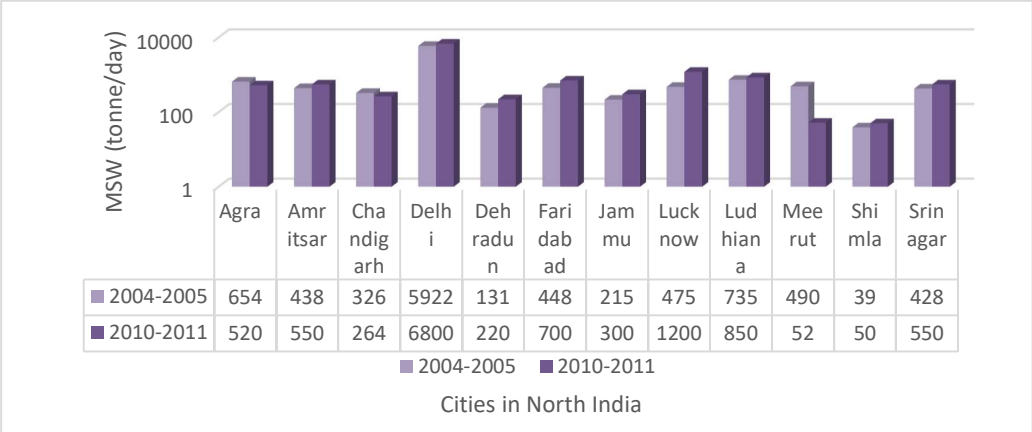
Itanagar in 2004-2005 generated the least of all these cities. However, by 2011, the generation increased by almost tenfold. This is mainly because of the pull factor of the capital city where the population growth is rampant and the commonly practiced waste disposal is haphazard dumping and the lack of segregation procedures and the lack of

scientific engineering of the landfills. Imphal today contributes second highest in the waste generation in this region at 15 percent where the disposal practice is done haphazardly in the low-lying ground at Lamphelpat. Although Aizwal produces 13 percent of the waste in this region, the management system has taken a lead in tackling the waste here. The authorities have initiated pilot projects in various localities with an investment of 15 lakhs for waste facility's construction and infrastructure. There is also proper waste segregation with an initiative of systematic segregation training of the rag-pickers (Centre of Science and Environment, 2016). Shillong alone supports 82 percent of the total population within an area of 14 percent of the total geographical area. Hence, the waste generation is very high. However, proper waste management lacks behind; only 45.91 percent (78.42 MT) of the waste is collected and disposed in the 5 acre Marten sanitary landfill which is not huge enough for the Greater Shillong Planning Area. (B.S.Mipun, et al. 2015) The overall scenario of north-east India remains not very suitable for the waste management where less than 70 percent of the waste is collected and less than 20 percent is processed and recycled (Centre of Science and Environment, 2016).

Figure No. 2.12 shows the waste generation in the northern part of India. Here lays the highest waste generating capital city, Delhi with 6800 tonne/day. However, as per the annual report of 2018-2019, Delhi produces 10817 TPD out of which 10614 TPD waste is collected, 5714 TPD waste is treated and 5225 TPD waste is landfilled. The municipal corporation is primarily managing and disposing almost all its Solid Wastes in the facility at Okhla dumpsite where waste to energy plant, compost plant and dumpsite exists. Delhi has 3 Waste to Energy Plants of 5250 TPD capacity at Okhla, Ghazipur and Bawana for generating 52 MW electricity. (CPCB ,2018-2019) The disposal is done in four landfills at Bhalswa, Okhla, Gazipur and Narela/Bawana. Three

of these landfills are almost saturated. Lucknow, the capital of Uttar Pradesh produces second highest amount of waste in north India and produces 1200 tonne/day. Every year, Lucknow Municipal Corporation spends 21 percent of its total budget on waste management (Francis, Singh and Prakash ,2013). As per 2011 Census, Lucknow has 4.5 million population and about quarter of them live in slums. In 2019, the waste generation is 1500 tonne/day, out of which 60-65 percent is collected and disposed in six landfill sites (Archana, et al. ,2014).

Fig. No. 2.12. Generation of MSW in North India

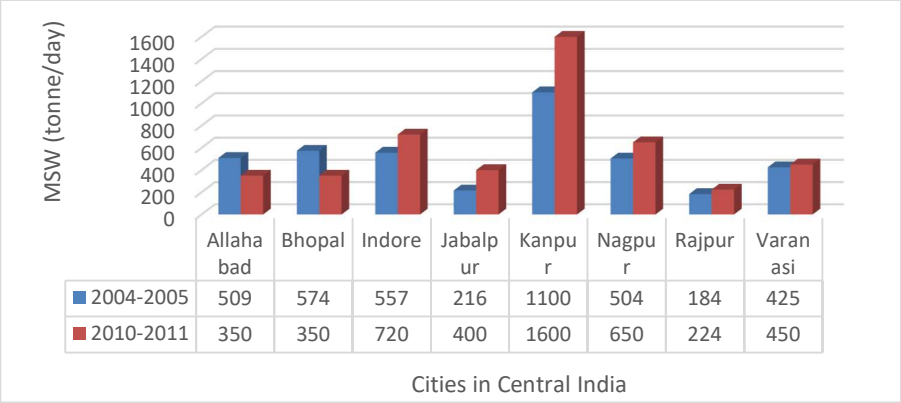


Source: CPCB (2004-2005, 2010-2011)

It is observed that Shimla produces the least amount of waste among the cities in North India at 50 tonne/day in 2011. Located in a hilly terrain, the waste management is a very promising story for the cities alike Shimla. With the Himachal Pradesh Municipal Corporation Act, 1994, Door-to-Door Garbage Collection Bye-laws has been enacted since 2006. The health department of Shimla ensures the transportation of collected waste which covers 86 percent of the households with door-to-door service. The processing and treatment and disposal facility are ensured by Shimla Environment, Heritage Conservation and Beautification (SEHB) on partnership with Hanjer Biotech Energies Pvt. Ltd. The hazardous waste from hospitals and clinic is also incinerated

within bio-medical incinerator facility. Proper presorting contributes to the success which is then supported by the diversion of waste from being landfilled by in-vessel composting. (Bharti, et al. ,2014)

Fig. No. 2.13. Generation of MSW in Central India

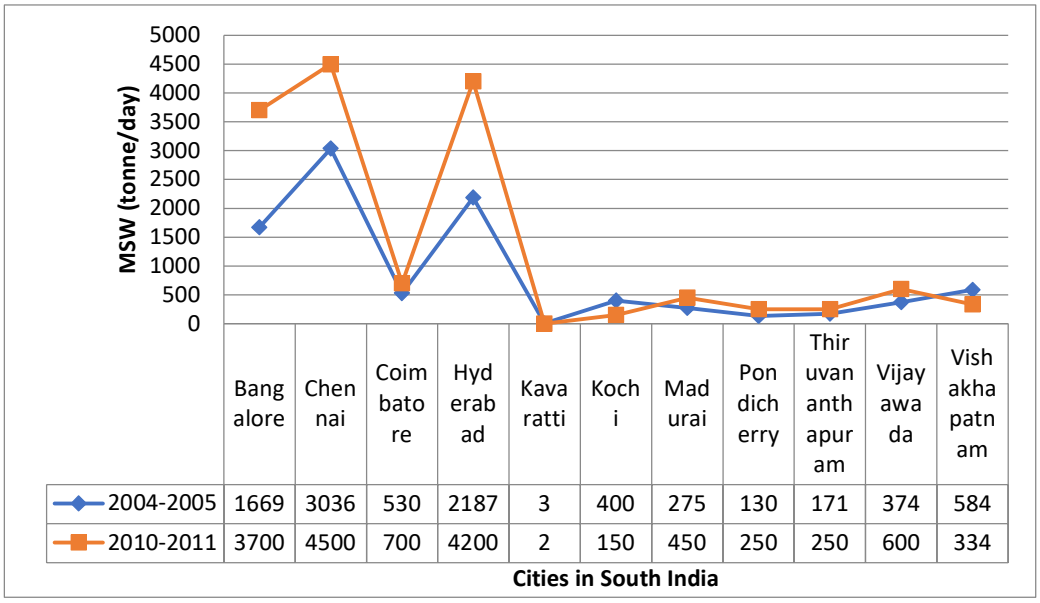


Source: CPCB (2004-2005, 2010-2011)

Figure 2.13 shows that among the cities in central India, Kanpur has the highest waste generation of 1600 tonne/day and the least is in Rajpur at 224 tonne/day in 2011. In Kanpur, the waste management is done by Kanpur Municipal Corporation in partnership with A2Z Infrastructure Ltd., Gurgaon since 2012. Today, this project of 30 years has shown a tremendous success in tackling the generated waste. The collection has 90 percent efficiency in the city with 50 percent increase in door-to-door collection. Recycling and reusing have increased to 85 percent and the rag-pickers have now formal job. Another highlight of the waste treatment here is there is the conversion of collected waste into 40 percent of refused derived fuel (RDF). There is use of GPRS enabled devices and GPS system for collection of user charge and monitoring the vehicles halting in each of the public bins mapped and tabulated by the service providers. (SBM ,2018) As for the waste quantification of Allahabad and Bhopal, it is mainly acquired from the number of trips a vehicle makes to transport the waste or from the fuel consumption. Thus, there is a decline in the waste quantification from 2004-

2005 to 2010-2011. Such misleading quantum of waste is found all over India, mainly because of the lack of better records of waste with the local bodies due to statistical and resource limitations (Dasgupta ,2013).

Fig. No. 2.14. Generation of MSW in South India



	Bangalore	Chennai	Coimbatore	Hyderabad	Kavaratti	Kochi	Madurai	Pondicherry	Thiruvananthapuram	Vijayawada	Vishakhapatnam
2004-2005	1669	3036	530	2187	3	400	275	130	171	374	584
2010-2011	3700	4500	700	4200	2	150	450	250	250	600	334

Source: CPCB (2004-2005, 2010-2011)

The waste management in South India has better success stories in India even when the generation is high in quantum. Chennai shares the highest waste generation among the South Indian region at 4500 tonne/day, followed by Hyderabad at 4200 tonne/day and Bangalore at 3700 tonne/day. The lowest share of waste generation is from the capital of Lakshadweep, Karavatti at 2 percent. This is because the population is only 11,221 as per Census of India, 2011. Kochi follows second least rank at 150 tonne/day and Thiruvananthapuram at 250 tonne/day. One of the most important features of Kochi is the segregation of waste at source and composting and bio-methanization practices at household level. Facilities of aerobic bins, biogas plants, organic waste converters and portable bio bins in public places like markets and outside building compartments and housing colonies have major contribution to that. While door to door collection is done

by Kudumbasree workers from households and then disposed at the waste treatment plant at Brahmapuram which have a capacity of 220 tonnes/day (Chedambath n.d.).

Thiruvananthapuram is another city who has popularized minimization of waste by decentralization of waste management. This includes introduction of the following infrastructure given in Table No. 2.4. Followed by the shutdown of only one dumpsite at Vilappilsala, Kerala Suchitwa Mission which was initiated long before the crisis in 2008 enforced the decentralized waste management since 2013. Freedom of Waste Campaign of 2017 and Green Protocol further banned not only single use plastic bags but also non-woven polypropylene bags. Today, Clean Kerala Company operates the resource recovery centre in partnership with TMC where plastic refuse and electronic waste are processed (Ramachandran ,2019). Furthermore, the Anti-Littering enforcement Team (ALERT) makes sure that there is no littering of water bodies or public spaces with constant patrolling. These have led to 83 percent of total waste to be compostable (Henam and Sambyal ,2019).

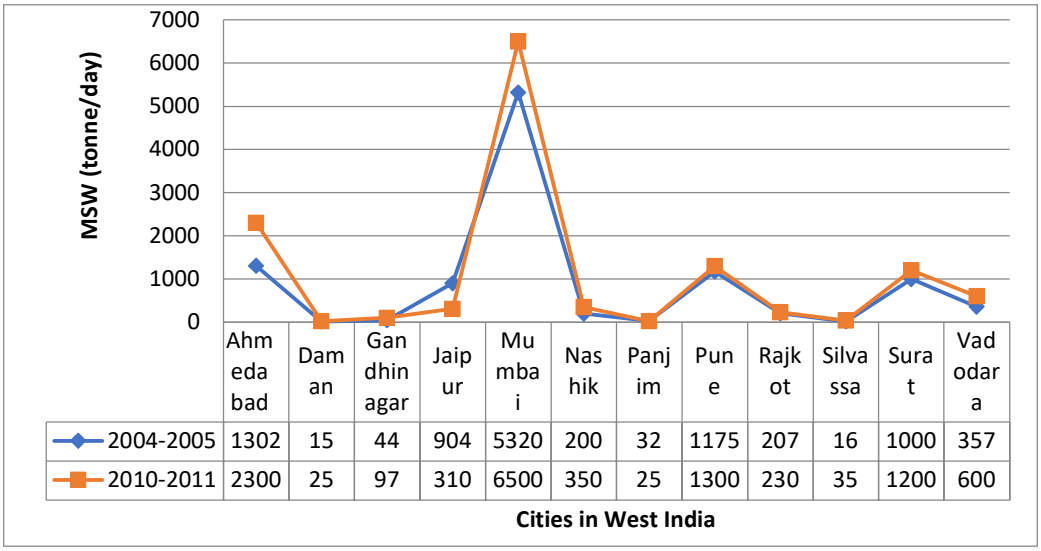
Table No. 2.4. Decentralized Waste Management Facilities in TMC

Infrastructure	Units	Capacity(TPD)	Utilization(TPD)
Kitchen Bins	19000	19	80%
Bio Bins	109	2.72	60%
Biogas Plants	3982	3.98	60%
Pipe Compost units	87000	87	50%
Organic Waste Converters	2	0.5	100%
Aerobic Bins	383	11.49	100%
Mobile Composting Units	154	4.62	100%
Community Biogas Plants	23	23	80%
Dry Waste Collection Bins	2	0.2	100%
Dry Leaves Collection Bins	3	0.3	100%
Material Recovery Facilities	44	44	100%
Resource Recovery Centre	2	10	100%
Facilities in the Private Sector(Rendering Plants, Farms, Piggeries)	19	150	60%
TOTAL		**356.8**	**67.89%**

Source: (Ramachandran ,2019)

Despite exemplary examples of efficient waste management in South India, some uncertainty and unpredictability have caused a negative impact after the action plan in Greater Hyderabad Municipal Corporation is implemented. After the removal of all the waste bins to make it a bin free city, waste generated is now piling up along the roadside. It will be resolved only when the contract with Ramky Environmental Engineers is functional. (Tiwari ,2021)

Fig. No. 2.15. Generation of MSW in West India



	Ahmedabad	Daman	Gandhinagar	Jaipur	Mumbai	Nashik	Panjim	Pune	Rajkot	Silvassa	Surat	Vadodara
2004-2005	1302	15	44	904	5320	200	32	1175	207	16	1000	357
2010-2011	2300	25	97	310	6500	350	25	1300	230	35	1200	600

Source: CPCB (2004-2005, 2010-2011)

The waste generation in Western Indian region is highest in Mumbai. It generates 6500 tonne/day as per 2010-2011. However, as per State of Environment Report, 2009, almost 90 percent of waste in Mumbai is collected. The city contributes to 5 percent of the country's GDP. Despite this, there is more than 50 percent of Mumbai's population living in slums with no access to waste services and there is an acute problem of lack of landfilling. To tackle this high waste quantity, Government of Maharashtra have enforced Maharashtra Non-Biodegradable Garbage (Control) Act 2006 for citizens and Maharashtra Plastic Carry Bags Rules 2006 for manufacturers and sellers to minimize

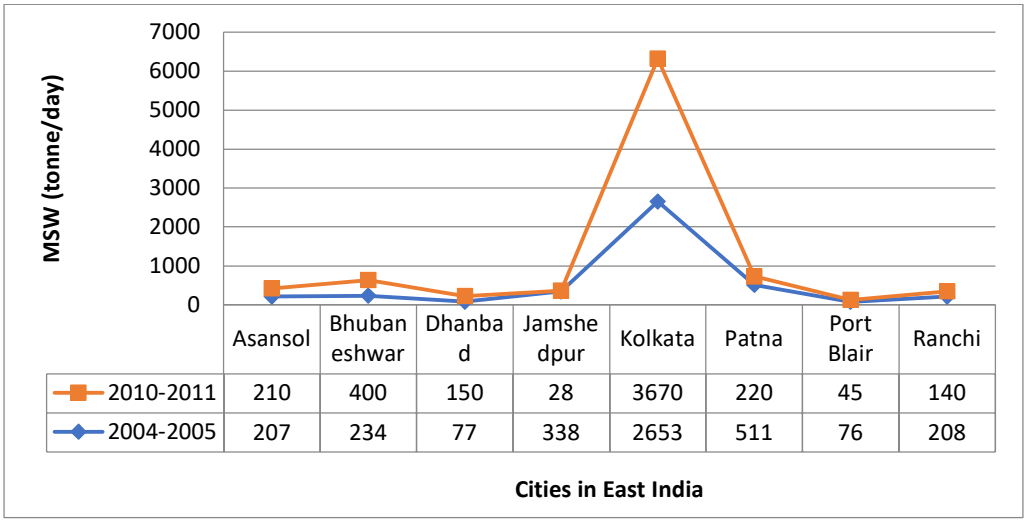
the plastic waste. The ultimate need now is focused to WTE facility which is looked as a provider of cleaner environment. (Themelis and Bhada ,2008)

Surat generates 1000 tonne/day among the cities in Western India. However, the waste management here has taken a better turn after the introduction of the solid waste management project under JnNURM. Door-to-door collection is 92 percent and waste segregation are 17 percent presently. Furthermore, Surat Municipal Corporation now has partnership with its private partner and runs 600 TPD waste to energy plant. (JnNURM ,2013) Surat has *Anudaan* initiative which provides monetary incentives to 600 societies who participate in sorting and segregating the waste in house itself. Rajkot Municipal Corporation and Ahmedabad Municipal Corporation are cities in Gujarat where the waste management have taken a lead in advancement of efficient waste regulations not only upon the households but also upon the workers of solid waste management. The recording of attendance with face recognition and automatic sweeping machine are one of its first kinds in India under SWM. The GPS system not only tracks the trucks but also how much of work has been done. The disposal of waste is done in the allotted lands in all the three Municipal Corporations, namely, Ahmedabad, Surat and Rajkot by City Development Plan (CDP) with 1048 acres, 2718 acres and 100 acres, respectively (2014).

Pune is the ninth-most populous city in India according to Indian Census, 2011 and the third highest generator of waste among the cities in West Indian region. An important approach to the waste management in Pune is the inclusiveness of the waste pickers Kagad Kach Patra Khastakari Panchayat (KKPKP) formed in 1993 since 1995. In 2006, the Maharashtra Non-Biodegradable Solid Waste Rules was initiated to provide a material recovery facility to divert the waste going to the landfills. By 2008 Pune Municipal Corporation took another initiative of authorizing the Solid Waste Collection

and Handling (SWaCH) to further enhance the door-to-door collection who by 2013 served 390,000 properties and by 2016 covered 640,000 properties with the help of 3,000 waste pickers. Today, the waste collection is over 87.5 percent and the composition of waste here has 74.2 percent of compostable and the plastic waste generation is 8.31 percent only (Moora and Barde ,2019).

Fig. No. 2.16. Generation of MSW in East India



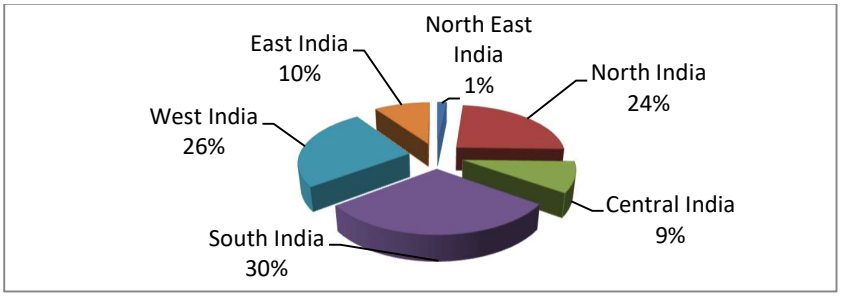
Source: CPCB (2004-2005, 2010-2011)

Figure No. 2.16 highlights the waste generation among the cities located in the eastern part of India. It is reflected that the waste generation is highest in Kolkata who alone contributes 75 percent to the total generation among the following cities in East India. The lowest waste generation is observed in Port Blair in 200-2011 at 45 tonne/day. Kolkata is one of the metropolitan cities in India with a population of over 14.1 million as per Census of India making it the third most populous metropolitan city. The waste collection is limited to 60 percent area on the contrary to the expenditure of 70-75 percent of KMC's waste budget in collection alone; 25-30 percent on transportation and below 5 percent on the disposal of the collected wastes (2009). The waste is disposed in Dhapa disposal ground and the site located in the Garden Reach area. For

the hazardous waste management, West Bengal Control Board along with Haldia Development Authority has constructed a complex in Haldia which measure 28 ha at 150 km of distance from KMC area (2009).

Patna, the capital city of Bihar is one of the most inefficiently managed cities with regards to waste. As per the 2011 Census of India, the population is 1,683,200. However, the figure no. 2.16 reflects that there is a decrease in waste generation from 2005 to 2011 which is due to the lack of proper research resources. The city report published by NSWAI shows that the waste generation in 2021 is more than 1500 tonne/day (Pandey ,2014). In 2010, after a public-private partnership with A2Z Infrastructure Ltd, New Delhi, the UD&HD of Bihar worked in waste collection and treatment for one and half years which eventually stopped due to shortage of funding; the same was assigned to Bihar Urban Infrastructure Development Corporation Ltd (BUIDCO) in 2012 with Jindal ITF Urban Infrastructure Limited on PPP basis which was cancelled before the commencement of the work (Pandey ,2014). Today, the waste disposal is allotted in Bairia in 80-acre land by Patna Municipal Corporation (Solid Waste Management in Patna ,2014). However, 75 percent of households and 80 percent of the commercial complex and shops disposes their waste on the open streets. (Solid Waste Management in Patna ,2014). Patna bags the title of the dirtiest city among the cities with population above 1 million (Swachh-Survekshan ,2020).

Fig. No. 2.17. Distribution of generation of MSW in India



From the analysis above, it is reflected in the figure no. 2.17 that the highest generator of waste among the regions of India is South India followed by Western region and Northern region. The least contribution is done by the North-Eastern region in India. However, it is to be known that the quantification of waste is very conflicting in the records. This is because of the lack of periodic and efficient collection of waste accounts due to lack of resources in the urban local bodies (Mani and Singh ,2016). Despite it all, the most prominent quantum of waste generation is contributed by the Golden Quadrilateral cities in India, namely, Chennai, Mumbai, Delhi and Kolkata. It is also observed that the population increase in cities is not always proportional to the quantity of waste generation. Delhi alone shares 32 percent of the waste contribution among these four metropolitan cities followed by Mumbai with 30 percent, Chennai 21 percent and Kolkata 17 percent. However, the population of these four cities shows that Mumbai has higher population enumeration as per Census of India, 2011.

Table No. 2.5. Population distribution in the Golden Quadrilateral cities

Sl. No.	Cities	Population
1	Mumbai	1,24,42,373
2	Delhi	1,10,34,555
3	Chennai	46,46,732
4	Kolkata	44,96,694

Source: Census of India, 2011

Majority of the cities in India still practices open-dumping and burning to tackle the waste generated. While majority of the western countries have already shifted to tackling the diseases of affluence, India still struggles to manage the waste collection and transportation (Kumar 2016). The overall scenario of waste management in Indian cities are such that there is no consistent and one super model to achieve the same outcome because despite a similar growing consumerism pattern of globalization, there is subtle differences in the ways that people live and as suggested by (Mani and Singh

,2016), rather than focusing only in technical solution, the focus should shift in the behaviour of the citizens, policy makers and elected representatives.

CHAPTER – III

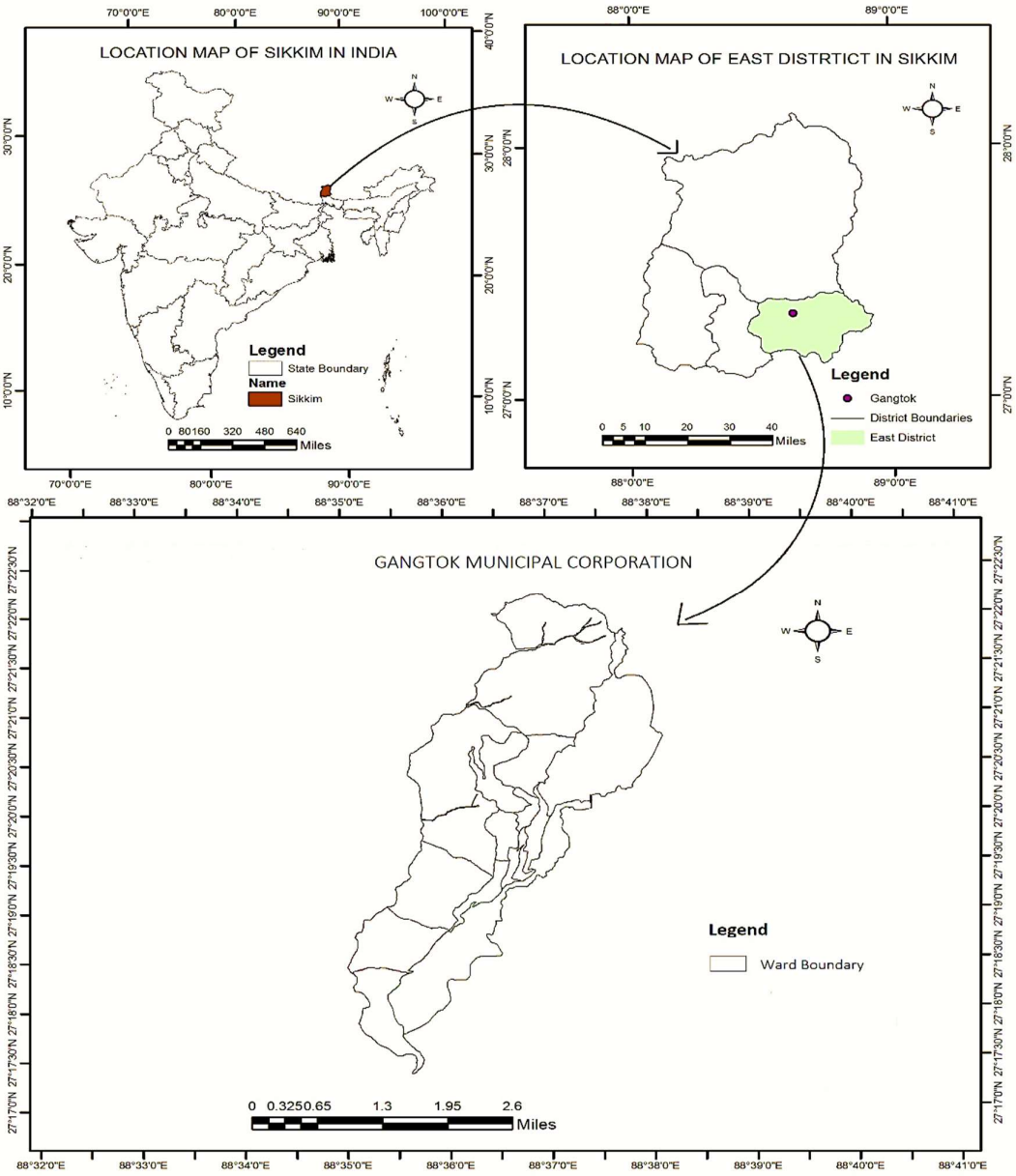
MUNICIPAL SOLID WASTE MANAGEMENT IN SIKKIM - A SPATIO-TEMPORAL ANALYSIS

3.1. Urbanization: An Introduction

Urbanization is a continuous process of population concentration that brings about gradual structural and socio-economic changes to a geographical space. It is usually implied to generalize a picture of an agrarian economy transforming into industrialized and sophisticated economy with the use of modern ideas and technologies. However, the pattern and degree of urbanization is never identical and varies from place to place. This is mainly because of the variation in the space, which is naturally inclined with the demographics, socio-cultural discrepancies and geographical characteristics of that particular place. Furthermore, apart from these understandings of the urbanization, Riesman in 1964 states yet another distinct feature to it – transformation from a *"small homogenous society to a large heterogeneous mass* (Paul and Sharma ,2016)*".* Studies show that in developing countries, the cities have grown more compact despite of deceleration and decentralization of the population (Jr. and Davidson ,1996). This feature is no less different in Sikkim's capital, Gangtok, where the urbanization footprint has left no stone unturned. Despite the development in Gangtok Municipal Corporation already being challenged with the lofty-mountainous slope and rugged terrain, the city has observed almost quadruple increase in the population between 2001 to 2011 and has influx of over 16 lakhs tourists since 2019. This has led to major pressure on the infrastructural services and the environment, particularly on the solid waste management. Municipal solid waste management is one of the fundamental services in urban space, especially in hill towns of India where the pressure is already felt while developing infrastructures due to its inauspicious climate, rugged terrain and ecological fragility. Contrarily, there has been more urban-agglomeration induced issues of solid waste in Gangtok since the past decade which is also contributed from the tourism industry.

a. Study Area

Fig. No. 3.1. Location map of the study area



Source: GADM, Arc-GIS, 2019.

Blessed with vast vegetation cover and greenery, Sikkim lies in a hilly terrain in North-Eastern region of India and with a total geographical area of 7,096 sq. km, Sikkim forms one of the smallest states in India and has the total population of 610,577 as per the Census of India (2011). Sikkim lies between 27 degree 17'20" to 27 degree 21'47" N latitude and 88 degree 35'12" to 88 degree 39'40" E longitude. There are four districts in Sikkim – East, West, North and South districts. Out of the total area, the North district

alone accounts for almost sixty percent of its area and is the largest district of Sikkim. Running right behind is the East district with an area of 954 sq. km and the smallest area is covered by the South district with 750 sq. km. Gangtok is the capital located in East district and the area cover of Gangtok is 19.20 sq. km.

In 2010, Gangtok established a municipality with the steadily urbanizing and growing population. The Municipal Corporation department of the state has taken up the functions enshrined by Gazette Notification No.293 dated June 25, 2010 which works for the development of the capital city. Out of the total urban population in Sikkim, Gangtok alone has 55.5% of the urban population today. It is also the only Class-I town of the state where the total population is 100,286 as per Census of India (2011).

3.1.1. Urbanization in Sikkim

Table No. 3.1. Growth of Population in Sikkim

Sl No.	Year	Total Population
1	1901	59,014
2	1911	87,920
3	1921	81,721
4	1931	1,09,808
5	1941	1,21,520
6	1951	1,37,725
7	1961	1,62,189
8	1971	2,09,843
9	1981	3,16,385
10	1991	4,06,457
11	2001	5,40,851
12	2011	6,10,577

Source: (District Census Handbook - North, West, South and East Districts ,2011)

The population of Sikkim before the merger with India is negligible and more so, irrelevant in the case of urban population. In 1901 the total population of Sikkim was only 59,014 but the decadal growth is second highest at 49 percent between 1901-1911.This is mainly because of lack of famine and decrease in death rates. However, from 1911-1921, the decadal population growth rate decreased by -7 percent. This is mainly due to the outbreak of influenza in 1918 and partly due to the death toll taken by the *Gurkha* soldiers in World War I (Lama ,2001). In the history of Demographic

Transition of India, it is known as the "Demographic divide" which is because of the consistent increase in growth of the population after this year, which was not the case before. Since then, the decadal growth rate in Sikkim grew but at a very slow pace until 1971. Nevertheless, post-merger i.e., after 1975, the percent of decadal population growth flung up to 51 percent. The in-migration exploded between 1971-1981 with decadal growth of 1,06,542 populations due to the centrally funded large-scale development activities. From then on, the growth of decadal population is steady but with rates that are much lower than the early merger period. 2011 has only 13 percent of decadal growth rate which is solely due to the increasing rate of literacy and modern perspective on family planning.

Table No. 3.2. Decennial Population Growth in Sikkim

Year	Decennial pop. growth in Sikkim	Decennial pop. growth in Sikkim in %
1901-1911	28906	49
1911-1921	-6,199	-7
1921-1931	28,087	34
1931-1941	11,712	11
1941-1951	16,205	13
1951-1961	24464	18
1961-1971	47654	29
1971-1981	106542	51
1981-1991	90072	28
1991-2001	134394	33
2001-2011	69726	13

Source: (District Census Handbook - North, West, South and East Districts ,2011)

Table No. 3.3. Urban Demographics of Sikkim

Year	Total Population	Total Urban Population	Total Urban Population in %	Decennial Growth in %
1951	1,37,725	2,744	2	-
1961	1,26,189	6,848	5	150
1971	2,09,843	19,662	9	187
1981	3,16,385	51,096	16	160
1991	4,06,457	36,988	9	-28
2001	5,40,851	59,870	11	62
2011	6,10,577	1,51,726	25	153

Source: (District Census Handbook - North, West, South and East Districts ,2011)

Sikkim has always been a state where the majority of the population lives in rural areas than urban. The primary occupation is traditional and allied activities. Table No. 3.3.

shows that the urban population is non-existent in 1941 census and only in 1951 the urban population comes up to 2 percent, only. Sikkim owes its share of growth of urban population to the merger with the Indian Union yet it is still one of the least urbanized states in the country. In 1971, the urban population to the total population is only 9.37 percent which steepens up to 16.15 by 1981 after ten years. However, the degree of urbanization didn't do too well until recently. The year 2011 shows the maximum percentage of urban population to the total population of the state has hit 25.2 percent which is still lower than the average level of the country by more than 2 percent.

Table No. 3.4. Percentage Distribution of Degree of Urbanization in Sikkim:

Sl No.	Year	Degree of Urbanization in %
1	1971	9.37
2	1981	16.15
3	1991	9.1
4	2001	11.07
5	2011	25.2

Source: (District Census Handbook - North, West, South and East Districts ,2011)

Table No.3.5 highlights that the density of the population is also only 29 per sq.km in 1971. However, there is a steep increase to 45 per sq. km within ten years. This increase can be associated with the culmination of many periphery areas of the core by the authorities to the municipalities. When comparing the urban decennial growth percent, there is a decrease in the year 1991 by -28 percent which accounts mainly due to the decrease in the urban areas (Table No. 3.3). However, the growing urban population to the total population within the state is not ubiquitous. The East district is the only district with a census town in the year 1951. Gangtok being the capital of the state remained a lone census town for more than two decades when the merger brought about a vast change in the demography of the state as the non-agricultural activities swelled up in the state.

Table No. 3.5. Distribution of Density of Population in Sikkim

Item	Year	Unit	Density
Density of Population	1971	Per sq. km	29
Density of Population	1981	Per sq. km	45
Density of Population	1991	Per sq. km	57
Density of Population	2001	Per sq. km	76
Density of Population	2011	Per sq. km	86

Source: (District Census Handbook - North, West, South and East Districts ,2011)

Gangtok Municipal Corporation accounts for 81.8 percent of the total urban population in East district. At 14.4 percent, South district holds the second place in the total urban population distribution where Namchi Municipal Council and Jorethang Nagar Panchayat contribute 12,190 and 9,009 urban populations, respectively (Table No.3.6). Furthermore, it is derived from Table No. 3.6 and Table No. 3.7 that Mangan Nagar Panchayat's 4,644 urban populations alone make up the 10.6 percent of the North district's total urban population as compared to the West district's 3.8 percent of total urban population which is due to the aggregation of least number of total populations in the North district. As of today, the number of classified towns in Sikkim has increased from Gangtok being the only one census town in 1971 to nine classified towns in 2011. The number of populations living in urban area has also increased from 2,744 in 1951 to 1,51,726 by 2011.

Table No. 3.6. District-wise Percentage Distribution of Urban Population, 2011:

State / District Name	Sector	Total Population	Urban Population to Total Population
North District	Rural	39065	
North District	Urban	4644	
North District	**Total**	**43709**	**10.6**
East District	Rural	161096	
East District	Urban	122487	
East District	**Total**	**283583**	**43.2**
South District	Rural	125651	
South District	Urban	21199	
South District	**Total**	**146850**	**14.4**
West District	Rural	131187	
West District	Urban	5248	
West District	**Total**	**136435**	**3.8**
Sikkim	Rural	456999	
Sikkim	Urban	153578	
Sikkim	**Total**	**610577**	**25.2**

Source: (District Census Handbook - North, West, South and East Districts ,2011)

There is an infrastructural investment within the state's highly urbanized districts which results as a major pull factor for urban population growth. The sizeable rural to urban migration is accountable to the swift urbanization lately. In the last decade, smaller towns like Singtam, Rangpo, Jorethang and Namchi have also been influenced by the rapidly growing urbanization. There is high growth of urban population in these smaller towns basically due to influx of floating population. The establishment of many pharmaceutical companies and hydel power in Sikkim has attracted and employed many intra-state and inter-state populations. With the dynamically evolving occupational sector in Sikkim from primary to secondary and tertiary sectors, the commercialization of or else, traditional products from the rural local areas also has its toll on the increasing influx of populations from rural to these growing urban towns.

Table No. 3.7. Distribution of Population in Urban Local Bodies of Sikkim, 2011:

Name and civic administration status of towns	Populations of Towns		
	Total	Males	Females
North District	**4,644**	**2,456**	**2,188**
Mangan Nagar Panchayat	4,644	2,456	2,188
West District	**5,248**	**2,710**	**2,538**
Gyalshing Nagar Panchayat	4,013	2,054	1,959
Nayabazar Notified Bazaar Area	1,235	656	579
South	**21,199**	**10,822**	**10,377**
Namchi Municipal Council	12,190	6,166	6,024
Jorethang Nagar Panchayat	9,009	4,656	4,353
East District	**1,22,487**	**64,285**	**58,202**
Gangtok Municipal Corporation	1,00,286	52,459	47,827
Singtam Nagar Panchayat	5,868	3,097	2,771
Rangpo Nagar Panchayat	10,450	5,555	4,895
Rhenock Census Town	5,883	3,174	2,709
State Total	**1,53,578**	**80,273**	**73,305**

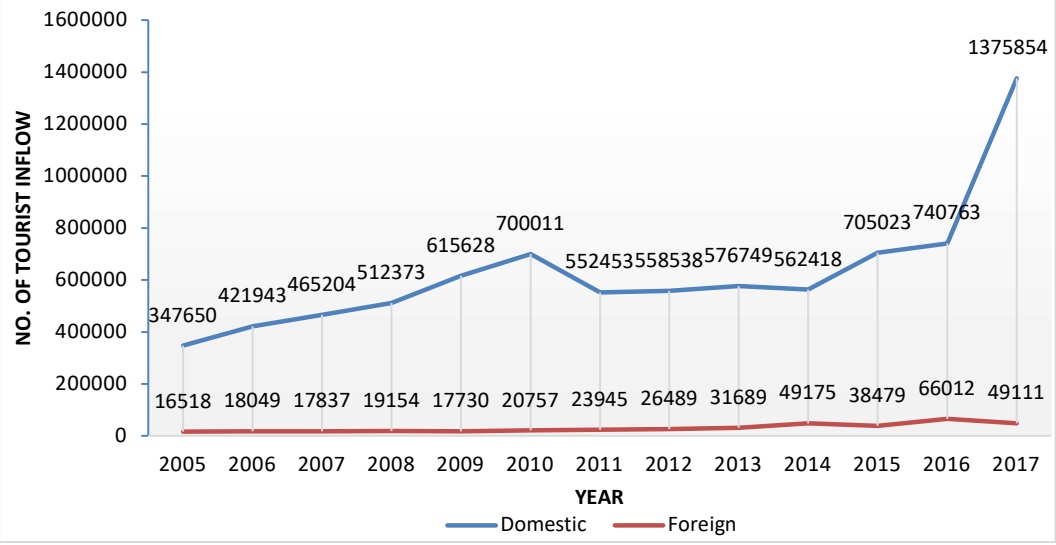
Source: (District Census Handbook - North, West, South and East Districts ,2011)

a. Tourism and floating population

Tourism is the one of the most booming industries of Sikkim and has been deemed as a major employment generating sector as per the Census of India, 2011.The lofty mountains and pleasant weather has become a getaway for majority of the populations in India, neighbouring countries and overseas. However, the tourism industry in its

initial years did not yield much of the revenue and only after 2000 did the tourist inflow pick up. Figure No. 3.2. shows that in 2005 the annual enumeration of domestic tourist is 3, 47,650 and foreign tourist is 16,518. The decline in tourist influx is observed from 2010-2011 which is due to the massive earthquake of September, 2011. However, there has been steady rise in tourist influx since the state has been declared Cleanest Tourist Destination of the country (ENVIS, State of Environment Report Sikkim 2016 ,2016). The records show that tourism alone contributed 7.68 percent to Sikkim's Gross State Domestic Product in the year 2016-2017 (Department of Tourism and Civil Aviation). Recently, the annulment of restrictions imposed on Bangladeshi tourists by the state Government in 2018 have played a vital role in the rapidly growing tourism industry. In 2018, the total tourist influx is 14, 26,127 and in 2019, the tourist influx is over 16 lakhs and out of 1, 33,388 foreign tourists, 60,542 are from Bangladesh (Ravidas ,2020).

Fig. No. 3.2. Growth of Domestic and Foreign Tourists in Sikkim



Source: (Tourism and Civil Aviation Department, 2020)

Alike the regionally imbalanced influx of migration to the East district of Sikkim, the tourist influx is mainly confined to East district too, especially in Gangtok (Chakrabarti

,2009) after being awarded the Cleanest Hill Station of India in 2015 (ENVIS 2015) which exerts an enormous pressure on the basic infrastructural amenity in the city.

b. Migration, population growth and urban development projects in Gangtok

Table No. 3.8. District-wise Distribution of Migrants in Sikkim

Districts	Migrants	Percentage
North	11557	7.88%
East	95292	65.02%
South	25974	17.72%
West	13741	9.38%
Total	**146564**	**100%**

Source: State Socio Economic Census (SSEC), 2006

As per Census of India, 2011, East district still holds the first place in total urban population distribution at 43.4 percent. From the Table No. 3.8 we can perceive that 65.02 percent of migrants are confined to the East district, especially in the capital city. Gangtok Municipal Corporation accounts for 81.8 percent of the total urban population in East district.

Table No. 3.9. Reasons for migration in Gangtok Municipal Corporation

Area Name	Total Migrants	Reasons for Migration						
		Employment/Work	Business	Education	Marriage	Moved after birth	Moved with Households	Others
Gangtok M.Corp.	62161	15980	1951	3038	10562	975	10114	19541

Source: (Census of India ,2011)

Table No. 3.10. Reasons for intra-state migration to GMC

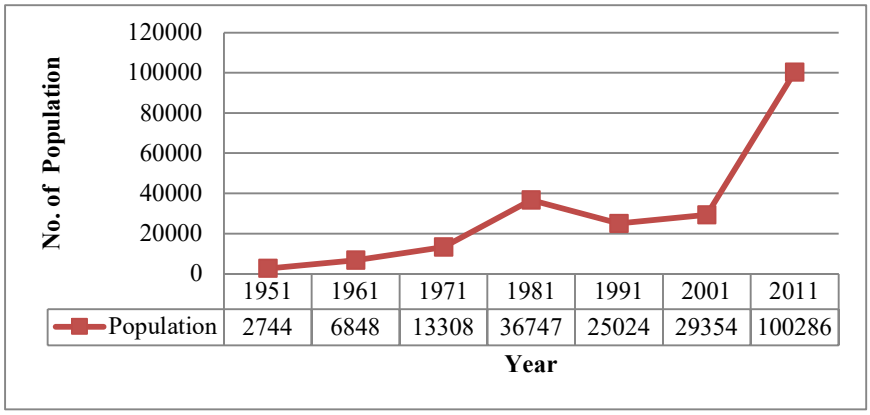
Last Residence	Residence Type	Total Migrants	Reasons for Migration						
			Employment	Business	Education	Marriage	Moved after birth	Moved with Households	Others
Within the state of enumeration but outside the place of enumeration	Rural	16,200	5,250	376	1,322	3,419	209	2,558	3,066
	Urban	11,988	2,034	286	553	1,480	184	2,820	4,631
Elsewhere in the district of enumeration	Rural	9,350	2,930	224	556	2,030	143	1,606	1,861
	Urban	9,778	1,330	231	343	1,087	149	2,385	4,253
In other districts of the state of enumeration	Rural	6,850	2,320	152	766	1,389	66	952	1,205
	Urban	2,210	704	55	210	393	35	435	378

Source: (Census of India ,2011)

It is observed that the majority of the migrants in Gangtok have come seeking employment opportunities and other reasons; it is also noteworthy that the migrants

have moved to Gangtok with their family (Table No. 3.9). When the intra-state migration is examined, (Table No. 3.10) the result shows that the employment opportunities have attracted majority of the migrants from a rural area followed by the migration of population due to marriage from the rural area. This is mainly due to the schemes like Jawaharlal Nehru National Urban Renewal Mission, Smart City Mission and Swachh Bharat Mission that have encouraged projects which have broadened the employment spectrum of the population in the capital city of Sikkim since the early 2000s'.

Fig. No. 3.3. Growth of Population in Gangtok



Source: (JNNURM, Section 3:Social,Demographic & Economic Profile ,2011)

Focussing on the rapid growth of urban population in Gangtok particularly, the mission that have boosted this possibility in particular is the launch of JNNURM in 2005 and 'Smart Cities Mission' under Ministry of Urban Development on 25th of June, 2015 (MoHUA ,2015). Gangtok being the second city after Namchi to be nominated as the smart cities have taken up a swift growth in both tourist attraction as well as immigration. Forthcoming with smart solutions in partnership with private sector is on emphasis and for the same, six wards in Gangtok have been the centre of Area-Based Development. These wards are commercial hub and a true representative of Gangtok (Smart City Proposal - Gangtok ,2018). The partnership includes Effwa Infra &

research Pvt. Ltd. for solid waste management, Delta Electronics for solar energy and power management, city surveillance & management solutions., ACME for energy efficiency & management solutions, 3M India Limited for City Branding, Road Signage, Public Safety and Security, Parking and Traffic management Solutions for city management system, Potence Controls Private Limited for air and water quality monitoring systems and Petrichor Emerging Technologies India Pvt Ltd for decentralized waste water treatment (Smart City Proposal - Gangtok ,2018).

Table No. 3.11. Projects carried out in GMC under Smart City Mission

MOBILITY:	**Amount Cr.**	**LIVEABILITY:**	**Amount Cr.**
Construction of new footpaths	₹ 100	Sewer line (new)	₹ 140
Improving existing footpaths	₹ 20	Strengthening & augmentation of sewerage system	₹ 50
Road & junction improvement	₹ 60	Sewage treatment plant (packaged STP)	₹ 20
Upgradation & smart solutions for existing parkings	₹ 40	Augmentation of water supply (included in Pan City initiative) revamping of power distribution network	₹ 45
Multilevel car park(near MG Marg)	₹ 80	Energy efficient solar street light (LED)	₹ 20
App based public transport management system	₹ 20	Underground distribution cabling	₹ 35
New pedestrian walkways	₹ 50	Smart metering	₹ 12
New pedestrian walkways & staircas	₹ 50	Citywide OFC & WiFi network	₹ 15
Pedestrian FOBs	₹ 50		
Ropeway (cable car)	₹ 25		
Cycle track (Ridge park/MG market)	₹ 5		
CLEANLINESS:	**Amount Cr.**	**PROSPEROUS**	**Amount Cr.**
Door to Door collection	₹ 5	Heritage, Culture & recreational	₹ 200
Smart Road Bins	₹ 7	Economic regeneration	₹ 175
Smart Community Bins	₹ 5	Safety & security	₹ 28
Road cleaning equipments	₹ 10	City branding	₹ 21
Composters	₹ 10	Other development works (including redevelopment at STNM hospital complx and Star	₹ 465
Covering of open drains	₹ 25		
Strengthening & Augmentation of drainage network	₹ 50		

Source: (Smart City Proposal - Gangtok ,2018)

Other schemes/ missions that is converged and boost the development and growth of Gangtok are AMRUT, PPP, MLDAA, SBM, IPDS, NSM, CCTNS, NULM, MUDRA and 14th Financial Commission whose components/ features the work on mobility, heritage, culture and recreation, infrastructure/utility upgradation, water supply distribution network, safety and security and other development works within Gangtok (Smart City Proposal - Gangtok ,2018). All of these schemes/projects/missions have

resulted in the swift growth of urban population and urbanization in Gangtok Municipal Corporation as mentioned in the earlier section of this chapter.

Table No. 3.12. Projects carried out in GMC under JNNURM

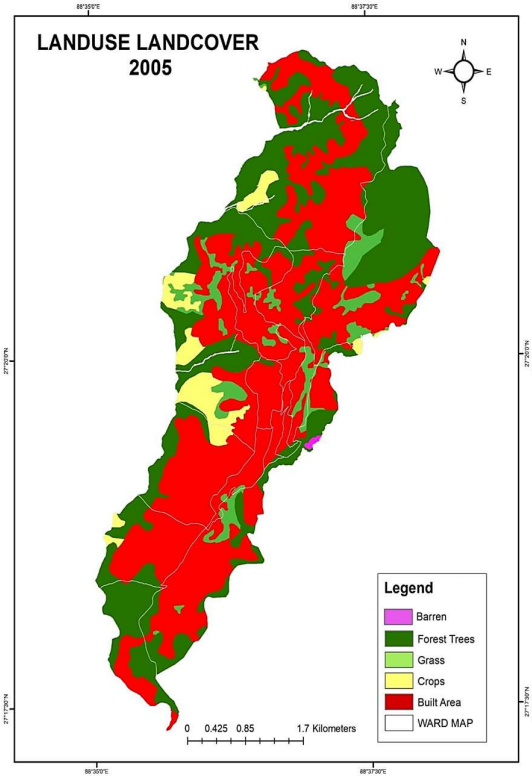
S.No.	Items	Amount (in lacs)
1	Urban renewal projects	5000
2	Water supply and integrated fire fighting network	19540
3	Sewerage	10815
4	Solid waste management	650
5	Drainage and landslip projection	10000
6	Traffic/transport and streetlighting	36800
7	Urban transport	100000
8	Tourism and environment	9200
9	Crematoria/burial grounds	600
10	Upgradation of slums-facility for urban poor	6200
11	Heritage	1995
12	Social housing	3000
13	Land acquisition	10000
14	Other development projects	6000
15	Urban governance and institution strengthening including IEC	1900
	Total	221700

Source: (JNNURM, Section 7: Projects And Capital Investment Plan ,2011)

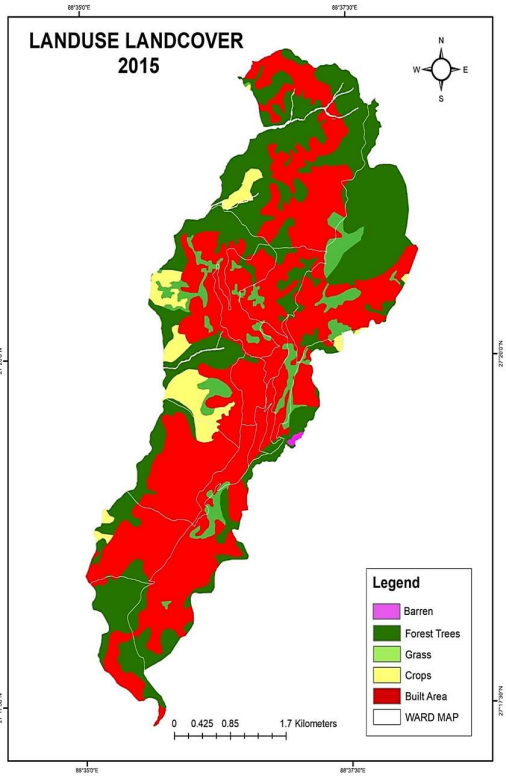
Howsoever, it is not to say that migration of populations from the rural villages to urban towns within Sikkim and inter-state immigration of populations have alone led to the rapidly pacing urbanization in the state. It is also due to natural increase and sometimes due to the amalgamation of periphery sub-urban areas and nearby villages into the core which results in expansion of geographical area and eventually, urban growth. In addition to all these, there are the programmes and projects initiated by the Urban Development and Housing Department, Government of Sikkim and Gangtok Municipal Corporation under 'Smart City Mission' like Multi-Level Car Park in Deorali, Gangtok, Improvement and Modification of Urban Roads in Gangtok, the state capital of Sikkim, Kissan Bazaar at Gangtok, Construction of Pedestrian Fly-overs at Deorali and many more that contributes to the pull-factors of urban growth. On the contrary, there are note-worthy short-comings of urbanization process in Sikkim, precisely in Gangtok that has major sustainability issues to be tackled if not checked with proper and efficient plans and strategies.

c. Landuse pattern change and growth of built-up area in GMC

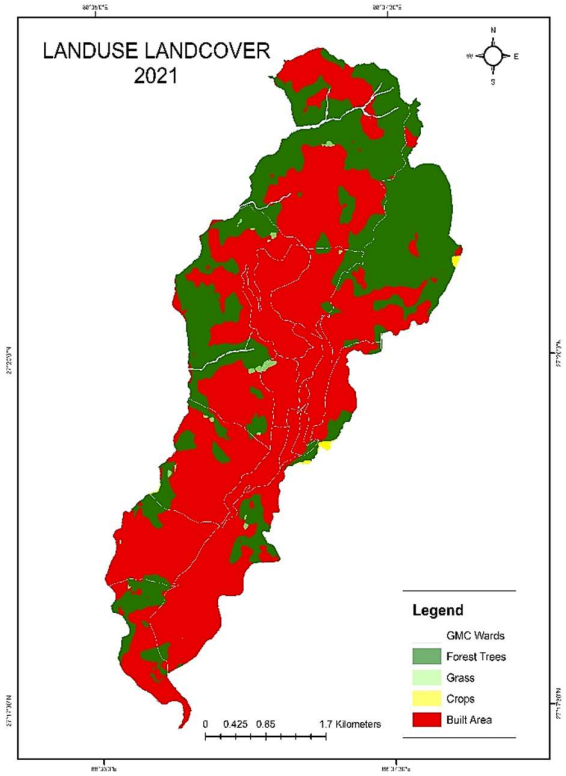
Fig. No. 3.4. Landcover changes in Gangtok Municipal Corporation



Source: Resourcesat-1 LISS III, 2005-06, ISRO.

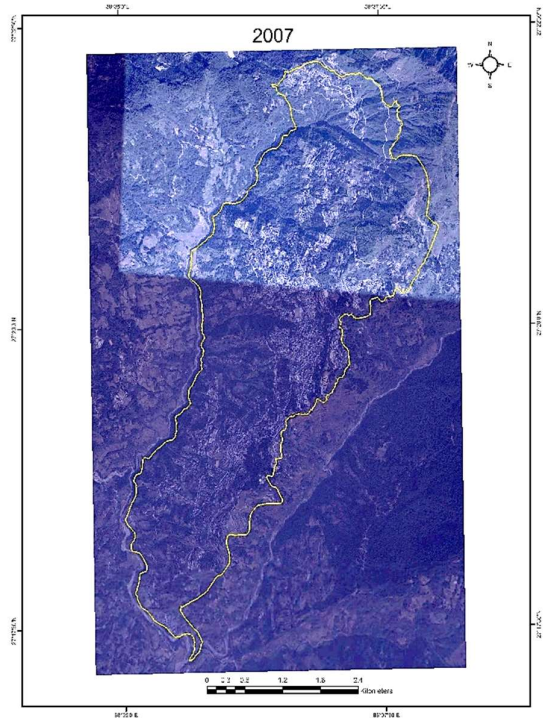


Source: Resourcesat-2 LISS III, 2015-2016, ISRO.

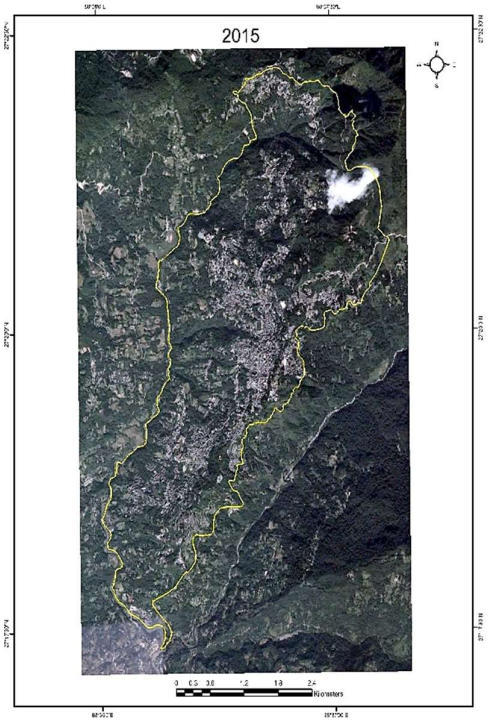


Source: Sentinel – 2, ESRI Inc. 2020

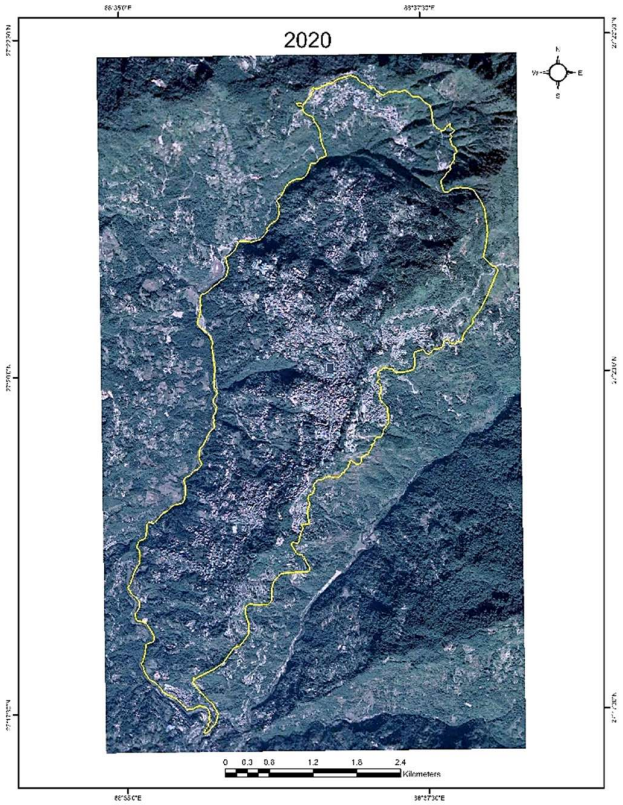
Fig. No. 3.5. Changes in urban settlement in Gangtok Municipal Corporation



Source: Google Earth Pro, November, 2007.



Source: Google Earth Pro, November, 2015.



Source: Google Earth Pro, December, 2020.

The land-use landcover map (Fig No. 3.4) is used to show the growing built-up area in different wards of GMC from 2005 to reflect upon the multiplying waste quantities from early 2000's till date. The landcover pattern is as following:

Table No. 3.13. Landuse pattern changes in GMC

Landuse pattern	YEAR					
	2005		2015		2021	
	Area in sq. km.	Area in %	Area in sq. km.	Area in %	Area in sq. km.	Area in %
Forest Cover	7.42	39.28	6.90	36.53	6.81	36.04
Grass	1.11	5.88	1.06	5.61	0.07	0.37
Crops	0.90	4.76	0.90	4.76	0.04	0.21
Built-up area	9.46	50.08	10.03	53.10	11.98	63.38
Barren	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	19	100	19	100	18.91	100

Source: Resourcesat-1 LISS III, 2005-06, ISRO; Resourcesat-2 LISS III, 2015-2016, ISRO; Sentinel – 2, ESRI Inc., 2020

The built-up area is only 50.08 percent in 2005 with a gradual increase up to 53.10 percent by 2015. However, there is a steady increase by ten percent by 2021. Following up the built-up area is the forest cover which is slowly declining as the settlements are increasing. The forest cover is 39. 28 percent in 2005 which has declined to 36.53 percent by 2015 and currently covers only 36.04 percent of the total GMC area. Grass and crop covers are very scanty in amount within Gangtok Municipal Corporation and the barren land is negligible within the municipal area of Gangtok. As mentioned in the previous section, the Smart City Mission scheme enforced in 2015 to develop the capital city have brought about a distinctive and rapid change in the built-up area here.

3.2. Municipal Solid Waste in Sikkim – An Outcome of Urbanization

Sikkim has an urban population of 25.2 percent as against the rural population of 74.8 percent. As per the Census of India, even Goa has an urban population of more than the national average at 49.8 percent. Given these figures, the degree of urbanization has a long way to catch up with the pace of the national average. However, due to the various reasons discussed before, there is an imbalanced growth of the region. Gangtok has a

population of 100,286 alone that constitutes 81.8 percent of the total urban population in the district of east and 65.2 percent of total urban population is settled here. In 2019, Sikkim had an influx of more than 16 lakhs of tourists which majorly like any other years, stays in and around Gangtok as the state capital is the junction for North Sikkim and other tourist hotspots in East Sikkim. Consequently, due to these imbalanced distributions of urban population and tourist influx, Gangtok faces many acute shortages like scarcity of water, housing congestions, terrible traffic and upheaval of solid waste. Ultimately, the Municipal Corporation is left with a huge burden of the never-ending upheaving piles of municipal solid wastes. As the urbanization is getting rampant in and around Gangtok Municipal Corporation, so is the stream of waste. The waste stream has more composition of complex waste which is not easily succumbed by the environment. Thus, a dire demand for a sound waste management is called for.

3.2.1. History of Solid Waste Management in GMC before 2010

The earliest phase of Urbanization in Sikkim holds account for only 2 percent of urban population in 1951 which was build up by 2744 populations of Gangtok alone. It remained the only census town for two decades. The solid waste scenario was irrelevant in the early post-monarchy period. However, Urban Development and Housing Department was assigned with the responsibility of managing the urban solid waste. In 1971, Gangtok swung up to Class IV town with 13,308 populations. However, 1981 onwards, the impact of post-merger with the Indian Union started to reflect with the growing number of urban populations in Gangtok at 36,747. Gangtok had now started becoming the ultimate destination for majority of the floating population. On the contrary, in 1991, the population in Gangtok was declined to 24,971 which were mainly due to the disintegration of few areas from the total area of Gangtok after the ‘civic status of Municipal Corporation in 1981 Census was changed into Notified Town in

1985 (Census of India ,1991).' It was in this decade that the country enforced amended Environmental Protection Act, 1991 which was put into immediate action in all of the parts of Indian Territory, including Sikkim. However, as per the Urban Development and Housing Department, the solid waste generation remained 54,317 kg per annum and rose by only 1000 kg in 1992. The growth of waste started taking slow start in the beginning with a rise of waste generation in 1993 to 58,592 kg per annum. There was an annual growth rate of waste of only 5.2 percent in between 1993-1994. (Table No. 3.14)

Table No. 3.14. Distribution of Solid Waste Generation in Gangtok

Year	Solid Waste Generation (kg/year)	Solid Waste Generation (tonne/day)	Population of Gangtok	Growth of generation	Growth Rate in %
1991	54,317	0.149	25024	-	-
1992	55,602	0.152	-	1,285	2.4
1993	58,592	0.160	-	2,990	5.4
1994	61,750	0.169	-	3,158	5.4
1995	63,824	0.174	-	2,074	3.4
1996	70,345	0.192	-	6,521	10.2
1997	75,895	0.207	-	5,550	7.9
1998	91,503	0.250	-	15,608	20.6
1999	95,214	0.260	-	3,711	4.1
2001	1,67,500	0.459	29,354	72,286	76
2005	47,45,000	13	-	45,77,500	2733
2011	1,64,25,000	45	1,00,286	1,16,80,000	246
2020	2,04,40,000	56	-	40,15,000	24

Source: Urban Development and Housing Department, Government of Sikkim, 2020.

According to the words of an interviewee, *"There were public dumping racks in all wards. The vehicles assigned by UDHD would then collect the wastes from these racks just to throw them away from the cliff (Namley Bhir) located nearby Smile Land in Ranipool today."* However, it is to be recalled that the waste generation was only 54,317 kg/year which with a population of 25,024 generated almost scanty amount of waste at 0.01kg/capita/day. The annual growth of the solid waste in Gangtok remained fairly consistent after 1995 until 1997. The Non-Biodegradable Garbage Control Act, 1997 was imposed in the whole of Sikkim. Nevertheless, the annual growth rate flung

up to 20.6 percent in 1998. It should be known that this year became a milestone in the history of not only Sikkim but of the whole nation. 1998 was the year when Sikkim became the first states in India to notify the order of ban of plastic bags on 4th of June which was issued by UDHD under Sikkim Trade License and Miscellaneous Provisions Amendment Rules, 1998.

This notification became mandatory as the landslide which occurred in the same year in Gangtok was due to the diversion of the flow of torrential rainwater from the *jhoras* because of the discarded plastic wastes in the streams, thereby, choking and blocking the drains. As per one of the interviewees, "*The landslide was a wake-up call to us all. One whole building was swept away and more than four casualties took place*." Following up the next year in 1999, the solid waste's annual growth rate decreased to 4.1 percent as the notification was mainly imposed upon the manufacturers and shop-keepers.

Soon after, Municipal Solid Waste Management and Handling Rules, 1998 – 2001 was imposed in Sikkim providing guidelines for the disposal of solid waste. The following decade became more infused in tackling the environmental problems faced by the urban populations in Gangtok. The Non-biodegradable Garbage Control Act was amended in 2001 wherein it deemed improper handling of waste punishable with imprisonment of six months and an allotted amount of fine.

Another important attempt of solid waste management started in early 2000 with the project funded by Australian Agency of International Development (AusAID) under Water and Sanitation Program. This led to the formation of many NGOs for door-to-door collection of solid waste with an attempt to abolish the use of public dumping racks. However, the project had a limitation with the lack of man-power and was confined to only few of the rapidly growing wards in Gangtok. Watson Committee and

United Arithang Development Society attended in DPH and Arithang wards and Ecotourism and Conservative Society of Sikkim and Golden Circle (no longer active) catered to the needs of Development Area. The Gangtok's population in 2001 had hit 29,345 as per the Census of India, 2001 and by 2004-2005, the solid waste generation rose up to 13 tonne per day (CPCB ,2005). It started growing unmanageable in the later years of the decade which eventually led to the authorization of establishing waste processing facility, disposal facility at Martam by State Pollution Control Board to UDHD under the Water Prevention and Control Pollution Act, 1974, Air Prevention and Control of Pollution Act, 1981, Hazardous Waste Management and Handling Rules, 1989 and Municipal Solid Waste Management and Handling Rules, 2000 in 2007 (NERCCDIP ,2011).

3.2.2. Introduction of GMC and Municipal Solid Waste Management (2010-2020)

By the end of 2001 decade, the population of Gangtok had rose to 1,00,286 populations with the decadal growth of 241.74 percent according to Census of India (2011). With the rampantly speedy annual growth of urban population, the scenario of solid waste management went haywire. Eventually, Gangtok jumped up to become the only Class - I town in Sikkim and to reduce the increasing administrative pressure from Urban Development and Housing Department, Gangtok was provided the civic status of Municipal Corporation again starting with 15 wards on 27th April, 2010 (GMC ,2011). The responsibility of setting up and operation of municipal solid waste management is now solely over to Gangtok Municipal Corporation. Till date, the Corporation has set up a composting plant of 1 tonne in Kanchendzonga vegetable market, an organic waste converter of 50 tonne in Martam landfill and a weighing bridge which are all inoperative at the moment.

3.2.2.1. Generation and Composition of the Municipal Solid Waste

Table No. 3.15. Distribution of Solid waste generation in different ULB's of Sikkim

ULB Names	Population -2011	Solid Waste Generation (TPD)
Gangtok Municipal Corporation	100286	50
Gyalsing Municipal Council	6185	3.5
Mangan Nagar Pachayat	4644	0.6
Namchi Municipal Council	15953	4.6
Rangpo Nagara Panchayat	10540	10
Singtam Nagara Panchayat	5868	2.5
Jorethang Municipal Council	11286	3.5
TOTAL	154762	74.7

Source: (SPCB-Sikkim ,2020)

Gangtok has always been a major attraction for employment bound floating population. Apart from this, Sikkim on the whole has 94,567 non-working populations to the total migrant population which is because of the majority of the working population is here with the family (Bhutia and Srivastava ,2014). However, there are other amenities that favour this influx of immigrants like the educational institutions and medical institutions. Hence, the municipal solid waste has also taken a great leap by 2011. As per the (NERCCDIP ,2011) report, GMC generates solid waste of 45 tonne per day in 2011 which makes up 405.56 g/capita/day and the composition of waste included 63.3 percent of organic waste, 17.2 percent of recyclables and 19.5 percent of inert materials. The main source of the municipal waste generation is households at 60 percent, 15 percent from markets, 10 percent from hotels and restaurants, 10 percent from tourist and 5 percent from the street sweepings (NERCCDIP ,2011). By 2013, the solid waste generation reached 50 tonnes per day during the peak tourist season out of which 17.18 percent of the waste stream comprised of plastic composition waste (ECOSS ,2014). The notification of the ban of plastic bags in 1998 is found quite effective in Gangtok particularly and it has decreased by 8 percent. It is now replaced by non-woven polypropylene bags which makes up 28 percent of the total types of bags used in Gangtok alone (ECOSS ,2014). However, the waste generation from 50 tonne per day

in Gangtok in 2013 is still accounted to be the same in 2019 as per the figures in Table No. 3.15.

Out of the total solid waste generation in Sikkim, Gangtok is the highest contributor accounting 66.9 percent of the urban waste. It is also to be noted that Gangtok had a decadal population growth of 241 percent in 2001-2011 and with the increase in threefold tourist influx in 2019 after the annulment of the restriction imposed upon Bangladeshi tourists (Ravidas ,2020), yet the generation remains very low than projected by SIPMIU under North-Eastern Capital Cities Development and Investment Programme project funded by the Asian Development Bank. The solid waste generation per capita per day in Gangtok is 500g in 2019 (State Policy and Strategy on Solid Waste Management ,2019).

Table No. 3.16. Projection of Solid Waste Generation in Gangtok

Year	Population	Households	Projected Waste Generation (TPD)
2012	1,29,500	25,145	54
2017	1,45,510	28,254	65
2022	1,63,500	31,747	78

Source: (NERCCDIP ,2011)

Over the next year i.e., 2020, the impact of the Covid-19 pandemic marked a very serious impact upon the management system of the solid waste in Gangtok Municipal Corporation. The collection was carried out despite being irregular but the sorting at the dumpsite in Martam was prohibited due to Covid-19 protocols for more than three months only to dispose the mixed waste altogether in the dumping ground. The Table No.3.17 shows the monthly variation of municipal solid waste generation from January to December, 2020. The month of July have the lowest generation of solid waste of 42 tonne per day. This outcome is due to the lockdown of the state.

Table No. 3.17. Municipal Solid Waste Generation in Gangtok, 2020

Months	Average Solid Waste Generation/Day (tonne per day)	Solid Waste Generation gm/capita/day	Monthly Growth Rate %
January	63	628	-
February	61	608	-3
March	62	628	1.6
April	-	-	-
May	-	-	-
June	-	-	-
July	42	418	-
August	43	428	2.4
September	45	448	4.7
October	60	598	11.1
November	62	618	3.3
December	63	628	1.6

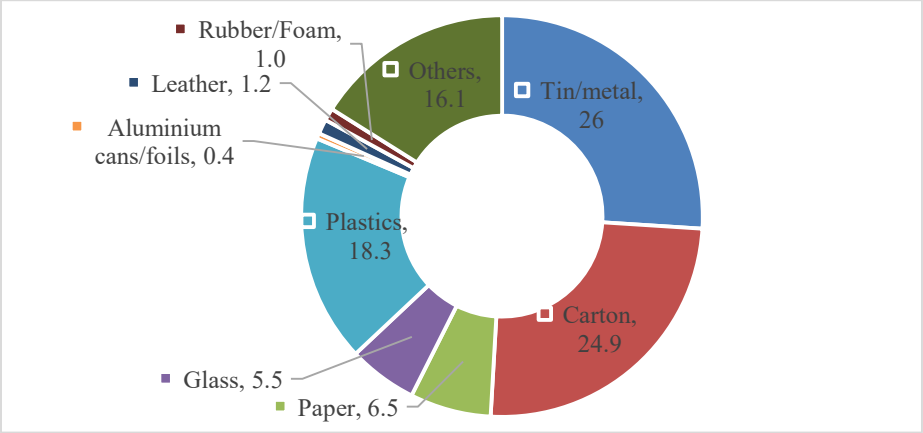
Source: (Martam Landfill, Field Survey, 2020*)*

As mentioned earlier, the municipal waste comprises of 60 percent of household waste. Additionally, the restaurants and hotels remained closed except the grocery shops and market. However, even with majority of the municipal solid waste generation contributed from the households, there is a decline in the total amount generated. This is because of the shortage of manpower in the collection practice of household waste. The gradual rise in monthly growth from 1.2 percent in July-August to 4.2 percent in August-September is mainly due to the reopening of inter-district movement with the state. However, there is a steep rise of waste generation in the month of October to 60 tonne per day with the highest monthly growth rate of 32.5 percent. The resume of inter-state movement and the restart of tourism from October 10th are mainly accountable for this. The municipal solid waste generation has a gradual increase from October onwards to 62 tonne/ day and 63 tonne/day in November and December, respectively but with a very gradual monthly growth. Therefore, the average solid waste generation in Gangtok in these nine months of 2020 is 56 tonne per day with the per capita solid waste generation of 556 gm/capita/day.

With the urbanization rapidly increasing in Gangtok, the municipal solid waste stream is becoming more complex and the composition of waste has increased into many

varieties that it has become very difficult to sort out this composition from the non-segregated waste. The major composition of waste is organic in Gangtok at more than 63 percent of the total municipal solid waste in 2011 (NERCCDIP ,2011). Apart from this, the waste stream includes plastic, tins/metals, cartons/cardboards, glass, rubber/foam, aluminium and others as per the 2019-2020 annual report of dry waste collected by the NGO (Voyage ,2021).

Fig No. 3.6. Composition of dry waste(only) collected in GMC in percentage



Source: (Voyage - Pany Foundation Annual Report ,2021)

It is visible in the Fig. No. 3.4 that in 2021, the settlements have increased heavily in Gangtok Municipal Corporation. It is hence drawn that the households are the major contributors of the waste here in the capital city. Furthermore, the increase of built-up area in the central wards has also led to increase of the waste generation. Upper M.G. Marg, Lower M.G. Marg and Tibet Road produces more than 7 tonne/day as per 2020 while Tadong, Deorali, and Ranipool are swiftly getting highly commercialised as well and are steadily increasing its built-up area; the waste generation exceeds 5 tonne/day (Table No. 3. 18). However, Burtuk, Upper Sichey and Daragaon have comparatively more waste generation/day today than they used to fifteen years ago due to rapid growth of built-up area here. They produce 4 tonne/day. The lowest waste producer is the ward

Development Area followed by Arithang and Upper Syari where the buildings are more residential than mixed used. However, despite vast increase of built-up areas in Syari, there is not much quantity of waste generation recorded. This is mainly because the waste collection facility is absent in the Middle Syari and Lower Syari due to the lack of road network. It is only recently that the ward has been accessed with the metalled roadways and the construction is still under process and yet to reach Lower Syari.

Table No. 3. 18. Ward wise distribution of waste generation per day

Wards	MSW generation tonne/day in 2005	MSW generation tonne/day in 2011	MSW generation tonne/day in 2020
Burtuk	0.5	3	4
Upper Sichey	1	3	4
Lower Sichey	0.5	2	3
Daragaon	1	3	4
Tadong	1	4	6
Upper Syari	0.5	1	2
Deorali	1	3	5
Upper MG Marg	1.5	5	7
Lower MG Marg	2	6	8
Tibet Road	1	5	7
Diesel Power House	0.5	2	3
Arithang	0.5	2	2
Development Area	0.5	1	1
Chandmari-Tathangchen	0.5	2	3
Ranipool	1	3	5
TOTAL	13	45	64

Source: Field Survey, 2020

3.2.2.2. Municipal Solid Waste Collection and Disposal

As per 2021, GMC now has 19 wards and the solid waste that is generated in all of these wards is collected by the trucks registered for the same by the Corporation (Gangtok Municipal Corporation ,2016). The subproject of GMC funded by Asian Development Bank have procured 51,000 bins and distributed to 25,500 households in Gangtok Municipal Corporation (NERCCDIP ,2011). The bins are of green and blue colours for biodegradable and non-biodegradable wastes, respectively. The Corporation has also provided few drums in the various wards for waste collection. Furthermore, there are 27 trucks which run from Jalipool, Ranipool ward in south to Tashi View

Point, Burtuk ward in the northern extreme of GMC boundary. Each truck has four man-powers, one driver and the others help in collecting, loading, sorting and disposing the wastes. There is a system of ringing of bell to notify the arrival of the garbage truck for collection. However, there are many settlement areas with narrower roads which create the truck services to be limited. In such places, there is door to door collection facilitated by the various NGO's of Gangtok who works hand in hand with the GMC. 15% to 20% door-to-door collection is obtained as of now (Swachh Bharat Mission ,2020). The solid waste is then taken to the dumpsite located 18 km away from Gangtok at Martam. However, Martam dumping ground is used for the disposal of waste from Rangpo Nagar Panchayat and Singtam Nagar Panchayat too. Nevertheless, Gangtok Municipal Corporation contributes the most to the waste brought to the landfill. Furthermore, National Highway 10 is the only route viable to reach the Martam landfill.

- **Ward-wise Collection Order of Municipal Solid Waste in GMC**

  Burtuk Ward lies in the northern part of the GMC and Tashi View Point is the extreme end of the GMC boundary. The jurisdiction area of this ward is from Tashi View Point in the north to Rani Khola in the south and Ganesh Tok in the east to Takste Gate in the west. Here, the truck of GMC runs on NH 10 and Lower Burtuk Road for curb side collection. It reaches till the Tashi View Point where door to door collected household wastes by Solid Waste Management Team (earlier known as United Swastik Youth) is picked up and taken to the Martam dumpsite via Lower Burtuk Road which merges with NH 10 in the Indira Bypass Junction. Some landmarks which lie on this route include Vajra Hall, Swastik, Pakthang Falls, Helipad, Bojoghari and District Court.

  Upper Sichey Ward lies to the south of Burtuk Ward whose jurisdiction runs from Burtuk Jhora in the north till Gandhey Jhora, Indira Bypass in the south and west. One the eastern boundary lies the Mishri Lall Jhora which intersects nearby Norkhill Hotel.

GMC trucks which run on Palzor Stadium Road, DPH Road joining Ranka Road till Lower Burtuk Road does curb side collection and door to door collection service is provided by Upper Sichey Educated Unemployed Cooperative and United Arithang Development Society in this ward. There are more than twenty workers who lend hand in facilitating this service. After the collection, the trucks run via DPH Road which merges with NH10 in Indira Bypass to the dumpsite.

Lower Sichey Ward lies on the west boundary of Upper Sichey and Burtuk forms the northern boundary of this ward. This ward is where the new Sir Thutob Namgyal Memorial Hospital is located. For the municipal solid waste collection, the roads used by the GMC trucks are DPH Road, Ranka Road and Lingding Road. Majorly, Ranka Road is feasible for curb side collection till Ban Jhakri Falls and STNM hospital. The waste collected from the hospital is mostly combustible waste and bio-medical wastes are incinerated at the source. The rest of the settlements where the trucks cannot reach are aided by United Arithang Development Society for household waste collection. Finally, the trucks return the same route it arrives till the dumping ground.

Dara Gaon Ward is located to the south of Lower Sichey ward, north of Tadong ward and west of Deorali ward. For the collection of solid waste, GMC truck travels through NH 10 towards Lumsey School Road till the food godown/warehouse (landmark). The rest of the household wastes are collected with the help of Mahila Sangaj Sanjeevani Cooperative Society since 2017. Another road feasible for curb side collection in Dara Gaon is Lingding Road which goes to Greendale School neighbourhood and Fewa Basti, below Indira Bypass. United Educated Unemployed is another NGO who collects the waste from households situated further away from Greendale School Road area in this ward. The GMC truck also reaches till the end of the Nar Bahadur Bhandari College Road for the collection of solid waste which is then taken to Martam via NH 10.

Tadong lies between Daragaon and Ranipool in north and south, respectively. Starting from the boundary of Nar Bahadur Bhandari College, it is bounded by Syari-Tathangchen ward on the east. The only route in this ward is NH 10 where the GMC truck can achieve the curbside collection. However, there are couples of NGOs that help with door-to-door services. Megalink Waste is one of those organization that collects household wastes from Tadong school area, Khangu Gaon, Fala Gaon, below Entel, Tadong College valley, and Bhotay Gaon in this ward. Next organization working in Tadong ward is United Educated Unemployed who are centered on ICAR locality and households located above Manipal Hospital which is quite far from the NH 10. The bio-medical waste from Manipal Hospital is also incinerated and then thrown in the truck for further disposal in the landfill.

Syari-Tathangchen makes up the eastern boundary of GMC. This ward is elongated and shares boundary with Chandmari in the north to Ranipool in the south. Syari is divided into Upper Syari which is the closest to the NH10 in Deorali ward, Lower Syari which runs into Ranipool ward near the Seti Pool and the Middle Syari lies in the middle of them. When it comes to the collection of solid waste by GMC truck, it is to be noted that the GMC truck only runs till the Upper Syari, a little further away from Royal Plaza. This is because the Syari Road is very narrow with steep curves. The truck then merges with NH 10 at Butterfly Flyover, Deorali and takes the collected waste to the dumpsite. However, in Tathangchen, the truck reaches to area below Tathangchen Secondary School via Tathangchen Area Road and while returning merges with Ridge Road, Tibet Road, Secretariat Road, Sonam Tshering Marg, Kashi Raj Pradhan Road and finally with NH 10 at Nam Nang Junction to take the collected waste to the dumpsite.

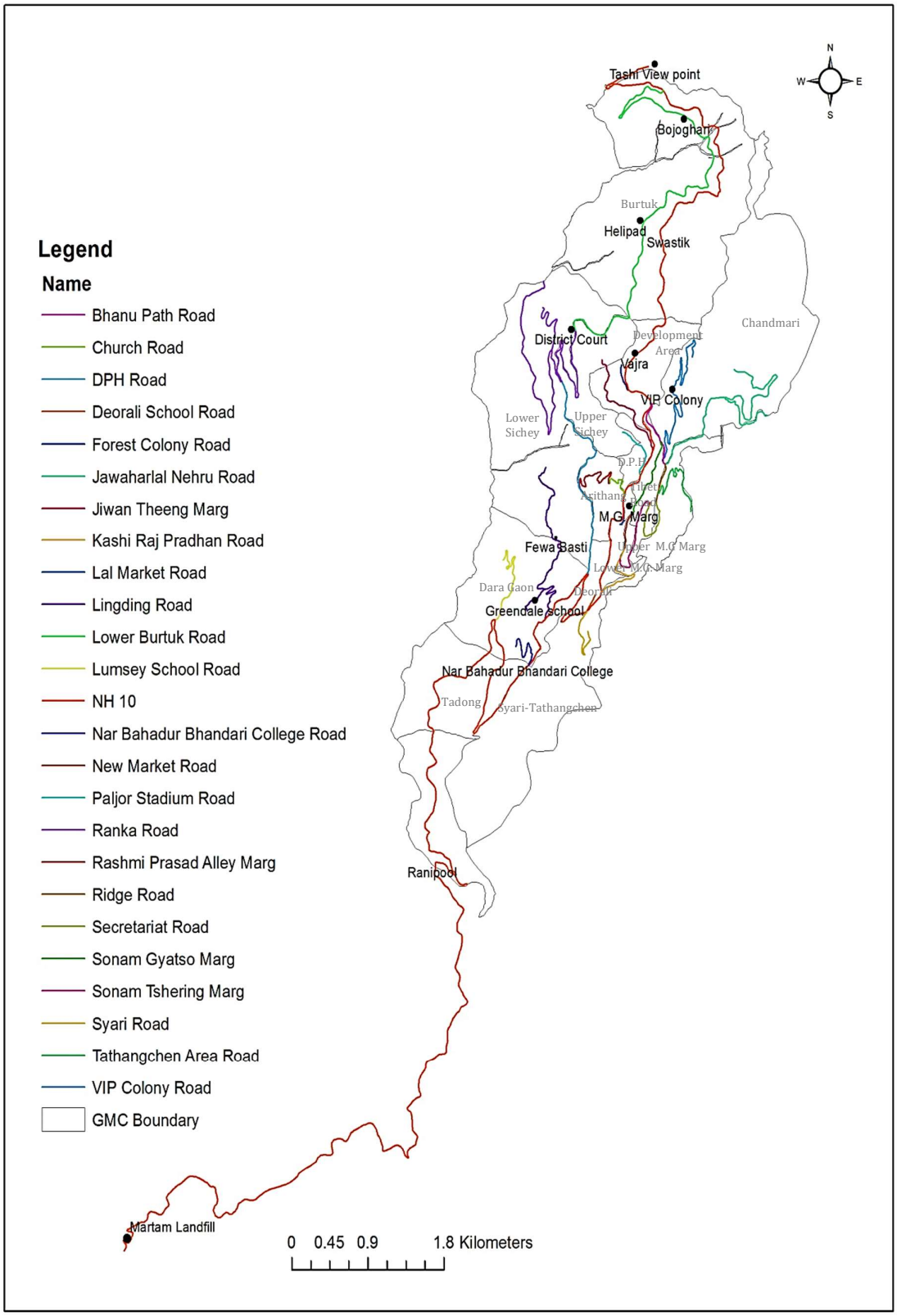
Deorali ward is surrounded by Lower Sichey, Arithang and Lower M.G. Marg in the north and by Syari and Daragaon in the south. The municipal solid waste is curb side collected within the Deorali School Road and the Deorali Kalyan Samaj provides door to door services for the household solid waste collection in Deorali ward. NH 10 is the only route viable here.

M.G Marg has been divided into Upper and Lower M.G. Marg. These two wards mainly form the commercial hub of Gangtok. It is also the only Marg which is vehicle free zone for twenty-four hours a day. Since it is a one-way route Upper M.G. Marg, the GMC truck for collection runs from New Market Road to Kashi Raj Pradhan Road merging with NH 10 at Nam Nang junction. However, in the Lower M.G. Marg, the GMC truck goes Lal Market via the road named the same. The truck basically loads the waste garbage from the market. Additionally, an organization named Genesis Educated Unemployed Cooperative Society Private Ltd. has been facilitating door to door collection in this ward till Nam Nang Point since 2015.

Arithang ward has been recognized for being the most efficient in the household waste collection. United Arithang Development Society provides the door-to-door collection with fifteen numbers of man-power to the places where the GMC truck cannot reach. The roads used by GMC truck is majorly NH10 to Church Road which merges with the DPH road nearby Indira Bypass.

Development Area is landlocked by Upper Sichey, Burtuk, Chandmari, Tibet Road and DPH wards. For the collection purpose, GMC trucks take NH 10 which demerges into Jiwan Theeng Marg and goes to the end till Tashi Namgyal High Secondary School crossing Manan Kendra on the way. The trucks also take up Forest Colony Road which then heads towards Martam landfill via NH10.

Fig. 3.7. Route covered by GMC trucks for solid waste collection



Source: Gangtok Municipal Corporation, Govt. of Sikkim; ArcGIS, 2019.

Tibet Road is yet another ward which lies north to the M.G. Marg and is very commercial in nature. The collection of household waste here is done directly by the GMC trucks. The route for curb side collection is Bhanu Path Road covering Tashi Namgyal School area, Minto Gang and White Hall. It then runs on Secretariat Road finally joining Sonam Tshering Marg at the Upper M.G. Marg which eventually meets New Market Road at Lower M.G. Marg Another road used in this ward by the truck is Sonam Gyatso Marg covering landmarks like Old Sardar Thana and Live and Loud Café which merges with New Market Road at Upper M.G.Marg.

Diesel Power House is the ward which is bounded by Upper Sichey and Lower Sichey in the west to Tibet Road in the east and north – south extend is between Development area and Lower M.G. Marg and Arithang ward. The GMC truck travels through NH10, Paljor Stadium Road and Jiwan Theeng Marg for curbside collection. However, since the ward does not have many viable roads suitable for big GMC trucks, organization like Watson Committee, United Educated Unemployed and United Arithang Development Society provides door to door collection services to the households away from the main road network. Watson Committee is one of the first NGOs to be officially formed in 2nd October, 2003 and till date they cover the solid waste collection of households located in and around Pani House, Tenzing and Tenzing, jhora surrounding Tripti's and above Indira Bypass in alternative schedule. United Arithang Development Society covers the area around Paljor Stadium in this ward and United Educated Unemployed lends their services in and around SNT department and Housing Colony at Development area. The trucks then take NH 10 route to unload the waste in the Martam dumpsite.

Chandmari makes up the north-east boundary of the GMC where the curbside collection is done from VIP Colony Road and Jawaharlal Nehru Road. The trucks collect solid

waste from the areas in and around West Point School, Enchey Gumpa, Dichenling till 2nd Mile check post. Chandmari Youth is the NGO who serves this ward for the door-to-door collection of household waste. When the collection is over, the truck takes the route via Nam Nang and merges with NH 10 for reaching the Martam landfill.

- **Disposal Arrangements of Municipal Solid Waste in Gangtok**
  - Salient Features of Martam landfill

The landfill site is geologically on a Precambrian rock consisting of schists and foliated phyllites (NERCCDIP ,2011). Thus, the site is vulnerable to weathering and erosion alike. Being located on a hilly slope, the site is limited on both the western side and on the bottom side due to Rani Khola. Furthermore, the total dumpsite in Martam is about 4.2 hectare (SIPMIU ,2012). However, due to natural constraints and infrastructural constraints like composting plant, segregation station, road, weighing bridge and others, the available yard to dump the waste is only about 9900 sq.m. or 0.99 hectare (SIPMIU ,2012). In addition, the soil used to cover the site is mainly sandy loam soil and despite the thickness ranging between 3m to 5m (NERCCDIP ,2011), the soil is highly porous and acidic in nature.

The current disposal method of collected solid waste is unsuitable for the environment and the people both as the methods do not align with the current rules of municipal solid waste management (SIPMIU ,2012). On the way to the landfill from Gangtok, there are three points, namely, Ranipool, Smile Land and Radang, where the trucks unload the readily sorted PET bottles, plastic jugs and glass bottles. Since there is no material recovery facility, the rest is dumped directly to the landfill where further sorting of waste is carried on. The methods run opposite of how it prevalently should at the landfill. There is a 50-tonne compost plant which has remained non-operational. The contractor in the Martam landfill says, *"The composting plant was in operation in*

2019 for couple of months. More than 700 kgs of organic waste was dried and then put into organic waste converter every few days. The compost extracted was used for a trial basis by the Sajong Farmers Society but the composting stopped. When the waste stopped segregating at the source, the segregation of wet organic waste here alone was near to impossible so we stopped eventually."

The segregation and sorting are still carried on in the landfill. However, the method is manually performed which is unsafe, insufficient, inefficient and time-consuming. At present, there are 40 rag-pickers who work at the landfill out of which 8 are formal workers and 32 of them are informal workers. Another limitation at the landfill is the absence of proper weighing machine. It is only recently that GMC have provided a detailed inspection report with 12-point proposals for mechanization of scientific sanitary landfill and the eleventh point focus on the need of appropriate weighing machine to collect 'actual data that can be monitored on daily/weekly/monthly/quarterly/half yearly/yearly basis for future reference' (Gangtok Municipal Corporation ,2020). Currently, the sorted waste is weighed with the help of a weighing hook in the landfill. After the sorting of the solid wastes, the plastic bottles are squeezed and packed with the help of a balling machine. The glass bottles are packed in large non-woven PP bags and so are the rest of the sorted wastes. It is then sent for recycling to Siliguri via NH 10.

As in 2020, an impact of globalization and urbanization in the waste system is strongly felt in Gangtok Municipal Corporation. The waste streams have increased in the variated forms of plastic composition irrespective of the notification of the plastic ban in 1998. The emission of methane (CH4) from the landfill alone is 16 percent (Edenhofer, et al. ,2014). In Sikkim, the emission of methane is 5652 tonnes/year in 2019 from the landfills alone which is projected to increase to 11390 tonnes/year by

2025 (Swachh Bharat Mission ,2020). Such an issue is grievous to the hill area environment where the residents of this fragile ecosystem will be the primary victims to the unhygienic and catastrophic consequences of the fragmentary urban lifestyle. Despite rigorous attempt of the local bodies to curtail down the negative impacts of heaping wastes in Gangtok, the rising numbers of tourist influx in the recent years have further exasperated the authorities to function adequately; lack of man-power is strongly felt. Despite various policies and regulations on waste management and sanitization in urban spaces of India is drafted at national level from time to time, focus on ways to efficiently tackle this herculean task in hilly urban towns have not gained much specialization. Additionally, the segregation of solid waste at the source remains only a wishful thinking in most of the urban cities and towns in India which only makes the service capacity of the local bodies less efficient. Ultimately, the problem of non-segregation of solid waste demands an understanding of the discrepancy between verbal values and actual action towards environmental behaviour at the household level. Thus, it can be useful for improving the effectiveness of environmental measures and policies for a healthy future in the hill station.

CHAPTER – IV

BEHAVIOURAL ANALYSIS ON WASTE MANAGEMENT AT HOUSEHOLD LEVEL

Introduction

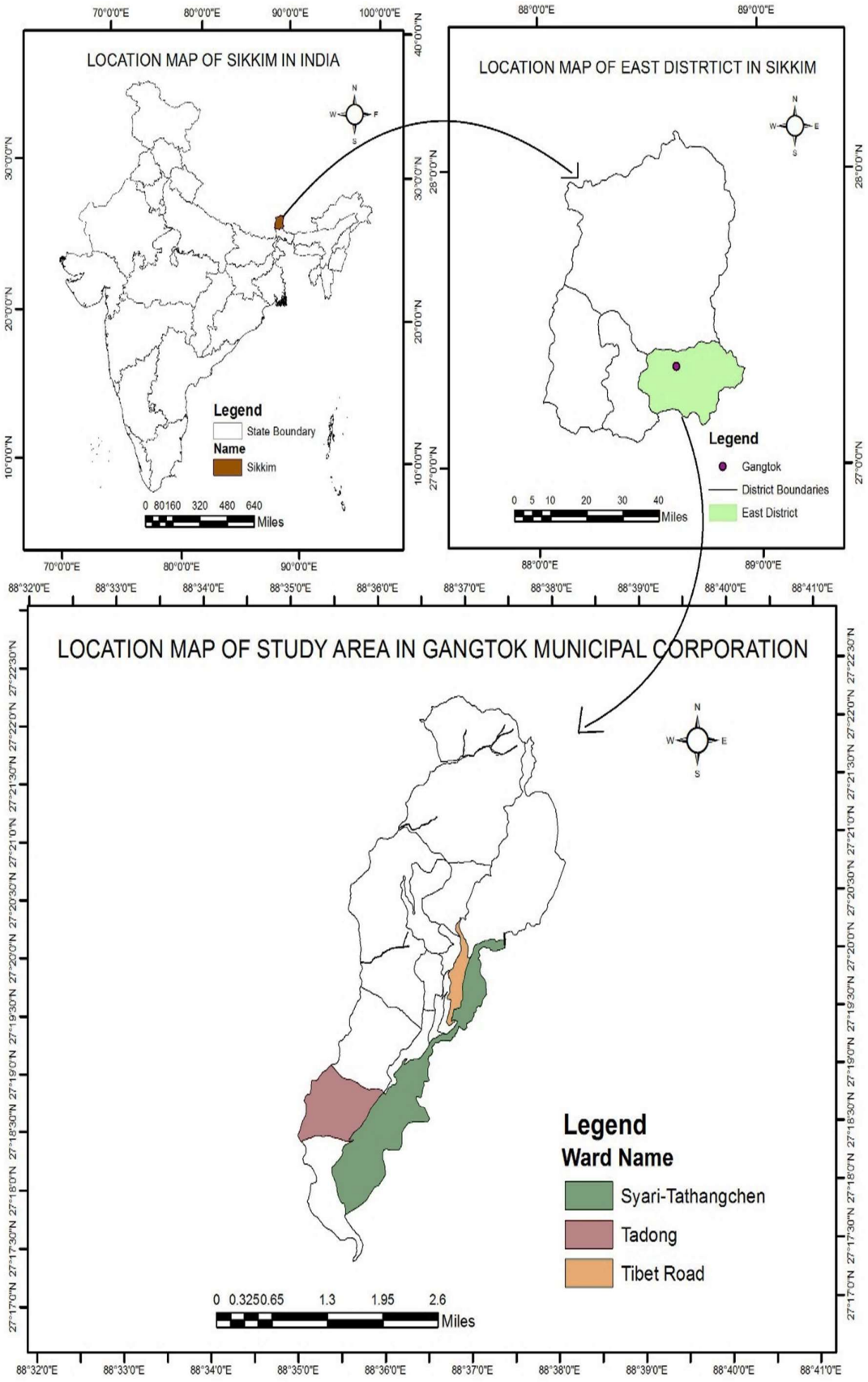
Located at an altitude of 1650m above sea level in the ecologically fragile Eastern Himalayas, the hilly terrain Gangtok is a rapidly urbanizing capital of Sikkim. Due to the unbalanced regional growth, Gangtok accentuates intrastate and interstate migration for various socio-economic reasons. Over the last few years, the credits of the cleanest state and the organic state (ENVIS, 2016) have bagged Sikkim a brighter image which is also contributing towards the tourist influx throughout the year. In 2019, the tourist influx went over 16 lakhs and the numbers are only increasing with little signs of slowing down. The urban population growth in Gangtok alone steepened from 29,345 in 2001 to 1,00,286 in 2011 (Census of India, 2011) which accounts for 65.2 percent of total urban population in Sikkim. Eventually, this rapid urban growth in Gangtok have created records of landslide caused due to disposal of waste in the water streams (ECOSS ,2014). This unprecedent increase of solid waste have also put a tremendous pressure upon the Martam landfill which as estimated may not last for 20 years as it is supposed to. Gangtok generates 50 metric tonne of solid waste per day, out of which, household waste comprises 60 percent, 15 percent from markets, 10 percent from hotels and restaurants, 10 percent from tourist and 5 percent from the street sweepings (NERCCDIP ,2011). Since prior research of waste in Gangtok is focussed only upon quantification of the managerial practices at household level, this paper is an attempt to understand the factors influencing those actions which can be achieved only with an elaborative study of human behaviour.

4.1. Understanding attitudes and behaviour at household level

The households are a prime contributor of waste in Gangtok. Thus, it demands the study to have a clear understanding on what they generate and how they manage the waste on the daily basis. However, the research will be incomplete without bringing out the

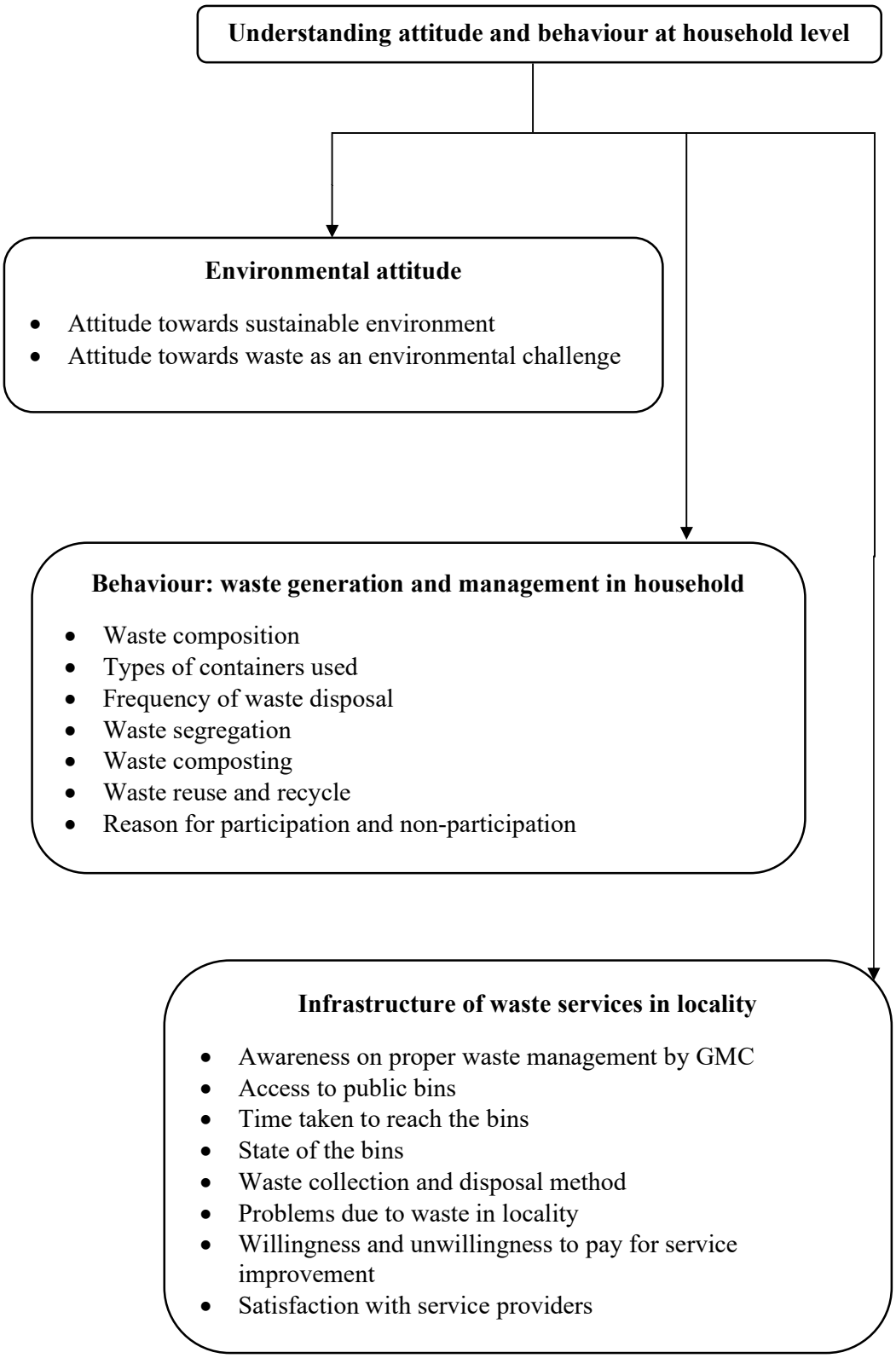
clarity on the question often ignored, ‘why do they manage the waste the way they do?’ When such a big question is ignored, the ultimate goal of any waste policy and regulations implemented fails. Since the ultimate aim of the research is to have a better understanding of waste management at households to come up with a generally suitable recommendation, three locations of varied characteristics have been selected for enriching the interpretation of reality, namely, residential location Syari, mixed location Tadong and commercial location Tibet Road from July to October, 2020 with the help of purposive sampling as the limitation to cover all the wards of GMC is faced due to the emergence of novel Coronavirus in the same year.

Referring to the theory of *cognitive map and spatial behaviour* (Stea and Downs, 1970), three major components to examine the behaviour of the households are taken: environmental attitudes, behaviour: waste generation and management in household and infrastructure of waste services in locality; each of which have various sub-components (Fig.4.1). Under these components, various socio-demographic variables are examined to check the possibilities of their influence on the household’s waste behaviour. Factors like age, gender, education background, household income level, age-wise household size and working characteristics provide initial exploration on the waste consciousness and practices. Nevertheless, to assume that the attitudes built up by these factors alone is compatible with the behaviour is to align with the positivist assumption of an ‘economic man’. Contrarily, embarking in the field without any prior assumption will unfold the ground reality as the research process. Thus, following a mixed approach to answer the main question of ‘why’, in-depth interview is taken after the questionnaire survey and data analysis to have a general outlook upon the waste management system in the three wards with different characteristics of Gangtok Municipal Corporation.



Source: GADM, ArcGIS, 2019.

Fig. 4.1. Framework of understanding attitude and behaviour at household level



Source: Field Survey, 2020

a. General information of the households

Table No. 4.1. General information about the respondents

	Total study area % of Respondents	Syari % of Respondents	Tadong % of Respondents	Tibet Road % of Respondents
Gender				
Male	52% (56)	68% (32)	41% (19)	33% (5)
Female	48% (52)	32% (15)	59% (27)	67% (10)
Age				
<18	6% (7)	4% (2)	6%(3)	13% (2)
18-38	49% (53)	28% (13)	64% (30)	67% (10)
38-58	31% (33)	45% (21)	21% (10)	13% (2)
>58	14% (15)	23% (11)	6% (3)	7% (1)
Education level				
Illiterate	15% (16)	32% (15)	2% (1)	
Primary	22% (24)	28% (13)	17% (8)	20% (3)
Middle School	18% (19)	6% (3)	24% (11)	33% (5)
High School	32% (35)	28% (13)	35% (16)	40% (6)
Graduation	13% (14)	6% (3)	22% (10)	27% (4)
Occupation				
Farmer	6% (7)	15% (7)		
Govt. Job	16% (17)	32% (15)	4% (2)	
Private Job	6% (6)	6% (3)	7% (3)	
Business	16% (17)	2% (1)	35% (16)	47% (7)
Student	15% (16)	9% (4)	26% (12)	20% (3)
Unemployed	13% (14)	9% (4)	22% (10)	33% (5)
Retired	3% (3)	4% (2)	2% (1)	
Others	12% (13)	23% (11)	4% (2)	
Religion				
Hindu	50% (54)	30% (14)	63% (29)	73% (11)
Muslim	4% (4)		7% (3)	7% (1)
Christian	19% (21)	25% (12)	17% (8)	7% (1)
Buddhist	27% (29)	45% (21)	13% (6)	13% (2)
Others				
Marital status				
Married	70% (76)	81%(38)	57% (26)	80% (12)
Unmarried	26% (28)	13%(6)	41% (19)	20% (3)
Widow	4% (4)	6% (3)	2% (1)	
Social Category				
General	31% (34)	11% (5)	41% (19)	67% (10)
SC	6% (7)	6% (3)	9% (4)	
ST	40% (43)	64% (30)	24% (11)	13%(2)
OBC	19% (21)	19% (9)	22%(10)	13%(2)
MBC	3% (3)		4% (2)	7%(1)
Other				
Household Income level				
>15,000	7% (8)	11% (5)	2 % (1)	13% (2)
15,000-34,999	13% (14)	23% (11)	4% (2)	7% (1)
35,000-54,999	22% (24)	23% (11)	22% (10)	20 % (3)
55,000-74,999	38% (41)	23% (11)	52% (24)	40% (6)
<75,000	19% (21)	19% (9)	20% (9)	20 % (3)
Ownership of house				
Owner	46% (50)	87% (41)	20% (9)	
Tenant	54% (58)	13% (6)	80% (37)	100 % (15)
Household size (persons)				
≤ 2	16% (17)	17%(8)	13% (6)	20% (3)
3	31% (33)	32%(15)	30% (14)	27% (4)
4	31% (33)	28% (13)	37% (17)	20% (3)
5	13% (14)	13% (6)	9% (4)	27% (4)
6	6% (6)	4% (2)	7% (3)	7% (1)
7	5% (5)	6% (3)	4% (2)	
≥8				
Age-wise no.of members				
No. of members ≤15 years	26% (105)	27 % (48)	24 %(42)	27 % (15)
No. of members 16-25 years	14% (56)	14 % (25)	14% (25)	11% (6)
No. of members 26-35 years	23% (92)	22% (38)	23% (40)	25% (14)
No. of members 36-45 years	16 % (66)	16 % (28)	17% (29)	16 % (9)
No. of members 46-55 years	8 % (33)	9% (16)	7% (13)	7 % (4)
No. of members ≥ 56 years	13%(54)	12% (21)	14% (25)	14% (8)

Source: Field Survey, 2020.

Table No. 4.2. Age-wise composition of household members with household size

Household size (persons)	Age-wise members of various household size in %							
	Syari							
	No. of households	Members ≤ 15 years	Members 16-25 years	Members 26-35 years	Members 36-45 years	Members 46-55 years	Members ≥ 56 years	Total No. of members
≤2	17% (8)		12 % (2)	25 % (4)	25 % (4)	12 % (2)	25 % (4)	9% (16)
3	32% (15)	33 % (15)	18 % (8)	27 % (12)	13 % (6)	9 % (4)		25% (44)
4	28% (13)	35 % (18)	13 % (7)	19 % (10)	15 % (8)	8 % (4)	10 % (5)	30% (51)
5	13% (6)	20 % (6)	10 % (3)	17 % (5)	20 % (6)	13 % (4)	20 % (6)	17% (30)
6	4% (2)	33 % (4)	8 % (1)	17 % (2)	8 % (1)	8 % (1)	25 % (3)	7% (12)
7	6% (3)	24 % (5)	19 % (4)	24 % (5)	14 % (3)	5 % (1)	14 % (3)	12% (21)
≥8								
TOTAL	100% (47)	100% (48)	100% (25)	100% (38)	100% (28)	100% (16)	100% (21)	100% (174)
Household size (persons)	**Age-wise members of various household size in %**							
	Tadong							
	No. of households	Members ≤15 years	Members 16-25 years	Members 26-35 years	Members 36-45 years	Members 46-55 years	Members ≥ 56 years	Total No. of members
≤ 2	13% (6)		17 % (2)	33 % (4)	17 % (2)	25 % (3)	8 % (1)	7% (12)
3	30% (14)	24 % (10)	17 % (7)	29 % (12)	9 % (4)	7 % (3)	14 % (6)	24% (42)
4	37% (17)	25 % (17)	15 % (10)	21 % (14)	26 % (18)	6 % (4)	7 % (5)	39% (68)
5	9% (4)	30 % (6)	5 % (1)	15 % (3)	15 % (3)	10 % (2)	25 % (5)	12% (20)
6	7% (3)	33 % (6)	11 % (2)	16 % (3)	6 % (1)	6 %(1)	28 % (5)	10% (18)
7	4% (2)	21 % (3)	21 % (3)	29 % (4)	7 % (1)		21 % (3)	8% (14)
≥ 8								
TOTAL	100% (46)	100% (42)	100% (25)	100% (40)	100% (29)	100% (13)	100% (25)	100% (174)
Household size (persons)	**Age-wise members of various household size in %**							
	Tibet Road							
	No. of households	Members ≤15 years	Members 16-25 years	Members 26-35 years	Members 36-45 years	Members 46-55 years	Members ≥ 56 years	Total No. of members
≤ 2	20% (3)			50 % (3)	50 % (3)			11% (6)
3	27% (4)	33 % (4)	16 % (2)	33 % (4)	8 % (1)	8 % (1)		21% (12)
4	20% (3)	41 % (5)	8 % (1)	16 % (2)	17 % (2)	8 % (1)	8 % (1)	21% (12)
5	27% (4)	20 % (4)	10 % (2)	20 % (4)	10 % (2)	10 % (2)	30 % (6)	36% (20)
6	7% (1)	33 % (2)	16 % (1)	16 % (1)	16 % (1)		16 % (1)	11% (6)
7								
≥ 8								
TOTAL	100% (15)	100% (15)	100% (6)	100% (14)	100% (9)	100% (4)	100% (8)	100% (56)

Source: Field Survey, 2020

4.1.1. Environmental attitudes

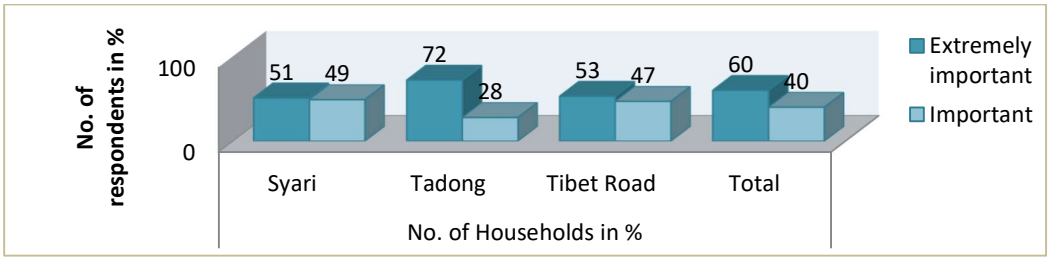
The evaluative feeling towards any subject, here waste, is known as an attitude (Fazio and Zanna, 1981). There are incognitive factors those influence the evaluation a person has towards waste which are not often talked about openly while considering the management of solid waste. Thus, the same has been tried to vent out in three wards of GMC to get a bigger picture. However, to build up those incognitive influential factors, first an understanding of household's cognitive factors is to be done. Initially focusing on waste, it asks for an understanding of whether the environmental consciousness

among the population buds the attitude towards the waste management or not. To evaluate that particular attitude, questions are focused on household's consciousness of environment.

a. Household's attitude towards sustainable environment

First of all, when the householders of each ward were asked to rate the importance of sustainable environment in the scale of 'extremely important', 'important', 'not important at all' and 'not sure', 60 percent of the total households surveyed said it is 'extremely important' and 40 percent of the total householders rated 'important'. In all the wards, level of concern for the sustainability of the environment was shown to be consistently high which went over 50 percent. 72 percent in Tadong rated 'extremely important' followed by 53 percent in Tibet Road and 51 percent in Syari. (Table No. 4.3) All of the respondents expressed positive concern towards the environment and everybody seems to know about the importance of sustainability for environment. To have detailed information on who expressed what, socio-demographic factors are further examined.

Fig. 4.2. Households listing the importance of sustainable environment



Source: Field Survey, 2020.

Table No. 4.3. Households listing the importance of sustainable environment

	No. of Households in %			
How important is sustainable environment?	Syari	Tadong	Tibet Road	Total
Extremely important	51% (24)	72% (33)	53%(8)	60% (65)
Important	49% (23)	28% (13)	47% (7)	40% (43)
Not important at all				
Not sure				

Source: Field Survey, 2020

i. Age

Based upon the age, Table No. 4.4 shows that the respondents below the age of eighteen have their major focus in 'extremely important'. These respondents are all of seventeen years old and not any less than that. In Syari, the highest percent share in 'extremely important' is from respondents below 18 years of age. It is followed by 62 percent of respondents in the age group of 18-38 and 52 percent of respondents in the age group 39-58. The lowest percent share is from respondents who are above the age of 58 here. Nevertheless, 73 percent of respondents in this age group still acknowledge that the sustainable environment is 'important' if not 'extremely important'. Similarly, Tadong has the highest percent share in acknowledgement of 'extreme importance' for sustainability from the respondents in the age group below eighteen, followed by 77 percent share from 18-38 age group. The respondents above the age of 58 contributes third highest percent share towards 'extremely important' and there is a fifty-fifty percent share between 'extremely important' and 'important' acknowledgement by the age group of 39-58 for environmental sustainability.

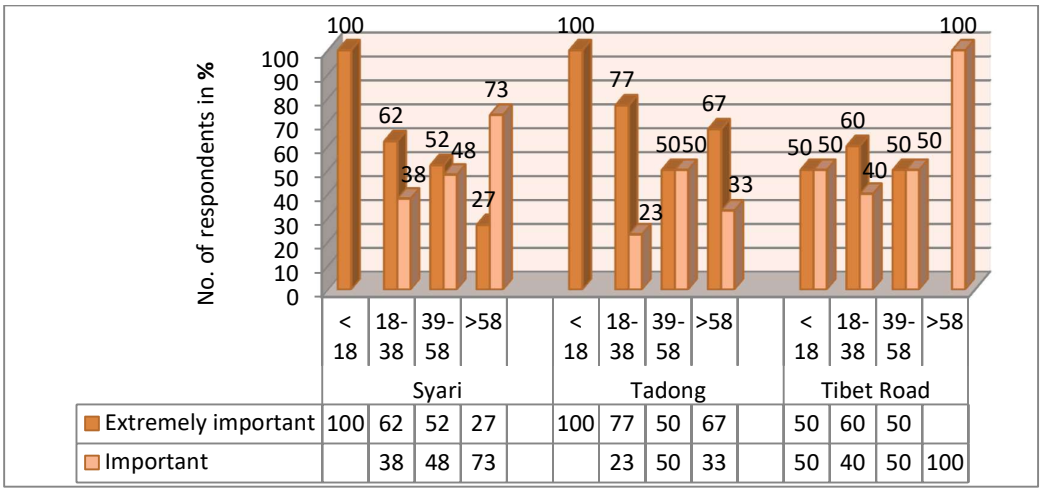
Table No. 4. 4. Households listing importance of sustainable environment by age

	No. of respondents in %			
How important is sustainable environment?	Syari			
	< 18	18-38	39-58	>58
Extremely important	100% (2)	62% (8)	52% (11)	27% (3)
Important		38% (5)	48% (10)	73% (8)
Not important at all				
Not sure				
How important is sustainable environment?	Tadong			
	< 18	18-38	39-58	>58
Extremely important	100% (3)	77% (23)	50% (5)	67% (2)
Important		23% (7)	50%(5)	33% (1)
Not important at all				
Not sure				
How important is sustainable environment?	Tibet Road			
	< 18	18-38	39-58	>58
Extremely important	50% (1)	60% (6)	50% (1)	
Important	50% (1)	40% (4)	50% (1)	100% (1)
Not important at all				
Not sure				

Source: Field Survey, 2020

While the two other wards have the highest percent share in acknowledgement of 'extreme importance' for sustainable environment from the respondents below the age of eighteen, there is a fifty-fifty percent of respondents from this age group acknowledging 'extremely important' and 'important' as the need for sustainability of environment in Tibet Road. Also, fifty-fifty percent of respondents in the age group of 39-58 acknowledges the need of sustainable environment as 'extremely important' and 'important'. The highest percent of respondents who views sustainability with an extreme importance is between the age group of 18-38 at 60 percent and the respondent above the age of 58 in Tibet Road acknowledges that the development of society should happen in sustainable manner. However, the respondent does not think that it is extremely important here.

Fig. 4.3. Households listing the importance of sustainable environment by age



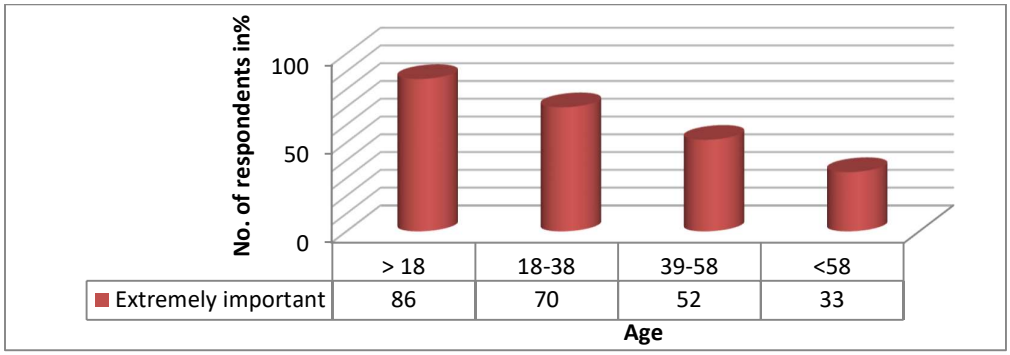
	Syari				Tadong				Tibet Road			
	< 18	18-38	39-58	>58	< 18	18-38	39-58	>58	< 18	18-38	39-58	>58
Extremely important	100	62	52	27	100	77	50	67	50	60	50	
Important		38	48	73		23	50	33	50	40	50	100

Source: Field Survey, 2020

Figure 4.4 below shows that the population in the age of seventeen years has the highest preference of sustainable development in today's world. Not lacking far behind is the population in the age group of 18-38 years. It can be drawn from here that the young adults have a better consciousness and attitude towards sustaining the environment. As the age increases, the importance of the need of sustainable environment is

acknowledged by less and a smaller number of respondents. It stoops lowest in the number of responses from the population who are senior citizens. The trend that can be highlighted from the figure below is that as the age increase, the attitude favouring betterment of the environment decreases. Also, the independent population on the whole has a positive attitude towards the preservation of the environment.

Fig. 4.4. Distribution of total acknowledgement of sustainable environment's extreme importance across various age groups



Source: Field Survey, 2020

ii. Gender

Table No. 4. 5. Households listing importance of sustainable environment by gender

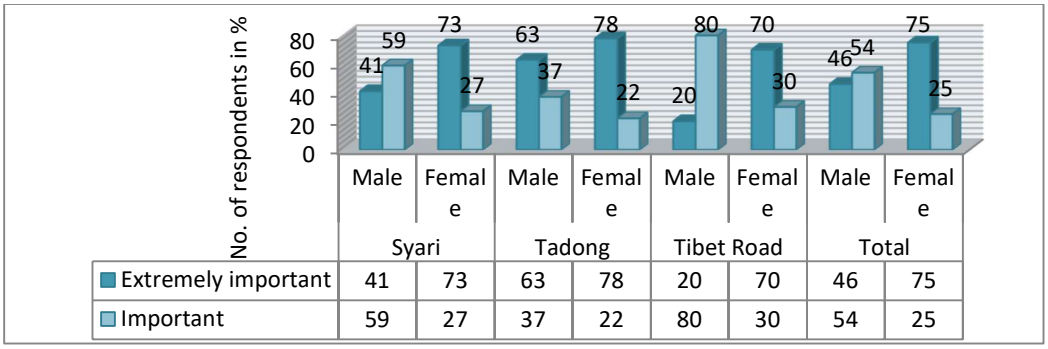
	No. of Respondents in %							
How important is sustainable environment?	Syari		Tadong		Tibet Road		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Extremely important	41% (13)	73% (11)	63% (12)	78% (21)	20% (1)	70% (7)	46% (26)	75%(39)
Important	59% (19)	27% (4)	37%(7)	22% (6)	80% (4)	30%(3)	54% (30)	25% (13)
Not important at all								
Not sure								

Source: Field Survey, 2020

When evaluating the percent share based on gender, females are observed to be more conscious about the sustainability of environment; 75 percent of total female respondents have acknowledged 'extremely important' need of sustainable environment as opposed to 46 percent share from total male surveyed. When compared among the three study wards, all of them have highest percent share from females at 73

percent, 78 percent and 70 percent in residential Syari ward, mixed Tadong ward and commercial Tibet Road ward, respectively. Apart from the gender variation, when observed, it is only in Tadong that a higher number of males acknowledge the scale 'extremely important' for sustainable environment whereas in both Syari and Tibet Road, higher percent of male respondents acknowledge the scale 'important' for the same. Only 41 percent of males in Syari say that sustainable environment is 'extremely important' and even lower percent of only 20 percent of males in Tibet Road express the same (Table No. 4.5). Overall, it is observed that the females are more conscious about the sustainability of the environment than the males in general.

Fig. 4.5. Households listing the importance of sustainable environment by gender



	Syari		Tadong		Tibet Road		Total	
Extremely important	41	73	63	78	20	70	46	75
Important	59	27	37	22	80	30	54	25

Source: Field Survey, 2020.

iii. Education level

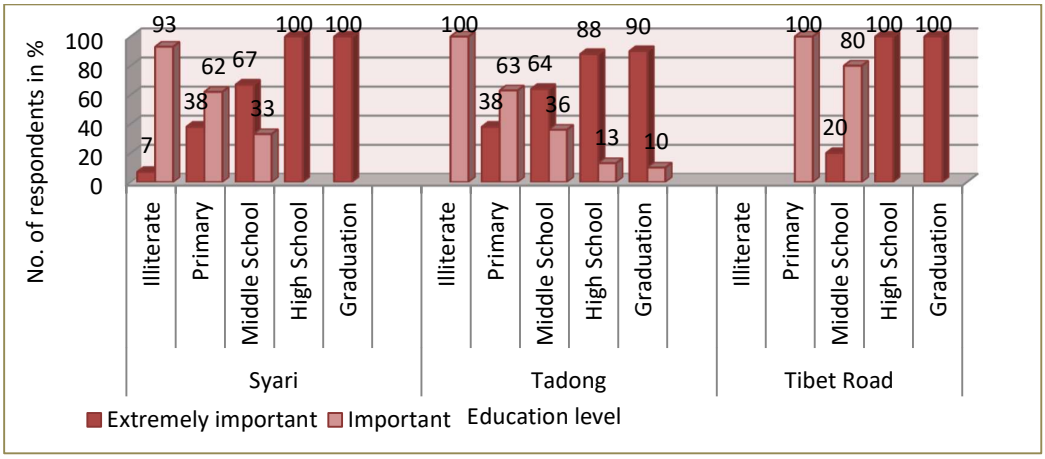
It is also observed that population with 'high school' and 'graduation' education level have acknowledged 'extremely important' role of sustainability in all of the three wards with 100 percent share from both Syari and Tibet Road each while in Tadong, though the percent share remains highest from these two education levels, it does not exceed 90 percent. The lowest percent share of 'extremely important' category is contributed by respondents with no formal education at 7 percent in Syari, 38 percent of respondents with primary level of education in Tadong and 20 percent of respondents with middle school level of education in Tibet Road.

Table No. 4.6. Households listing the importance of sustainable environment by education level

	No. of Households in %				
How important is sustainable environment?	Syari				
	Illiterate	Primary	Middle School	High School	Graduation
Extremely important	7% (1)	38% (5)	67% (2)	100% (13)	100% (3)
Important	93% (14)	62% (8)	33% (1)		
Not important at all					
Not sure					
How important is sustainable environment?	Tadong				
	Illiterate	Primary	Middle School	High School	Graduation
Extremely important		38% (3)	64% (7)	88% (14)	90%(9)
Important	100% (1)	63% (5)	36% (4)	13% (2)	10%(1)
Not important at all					
Not sure					
How important is sustainable environment?	Tibet Road				
	Illiterate	Primary	Middle School	High School	Graduation
Extremely important			20% (1)	100%(6)	100% (1)
Important		100% (3)	80% (4)		
Not important at all					
Not sure					

Source: Field Survey, 2020.

Fig.4.6. Households listing the importance of sustainable environment by education level



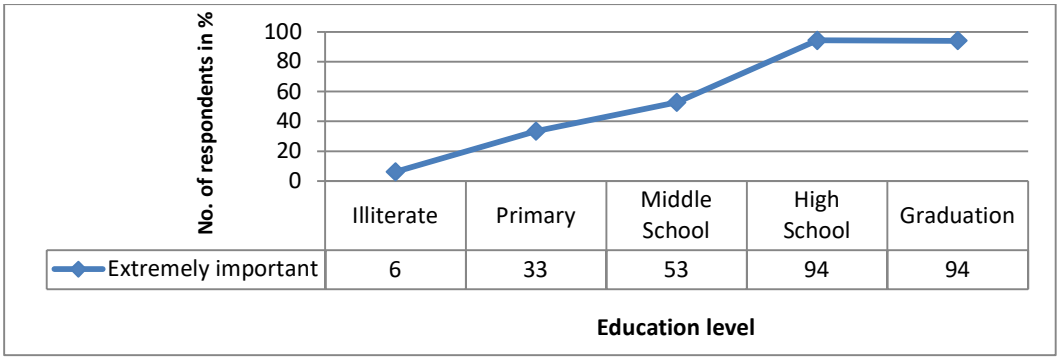
Source: Field Survey, 2020.

It is observed that the high percent of people who acknowledge that sustainable environment if 'important' is either with no formal education like in Syari and Tadong or with primary level of education. The important observation drawn from this table is that despite high level of education level, few of the respondents in Tadong ward hold

the view that the sustainability is 'important' but not 'extremely important'. Mr. Pradhan from 5th Mile, Tadong says, *"There should definitely be a balance between the lifestyle we lead and our environment. In today's time we cannot compromise on the basic standard of living. We have constant need of utilizing natural resources. That is why I feel sustainability is important but not extremely important."*

The attitude that favours environment's sustainability is strongly dependent upon the education level and qualification of the population. It is derived that out of the total respondents surveyed, population with a qualification with high school level degree and graduation degree are highly aware about the need for preservation of resources in the world. They are the highest percent of respondents who holds an attitude favouring sustainability. The least percent of respondents who favours the same are with no formal education and the trend observed is that as the education level increases, there is an increase in the acknowledgement of sustainable environment's extreme importance with environmentally friendly attitudes. (Figure 4.7)

Fig. 4.7. Distribution of total acknowledgement of sustainable environment's extreme importance across various education levels



Source: Field Survey, 2020.

iv. Occupation

Another aspect to look into while examining environmental consciousness is the characteristics of the work of respondents. Their present occupation can influence the way they perceive their environmental awareness. Likewise, Table No. 4.5 shows that

in Syari all of the respondents who are student and one respondent who does business are conscious of 'extremely important' need of a sustainable environment followed by 80 percent of respondents in government job while the lowest percent share in this category is from farmers at 14 percent; rest of the farmers states 'important' as the scale for sustainable environment which shows that the respondents of farming profession feels the vital need to preserve and conserve the nature. However, they acknowledge that infrastructural development is as important as preserving the natural landscape.

Table No. 4.7. Households listing the importance of sustainable environment by occupation in Syari

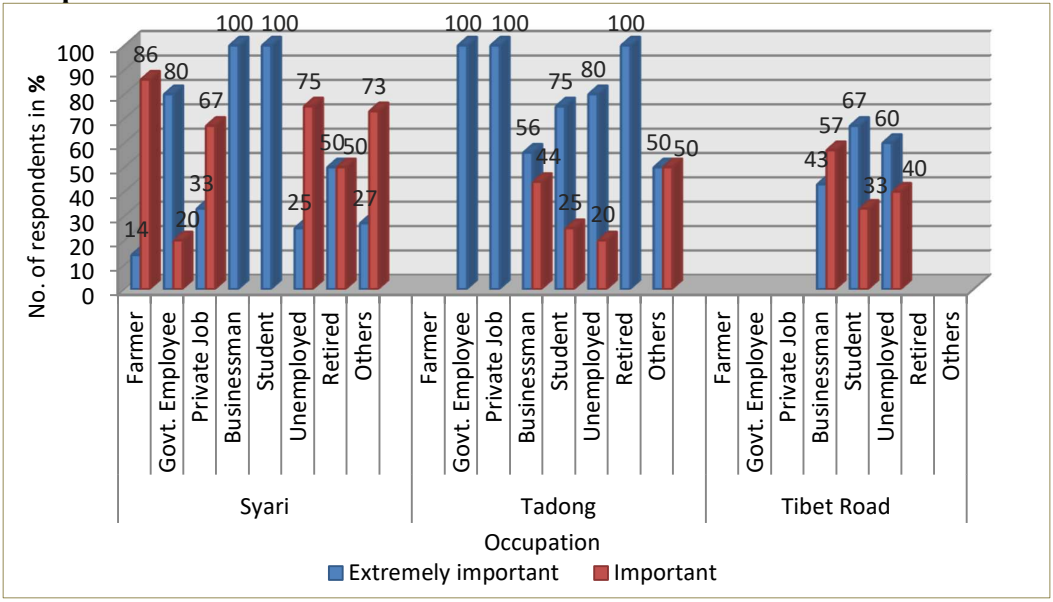
	No. of Households in %							
How important is sustainable environment?	Syari							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Extremely important	14% (1)	80% (12)	33% (1)	100%(1)	100% (4)	25% (1)	50% (1)	27%(3)
Important	86% (6)	20% (3)	67% (2)			75% (3)	50% (1)	73% (8)
Not important at all								
Not sure								
How important is sustainable environment?	Tadong							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Extremely important		100% (2)	100% (3)	56% (9)	75% (9)	80% (8)	100% (1)	50% (1)
Important				44% (7)	25% (3)	20% (2)		50% (1)
Not important at all								
Not sure								
How important is sustainable environment?	Tibet Road							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Extremely important				43% (3)	67% (2)	60% (3)		
Important				57% (4)	33% (1)	40% (1)		
Not important at all								
Not sure								

Source: Field Survey, 2020.

The second highest percent of respondents who acknowledges 'important' category is unemployed, followed by respondents in others who are labours in majority and carpenters. A noticeable feature in Tadong and Tibet wards which set them both apart from residential Syari ward, as per the populations' occupation is the absence of farmers in the mixed and commercial locations. While there is variation in the occupation

between these two locations itself, the uncanny resemblance that can be promptly observed between these two wards is the absence of respondents who are engaged in agricultural activities for their livelihood.

Fig.4.8. Households listing the importance of sustainable environment by occupation

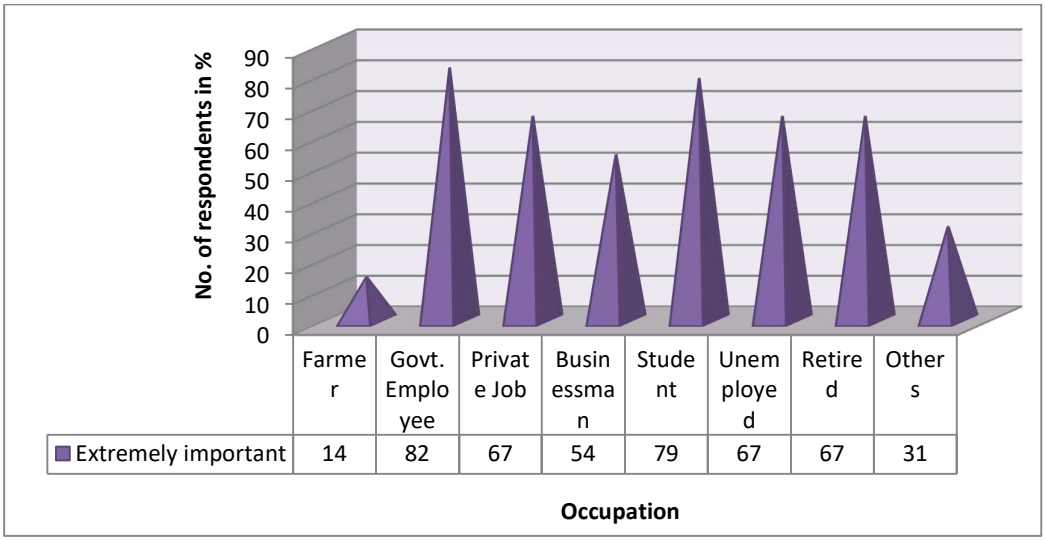


Source: Field Survey, 2020

In Tadong, out of all the respondents surveyed, the respondents with either government jobs or retired from a government job and those who are employees of private job says that the sustainable environment is 'extremely important' followed by respondents who are unemployed and then by students. It is however important to inform that the unemployed category mainly consists of females who are housewives. Thus, the high percent share. The lowest percent of respondents who acknowledges the same have driving occupation. The major difference between Tadong ward and Tibet ward in terms of occupation observed is distinct. In Tibet Road, the respondents surveyed are mostly businessmen and an absence of respondents having various different occupations is visible. It is also to be noted that the students surveyed here have the head of the family's occupation as business. This is mainly because of its locational

factor. Alike other two wards unemployed respondents are the wives of the household head. The student respondents are highest in number to say that the sustainable environment is 'extremely important' at 67 percent and the highest number of respondents to say that sustainable development is 'important' are businessmen at 57 percent. (Table No. 4.5)

Fig. 4.9. Distribution of total acknowledgement of sustainable environment's extreme importance across various occupations



Source: Field Survey, 2020.

Out of the total respondents surveyed, it is visible that the respondents in Government jobs are the ones who have highest acknowledgement of the environment's sustainability. It is followed by the students where 79 percent of the total students' respondents focus upon sustainable environment. Retired respondents, ones working in private company and unemployed respondents are the third highest contributor in acknowledgement of the same. The unemployed respondents are basically females who are housewives. The respondents in business profession are observed to have not as strong environmental attitude and only 54 percent of respondents with business occupation have acknowledged extreme importance of environment's sustainability.

Lastly, farmers are the least number of respondents who have a strong environmentally friendly attitude.

v. Income level

Table No. 4. 8 show the responses in accordance to the household's income distribution per month. Looking into the income distribution, it is observed that the highest percent respondents with household income level above 75,000 rupees suggest that the sustainability of environment is 'extremely important'. These respondents are the government employees who have high education level. On the contrary, only 20 percent of the respondents with household income level below 15,000 rupees acknowledged 'extremely important' category for the environment sustainability. This is attributed from the respondents who have either initial primary education level or no formal education at all. The respondents of lower income level are ones who are either engaged in agricultural activities or manual labour for their livelihood. Here, it is observed that as the household income increases, the level of environmental consciousness increases. When analyzing the data of Tadong and Tibet Road, it is however not the same case. The scenario in Tadong ward is such that the respondents who says that the environmental sustainability is 'extremely important' is highest from household with an income below 15,000 rupees per month followed by household income above 75,000 rupees per month and then the households with monthly income level between 55,000-74,999 rupees. A huge leap from the lowest end to the highest end in responses is accounted. Again, the lowest acknowledgement is seen from the households with an income level of 15,000-34,999 per month which is just above 15,000 rupees.

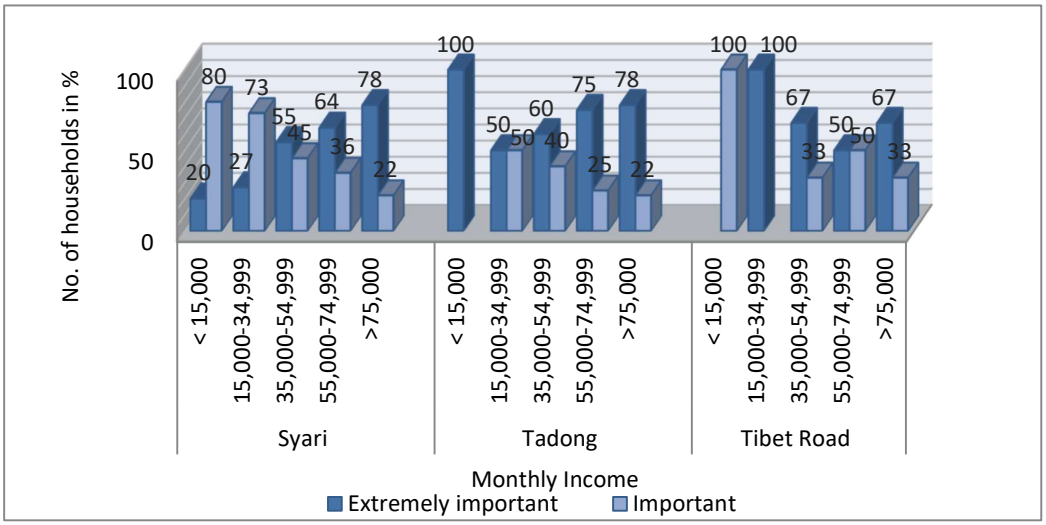
Table No. 4. 8. Households listing the importance of sustainable environment by income level

	Monthly Household Income in Rs. (Syari Ward)in %				
How important is sustainable environment?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Extremely important	20% (1)	27% (3)	55% (6)	64% (7)	78% (7)
Important	80% (4)	73% (8)	45% (5)	36% (4)	22% (2)
Not important at all					
Not sure					
	Monthly Household Income in Rs. (Tadong Ward)in %				
How important is sustainable environment?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Extremely important	100% (1)	50% (1)	60% (6)	75% (18)	78% (7)
Important		50% (1)	40% (4)	25% (6)	22% (2)
Not important at all					
Not sure					
	Monthly Household Income in Rs. (Tibet Road Ward)in %				
How important is sustainable environment?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Extremely important		100% (1)	67% (2)	50% (3)	67% (2)
Important	100% (2)		33% (1)	50% (3)	33% (1)
Not important at all					
Not sure					

Source: Field Survey, 2020.

Likewise, in Tibet Road, respondents with household income level of 15,000-34,999 per month have highest response of 'extremely important' followed by households with income level of 35,000-54,999 rupees and above 75,000 rupees per month together in the second percent share. On the other hand, the need of sustainable development as 'important' is suggested by 100 percent of respondents with monthly household income below 15,000 rupees here. There is an unpredictability and uncertainty to assume populations' environmental consciousness. Nevertheless, it is also observed that the number of respondents is more in higher income level. Needless to say, it is also important to understand that this is the very reason why there is higher percent prevalent in the response of 'extremely important' in households with lower income level. Hence, it can be suggested that the respondents with higher monthly household income are more aware of environment's sustainability. (Table No. 4.8)

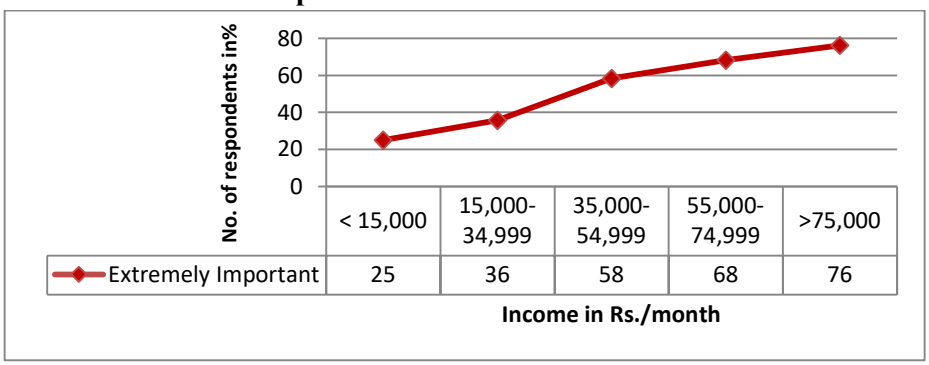
Fig.4.10. Households listing the importance of sustainable environment by income level



Source: Field Survey, 2020.

To further analyze the trend of environmental awareness among the population across various income levels, Figure 4.11 shows that the attitude favouring sustainable development is lowest among the respondents with a monthly household income below 15,000 rupees. There is a gradual increase in the percent of respondents who holds sustainable attitude as the income of the households' increases. The highest percent of respondents acknowledging the same are ones whose monthly household income exceeds 75,000 rupees. Therefore, it is derived from the figure below that the attitude which prefers sustainable approach towards the environment increases as the income level of the households increases.

Fig.4.11. Distribution of total acknowledgement of sustainable environment's extreme importance across various income levels



Source: Field Survey, 2020.

It is observed from the tables above that education level and income level have direct effect upon the environmental consciousness among the population. This environmental attitude is observed more among the females than the males even though they are unemployed and among the respondents who is either student or government employee. Furthermore, population in their young adulthood between the age of seventeen to thirty-eight are more aware of the ongoing issues of environment and have an attitude favoring the sustainable development. However, the same is unsaid about the attitude towards waste in environmental context. Thus, given hereafter is an analysis of household collected data evaluating the socio-demographic factors in building the attitude that views the accountability of waste in shaping the environment's quality.

b. Household's attitude towards waste as an environment challenge

Table No. 4. 9. Households listing improper waste management as an environmental problem

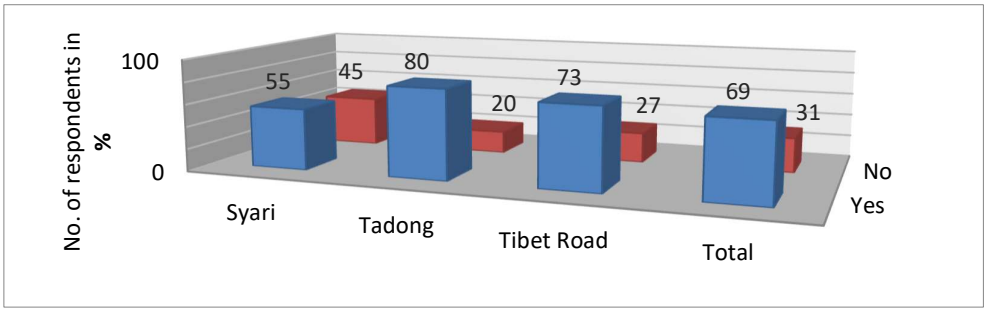
	No. of Households in %			
Is improper waste management an environmental problem?	Syari	Tadong	Tibet Road	Total
Yes	55% (26)	80% (37)	73% (11)	69% (74)
No	45% (21)	20% (9)	27% (4)	31% (34)

Source: Field Survey, 2020

Given the self-expressed concern for the need of sustainable environment, now it is important to learn the households' opinion on improperly managed waste and whether or not, the respondent's knowledge of environmental issue is vivid enough to view mismanaged waste as a threat to the environment. Table No. 4. 9 shows that a total of 69 percent of the respondents agree waste is an environmental problem whose efficient management directly corresponds to better environment. Tadong ward has the highest percent of respondents' acknowledgement at 80 percent. Following up, 73 percent of respondents acknowledged the improperly managed waste as an environmental problem in Tibet Road and in Syari, only 55 percent of the respondents acknowledged

the same which contributes the least percent share. To examine this account, a detailed examination of the respondents' various socio-demographic attributes is done.

Fig. 4.12. Households listing improper waste management as an environmental problem



Source: Field Survey, 2020.

i. Age

When examining among the age group, it is observed that in Syari, the respondents below the age of eighteen are the highest contributor towards the percent share in acknowledging that waste mismanagement is an environmental issue, followed by respondents in the age group of 18-38 and then by 39-58 age grouped population at 100 percent, 71 percent and 62 percent, respectively. The ones who acknowledge that waste mismanagement does not contribute towards the poor quality of the environment are primarily respondents who are above the age of 58. Unlike Syari ward, both Tadong and Tibet Road have a highest percent share of acknowledgement from the respondents above the age of 58 at 100 percent each, followed by the age group of 18-38 at 83 percent and 80 percent in Tadong and Tibet Road, respectively. However, it should be known that the number of respondents above the age of 58 in Tadong is only three and in Tibet Road, only one as opposed to thirty respondents in the age group of 18-38 in Tadong and ten respondents in 18-38 age-group in Tibet Road.

This shows that the respondents who are young adults are more aware of the implications of mismanaged waste on the environment. Nevertheless, it is unwise to

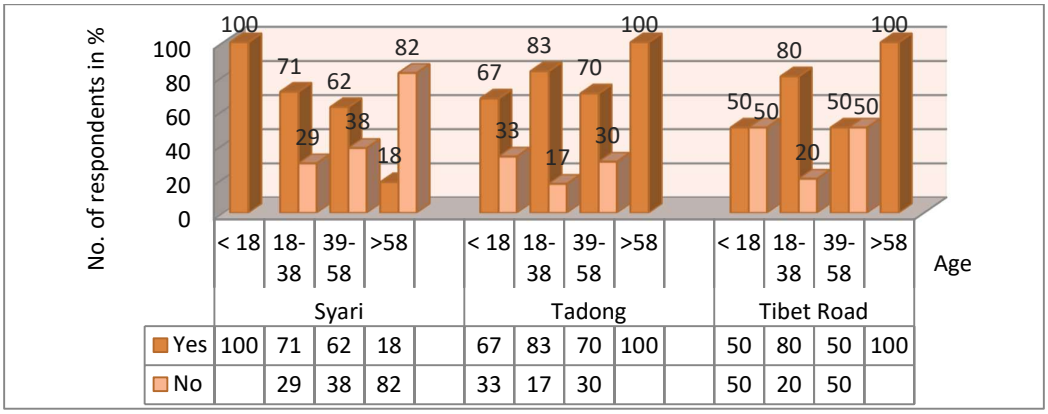
generalize that all of the senior citizen population are uninformed and unaware of the environmental implications of improperly managed waste; rather the data reflects that it is the young adults who are well acquainted to the mishaps of waste and have in general, better knowledge of the rising problems of waste as compared to the elderly population. (Table No. 4.10)

Table No.4.10. Households listing improper waste management as environmental problem by age

	No. of respondents in %			
Is improper waste management an environmental problem?	Syari			
	< 18	18-38	39-58	>58
Yes	100% (1)	71% (10)	62% (13)	18% (2)
No		29% (4)	38% (8)	82% (9)
Is improper waste management an environmental problem?	Tadong			
	< 18	18-38	39-58	>58
Yes	67% (2)	83% (25)	70% (7)	100% (3)
No	33% (1)	17% (5)	30% (3)	
Is improper waste management an environmental problem?	Tibet Road			
	< 18	18-38	39-58	>58
Yes	50%(1)	80% (8)	50% (1)	100% (1)
No	50% (1)	20% (2)	50% (1)	

Source: Field Survey, 2020

Fig.4.13. Households listing improper waste management as an environmental problem by age

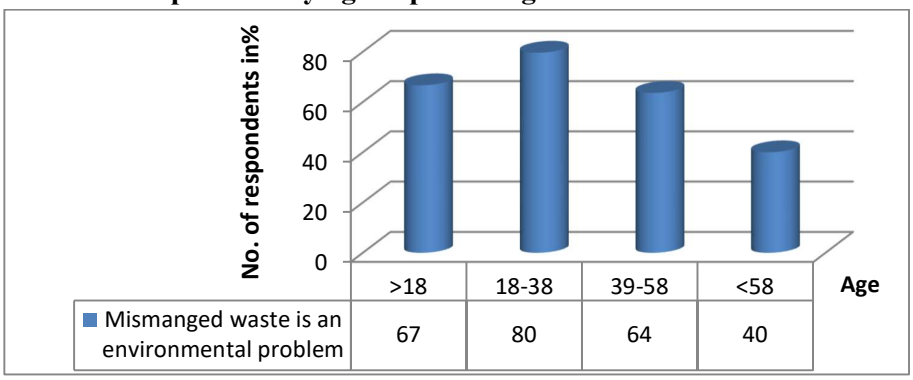


Source: Field Survey, 2020.

From the figure 4.14 given below, the observation drawn is that the population above the age of 58 is not much acquainted to understand the implications of mismanaged waste upon the environment. The highest percent of respondents who easily

acknowledge the adverse impact of mismanaged waste on environment are in the age group of 18-38. The second highest acknowledgement is from the respondents of the age group below 18, here, everyone is seventeen years old. Finally, the adult population between the age group of 39-58 is third highest population to acquaint the improperly managed waste as an environmental challenge. From the chart below, it is thus, derived that the young adults are the most prominent population with a promising approach of tackling the waste efficiently.

Fig. 4.14. Distribution of total respondents listing improper waste management as an environmental problem by age in percentage



Source: Field Survey, 2020.

ii. Gender

Table No. 4.11. Households listing waste management as an environmental problem by gender

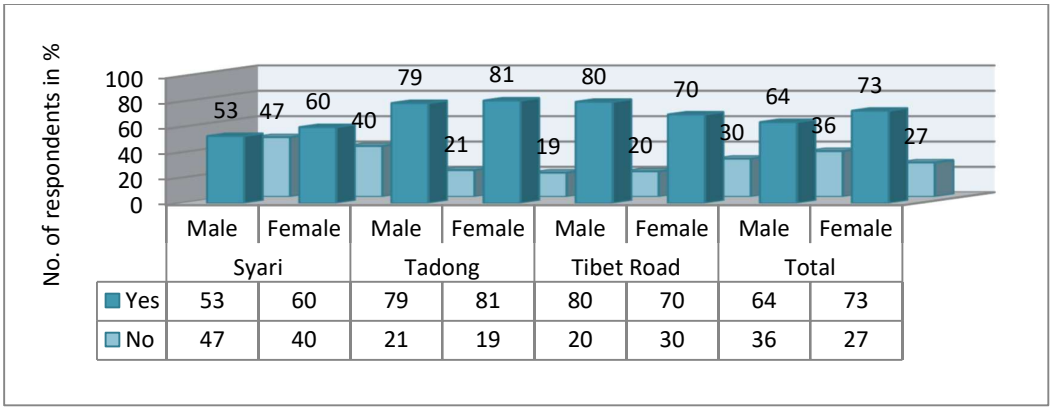
	No. of Respondents in %							
Is improper waste management an environmental problem?	Syari		Tadong		Tibet Road		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Yes	53% (17)	60% (9)	79% (15)	81% (22)	80% (4)	70% (7)	64% (36)	73% (38)
No	47% (15)	40% (6)	21% (4)	19% (5)	20% (1)	30% (3)	36% (20)	27% (14)

Source: Field Survey, 2020.

As per the gender, majority of the total female respondents surveyed agree that the improperly managed waste is problematic towards environment as compared to response of the total male respondents surveyed by 9 percent. It is observed that the females in Syari ward and Tadong ward are more acknowledgeable towards environmental implications of an improper waste management at 60 percent and

81percent, respectively. However, in Tibet Road, more of male respondents acknowledge this issue, 80 percent of the males acknowledges that the waste, if improperly managed, can be environmentally unsound in contrary to 70 percent of the female's respondents. However, the total account reflects those females are better aware about the issues of the mismanaged household wastes. (Table No. 4.11)

Fig.4.15. Households listing improper waste management as an environmental problem by gender



Source: Field Survey, 2020

iii. Education level

Table No. 4.12 shows that in Syari, the respondents with an education level above middle school acknowledge the environmental issues of improperly managed waste with 100 percent of positive response each; whereas only 46 percent of respondents with primary level of education does the acknowledgement of the same. The least percent contributor towards this acknowledgement is from the respondents without any formal education at 7 percent; majority of 93 percent respondents with no formal education inclines towards the lack of knowledge that the waste can be an environmental challenge if not handled efficiently. One of the respondents with no formal education, pointing towards his waste bin says, *"There is no problem in our*

environment until now. I burn the waste when this bucket is full. Everyone here burns their waste but I see no change in our climate."

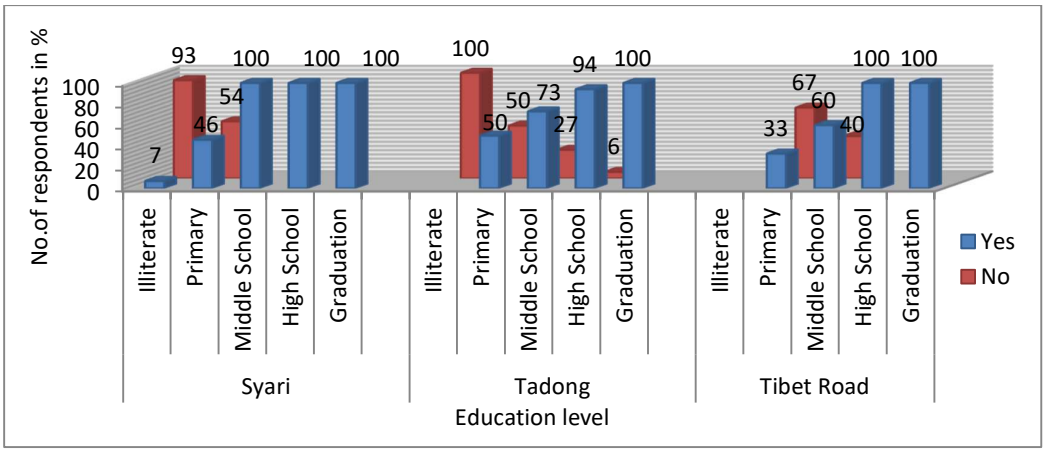
Table No. 4.12. Households listing waste management as an environment problem by education level

	No. of Households in %				
Is waste management an environmental problem?	Syari				
	Illiterate	Primary	Middle School	High School	Graduation
Yes	7% (1)	46% (6)	100% (3)	100% (13)	100% (3)
No	93% (14)	54% (7)			
Is waste management an environmental problem?	Tadong				
	Illiterate	Primary	Middle School	High School	Graduation
Yes		50% (4)	73% (8)	94% (15)	100% (10)
No	100% (1)	50% (4)	27% (3)	6% (1)	
Is waste management an environmental problem?	Tibet Road				
	Illiterate	Primary	Middle School	High School	Graduation
Yes		33% (1)	60% (3)	100% (6)	100% (1)
No		67% (2)	40% (2)		

Source: Field Survey, 2020.

Similar response from the respondents in Tadong ward and Tibet Road is reflected. All of respondents with graduation level of education in Tadong state that an improperly managed waste can be an environmental issue. Also, it is only in Tadong where one of the total respondents with high school level of education is in denial. All of the respondents with no formal education here are unaware of the environmental implications that an improperly managed waste has which is followed by half of the respondents with primary level of education. Similarly, in Tibet Road, larger number of respondents with primary level of education incline towards the denial of the environmental impacts of mismanaged waste whereas, all of the respondents with high school level of education and graduation acknowledge improper waste management as an environmental problem. (Table No. 4.12)

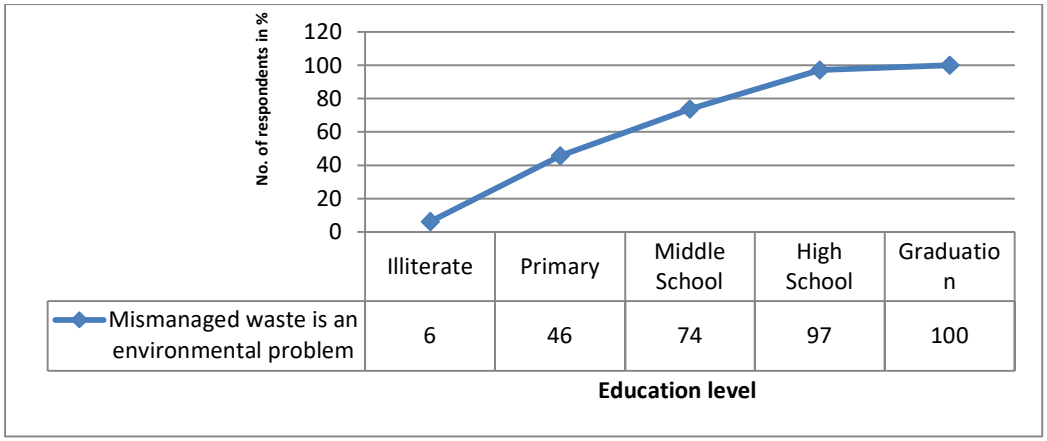
Fig.4.16. Households listing improper waste management as an environmental problem by education level



Source: Field Survey, 2020.

From the figure 4.17 one can draw that as the level of education increases, the knowledge and ability to see how environmentally unsuitable an improperly managed waste is, also increases.

Fig.4.17. Distribution of total respondents listing improper waste management as an environmental problem by education level in percentage



Source: Field Survey, 2020.

iv. Occupation

Table No. 4.13 highlights the attitude that the respondents have towards improperly managed waste as an agent of environmental problems by occupation. Here it is noticed that the respondents who are students, working in private job, business and government

jobs are more acknowledgeable of improperly managed waste as an environmental problem than compared to rest of the respondents. 100 percent of the farmers here do not view mismanaged waste as an environmental challenge followed by 75 percent of unemployed respondents and 73 percent of respondents in others category that are either manual labourers or carpenters.

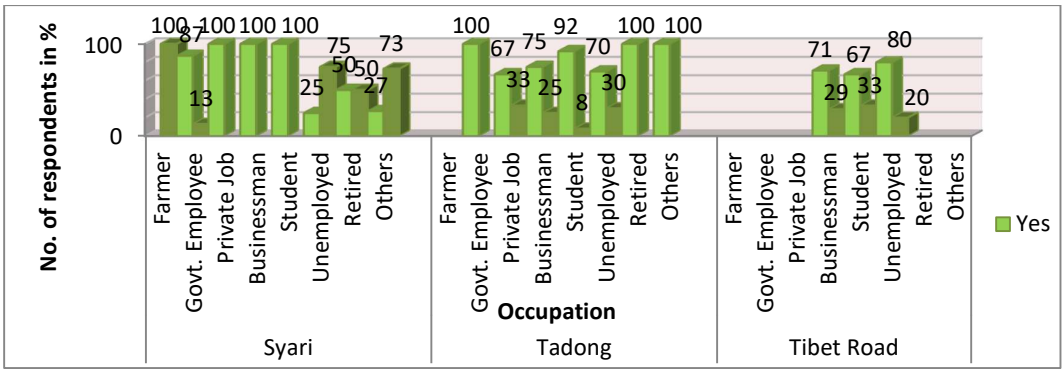
The respondents in Tadong ward shows that all the respondents who are working in government jobs, retired from government job and in others category who are local taxi drivers show acknowledgement of improper management of waste contributes to environment in a negative manner. It is followed by 92 percent of students, 75 percent of respondents in business field and 70 percent of the unemployed population. In Tibet Road ward, the respondents those who are unemployed share the highest percent share of the acknowledgement that improperly managed waste is an environmental problem, followed by 71 percent of the total businessman surveyed and 67 percent of the total students surveyed. It is however to be noted that the unemployed category respondents are only housewives in both of the wards. (Table No. 4.13)

Table No. 4.13. Households listing waste management as an environment problem by occupation

	No. of respondents in %							
Is improper waste management	Syari							
an environmental problem?	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes		87% (13)	100% (3)	100% (1)	100% (4)	25% (1)	50% (1)	27% (3)
No	100% (7)	13% (2)				75% (3)	50% (1)	73% (8)
Is improper waste management	Tadong							
an environmental problem?	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes		100% (2)	67% (2)	75% (12)	92% (11)	70% (7)	100% (1)	100% (2)
No			33% (1)	25% (4)	8% (1)	30% (3)		
Is improper waste management	Tibet Road							
an environmental problem?	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes				71% (5)	67% (2)	80% (4)		
No				29% (2)	33% (1)	20% (1)		

Source: Field Survey, 2020.

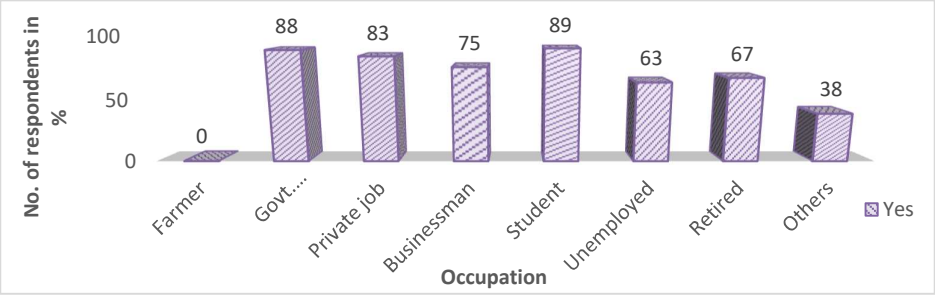
Fig.4.18. Households listing improper waste management as an environmental problem by occupation



Source: Field Survey, 2020.

From the figure 4.19 it is reflected that the respondents who are students provides the highest acknowledgement of mismanaged waste as an environmental problem. Government employees are the second listed respondents who are more acquainted to this knowledge followed by respondents who are privately employed. The high percent of acknowledgement from the businessmen here shows that despite the knowledge of the challenges arising out of mismanaged waste, the businessmen in the earlier section do not feel a strong importance of sustainable environment. Majority of the respondents engaged in manual labour and carpentry for their livelihood also are not very highly conscious of the problematic aspects of waste towards the environment and climate change and all the ones who do not hold the attitude that an improperly managed waste is an environmental challenge are engaged in agricultural activities.

Fig.4.19. Distribution of total respondents listing improper waste management as an environmental problem by occupation in percentage



Source: Field Survey, 2020.

v. Income Level

Based on monthly income level of the households, Table No. 4.14 shows that 100 percent of respondents in Syari with income level above 75,000 rupees per month views improperly managed waste as the environment problem, followed by respondents with an income level of 55,000-74,999 per month at 73 percent and 55 percent of 35,000-74,999 income level respondents. The only respondents in denial are those whose income level is below 15,000 rupees per month. Similarly, in Tadong ward, 100 percent of respondents with income level above75,000 rupees per month acknowledge that waste mismanagement can cause environment problems followed by 83 percent of respondents with monthly household income level of 55,00-74,999 rupees. There is a gradual decrease in agreement with decreasing household income. The agreement stops at 50 percent with respondents having monthly income between 15,000-34,999 rupees. Finally, there is a complete denial of acknowledgement here with household income level below 15,000 rupees per month.

Table No. 4.14. Households listing waste management as an environmental problem by income level

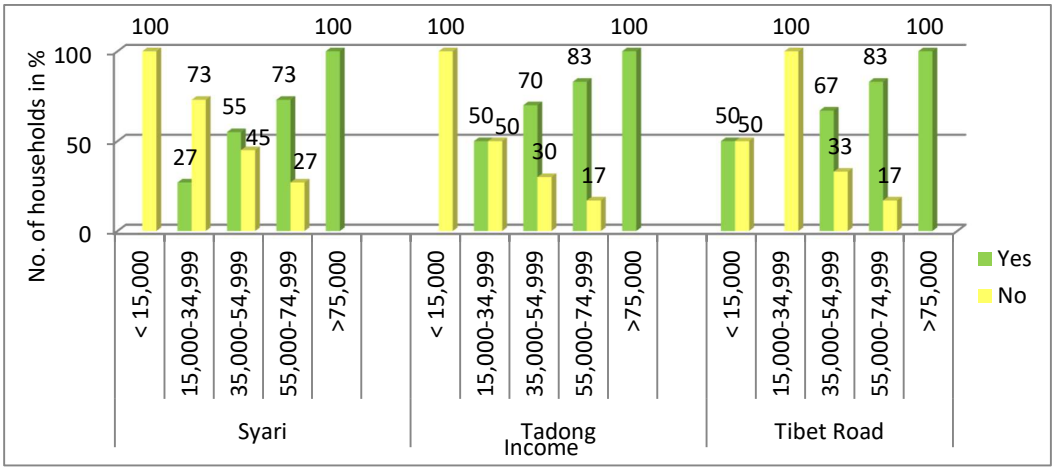
	Monthly Household Income in Rs. (Syari Ward)in %				
Is improper waste management an environmental problem?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes		27% (3)	55% (6)	73% (8)	100% (9)
No	100% (5)	73% (8)	45% (5)	27% (3)	
	Monthly Household Income in Rs. (Tadong Ward)in %				
Is improper waste management an environmental problem?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes		50%(1)	70% (7)	83% (20)	100% (9)
No	100% (1)	50% (1)	30% (3)	17% (4)	
	Monthly Household Income in Rs. (Tibet Road Ward) in %				
Is improper waste management an environmental problem?	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes	50% (1)		67% (2)	83% (5)	100% (3)
No	50% (1)	100% (1)	33 % (1)	17% (1)	

Source: Field Survey, 2020.

A little different from other two wards, in Tibet Road, 50 percent of the respondents with income level below 15,000 perceives the issue of mismanaged waste. The highest

acknowledgement of the same at 100 percent is from the respondents with monthly household income above 75,000. The same trend is observed in this commercial location as well. With the decreasing income level, there is a declining knowledge of the population. (Table No. 4.14)

Fig.4.20. Households listing improper waste management as an environmental problem by income level



Source: Field Survey, 2020.

It can be drawn from all the tables in this section that the respondents with higher education level who are either student, private job employee, perform business, works for the government or retired from government jobs with better income level in majority have knowledge that the improperly managed waste is an environment problem. Although Syari shows that unemployed respondents have very little share in this acknowledgement, the unemployed respondents of Tadong and Tibet Road have higher percent share of the acknowledgement which is mainly because most of these respondents are females who are housewives and have education level above middle school. In overall, the study finds out that more females acknowledge the environmental implications that the waste mismanagement has as compared to males. The adults between the age of seventeen to fifty-seven holds a better recognition and perception

of waste as an important agent of environmental challenges which is not tackled in a proper manner can lead to undesirable climate change.

Hence, from the analysis provided it is reflected that the respondents who are particularly aware about the extreme importance of sustainability for the environment also have the knowledge to associate waste as a challenge to the environment. Furthermore, similar pattern of perception from the various socio-demographic attributes have been drawn in both of the questions. Under the examination of both the questions, the result highlights that the independent population have proper attitudes toward environment's wellbeing and are better perceiver of the underlying reality. It is also distinct that as the education level increases, so does the opportunity of better working conditions which ultimately provides better standard of living. It shows that the environmental concern is more among the students who are pursuing their high school studies and graduation. It is also observed that the populations with higher education level who are majorly working in government jobs particularly have environment-friendly attitude. As the monthly income increases, the concern and awareness towards environment too is increasing. The unemployed respondents who have higher education level also shows environment-friendly attitude, given the fact that majority of the respondents are females. It is also reflected that the males express lower rate of environmental concern than the females although the male respondents surveyed are higher in number than the number of females.

4.1.2. Behaviour towards waste generation and management in household

To understand the action of the households, first, understanding the level of concern for environment is vital so as to draw, whether or not, the households can associate waste as an environmental challenge in the bigger picture. Accordingly, from the analysis of

the socio-demographic attributes of the respondents, it highlights that people's perception of waste as an environmental challenge is proportional to their knowledge of the need for sustainable development which is based upon higher education level first, followed by independent age group, high income level and character of their occupation, and finally gender; given the platform where the females are properly educated. Hence, moving on to examine whether the respondent's attitude synchronize with their actions or not, generation and composition of waste at the household level and the measures taken to handle the generated waste in the household itself is enquired.

a. Household's waste generation

To begin with, firstly, the household generation of waste is taken into consideration in all the three wards of the study area. The data is acquired on verbal account and observation as well as weighing each type of waste is limited due to the mixed nature of the waste despite some households having segregated dustbins. Table No. 4.13 suggests that the highest generation is of food waste and vegetable-fruit peels in all of the three wards at an average of 63 percent which is followed by plastic waste which includes all the food wrappers, packages, sanitary napkins, PET bottles, plastic cans, carry bags, etc. at 18 percent. The generation of paper and cardboard waste is third highest at 7 percent. The generation of glass bottles is from the alcohol bottles alone at 6 percent. This is mainly because the price of alcohol is comparatively cheaper than other states in India due to lower excise duty enforced by the Sikkim Excise Act, 1992; also drinking liquor have become a culture in Sikkim where majority of the communities align drinking to one of the traditions of festive celebration and social inclusiveness. On the other hand, fiber bags are of 5 percent each. It is to be noted that the ban of plastic bags is the main reason for the rising quantity of fiber bags. It is only in scanty amount that waste made up of tin is generated in the households in all the

three wards weekly. Furthermore, the generation of electrical and electronic waste is absent on weekly basis and these types of waste is not generated as often in the study area. When comparatively examining the generation of waste among all the three locations, it is visible that generation of food waste is highest in Syari.

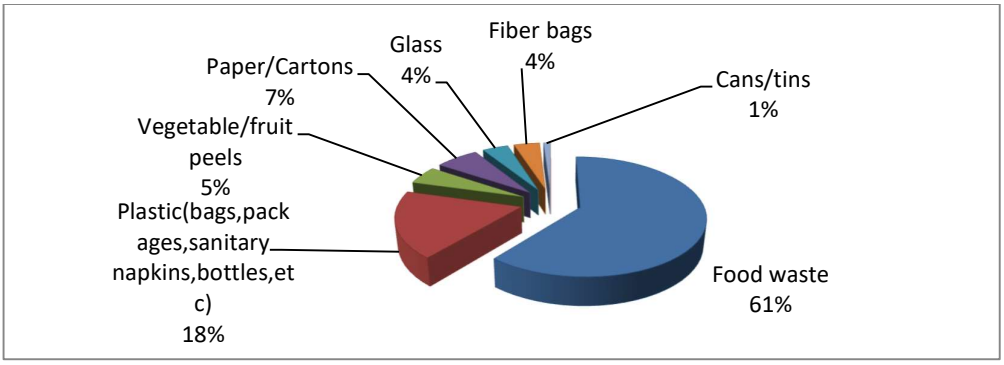
Table No. 4. 15. Types of waste generation per week

Composition of waste	Generation of waste per week in %			
	Total	Syari	Tadong	Tibet Road
Food waste/Vegetable-fruit peels	63	70	60	60
Plastic(bags,packages,sanitary napkins,bottles,etc)	18	15	20	20
Paper/Cardboard	7	5	5	10
Glass bottles	6	5	8	4
Fiber bags	5	5	5	5
Cans/tins	1	0	2	1
Electrical waste	0	0	0	0
	100	100	100	100

Source: Field Survey, 2020

The generation of plastic waste though observed in all the three wards is predominant in Tadong and Tibet Road and Syari has the least plastic waste generation out of them all. The cardboards/paper waste is highest in Tibet Road which is mainly due to the commercial characteristics of occupation of the residents here. Generation of cans and drums made up of tin is absent among households in residential Syari on the weekly basis and the little that is generated in Tadong and Tibet Road are the drink cans majorly and sometimes oil tin drums and barrels. The generation of glass and fiber bags are more in Syari and Tadong as compared to Tibet Road and the electrical waste generation per week is completely absent in all of the three wards. (Fig. 4.21)

Fig. 4.21. Total types of waste generation per week



Source: Field Survey, 2020.

b. Household's waste composition

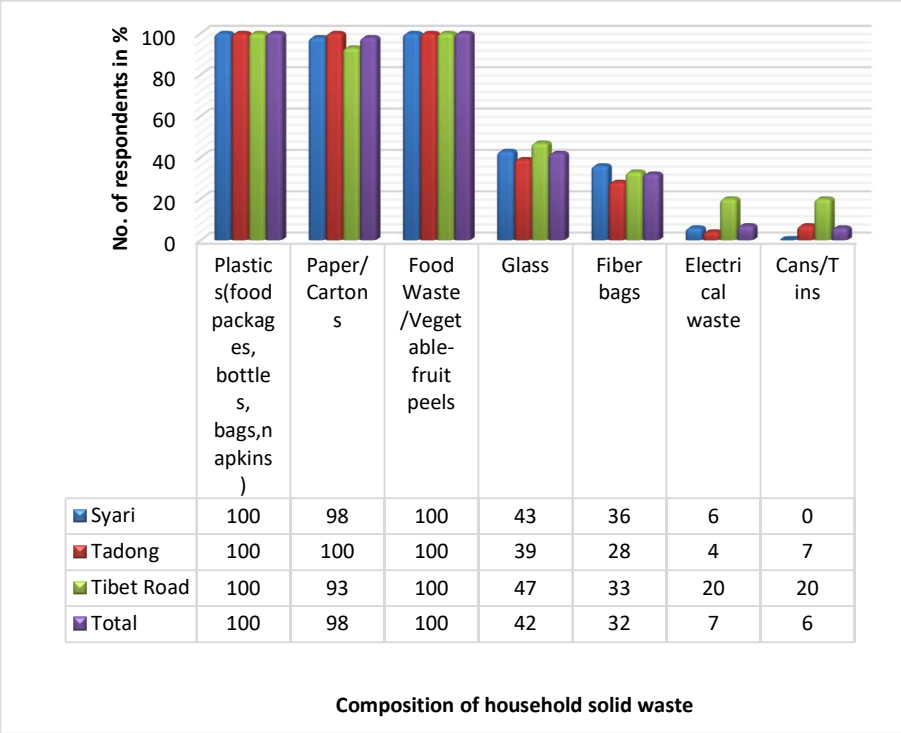
Table No. 4. 16. Composition of household solid waste

Household Composition of Solid Waste	No. of Households in %			
	Syari	Tadong	Tibet Road	Total
Plastics(food packages,sanitary napkins,bottles)	100% (47)	100% (46)	100% (15)	100% (108)
Paper/ Cartons	98% (46)	100% (46)	93% (14)	98% (106)
Food Waste/Vegetable-fruit peels	100% (47)	100% (46)	100% (15)	100% (108)
Glass	43% (20)	39% (18)	47% (7)	42% (45)
Fiber bags	36% (17)	28% (13)	33% (5)	32% (35)
Electrical waste	6% (3)	4% (2)	20% (3)	7% (8)
Cans/Tins	-	7% (3)	20% (3)	6% (6)

Source: Field Survey, 2020

When examining the composition of waste, an absence of 'cans/tins' is found in the rural residential area of Syari. However, all the households produce plastic waste and there is also a very high percent of households at 98 percent who generate paper/cartons which shows that the marketed products are on constant use in the distant residential area as well. The generation of fiber bags in the waste system is acknowledged by 36 percent of the total households surveyed in Syari. This is mainly due to the reason that Syari ward is located in a distant location from the highway and commercial hub. As per one of the Lower Syari residents, *"I have to hire a taxi to reach the nearest shop. It is either Deorali in taxi from Middle Syari or Ranipool on foot from the unmetalled road so, carry bag is always mandatory."* Another respondent in Syari ward focus in the need for cartons, *"Carton is necessary. I always ask the shop-keeper to put everything in one carton and tie it; it's easier and better to carry one big carton than many small bags."* Furthermore, glass is also one of the compositions of waste in 43 percent of the households surveyed in Syari ward which is liquor glass bottles. Another feature in waste composition here is that all of the households produce food/vegetable-fruit waste, although the quantity observed is very less in amount. There is a minimization in food waste generation in a slowly developing residential area. (Table No. 4.16)

Fig.4.22. Households listing their composition of solid waste in the study area



	Plastics(food packages, bottles, bags,napkins)	Paper/ Cartons	Food Waste /Vegetable-fruit peels	Glass	Fiber bags	Electrical waste	Cans/Tins
Syari	100	98	100	43	36	6	0
Tadong	100	100	100	39	28	4	7
Tibet Road	100	93	100	47	33	20	20
Total	100	98	100	42	32	7	6

Source: Field Survey, 2020.

When evaluating the weekly generation of waste and composition of waste in all of the three wards, one can draw from Table no. 4.15 and Table No. 4. 16 that the generation of food waste/vegetable-fruit peels per week is highest in Syari which makes up 70 percent of the waste stream. In Tadong and Tibet Road, food waste/vegetable-fruit peels make up 60 percent each of the households' waste stream per week. Another distinctive feature drawn from these two tables are that although paper and cardboard is found only in 93 percent of the households in Tibet Road, the weekly generation is five percent more than in Syari and Tadong and even though the composition of glass is found in high percent of households in the commercial Tibet Road, the weekly generation is lesser than Tadong and Syari Road which is mainly because majority of the families in that settlement site belong to non-Nepalis communities who do not endorse drinking culture like the Nepali communities do and few who does have easy access to the

restaurants and bars in M.G. Marg. Finally, the predominance of globalization is felt in all of the three wards where the plastic composition in waste stream is observed in all the households. However, the least amount of plastic generation per week is in Syari which is five percent less than that of Tadong and Tibet Road.

i. Income level

Household's waste generation and composition is dependent upon socio-economic factors like income and size of the family. Likewise, an evaluation of waste composition based upon monthly income level in all the three wards is done.

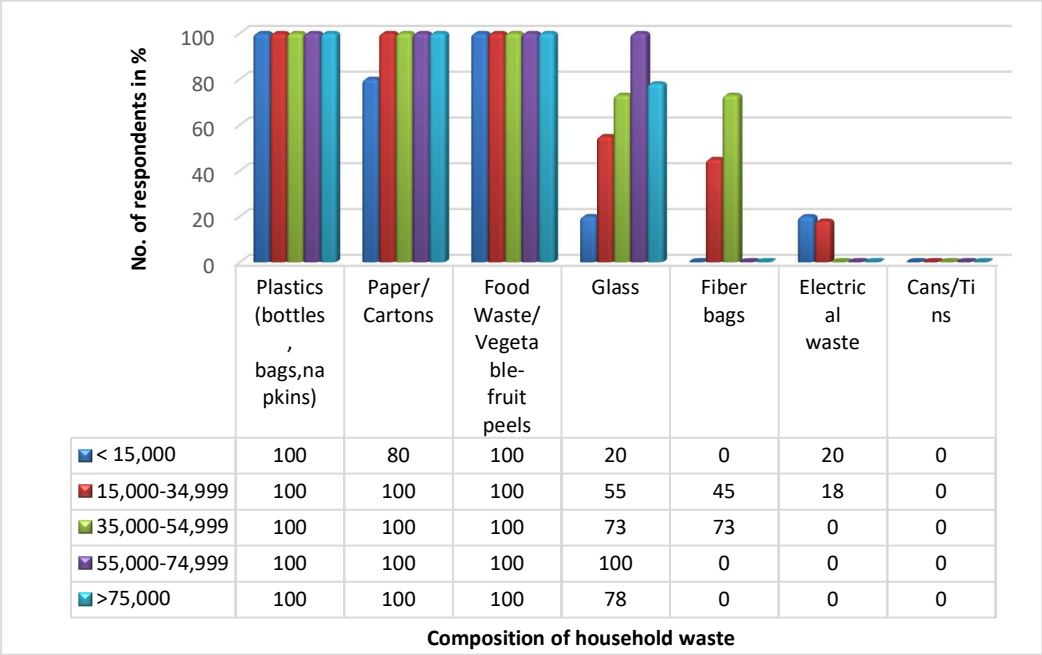
Table No. 4. 17. Composition of household solid waste by income level in Syari

Household Composition of Solid Waste	Monthly Household Income in Rs. (Syari Ward)in %				
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Plastics(bottles, bags,napkins)	100% (5)	100% (11)	100% (11)	100% (11)	100% (9)
Paper/ Cartons	80% (4)	100% (11)	100% (11)	100% (11)	100%(9)
Food Waste/Vegetable-fruit pe	100% (5)	100% (11)	100% (11)	100% (11)	100%(9)
Glass	20% (1)	55%(6)	73% (8)	100% (11)	78%(7)
Fiber bags	-	45% (5)	73% (8)	-	-
Electrical waste	20% (1)	18% (2)	-	-	-
Cans/Tins	-	-	-	-	-

Source: Field Survey, 2020.

Table No. 4.17 shows that in Syari all of the households surveyed have plastic composition in their waste stream. The households' whose income level is above 15,000 rupees per month have paper/cartons in their waste composition while only 80 percent of households with monthly income below 15,000 rupees have paper/cartons in their waste composition. The highest share of food waste composition is also observed in all of the households across various income level. However, the quantity is very less in amount and the only waste in few of the households are the non-edible food parts and vegetable-fruit peels.

Fig.4.23. Households listing their composition of solid waste in Syari by income



Source: Field Survey, 2020

It is observed that the glass composition in waste is highest in households whose monthly income lies between 55,000-74,999 which is followed by households earning above 75,000 rupees per month. As the income decreases, glass composition is seen to decreases well. However, only households earning between 15,000-34,999 rupees and 35,000-54,999 rupees generate fiber bags in their waste stream. Mr. Gurung who earns below 15,000 per month says, *"I have a net* (nylon) *bag which I use while I visit the shop. It is huge and sturdy."* While the nylon bags are mainly used by large number of populations for shopping groceries, the households also use woven PP bags and cloth bags. Hence, the fiber bags composition is absent for households of high monthly income level in Syari. One distinct nature observed is the composition of electrical waste among the households earning below 15,000 rupees/month and 15,000-34,999 rupees/month. These are the batteries used for flashlights.

Table 4.18 shows the household's composition of waste in Tadong. It is observed that all the households surveyed across all the income level have the composition of

paper/cartons, food waste and plastic waste which includes the unrecyclable materials at the source like food packages, sanitary napkins, bottles, bags and good packages. However, it is observed that households with income level above 75,000 rupees do not have fiber bags in their waste composition. Mrs. Suman Subba says, *"If I start bringing home new plastic bags and carry bags everytime I buy something then my waste pile will grow very fast. I carry my cotton cloth bag in my handbag whenever I head out and if I find any good vegetables or edibles to buy, I use it. I have been doing it since a long time and it really minimizes the waste and time which or else goes in emptying the dustbin on frequent days."*

Table No. 4. 18. Composition of household solid waste by income level in Tadong

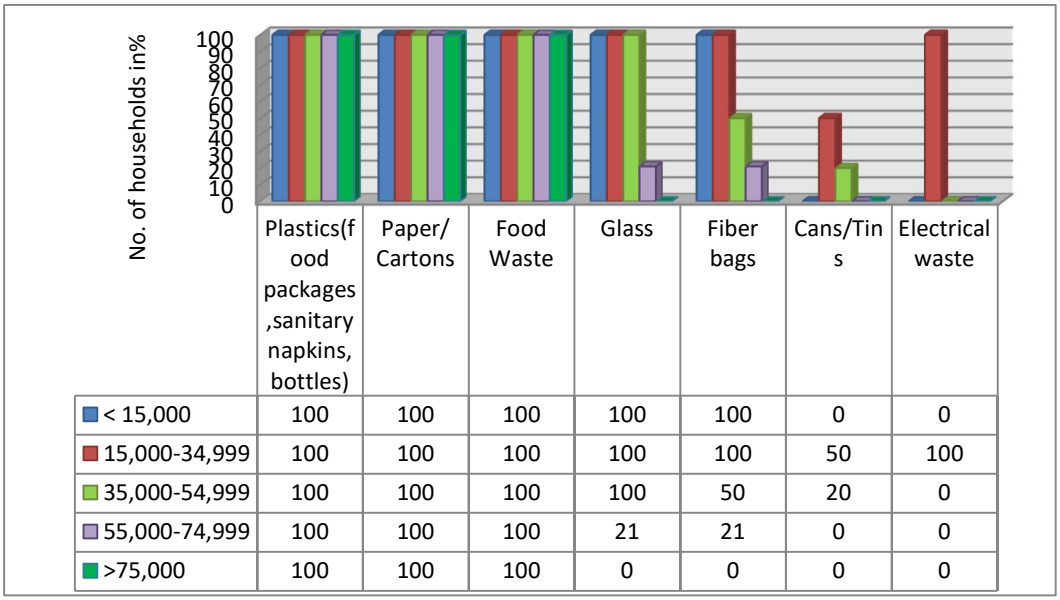
Household Composition of Solid Waste	Monthly Household Income in Rs. (Tadong Ward)in %				
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Plastics(Bottles/Bags,napkins)	100% (1)	100% (2)	100% (10)	100% (24)	100% (9)
Paper/ Cartons	100%(1)	100% (2)	100% (10)	100% (24)	100% (9)
Food Waste/Vegetable-fruit peels	100% (1)	100% (2)	100%(10)	100% (24)	100%(9)
Glass	100% (1)	100% (2)	100% (10)	21% (5)	-
Fiber bags	100% (1)	100% (2)	50%(5)	21% (5)	-
Cans/Tins	-	50% (1)	20% (2)	-	-
Electrical waste	-	100% (2)	-	-	-

Source: Field Survey, 2020.

Cans and tins in the waste composition is acknowledged by 50 percent of households with income level of 15,000-34,999 and 20 percent of households earning between 35,000-54,999 but absent among the households with income level below 15,000 rupees and above 55,000 rupees/month. It is also observed that the glass composition is decreasing as the income level is increasing and totally absent in households with income level above 75,000 rupees/month. The main contribution of glass in household level in the study area is glass bottles and majority of the households with high income level have more frequency to have a night out than the lower income level households. Hence, though the contribution of glass composition is negligible among the higher income level, they are not completely clean from the contribution towards glass in their

waste composition. When asked on why there is no glass composition in the household waste stream, Mr. Mahindra Subba says, *"Glass waste is only liquor bottles if any and more importantly we do not drink at home. We are just three family members and every once in a while, when we go Mayfair (resort) or at friend's house for dinner, I drink."*

Fig.4.24. Households listing their composition of solid waste in Tadong by income level



	Plastics(food packages,sanitary napkins, bottles)	Paper/ Cartons	Food Waste	Glass	Fiber bags	Cans/Tins	Electrical waste
< 15,000	100	100	100	100	100	0	0
15,000-34,999	100	100	100	100	100	50	100
35,000-54,999	100	100	100	100	50	20	0
55,000-74,999	100	100	100	21	21	0	0
>75,000	100	100	100	0	0	0	0

Source: Field Survey, 2020.

Finally, electrical waste is acknowledged by respondents whose household income is between 15,000-34,999 rupees/month in Tadong which also consists of batteries and light bulbs but the generation of such waste is negligible in the household level.

Table No. 4.19 shows that food waste and plastic materials is acknowledged by each and every household among all of the income level in Tibet Road. The paper and cartons/cardboards in waste composition are predominant in all of the households earning more than 15,000 rupees/month whereas only 50 percent of the households with income level below 15,000 rupees/month have paper/cardboard in their waste composition. The main reason for this is that the respondents whose household income is above 15,000 rupees/month are either businessman or the respondent's family run a business. Mr. Nir Bahadur Chettri says, *"Papers and cartons don't come out from*

house but from the shop. On a week, five to six kilograms of cartons comes out when I bring in the goods but I sell it."

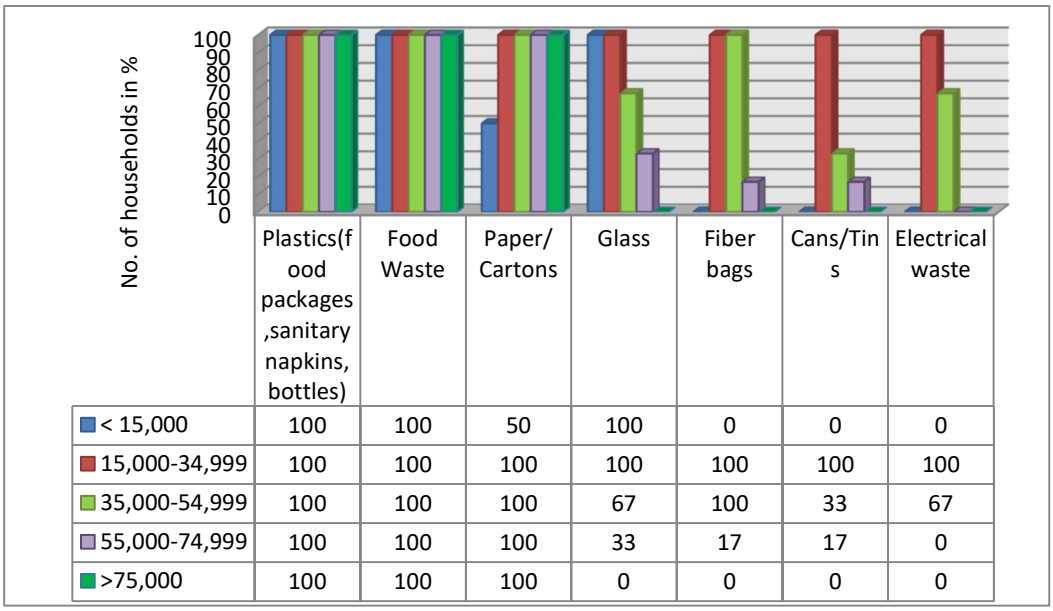
Table No. 4. 19. Composition of household solid waste by income in Tibet Road

Household Composition of Solid Waste	Monthly Household Income in Rs. (Tibet Road Ward)in %				
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Plastics(bags,bottles,napkins)	100% (2)	100% (1)	100% (3)	100% (6)	100% (3)
Food Waste/Veg. - fruit peels	100% (2)	100%(1)	100% (3)	100% (6)	100% (3)
Paper/ Cartons	50% (1)	100% (1)	100% (3)	100% (6)	100% (3)
Glass bottles	100% (2)	100% (1)	67%(2)	33% (2)	-
Fiber bags	-	100% (1)	100% (3)	17% (1)	-
Cans/Tins	-	100% (1)	33% (1)	17% (1)	-
Electrical waste	-	100% (1)	67% (2)	-	-

Source: Field Survey, 2020.

Like Tadong, the glass composition is declining as the income increases. There are also no fiber bags and tin cans in the waste stream in the households with income level below 15,000 rupees and above 75,000 rupees. The electrical waste is acknowledged mostly by households with monthly income between 15,000-34,999 rupees which are not in regular generation and it is only very rarely that households contribute to electrical and electronic waste stream.

Fig.4.25. Households listing their composition of solid waste in Tibet Road by income level



	Plastics(food packages,sanitary napkins, bottles)	Food Waste	Paper/ Cartons	Glass	Fiber bags	Cans/Tins	Electrical waste
< 15,000	100	100	50	100	0	0	0
15,000-34,999	100	100	100	100	100	100	100
35,000-54,999	100	100	100	67	100	33	67
55,000-74,999	100	100	100	33	17	17	0
>75,000	100	100	100	0	0	0	0

Source: Field Survey, 2020.

The examination of the influence that income level has on waste composition of households highlight the fact that plastic waste is prevailing among all the income class. Paper and cardboard waste, though with only little variation, is rising as the income is increasing. The composition of food waste is found in all of the households in commercially located Tibet Road, mixed location of Tadong and residentially located Syari irrespective of the income level. Another prominent similarity among all the three wards is the absence of fiber bags in the waste composition in the households with income level above 75,000 rupees and absence of cans and tins in the waste composition among the households with income level below 15,000 rupees per month. The composition of glass, although is increasing as the income level increases in Syari, there is a contrary observation in Tadong and Tibet Road where majority of the higher income households have lesser glass composition for the reasons mentioned earlier. Lastly, the electrical waste composition is observed in lower income level than the higher income level. It is however to be known that the electrical waste is generated in a very scanty amount and frequency in household level. Hence, majority of the households among all of the income level do not acknowledge the electrical waste in their waste composition.

ii. Household size

Another aspect to look into is the size of the household to examine the composition of waste among the households. Table No. 4.20 shows the households' waste composition in Syari and it is observed that households of all household sizes have plastic in their waste composition which comprises of food packages made out of complex materials which cannot be easily managed at household and sanitary napkin waste and product packages. While food waste is more prominent among higher number of household size, the generation of fiber bags is absent in the households with highest number of

members. This can be acquainted with the family whose income level is below 15,000 rupees per month and high above 75,000 rupees per month in Syari. The composition of glass in waste stream is highest in household size above 7 members followed by households with 6 members and 2 members. The glass composition in household size and below 2 are more than the households with members more than 5 because the household members are mainly manual labour, carpenter and farmers earning between 15,000-34,999 rupees/month who frequently drinks in the comfort of their home.

Table No. 4. 20. Composition of household solid waste by household size in Syari

Household Composition of Solid Waste	Household Size per persons in % (Syari)						
	< 2	3	4	5	6	7	> 8
Plastics(food packages, bottles, bags,napkins)	100% (8)	100%(15)	100% (13)	100% (6)	100% (2)	100% (3)	
Paper/ Cartons	88% (7)	100%(15)	100%(13)	100% (6)	100% (2)	100% (3)	
Food Waste/Vegetable-fruit peels	100% (8)	93% (14)	100% (13)	100%(6)	100% (2)	100% (3)	
Glass bottles	50%(4)	33%(5)	38% (5)	33% (2)	50%(1)	100% (3)	
Fiber bags	25%(2)	60% (9)	38% (5)		50% (1)		
Electrical waste	25%(2)	7% (1)					
Cans/Tins							

Source: Field Survey, 2020.

Table No. 4.21 shows the composition of waste in Tadong ward by the size of the household where it is reflected that 100 percent of paper waste, food waste and plastic waste is prominent across all of the household size. The percent share for fiber bag is highest at 50 percent in the household size of 7 whereas the lowest share at 17 percent is from household size of 2 and below.

Table No. 4. 21. Composition of household solid waste by household size in Tadong

Household Composition of Solid Waste	Household Size per persons in % (Tadong)						
	< 2	3	4	5	6	7	> 8
Plastic (food packages/bottles,bags,sanitary napkins)	100% (6)	100% (14)	100% (17)	100% (4)	100% (3)	100% (2)	
Paper/ Cartons	100% (6)	100% (14)	100% (17)	100% (4)	100% (3)	100% (2)	
Food Waste/Vegetable-fruit peels	100% (6)	100% (14)	100% (17)	100% (4)	100% (3)	100% (2)	
Glass bottles	50% (3)	36% (5)	29% (5)	50% (2)	67% (2)	50% (1)	
Fiber bags	17% (1)	29% (4)	29% (5)	25% (1)	33% (1)	50% (1)	
Cans/Tins			6% (1)	25% (1)	33% (1)		
Electrical/electronic waste			12% (2)				

Source: Field Survey, 2020.

The composition of cans and glass is highest in the household size of 6 at 67 percent, followed by 50 percent households with family size of 7 and 5. The highest percent of households who has tins/cans in their waste stream have a family size between 4 to 6. However, it is to be noted that majority of the households only refers to soft drink/hard drink cans and glass bottles of alcohol when mentioning cans and glass composition in their waste.

Table No .4. 22 shows in Tibet Road ward, all of the households of various household sizes have food waste and plastic waste in the waste composition. As the number of household increases, the composition of waste also increases where paper/cartons, plastics, cans/tins, fiber bags and glass are acknowledged by a greater number of respondents than the respondents with smaller family size in Tibet Road.

Table No. 4. 22. Composition of household solid waste by household size in Tibet Road

Household Composition of Solid Waste	Household Size per persons in % (Tibet Road)						
	<2	3	4	5	6	7	>8
Plastics(Food packages/Bottles/Bags/sanitary napkins)	100% (3)	100% (4)	100% (3)	100% (4)	100% (1)		
Paper/ Cartons	100% (3)	75% (3)	100% (3)	100% (4)	100% (1)		
Food Waste/Vegetable-fruit peels	100% (3)	100% (4)	100% (3)	100%(4)	100% (1)		
Glass bottles	67% (2)		67% (2)	75% (3)	100% (1)		
Fiber bags		25% (1)		75% (3)	100% (1)		
Cans/Tins		25% (1)		50% (2)	100% (1)		
Electrical/electronic waste		25% (1)	67% (2)				

Source: Field Survey, 2020.

On the whole, it is observed that despite snippets of consciousness among the higher income level households where they seek to opt for the use of eco-friendly products (which are more costly), the waste composition gets more varied as the income level slowly rises and the majority of households with middle income level have shown variation in their waste composition. On the other hand, though the composition of household members plays a vital role in generating various types of waste, the family

size ultimately plays a bigger role in today's world where majority of the food products are sold in complex plastic packages and despite the differences in family composition and income, the composition of household waste gets more varied as the number of family members increases.

c. Household's types of waste container and frequency of waste disposal

Following up the generation and composition of waste in households, it is reflected that despite the previous acknowledgement of the environmental concern-built attitude, there is little contribution in minimizing the generation of varied composition of waste, especially that of various types of plastic waste, among the households. To further examine the consistency of the environmentally favourable attitude, the type of waste container used for collection of the household waste is brought up. The types of waste container used by household provide an important contribution towards the waste management process and it reflects upon the consciousness of the household towards the environment.

Table No. 4.23. Type of container used for the collection of household waste

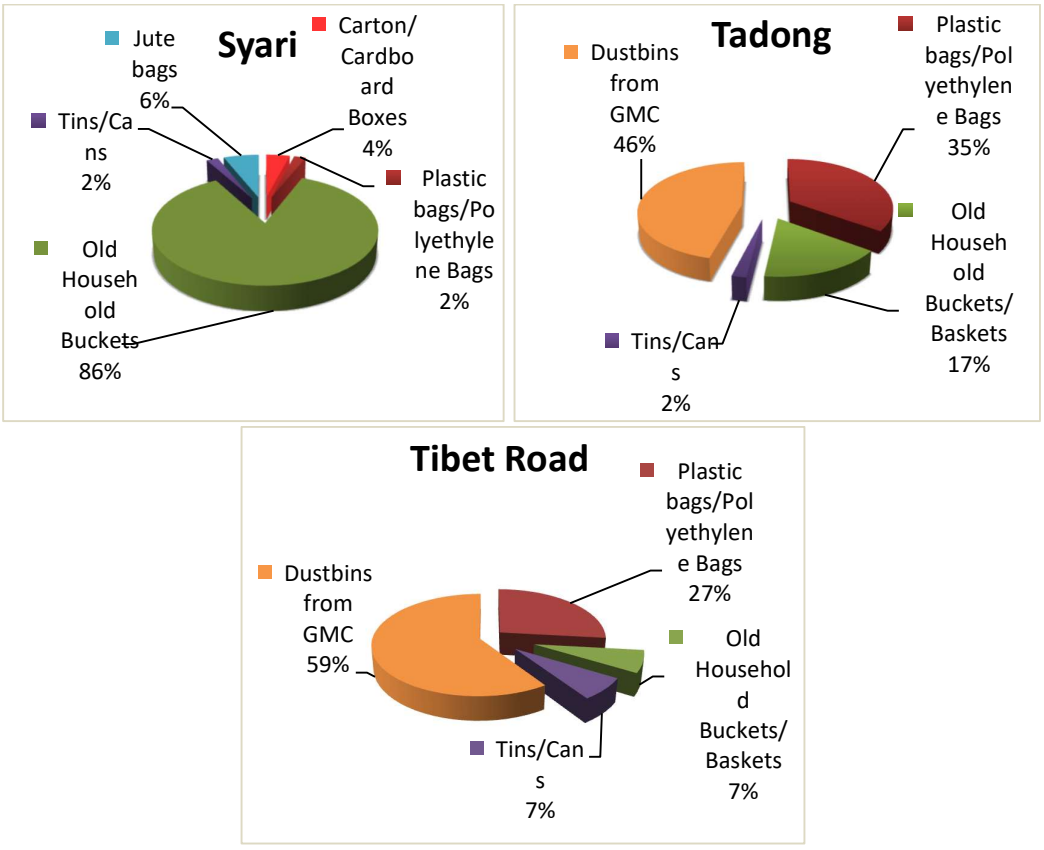
Type of container used for collection of Household Solid Waste	No. of Households in %		
	Syari	Tadong	Tibet Road
Carton/Cardboard Boxes	4% (2)		
Plastic bags/Polyethylene Bags	2% (1)	35% (16)	27% (4)
Old Household Buckets/Baskets	85% (40)	17% (8)	7% (1)
Tins/Cans	2% (1	2% (1)	7% (1)
Jute bags	6% (3)		
Dustbins from GMC		46% (21)	60% (9)

Source: Field Survey, 2020

Table No. 4.23 shows that the majority of households i.e., 85 percent in the residential area of Syari use 'old household buckets/baskets' followed by 6 percent households using large jute bags and non-woven PP bags. Tadong has highest number of households of 46 percent who uses the bins provided by the GMC followed by plastic bags/polyethylene bags at 35 percent and the same is observed in Tibet Road where

majority of the households uses buckets and bins distributed by GMC at 60 percent followed by 27 percent of plastic/polyethylene bag users. It is procured from these figures that reuse of products are carried out mostly in Syari ward where the 'cartons/cardboard boxes' are used along with jute bags and non-woven PP bags for the collection of waste and only 2 percent of households use 'plastic/polyethylene bags' for the same. On the contrary, the reuse of cardboard boxes and cartons is absent among the households in Tadong and Tibet Road and use of plastic/polyethylene bags are observed among high number of households. The reason for high percent use of this is due to an easy access of commercialized product where the locational factor plays a vital role.

Fig 4.26. Type of container used for the collection of household waste



Source: Field Survey, 2020.

From the previous section, it is derived that the composition of waste shows little variation in the households of Syari, Tadong and Tibet Road and it is almost similar

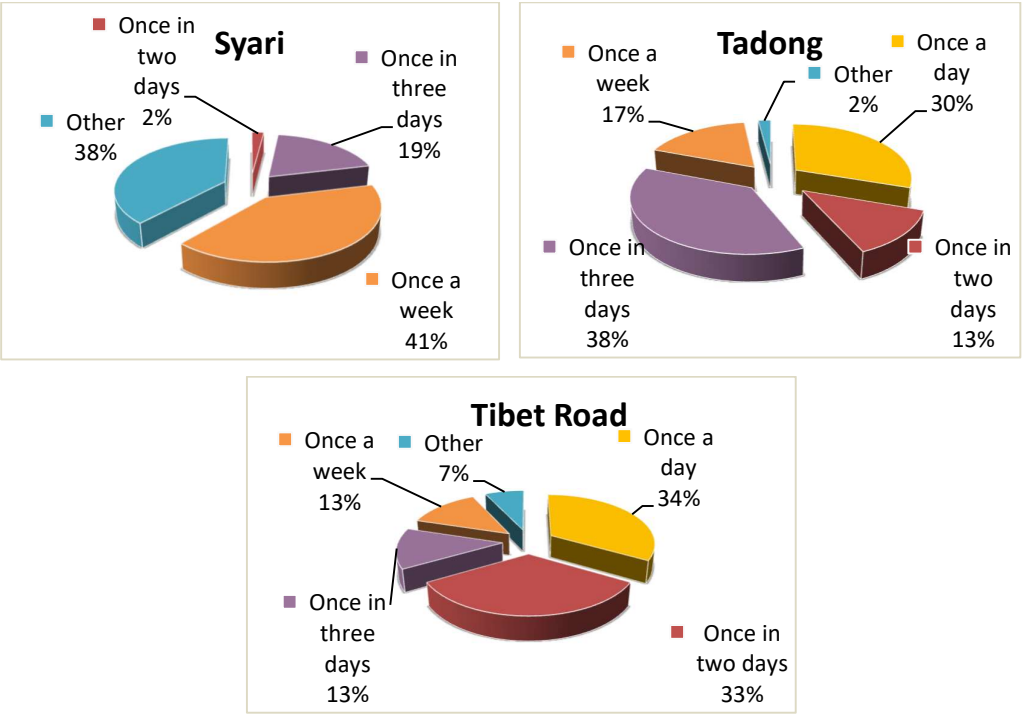
but, the difference can be drawn more distinctively when the amount of waste generation is acknowledged. Though the study lacks accurate quantification of the waste among the households surveyed, the frequency of the waste container emptied is enquired to analyze this difference and the distinction is evident. In fact, the frequency of the household container being emptied for Syari is highest at 40 percent in 'once a week' followed by 38 percent of 'other' which denotes once ever ten to fifteen days. Tadong, on the other hand, have majority of 37 percent households empty their container of household waste every 'once in three days' followed by 30 percent of households for 'once a day' and Tibet Road have highest frequency of waste container emptied 'once a day' and 'once in two days' at 33 percent each. It is procured from this analysis that the quantity of waste generated at households is more in households located in commercialized and mixed location than in the far-off rural residential location. The account shows that in Syari, 'once a day' frequency to empty the household waste container is totally absent and only 2 percent of households acknowledge 'once in two days' as the frequency of their household waste disposal. It shows that though the composition of waste is quite similar across different locations in Gangtok, the overall quantity has a vast variation among these wards. The commercially located Tibet Road have more quantity of waste generation followed by households located in mixed location of Tadong and waste generation is least in Syari which is situated farthest from the commercial center. (Table No. 4.24)

Table No. 4.24. Frequency of household waste container emptied

	No. of Households in %		
Frequency of container emptied	Syari	Tadong	Tibet Road
Once a day		30% (14)	33% (5)
Once in two days	2% (1)	13% (6)	33% (5)
Once in three days	19% (9)	37% (17)	13% (2)
Once a week	40% (19)	17% (8)	13% (2)
Other	38% (15)	2% (1)	7% (1)

Source: Field Survey, 2020

Fig. 4.27. Frequency of household waste container emptied



Source: Field Survey, 2020.

d. Household's participation in waste segregation

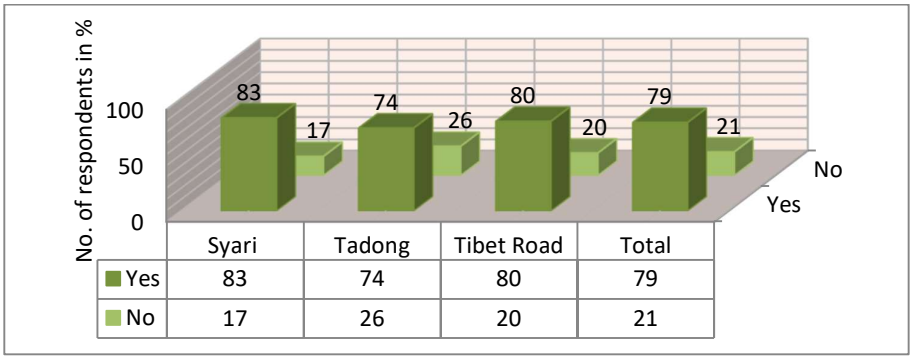
The important practice of the household in waste management is the segregation of the waste generated at the source itself. The participation of the households in the segregation of waste at the source is looked into and Table 4.25 highlights that the segregation participation rate is 78 percent in the total study area and 22 percent households do not segregate their wastes. The segregation rate in Syari is the highest at 83 percent and non-participation rate of segregation is 17 percent. In Tadong, it is observed that 74 percent of the total households surveyed do participate in the waste segregation and 26 percent do not. In Tibet Road, 73 percent of the households segregate the wastes and 27 percent do not. It is reflected that Syari ward have the most participation in segregation as compared to other wards. To examine why, further evaluation of socio-demographic factors has been done.

Table No. 4.25. Percentage of households segregating waste at source in study area

	No. of Households in %			
Do you segregate waste at source?	Syari	Tadong	Tibet Road	Total
Yes	83% (39)	74% (34)	80% (12)	79% (85)
No	17% (8)	26% (12)	20% (3)	21%(23)

Source: Field Survey, 2020

Fig.4.28. Households listing segregation of waste at source



Source: Field Survey, 2020.

i. Gender

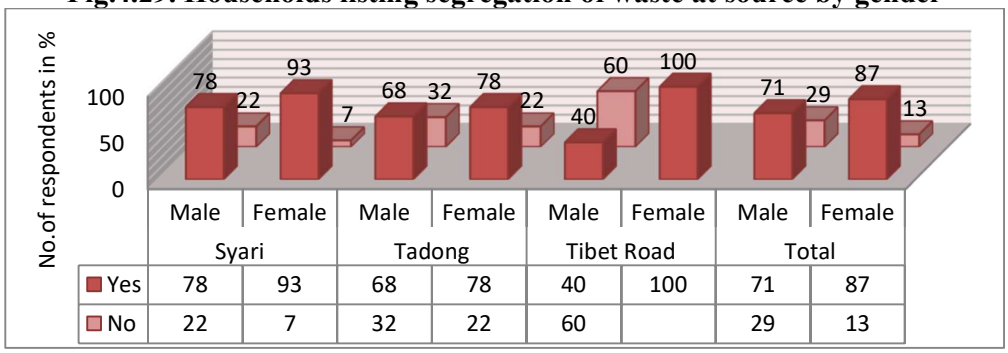
It is observed that there is gender variation in the participation of segregation. Out of the total females surveyed, 93 percent of them agreed that they segregate the wastes whereas only 78 percent of the total males did segregate their waste at the source in Syari. Mrs. Tamang says, *"Since I am the one who does the domestic chore, I have kept separate bins for dry and wet household wastes. My family knows what type of waste goes where; it's our way of day-to-day life and that helps efficiently for disposal later on."*

Table No. 4. 26. Segregation of waste at source by gender in study area

	No. of Respondents in %							
Segregate waste at source	Syari		Tadong		Tibet Road		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Yes	78% (25)	93% (14)	68% (13)	78% (21)	40% (2)	100% (10)	79% (40)	87% (16)
No	22% (7)	7% (1)	32% (6)	22% (6)	60% (3)		21% (16)	13% (7)

Source: Field Survey, 2020

Fig.4.29. Households listing segregation of waste at source by gender



Source: Field Survey, 2020.

When comparing the percent participation of males and female in Tadong ward, 78 percent of the total females acknowledge their participation in segregation whereas out of the total males' 68 percent do segregate their wastes. A same pattern is observed between male and female. Likewise, in Tibet Road, there is a vast gender-led contrast noticeable in this ward in segregation participation. 100 percent of the total females segregate the waste whereas only 40 percent of the total males participate in the segregation activity. Mr. Benedict justifies by saying, *"I sit in the shop the whole day and close it only after 7pm; my wife and daughters are mostly at home and do what is to be done there."*

ii. Age

Based on age, Table No. 4.27 shows that in Syari 100 percent of segregation participation is from age group below eighteen followed by age group above fifty-eight at 91 percent. 85 percent share is from respondents in the age group of 39-58 years and here the least contribution is from the age group of 18-38 years. No matter how high percent acknowledgement of environmental concern and association of waste to the environment from this age group is obtained in previous section of analysis from Syari, a contrasting outcome is derived when examining the ground practices. In Tadong, the

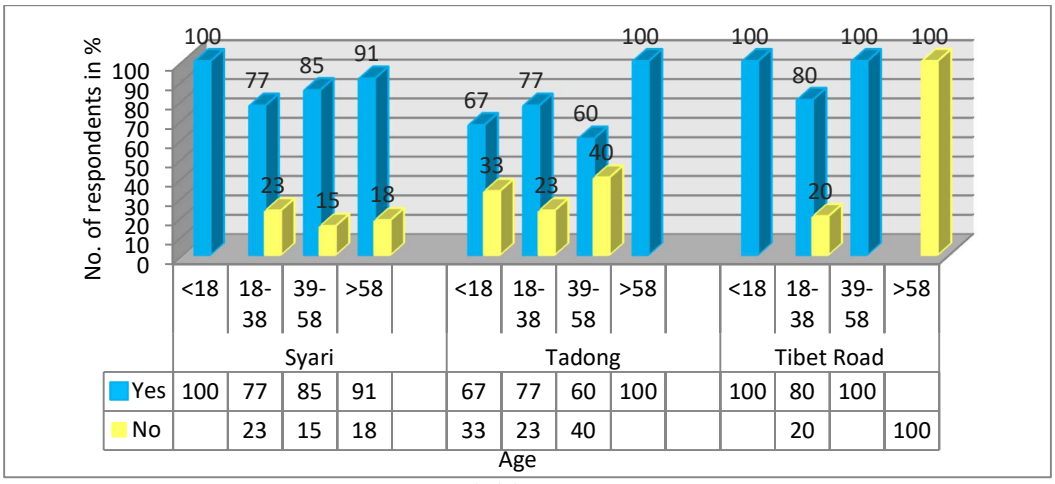
age group above 58 years is the ones who have the highest segregation participation followed by respondents in the age-group of 18-38 years. Similarly, in Tibet Road, the highest contribution in segregation participation is done by population lying in the age group below 18 and between 39-58 years.

Table No. 4.27. Segregation of waste at source by age

	No. of respondents in %			
Do you segregate waste at source?	Syari			
	<18	18-38	39-58	>58
Yes	100% (2)	77% (10)	85% (17)	91% (10)
No		23% (3)	15% (3)	18% (1)
Do you segregate waste at source?	Tadong			
	<18	18-38	39-58	>58
Yes	67% (2)	77% (23)	60% (6)	100% (3)
No	33% (1)	23% (7)	40% (4)	
Do you segregate waste at source?	Tibet Road			
	<18	18-38	39-58	>58
Yes	100% (2)	80% (8)	100% (2)	
No		20% (2)		100% (1)

Source: Field Survey, 2020

Fig.4.30. Households listing segregation of waste at source by age

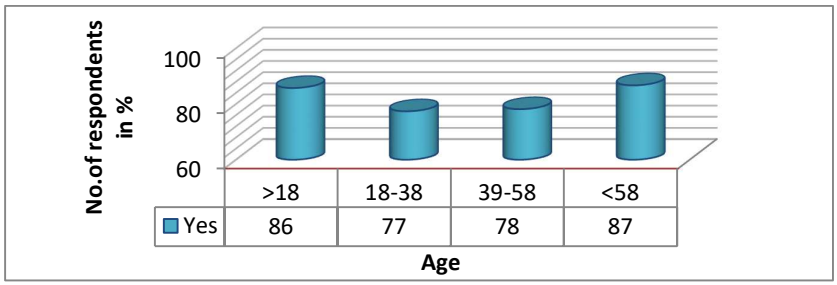


Source: Field Survey, 2020.

It can be drawn from the figure 4.31 that the highest participation is observed among the senior population even though the level of environmental consciousness is not very high among them. The respondents in their young adulthood had previously provided a promising concern towards the knowledge of the on-goings of the environmental challenges, especially the respondents lying in the independent population. However,

the lack of participation in segregation among this age group is reflected from the figure given below.

Fig. 4.31. Distribution of total participation in waste segregation by age %



Source: Field Survey, 2020.

iii. Education level

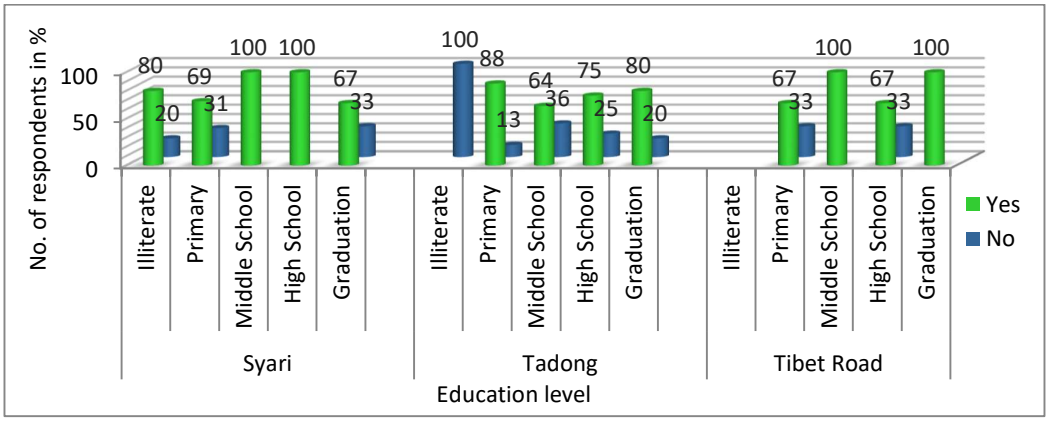
So far, the age factor has provided a vivid disparity in the attitude and behaviour of the respondents. On further examination of education's impact on the participation in waste segregation, Table No. 4.28 reflects that in Syari, irrespective of the education level, respondents with no formal education have shown better participation in waste segregation than respondents with graduation level of qualification. Although all of the respondents with education level of middle school and high school participate in waste segregation, graduated respondents are the least contributor to the segregation practices at household; even respondents with primary level of education leads with two percent of more participation.

Table No. 4. 28. Segregation of waste at source by education level

	No. of Households in %				
Do you segregate waste at source?	Syari				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes	80% (12)	69%(9)	100% (3)	100% (13)	67% (2)
No	20% (3)	31% (4)			33% (1)
Do you segregate waste at source?	Tadong				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes		88% (7)	64% (7)	75% (12)	80% (8)
No	100% (1)	13% (1)	36% (4)	25% (4)	20% (2)
Do you segregate waste at source?	Tibet Road				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes		67% (2)	100% (5)	67% (4)	100% (1)
No		33% (1)		33% (2)	

Source: Field Survey, 2020

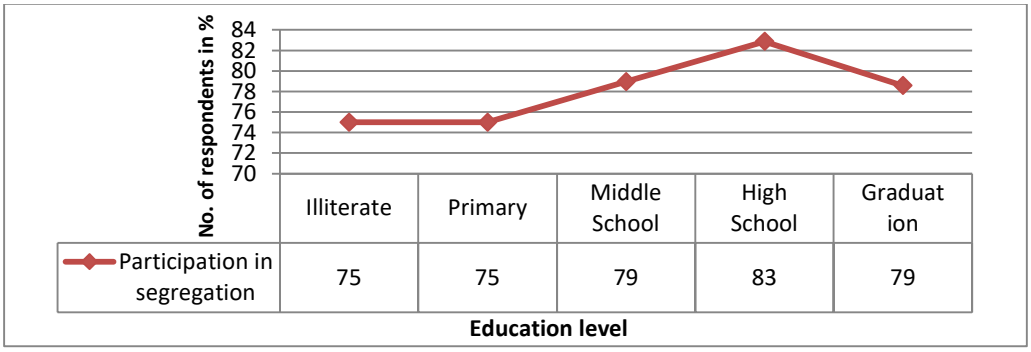
Fig.4.32. Households listing segregation of waste at source by education level



Source: Field Survey, 2020.

Tadong have a better participation in waste segregation from respondents with graduation level of qualification at 80 percent. However, it is also observed that the respondents with primary level of education have better participation than them at 88 percent. 75 percent of respondents with high school level of education follow up and the least participation is from the middle school qualified respondents here. In Tibet Road, it is derived that the participation is more from middle school qualified respondents and a graduated respondent. On the contrary, respondents with primary level of education and high school level of education have equal rate of participation in the segregation of household waste. (Table No. 4.28)

Fig.4.33. Distribution of total participation in waste segregation by education %



Source: Field Survey, 2020.

Despite variation among the rate of participation within each of the three wards, it is derived from the figure 4.33 above that as the level of education increases, the

participation in the waste segregation increases as well. However, the fall in the participation from 83 percent among respondents with qualification of high school to 79 percent among the respondents with graduation as their qualification gives a loophole with uncertainty and no assurance that people with better qualification will always participate in the needful practices for a proper waste management. It is also observed that despite not having any formal education and inability of those respondents to acknowledge the mismanaged waste as an environmental challenge, the participation rate is 75 percent which is just 4 percent less than the participation rate of graduated respondents. Thus, to generalize that highly qualified population shows consistency in their attitude and action is unwisely.

iv. Occupation

Table No. 4. 29. Segregation of waste at source by occupation

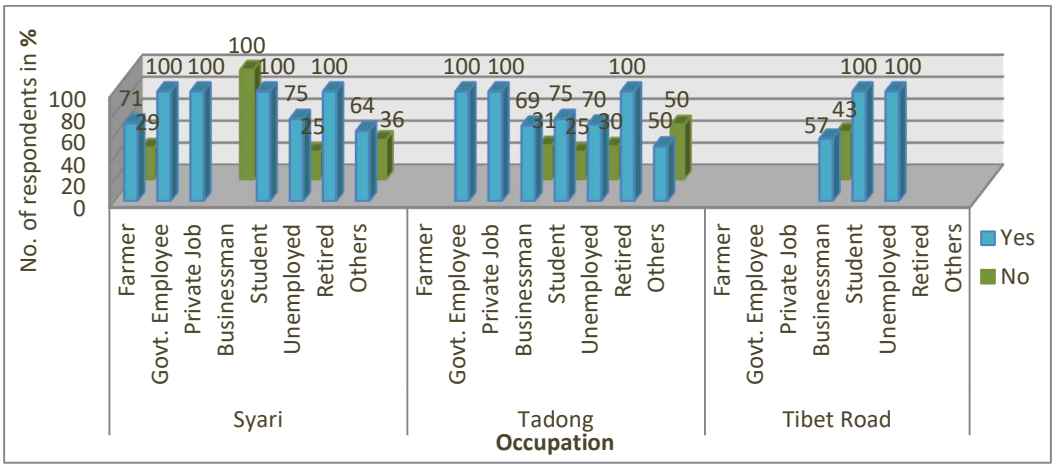
	No. of Households in %							
Do you segregate waste at source?	Syari							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes	71% (5)	100% (15)	100% (3)		100% (4)	75% (3)	100% (2)	64% (7)
No	29% (2)			100% (1)		25% (1)		36% (4)
Do you segregate waste at source?	Tadong							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes		100% (2)	100% (3)	69% (11)	75% (9)	70% (7)	100% (1)	50% (1)
No				31% (5)	25% (3)	30% (3)		50% (1)
Do you segregate waste at source?	Tibet Road							
	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
Yes				57% (4)	100% (3)	100% (5)		
No				43% (3)				

Source: Field Survey, 2020

From the Table No. 4.29 it is highlighted that in Syari, the participation is highest among the respondents who are either students, working in private jobs, are government employees or are retired from a government job. The participation is followed by unemployed respondents and the farmers. Out of the total farmers surveyed, 29 percent do not segregate their waste mainly because there is no wastage of food waste or wet waste; even when some days there is little food waste generation, it is fed to the dogs

and poultry immediately. The least segregation participation is from a businessman here. Similarly, in Tadong better participation in waste segregation is observed among the respondents who are students, government employee or retired and are working in a private pharmaceutical company. While in Tibet Road, a healthier participation in waste segregation is done by unemployed respondents and students than the respondents who run a business. The unemployed respondents are all females and housewives.

Fig.4.34. Households listing segregation of waste at source by occupation



Source: Field Survey, 2020

Overall, the participation in waste segregation is observed more among the participants who are government employees or retired from a government jobs and respondents working in a private company. The respondents who also segregate waste at the source after those mentioned are currently students who are pursuing higher studies. It is further reflected that the unemployed population are also participating better than farmers and manual labourers. The farmers are better participants than carpenters and labours mainly because the organic waste is utilized as fodder for their poultry and cattle. (Figure 4.35)

Fig.4.35. Distribution of total participation in waste segregation by occupation %

Source: Field Survey, 2020

v. Income level

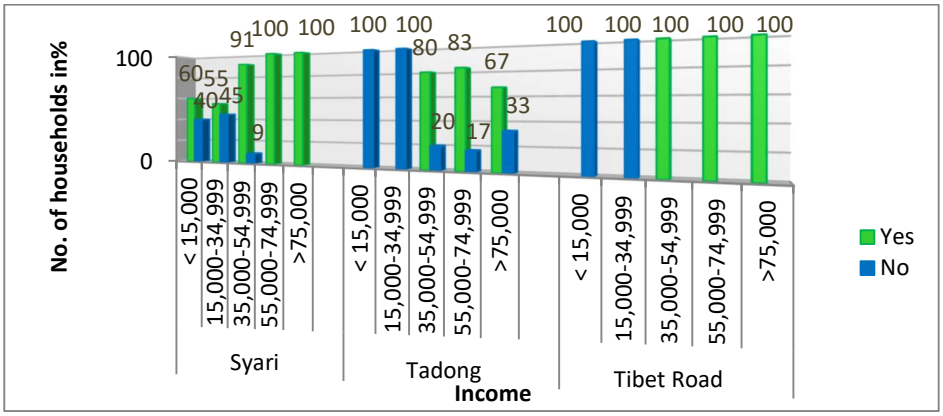
As per the income level, Syari have least participation from the households earning monthly income between 15,000-34,999 rupees. The respondents with an income level below 15,000 rupees per month have higher participation than the income group of 15,000-34,999 rupees mainly due to the contribution of respondents who have farming as their occupation. A vivid contrast is seen in Tadong and Tibet Road when compared to Syari. There is no participation in waste segregation among the households with monthly income level below 35,000 rupees in both of the mixed and commercially located wards. Although all of the higher income households in Tibet Road have participation in waste segregation, there is decrease in participation among the households with an income level above 75,000 rupees in Tadong.

Table No. 4. 30. Segregation of waste at source by income level

Do you segregate waste at source?	Monthly Household Income in Rs. (Syari Ward)in %				
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes	60% (3)	55% (6)	91% (10)	100% (11)	100% (9)
No	40% (2)	45% (5)	9% (1)		
	Monthly Household Income in Rs. (Tadong Ward)in %				
Do you segregate waste at source?					
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes			80% (8)	83% (20)	67% (6)
No	100% (1)	100% (2)	20% (2)	17% (4)	33% (3)
	Monthly Household Income in Rs. (Tibet Road Ward)in %				
Do you segregate waste at source?					
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes			100% (3)	100% (6)	100% (3)
No	100% (2)	100% (1)			

Source: Field Survey, 2020

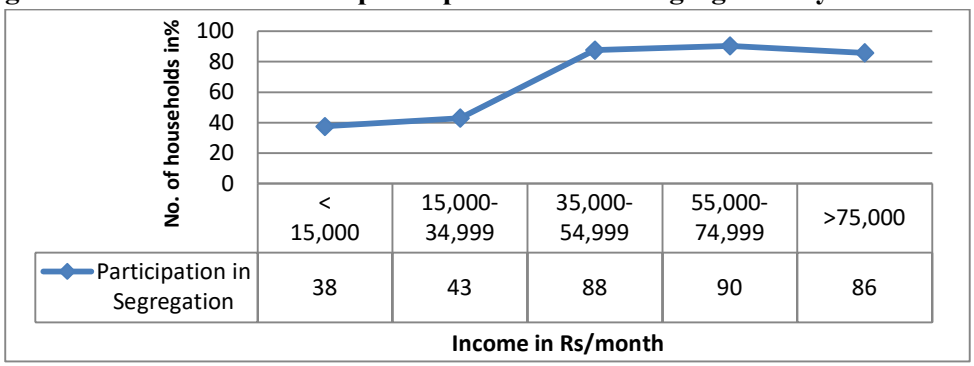
Fig.4.36. Households listing segregation of waste at source by income level



Source: Field Survey, 2020

Figure 4.37 below shows the total participation in waste segregation by income distribution. It is derived from here that the highest participation in waste segregation is from households with an income level between 55,000-74,999 rupees/month followed by households with a monthly income between 35,000-54,999 rupees. There is an increase in the participation rate as the income is increasing until 75,000 rupees/month. However, the participation of households is declined among households above 75,000 rupees per monthly income and it can be drawn from the figure below that the participation rate goes even below the income level of 35,000-54,999 rupees.

Fig.4.37. Distribution of total participation in waste segregation by income level



Source: Field Survey, 2020

e. Household's participation in waste composting

Likewise, participation of households in composting activity varied across the space, gender, age, education level and occupation are observed.

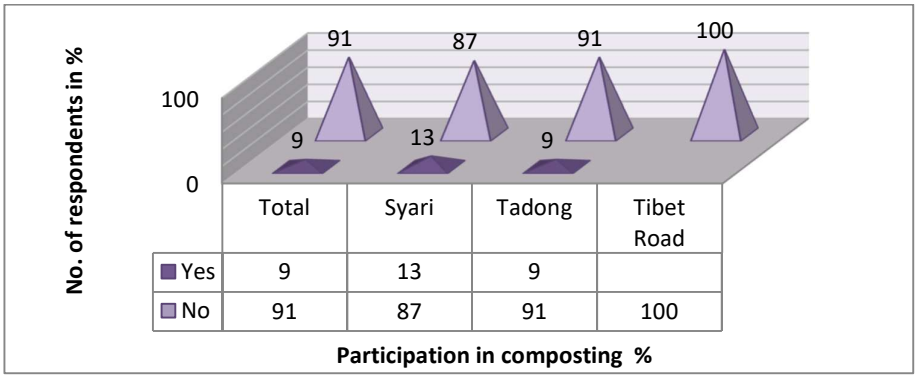
Table No. 4.31. Households listing composting participation at source

	No. of respondents in %			
Participation in Composting	Total	Syari	Tadong	Tibet Road
Yes	9% (10)	13% (6)	9% (4)	
No	91% (98)	87% (41)	91% (42)	100% (15)

Source: Field Survey, 2020

The total participation in composting is almost scanty among the respondents at 9 percent participation and the rest of the 98 percent do not practice this activity. There is also spatial variation in the participation among the three study areas. Only 13 percent of the respondents in Syari practices composting which is the highest percent share observed among the three wards. Tadong shows 9 percent of the respondents 'participation in composting activity. Contrary to this, Tibet Road has nil participation in composting practice. Thus, it is derived that as the location gets more urbanized, the households' participation in composting decreases. (Table No. 4.31)

Fig.4.38. Households listing composting participation at source



Source: Field Survey, 2020

i. Gender

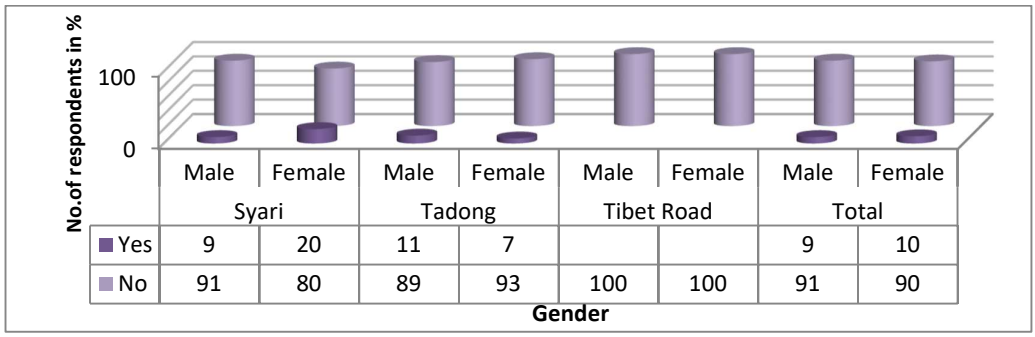
Table No. 4.32. Participation in composting activity by gender in study area

	No. of Respondents in %							
Participation in Composting	Syari		Tadong		Tibet Road		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Yes	9% (3)	20% (3)	11% (2)	7% (2)			9% (5)	10%(5)
No	91% (29)	80% (12)	89% (17)	93% (25)	100% (5)	100% (10)	91% (51)	90% (47)

Source: Field Survey, 2020

To further examine the details in participation, gender differentiation is done. Out of all the total respondents surveyed, it is observed that the participation difference in composting activity is almost negligible between males and females. Only by one percent, total female participation exceeds total male participation. In residential Syari, the participation is more prominent among females than males whereas in Tadong, males are observed to have better participation rate than the females.

Fig.4.39. Households listing composting participation at source by gender



Source: Field Survey, 2020

ii. Age

Table No. 4. 33. Participation in composting activity by age in study area

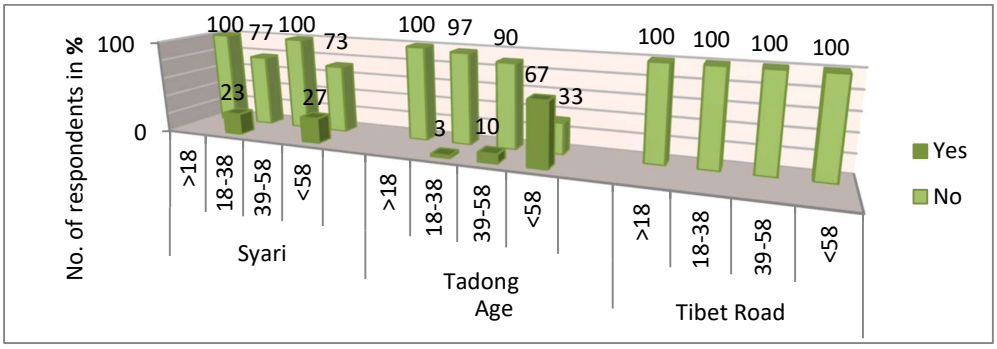
Participation in Composting	No. of Respondents in %			
	Syari			
	>18	18-38	39-58	<58
Yes		23% (3)		27% (3)
No	100% (2)	77% (10)	100% (21)	73% (8)
Participation in Composting	Tadong			
	>18	18-38	39-58	<58
Yes		3% (1)	10% (1)	67% (2)
No	100% (3)	97% (29)	90% (9)	33% (1)
Participation in Composting	Tibet Road			
	>18	18-38	39-58	<58
Yes				
No	100% (2)	100% (10)	100% (2)	100% (1)

Source: Field Survey, 2020

Age is one of the important socio-demographic factors that affects the participation attitudes of the population. From the Table No. 4.33 it is highlighted that in Syari, the respondents above the age of 58 are better participants than any other age group. The second population groups who have participation in composting activity are in their age

group of 18-38 years. However, no participation is observed among the respondents in the age group below 18 and between 39-58. Likewise, in Tadong, the respondents above the age of 58 are better participants than the younger respondents. Despite environmentally favouring attitudes, the respondents in the age-group of 18-38 show only 3 percent of participation here.

Fig.4.40. Households listing composting participation at source by age



Source: Field Survey,2020

iii. Occupation

Table No. 4.34. Participation in composting activity by occupation

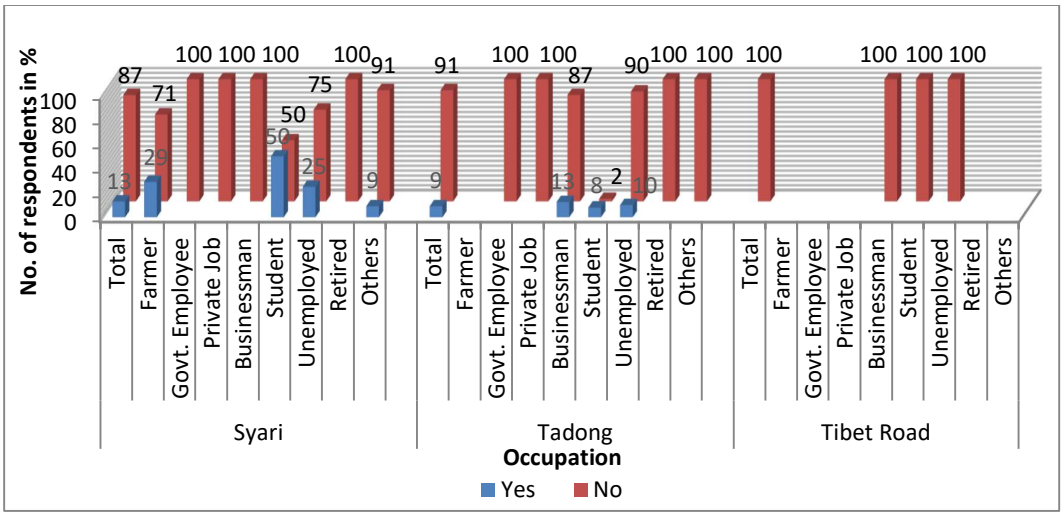
	No. of Respondents in %								
Participation	Total	Farmer	Govt. Employee	Private Job	Businessman	Student	Unemployed	Retired	Others
	SYARI								
Yes	13% (6)	29% (2)				50% (2)	25% (1)		9% (1)
No	87% (41)	71% (5)	100% (15)	100% (3)	100% (1)	50% (2)	75% (3)	100% (2)	91% (10)
	TADONG								
Yes	9% (4)				13%(2)	8% (1)	10% (1)		
No	91% (42)		100% (2)	100% (3)	88% (14)	92% (11)	90% (9)	100% (1)	100% (2)
	TIBET ROAD								
Yes									
No	100% (15)				100%(7)	100% (3)	100% (5)		

Source: Field Survey,2020

The profession of the respondents reflects those farmers and student have more participation in the composting practices than the rest of the participants in Syari. The unemployed respondents and respondents who are a daily wage worker have better participation than any of the white-collar respondents. A similar observation is made in Tadong ward where the respondents in white collar jobs do not participate in composting activity. Out of the total participants, better participation is derived from

respondents who run a business. However, it is to be pointed out that by 'business' here it means poultry shop and grocery shop only. Also, the students and unemployed respondents contribute to the participation percent in Tadong. (Table No. 4.34)

Fig.4.41. Households listing composting participation at source by occupation



Source: Field Survey,2020

iv. Education level

The education level also helps in framing the suitable scenario that encouraging an environment friendly engagement in minimization of waste. In Syari, an important thing noticeable is that respondents with no formal education have better participation rate than the respondents of primary education level. This is mainly because of their occupation where they perform farming for livelihood. Given the fact that it is not always environmentally driven participation yet, it is significant in the management process. Furthermore, it is observed that the participants are higher in education level of high-school and graduation. In Tadong ward, respondents with high education level are more actively participating in composting activity. It is followed by 9 percent of 'middle school' level of education participants. Thus, it is drawn that better education can provide an influence in the participation in proper waste composting. However, it is also observed that it cannot always be assumed as majority of the respondents are

non-participants. When compared to participation in segregation, composting activity is carried out by very little number of populations and even though there are few participants, they are not always pro-environmental in their attitude and various incognito reasons could be more influential than the environmental causes being the main reason for their participation in the efficient management of their household wastes. However, these will be covered in later section and for now, socio-demographic factors' influence in the participation of reuse and recycle among the respondents in all the three wards are given.

Table No. 4.35. Participation in composting activity by education level

	No. of Households in %				
Participation in composting:	Syari				
	Illiterate	Primary	Middle School	High School	Graduation
Yes	13% (2)	8% (1)		15% (2)	33% (1)
No	87%(13)	92% (12)	100% (3)	85% (11)	67% (2)
Participation in composting:	Tadong				
	Illiterate	Primary	Middle School	High School	Graduation
Yes			9% (1)	13% (2)	10% (1)
No	100% (1)	100% (8)	91% (10)	87% (14)	90% (9)
Participation in composting:	Tibet Road				
	Illiterate	Primary	Middle School	High School	Graduation
Yes					
No		100% (3)	100% (5)	100% (6)	100% (1)

Source: Field Survey, 2020

f. Household's participation in reuse and recycle:

Table No. 4.36. Participation in reuse and recycle

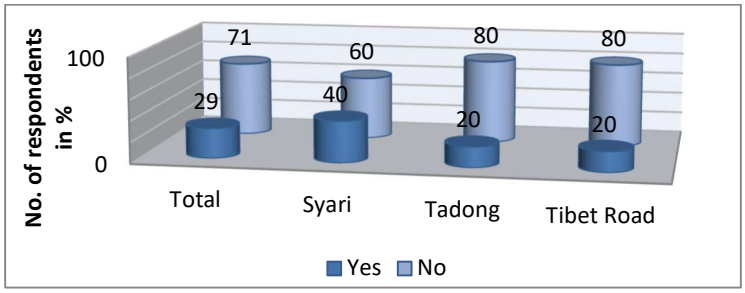
	No. of respondents in %			
Participation in reuse and recycle:	Total	Syari	Tadong	Tibet Road
Yes	29% (31)	40% (19)	20%(9)	20% (3)
No	71% (77)	60% (28)	80% (37)	80% (12)

Source: Field Survey, 2020

Table No. 4.36 shows that the participation in reuse and recycle in all of the wards is better than composting participation. 29 percent of the total respondents participates in reuse and recycle activity. However, it is to be noted that for all the participants recycling is interchangeably used for the activity of reusing. Nevertheless, majority of

the households participated partly in the process of recycling by selling the glass and plastic bottles/jugs to the rag-pickers. It is observed that Syari has the highest percent acknowledgement in reusing and recycling participation followed by households in Tadong and then Tibet Road. The households expressed that provision of recycling centres in the neighbourhood would help improve the waste management behavior to minimize the waste stream.

Fig.4.42. Households listing participation in reuse and recycle



Source: Field Survey,2020

i. Gender

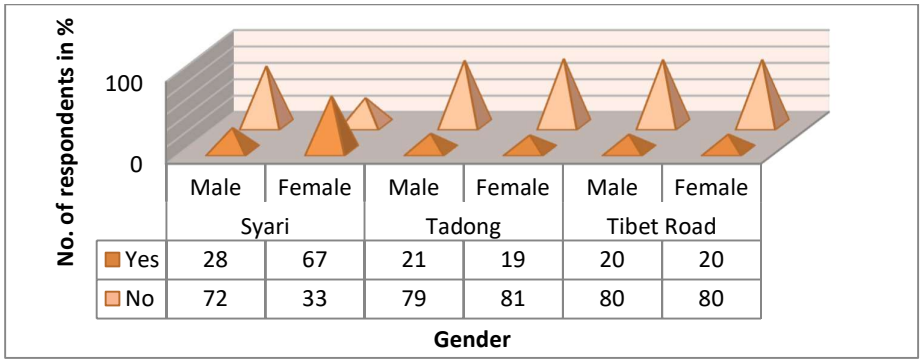
Based on gender, it is reflected that females are better participants than males in reusing and recycling the waste generated. In Syari, females have 67 percent of female participation as compared to 28 percent of the males. In Tibet Road there is equal participation between male and female in reutilizing the waste generated as households. However, in Tadong ward, female participation is two percent below males. Nevertheless, the total distribution of participation shows that the females are performing these activities more than the males at 33 percent as compared to 25 percent of males. (Table No. 4.37)

Table No. 4.37. Participation in reuse and recycle by gender

	No. of Respondents in %					
Participation in reuse and recycle:	Syari		Tadong		Tibet Road	
	Male	Female	Male	Female	Male	Female
Yes	28% (9)	67% (10)	21% (4)	19% (5)	20% (1)	20% (2)
No	72% (23)	33% (5)	79% (15)	81% (22)	80% (4)	80% (8)

Source: Field Survey, 2020

Fig.4.43. Households listing participation in reuse and recycle by gender



Source: Field Survey,2020

ii. Age

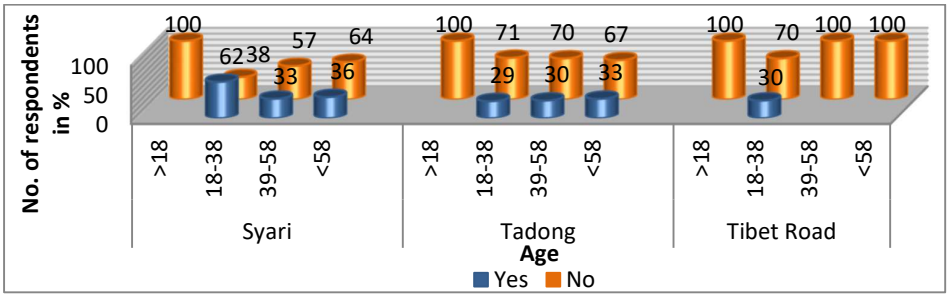
Table No. 4.38. Participation in reuse and recycle by age

Participation in reuse and recycle	No. of Respondents in %			
	Syari			
	>18	18-38	39-58	<58
Yes		62% (8)	33% (7)	36% (4)
No	100% (2)	38% (5)	67% (14)	64% (7)
	Tadong			
Participation in reuse and recycle	>18	18-38	39-58	<58
Yes		29% (5)	30% (3)	33% (1)
No	100% (3)	71% (25)	70% (7)	67% (2)
	Tibet Road			
Participation in reuse and recycle	>18	18-38	39-58	<58
Yes		30% (3)		
No	100% (2)	70% (7)	100% (2)	100% (1)

Source: Field Survey, 2020

Age variation is observed in Table No. 4.38 and in Syari, the maximum respondents' participation in reuse and recycle is from the age group of 18-38 followed by the respondents above the age of 58 and respondents in the age group of 39-58. However, there is no participation from the respondents below the age of eighteen. In Tadong ward, it is observed that the respondents above the age of 58 are better participants and there is a gradual decrease in participation as the age is decreasing. However, in Tibet Road, only the respondents in the age group between 18-38 years are participating in reuse and recycle and a major absence of participation is felt among the residents in the commercialized location.

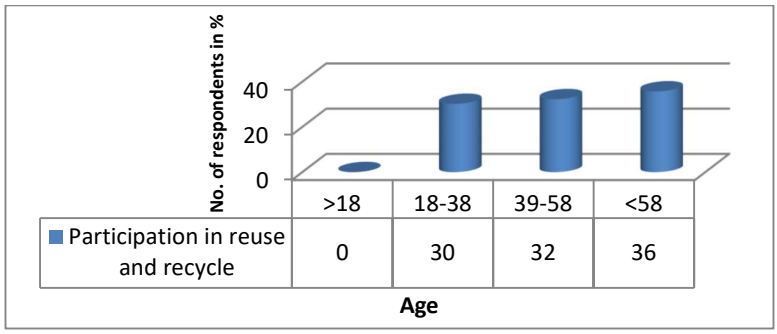
Fig.4.44. Households listing participation in reuse and recycle by age



Source: Field Survey,2020

Therefore, a gradual rise in the percent participation is drawn where it is reflected that the elder population are more active participants in making reuse of the waste generated than any other age grouped population. (Figure 4.45)

Fig.4.45. Distribution of total participation in reuse/recycle across age groups



Source: Field Survey, 2020

iii. Education level

Examination of the education level shows that the respondents with education level higher than high school degree have a better contribution in reusing and recycling participation in Syari. However, even the participation from the respondents without formal education is depicted more than the respondents with middle school degree. While in Tadong, it can be seen that the respondents with graduation degree is the leading participant in reuse and recycle this is followed by the primary school qualified respondents. Here, respondents with high school qualification have a contrary observation than in Syari and makes up the second least participation rate after the population with no formal education. Tibet Road have no participants from graduation

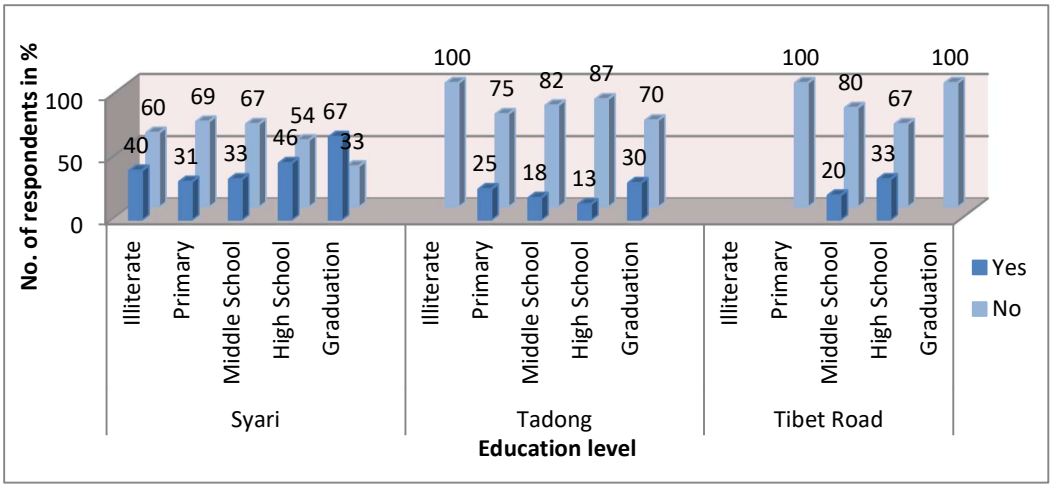
qualification and only high school and middle school qualified respondents participate in reuse of some of the household waste. (Table No. 4.39)

Table No. 4.39. Participation in reuse and recycle by education level

	No. of Households in %				
Participation in reuse and recycle	Syari				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes	40%(6)	31% (4)	33% (1)	46% (6)	67% (2)
No	60% (9)	69% (9)	67% (2)	54% (7)	33% (1)
Participation in reuse and recycle	Tadong				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes		25% (2)	18% (2)	13% (2)	30% (3)
No	100% (1)	75% (6)	82% (9)	87% (14)	70% (7)
Participation in reuse and recycle	Tibet Road				
	Illiterate	Primary	Middle Schoo	High School	Graduation
Yes			20% (1)	33% (2)	
No		100% (3)	80% (4)	67% (4)	100% (1)

Source: Field Survey, 2020

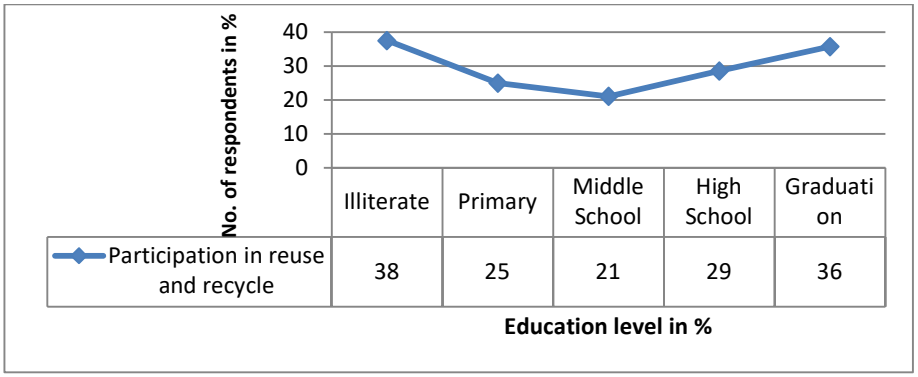
Fig.4.46. Households listing participation in reuse and recycle by education level



Source: Field Survey,2020

However, despite the variation among the three wards, figure 4.47 shows that the majority of the respondents with no formal education are the highest participants in the reuse and recycling practices. Population with higher level of education has shown participation in the management process as well. Nevertheless, highly qualified respondents do not exceed the participation rate of the illiterate respondents which suggests that high education level does not always mean better participation in proper waste recycle and reuse.

Fig.4.47. Distribution of total participation in reuses/recycles by education



Source: Field Survey, 2020

iv. Income level

Table No. 4.40. Participation in reuse and recycle by income level

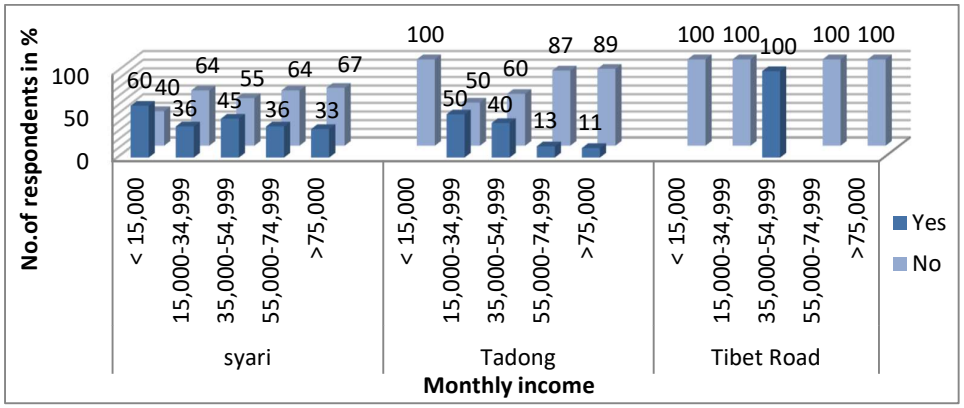
Participation in reuse and recycle:	Monthly Household Income in Rs. (Syari Ward)in %				
	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes	60% (3)	36% (4)	45% (5)	36% (4)	33% (3)
No	40% (2)	64% (7)	55% (6)	64% (7)	67% (6)
	Monthly Household Income in Rs. (Tadong Ward)in %				
Participation in reuse and recycle:	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes		50% (1)	40% (4)	13% (3)	11% (1)
No	100% (1)	50% (1)	60% (6)	87% (21)	89% (8)
	Monthly Household Income in Rs. (Tibet Road Ward)in %				
Participation in reuse and recycle:	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Yes			100% (3)		
No	100% (2)	100% (1)		100% (6)	100% (3)

Source: Field Survey, 2020

Table No. 4.40 reflects that in Syari there is more participation in reuse and recycling from the households with an income level below 15,000 per month followed by the households with a monthly income of 35,000-54,999 rupees. The least number of participants are from the households with an income level above 75,000 rupees per month. There is an irregularity observed as the income increases. However, in Tadong, an inverse relationship is observed where the participation is decreasing with an increase in household's monthly income. In Tibet Road, only households with an income level of 35,000-54,999 rupees are participating in the waste reuse and recycle.

Overall, the picture framed is that it is the lower income level that participates more in reuse and recycle activities than the higher income households.

Fig.4.48. Households listing participation in reuse and recycle by income level



Source: Field Survey, 2020

A brief analysis of the details obtained from the section earlier is needed to understand the ground reality of the waste system in the households studied. The first and foremost important distinction vivid is the participation of females in all of the waste management practices like segregation, composting and reusing and recycling of household wastes. It is also the only consistency observed between the waste attitude and behaviour among the various socio-demographic distributions. There is a vast value-action gap observed in the population as per age distribution. The sustainability and waste as an environment's challenge are acknowledged in highest percent by the population in their young adulthood in the age group of 18-38 and the least is acknowledged by the population above the age of 58. Contrarily, the same percent of participation is devoid in action from the age group of 18-38; rather it is the age group above the age of 58 that have highest participation in all of the waste practices.

Following up the qualification, the highlight is that the population with high education level have an ease to understand the impacts of mismanaged waste upon the environment. They are also the ones who have highest percent acknowledgement of

extreme importance for sustainable development. Be that as it may, the ground practices derived from the evaluation is that higher qualification do not always mean better participation. The respondents with no formal education have showed good number of participations in segregation, composting and reuse and recycle of the waste and are about as close as the respondents with graduation degree. Furthermore, the white collared population and students have shown a promising attitude towards the alignment of waste as an environmental challenge and how sustainable development is of extreme importance; but when the actual practices are examined, there is very little participation from the respondents who are engaged in tertiary and quaternary activities. Although participation in waste segregation is vivid among the professionals, composting and reuse/recycle is not much carried out by them. It is mostly students, farmer, unemployed and self-employed populations who have such waste practices. Finally, higher the income level, higher is the level of awareness and attitudes favouring efficient waste management yet the participation in waste practices is more confined to decent earning households. Even though the segregation is good among the households earning between 35000-74,999 rupees per month, the participation in composting and reuse/recycle is more prominent in the lower income households.

It is also observed that the waste generation and waste practices is varied across the location although the households 'composition of waste is almost alike. For instance, in Syari, the generation of food waste is in all of the households like in Tadong and Tibet Road. Similarly. Although the plastic waste is found in all of the households in all of the three wards, the generation per week is quite less than that of Tadong and Tibet Road. Another important locational distinction is the number of times household waste disposed and in what type of container, which, can determine whether it contributes in waste minimization and participation in reuse practices or adds to the

growing waste system. While it is derived that the composting practices is more practiced by illiterate population in Syari, it is mainly because of the locational factor that supports allied agriculture and the farming occupation can be practiced here. Also, the participation is not always driven by environmental concern. Likewise, populations lying in the lower end of income are better participants in reuse and recycle which similarly is not mostly environmentally driven. A locational variation can also be drawn from the generation of glass composition among the higher income households in Syari which is missing in the households with same income level in Tibet Road and Tadong. This is due to the absence of commercialized bars and restaurants in Syari whereas the easily accessible dine-out places in Tadong and Tibet Road are ample in number.

g. Reason for participation in segregation:

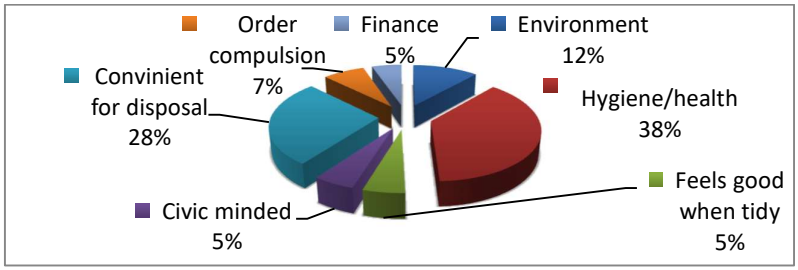
Waste segregation is the one of the most important process in the management of waste and waste minimization. It is only after the segregation of waste that needful practices are done to tackle the waste. However, it has also been observed in the previous sections that not everyone who segregates practices composting and reusing. Nevertheless, this is an important part of the management process and since it is derived that environmentally favouring practice is not constant with the level of environment concerning attitude across various socio-demography, an assumption or generalization of why people practice and not practice an efficient management of waste cannot be drawn without exploring the various possible reasons for the participation.

Figure 4.49 show that the highest reason acknowledged by the respondents for their participation in waste segregation is due to hygiene and heath concern. It is followed by the sole reason of convenience for disposal. There is only 12 percent of participation in the segregation due to environmental concern. Order compulsion is also one of the many reasons why people segregate the waste. Finally, finance have been given priority

by 5 percent of the respondents. Here, by finance it means there is a system of alcohol bottles and cardboard/carton being given by the households to the rag-man in return of monetary exchange. The 5 percent of the respondents acknowledge civic mindedness and good feeling/habit while segregating the household waste.

Now to examine which reasons are acknowledged by what population, a socio-demographic study is done.

Fig.4.49. Total distribution of reason for segregation



Source: Field Survey, 2020

i. Gender

Table No. 4. 41. Reason for segregation by gender

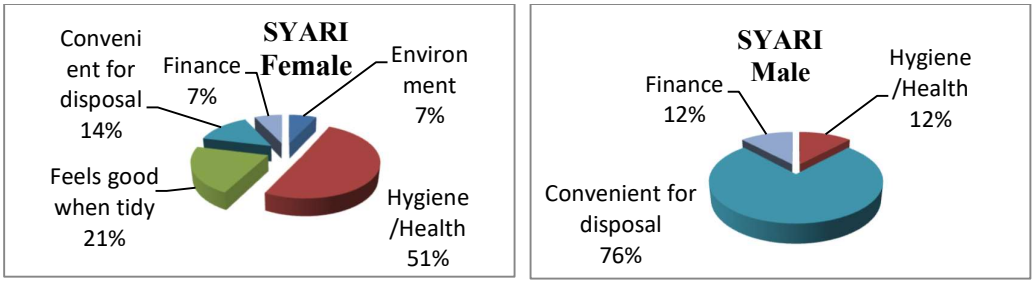
Main reason for participation:	No. of Respondents in %					
	Syari		Tadong		Tibet Road	
	Male	Female	Male	Female	Male	Female
Environment		7% (1)	23% (3)	14% (3)	50% (1)	30% (3)
Hygiene/Health	12% (3)	51% (7)	23% (3)	42% (9)		40% (4)
Feels good when tidy		21% (3)		10% (2)		
Civic Minded			8% (1)	19% (4)		
Convenient for disposal	76% (19)	14% (2)	31% (4)	5% (1)		
Order Compulsion			8% (1)	10% (2)	50% (1)	30% (3)
Finance	12% (3)	7%(1)	8% (1)			

Source: Field Survey, 2020

The main reason for the segregation between males and females in the study area do vary. Likewise, in Syari, 76 percent of males segregates because of the 'convenience for disposal' while only 14 percent of the females who segregates are doing it for the disposal convenience. 51 percent of these females segregate for 'hygiene/health' purpose while only 12 percent of males segregate due to 'hygiene/health' issue. As per one of the female interviewees, *"If I do not have separate bins for kitchen waste and dry waste then there will be very unhygienic environment in my home with food flies*

hovering over the same garbage bin which is continuously used so I have another bin in kitchen with the lid." Also, 21 percent of these females participate in segregation because it makes them 'feel good when tidy' space is there for other household chores. A female interviewee says,*" If I do not separate the wastes, I feel that my house is dirty and untidy."* This shows that that the constant need to keep the household tidy have created a habit of efficient waste practices among the females as opposed to the males. 7 percent of these females also participated in this activity for the environmental cause. Of these males and females, 12 percent of males and 7 percent of females segregates for finance.

Fig.4.50. Households listing reason for segregation by gender in Syari



Source: Field Survey,2020

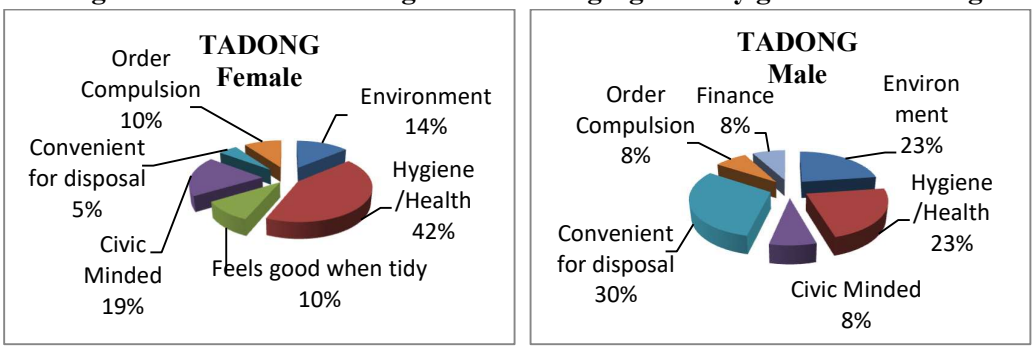
Over all, it is observed in Syari that majority of the females do it for hygiene purpose followed by need for tidiness at home which have become a habit; only then does the women segregates for the convenience of disposal. On the contrary, males segregate mainly for convenience of disposal followed by hygiene purposes and finance.

Tadong shows an extra reason for the segregation participation than Syari and Tibet Road. Among the male population who participates, 8 percent of the males did it due to 'civic mind' and 19 percent of the females who segregate did it for the same reason. Mrs. Lamichaney says, *"I think about the labours who work at the landfill to segregate the waste from the heaps and heaps of unhygienic and sickening waste disposed. On the other hand, segregation of waste at house is so much easier if different bins are*

maintained for the food waste and dry waste. I also wash the sanitary napkins that I use before throwing them away in the public bins. So, it relieves me to know that I am doing what I can for the workers safety."

Apart from that, highest percent of female participation, i.e., 43 percent is due to 'hygiene/health' issues. Mrs. K. Chettri says, *"For the health of my family, I segregate the waste and cover the wet waste properly."*; whereas the highest male participation of 31 percent is due to 'convenience for disposal'. Mr. Pradhan says, *"If I use one dustbin/garbage bag then it is easy to carry it for disposal."* Whereas, only 5 percent of participating females are driven by the reason of 'convenience for disposal'. The 10 percent females also participate because it makes them 'feel good when tidy' surrounding is there. It is observed that this feeling of individuality is only strongly expressed by females in both Syari and Tadong wards. However, 10 percent of these females segregate due to the compulsion of the order from the service providers while 8 percent of these males are driven by this reason for segregation and another 8 percent of males segregate for financial reason. However, in contrast to Syari ward, there is larger percent of males of 23 percent who segregates due to environmental cause as compared to 14 percent of the females. One of the male respondents says, *"I have to take responsibility of what I generate and how I handle it for the sake of my child. I was never an active participator of waste segregation but looking at the Martam landfill now I feel I am responsible for the environment that is building up and in it, is where my child has to live so I have to look after it."* Such a case shows an individual's value bearings is reflecting in his environmental attitude and then his waste actions. Another man's practicality is reflecting upon his eco-friendly initiative of waste practices as he says, *"The kitchen waste is always there, especially tea leaves in majority so, I have started composting which is also best for the environment*."

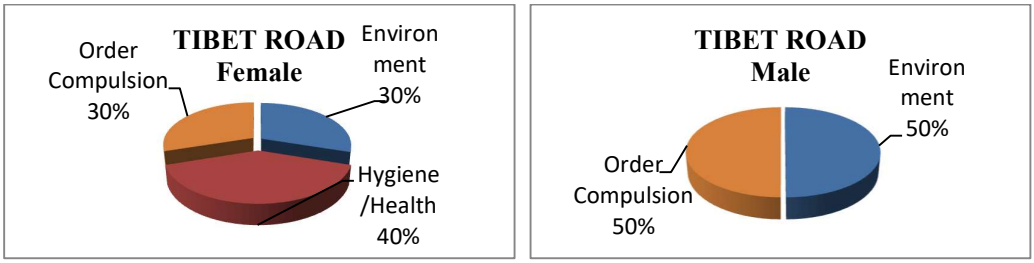
Fig.4.51. Households listing reason for segregation by gender in Tadong



Source: Field Survey,2020

Out of the total male respondents and female respondents participating in segregation in Tibet Road, 50 percent of males and 30 percent of females do it because of the 'order compulsion'. A resident of Tibet Road says,*" The waste workers take the waste if it is segregated or else, they do not."* Rests of the 50 percent males participate for environmental reasons while only 30 percent of the females participate due to environment reason. The remaining 40 percent of females segregates for the sake of 'hygiene/health'.

Fig.4.52. Households listing reason for segregation by gender in Tibet Road



Source: Field Survey, 2020

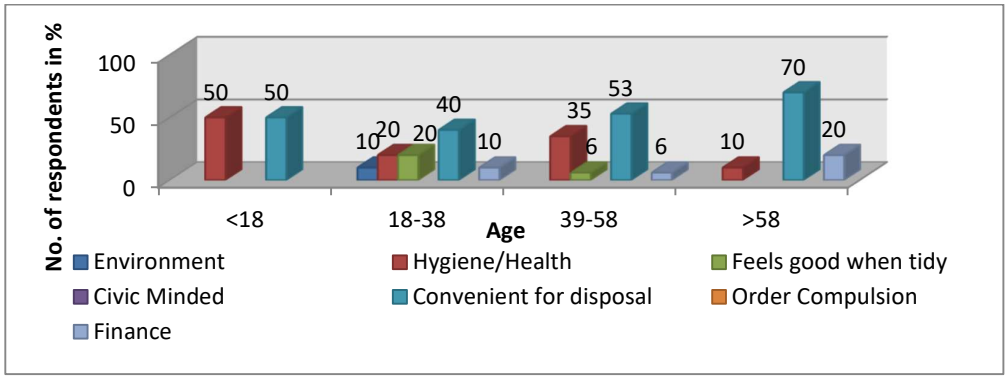
Therefore, it can be drawn from above that the females have better participation due to health and hygiene concern whereas for males it is for the convenience of disposal.

ii. Age

Segregation of waste also has an influence of age variation. In Syari, population below the age of eighteen segregates only for health/hygiene reasons and for the convenience of disposal. As the age increase to 18-38 years, participation is done for various reasons.

However, convenience for disposal of waste is highest percent for the reason of segregation. It is also observed that this is the only age group who segregates for the environment concern. Following up, age group 38-58 is also observed to participate mainly for the convenience of disposal. Similarly, the respondents above the age of 58 segregate majorly for the convenience of disposal too. (Table No. 4.42).

Fig.4.53. Households listing reason for segregation by age in Syari



Source: Field Survey,2020

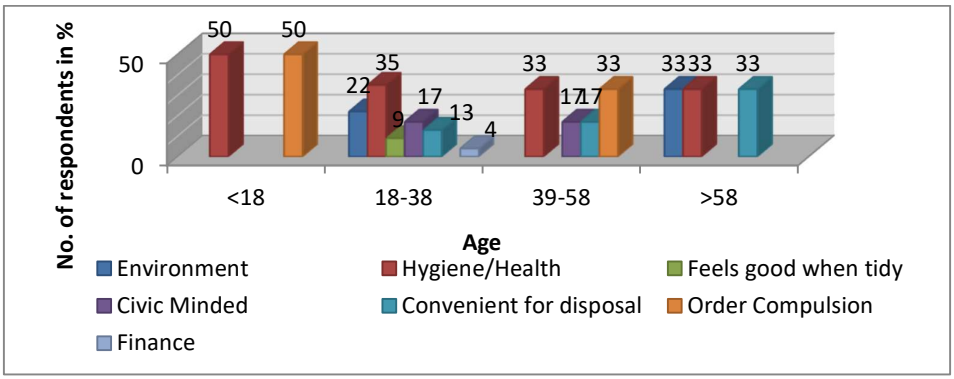
Table No. 4. 42. Reason for segregation by age

	No. of respondents in %			
Main Reason for participation	Syari			
	<18	18-38	39-58	>58
Environment		10% (1)		
Hygiene/Health	50% (1)	20% (2)	35% (6)	10% (1)
Feels good when tidy		20% (2)	6% (1)	
Civic Minded				
Convenient for disposal	50% (1)	40% (4)	53% (9)	70% (7)
Order Compulsion				
Finance		10% (1)	6% (1)	20% (2)
Main Reason for participation	Tadong			
	<18	18-38	39-58	>58
Environment		22% (5)		33% (1)
Hygiene/Health	50% (1)	35% (8)	33% (2)	33% (1)
Feels good when tidy		9% (2)		
Civic Minded		17% (4)	17% (1)	
Convenient for disposal		13% (3)	17% (1)	33% (1)
Order Compulsion	50% (1)		33% (2)	
Finance		4% (1)		
Main Reason for participation	Tibet Road			
	<18	18-38	39-58	>58
Environment	50% (1)	25% (2)	50% (1)	
Hygiene/Health		50% (4)		
Feels good when tidy				
Civic Minded				
Convenient for disposal				
Order Compulsion	50% (1)	25% (2)	50% (1)	
Finance				

Source: Field Survey, 2020.

In Tadong, the age group below eighteen segregates for hygiene and order compulsion. The age group of 18-38 does it mainly for hygiene purpose, followed by environmental concern. A good number of respondents also participate due to a sound civic spirit which makes 17 percent of the percent share. It is then followed by the reason of convenience for disposal. Furthermore, a sense of good feeling is also acknowledged by the respondents for their reason for segregation and finally, financial reason influences the participation here. (Figure No. 4.54)

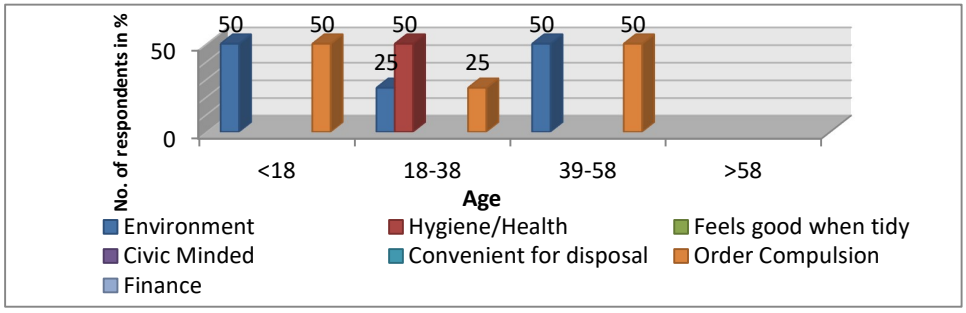
Fig.4.54. Households listing reason for segregation by age in Tadong



Source: Field Survey,2020

Tibet Road have majority of the segregation participants due to 'order compulsion'. Even 50 percent of respondents in the age group of below eighteen years and above fifty-eight years are participating in this activity agreed due to this reason. Although it is acknowledged by the age group of 18-38 as well, this age group is the only ones who show 50 percent of participants led to segregation activity due to hygiene concern as compared to 25 percent of participation due to order compulsion. However, environmental cause was expressed by majority of the participants here in Tibet Road. This may be partially because of the awareness program accessed to this ward in high percent than the other two wards in Gangtok.

Fig.4.55. Households listing reason for segregation by age in Tibet Road



Source: Field Survey,2020

iii. Education level

Table No. 4. 43. Reason for segregation by education level

	No. of Households in %				
Main Reason for participation	Syari				
	Illiterate	Primary	Middle School	High School	Graduation
Environment					50% (1)
Hygiene	17%(2)	56% (5)		23% (3)	
Feels good when tidy			33% (1)	15% (2)	
Civic Minded					
Convinent for disposal	50% (6)	44% (4)	67% (2)	62% (8)	50% (1)
Order Compulsion					
Finance	33% (4)				
Main reason for participation	Tadong				
	Illiterate	Primary	Middle School	High School	Graduation
Environment				25% (3)	38% (3)
Hygiene		43% (3)	14% (1)	42%(5)	38% (3)
Feels good when tidy			14% (1)		13% (1)
Civic Minded		14% (1)	29% (2)	17% (2)	
Convinient for disposal		29% (2)	14% (1)	8% (1)	13% (1)
Order Compulsion		14% (1)	14% (1)	8% (1)	
Finance			14% (1)		
Main reason for participation	Tibet Road				
	Illiterate	Primary	Middle School	High School	Graduation
Environment			20% (1)	50% (2)	100% (1)
Hygiene		50% (1)	20% (1)	50% (2)	
Feels good when tidy					
Civic Minded					
Convinient for disposal					
Order Compulsion		50% (1)	60% (3)		
Other					

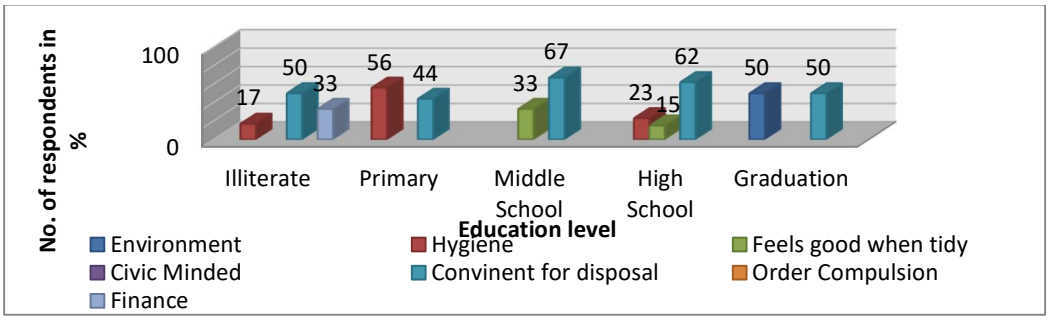
Source: Field Survey, 2020

Apart from the gender and age variation, level of education shapes the motivation of participation of the respondents. It is observed that the majority of the high educated populations also sort to segregation for the convenience of disposal. There is only 50

percent of the participant respondent from 'graduation' level who segregates the waste for environmental cause. In addition, out of the participants with no formal education, 33 percent expressed they segregated only when they had varied waste streams because majority of them are farmers who use the food waste as fodder and compost and labours who sell the glass bottles to the rag-pickers.

In Syari, there is more of participation from the households in waste segregation for the convenience of disposal. Individuals with no formal education also participates for financial reason. One of the respondents with no formal education says," The *glass bottles and cartons are easier to separate and also better to sell than just throw it away."* Individuals with higher education qualification also majorly participates for disposal convenience and only ones who carries out segregation for environmental concern are graduates in Syari.

Fig.4.56. Households listing reason for segregation by education level in Syari

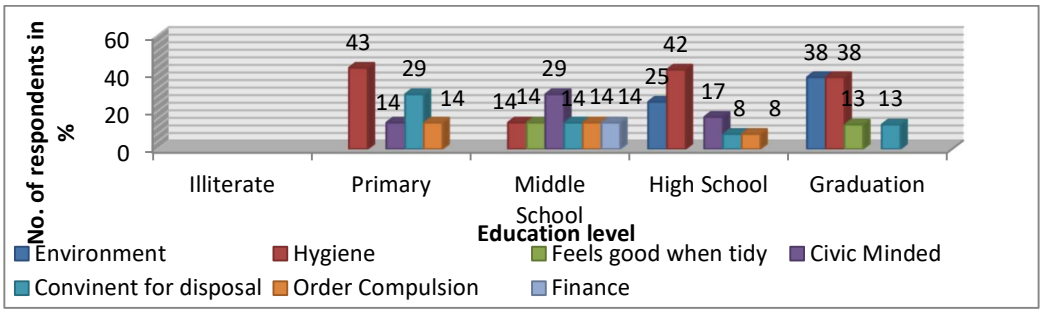


Source: Field Survey,2020

There is an absence of respondents with no formal education in Tadong and Tibet Road. Even though higher education not always means higher rate of participation in waste practices, it is observed that amongst the higher qualification respondents who participate, Tadong shows that 38 percent of graduated respondents are driven by environmental cause for segregation participation followed by 25 percent of high-school level within their own education category. It is also to be noted that they are the only respondents who participates for environmental reasons. One of the highly

educated respondents believes,*" Waste is a growing problem today; the river is just nearby the dumpsite and the waste stench is horrible when we pass by the area so, I have grown conscious."* However, only in Tadong ward is 'civic mindedness' the influence for the segregation participation with 29 percent of 'middle school' participants acknowledging their influential motive for the activity. These respondents are basically females who say, *"If I segregate the waste myself then it will at least make the work of the waste workers a little easy."*

Fig.4.57. Households listing reason for segregation by education level in Tadong

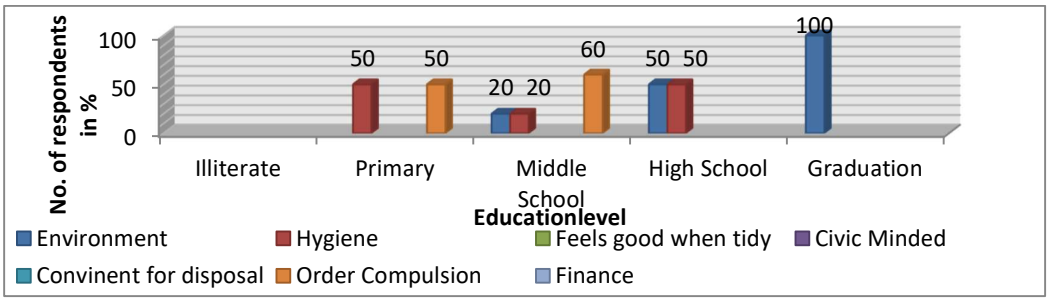


Source: Field Survey, 2020

In Tibet Road, the main reason for segregation also follows a trend of increase for environmental cause with the increase in the education level. A concerned parent of two children also says that being environmentally concerned is what drives her waste segregation practices, she says, *"I do what I can for my children's future."* It is procured from the Table No. 4.43 that environmental reason is 20 percent for 'middle school', 50 percent for 'high school' and 100 percent for 'graduation'. 'Convenient for disposal' is strongly admitted by 25 percent of the 'primary' participants followed by 17 percent of 'middle school' participant. The influence of 'order compulsion' is strong among 'primary' and 'middle school' participants at 50 percent and 60 percent each respectively in Tibet Road. The respondents admit that the waste collector does not take away the waste if not segregated at the source. Hence, the segregation at source is done by majority of the participants of low formal education levels for this reason. The same

is applicable in Tadong ward where 25 percent of the total 'primary' education level participants are carrying out the activity of segregation at the source itself.

Fig.4.58. Households listing reason for segregation by education in Tibet Road



Source: Field Survey, 2020

iv. Income level

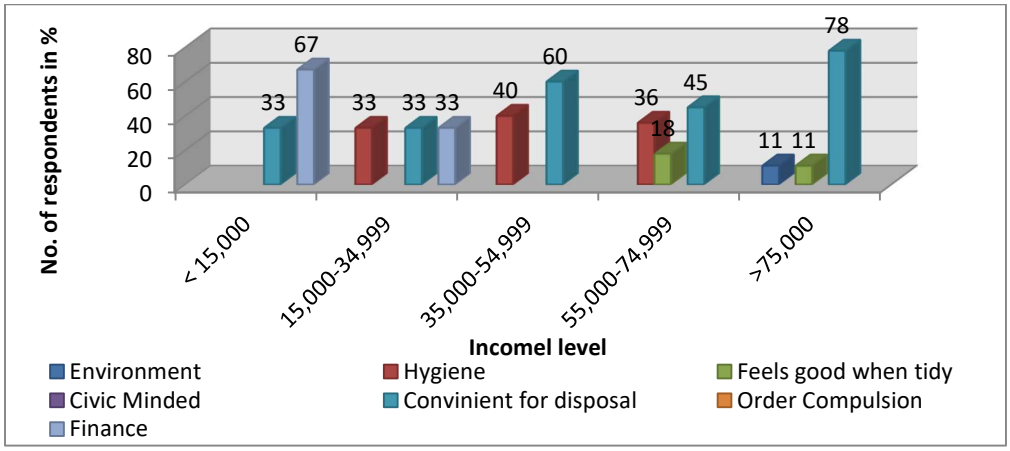
Table No .4. 44. Reason for segregation by income level

	Monthly Household Income in Rs. (Syari)in %				
Main Reason for participation	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Environment					11% (1)
Hygiene		33% (2)	40%(4)	36% (4)	
Feels good when tidy				18% (2)	11% (1)
Civic Minded					
Convinient for disposal	33% (1)	33% (2)	60% (6)	45% (5)	78% (7)
Order Compulsion					
Finance	67% (2)	33%(2)			
	Monthly Household Income in Rs. (Tadong)in %				
Main Reason for participation	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Environment			13% (1)	10% (2)	50% (3)
Hygiene			38% (3)	29% (6)	50% (3)
Feels good when tidy				10% (2)	
Civic Minded				24% (5)	
Convinient for disposal			13% (1)	24% (5)	
Order Compulsion			38% (3)		
Finance		100% (1)			
	Monthly Household Income in Rs. (Tibet Road)in %				
Main Reason for participation	< 15,000	15,000-34,999	35,000-54,999	55,000-74,999	>75,000
Environment				17% (1)	100% (3)
Hygiene			33%(1)	50% (3)	
Feels good when tidy					
Civic Minded					
Convinient for disposal					
Order Compulsion			67% (2)	33% (2)	
Finance					

Source: Field Survey, 2020

The income level of the participants is examined and Fig. No. 4.59 shows that in Syari, finance is a better cause for participation for 67 percent of the respondents below 15,000 rupees/month. Next reason is convenience for disposal for the remaining participants under this income level. It is observed among income between 15,000-34,999, there is equal participation due to hygiene, finance and convenience for disposal. People have a valid financial reason for waste minimization and waste segregation as observed; one of the many respondents says, *"I think waste of food is wastage of money."* Another respondent says, *"Hard earned money goes into buying edible goods, if those goods can return us some money, then why not?*"

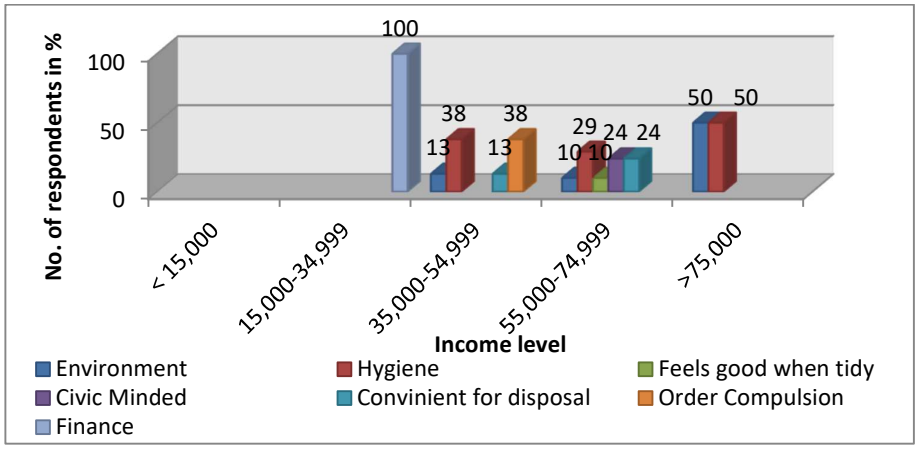
Fig.4.59. Households listing reason for participation by income level in Syari



Source: Field Survey, 2020

In income group of 35,000-54,999, hygiene and convenience for disposal are the main reasons for segregation. However, convenience for disposal remains at a higher percent share even among households earning more than 55,000 and 75,000 rupees/month. One of the interviewees with high income says, *"We don't have collection facility so it is easier to separate the waste beforehand than at the time of burning it from one bin."*

Fig.4.60. Households listing reason for participation by income level in Tadong

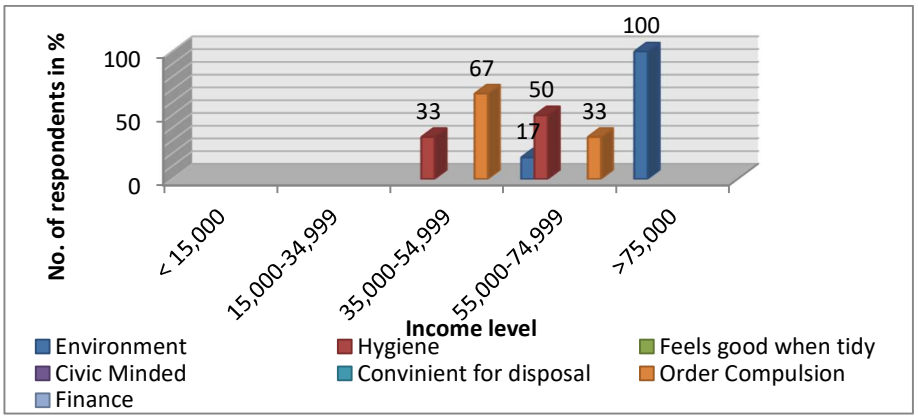


Source: Field Survey, 2020

It is so observed in Tadong ward that households have better participation due to financial purpose in lower end of income level who also have waste minimization characteristics for financial reason as well. For example, a household earning between 15,000-34,999 rupees/month consisting of only two brothers says, *"The groceries are very costly here in Gangtok and only I earn so, I buy less unnecessary packaged food and try to minimize the food waste."* Apart from this, the ways people segregate also varies. For instance, one of the respondents say,*" We reuse the junk food packets (chips and biscuits) and small plastic bags for throwing the left-over food. It's better than using big garbage bags as the food waste can't be kept for a long time and given the size of the bags, it's just a waste of money."* It is also observed that order compulsion is focused by households earning between 35,000-54,999 rupees/month apart from good number of participation due to hygiene and health reasons. As the income increases to 55,000-74,999 rupees, it is observed that reasons of 'feeling good' and 'civic mindedness' is also prominent, Mrs. E. Subba says, *"As a citizen of Sikkim, I want to contribute towards keeping green and clean environment here."*; even though hygiene is mainly the sole reason for segregation. The participation in segregation

mainly because of environmental reasons is observed among all of the income level above 35,000 rupees per month.

Fig.4.61. Households listing reason for participation by income in Tibet Road

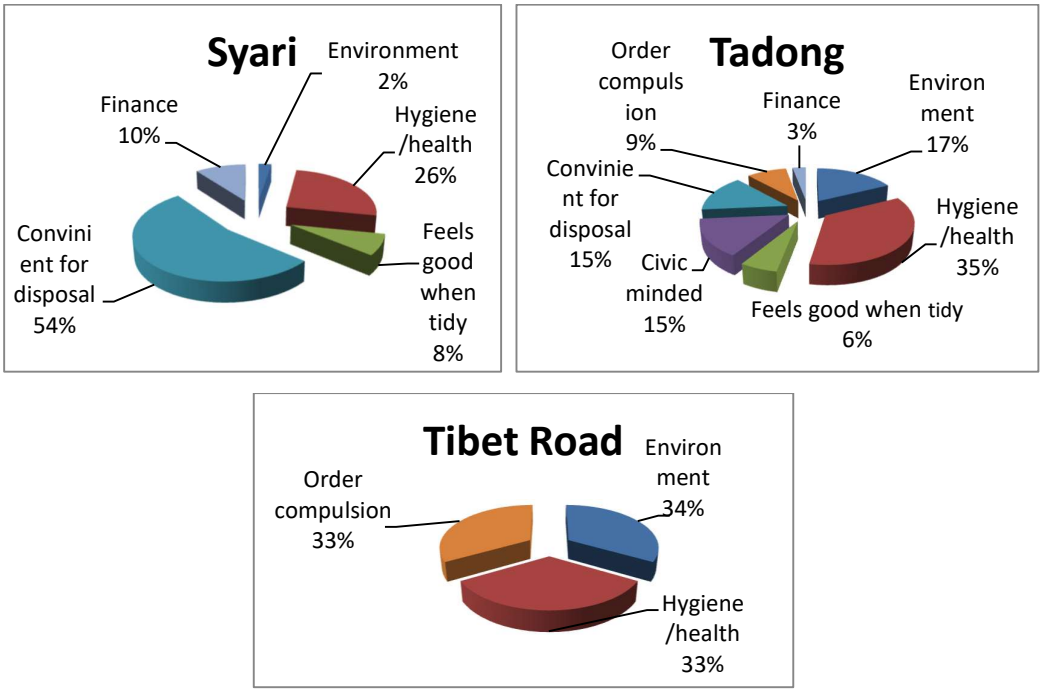


Source: Field Survey, 2020

In Tibet Road, there are mainly three reasons why people participate in waste segregation and they are mainly order compulsion, hygiene purpose and environment. As the income level decreases the participation reason due to order compulsion increases and as the income level increases the environmental reason for waste segregation increases. Mr. Tobgay who have a very high income as an environmentally conscious individual says, *"As a citizen, I think I should be responsible for what I contribute to the society."* (Fig. No.4.61)

Figure 4.62 shows that there is a distinct difference among all the locational wards. The residential ward, Syari has majority of the participation in waste segregation due to disposal convenience and then hygiene purposes. Tadong on the other hand have higher participation for hygiene purposes and then for environment led consciousness. However, civic mindedness and convenience for disposal is also one of the major three main reasons for waste segregation. It is observed that as the location shifts from residential to more commercial location, the reason for waste segregation increases due to environmental concern. It is highest percent of reason for household's participation in segregation in Tibet Road., followed by order compulsion and hygiene and health.

Fig.4.62. Distribution of reason for participation



Source: Field Survey, 2020

On the whole, it is observed is that socio-demographic factors cannot always determine the participation of the population in waste segregation. Even though there is variation between gender where majority of the females participates for hygiene purpose and males for convinience of diposal, the reason for disposal varies within each gender across different locations. For instance, majority of the males in both Syari and Tadong participates for disposal convinience. However, males in Tibet Road do not have this reason for waste segregation. It is rather order compulsion and environmental concern. Likewise in age factor, the participation reason varies not only across the age group but more within itself. There is an observation that population with higher education level have more participation due to environmental concern but there is also reasons like order compulsion in Tadong and convinience for disposal in Syari among the higher qualification population. Like wise across income level, it is refelected that although there are good chances that high income population participate in segregation for environmental reasons, the chances that it will not always be the same is higher and

better. For example, the majorityof the higher income population in Syari have shown better participation for disposal convinience whereas in Tadong it is mainly for hygiene and health reasons. It is therefore, safe to draw that the locational factor have better chances of influencing the nuance reasons for participation in waste management than the socio-demographic factors.

h. Reason for non-participation in segregation

Even though the segregation participation percentage is higher than the non-segregation participation, the concerned influential motive behind it remains far from environmental concern. However, irrespective of the different reason than environment, it at least demonstrates the motivation for acting positively towards waste challenges. Nonetheless, the non-segregation in the total study area still remains. Out of the total non-participants, it is observed that highest numbers of respondents do not segregate because they do not have proper knowledge of the sorting and which waste goes where? It is followed by a good number of respondents who suggests that it does not make any difference. This shows that they have put an effort before but for some reasons unknown yet have stopped doing the needful. A high percent of respondents also says that despite proper knowledge of types of waste, they do not segregate simply because they have a busy schedule most of the days. In Syari, the disagreement to segregation is 17 percent, in Tadong, it is 26 percent and Tibet Road has 20 percent at the household. Out of these 17 percent respondents in Syari, a very high percent of the respondents expressed that 'it does not make any difference' and the rest of them are willing to participate but do not have proper knowledge. An interviewee says, *"The management of waste is in the house owner's hand here, we have never had any collection and disposal facility in our village."*

In Tadong, 50 percent of the non-segregating respondents are willing to segregate but do not have proper knowledge about the waste sorting; one of the many respondents says, *"I do not know what and how to separate the waste. The waste workers only ask us to segregate the wet waste and dry waste, apart from that I am unclear."*

25 percent do not have time to segregate; a respondent who in particular selected 'no time to segregate' reason for not participating in segregation activity mentions:

"There is no time to segregate because most of the time I am in college and when I am in my room, there are friends who come over and I guess, I have never really given it any thought. It always felt easier to use one dustbin for everything."

17 percent says segregation is 'more expensive'; *Mr. Rai says, "I have to use two garbage bags at a time and it's not worth it so I use only one bin."* and for 8 percent it 'does not make any difference'. For many of the household respondents they had not much reliance on the collection, transportation, disposal services of the authority. While one of the interviewees says, *"I have observed that the waste truck collects and transports is mixed so it does not make any difference whether we segregate it at home or not."*, another interviewee says, *"The service providers throw the waste directly into the landfill so what I do in my home is meaningless."*

Apart from this, there is also an unreliability on the production of the goods. Many shared the same view on this; one of such respondents says, *"Actually, the manufacturers sell the goods in plastic packaging so, we are powerless."*

Tibet Road on the other hand have 33 percent of the non-segregating respondents express that they do not have time to segregate. There are also non-participants who says that their household actions do not make any difference and rest of the respondents are willing to participate in segregation but do not have a proper knowledge on what

type of waste should be put apart or together. This have been observed not only in Tibet Road but also in other two wards.

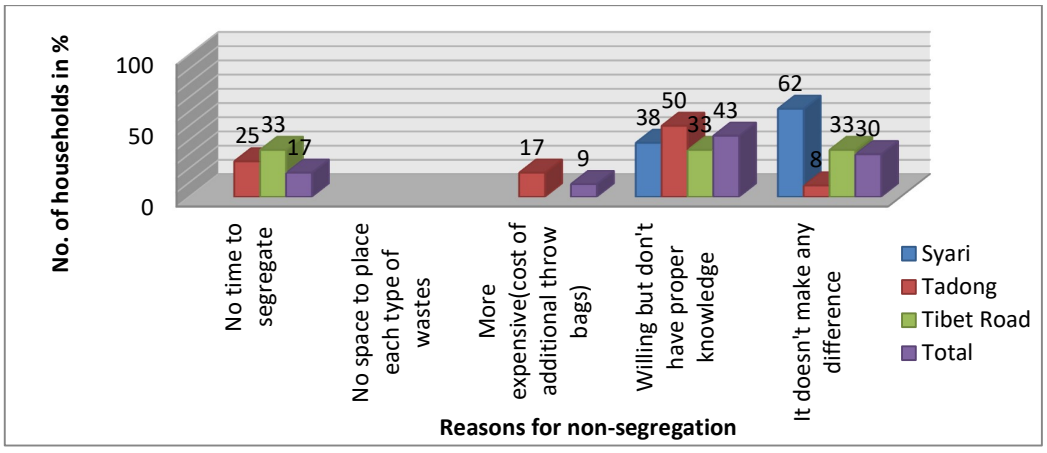
Table No. 4. 45. Households listing the reason for non-segregation at source

If no, specify the reason:	No. of Households in %			
	Syari	Tadong	Tibet Road	Total
No time to segregate		25% (3)	33% (1)	17% (4)
No space to place each type of wastes				-
More expensive(cost of additional throw bags)		17% (2)		9% (2)
Willing but don't have proper knowledge	38% (3)	50% (6)	33% (1)	43% (10)
It doesn't make any difference	62% (5)	8% (1)	33% (1)	30% (7)

Source: Field Survey, 2020

On further enquiry, majority of the respondents also share that they are not well acquainted with the policies and regulations of waste management. Many respondents said that the ban of plastic is just verbally there as all of them have experienced bringing goods in plastic bags from the market and shops. Apart from the standard regulation on waste management, lack of the popularity of waste policies among the citizens is felt strongly as all the respondents vocally expresses, *"I have never heard of strict regulation of recycling and reusing: there are policies and acts but I have never gone through it, never had a need to."*

Fig.4.62. Households listing reason for non- participation



Source: Field Survey, 2020

When asked upon whether the households will segregate waste if monetary incentives would be awarded, 100 percent of the total three wards agreed to participate. For the

respondents who do not participate in segregation, economic benefits seem important as compared to the active respondents. On further inquiry of what measures, if any, would help encourage and improve the environmentally sound practices of waste management behavior, majority of the respondents expressed for better services and facilities of collection, recycling station and demand for regular education on waste handling in their locality.

4.1.3. Infrastructure of waste services in locality

The results of reasons for waste segregation and non-participation on waste segregation highlights that there are more locational and situational factors that affects the waste practices of the population than the socio-demographic factors. Thus, the locational infrastructure of waste facilities and incompetence are acquired. When it comes to the waste management, allotted department of the government plays a huge role in shaping up a sound mechanism of the system. From the awareness program to services like providing temporary household disposal public bins and collection facility, it is vital in attributing towards the perspective a household has towards a proper management of waste. The same has been tried to look upon to understand the level of engagement of the households in managing their waste.

a. Awareness on proper waste disposal by GMC

Table No. 4.46. Awareness on proper solid waste disposal by GMC

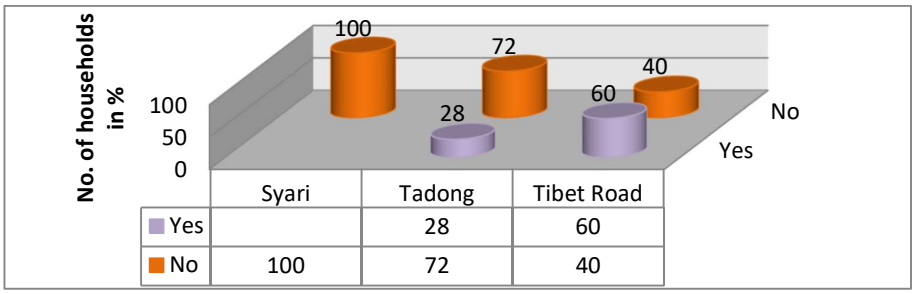
Awareness on proper solid waste disposal by GMC	No. of Households in %		
	Syari	Tadong	Tibet Road
Yes		28% (13)	60% (9)
No	100% (47)	72% (33)	40% (6)

Source: Field Survey, 2020

Firstly, the awareness program is taken into consideration. While 60 percent of the households in Tibet Road have been engaged with GMC's awareness campaign, only

28 percent of Tadong respondents have been facilitated with the awareness on proper solid waste disposal methods whereas in Syari, there is none.

Fig.4.63. Households listing awareness on proper solid waste disposal by GMC



Source: Field Survey, 2020

b. Access to public bins

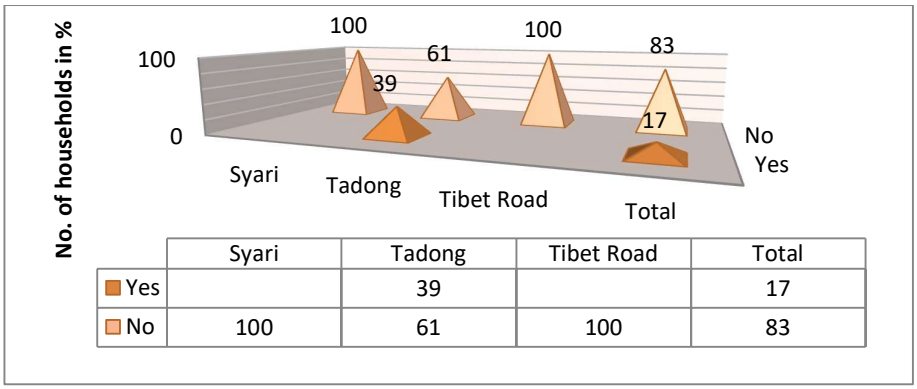
Table No. 4.47. Public bins near the household

	No. of Households in %			
Pubic Bins near your house	Syari	Tadong	Tibet Road	Total
Yes		39% (18)		17% (18)
No	100% (47)	61% (28)	100% (15)	83% (90)

Source: Field Survey, 2020

The next facility is the availability of public bins for temporary household waste disposal. The households of residential location, Syari and commercial location, Tibet Road are deprived of the facility of disposing their household waste in the bins allotted by the concerned department of the government. However, it is reflected that 39 percent of the total households in Tadong have an access to the public bins in their locality.

Fig.4.64. Households listing the availability of public bins near their households



Source: Field Survey, 2020

c. Time taken to reach the disposal bins

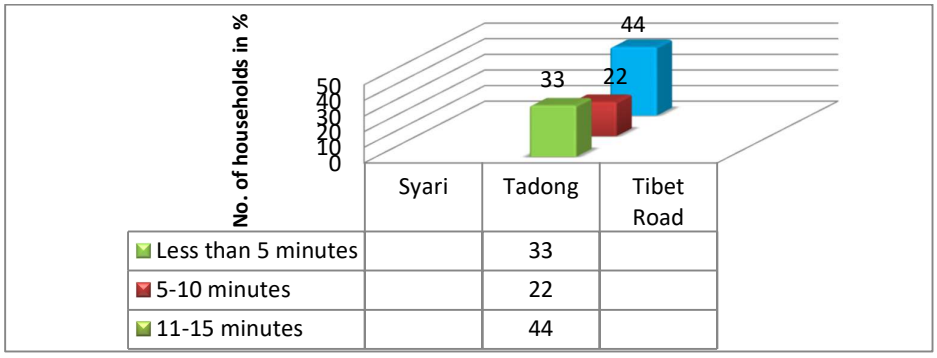
Table No. 4.48. Time taken to reach the bin

	No. of Households in %		
If Yes, minutes taken to reach the bin	Syari	Tadong	Tibet Road
Less than 5 minutes		33% (6)	
5-10 minutes		22% (4)	
11-15 minutes		44% (8)	
16-20 minutes			
21-25 minutes			
Other			

Source: Field Survey, 2020

The ground practices of the households are determined not only by the accessibility of the public waste bins but rather by the time taken to reach the allotted waste bins. Time has been considered in the enquiry and not distance because of the steep topographical factor in the study area; even if the distance to the public bin is same between two households, the time taken to walk to-and-fro does vary between these two households if one is located nearby the roadside and the other on a distant site from the road. Hence, time is the knowledge of distance and time taken will act as a barrier in a frequent use of the facilities.

Fig.4.65. Households listing the time taken to reach the public waste bin



Source: Field Survey, 2020

It is also observed from Table No. 4.48 that the respondents who utilize this facility do not take more than 15 minutes to reach the bins but the highest utilization of this facility is from the households who are farthest from public bins. However, this contributes to one of the reasons why there are households who dispose the household waste every once in three days followed by 17 percent households with once a week in Tadong. Mr.

Chhetri says, *"There is no waste bins here and no collection system in my area so, we throw the waste altogether when two-three bags get full near the housing gate."* Here in Tadong, by housing gate it means the allocated public bin point on the roadside.

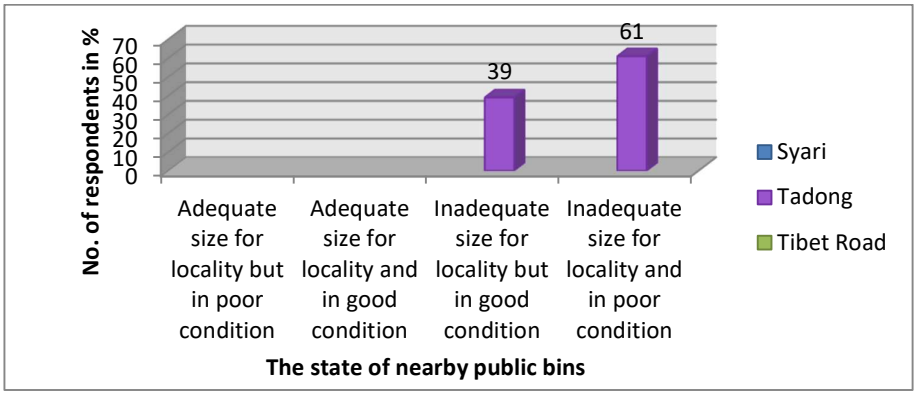
d. State of the bins

Table No. 4.49. Listing the state of the public bin

	No. of Households in %		
If yes, the state of nearby public bin	Syari	Tadong	Tibet Road
Adequate size for locality but in poor condition			
Adequate size for locality and in good condition			
Inadequate size for locality but in good condition		39% (7)	
Inadequate size for locality and in poor condition		61% (11)	

Source: Field Survey, 2020

Fig.4.66. Households listing the state of the public waste bin



Source: Field Survey, 2020

Despite the low number of households facilitated by this service and using it for their households' waste disposal, an enquiry on the householders' perception on the waste disposal point is done which helps in uncovering the process that is affecting the behaviour of the respondents. When asked about the state of the public bins in their locality, there is main focus upon the inadequate number of bins which is not enough for the disposal of their locality. However, 39 percent of the households accessing this facility say it is in clean/good condition whereas higher percent of the households accessing this facility say that the bins are in poor condition. One of the respondents

says, *"There are just two-three blue coloured bins in our area with no proper mark on what type of waste goes where so, we just place the waste there."*

e. Waste collection and disposal method

Table No. 4.50. Households listing waste collection-disposal method in locality

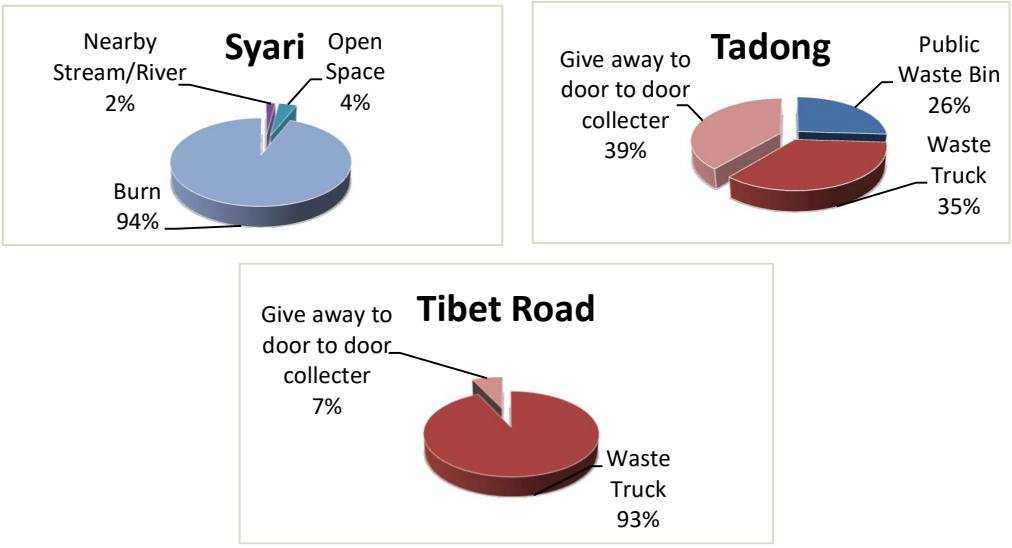
	No. of Households in %		
Disposal of Collected Waste	Syari	Tadong	Tibet Road
Public Waste Bin	-	26% (12)	-
Waste Truck	-	35% (16)	93% (14)
Nearby Roadside	-	-	-
Nearby Stream/River	2% (1)	-	-
Open Space	4% (2)	-	-
Hole in Own Compound	-	-	-
Burn	94% (44)	-	-
Give away to door to door collecter	-	39% (18)	7% (1)

Source: Field Survey, 2020

The reality of how the household action in waste disposal is carried out is varied due to the infrastructure of waste services and also due to the gazette notifications passed with regards to making M.G. Marg a litter and spit free zone in Gangtok. Despite passing a gazette notification No. 196/FEWMD to ban the open-burning by the Forest, Environment and Wildlife Management Department, Government of Sikkim in **Invalid source specified.**, 94 percent of the total households in Syari practice open-burning for disposing the solid waste, 4 percent dumps it in an open space and 2 percent throws it nearby stream and river. As compared to Syari, Tadong and Tibet Road have an access to waste collection services due to its locational factor. 35 percent of Tadong households out of the total surveyed households here dispose it on the waste truck directly, 39 percent of them have a door-to-door collection service and 26 percent of the households dispose their household waste in the public waste bin in their locality. However, it is drawn from Table No. 4.47 that 39 percent of the households in Tadong have this facility but from Table No. 4.50, it is reflected that only 26 percent out of these 39 percent households make use of this facility. Tibet Road has 93 percent of the households dispose the waste directly in the waste truck and 7 percent have door-to-

door facility. However, the public waste bins here are not available as per beautification plan of the core of the city. (Table No. 4.50)

Fig.4.67. Households listing waste collection and disposal method in locality



Source: Field Survey, 2020

f. Problems due to waste in locality

Table No. 4. 51. Environmental problem in locality due to waste in study area

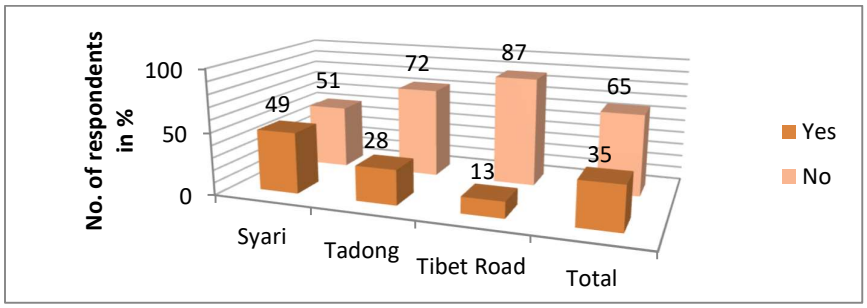
Environmental problem in neighbourhood due to solid waste	No. of Households in %			
	Syari	Tadong	Tibet Road	Total
Yes	49% (23)	28% (13)	13% (2)	35% (38)
No	51% (24)	72% (33)	87% (13)	65% (70)

Source: Field Survey, 2020

Given the disposal practice of the households above, it is drawn that residential Syari have a long way to go in bringing out a more efficient technique of waste disposal. Despite being the best among the three wards in the participation rate in segregation, composting and reuse of the generated waste, the ultimate disposal method is unsuitable for the environment. In Syari, out of total number of households surveyed, 49 percent of respondents agreed to the environmental issues in their neighbourhood and all of them emphasized in the air pollution due to the disposal technique used here. Mrs. Tamang expresses, *"We are well aware of the environmental consequences of burning but what can we do? There is neither collection facility nor any disposal facility*

provided by the authority here." Out of these 49 percent, almost 50 percent of the respondents had an education level of high school and 52 percent were in government service followed by 17 percent of students. On the other hand, only 28 percent of the households in Tadong expressed that there is an environmental issue in their locality and only 13 percent of households acknowledge the same in Tibet Road. It is observed from this that the residentially located households are more aware of their actions. (Table No. 4.51)

Fig.4.67. Households listing the environmental problem in locality due to waste



Source: Field Survey, 2020

On the other hand, problems like water clogging, odour and flies are the main problems of waste in the locality of Tadong. Majority of the respondents express that there is water clogging more often prevalent during monsoon season which causes the odour to be more prominent and have problems of fruit flies in the household. One of the shopkeepers interviewed says, *"At evening, everyone around here comes to throw the garbage and I see that the waste isn't segregated and closed properly and the stray dogs spread all of those wastes and most days is left on the pavements beside my shop. I always have to sweep it off."*

However, it is only in small percent as compared to the disagreement that the households expressed to these environmental issues in their neighbourhood in Tadong. It is also observed that in Tibet Road, the main problem is only water clogging in the drainage which as expressed by the households also causes odour (Table No. 4.51). One

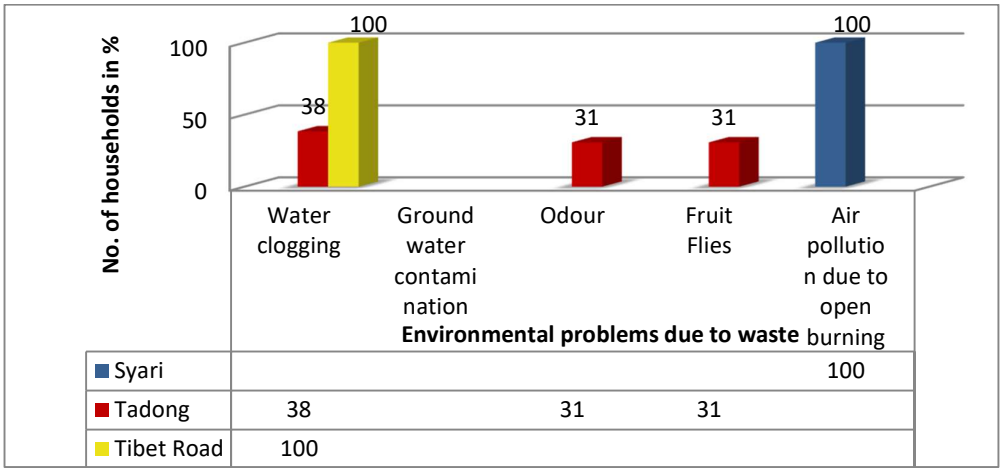
of the respondents says, *"People in my colony throws their waste in the drainage and nobody owns up so, I clean it up most of the times or else there is foul odour and mosquitoes."* However, it is only 13 percent of the Tibet Road's households surveyed that they have problems arising from the waste in their locality. (Table No.4.52)

Table No. 4.52. Specific lists of environmental problem faced due to waste

If yes, environmental problem in locality due to solid waste	No. of Households in %			
	Syari	Tadong	Tibet Road	Total
Water clogging		38% (5)	100% (2)	18%(7)
Ground water contamination				
Odour		31% (4)		11% (4)
Fruit flies		31% (4)		11% (4)
Air pollution sue to open burning	100% (23)			60% (23)
TOTAL				**100**

Source: Field Survey, 2020

Fig.4.68. Households listing specific environmental problem in locality due to waste

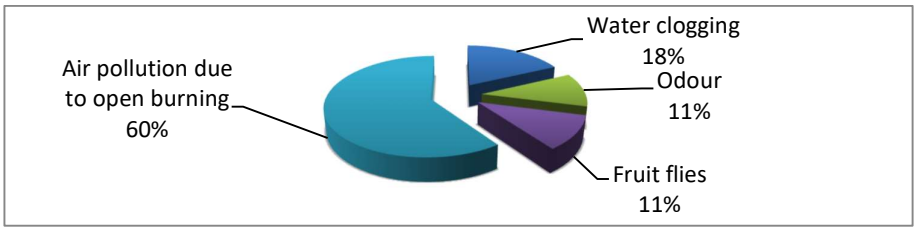


Source: Field Survey, 2020

As opposed to 35 percent of total sampled households surveyed, 65 percent of the total households are content with their surrounding environment. Out of the total households who express the problems currently facing by them due to waste, air pollution is the top most acknowledgement which are all from the households of Syari. Further, water clogging is more prominent in mixed location and commercial location of Tadong and Tibet Road which makes up 18 percent of the total problems of waste in the study area.

Finally, odour and problem of fruit flies also contributes to the waste issues here. (Figure 4.69)

Fig.4.69. Distribution of total environmental problem in locality due to waste



Source: Field Survey, 2020

g. Willingness and unwillingness to pay extra amount for services

Lastly, waste collection charge in Gangtok Municipal Corporation ranges between 100 rupees to 300 rupees per month, varying according to the geographical accessibility and by the service provided. Table No. 4.53 shows that out of the total households surveyed in the study area, 29 percent are not willing to pay for an improved waste collection service.

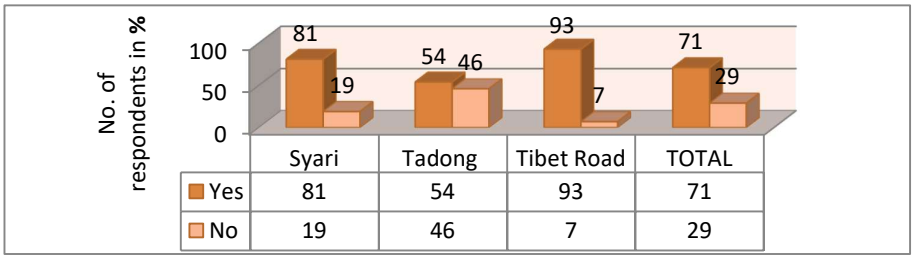
Table No. 4.53. Willingness to pay to improve the current services

Willingness to pay for improved services:	No. of respondents in%			
	Syari	Tadong	Tibet Road	TOTAL
Yes	81% (38)	54% (25)	93% (14)	71% (77)
No	19% (9)	46% (21)	7% (1)	29% (31)

Source: Field Survey, 2020

Tadong ward shows highest unwillingness to pay with 46 percent of the respondents disagreeing to indulge in extra pay. However, in Syari 19 percent are unwilling to pay for improved waste services and in Tibet Road only 7 percent is unwilling to pay.

Fig.4.70. Households' willingness to pay to improve the current services



Source: Field Survey, 2020

In opposition to this, out of the total households surveyed, 71 percent of these households show that they are willing to pay certain amount for certain type of services provided which also varies in all of the three wards.

Table No. 4.54. Extra amount willing to pay with services

Services	Extra pay range/month willing to pay				
	Syari				
	< Rs. 50	Rs. (51-100)	Rs. (101-150)	Rs. (151-200)	> Rs. 200
Provision of collection services	66% (25)	34% (13)			
Sanitization of area of/around public bins					
Increase the no. of public bins					
Increase the frequency of door-to-door collection					
Fixed timing of truck arrival					
Provision of door-to-door collection					
	Tadong				
	< Rs. 50	Rs. (51-100)	Rs. (101-150)	Rs. (151-200)	> Rs. 200
Provision of collection services					
Sanitization of area of/around public bins	16% (4)				
Increase the no. of public bins	16% (4)				
Increase the frequency of door-to-door collection		28% (7)	16% (4)		
Fixed timing of truck arrival	16% (4)				
Provision of door-to-door collection				8% (2)	
	Tibet Road				
	< Rs. 50	Rs. (51-100)	Rs. (101-150)	Rs. (151-200)	> Rs. 200
Provision of collection services					
Sanitization of area of/around public bins					
Increase the no. of public bins					
Increase the frequency of door-to-door collection					
Fixed timing of truck arrival		43% (6)	29% (4)		
Provision of door-to-door collection				21% (3)	7% (1)

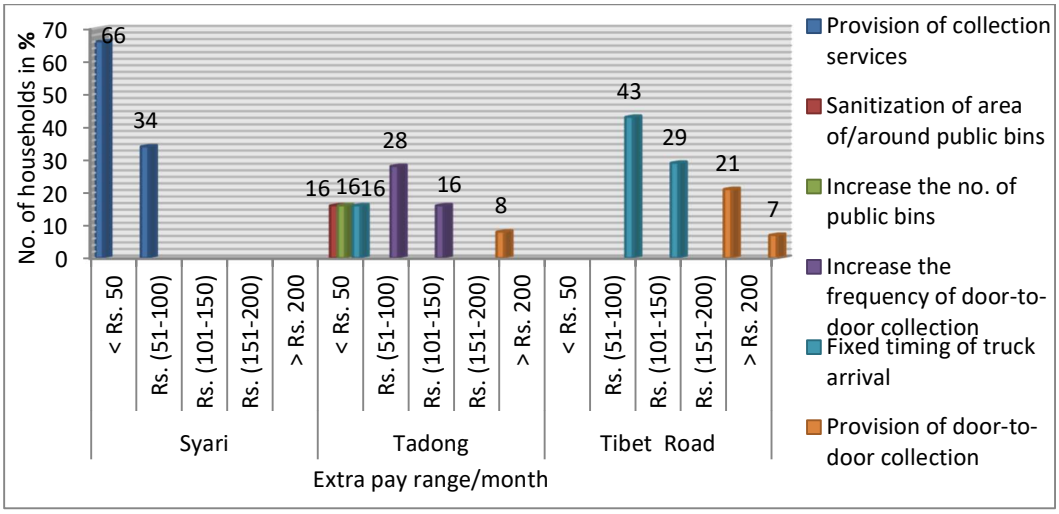
Source: Field Survey, 2020

Table No. 4.54 highlights that the Syari ward still does not have the facility of waste collection and majority of the households are willing to pay up to 50 rupees for the provision of collection facility here. It is followed by 34 percent of those households willing to pay up to rupees 100 per month for the same service. This shows that the residents here are willing to co-operate in the management process given that the service be initiated at the earliest. As per one of the interviewees, *"The waste services are not accessed in our neighbourhood though it is provided to the people in Upper Syari. I do understand that it was due to the lack of road network but now that it has*

been constructed, the collection with waste truck should be done here as well; if not every day, then they should at least provide a public waste bin for temporary disposal."

However, there is also 19 percent of the households who do not want any of these services because they feel that the waste management is being efficiently handled by themselves in Syari as they only have generation of food waste which is either fed to pigs and dogs or mixed with the soil as compost directly in the agricultural field. Mr. Lakpa Tamang says, *"The waste that comes out is very little in amount and only occasionally we have the need to burn them so, it is alright even if the service cannot reach until here."*

Fig.4.71. Willingness of households to pay extra amount with services



Source: Field Survey, 2020

In Tadong ward, it is observed that majority of the households want more frequent collection of waste from their households and are willing to pay up to rupees 150 extra for the same to the service providers. Miss Elina Subba says, *"The door-to-door collection is very irregular. Some days they come every alternative day and some days they don't come for even a week which creates waste storage problem as there are no public bins nearby and limited space at the source."*

Some of the residents are even willing to pay rupees 200 more for the commencement of door-to-door services for the collection in their houses and locality. Another important demand from the households is fixing the truck timing for collection, increasing the number of bins in the collection point and sanitization of these points from time to time. They expressed concern with regards to the waste collection issues in the public bins. As per one of the respondents, "*The problem with the collection of waste in the public bins is that there is shortage of drums. There should also be green drums for organic waste collection but well I guess it is just the structure of the authority. It is not sufficient to facilitate the growing number of people in Gangtok."*

However, in Tibet Road, since there is only roadside collection of waste by GMC waste trucks and door-to-door collection, majority of the households express the willingness to pay up to rupees 150 extra to have the arrival of these collection trucks on scheduled time whereas, for the commencement of door-to-door facility of collection, it is observed that people are even willing to pay above Rs.250 extra per month (Table 4.54)

Table No. 4.55. Listing the reasons for unwillingness to pay to improve the services

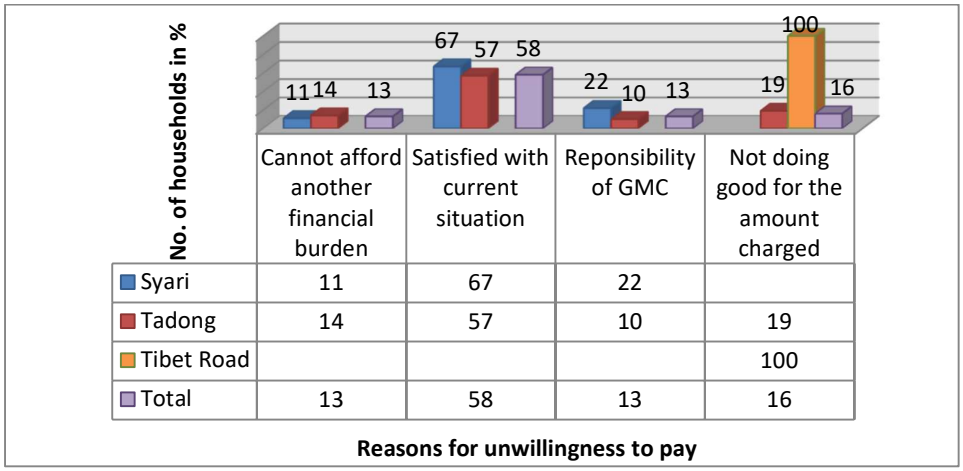
	No. of Households in %			
If no, specify the reason:	Syari	Tadong	Tibet Road	Total
Cannot afford another financial burden	11% (1)	14% (3)		13% (4)
Satisfied with current situation	67% (6)	57% (12)		58% (18)
Reponsibility of GMC	22% (2)	10% (2)		13% (4)
Not doing good for the amount charged		19% (4)	100% (1)	16% (5)

Source: Field Survey, 2020

Table No. 4.55 suggests that out of the 29 percent of the total households unwilling to pay extra, highest percent i.e., 58 percent of them are satisfied with the current situation. It is followed by the reason that the service providers are not doing proper job for the charge taken: *"The service providers are very punctual every month for the collection of fees for the waste collection facility that we use but their service is not even regular, it has been more than three weeks that the services have been stopped. We understand*

that it is due to the pandemic but they are irregular other times too. The collection is done only once and some days, twice a week and the speed at which the amount of waste gets piled up in the neighbourhood is much more rapid than the collection frequency." However, this is applicable only in Tadong and Tibet Road where they have an access to the waste services.

Fig.4.72. Reasons for unwillingness to pay extra to improve the services



Source: Field Survey, 2020

The reasons that are found in only Syari and Tadong ward is that the respondents cannot afford another financial burden and 4 percent in each of both the wards perceive that the management of the waste is actually the responsibility of the allotted department's and not that of the households. For instance, a respondent who does not segregate the household waste says, *"The responsibility of sound waste management is of the authority. If they do not adhere to the notifications of plastic ban then we are not to be blamed as we merely generate what is served by the manufacturers and shop-keepers. Moreover, the big pharmaceutical companies are getting away with it and nobody is stopping them."*

h. Satisfaction with service providers

Given the environmental issues expressed by the respondents and unavailability of temporary disposal facilities above, the satisfaction level of the households is good with

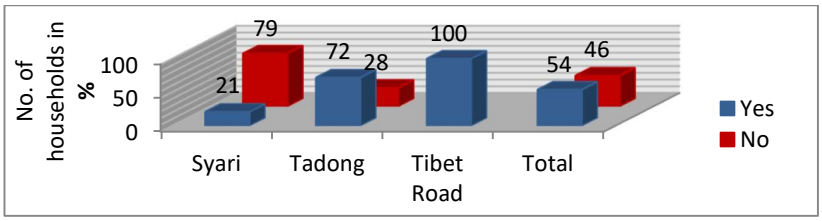
an overall satisfaction of 54 percent. The level of satisfaction of the respondent is determined by the level of awareness about the waste challenges and issues faced by the respondents in the study area

Table No. 4.56. Satisfaction with the service provided by the GMC

Satisfied with the existing collection and disposal services provided by the Corporation?	No. of Households in %			
	Syari	Tadong	Tibet Road	Total
Yes	21% (10)	72% (33)	100% (15)	54% (58)
No	79% (37)	28% (13)		46% (50)

Source: Field Survey,2020

Fig.4.73. Households' satisfaction with the service proved by the GMC



Source: Field Survey,2020

It is understandable that only one of respondent in Tibet Road accounted for water logging issue, the satisfaction is from 100 percent of the respondents surveyed here. However, in Tadong ward, 28 percent of the respondents expressed odour problem along with water clogging and problems of fruit flies which can cause human diseases. Even though as it may be, the satisfaction level is high among 72 percent of the households and the remaining 28 percent who expressed dissatisfaction are mainly because the door-to-door collection practice is erratic and due to the unavailability of a public bin nearby, the waste storage becomes a problem at the household. On the other hand, the satisfaction level of Syari ward is 21 percent in contrast to the very high percent in the contribution of environmental pollution from the waste disposal method used. However, all households contributing to this 21 percent have scanty amount of waste that only consist of food waste/vegetable peels which is easily discarded by feeding it to the pigs and cattle.

CHAPTER – V

FINDINGS, RECOMMENDATION AND CONCLUSION

5.1. Findings

Alike many of the cities in the developing country, Gangtok have become an epitome of unbalanced regional growth in Sikkim. After a careful examination of the data and materials collected, it reflects that prior to merger with India, Sikkim have only 2 percent of urban population which is confined to Gangtok as the only census town in 1951. However, after the merger, the 1981 data shows a steep increase in urban population to 16 percent from 9 percent in 1971. However, the waste generation is irrelevant till 1991 at only 54,317 kg/year although the amended Environmental Protection Act was enforced in Sikkim in the same year which embarks the first step to check the environmental impact of the new urbanizing state. The waste sector in early decades show no proper disposal site and management facilities; the shortcoming of urbanization and globalization leads to the notification in the ban of plastic in 1998. The pull factors in Gangtok only increased the regional imbalance. Rampant urban growth and shift from traditional activities towards non-allied activities like tourism have resulted in increase of total waste generation. The rate of urban population is highest in East district at 43 percent out of which Gangtok accounts for 81.8 percent of the total urban population in East Sikkim.

Today, Gangtok Municipal Corporation manages the municipal solid waste generated in the capital where the population of 1, 00,286 produces solid waste of 53 tonne per day and 524 g/capita/day. Although plastic bags have been replaced by non-woven PP bags to some extent, the plastic composition in the waste stream is still treacherously thriving. The field data shows that the plastic waste is highly concentrated in all of the six months of data acquisition for 2020. The local authority has outsourced many non-governmental organizations for the door-to-door collection service in all of the wards in Gangtok. However, shortage of community public waste bins and lack of man-power

is reflected upon study. Nevertheless, the facility of curb side collection is prevalent on daily basis. Regardless of it all, the ultimate issue with the waste in GMC is the disposal method in the Martam landfill. Of all the rules and acts, Municipal Solid Wastes Management and Handling Rules, 2000 and Solid Waste Management Rules, 2016 are the latest and are vital to Gangtok Municipal Corporation as they provide the basic terms and guidelines to be followed for an efficient solid waste management. Unfortunately, proper scientific machineries and safety equipment is limited. The process of waste segregation and sorting is confined only to cardboards, glass, plastics and metals which are also inefficiently sorted. This temporal evaluation of waste system in Gangtok suggests that the root of the waste problem eventually goes back to the unrestrained and unchecked urbanization and globalization. It also scrutinizes the vast issue of waste by breaking down the complexity of the problem as the non-segregation practices at the source itself is partly liable to this problem.

Hence, the environmental attitude and waste practices of the population among the three differently characterized wards, namely Syari, a rural-residential ward, Tadong, a mixed used ward and Tibet Road, a ward deeply commercialized and core of the city is analyzed. With the varied socio-economic demographics like gender, age, income, education level and occupation and spatial-institutional infrastructure like allocation of public waste bin, distance from the waste bins and condition of the disposal bins in the neighbourhood, services of waste collection, etc., potential factors that actually shapes sound waste management attitude and efficient ground practices of the household is drawn. It is found in this study that the values of the people are not fixed and rational as supposedly understood. People of same socio-demographical and institutional arrangement have shown contradicting opinions and waste actions in the same environment. This finding is drawn from the following analysis:

Firstly, evaluating if an environmental attitude prevails among the population in the study area or not, it is found that the 60 percent of the total households surveyed said it is 'extremely important' and 40 percent of the total householders rated 'important'. In all the wards, level of concern for the sustainability of the environment was shown to be consistently high which went over 50 percent. 72 percent in Tadong rated 'extremely important' followed by 53 percent in Tibet Road and 51 percent in Syari. The highest percent share in 'extremely important' is from respondents between the age group of 17-38 and the lowest percent share is from respondents who are above the age of 58 in all the three wards. Similarly, females show better consciousness of environmental concern in all the three wards too. Population with higher income level who are either employed in government jobs/private jobs or either retired from the government jobs and are currently pursuing high education are more aware about the issue of sustainability and waste in all the three wards. The attitude that favours environment's sustainability is strongly dependent upon the education level and qualification of the population. It is derived that out of the total respondents surveyed, population with a qualification with high school level degree and graduation degree are highly aware about the need for preservation of resources in the world. They are the highest percent of respondents who holds an attitude favouring sustainability. The least percent of respondents who favours the same are with no formal education. However, the reflection of the same is not observed in the waste behaviour.

45 percent of the households in Syari did not acknowledge waste as an environment issue. Among these respondents, 58 percent of the population is above 60 years old and all of them either have primary education level or no formal education at all. Additionally, out of the total respondents surveyed, 53 percent of the female respondents participated in segregation activity and the age variation shows that 18-29

ages grouped respondents are more inclined in the segregation participation. Only respondents with higher education level participate in the segregation due to environmental concern. A territorial variation is visible in the suitable environmental attitude churned. Households in Tadong and Tibet Road have had awareness consultation on proper solid waste management which Syari is devoid of. This contribution from the local authority is partially accountable for majority of respondents' acknowledgement of waste as an environmental problem. Irrespectively, it is also observed that the composting activity is performed by farmers in Syari and businessman and students in Tadong whereas there is a complete absence of composting activity in Tibet Road. This is majorly due to the variation in the settlement infrastructure among these wards. While most of the farmers of Syari ward compost not for the environment but for the convenience of disposal, the students in Tadong ward perform it for the environment.

The composition of waste shows little variation as all the wards have papers/cartons, fiber bags, glass and plastic in the waste stream though the quantity generated varies. The highest generation is of food waste and vegetable-fruit peels in all of the three wards at an average of 63 percent which is followed by plastic waste which includes all the food wrappers, packages, sanitary napkins, PET bottles, plastic cans, carry bags, etc. at 18 percent. The generation of paper and cardboard waste is third highest at 7 percent. The generation of glass bottles is from the alcohol bottles alone at 6 percent. This is mainly because the price of alcohol is comparatively cheaper than other states in India due to lower excise duty enforced by the Sikkim Excise Act, 1992; also drinking liquor have become a culture in Sikkim where majority of the communities align drinking to one of the traditions of festive celebration and social inclusiveness. On the other hand, fiber bags are of 5 percent each. It is to be noted that the ban of

plastic bags is the main reason for the rising quantity of fiber bags. It is only in scanty amount that waste made up of tin is generated in the households in all the three wards weekly. Furthermore, the generation of electrical and electronic waste is absent on weekly basis and these types of waste is not generated as often in the study area.

When comparatively examining the generation of waste among all the three locations, it is visible that generation of food waste is highest in Syari. The generation of plastic waste though observed in all the three wards is predominant in Tadong and Tibet Road and Syari has the least plastic waste generation out of them all. The cardboards/paper waste is highest in Tibet Road which is mainly due to the commercial characteristics of occupation of the residents here. Generation of cans and drums made up of tin is absent among households in residential Syari on the weekly basis and the little that is generated in Tadong and Tibet Road are the drink cans majorly and sometimes oil tin drums and barrels. The generation of glass and fiber bags are more in Syari and Tadong as compared to Tibet Road and the electrical waste generation per week is completely absent in all of the three wards.

Majority of the households in Syari ward have the lowest frequency; 40 percent of the households empty the waste container ‘once a week’ and 38 percent empties the container every once in ten days or even fifteen days. In comparison, the highest share of 37 percent of the household in Tadong empties the waste container ‘once in three days’ and 30 percent empties it ‘once a day’. Likewise, highest contribution of each 33 percent of Tibet Road households acknowledges that the waste container is emptied ‘once a day’ and ‘once in two days’. However, the globalization and urbanization impact are solely felt here. On the other hand, the collection and disposal pattern show vast variation among the three wards, 87 percent of Syari residents surveyed burns the waste due to unavailability of collection services while 93 percent of the Tibet Road

respondents directly dispose their household waste in the garbage truck. On the contrary, 57 percent of the Tadong respondents use the garbage truck and 26 percent of the respondents have accessibility to the public waste bins. The situational constraints thus, build up the mechanism of waste management to great extent.

The only consistency observed between the waste attitude and behaviour among the various socio-demographic distributions is the participation of females in all of the waste management practices like segregation, composting and reusing and recycling of household wastes in all of the wards. Though optimistic attitude towards waste and environment is seen among the young adults, the same percent of participation is devoid in action from the age group of 17-38; rather it is the age group above the age of 58 that have highest participation in all of the waste practices. Likewise, literate population does not always mean better participation. The respondents with no formal education have showed good number of participations in segregation, composting and reuse and recycle of the waste and are about as close as the respondents with graduation degree. Furthermore, the white collared population and students have shown a promising attitude towards the alignment of waste as an environmental challenge and how sustainable development is of extreme importance; but when the actual practices are examined, there is very little participation from the respondents who are engaged in tertiary and quaternary activities. Although participation in waste segregation is vivid among the professionals, composting and reuse/recycle is not much carried out by them. It is mostly students, farmer, unemployed and self-employed populations who have such waste practices. Finally, higher the income level, higher is the level of awareness and attitudes favouring efficient waste management yet the participation in waste practices is more confined to decent earning households. Even though the segregation is good among the households earning between 35000-74,999 rupees per month, the

participation in composting and reuse/recycle is more prominent in the lower income households.

A territorial variation is also visible in the suitable environmental attitude churned. Since households in Tadong and Tibet Road have had awareness consultation on proper solid waste management which Syari is devoid of. This contribution from the local authority is partially accountable for majority of respondents' acknowledgement of waste as an environmental problem. The waste generation and waste practices are varied across the location although the households' composition of waste is almost alike. For instance, in Syari, the generation of food waste is in all of the households like in Tadong and Tibet Road. Although the plastic waste is found in all of the households in all of the three wards, the generation per week is quite less than that of Tadong and Tibet Road.

Another important locational distinction is the number of times household waste disposed and in what type of container; while majority of the households in Syari throws away their waste every once a week or once every ten days, Tadong and Tibet Road households throw it away once in every three days or every day and while Syari households use the rice bags, cartons or old buckets and simple bins to collect their household waste, in Tadong and Tibet Road it is seen there is more use of polypropylene garbage bags and buckets provided by the GMC in some households. While it is derived that the composting practices is more practiced by illiterate population in Syari, it is mainly because of the locational factor that supports allied agriculture and the farming occupation can be practiced here. However, the participation is not always driven by environmental concern. It is more because of practicality. A locational variation can also be drawn from the generation of glass bottles among the higher income households in Syari which is missing in the

households with same income level in Tibet Road and Tadong. This is due to the absence of commercialized bars and restaurants in Syari whereas the easily accessible dine-out places in Tadong and Tibet Road are ample in number.

Following up the disposal methods among the varied locational households, it is reflected that households in Syari ultimately practice open burning due to the lack of waste services reaching here. Similarly, Tadong have the facility of door-to-door collection, access to public waste bins and curbside collection. However, an erratic relation between the service provider and the households and judgmental relationship among households is reflected. Likewise, Tibet Road have door-to-door collection and curbside collection. However, the unreliability on the truck timing and actual waste practices of the service providers is heavily scrutinized and tallied by the households here for their own practices back at home. Finally, problems of water clogging, pollution of air and flies-diseases are expressed by the population which needs the following suggestions for an efficient management system.

The analysis reflects that the attitude and action/behaviour is not consistent and the attitude is rarely much influenced by the demographic factors. Provided the analysis of the field data, it is rather eloquent to articulate that the actual influential factors that can help in understanding this attitude-behaviour consistency or discrepancy are relationship, responsibility, practicality, extrinsic motivation and individual personality. Based on each of these incognito factors, the behaviour is implemented irrespective of the attitudes of the respondents.

Firstly, the significance of relationship is felt throughout the study between the households and their respective civil society and the local authority for the waste management behaviour. However, the nature of their relationship defines the attitude that respondents perceive which have determined the practices of waste management.

Given the fact that it is the local authority, here GMC, who has a prime role in waste management of the city, all the respondents of the total households surveyed and interviewed mentioned about them. Nevertheless, the variation in the nature of the relationship among the respondents and the local authority procured differing attitudes and actions of waste handling. For instance, majority of the respondents in Syari ward expressed displeased attitude towards the authority's implementation of waste handling policies in the neighbourhood despite being a ward under GMC which eventually leads to open burning of the household waste.

The unpleasant attitude towards the local authority is not only felt in Syari ward but also in Tadong ward where the issue is with regards to the charges, they take for the services provided. The lack of standard waste handling regulation is expressed where the waste segregation practices of the households ends up in the same mixed pile of waste disposed; it eventually leads to discouragement in segregation participation at the source. However, there are respondents who are much considerate towards the issues of waste management faced by the local authority. As significant as it is, the efficient practice of waste management is not only one-way relationship. There are respondents who have hostile attitude towards the local authority but there are also people who are aware of the importance of the household's role in the waste management. They are more aware that this problem will not simply resolve with only authority's better engagement in the waste services.

Apart from the relationship with the local authority, intra-societal relationship also plays a huge role in shaping up the attitudes of the households. For instance, some respondents were quick to pick out the negative ways employed by others in the neighbourhood who did not line up to the expected societal methods of waste management. In Syari, few of the respondents expressed that some of the households

are illegally dumping the waste from the roadside cliff which to them seems unhygienic and unsuitable for the existing nature of the environment in the neighbourhood. In Tibet Road, some respondents expressed that the households in their society disposes both of the dry and wet wastes in the drainage. This eventually leads to the participation behavior in community cleanup by them not due to environmental issues particularly but due to the uncooperative relationship.

On the other hand, the composition of the waste in the waste stream of a household is seen to be directly influenced by the relationship between the consumers and manufacturers. When interviewed on this matter, the households expressed that the power to influence the positive environment friendly waste management behavior lied on the manufacturers as despite the willingness to curtail the generation of plastic waste the households are inevitably tied to certain consumption pattern where they become a major part of the plastic waste economy. Thus, relationship is also a policy level and community level situational factor where the government and policy makers should look into minutely to attain a positive relationship between waste service providers, manufacturers and the public which directly affects the composition in waste generation behavior. On the whole, this study reflects that the segregation of relationship among the households, local authority and manufacturers only leads to an inefficient waste management system which needs to be co-operative if a linear path is to be carved for the waste handling.

Secondly, the sense of responsibility is felt in quite few numbers of the households surveyed. It is observed that value bearings caused by the social interest is effective in bringing out the environmental waste management behaviour of the participant.
Contrarily, sense of responsibility is also built up with an absence of effectiveness; this has a reversal of sense of responsibility where a strong sense of waste as others problem

is felt among the non-segregating population. This reflects the lack of standard regulation on waste management and lack of reliability in connection directly determines a negative attitude towards the waste management and sequentially on the inefficient behaviour and vice-versa. In this context, the lack of proper awareness and strict rules implementation in Gangtok Municipal Corporation is felt. Hence, sense of responsibility has direct relationship in shaping up what type of attitudes and behaviors the household has.

Third, practicality has the most influential potential in nurturing the attitude and determining the behavior of waste management practices. This is felt throughout the study. In Syari ward, the context of practicality is particularly present. Syari expressed that there is an environmental problem of air pollution caused by the open-burning, the residents still opt for burning the wastes in an open space within their compound. This is mainly because of the 'reliability of connection', particularly 'reliability on collection and transportation' where the households seek to the most convenient method of their household disposal available to them. In Tadong ward, practicality has a negative bearing in attitudes and behavior of waste management where the inefficient community norms of waste practices have direct impact on the waste practices at the household of the individual. Likewise, in Tibet Road, the respondents are of the view that the wastes are directly dumped into the truck with no segregation compartments so, they see no difference with a practical validation.

The practicality here highlights that the 'community norms' and 'reliability on collection and transportation' have a strong influence upon the waste management behaviour of the households. If there is a positive influence of 'reliability on connection' and 'group norms' then an efficient waste management at the source can be achieved through practicality.

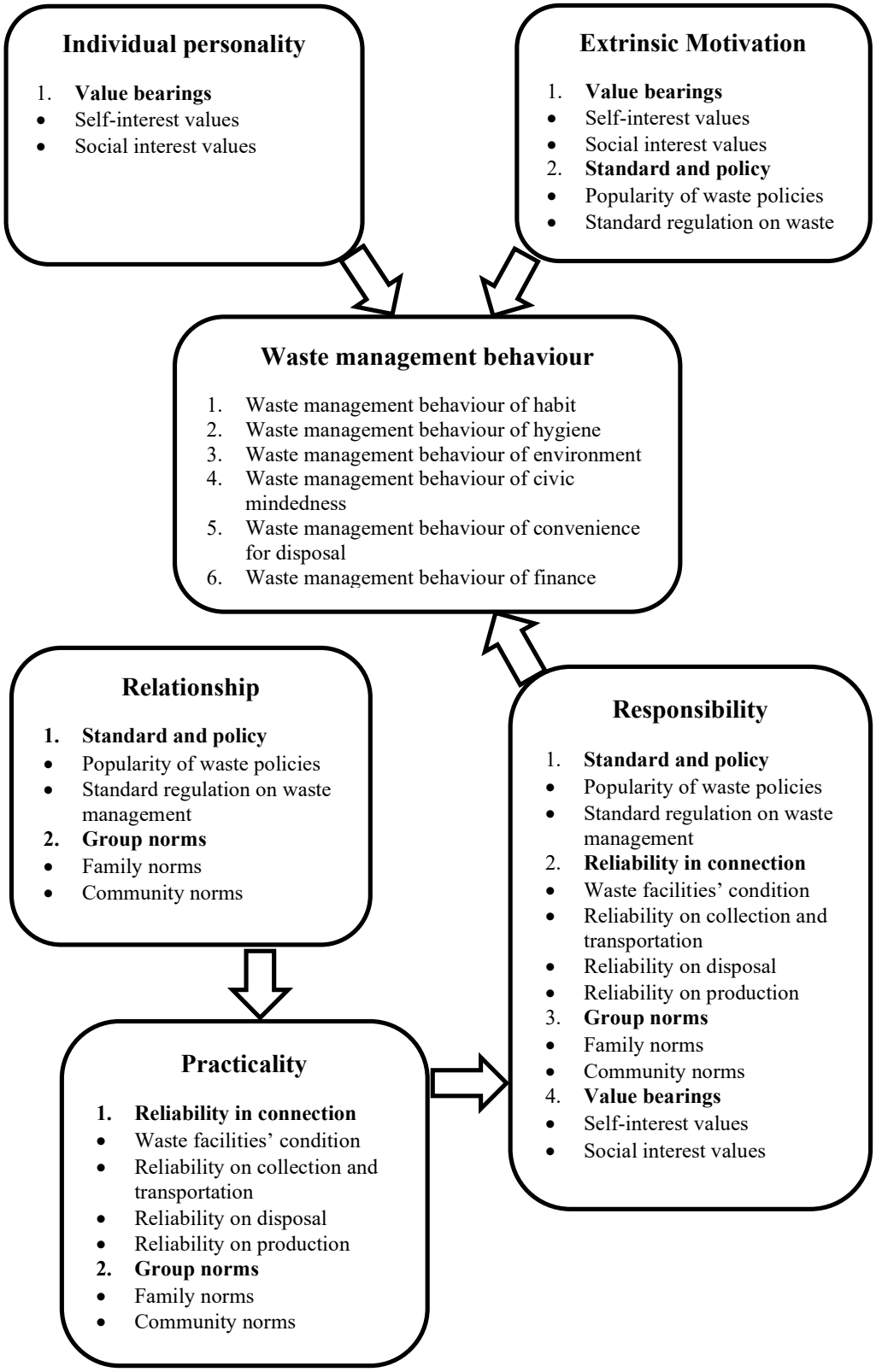
Fourth, it is also noticed that extrinsic motivation has its part in churning the attitudes towards waste and shaping up the actual behavior. This is evident in Syari and Tadong wards where few of the respondents sort their wastes at source for financial reasons. The glass bottles are sold to the rag-pickers in exchange of money. On the other hand, the respondents here also expressed that the segregation is more expensive as the demand for more PP bags to segregate the waste would arise. Thus, the 'value bearings' of 'self-interest values' is felt. This extrinsically motivated practices of waste management fits perfectly in the 'waste management behaviour of finance'. On the other hand, Tibet Road respondents are quite expressive of the motivation behind their segregation which is 'order compulsion'. There is a peer pressure from the waste collectors that the waste be segregated at the source or else, the collector does not collect the household waste. Hence, the proper 'standard regulation on waste management' shows a positive effect on the participation in waste segregation; though the waste management behaviour is for convenience of disposal. On the further inquiry, all the non-participants of segregation in the three wards under study area shows willingness to segregate, provided, they are rewarded with monetary incentives. Thus, better external motivation will give efficient participation in proper waste practices at households.

Finally, an individual personality has its own manner of influencing the attitudes and actions of the household respondents which can be identified as 'waste management behaviour of habit'. It is an instinctive reaction, which contributes to the pattern of household waste management practices. For example, there are respondents who segregated because of the 'civic minded' personality and some segregates because it makes them 'feel good when it is tidy'. While there are respondents whose personality challenge them to do better and have a sense of grip on their life, there are respondents

whose sound waste management behavior is influenced by the civic spirited nature of their personality. On the other hand, there are respondents whose attitude and action are influenced by the personality in a larger picture as opposed to other factors. Thus, it comes to our knowledge that the 'value bearings' led by the 'self-interest values' provides a better clarity to understand the waste management behavior; in this case, it is the 'waste management behavior of habit'. If the value bearings are positive then the action will directly be optimistic and proper for waste management among the individuals and vice-versa.

There is a mixture of factors like social relationship between the respondent and the local authority or with the community, practical opportunities or barriers like access to collection services or lack of public bins, an optimistic or pessimistic personality like individual civic spirit, tidiness or laziness, responsibility which is basically environmentally driven or sense of reverse responsibility where it is felt that the responsibility is that of others and not mine and extrinsic motivation which is either for personal gain or reward. Thus, evaluating the reasons for current waste management practices of households and why majority of them failed to meet their concerns for proper waste management sums up to an understanding that the environmental concern and awareness alone cannot be consistent with the action and habits. Between the attitude and behaviour lies a plethora of sustained and constrained social, institutional and infrastructural foundations that webs the net of the household waste management.

Fig. No. 5.1. The mechanisms of influential factors of waste management behaviour



Source: Field Survey, 2020

5.2. Recommendations

First and foremost, there needs to be participatory meetings held every month in each ward. An involvement of households, service providers like the outsourced NGOs and the government is required since solid waste management is the responsibility of all the waste generators where two-way interaction for efficient management is needed. This is the most basic and the most mandatory requirement of the hour. The participation of the people is needed because the authority should first listen to the issues of the people living in each ward and then initiate the services accordingly. Likewise, the people will learn about the financial and technological limitations of the authority which will then turn into a collaborative work due to the transparency of the waste system or else, it will result in counter-productivity as reflected in the case of Syari ward where respondents feel that they are excluded from matters of local significance.

Secondly, since the door-to-door waste collection is done by the NGOs in every ward, the field workers and service providers should first be trained and have thorough knowledge of what types of waste goes where as they are the ones with whom the households converse on a daily basis and the households can learn consequently. This will be very significant for the employees working in the landfill who can invest their time on sorting the waste for further transfer rather than segregating the dry waste from the mixed pile of waste in the landfill, like they do now, which is very time consuming and also unsafe for their health in the long run.

Thirdly, traffic is very bad in Gangtok due to the increasing number of vehicles and limited road network due to its topography. The collection trucks are supposed to be out from Ranipool check-post by 8 am and are only allowed to return after 3 pm. However, the same is not feasible due to heavy traffic. Now majority of the households

expressed inconvenience of waiting for the truck for more than an hour. This is not a problem for the households located beside the highway. However, it is one of the mostly conveyed grievances of the households located far off from the road with no door-to-door collection services; people can't afford to waste their morning time just waiting. Thus, the allotted NGOs and trucks should start the collection from 4 am so that the truck reaches the allotted site of collection on time. Consequently, the time should be fixed for truck arrival and collection. For the same, a collection crane can also be used which empties the curbside waste in bulk. This is time saving if feasible by the government.

Fourthly, lack of adequate public drums for temporary disposal is felt. Hence, a need for rather two large container, a green one for organic and wet waste and blue one for dry waste with cover should be available on the pre-allotted sites. Since these public bins are only available beside the national highway, the number of such disposal sites should be expanded in areas away from the main road. Placing such containers away from the main road is also better, given the width of the road and is also convenient for the households located far off from the highway. Since NGOs collect the wastes from areas where the truck cannot reach, the same will be collected by the workers and more disposal pockets means more man-power. Thus, it generates employment too.

Fifth, there should be an increase in the frequency of the door-to-door collection to the households who already have an access to this facility and commence the same in the areas where the facility is not available yet. This can be achieved by formalizing more NGOs by recruiting youths and women of their particular ward which not only resolves the erratic collection problem but also generates employment and is more convenient and time saving.

Sixth, there should be proper transfer station points and operational weighing bridge and composting plant within the city. This will not only help in minimizing the landfilled waste but also help track and reflect on the management system of the waste for future prospects. Similarly, it is observed that the citizens mostly reflect on how the disposal mechanism works in the landfill. Thus, if there prevails a systematic management system then the reliability of the households on the service provider is enriched, as well as, a sense of participation towards making an actual difference among the citizens grow. This ultimately affects the waste practices at the source.

Seventh, the participation should not only be for the households. It should rather be exercised as a regular class in the educational institutions. A participative learning in schools and colleges will be more productive than a passive awareness and information on waste alone. Based on the FGDs of the school children, it is suggested that there be an introduction of recycling scheme in educational institutions which will enable proper indulgence of the students in relevant learning and informative waste reduction activity.

Eighth, the produced goods and products are all packed with varied composition of plastic and as the consumerism culture is increasing with the rapid urbanization, there should be a strict and standardized regulation of the policies and notifications that is already enforced. For instance, in Sikkim, the notification on plastic ban is only applicable to the shopkeepers and is confined to the use of plastic bags alone. The households and residents are not lawfully included for the same. Since consumerism culture is so entrenched among the population today, both the households and the shopkeepers should be charged with strict fines and punishments for violating the use of plastic bags.

Ninth, only strict regulation and fines are not always practical. For example, some notifications like ban on open burning of waste including plastic needs to be looked into minutely and needs an introspection by the authority first because for some remote wards like Syari, open burning is the only feasible practice to get rid of the household waste as there is no waste collection facilities. For the same, the participation of the households to understand the ground reality is required to efficiently roll out a notification.

Tenth, people have shown willingness to participate in waste sorting if the government provides some monetary incentives. Thus, a scheme should be there where the households who officially apply to participate in the waste sorting at household will be given certain monetary incentives for actively participating. The waste can either be dropped in by the participant themselves in the nearest transfer station within the city or be collected from their home every once a week by the legal workers where the authenticity of the participant is monitored.

Finally, the consumerism has now become a global culture where the people regularly get together and enjoy the perks of the immediately available goods and services at the comfort of their home. It is also observed that the number of household members bear more upon waste generation than the age-wise composition of the household as most of the goods produced are supplied to the market packaged in plastic. A notification as such should be there which allocates certain pockets within the city for big events and celebration where the waste disposal and collection is particularly given in more preference or at least twice a day. Likewise, only a limited number of people should be allowed to attend such events. If the host wishes to have more guests, then he should bear the transportation cost of extra waste collection and disposal. A ‘producer pay policy’ approach should be applied to the citizens which could help in waste

minimization. If this is seriously looked into then there will be efficient waste system in the city.

5.3. Conclusions

Municipal Solid Waste have become a herculean task for the waste managers as it has to be tackled in the most environmentally, socially and economically suitable manner possible. 1.3 billion tonnes MSW is generated per year globally by 3 billion urban residents alone which have been estimated to grow to 2.2 billion tonnes MSW per year by the year 2025 by the estimated 4.2 billion urban residents globally (Hoornweg and Bhad-Tata, 2012). In 2010, of the entire municipal waste sector, landfills were responsible for emitting almost half of the methane and the MSW accounts for 5 percent of the total GHG emissions (Hoornweg and Bhada-Tata 2012) which are of great concern at present. The high-income countries sort to recycling and 100 percent of collection is achieved. The advanced countries have proper treatment and disposal system of waste. OECD produces hundred times the waste than third world countries. However, it is to be noted that 60 percent of this waste stream is 'diverted from landfills' in OECD (Hoornweg and Bhada-Tata 2012). However, the same is unsaid about the collection and disposal in the developing nations.

Likewise, with 1.02 billion populations, India is the second most populous country after China. This growing rate of population in urban areas is one of the direct factors influencing the generation of the municipal solid waste in India. Due to these rapidly industrializing and urbanizing factors, the generation of waste in India has steepened to 145,133 tonne/day where 48 percent of segregation have been achieved with 82 percent of door-to-door collection and 37.23 percent of waste processing (MoHUA ,2018-2019). At present, the composition of municipal solid waste consists of 50 percent

compostable, 17 percent recyclables and 33 percent of inert wastes (CPCB ,2005). However, the quantity and quality of waste generation varies from place to place for various reasons. Majority of the cities in India still practices open-dumping and burning to tackle the waste generated. While majority of the western countries have already shifted to tackling the diseases of affluence, India still struggles to manage the waste collection and transportation (Kumar 2016).

Alike many of the cities in the developing country, Gangtok have become an epitome of unbalanced regional growth in Sikkim. After a careful examination of the data and materials collected, it reflects that prior to merger with India, Sikkim have only 2 percent of urban population which is confined to Gangtok as the only census town in 1951. However, after the merger, the 1981 data shows a steep increase in urban population to 16 percent from 9 percent in 1971. However, the waste generation is irrelevant till 1991 at only 54,000 kg/year although the amended Environmental Protection Act was enforced in Sikkim in the same year which embarks the first step to check the environmental impact of the new urbanizing state. The wastes sector in early decades show no proper disposal site and management facilities; the shortcoming of urbanization and globalization leads to the notification in the ban of plastic in 1998. As discussed in chapter three, the pull factors in Gangtok only increased the regional imbalance. Rampant urban growth and shift from traditional activities towards non-allied activities like tourism have resulted in increase of total waste generation. As per Census of India, 2011, the rate of urban population is highest in East district at 43 percent out of which Gangtok accounts for 81.8 percent of the total urban population in East Sikkim.

Today, Gangtok Municipal Corporation manages the municipal solid waste generated in the capital where the population of 1, 00,286 produces solid waste of 53 tonne per

day and 524 g/capita/day. Although plastic bags have been replaced by non-woven PP bags to some extent, the plastic composition in the waste stream is still treacherously thriving. The field data shows that the plastic waste is highly concentrated in all of the six months. The local authority has outsourced many non-governmental organizations for the door-to-door collection service in all of the wards in Gangtok. However, shortage of community public waste bins and lack of man-power is reflected upon study. Nevertheless, the facility of curb side collection is prevalent on daily basis. Regardless of it all, the ultimate issue with the waste in GMC is the disposal method in the Martam landfill. Of all the rules and acts, Municipal Solid Wastes Management and Handling Rules, 2000 and Solid Waste Management Rules, 2016 are the latest and are vital to Gangtok Municipal Corporation as they provide the basic terms and guidelines to be followed for an efficient solid waste management. Unfortunately, proper scientific machineries and safety equipment is limited. The process of waste segregation and sorting is confined only to cardboards, glass, plastics and metals which are also inefficiently sorted. A temporal evaluation of a space is thus, mandatory to locate the problem sequentially and enhance an understanding of the spatial constraints. Henceforth, it is suggestive that the root of the waste problem eventually goes back to the unrestrained and unchecked urbanization and globalization. Nevertheless, this analysis also brings forth an approach in attempt to study and scrutinize the vast issue of waste by breaking down the complexity of the problem as the non-segregation practices at the source itself are partly liable to this problem. Thus, the behaviour of the households has been taken as the tools to understand the waste practices.

For the same, three wards representing the types of locational characters of the wards in Gangtok Municipal Corporation is taken up for the study where the results shows that there is always difference and gap between what people thinks is right and what

they actually practice. The socio-demographic factors play little part in influencing the behaviour of the people. It is rather the incognito factors which as very nuanced and slips away from the fast pace of life. However, it is drawn into conclusion from the study that there are factors functions at policy level, community level and individual level. The relationship between the and producers /service providers and households is policy level factor, intra-societal relationship and reliability on the waste service providers depicts community level factors which gives the household a continuous reflection upon their waste practices at home. Similarly, these factors can also be intrinsic and have social value bearings above any other reasons for the waste behaviour of an individual which is psychological level factor. On the contrary, if the policy level factor is taken into account, then the community level factors will sequentially align with it and impact an individual's psychology. Hence, the waste attitude and behaviour can then be predicted rather than postdicted.

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ANNEXURE – I

Countries classification according to region

Africa (AFR)	East Asia & Pacific (EAP)	Eastern & Central Asia (ECA)	Latin America & the Caribbean (LAC)	Middle East & North Africa (MENA)	Organisation for Economic Co-operation and Development (OECD)	South Asia (SAR)
Angola	Brunei Darussalam	Albania	Antigua and Barbuda	Algeria	Andorra	Bangladesh
Benin	Cambodia	Armenia	Argentina	Bahrain	Australia	Bhutan
Botswana	China	Belarus	Bahamas, The	Egypt, Arab Rep.	Austria	India
Burkina Faso	Fiji	Bulgaria	Barbados	Iran, Islamic Rep.	Belgium	Maldives
Burundi	Hong Kong	Croatia	Belize	Iraq	Canada	Nepal
Cameroon	Indonesia	Cyprus	Bolivia	Israel	Czech Republic	Pakistan
Cape Verde	Lao PDR	Estonia	Brazil	Jordan	Denmark	Sri Lanka
Central African Rep.	Macao, China	Georgia	Chile	Kuwait	Finland	
Chad	Malaysia	Latvia	Colombia	Lebanon	France	
Comoros	Marshall Islands	Lithuania	Costa Rica	Malta	Germany	
Congo, Dem. Rep.	Mongolia	Macedonia, FYR	Cuba	Morocco	Greece	
Congo, Rep.	Myanmar	Poland	Dominica	Oman	Hungary	
Cote d'Ivoire	Philippines	Romania	Dominican Republic	Qatar	Iceland	
Eritrea	Singapore	Russian Federation	Ecuador	Saudi Arabia	Ireland	
Ethiopia	Solomon Islands	Serbia	El Salvador	Syrian Arab Republic	Italy	
Gabon	Thailand	Slovenia	Grenada	Tunisia	Japan	
Gambia	Tonga	Tajikistan	Guatemala	United Arab Emirates	Korea, South	
Ghana	Vanuatu	Turkey	Guyana	West Bank and Gaza	Luxembourg	
Guinea	Vietnam	Turkmenistan	Haiti		Monaco	
Kenya			Honduras		Netherlands	
Lesotho			Jamaica		New Zealand	
Liberia			Mexico		Norway	
Madagascar			Nicaragua		Portugal	
Malawi			Panama		Slovak Republic	
Mali			Paraguay		Spain	
Mauritania			Peru		Sweden	
Mauritius			St. Kitts and Nevis		Switzerland	
Mozambique			St. Lucia		United Kingdom	
Namibia			St. Vincent and the Grenadines		United States	
Niger			Suriname			
Nigeria			Trinidad and Tobago			
Rwanda			Uruguay			
Sao Tome and Principe			Venezuela, RB			
Senegal						
Seychelles						
Sierre Leone						
South Africa						
Sudan						
Swaziland						
Tanzania						
Togo						
Uganda						
Zambia						
Zimbabwe						

Source: (The World Bank, 2012)

ANNEXURE - II

MSW Generation of countries by region

Countries	Region	Total Urban Pop.	MSW Generation per capita (kg/capita/day)	Total MSW Generation (tonnes/day)
Angola	AFR	89,73,498	0.48	4,329
Benin	AFR	31,47,050	0.54	1,699
Botswana	AFR	8,60,779	1.03	890
Burkina Faso	AFR	25,49,805	0.51	1,288
Burundi	AFR	7,00,922	0.55	384
Cameroon	AFR	79,14,528	0.77	6,082
Cape Verde	AFR	2,74,049	0.5	137
Central African Rep.	AFR	15,96,934	0.5	795
Chad	AFR	25,66,839	0.5	1,288
Comoros	AFR	1,61,070	2.23	359
Congo, Dem. Rep.	AFR	1,88,55,716	0.5	9,425
Congo, Rep.	AFR	20,56,826	0.53	1,096
Cote d'Ivoire	AFR	90,06,597	0.48	4,356
Eritrea	AFR	8,78,184	0.5	438
Ethiopia	AFR	1,25,66,942	0.3	3,781
Gabon	AFR	11,44,675	0.45	521
Gambia	AFR	8,22,588	0.53	438
Ghana	AFR	1,16,80,134	0.09	1,000
Kenya	AFR	66,15,510	0.3	2,000
Lesotho	AFR	4,61,534	0.5	230
Madagascar	AFR	46,53,890	0.8	3,734
Malawi	AFR	22,88,114	0.5	1,151
Mali	AFR	39,00,064	0.65	2,534
Mauritania	AFR	11,97,094	0.5	603
Mauritius	AFR	5,19,206	2.3	1,195
Mozambique	AFR	77,06,816	0.14	1,052
Namibia	AFR	7,08,907	0.5	356
Niger	AFR	21,62,063	0.49	1,068
Nigeria	AFR	7,31,78,110	0.56	40,959
Rwanda	AFR	15,73,625	0.52	822
Sao Tome and Principe	AFR	88,673	0.49	44
Senegal	AFR	46,93,019	0.52	2,438
Seychelles	AFR	43,172	2.98	129
Sierra Leone	AFR	20,29,398	0.45	904
South Africa	AFR	2,67,20,493	2	53,425
Sudan	AFR	1,26,00,333	0.79	10,000
Swaziland	AFR	2,70,983	0.51	137
Tanzania	AFR	94,39,781	0.26	2,425
Togo	AFR	23,90,840	0.52	1,233
Uganda	AFR	34,50,140	0.34	1,179
Zambia	AFR	40,10,708	0.21	842
Zimbabwe	AFR	44,78,555	0.53	2,356
Brunei Darussalam	EAP	2,82,415	0.87	247
China	EAP	51,17,22,970	1.02	5,20,548
Fiji	EAP	3,39,328	2.1	712
Hong Kong,China	EAP	69,77,700	1.99	16,610

Source: The World Bank (2012)

Countries	Region	Total Urban Pop.	MSW Generation per capita (kg/capita/day)	Total MSW Generation (tonnes/day)
Indonesia	EAP	11,74,56,698	0.52	61,644
Lao PDR	EAP	19,16,209	0.7	1,342
Macao, China	EAP	4,66,162	1.47	685
Malaysia	EAP	1,44,29,641	1.52	21,918
Mongolia	EAP	13,70,974	0.66	904
Myanmar	EAP	1,28,47,522	0.44	5,616
Philippines	EAP	5,86,54,205	0.5	29,315
Singapore	EAP	48,39,400	1.49	7,205
Solomon Islands	EAP	50,992	4.3	219
Thailand	EAP	2,24,53,143	1.76	39,452
Tonga	EAP	22,162	3.71	82
Vanuatu	EAP	33,430	3.28	110
Vietnam	EAP	2,40,01,081	1.46	35,068
Albania	ECA	14,18,524	0.77	1,088
Armenia	ECA	19,64,525	0.68	1,342
Belarus	ECA	70,57,977	0.78	5,479
Bulgaria	ECA	54,23,113	1.28	6,959
Croatia	ECA	25,39,903	0.29	740
Cyprus	ECA	5,95,707	2.07	1,230
Estonia	ECA	9,31,657	1.47	1,367
Georgia	ECA	23,16,296	1.69	3,904
Latvia	ECA	15,49,569	1.03	1,600
Lithuania	ECA	22,56,263	1.1	2,474
Macedonia, FYR	ECA	13,41,972	1.06	1,425
Poland	ECA	2,33,98,400	0.88	20,630
Romania	ECA	1,16,48,240	1.04	12,082
Russian Federation	ECA	10,73,86,402	0.93	1,00,027
Serbia	ECA	38,30,299	0.79	3,041
Slovenia	ECA	9,86,862	1.21	1,192
Tajikistan	ECA	16,53,091	0.89	1,479
Turkey	ECA	4,88,46,780	1.77	86,301
Turkmenistan	ECA	20,61,980	0.98	2,027
Antigua and Barbuda	LCR	24,907	5.5	137
Argentina	LCR	3,36,81,145	1.22	41,096
Bahamas, The	LCR	2,52,689	3.25	822
Barbados	LCR	92,289	4.75	438
Belize	LCR	1,24,224	2.87	356
Bolivia	LCR	55,87,410	0.33	1,863
Brazil	LCR	14,45,07,175	1.03	1,49,096
Chile	LCR	1,34,50,282	1.08	14,493
Colombia	LCR	2,92,83,628	0.95	27,918
Costa Rica	LCR	23,90,195	1.36	3,260
Cuba	LCR	84,47,447	0.81	6,822
Dominica	LCR	50,793	1.24	63
Dominican Rep.	LCR	56,25,356	1.18	6,658

Source: The World Bank (2012)

Countries	Region	Total Urban Pop.	MSW Generation per capita (kg/capita/day)	Total MSW Generation (tonnes/day)
Ecuador	LCR	75,99,288	1.13	8,603
El Salvador	LCR	35,04,687	1.13	3,945
Grenada	LCR	31,324	2.71	85
Guatemala	LCR	52,37,139	2	10,466
Guyana	LCR	2,15,946	5.33	1,151
Haiti	LCR	32,27,249	1	3,233
Honduras	LCR	28,32,769	1.45	4,110
Jamaica	LCR	13,53,969	0.18	247
Mexico	LCR	7,98,33,562	1.24	99,014
Nicaragua	LCR	28,48,165	1.1	3,123
Panama	LCR	20,08,299	1.21	2,438
Paraguay	LCR	30,52,320	0.21	630
Peru	LCR	1,86,78,510	1	18,740
St. Kitts and Nevis	LCR	15,069	5.45	82
St. Lucia	LCR	44,119	4.35	192
St. Vincent and the Grenadine	LCR	48,255	1.7	82
Suriname	LCR	3,43,331	1.36	466
Trinidad and Tobago	LCR	1,44,645	14.4	2,082
Uruguay	LCR	30,25,161	0.11	329
Venezuela, RB	LCR	2,23,42,983	1.14	25,507
Algeria	MENA	1,92,25,335	1.21	23,288
Bahrain	MENA	5,74,671	1.1	630
Egypt, Arab Rep.	MENA	2,98,94,036	1.37	40,822
Iran, Islamic Rep.	MENA	4,62,19,250	0.16	7,197
Israel	MENA	51,79,120	2.12	10,959
Jordan	MENA	38,50,403	1.04	4,000
Kuwait	MENA	26,83,301	5.72	15,342
Lebanon	MENA	32,44,163	1.18	3,836
Malta	MENA	3,84,809	1.78	685
Morocco	MENA	1,57,53,989	1.46	23,014
Oman	MENA	16,29,404	0.7	1,142
Qatar	MENA	7,59,577	1.33	1,014
Saudi Arabia	MENA	1,53,88,239	1.3	20,000
Syrian Arab Rep.	MENA	91,09,737	1.37	12,493
Tunisia	MENA	60,63,259	0.81	4,932
United Arab Emirates	MENA	25,26,336	1.66	4,192
Australia	OECD	1,62,33,664	2.23	36,164
Austria	OECD	55,26,033	2.4	13,288
Belgium	OECD	1,02,65,273	1.33	13,690
Canada	OECD	2,12,87,906	2.33	49,616
Czech Rep.	OECD	75,47,813	1.1	8,326
Denmark	OECD	46,84,754	2.34	10,959
Finland	OECD	33,01,950	2.13	7,030
France	OECD	4,71,92,398	1.92	90,493
Germany	OECD	6,05,30,216	2.11	1,27,816
Greece	OECD	67,55,967	2	13,499
Hungary	OECD	67,17,604	1.92	12,904
Iceland	OECD	2,80,148	1.56	438

Source: The World Bank (2012)

Countries	Region	Total Urban Pop.	MSW Generation per capita (kg/capita/day)	Total MSW Generation (tonnes/day)
Ireland	OECD	25,89,698	3.58	9,260
Italy	OECD	3,99,38,760	2.23	89,096
Japan	OECD	8,43,30,180	1.71	1,44,466
Korea, South	OECD	3,88,95,504	1.24	48,397
Luxembourg	OECD	3,90,776	2.31	904
Netherlands	OECD	1,31,97,842	2.12	27,945
New Zealand	OECD	36,12,147	3.68	13,293
Norway	OECD	36,05,500	2.8	10,082
Portugal	OECD	61,62,205	2.21	13,616
Slovak Rep.	OECD	30,36,442	1.37	4,164
Spain	OECD	3,38,99,073	2.13	72,137
Sweden	OECD	76,62,130	1.61	12,329
Switzerland	OECD	54,90,214	2.61	14,329
United Kingdom	OECD	5,44,11,080	1.79	97,342
United States	OECD	24,19,72,393	2.58	6,24,700
Bangladesh	SAR	3,81,03,596	0.43	16,384
Bhutan	SAR	2,25,257	1.46	329
India	SAR	32,16,23,271	0.34	1,09,589
Maldives	SAR	70,816	2.48	175
Nepal	SAR	34,64,234	0.12	427
Pakistan	SAR	6,00,38,941	0.84	50,438
Sri Lanka	SAR	29,53,410	5.1	15,068

Source: The World Bank (2012)

ANNEXURE – III

Composition of Waste of countries by global regions

Country	Region	Organic %	Paper %	Plastic %	Glass %	Metal %	Other %
Benin	AFR	52	3	7	2	2	1
Cameroon	AFR	48	4	5	4	5	35
Ethiopia	AFR	88	4	2	1	1	4
Gambia	AFR	35	10	—	2	2	51
Ghana	AFR	64	3	4	—	1	28
Guinea	AFR	58	9	4	1	1	27
Liberia	AFR	43	10	13	1	2	31
Madagascar	AFR	52	4	1	1	1	41
Mali	AFR	18	4	2	1	4	1
Mauritius	AFR	70	12	9	2	3	4
Mozambique	AFR	69	12	10	3	2	4
Niger	AFR	38	2	2	—	1	57
Nigeria	AFR	57	11	18	5	5	4
Senegal	AFR	44	10	3	1	3	39
Sierra Leone	AFR	85	—	—	—	—	15
Togo	AFR	46	4	10	2	2	35
Uganda	AFR	78	3	1	1	2	16
Zambia	AFR	50	5	5	2	2	37
Zimbabwe	AFR	40	21	20	4	4	11
Brunei Darussalam	EAP	44	22	2	4	5	13
Cambodia	EAP	55	3	10	8	7	17
Fiji	EAP	68	15	8	3	3	4
Hong Kong, China	EAP	38	26	19	3	2	12
Indonesia	EAP	62	6	10	9	8	4
Lao PDR	EAP	46	6	10	8	12	21
Macao, China	EAP	4	4	24	4	1	63
Malaysia	EAP	62	7	12	3	6	10
Marshall Islands	EAP	20	15	15	5	20	22
Myanmar	EAP	54	8	16	7	8	7
Philippines	EAP	41	19	14	3	5	18
Singapore	EAP	44	28	12	4	5	7
Solomon Islands	EAP	65	6	17	5	6	2
Thailand	EAP	48	15	14	5	4	14
Tonga	EAP	47	31	5	3	8	5
Vanuatu	EAP	71	11	8	3	4	3
Vietnam	EAP	60	2	16	7	6	9
Albania	ECA	38	10	8	5	5	34
Armenia	ECA	51	12	10	9	5	14
Belarus	ECA	29	28	10	13	7	13

Source: The World Bank (2012)

Country	Region	Organic %	Paper %	Plastic %	Glass %	Metal %	Other %
Croatia	ECA	46	20	12	7	4	11
Cyprus	ECA	38	27	11	1	9	13
Georgia	ECA	39	34	3	3	5	16
Latvia	ECA	57	—	—	—	—	43
Macedonia, FYR	ECA	20	24	11	5	3	37
Poland	ECA	38	10	10	12	8	23
Romania	ECA	46	11	3	11	5	24
Serbia	ECA	5	37	12	10	5	31
Turkey	ECA	40-65	7-18	5-14	2-6	1-6	7-24
Argentina	LCR	40	24	14	5	2	15
Belize	LCR	60	20	5	5	5	5
Bolivia	LCR	24	6	8	2	1	59
Brazil	LCR	61	15	15	3	2	5
Chile	LCR	50	19	10	2	2	4
Peru	LCR	55	7	4	3	2	28
St. Vincent & the Grenadine	LCR	34	32	12	8	6	8
Trinidad and Tobago	LCR	14	32	24	3	16	12
Uruguay	LCR	54	20	11	3	5	8
Algeria	MENA	70	10	5	1	2	12
Egypt, Arab Rep.	MENA	60	10	12	3	2	13
Iran, Islamic Rep.	MENA	43	22	11	2	9	13
Israel	MENA	40	25	13	3	3	16
Jordan	MENA	62	11	16	2	2	6
Lebanon	MENA	63	18	7	5	3	4
Morocco	MENA	69	19	4	4	3	2
Syrian Arab Rep.	MENA	65	10	12	4	2	7
Tunisia	MENA	68	9	11	2	4	6
West Bank and Gaza	MENA	61	14	7	3	2	13
Andorra	OECD	19	26	14	11	3	27
Australia	OECD	47	23	4	7	5	13
Austria	OECD	35	22	11	8	5	19
Belgium	OECD	39	17	5	7	3	29
Canada	OECD	24	47	3	6	13	8
CzechRep.	OECD	18	8	4	4	2	63
Denmark	OECD	29	27	1	5	6	32
Finland	OECD	33	40	10	5	5	7
France	OECD	32	20	9	10	3	26
Germany	OECD	14	34	22	12	5	12
Greece	OECD	47	20	9	5	5	16
Hungary	OECD	29	15	17	2	2	35
Iceland	OECD	26	26	17	4	3	24

Source: The World Bank (2012)

Country	Region	Organic %	Paper %	Plastic %	Glass %	Metal %	Other %
Ireland	OECD	25	31	11	5	4	23
Italy	OECD	29	28	5	13	2	22
Japan	OECD	26	46	9	7	8	12
Korea, South	OECD	28	24	8	5	7	28
Luxembourg	OECD	45	22	1	12	4	16
Netherlands	OECD	35	26	19	4	4	12
New Zealand	OECD	56	21	8	3	7	5
Norway	OECD	30	33	9	4	4	20
Portugal	OECD	34	21	11	7	4	23
Slovak Rep.	OECD	38	13	7	8	3	31
Spain	OECD	49	21	12	8	4	7
Sweden	OECD	—	68	2	11	2	17
Switzerland	OECD	29	20	15	4	3	29
United States	OECD	25	34	12	5	8	16
Bangladesh	SAR	71	5	7	—	—	16
Bhutan	SAR	58	17	13	4	1	7
India	SAR	35	3	2	1	—	59
Nepal	SAR	80	7	3	3	1	7
Pakistan	SAR	67	5	18	2	—	7
Sri Lanka	SAR	76	11	6	1	1	5

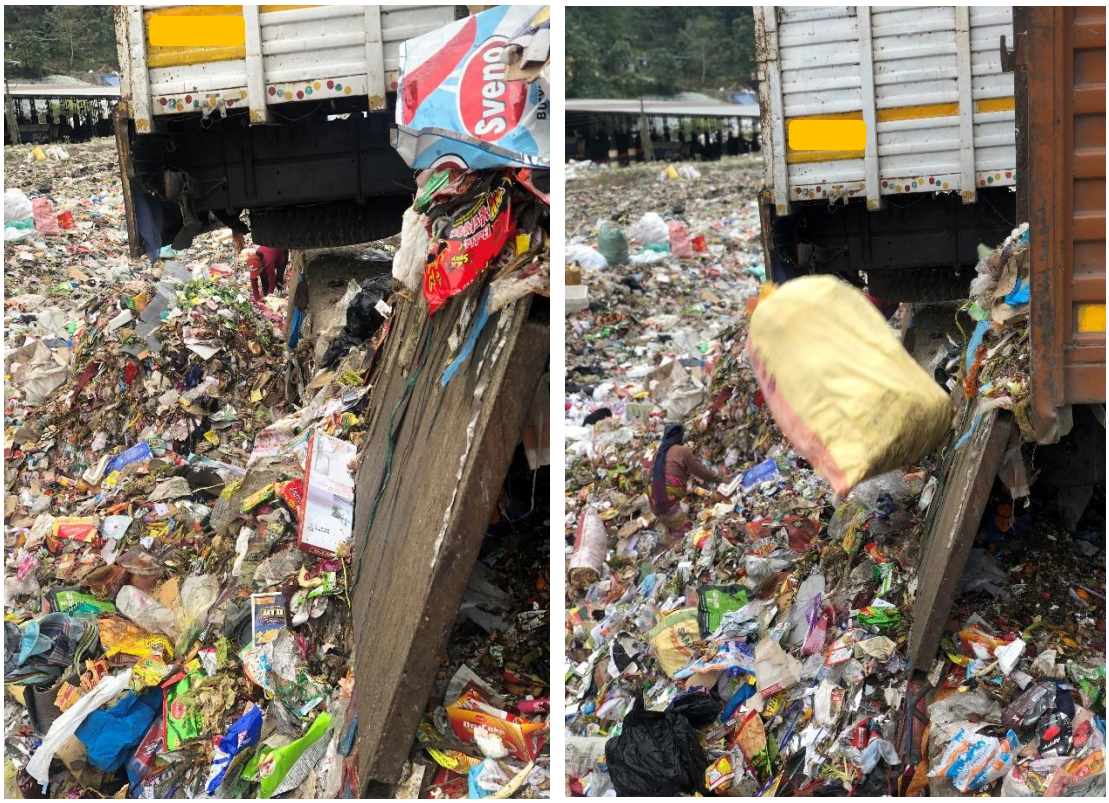
Source: The World Bank (2012)

PLATES

Plate No. 1. Martam landfill

Source: Field Survey, Martam, October, 2020.

Plate No. 2. Unloading of unsegregated waste at Martam landfill

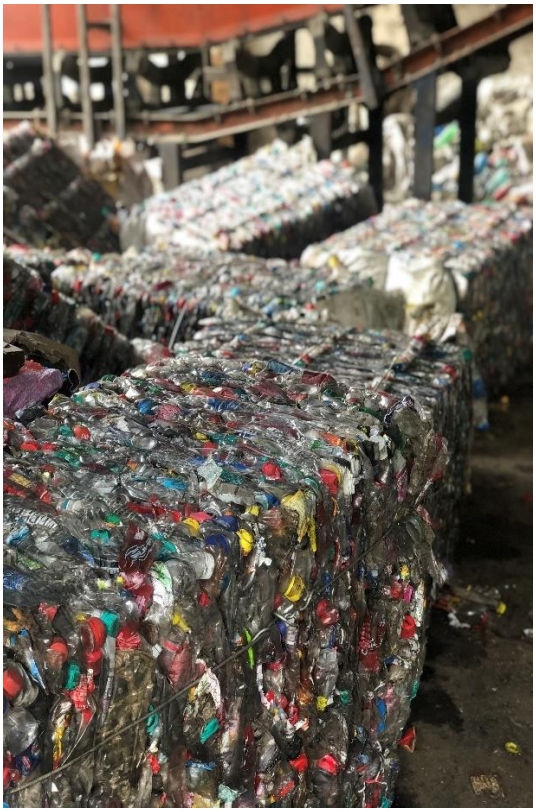
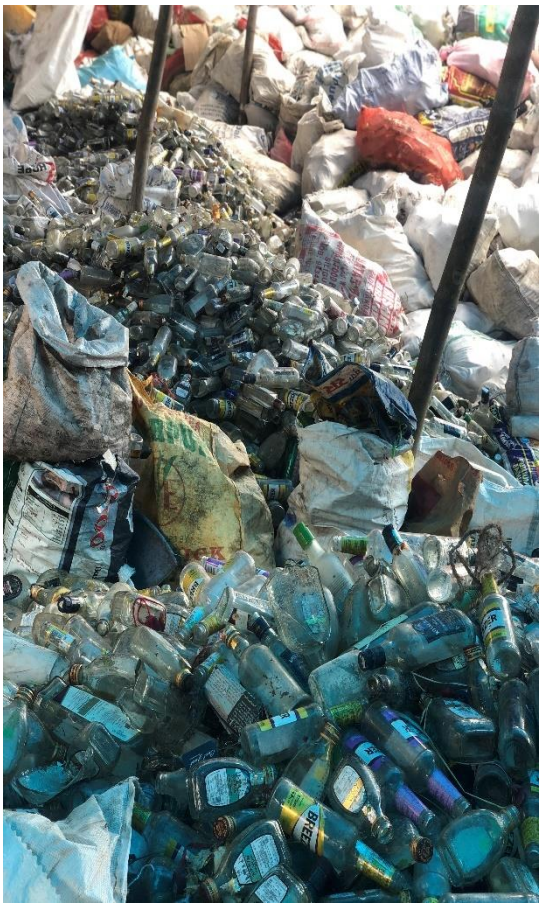
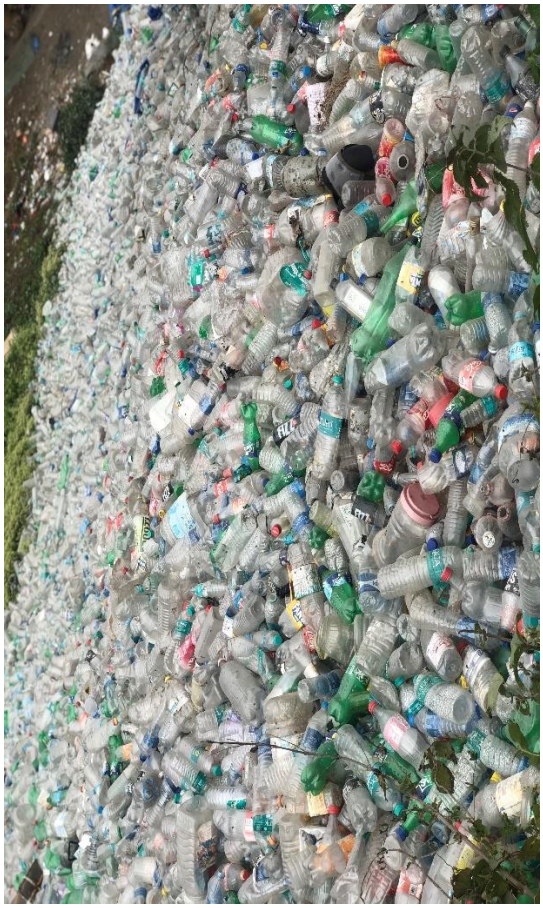


Source: Field Survey, Martam, October, 2020.

Plate No. 3. Waste sorting from the landfill

Source: Field Survey, Martam, October, 2020.

Plate No. 4. Sorting of segregated waste at the landfill

Source: Field Survey, Martam landfill, October, 2020

Plate No. 5. Waste transfer station at Ranipool, Gangtok

Source: Field survey, Ranipool, October, 2020

Plate No. 6. Waste transfer station nearby Smileland, Gangtok

Source: Field Survey, October, 2020

Plate No. 7. Waste transfer station in Radang

Source: Field survey, Radang, October, 2020

Plate No. 8. Waste transfer station in 32 Mile, East Sikkim

Source: Field Survey, 32 Mile, October, 2020

Plate No. 9. Weighing hook used for weighing waste in Martam landfill

Source: Field Survey, Martam landfill, October, 2020

Plate No. 10. 50-tonne composting plants in Martam landfill

Source: Field survey, Martam landfill, October, 2020

Plate No. 11. Open burning of waste led by waste facilities' condition in Syari

Source: Field Survey, Syari, October, 2020

Plate No. 12. Reuse of rice bags as dustbins/segregation of dry waste in Syari

Source: Field survey, Syari, October, 2020

Plate No. 13. Segregation of wet waste as fodder led by waste facilities' condition in Syari

Source: Field survey, Syari, October, 2020

Plate No. 14. Disposal of waste from the roadside cliff as an impact of waste facilities' condition in Syari

Source: Field Survey, Syari, October, 2020

Plate No. 15. Composting practices due to social-interest in Tadong



Source: Field Survey, Tadong, October, 2020

Plate No. 16. Sorting of dry waste for self-interest values in Tadong



Source: Field Survey, Tadong, October, 2020

Plate No. 17. Effect of community norms in Tadong

Source: Field survey, Tadong. October, 2020

Plate No. 18. Community norms' impact on waste disposal behaviour in T.R.

Source: Field survey, Tibet Road, October, 2020

Plate No. 19. Waste sorting for self-interest values in Tibet Road

Source: Field survey, Tibet Road, October, 2020