



Evaluation of Current Status and Recommendations to Plug in Gaps in Solid Waste Management at Chamoli Gopeshwar



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PREFACE

Population in urban areas of Uttarakhand is witnessing a rapid increase largely due to migration from the villages. This has put additional pressure on already inadequate infrastructure facilities and basic amenities available in the urban areas. Increase in population has correspondingly enhanced waste generation that is not being managed properly and thus leading to many problems that are largely related to health and environment. Due to the limited land availability in the hills waste is generally dumped on slopes and the same is invariably washed down into the rivers, thereby polluting rivers and choking the drainage. River pollution endangers the health of downstream habitants and choked drains often cause urban flooding and land instability.

Waste generation and management pattern of Gopeshwar and Chamoli towns of Chamoli district that are enroute to Badrinath shrine and experience inflow of pilgrims in large numbers has been studied and the report besides quantifying the nature of waste produced puts forth mechanism for sustainably managing it.

We, at DMMC, are grateful to Shri Vipin Kumar for sparing time to carry out this study. We are thankful to Shri Jagmohan Makhloga, Shri Subash Uniyal, Shri Vijandra Kapruwan and Shri Naveen Joshi all Search and Rescue instructors of DMMC for data collection and waste quantification for analysis of waste generation pattern. The study was carried out under GoI-UNDP project entitled Enhancing institutional and community resilience to disasters and climate change. Support and cooperation from Ministry of Home Affairs, Government of India and UNDP India is gratefully acknowledged. Shri R. Meenakshi Sundaram, Secretary, Disaster Management, Government of Uttarakhand is thanked for guidance and encouragement. All the colleagues at DMMC are thanked for their support and cooperation. Last but not the least we are thankful to the residents of Gopeshwar and Chamoli for their active participation, support and inputs.

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CONTENTS

Abbreviations	
Foreword	V
Acknowledgement	VI
Executive Summary	1
I- Introduction	
I.I. Background of the Study	3
I.II. Methodology	4
1. State , District and Town Profile	
1.1.Administrative Divisions	6
1.2.Demographics	7
1.3. District -Chamoli Gopeshwar	8
1.4. Nagar Palika Chamoli Gopeshwar	9
1.5.Municipal Board (NPP)	10
1.6.Ward Based Population Distribution	10
1.7. Density and percent Distribution of Population in Wards	10
1.8. Municipal Roads	12
1.9.Municipal Drains	13
1.10.Establishments in Gopeshwar	14
1.11.Status of Biomedical waste in Gopeshwar	15
1.12. Land use pattern of District Chamoli-Gopeshwar	15
1.13.Objectives of the Study	16
1.14. Scope of the Study	16
1.15. Study Limitations	17
2. Municipal Solid Waste Generation Pattern and Physical composition	
2.1.Household Waste Generation	18
2.2.Institutional and Commercial Waste Generation	27
2.3. Overall waste situation of Waste in Chamoli Gopeshwar	27
2. 4.Municipal Solid Waste Composition	
2.4.1. Municipal Solid waste composition at HH level	28
2 .4.2 Institutional Waste Composition	29
2.4.3. Market Waste Composition	32
2.4.4. Street Sweeping	33
3.Scenario of Existing Solid Waste Management System	
3.1.Collection and Segregation	34
3.2 Transport and Final Disposal	34
3.3. Material Resource Recovery Methods	37

3.3.1. Recycling	37
3.3.2. Composting	40
3.3.3.Public Awareness and Community Mobilization	40
3.3.4.Special Category waste	41
3.4. Behavioral Aspect in Solid Waste Management	
3.4.1. Availability of facilities	42
3.4.2 Impact of Garbage	43
3.4.3 Frequency of Different services provided by the ULB	43
3.4.4. Waste Disposal Pattern of Citizens	44
3.4.5 Availability of Collection and Transport Equipment	45
3.4.6.Level of satisfaction for SWM service provided by the ULB	46
3.4.7.Responsibility for Unsatisfactory State of SWM	47
3.4.8. Factors Responsible for Unsatisfactory SWM	48
3.4.9. Privatization of SWM and Willingness to Pay user Charge	49

4. Managerial Aspects of Solid Waste Management

4.1. Structure of SWM Organization at the ULB level	50
4.2. Allocation of Resources for Waste Management	50
4.3. Planning Solid Waste Management at the ULB level	50
4.4. Actors Involved in Solid Waste Management	51
4.5.Solid Waste Management Rules and Government orders	51

5. Challenges and recommendations

5.1. Evolving a Policy ,Strategy and an action plan	52
5.2. Promotion of Refuse ,Reduce, Reuse, Recover and Recycle	52
5.3. Strengthening Capacity of Local Bodies	53
5.4.Public Participation and Consultation Mohalla swachta samiti	54
5.5.User Charge	54
5.6.Improvements toward Integrated Solid Waste Management	55
5.7.Data Management, Updating, and Dissemination	55

ABBREVIATIONS

CBO	Community-based organization
DMMC	Disaster Mitigation and Management Centre
GO	Government Order
ISWM	Integrated Solid Waste Management
MSW	Municipal Solid Waste
MDP	Material Diversion Programme
MRF	Material recovery Facility
NH	National High way
NGO	Non-governmental organization
PPP	Public-Private Partnership
PPPUE	Public Private Partnership for Urban Environment
RRR	Reduce, Reuse, Recycle
SWM	Solid waste management
ULB	Urban Local Body
UDLE	Urban Development through Local Effort
UNDP	United Nations Development Program
UWEP	Urban Waste Expertise Program

FOREWORD

Disaster Mitigation and Management Centre (DMMC) Dehradun with support from GoI- UNDP under project " Enhancing Institutional and Community Resilience to Disasters and Climate Change" has initiated a study to access the existing practices in Solid Waste Management in the twin Hill towns of Gopeshwar – Chamoli situated on NH 58, en-route to the holy shrine of Badrinath. The town is District headquarters and is prone to high touristic activities during summers.

One of the problems of rapid urbanization and increasing consumerism is the increased generation of waste. This waste is not being adequately managed and is therefore creating a serious health and environmental hazard. The waste that is collected is dumped indiscriminately on hill slopes due to lack of open space. The habitations contiguous to such dumps are prone to risks and health hazards.

The high organic content of Indian municipal solid waste (MSW) having moisture content between 60 -70% decomposes rapidly during the summer season producing foul odour of Hydrogen sulphide, cadavarine and putrescine. These unattended dumps become a monotonous smitten of filth during the monsoons blocking the emission of gases but creating ideal conditions for breeding of disease causing vectors a potential threat to human health and safety. The accumulated waste on hill slopes due to its gradient is washed down into rivers and water bodies by creeks formed after a heavy down pour, which pollutes the water endangering the health of downstream settlers.

In fact solid waste management is a big challenge to all established and emerging urban centers' in Uttarakhand. The municipalities as per the antiquated urban act collect and dump the waste within or sometimes beyond the municipal limits of the town. The principle of 3R (waste reduction, re-use and recycle) are not prioritized by the municipalities for effective sustainable waste management.

This study aims to examine the existing Solid Waste Management programme of the ULB and the gaps within the existing system. The chapter on suggestions and strategies for improving waste segregation, collection ,treatment and disposal as per the Solid Waste Management Rules-2000-15 is expected to be suitably adopted by the Gopeshwar ULB and also other urban centers located in the mountains for improving urban health and environment.

Vipin Kumar
Study coordinator

ACKNOWLEDGEMENT

This report was principally developed on assistance from UNDP to assess the waste generation status of a hill ULB which besides being a District headquarter is a religious centre. The DMMC is grateful for the cooperation provided by the Nagar palika staff who helped the surveyors in collecting data. Thanks are also due to Mr.Subhash Uniyal, Mr.Navin Joshi, Mr. Vijendra Kapurwan and Mr.Jagmohan Singh who surveyed the clusters and collected data.

A word of gratitude is also due to Mr. Bhupendra Bhaisora Manager (Technical) DMMC for coordinating between study coordinator and the surveyors without which this study could not have taken shape. Thanks are also due to Ms. Bhavna Karki of DMMC for updating the formats and drafting the evaluation formats and Mr. Govind Rautela for formatting and type-setting of the report. Dr.Piyoosh Rautela, Director DMMC deserves all the credit for taking initiative in roping in all the members of the team to evaluate the state of Solid waste in Gopeshwar. Mr. S.P.Bhatt Executive Officer Nagar palika Gopeshwar extended all help in sharing information with the study coordinator who deserves all praise for his cooperation.

A word of thanks is also due to the citizens of Gopeshwar who participated in the entire exercise of waste collection and its physical verification. The safai nayak Gopeshwar, Chanderpal and the team of rag pickers headed by Prem Bahadur deserve appreciation for their unconditional help and support.

Vipin Kumar
Study coordinator

EXECUTIVE SUMMARY

In the previous decade Gopeshwar witnessed unprecedented growth in its urban population. This rapid and uncontrolled urbanization coupled with lack of public awareness, and poor management of waste has created environmental problems in the town. Though solid waste management (SWM) is an issue of major concern for Gopeshwar yet the status is not fully understood due to the lack of relevant data, which is essential for effective planning.

The main objective of the SWM survey was to estimate and evaluate the waste generation pattern through physical verification at door step. The exercise was to derive systematic and comprehensive data and information on SWM, including the quantity and composition of municipal solid waste. The behavior of the citizens and their expectations for a clean town was to be understood through their active participation which is an inseparable component of Solid Waste Management. The perceptions and expectations of the citizens for a better quality of life through clean and environmentally safe township has helped in deriving, approach for strategy.

The survey was conducted in March and May 2015 during the peak tourist season. The household survey revealed an average per capita household waste generation rate of 260 grams (g)/capita/day. This study also showed that the household waste generation rates varied depending on economic status. Households with monthly expenditures of INRs15,000(\$208) and above generate .49 kilograms (kg)/household/day on average, which is more than five times as much as .08 kg/household/day generated by households with monthly expenditures less than Rs5,000 (\$52). Waste generation rates as a rule were higher on weekend due to gatherings and low on week days. Similarly the total sample size of 5 schools and colleges and 10 different types of offices gave an average daily waste generation rate of 3.0 kg per school and 1 kg per office. A survey of 50 shops, 3 hotels, and 5 restaurants, yielded an average waste generation rate for commercial establishments of 0.4 kg per shop and 3 kg per hotel or restaurant during peak tourist season.

The waste composition analysis indicates that the highest waste fraction is compostable wet waste (74%) followed by plastics (11%), Paper as newsprint, record, mill board and cartons (8%), Laminated non-recyclable (1%), Tin (2%) and Glass (4%). Based on the analysis and findings, it is estimated that waste from households in general contributes about 75% of the total MSW generated. The study found that Institutional waste comprised of 45% paper and paper products, 22% wet waste, 24% plastics, and 6% laminated polymers used in junk food and 3 % others which included discarded shoes, and rubber. Thus, the average MSW generation was found to be 296 g/capita/day. Using these per capita waste generation rates and the population in 2011 (census), the total MSW generation of the Municipality was estimated at about 6.3 tons per day. The waste composition indicates that there is a great potential for producing compost from wet waste, and reusing and recycling other materials,

The study also uncovered that in rural urban wards about 40% of the households segregate their garbage for feeding cattle and composting the cow dung. The remaining urban wards will have to segregate their garbage if composting is to succeed at the NADEP composting site at Chamoli Kshetrapal.

Based on the information provided by Gopeshwar municipality about 15% of the total municipal budget is spent on SWM. The Nagar Palika spends nearly 60% of the total SWM budget on collection of waste through street sweeping, 20% on diesel and petrol and the rest on maintenance of tractors and equipment. These figures reflect the need to improve Door to Door collection services so that the costs incurring on sweeping can be minimized. This in turn will generate surplus both in terms of man hours and finance which can be utilized for effective disposal of waste. Since there is no weighing bridge it is difficult to estimate the cost incurring on managing one ton of waste at Gopeshwar. However, about Rs.3 to 4 thousand per ton is estimated as the cost of collection and disposal of waste.

The survey identified the following key policy recommendations for SWM.

First, Municipal bye laws and strategic framework needs to be developed

Second, IEC material for practicing (5R) refuse, reduce, reuse, recover recycle should be promoted. It should serve as a motivational factor for creating generic demand.

Third, strengthening the capacity of local bodies is essential, as they are mandated to provide SWM services to the citizens.

Fourth, enhancement of public participation and consultation would be effective in advancing SWM

Fifth, costs for SWM need to be recovered, albeit partially at first, to provide better services. The public is generally willing to pay for services if the level of services is improved.

Sixth, current poor management practices such as open dumping and open burning should be stopped immediately to allow for more integrated SWM.

Seventh Data management with evaluation through Key performance Indicators to be linked with incentives of the State Government.

I- INTRODUCTION

I.I. Background

Solid waste management (SWM) is one of the major environmental issues in Municipalities of Uttarakhand. Urban population growth coupled with migrant rural population leads to an increased generation of municipal solid waste (MSW). Unmanaged and untreated disposal of bio-medical wastes from hospitals and clinics also contribute to pollution and public health hazards.

The Government of India enacted the Solid Waste Management Rules 2000 being amended and modified as SWM rules 2015 and Plastic waste management Rules 2011 being updated and modified as PWMR-2015. The objective of the rules is to provide a clean and healthy environment to the citizens by minimizing the adverse effects of solid waste. The municipalities have been made responsible for the construction, operation, and management of infrastructure for collection, treatment, and final disposal of MSW. The Rules mandate the Urban Local Bodies to take necessary steps to promote refuse, reduce, reuse, recover and recycle (5R's), including segregation of MSW at source.

The rules authorize the local bodies to formulate bye-laws, and guidelines, with the approval of the municipal board. The aim is to evolve area specific approach for strategy keeping in mind the geographical situation of the Municipality. The Local bodies are experiencing difficulties in developing management plans due to the lack of SWM baseline information and data related to the functional elements of SWM. It is essential to know the quantity and composition of MSW when designing and implementing proper waste management plans that include Material Diversion Programme with Material Recovery System.



Waste collection after sweeping at Gopeshwar Bus Stand

This is the first attempt to collect SWM baseline information through physical verification of waste generation and composition pattern at door step. There were efforts made at Municipality level to update data, but due to the lack of consistent scientific methods and the different assumptions made to quantify the waste generated from different sources, the findings of these waste quantity and quality studies were inconsistent.

This baseline survey, undertaken as an activity supported by DMMC under GoI-UNDP project on 'Enhancing Institutional and Community Resilience and Climate Change' is intended to derive systematic and comprehensive data and information on SWM, at Chamoli, Gopeshwar. Based on the survey and other assessments undertaken the key policy recommendations have been identified.



Littered and Burning waste at Lower Bazaar Gopeshwar

I.II. Methodology

The study was planned in a phased manner which was initiated with the training of surveyors for data collection. It was followed with dummy interviews with the House Holds on the basis of customized formats to assess their behavior towards garbage. The role of the ULB viz. the participation of citizens was measured through Door to Door interaction with the stakeholders. In order to have a representative sample, 9 electoral wards were stratified according to the town's lay out. Clusters were marked on the map for sampling.

The method for collection of the same was based on the right hand rule through clusters so that out of a cluster of 30, 1st and 4th house were selected and from a cluster of 50, 1st and 6th house were selected. In the market area a cluster of 40 shops was surveyed with the 1st and 5th being the sample members. This made the representative sample more comprehensive. 120 HH from all 9

wards and 34 from Institutions and market were selected for measuring behavior and attitude of the citizens. In the entire process the Nagar Palika staff was briefed to elicit their cooperation.

The physical verification of source separated waste was done for 79 households from within clusters. They were provided with a black bag for collection of wet waste and a transparent LDPE bag for Dry waste. Wet waste was collected and weighed on Day 1, followed with the same exercise on Day 2. The Dry waste was weighed and collected separately from the households after two days. The clean Dry waste was desiccated for various constituents.

Further, the wet waste collected on two days was calculated for average waste generation and divided by the number of family members to calculate per capita wet waste generation. Similarly average of Dry waste was taken for two days and divided by the number of households. Both per capita wet and dry waste were added and multiplied by the number of family members. The total waste was divided by the total number of family members of the sample to calculate per capita waste generation. The cluster samples from 4 wards were added and average was taken to arrive at the figure of 191gm/cap/day for wet waste and 68 gms/cap/day for dry waste. Both the figures were rounded up to arrive at 260gms/cap/day.

The same methodology was followed for institutions, shops and restaurants. The waste was collected separately and desiccated for constituents. Road sweeping per m² was collected and weighed. The sample was spread to the road lengths which are swept daily. Professional judgment was used for estimating dust and soil for the areas where frequency of sweeping is twice or thrice a week.

The household waste was added with institution and commercial waste and road sweepings. It was divided by the total population to arrive at 296 gms/capita/day as waste generated in Gopeshwar. The data was shared with the executive officer of the Nagar Palika who as per his estimates was very close to the physically verified waste generation pattern at Gopeshwar. The other relevant data was collected from the municipal staff which has been incorporated in the study.

1-State, District and Town Profile

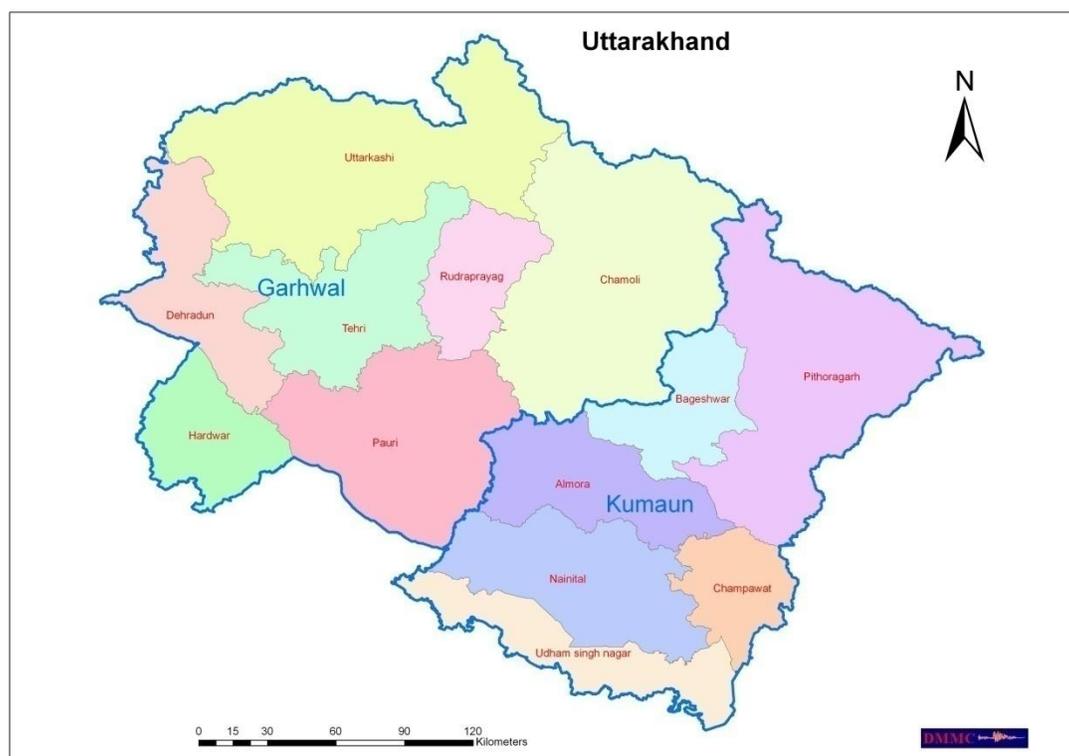
Uttarakhand the 27th. State of the Indian union was carved from Uttar Pradesh on the 9th. November 2000. Located in the foot hills of the Himalayas, the state is very rich in natural resources, especially water and forests as it has many glaciers, rivers, forests, mountain peaks. The state has international boundaries with China (Tibet) in the north and Nepal in the east. On its north-west lies Himachal Pradesh and Uttar Pradesh on its south.

Uttarakhand with an area of 53,384 sq. km and a population of 10,086 million (2011) has an average density of 189 persons per sq. km. Most of the population is confined to plains, valleys and lower slopes of the hills and mountains.

1.1. Administrative Divisions

The state consists of two administrative divisions, namely Garhwal and Kumaon.

Uttarakhand Fig 1



The Garhwal Division, comprising the districts of Garhwal, Dehradun, Uttarkashi, Tehri Garhwal, Chamoli, Rudraprayag and Haridwar is larger of the two . It accounts for 60 per cent of the total area, 56.8 per cent of total population and 62 per cent of total urban population of the state. The remaining six districts, namely Nainital, Almora, Udham Singhnagar, Champawat, Pithoragarh and Bageshwar form the Kumaon Division comprise 33.2 % of the total population.

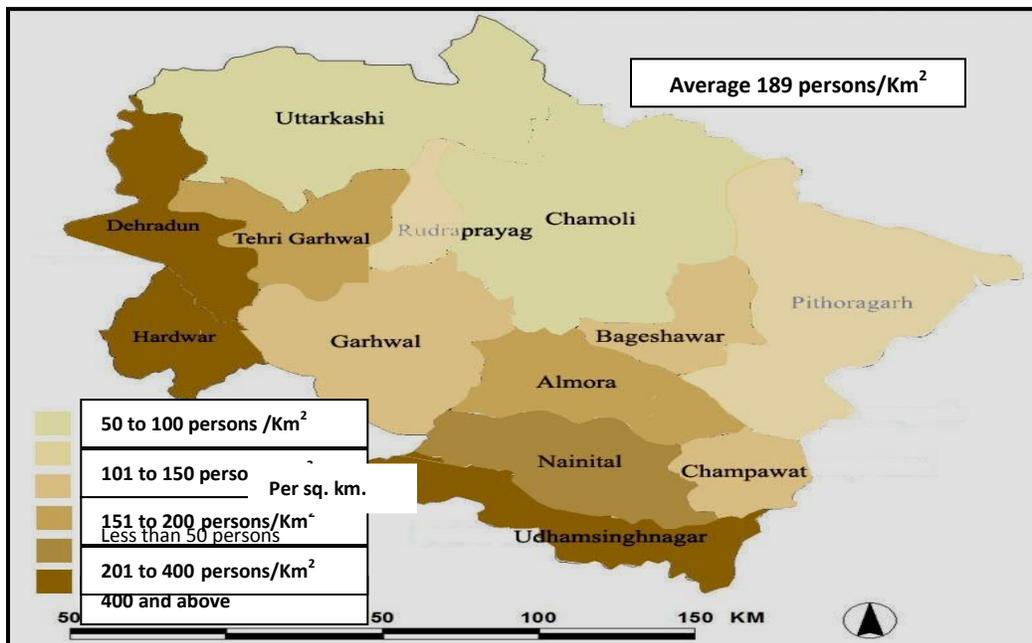
1.2. Demographics :

Uttarakhand's population was 10,086 million according to the 2011 census. The population growth rate was 19.17% compared to 19.2% of the previous decade. The population is still growing quickly but at a slower rate. The density of population in the state has increased from 133 persons per sq. km in 1991 to 159 in 2001 and 189 in 2011. This means that the population pressure in the state has increased by 30 persons per sq. km during the decade.

The highest density of population has been observed in Hardwar district (817), followed by Dehradun (550) and Udham Singh Nagar (567). The lowest density is in Uttarkashi (41) followed by Chamoli (51) and Pithoragarh (68). There are five districts, namely Champawat (146), Nainital (247), Bageshwar (113) and Almora (202), which have density of population varying between 100 to 250 persons per sq. km.

Many urban areas in the state contend with the transient population during summers comprising of pilgrims and tourists.

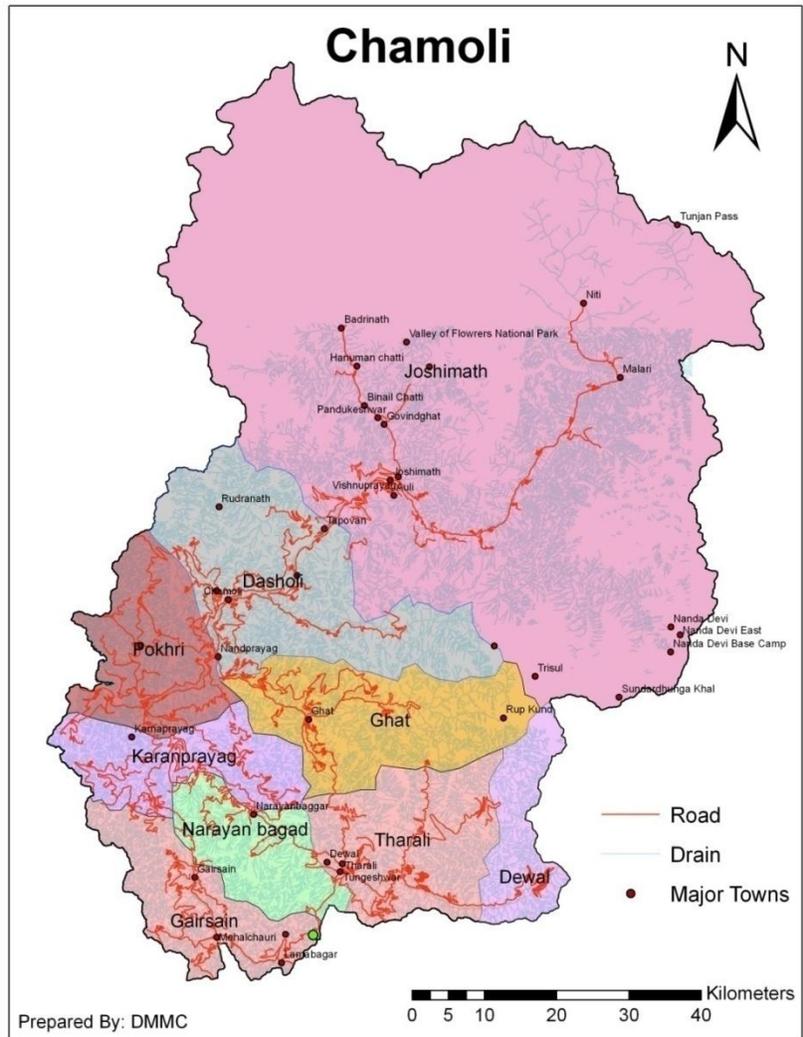
Uttarakhand Population Density- Fig-2



1.3. District -Chamoli Gopeshwar is located 30°25"N 79°20"E / 30.42°N 79.33°E [Coordinates](#). The District headquarters are located at Gopeshwar 1300 meters above sea level, As of 2011 India census, Population of Chamoli district is 391114. Chamoli is the 9th most populous district out of total 13 districts in Uttarakhand and it is 559th most Populous district in India. The population density of Chamoli is 51 Persons per square Km. Total Literacy rate of Chamoli is 87.41%. This means 87.41 out of 100 persons of age more than 6 years are literate. It is ranked 3 in terms of literacy rate out of total 13 districts of Uttarakhand and 559 out of total 640 districts of India. Male Literacy of Chamoli is 94.18% while female literacy stands at 73.2%.

Area of Chamoli is 7520 Sq. Km. It is the 2nd largest district in Uttarakhand and 101th largest in India in terms of total area.

Map of District Chamoli- Fig-3

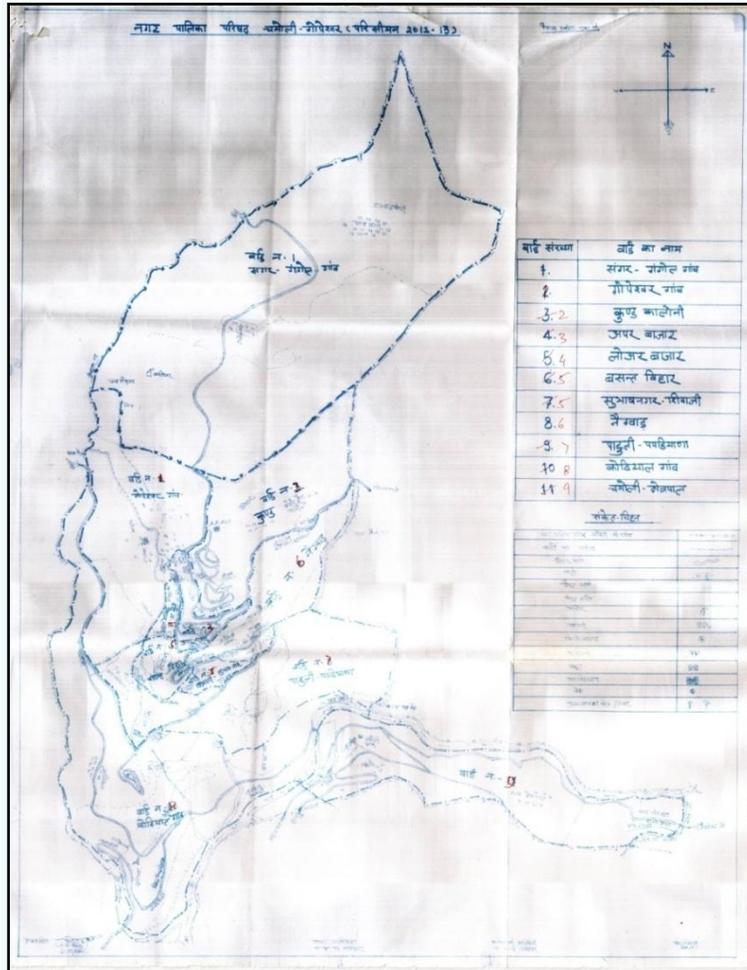


1.4. Nagar Palika Chamoli Gopeshwar is a Municipality in District Chamoli, Uttarakhand. The Gopeshwar city is divided into 9 wards for which elections are held every 5 years. The Chamoli Gopeshwar Nagar Palika Parishad has population of 21,444 of which 11,432 are males while 10,015 are females as per report released by Census India 2011.

Population of Children with age of 0-6 is 2491 which is 11.61 % of total population of Chamoli, Gopeshwar (NPP). The Female Sex Ratio is of 876 against state average of 963. Moreover Child Sex Ratio in Chamoli, Gopeshwar is around 795 compared to Uttarakhand state average of 890. Literacy rate of Chamoli, Gopeshwar city is 93.31 % higher than state average of 78.82 %. Male literacy is around 96.66 % while female literacy rate is 89.53 %.

The Nagar Palika Parishad has total administration over 5,333 houses to which it supplies basic amenities like sanitation and SWM service. It is also authorized to build roads within Nagar Palika Parishad limits and impose taxes on properties coming under its jurisdiction.

Ward Map of Nagar Palika Parishad , Gopeshwar



1.5.Municipal Board (NPP)The population development of Chamoli Gopeshwar for two decades is tabulated below :

Table - 1

<u>Name</u>	<u>District</u>	<u>Population Census 1991</u>	<u>Population Census 2001</u>	<u>Population Census 2011</u>
Chamoli Gopeshwar	Chamoli	15,378	19,833	21,444

(Source : census of India 2011)

The population of the town increased by 28.96% at a rate of 2.89 % per annum in the decade 1991-2001 . In the decade 2001-2011 the population increased at the rate of 8.13% at the rate of .81% per annum.

1.6 Ward Based Population Distribution The ward based distribution of population is tabulated below:-

Table -2

Ward	Population	Area in Km ²	No. of HH
Gangol Gaon	2445	4.21	608
Kund	2074	0.76	516
Upper Bazaar	2397	0.3	596
Lower Bazaar	2365	0.29	588
Subhash Nagar	3703	1.39	921
Negwaad	2466	1.04	613
Paduli-Papadiyana	2332	2.82	580
Kothiyal sain	1847	1.72	459
Chamoli-Kshetrapal	1815	1.55	452
Total	21444	14.08	5333

(Source : Nagar palika Parishad, Gopeshwar)

Ward number 1, 6, 7 and 8 are rural urban settings with people having meager land holding for agriculture purpose. 25% of the residents in these wards have domesticated cattle which are fed on leftover food. In ward 3 and 4 some of the residents also own cattle. The maximum residents reside in Subhash Nagar ward number 5 while the minimum in Chamoli Kshetrapal ward no.9.

1.7. Distribution of Population in Wards: The following table shows the density and percent distribution of population in 9 wards. Ward No.4 lower bazaar leading to the famous Gopinath temple is the most densely populated ward of Gopeshwar while Gangol Gaon is the least crowded.

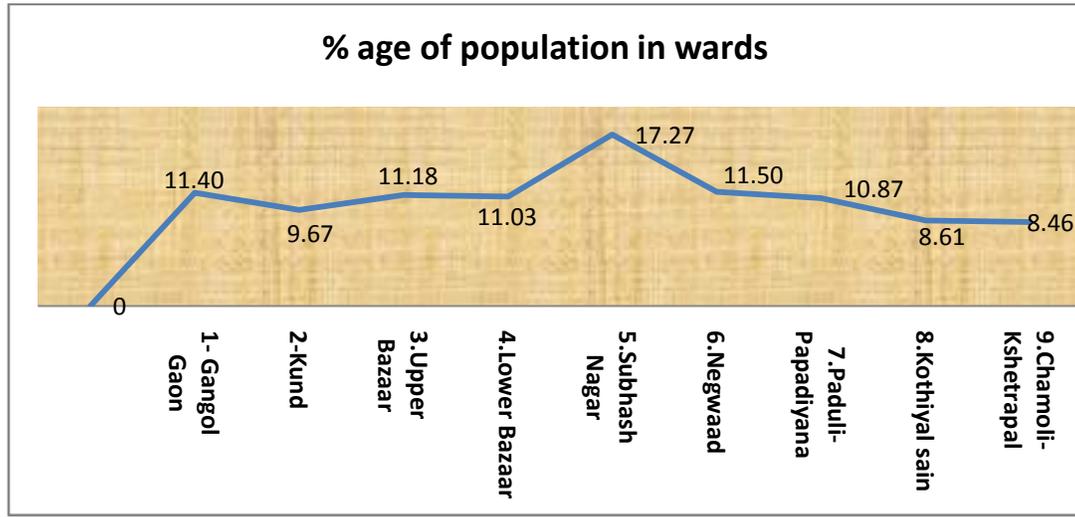
Table-3

Ward	Population	Area	% age of population in wards
Gangol Gaon	2445	4.21	11.40
Kund	2074	0.76	9.67
Upper Bazaar	2397	0.3	11.18
Lower Bazaar	2365	0.29	11.03
Subhash Nagar	3703	1.39	17.27
Negwaad	2466	1.04	11.50
Paduli-Papadiyana	2332	2.82	10.87
Kothiyal sain	1847	1.72	8.61
Chamoli-Kshetrapal	1815	1.55	8.46
Total	21444	14.08	100.00

(Source : Nagar palika Parishad, Gopeshwar)

Ward number 5 and 6 are new colonies which are unplanned having approach paths with a width of 1 meter to 1.25 meters. They are connected to main road by steps which are abutted by rain water drains as wide as .3 meters. The urban lay out supports manual waste collection system over mechanized methods of waste management. The town may partly support mechanical methodology in wards having motor able roads.

Figure -4



Source: Study DMMC/UNDP

Upper Bazaar, Lower Bazar, Subhash Nagar and Negwaad having high population densities and mixed income group were selected for study as representative samples for the Chamoli Gopeshwar township.

Approach Roads to House Holds in ward 3,4,5 and 6



access to Households is by steps



Steep slopes and steps impede mechanization



Littered Lanes and Bye lanes



Sweeping provides aesthetics



Lanes obstruct free movement



Manual waste collection during Survey

1.8. Municipal roads

The municipal roads built within the wards are 1 meter to 1.25 meters between two houses abutted by 0.25 meter wide shallow drains . The roads have steps to negotiate the declivities of the urban set up. The market area has 4 meter to 6 meter wide roads which are motorable. In the wards even wheel barrows cannot be plied for collecting waste post sweeping. The wards need to be served manually for door to door collection by using shoulder bins.

Table-4

Details	2015
Ward-1- Gangol Gaon	
Length in Kilometers	15

Width in meters	1.20
Ward-2 - Kund	
Length in Kilometers	4
Width in meters	1.20
Ward-3- Upper Bazaar	
Length in Kilometers	3
Width in meters	1.20
Ward-4 –Lower Bazaar	
Length in Kilometers	4
Width in meters	1.20
Ward- 5- Subhash Nagar	
Length in Kilometers	16
Width in meters	1.20
Ward-6 - Negwaad	
Length in Kilometers	4
Width in meters	1.20
Ward-7 –Paduli Papadiyaan	
Length in Kilometers	10
Width in meters	1.20
Ward-8- Kothiyal sain	
Length in Kilometers	13
Width in meters	1.20
Ward-9-Chamoli Kshetrapal	
Length in Kilometers	9
Width in meters	1.20

(Source : Nagar palika Parishad, Gopeshwar)

1.9.Municipal Drains

The municipal drains abutting the roads within the wards are shallow and hardly .25 meters in width. The drains are used for laying water pipe lines thereby further reducing their carrying capacity. They are connected to a main drain for flushing off rain and grey water. During the monsoons plastics remains stuck to the pipe lines choking the free flow of water.

Table-5

Details	
Ward-1 – Gangol gaon	
Length in Kilometers	8
Width in meters	0.25
Ward-2 - Kund	

Length in Kilometers	4
Width in meters	0.25
Ward-3 – Upper Bazaar	
Length in Kilometers	3
Width in meters	0.25
Ward-4 – Lower Bazaar	
Length in Kilometers	4
Width in meters	0.25
Ward-5 – Subhash nagar	
Length in Kilometers	9
Width in meters	0.25
Ward-6 - Negwaad	
Length in Kilometers	4
Width in meters	0.25
Ward-7 –Paduli-papadiyan	
Length in Kilometers	5
Width in meters	0.25
Ward-8 –Kothiyal sain	
Length in Kilometers	6
Width in meters	0.25
Ward-9 – Chamoli -Kshetrapal	
Length in Kilometers	5
Width in meters	0.25

(Source : Nagar palika Parishad, Gopeshwar)

1.10.Establishments in Gopeshwar

The Gopeshwar ULB has establishments like Shops, Hotels and Offices in addition to the households who constitute as major stake holders of the town. The Hotels and Restaurants are located in the Lower and Upper Bazaar wards near the Bus stand and the highway connecting Chamoil with Kund on way to Kedarnath. The following table lists the number of establishments at Gopeshwar:-

Table -6

Details	Units	2015
i. Commercial/Shops	Number	600
ii. Hotels/Restaurants	Numbers with Customer	37
iii. Offices and Institutions	Number	65
iv. Markets	Numbers	5
v. Vegetable Yards etc.	Number with Estimated waste qty	-
vi. Marriage Halls / Community Centers	Numbers with Capacity	4
vii. Gardens, Parks etc.	Numbers and Area in Sq km	2

viii. Dharmshala / Akhadas / Ashrams etc.	Numbers with Capacity	-
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(Source : Nagar palika Parishad, Gopeshwar)

1.11. Status of Biomedical waste in Gopeshwar

There are 2 hospitals in Gopeshwar generating about 15 kgs of untreated waste per day. This waste is disposed off in municipal bins. Patients with serious ailments are referred to the base hospital at Srinagar or Dehra Dun. There is not much of anatomical waste.

Table -7

Details	Bed capacity	2015 (Number)
Hospital	60	2
Dispensaries/clinics	08	
Nursing homes	----	
Diagnostic centres/ Pathological labs	-----	
Waste generated per day	15 Kgs/day	

(Source : Nagar palika Parishad, Gopeshwar)

1.12. Land use pattern of District Chamoli-Gopeshwar

There are Seven Urban Local Bodies in District Chamoli which constitute 1.04 % of the total area of the District. 65% is forest and 33.95 % is rural. The seven urban local bodies of the District are as follows :-

Table 8

Name of the ULB	Area in Km ²	Population
Chamoli Gopeshwar	14.08	21,444
Joshimath	11.49	16,025
Gauchar	15.00	08,864
Karnaprayag	25.00	8,297
Badrinath	02.00	0,850
Nanad Prayag	02.75	1,641
Pokhri	08.17	6119
Total	78.49	63,240

Source; This study DMMC/UNDP

The urban population is 63240 which is 16% of the total population . The remaining 84% reside in villages and peri-urban areas on the yatra route.

1.13.Objectives of the Study

The main objectives of this study are to determine the MSW generation and its composition in Chamoli - Gopeshwar, and to present the status, practices, and issues of SWM in the Municipality. The specific objectives of the study are to

- (a) Determine the per capita household waste generation and composition of household waste;
- (b) Estimate the quantity and composition of institutional and commercial wastes;
- (c) Estimate the average per capita MSW generation and its total quantity;
- (d) Determine the current practices of municipal SWM in the Municipality in terms of segregation collection, treatment, and final disposal;
- (e) Assess the level of services and allocation of financial and human resources in SWM; and
- (f) Identify key policy challenges and recommendations for improving Gaps in municipal SWM in Chamoli Gopeshwar ULB.

1.14. Scope of the Study

The survey mainly consisted of four parts:

- (i) Behavioral aspect of Households towards Solid waste Management;
- (ii) A sample survey of households to measure the quantity and composition of household waste, by source separation and door to door collection
- (ii) A sample survey of institutional and commercial establishments to measure the quantity and composition of wastes from these establishments; and
- (iii) A survey of the existing SWM system for organizational and institutional aspects of SWM through interviews with municipal staff, commercial establishments and households .

The survey covered all 9 wards for behavioral aspect in SWM however wards 3, 4, 5 and 6 were selected for per capita waste generation sampling. The sample size comprised of 79 households, 2 markets viz. Lower Bazaar around the Gopinath shrine and Bus stand in Gopeshwar and Chamoli market on National Highway 58 on way to Badrinath , 5 hotels and restaurants were selected for waste generation and composition.

The survey classified the waste into the following six categories:

- (i) Biodegradable waste (Wet Waste)

Dry waste :

- (ii) Plastics and its constituents category wise (Thermoplasts)

- (iii) Paper and paper products like Cartons, Mill Board, News print and Record
- (iv) Rubber ,leather, shoe uppers
- (v) Metals like tin and aluminum cans
- (v) Glass like bottles and cullet
- (vi) Others like, Gunny bags, micro plastics as sweet wrappers, jelly cups, straws and laminated polymers etc.

1.15. Study Limitations

The study covers MSW quantity and quality, including the waste generated from commercial and institutional establishments. However, waste generated from parks and gardens, street sweeping and treated bio-medical waste were not accounted for.

The small sample size and one-time sampling of waste generation may provide an approximate average value. They may vary in other wards with an error of $\pm 5\%$ to 10%. In the rural urban wards the content of biodegradable waste is less to the tune of 40% as the House Holds resort to composting. The generalization of the findings even in rural urban wards shall help to design infrastructure to cope up with additional waste as the rural urban wards transform themselves to complete urban set ups.

The average MSW generation in each municipality was calculated from the household waste generation pattern. The most densely populated wards were taken as a base line for the survey to evaluate infrastructure support for SWM service. Professional judgment was used for estimating waste from gardens, commercial and institutional establishments.

2-Municipal Solid Waste Generation Physical composition

Pattern and

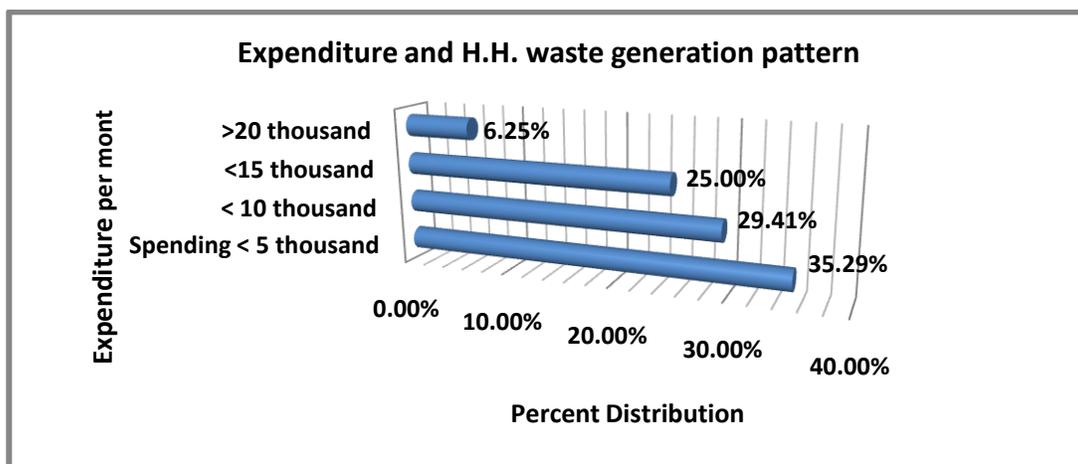
2.1. Household Waste Generation

The per capita waste generation of households was calculated by dividing the total waste produced by the number of people. The total sample size of 79 households varying from a minimum of 10 households to a maximum of 27 households, gave an average household waste generation figure of 191 /g/capita/day of wet waste and 68 grams of Dry waste. Overall waste generation is about 259 grams per capita per day which was rounded to 260 gms/c/day for estimation of waste at the household level. It needs to be noted here that sampling was carried out in mixed income group spread over four wards.

This study also showed that the household waste generation rates varied depending on economic status. Households with monthly expenditures of INRs15,000(\$208) and above generate .49kilograms (kg)/household/day on average, which is more than five times as much as .08 kg/household/day generated by households with monthly expenditures less than Rs5,000 (\$52). Waste generation rates as a rule were higher on weekend due to gatherings and low on week days. However it should be noted that hill towns like Mussoorie and Nainital regions record different average household waste generation rates. The municipalities in plains generate the largest amount of per capita daily waste.

The per capita household waste generation rate was found to vary from a minimum value of 25 g/capita/day (Ward 5 and 6) to a maximum value of 490 g/capita/day (ward 4). Households surveyed in the municipality , especially from the rural wards like Gangol Gaon, Kothiyal sain and part of Negwaad were found to use most of the wet waste for feeding their cattle, resulting in a lower rate of waste generation than the average.

Figure 5



Source: This study DMMC/UNDP

**Door to Door Physical quantification of source separated Wet and Dry Waste in
Ward Numbers 3, 4, 5 and 6**



Table -9

Estimating Per capita Waste Generation after source separation Ward 3 Upper bazaar												
S.No.	Name of the H.H.	No of Persons	Wt. of wet waste Day1 kgs	Per capita waste generation gms	Wt. of wet waste Day 2 kgs	Per capita waste in gms	Av.per/cap/day in gms BDW	Dry waste in gms for 2 days	Dry waste in gms 1 day	Per capita Dry waste in gms	P/c/d/total waste	Total waste
1	Pratap Singh	5	1.33	266	2.82	565	416	500	250	50	466	2330
2	Lakhpatt Singh	4	1.55	387	1.43	358	373	450	225	56	429	1716
3	Bhagwat Singh	6	0.4	66	0.59	98	82	235	117	20	102	612
4	Pramod Kumar	4	0.4	100	0.21	53	77	170	85	21	98	392
5	Poonam	4	0.23	58	0.32	80	69	160	80	20	89	356
6	Manoj Nautiyal	2	0.6	300	0.33	165	233	180	90	45	278	556
7	Mohd.Haneef	4	NA	NA	NA	NA	0	N.A.	N.A.	N.A.	NA	NA
8	Govind Singh	4	0.9	225	0.39	98	162	425	213	53	215	860
9	Meena	6	2.33	388	1.11	185	287	170	85	14	301	1806
10	Usha	8	1.27	158	0.82	103	130	600	300	38	168	1344
11	Usha Bisht	2	0.14	70	0.39	195	133	665	333	167	300	600
12	Yasodha	2	1.22	610	0.55	275	443	345	172	86	505	1010
13	Dilip S Negi	3	N.A.	N.A.	NA	NA	NA	NA	NA	NA	NA	NA
14	Yashwant S Negi	6	N.A.	N.A.	NA	NA	NA	NA	NA	NA	NA	NA
15	D.D.Maletha	4	0.76	190	0.64	160	175	115	58	15	190	760
16	Virendra Singh	4	1.27	317	2.65	662	490	305	153	38	518	2072
17	Shambu Pd.	2	0.49	245	0.57	285	265	500	250	125	390	780
	Total	70	12.89		12.82				2409	748		15194
	Per cap./Day /gms		226g		225g				42			268

Source; This study DMMC/UNDP

Table 10

Estimating Per capita Waste Generation after source separation Ward 4 Lower bazaar												
S.No.	Name of the H.H.	No. of Persons	Wt.of wet waste Day 1 in Kgs.	p/cap/day waste in gms	Wt.of wet waste Day 2 in Kgs	p/cap/day waste in gms	Av./day in gms	Dry waste Day 1 and 2 in kgs	Av./day in gms	Dry waste/cap/day	P/Cap/Day waste in gms	Total waste BD &NB
1	Gaina ram	7	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2	Brij Mohan	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3	Balab lal	8	1.335	166	1.245	155	160	1.23	615	77	237	1896
4	Dinesh Chand	4	N.A.	N.A.	NA	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	NP
5	Varsha Soni	7	1.94	277	1.815	258	267	0.43	215	31	298	2086
6	Chandrakala Bhatt	3	N.A.	N.A.	NA	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
7	Jagmohan S Bisht	3	0.16	53	0.59	196	124	0.7	350	116	240	720
8	Ashok Sikander	7	1.815	259	1.025	146	202	0.76	380	54	256	1792
9	Sanjay Bisht	2	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
10	Laxmi	2	0.08	40	0.31	155	98	0.25	125	63	161	322
11	Kushlanand Gairola	3	NA	NA	N.A.	N.A.	NA	N.A.	N.A.	N.A.	N.A.	N.A.
12	Mukesh Negi	8	0.9	45	0.38	47	46	0.7	350	44	90	720
13	Virendra Soni	12	1.02	85	1.23	102	93	0.67	335	28	121	1452
14	K.S.Khatri	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
15	Dhirendra Rawat	3	N.A.	N.A.	N.A.	NA	NA	N.A.	N.A.	N.A.	N.A.	N.A.
16	Geeta devi	4	0.59	196	0.45	112	154	0.35	175	44	219	876
17	Pradeep Hindwal	6	3.37	561	1.175	195	378	0.86	430	72	450	2700
18	Kishan Hindwal	7	1.07	152	1.18	168	160	0.7	350	58	218	1526
19	Mohd.Hashim Ansari	6	2.53	421	2.214	369	395	0.09	45	8	403	2418
20	Sunil	3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
21	S.P.maithani	6	0.5	80	0.58	96	88	0.23	115	19	107	642
22	Yogendra Singh	3	0.9	300	1.465	488	394	0.59	295	98	492	1476
23	Mansoor Ali	5	1.395	279	1.275	255	267	1.59	795	159	426	2130
24	Basanti Devi	5	NA	NA	NA	NA	NA	N.A.	N.A.	N.A.	N.A.	N.A.
25	Tara Devi	3	0.415	138	0.455	151	144	0.9	450	150	295	885
26	Manoj	2	0.255	127	0.32	160	143	0.47	235	118	261	522
27	Jayanti Devi	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
		132	18.275		15.71		3113	10.5	5260		4274	22163
	Per cap/day		205		176				59			249g/c/d

Table-11

Estimating Per capita Waste Generation after source separation Ward 5 Subhash nagar												
S.No.	Name of the H.H	No.of Persons	Wt.of wet waste Day 1 in Kgs.	Per capita waste in gms	Wt.of wet waste Day 2 in Kgs	Per capita waste in gms	Av./cap/day in gms	Dry waste Day 1 and 2 in kgs	Av./day in gms	Dry waste/cap/day	P/Cap/Day waste in gms	Total BDW and NBW
1	Vandana Kimothi	3	0.9	300	0.53	176	238	0.81	0.41	135	373	1119
2	G.S.Bhandari	6	0.8	133	0.78	130	132	1.095	0.55	91	223	1338
3	Mohan Singh Rawat	4	0.6	150	0.7	175	163	0.8	0.4	100	263	1052
4	Suresh Chandra	6	0.7	116	0.8	133	125	1.055	0.53	88	213	1278
5	Shanta Nautiyal	4	0.9	225	0.35	87	156	0.64	0.32	80	236	944
6	Harish Khali	3	0.8	266	0.72	240	253	0.79	0.4	130	383	1149
7	Kalpesh Chandra	3	0.56	186	0.39	130	158	0.47	0.24	78	236	708
8	Digpal Rawat	4	0.7	175	0.72	180	178	0.72	0.36	90	268	1072
9	Rajeshwari Rawat	1	0.2	200	0.39	390	295	0.8	0.4	400	695	695
10	B.L.Koliyal	6	0.48	80	0.36	60	70	0.42	0.21	35	105	630
	Total	40	6.64		5.74			7.6	3.8		2995	9985
			166g./c/d		143g/c/d				95g/c/d			249.5g/c/d
	Per/cap/day		249.5g/c/d									

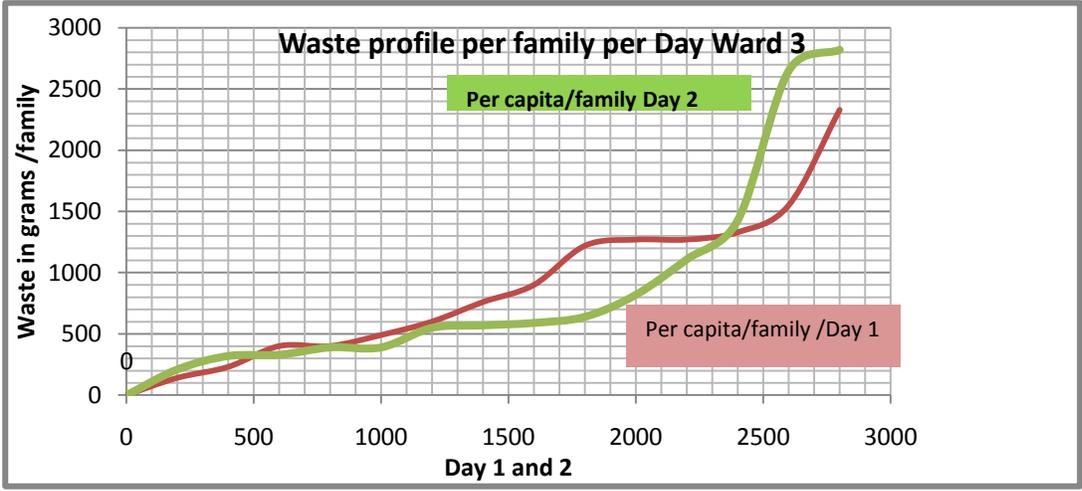
Source; This study DMMC/UNDP

Table 12

Estimating Per capita Waste Generation after source separation Ward 5 &6												
S.No	Name of the H.H	No. of Persons	Wt.of wet waste Day 1 in Kgs.	Per capita waste in gms	Wt.of wet waste Day 2 in Kgs	Per capita waste in gms	Av./day in gms	Dry waste Day 1 and 2 in kgs	Av./day in gms	waste/ca p/day	Total waste p/c/d	Total BDW & NBW
1	Neela Rawat	6	0.9	150	1.65	275	213	0.44	73	12	287	1722
2	Jagan Pal	5	0.6	120	0.4	80	100	0.4	80	16	116	580
3	Harish Lal	4	1.15	287	1-Jan	325	306	0.23	115	29	389	1556
4	Saroj Tamta	5	0.9	180	0.8	160	170	0.8	400	80	250	1250
5	M.L.Arya	5	1.48	296	0.75	150	223	0.5	250	50	273	1365
6	Vijay Mohan	3	0.75	250	0.83	276	263	0.79	40	13	276	828
7	Rakesh Negi	6	1.1	183	0.89	148	166	0.99	50	8	174	1044
8	Kishori Lal	5	0.33	66	0.43	86	76	0.38	190	38	114	570
9	Kundan S Rawat	7	1.83	261	1.3	185	223	1.06	530	75	298	2086
10	Bhupiner Singh	3	1.3	433	0.35	116	275	0.82	410	137	412	1236
11	Durga Prasad	2	0.75	375	0.23	115	245	0.49	245	123	368	736
12	Gambhir Singh	5	1.25	250	1.3	260	205	0.9	450	225	485	2425
13	Virendra Singh	6	1.41	235	0.56	93	164	0.98	490	82	246	1476
14	Beena Bisht	3	0.73	243	0.49	163	203	0.61	305	102	305	915
15	B.S.Bisht	4	0.25	63	0.12	30	24	0.18	90	23	47	188
16	Abhishek	1	0.48	480	0.3	300	390	0.26	260	130	520	520
17	Devndra S Rana	2	0.91	455	0.78	390	423	0.84	420	210	633	1266
18	Y.C.Purohit	5	0.91	182	0.65	130	156	0.78	390	78	234	1170
19	Vinita nautiyal	2	0.9	450	0.6	300	375	0.5	250	125	500	1000
20	Vinita Bisht	3	0.97	323	0.99	330	327	0.3	150	50	380	1140
21	Maheshi Devi	5	0.8	160	0.7	140	150	0.8	400	80	230	1150
22	Devendra Rawat	5	0.24	48	0.99	198	123	0.61	305	61	184	920
23	Geeta Rawat	2	0.91	455	0.3	150	303	0.6	300	150	453	906
24	M.S.Bisht	4	0.8	200	0.24	60	130	0.52	260	65	195	780
25	L.M.S.Bisht	4	0.5	125	0.12	30	78	0.3	75	18	96	384
		102	22.15		17.07			15.08				27213
			217		167			74				266

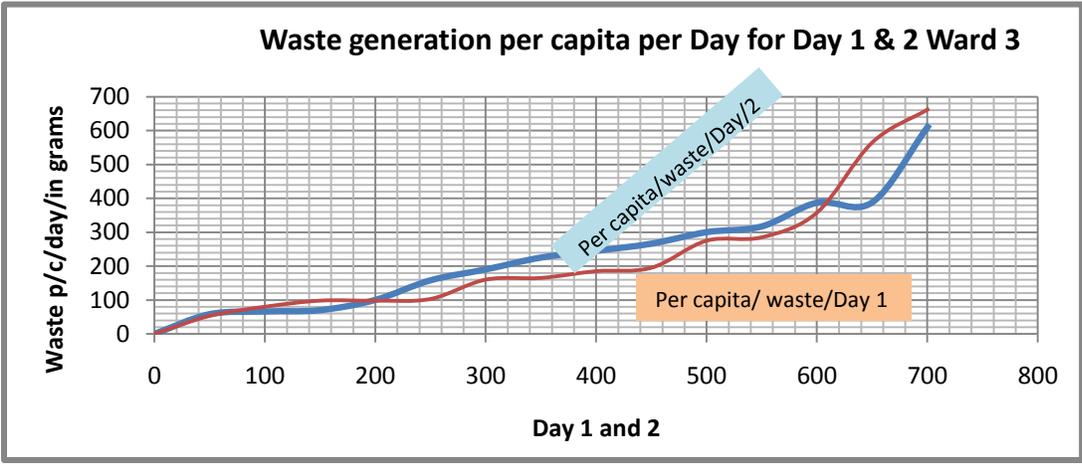
The waste generation per capita per person in Ward 3 varies between 0.4 kg. to 2.33 Kg.per capita per family per day on day 1, while between 0.3 to 2.82 Kg. per family on Day 2 . The following figure depicts the variation between expenditure and waste generation pattern:-

Figure-6



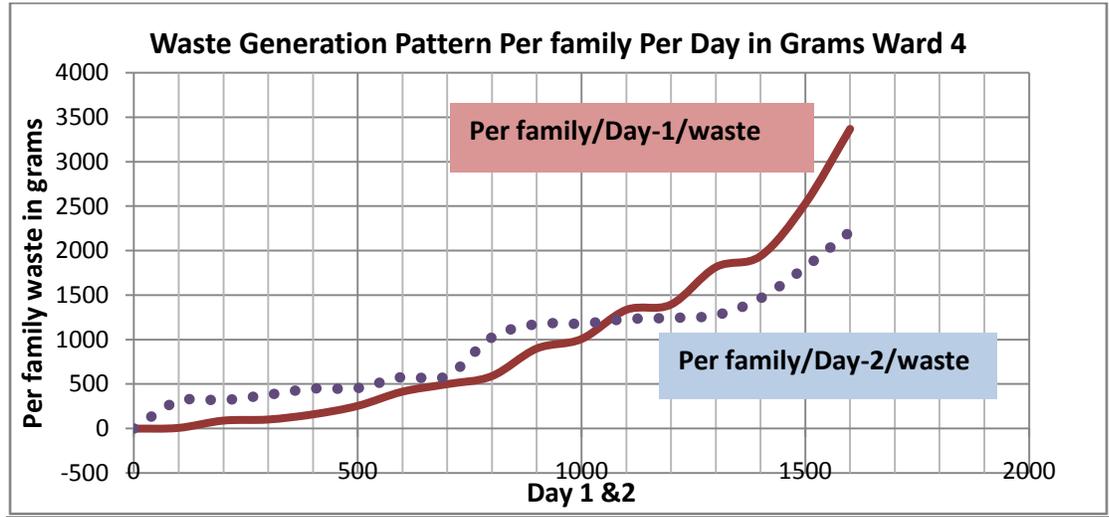
The per capita waste generation per day varies between 58 to 650 grams per capita per day on Day one. The variation lies between 53 grams to 662 grams on Day 2. The following figure shows variation of waste generation pattern with respect to income and expenditure:-

Figure 7



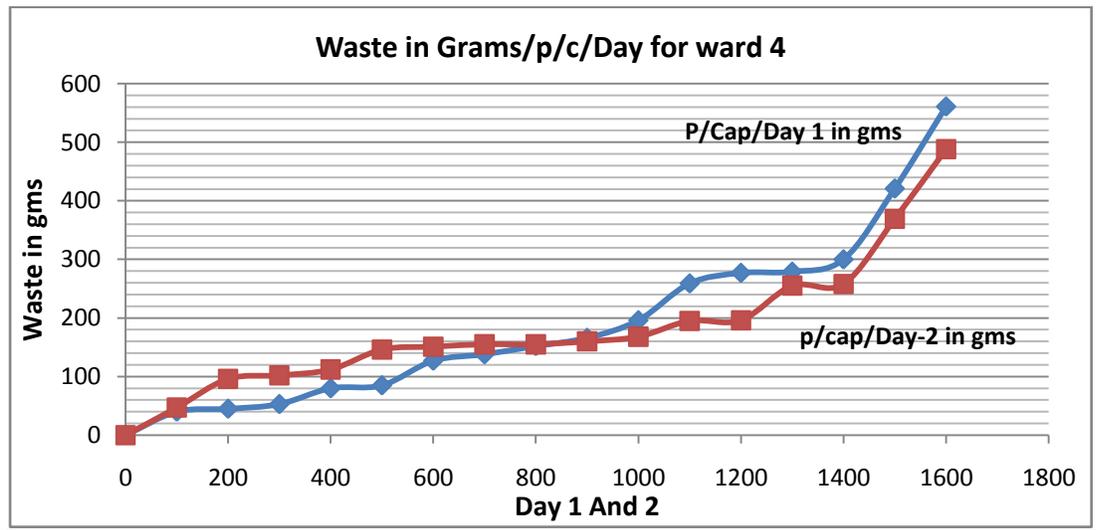
The waste generation pattern in ward 4 varies between .08 Kg to 3.37 kg on Day 1 to .31 Kg to 2.214 Kg on Day 2. Figure 8 depicts the variation in waste generation between the two days:-

Figure-8



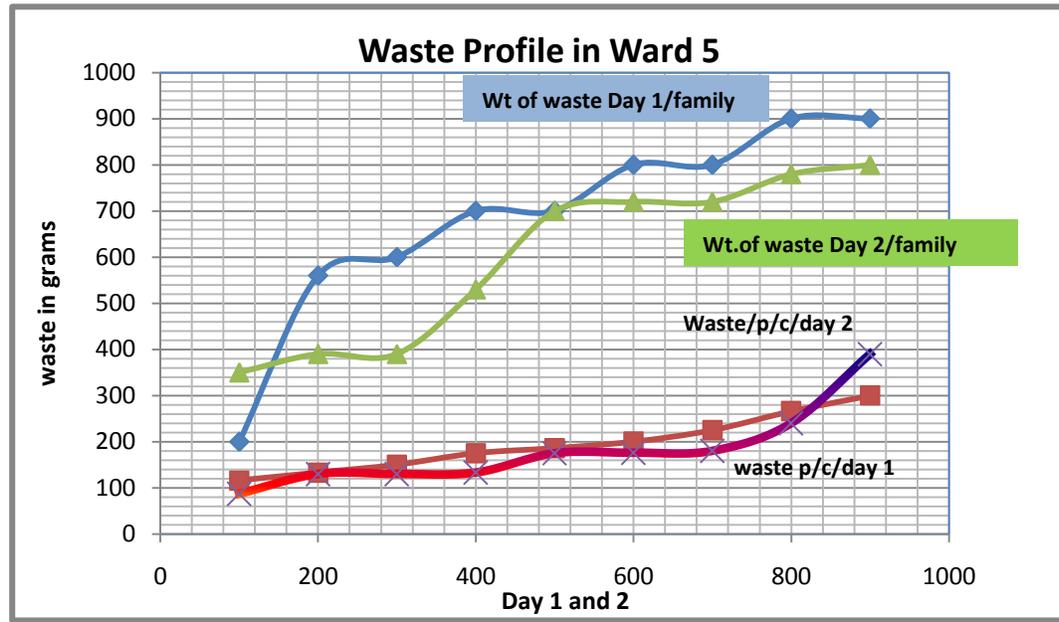
The Per capita waste generation varies between 40 grams to 561 grams on Day 1 to 47 grams to 488 grams per capita per day on Day 2 in Ward 4 :-

Figure -9



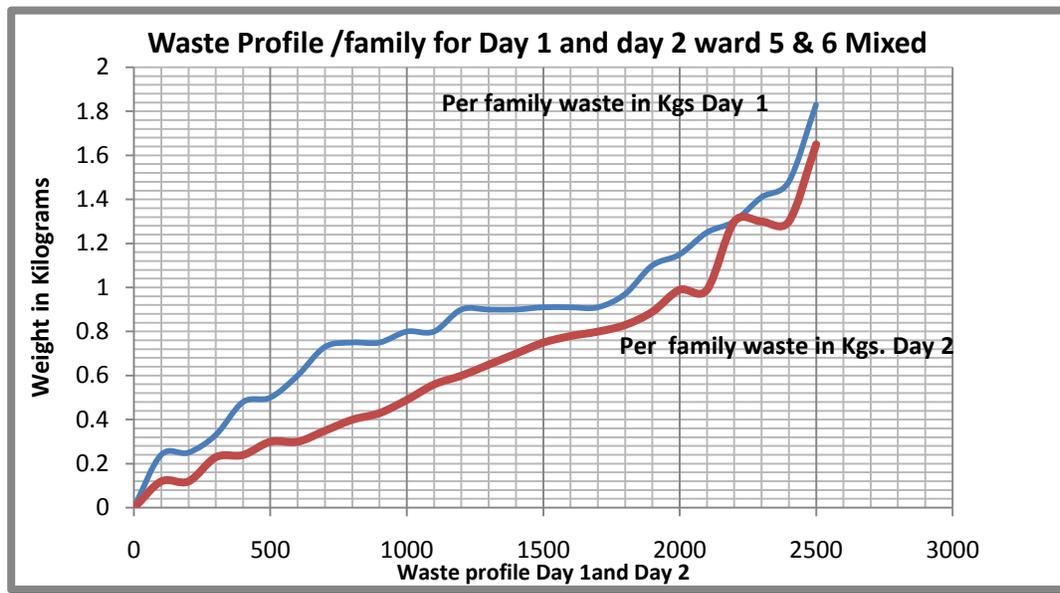
The waste generation pattern in Ward 5 which has professionals and high income group as the residents have a waste generation pattern ranging between .2 Kg to .9 Kg on day 1 to .35 Kg to .72 Kg. on Day 2. The per capita waste varies accordingly between 80 grams to 300 grams on Day 1 to 60 grams to 240 grams on Day 2.

Figure 10



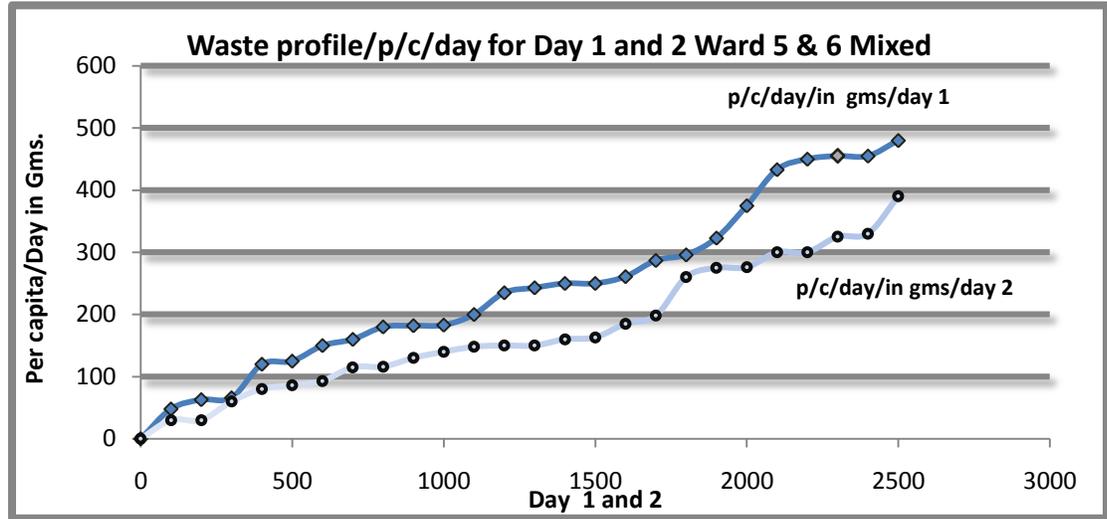
The following is waste generation pattern in a mixed sample of ward 5 and 6

Figure 11



The per capita waste generation in ward 5 and 6 varies between 40 grams per capita per day to 480 grams per capita per day on Day 1 and between 30 grams per capita per day to 390 grams per capita per day on Day 2. Figure 12 shows the variation between waste generation on the sampling days of the House Holds:-

Figure -12



2.2. Institutional and Commercial Waste Generation

The total sample size of 5 schools and colleges and 10 different types of offices gave an average daily waste generation rate of 3.0 kg per school and 1 kg per office. A survey of 50 shops, 3 hotels, and 5 restaurants, yielded an average waste generation rate for commercial establishments of .4 kg per shop and 3 kg per hotel or restaurant during peak tourist season. The following is the statistics for Institutional and Commercial waste:-

Table 13

Details	Number	Per capita waste	Estimated waste
Shops	600	.4 Kgs.	240 Kgs.
Restaurants/Hotels	37	5 Kgs	185 Kgs.
School	10	2 Kgs	020 Kgs
Offices	67	1 Kgs	067 Kgs
Total			512 Kgs.

In addition to the above approximately 300 Kgs. of street sweeping is estimated to be generated on a day to day basis.

2.3. Overall waste situation of Waste in Chamoli Gopeshwar ;

Household Waste	5577 Kgs.
Institutional & Commercial Waste	0512 Kgs.
Road Sweepings	0300 Kgs.
Total	6389 Kgs. Per day.
Per Capita per day	297 gms./cap/day.

2. 4.Municipal Solid Waste Composition

2.4.1. Municipal Solid waste composition at HH level

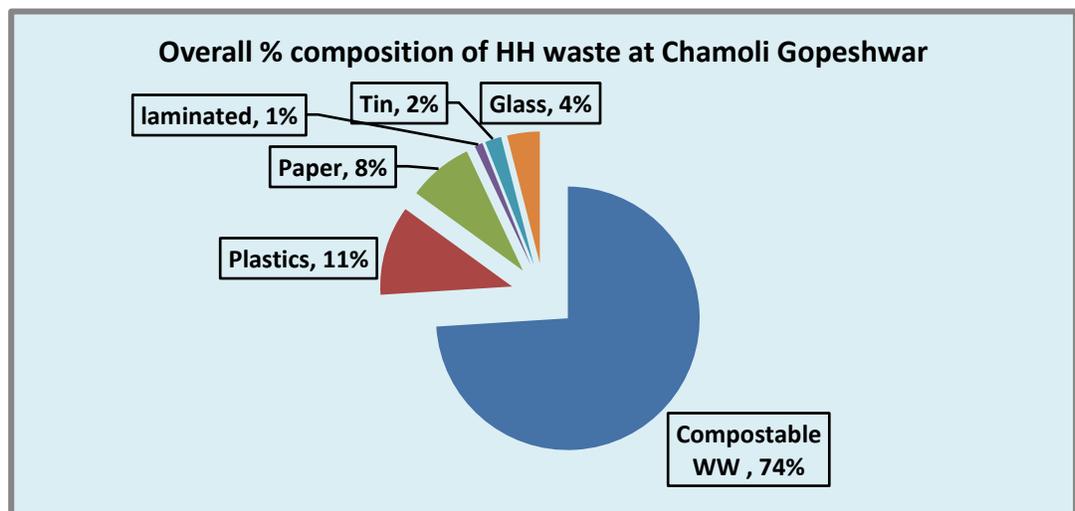
The characteristics of MSW from any area depend on various factors such as consumer patterns, food habits, the cultural traditions of inhabitants, lifestyles, climate, and economic status. The composition of MSW is changing with increasing use of packaging materials and plastics.

The waste composition analysis at household level indicates that the highest waste fraction is compostable wet waste (74%) followed by plastics (11%), Paper as newsprint, record, mill board and cartons (8%), Laminated non-recyclable (1%), Tin (2%) and Glass (4%). As a matter of rule tin and glass are sold to itinerant waste buyers which were recovered during the course of study through door to door collection.

The high organic content indicates a need for an upgraded collection and removal system so that resource may be recovered as compost. The content of major reusable and recyclable materials (i.e. plastic, paper and paper products, metal, glass) comprised 26% on average which can be recovered through material diversion programme for reducing the bulk on the dump site on one hand and revenue generation through value chain on the other. It needs to be mentioned here that rubber, leather and cloth were not recovered during the study which constitute a part of dry waste as the households were conscious to only collect the day to day used material.

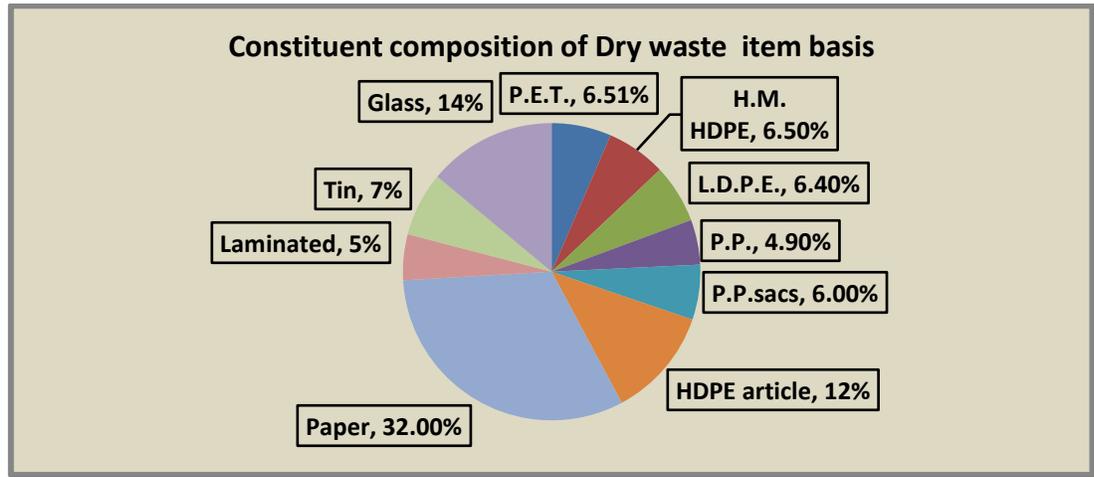
The following figure reflects the House Hold composition of waste at Chamoli Gopeshwar:-

Figure - 13



The Dry waste was subsequently segregated into constituents. Plastics viz. PET,H.M. (Carry bag waste), L.D.P.E. PP film, PP sacs , HDPE article , Paper, non-recyclable laminated polymers,tin and glass bottles were segregated and weighed .The following figure shows percent composition of Dry waste at the House Hold level :-

Figure 14

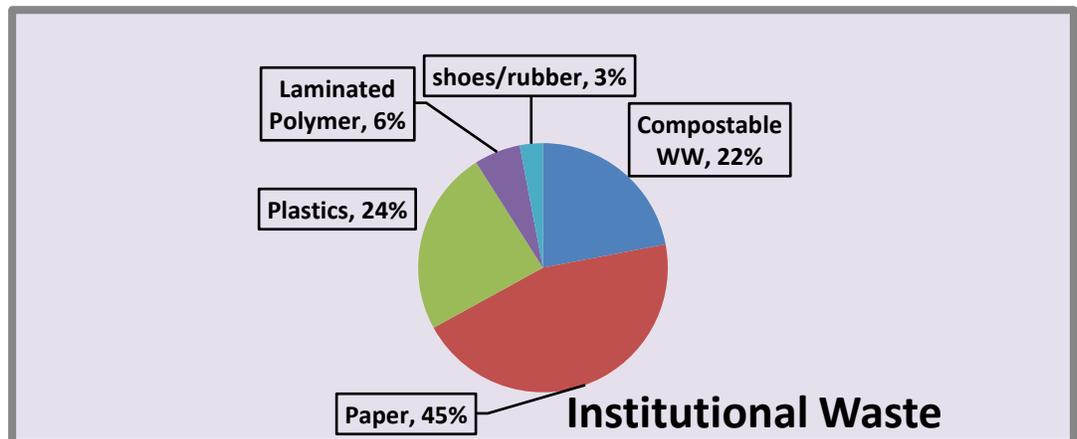


2.4.2 Institutional Waste Composition

Waste generated from offices, schools, and colleges were categorized as institutional waste. The composition analysis revealed 45% paper and paper products, 22% wet waste, 24% plastics, and 6% laminated polymers used in junk food and 3 % others which included discarded shoes, and rubber.

The higher fraction of paper and paper products and plastics came from students' snack boxes and discarded white paper. Compostable wet waste is only generated in schools having mid day facilities. The leftover food is fed to cattle. Figure No. 15 shows the constituents of Institutional waste at Chamoli ,Gopeshwar:-

Figure -15



Constituent Desiccation of H.H., Institutional and Market Dry Waste



Table 14

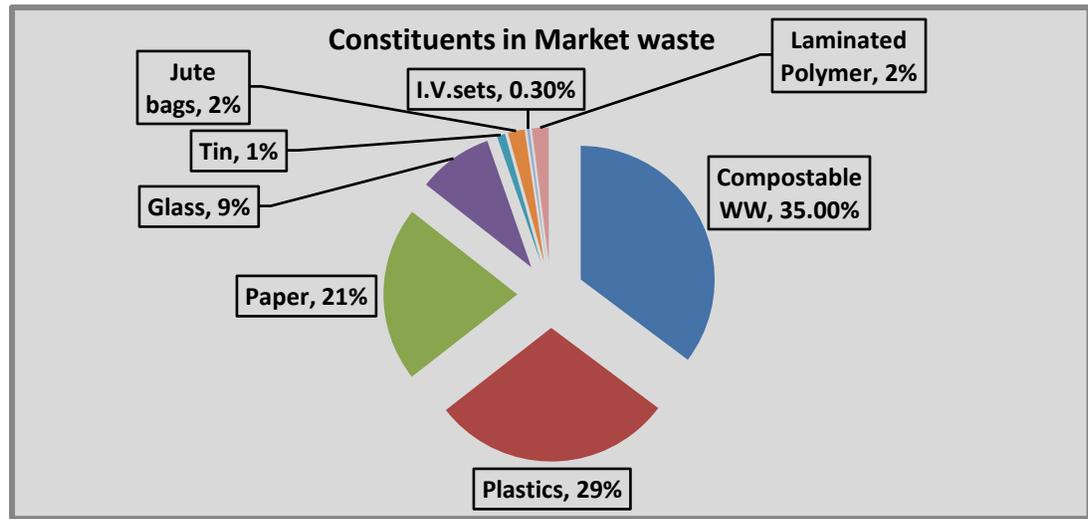
Scenario of House Hold Waste at Chamoli Gopeshwar									
Ward	Population	No. of HH	Estimated BDW in Kgs @ .19Kgs / Cap/ Day	Estimated NBW / cap / ay	Recyclable plastics 42%	Paper , carton, Mill board 32%	Non-recyclable laminated polymer 5%	Tin 7%	Glass 14%
Gangol Gaon	2445	612	465	171	72	55	9	12	24
Kund	2074	518	394	145	61	46	7	10	20
Upper Bazaar	2397	600	455	168	71	54	8	12	24
Lower Bazaar	2365	592	450	166	70	53	8	12	23
Subhash Nagar	3703	926	704	259	109	83	13	18	36
Negwaad	2466	617	469	173	73	55	9	12	24
Paduli-Papadiyana	2332	583	443	163	68	51	8	11	23
Kothiyal sain	1847	462	351	129	54	44	6	9	18
Chamoli-Kshetrapal	1815	454	345	127	53	40	6	9	18
Total	21444	5364	4074	1501	631	481	74	105	210
Total Garbage at				5577 Kgs.					
Notes: (1) News Papers, Glass Bottles and tin are not disposed of as a rule in MSW but are sold to itinerant waste buyers									

2.4.3. Market Waste Composition

The waste generated from shops, restaurants and hotels were categorized as market waste. Two samples viz. of Gopinath Market in Lower Bazaar ward and Chamoli situated on N.H. 58 were collected for two consecutive days and desiccated.

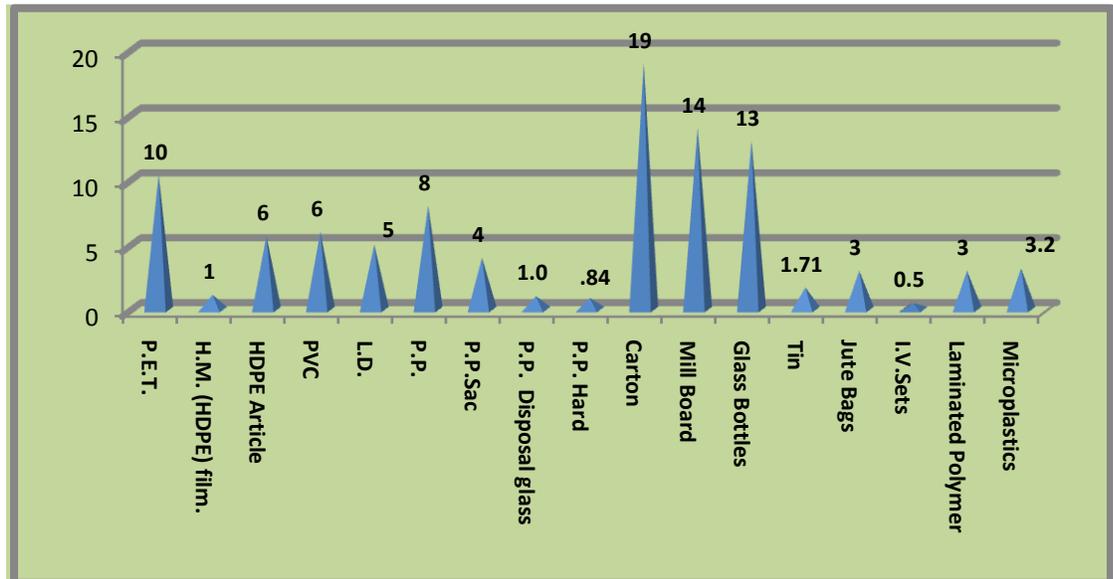
Wet compostable waste was 35%, Plastics 29%, Paper 21%, Jute bags 2%, Glass 9%, Tin 1% laminated wrappers 2% and 1% others. Figure No.16 shows the various constituents in Market waste :-

Figure -16



The dry waste 65% by weight collected from Gopinath and Chamoli market on desiccation shows the following percent constituents

Figure 17



A higher percentage of plastics was generally found in waste from shops, market area while the compostable wet waste fraction was observed to be higher in hotels and restaurants. More glass was found in commercial waste than in household and institutional waste, indicating the presence of beer and wine bottles discarded by hotel guests.

2.4.4. Street Sweeping

The streets in Gopeshwar Chamoli are swept every day by using long handle brooms. The waste is heaped and transferred in a wheel barrow. This wheel barrow is emptied around the tractor trolley on floor and then filled in it by using a spade.

Streets are swept with long handle brooms



3. Scenario of Existing Solid Waste Management System

3.1. Collection and Segregation

The study found that about 35% of surveyed households in the Municipality practice segregation of waste at source; which means that waste generated from about 65% of households is either littered in the open or is disposed off in Municipal Bins as mixed waste.

The households surveyed in Gangol Gaon, Kothiyal sain and a Part of Negwaad which are rural urban wards segregate kitchen waste for their own purposes, such as feeding cattle. Even in Lower Bazaar ward 10% of the households feed cattle post segregation of waste. However, effective and large-scale segregation program is yet to be implemented by the Municipality.

Analyzing the information provided by the Municipal staff, the present collection efficiency ranges between 40 % to 50%. The remaining waste is disposed of by Citizens indiscriminately which is scavenged by pigs or stray cows. The Dry waste is openly burnt or disposed of in drains and on vacant lots on the Hill side.

Collection and sweeping is not done on a daily basis except in main markets, along main roads, and in some residential areas. The rest of the areas are served intermittently twice or three times a week or are not served at all. Many households have engaged customary sweepers for waste disposal who deposit the collected waste in vacant spaces within the wards.

Source segregation, Door-to-door collection has not yet been initiated by the Urban Local Body. Container service is limited to some wards in Gopeshwar. Waste as a rule is collected from open piles along the road side .The waste within the open containers is invariably burnt.

3.2 Transport and Final Disposal

The vehicles and equipment available for waste collection consists of wheel barrows for primary collection on main roads tractors with open trolley for secondary collection and transport. Area compatible facilities and equipment are not available in the municipality which affects the efficiency of waste transfer from primary collection to processing centers or final disposal sites.

Site for treatment facility through NADEP composting has been identified 10 kms downstream in ward 9 at Chamoli Kshetrapal. The pits are in the process of being built which shall be used for treatment of wet compostable waste. At present waste is being disposed of without treatment on Pokhri Raod dumping site along the Bal Khila river a tributary of Alaknanda. This is creating public health risks and environmental problems.

Indiscriminate Waste Disposal in Chamoli Gopeshwar



Collection and Transport of Waste in Wards and Main Market in Chamoli Gopeshwar



Waste collection from streets in Plastic bags Ward 5



Waste collection from drains by Chajela and Patti Ward 6



Tractor Trolley being used for waste collection in ward 3



Wheel Barrows are used in market area



Tipper trolley is used for transport and disposal



Wheel Barrow is used as a mobile container

The problems faced by the municipality include lack of technical support, financial constraints, lack of awareness regarding waste and indifference of the citizens.

3.3. Material Resource Recovery Methods

The ambiguity between the antiquated municipal act regarding cleanliness and Solid waste management coupled with scarce resources has made municipal SWM an environmental, financial, and social liability for the municipality. Resource recovery through Material Diversion Programme (MDP) has helped the Gopeshwar Municipality generate revenue and meet a part of costs incurring on engaging skilled man power. However, the full potential for the MDP has not been fully harnessed. About 40 to 50% of the total dry waste is being diverted for Resource Recovery(RR).

3.3.1. Recycling



Compactor at Chamoli

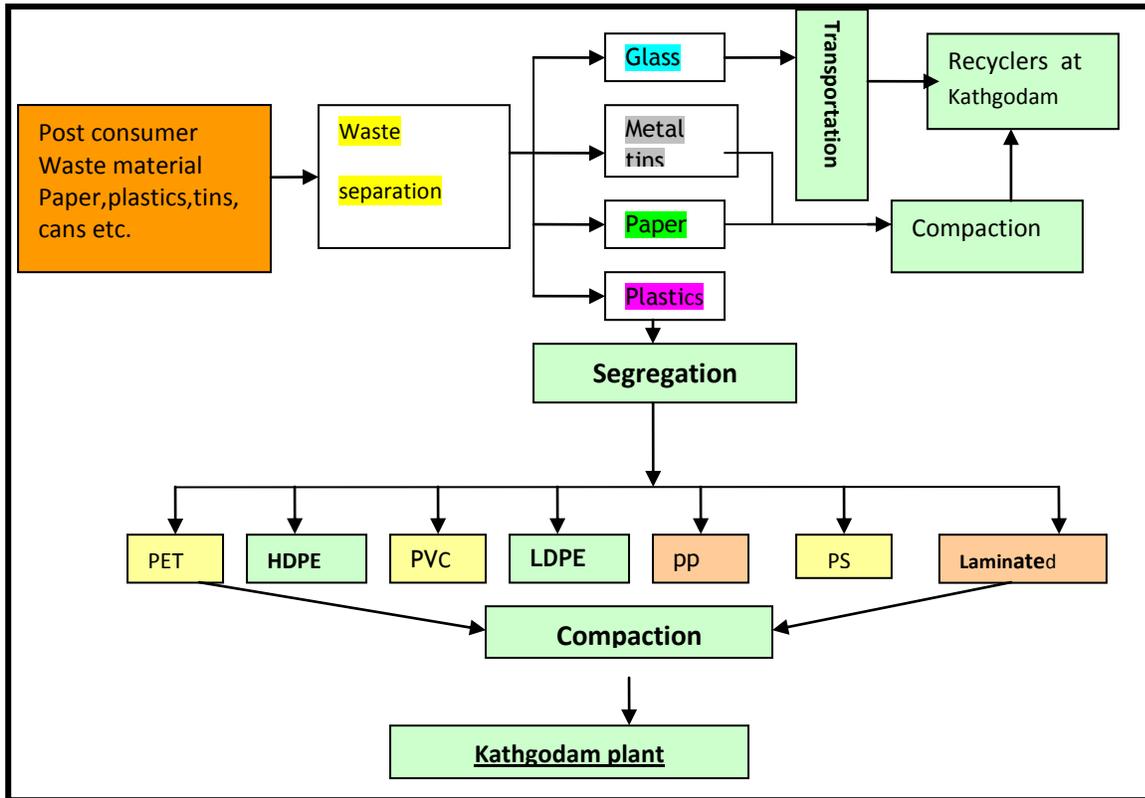
The household waste composition survey revealed that more than 26% of household waste and a much higher proportion of institutional and commercial waste could be either reused or recycled. The itinerant waste buyers procure newspapers, tin and glass bottles thereby diverting about 12% of value added waste. The Gopeshwar Municipality was provided with a compactor to reduce the voluminous dry waste and make it transportable under ADB SWM programme in the year 2012. A waste

pickers and municipality partnership (formal and informal) was forged which is working successfully. However, concerted efforts are required for material recovery at the House Hold, commercial and Institutional level for material diversion programme for making it a successful venture like the Joshimath ULB.

The compactor provides an integrated solution for collection, compaction and end use disposal of the non-biodegradable waste to the Urban Local Body and its surrounding area. The non-biodegradable waste which is left littered due to low value addition is disposed through the chain of recycling. The methodology is simple and replicable anywhere in the country more effectively in the hill regions of the country. Precisely, it is a process to minimize the exorbitant transportation costs accruing during the disposal of voluminous waste. The compactor minimizes the volume of the non-biodegradable waste in the ratio 6:1 for all types of plastics, metal cans , paper, and also the multi layered laminated packaging. Once segregated and compacted the waste becomes a resource and is sold for a price which helps in creating jobs and cleaning the environment.

The schematic below provides an overview of the role of compactor for handling the non biodegradable waste especially plastics:-

Figure -18



(Source : WRAP -Vipin kumar)



Vertical Hydraulic bailing Press

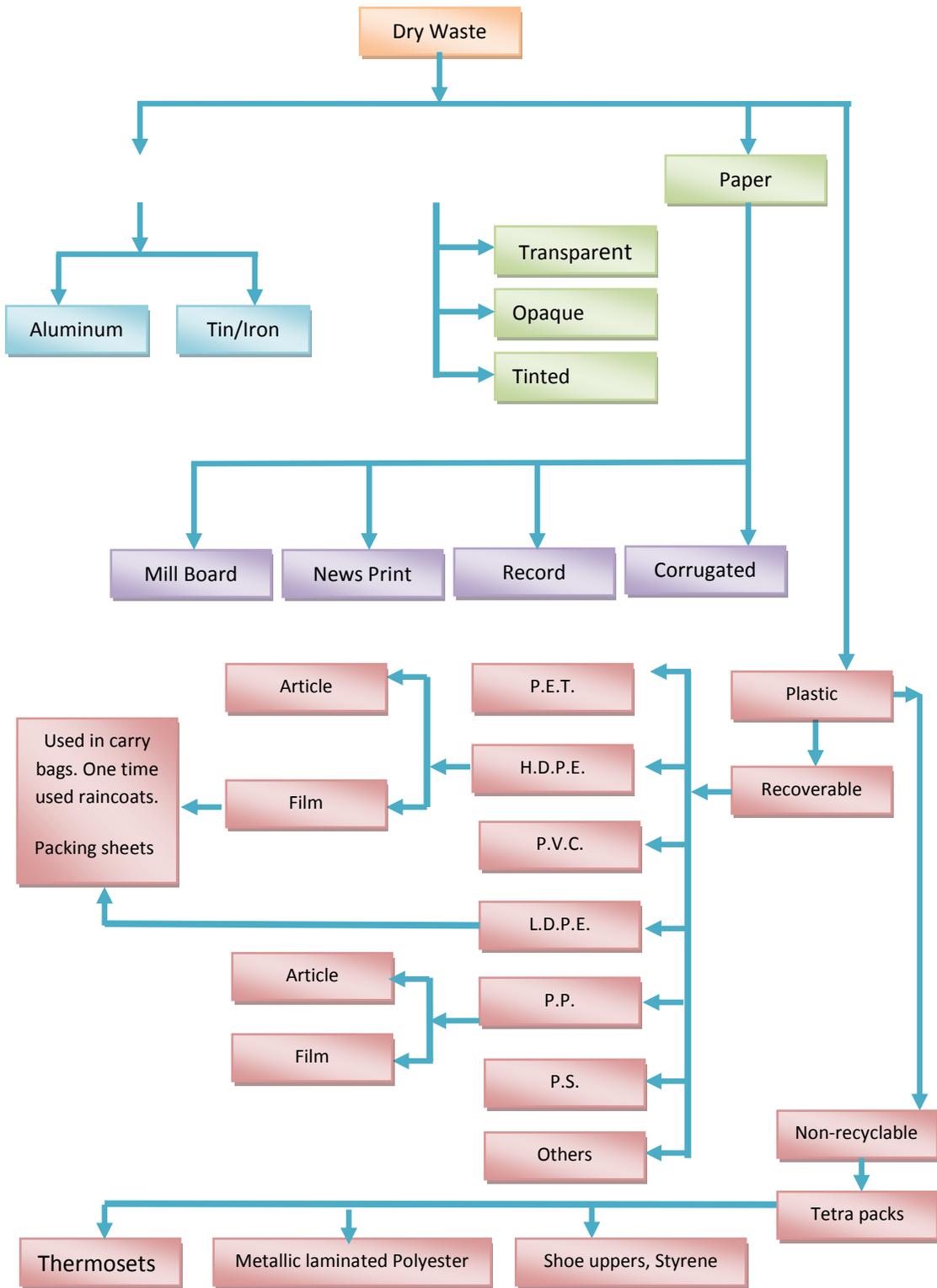


Compacted Bales at Chamoli

Figure -19

PRINCIPLE OF VALUE CHAIN IN POST CONSUMER DRY WASTE

(Vipin Kumar)





NADEP composting pits under construction at Chamoli Kshetrapal

Wet compostable waste that could be used for producing compost account for 73% of household waste on average. It was noted that about 40% of surveyed households in the rural urban wards are practicing composting. However, urban households are not generally practicing composting. Gopeshwar municipality is setting up a NADEP aerobic system at Chamoli Kshetrapal under State Plan Assistance(SPA) as a centralized waste treatment facility.

3.3.3.Public Awareness and Community Mobilization

Lack of public awareness is one of the major problems of SWM. Based on the survey data, the Municipality does not have a structured awareness programs for Municipal staff, citizens, students and other stake holders. The municipality has not collaborated with Community based organizations and NGO's to undertake public campaigns. The survey revealed that more than 80 % of households are not aware of SWM program and their responsibility in managing garbage. There is a complete disconnect between the community and the Municipality. The survey also revealed that the younger generation is aware of keeping their homes and neighborhood free of garbage. The municipality needs to address students to motivate the households to participate in the SWM programme. A citizen body also needs to be constituted at the ULB level as a bridge between Municipality and the Community. The ULB should also seek the support of experts in drafting IEC material and communicating with the stakeholders.

3.3.4.Special Category waste

Special categories of waste include dead animals, construction and demolition waste, and hazardous or infectious waste from hospitals and clinics. The biomedical wastes need to be managed differently from general MSW as it is the mandate of the State Pollution Control Board.

During the study it was observed that medical waste was burnt openly in the hospital compound. In Chamoli, medical waste like the disposable catheters and Intra venal transfusion sets are mixed with the municipal solid waste. The hospital staff is not aware of the Bio-medical Waste Management Rules, 1998 being amended and upgraded as Rules 2015. Further, dead animals are dumped in ravines without proper burial. It was also observed that dead animals like dogs and cats were disposed of with municipal solid waste.



The Dumpsite on Pokhri Road at Gopeshwar

The construction and demolition(C & D) waste which is bulky is packed in empty cement bags and disposed off on hill slopes. The depleting impact is observed in the form of eroded hill slope while the degrading impact is observed in the form of crushed saplings. The micro-eco-system of slopes is damaged due to debris flow. It needs to be kept in mind by the urban planners that waste arising out of wall has a density of 233.64 Kg/m^3 (Tellus) and that from roofing 355.80 Kg/m^3 (CIWMB).

3.4. Behavioral Aspect in Solid Waste Management

The population of Gopeshwar is distributed over nine wards. The surveyors collected 154 responses from citizens of all nine wards with 78% (120) being households, and 22% (34) being other waste generators like shops, schools and hotels. The study was based on customized format 2 in Hindi on various issues related to Solid waste management to assess the attitude and behavior of the citizens. The survey covered all sections of the society of various income groups.

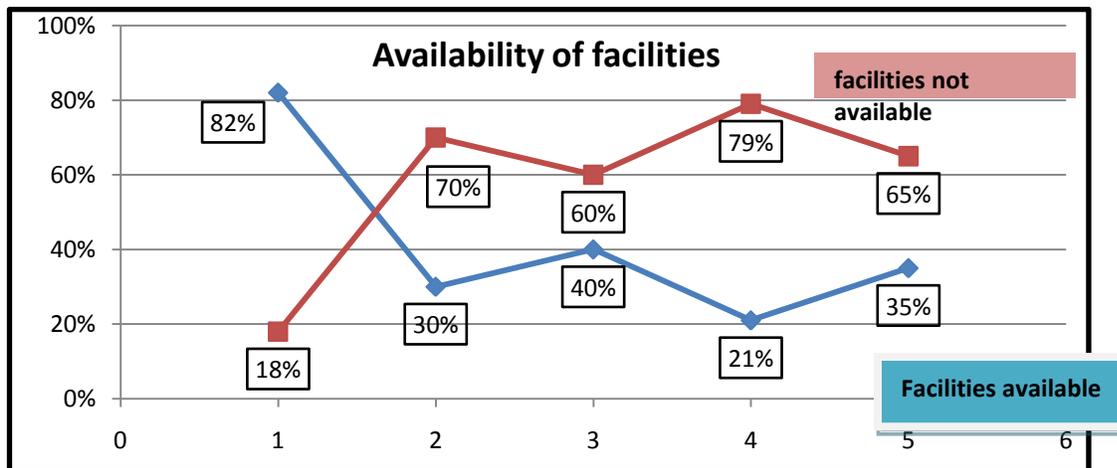
3.4.1. Availability of facilities

The citizens were asked regarding the availability of facilities like sweeping, Dust bins, drain cleaning and segregation of garbage at source. The following table and figure reveals their responses:-

Table 15

Facility	Available	Not Available
Regular Sweeping	82%	18%
Availability of Bins	30%	70%
Regular Drain cleaning	40%	60%
D to D collection on day to day basis	21%	79%
Segregation of garbage at source	35%	65%

Figure 20

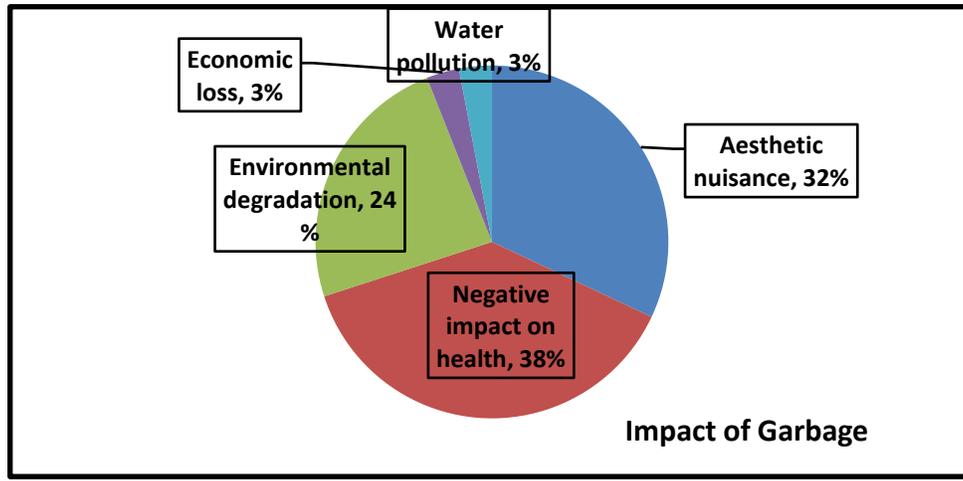


In response to the question of availability of facilities 42% on an average confirmed to the availability of services provided by the ULB while 58% responded in negative. The majority respondents at the HH level felt the services are inadequate while the respondents residing in the market area and along the approachable roads felt that the services were adequate. The residents of rural urban wards viz. Gangol gaon, Kothiyal sain and Negwaad confirmed using the wet waste for feeding the cattle after segregation. However, there was no evidence of source segregation of waste in the urban wards.

3.4.2 Impact of Garbage

In response to the unscientific waste treatment 32% of the respondents felt that the presence of Plastics in garbage is responsible for aesthetic nuisance. 38% of the respondents felt that indiscriminate waste deposits here and there are a health hazard while 24% of the respondents strongly expressed their concern for environmental degradation. 3% each of the interviewees thought that littering waste causes economic loss and water pollution. The citizens are concerned for improvement in waste management services.

Figure 21



3.4.3 Frequency of Different services provided by the ULB

The frequency of different services provided by the ULB shows that the frequency of sweeping the main roads and the wards on a day to day basis is about 31%. Twice and thrice a week is 23% and 21% respectively. Interestingly on request and no service account of 20% and 4% respectively.

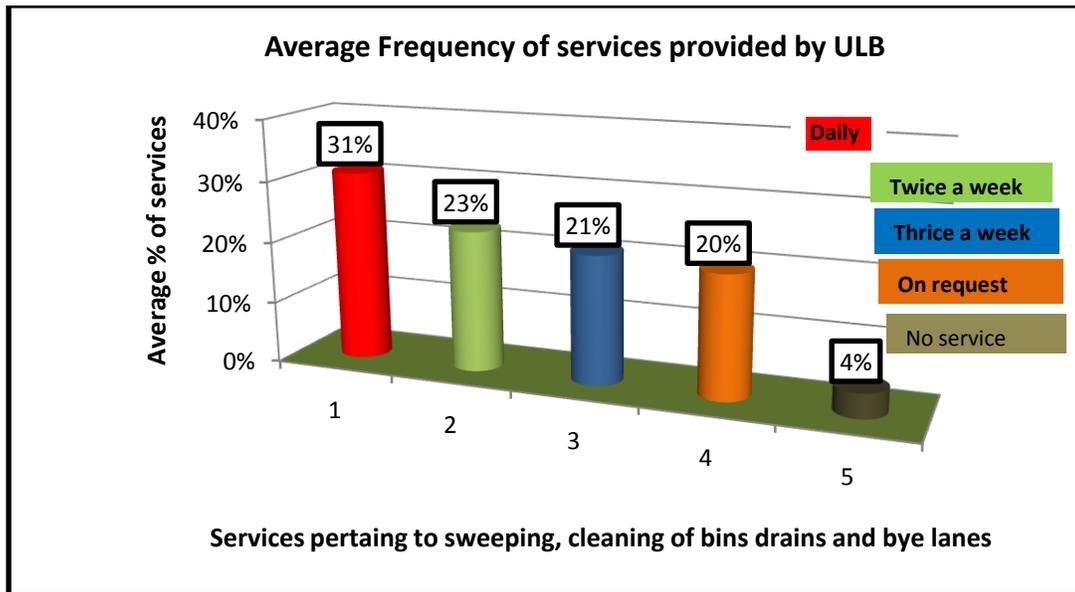
Table-16

Service provision by the ULB	Daily	Twice a week	Thrice a week	on request	No service
Frequency of sweeping of roads	45%	18%	19%	13%	5%
Frequency of waste collection from lanes and drains	30%	20%	24%	21%	5%
Frequency of cleaning Dust Bins	19%	32%	21%	26%	2%
Total % of services	94%	70%	64%	60%	12%
Average Frequency of services	31%	23%	21%	20%	4%

Further, it needs to be noted that all the above mentioned services should be on a day to day basis for improving the overall aesthetics of the town. However, lack of man-power and a beat system

for sweeping the roads is missing to ensure improvement in human resource deployment. Further, if a day to day collection falls in place the burden of sweeping will be reduced which will help the ULB to use the available man power for other important services pertaining to waste management .

Figure -22

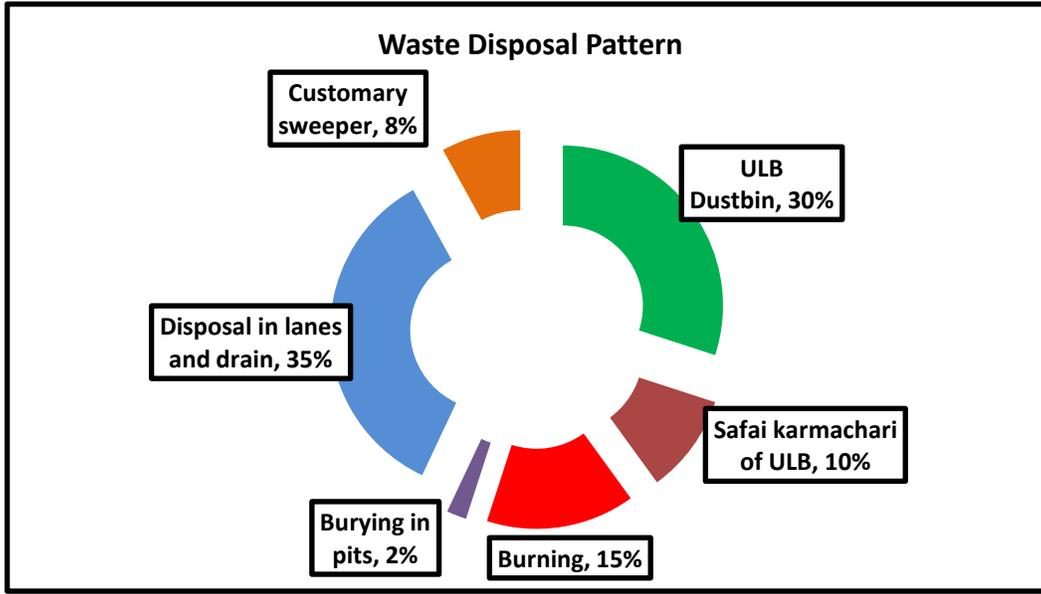


3.4.4. Waste Disposal Pattern of Citizens

The survey reveals that waste is disposed of by the citizens as per their convenience. Residents who live in the proximity of ULB’s containers use it for deposition of waste which is mere 30% of the total population. The customary sweepers and the ULB safai karamcharis who provide service to households do not confirm for deposition of waste in the Bins. Hence littering in lanes and drains, vacant lots, burning and burial of garbage is a common practice. There are two reasons for uncontrolled waste disposal firstly it is due to non-availability of Door to Door collection and secondly , secondary collection bins cannot be installed due to lack of space and narrow lanes and bye lanes. Further, deposition in bins also does not ensure the safe disposal of garbage through recycling and composting as the deposited waste is burnt for reducing the final volumes of garbage.

In all the wards waste collection is done by sweeping and by the use of Chajela and Patti from drains in the inhabited areas. The residents and shop keepers living on main roads throw garbage on the lanes and roads as they are aware that the sweeping staff of the ULB shall provide aesthetics. There is no concern to know what happens to their waste after collection in tractor trolleys. The following figure shows the waste disposal pattern in Gopeshwar:-

Figure 23



3.4.5 Availability of Collection and Transport Equipment

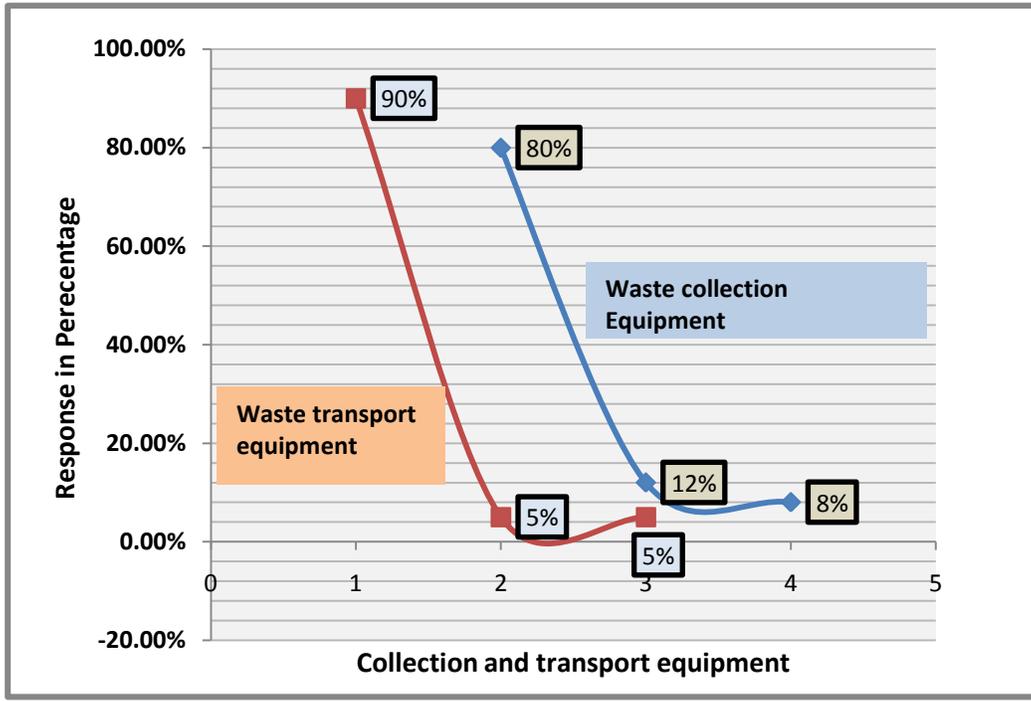
In response to the question of availability of collection equipment the residents confirmed about the availability of Wheel barrow (Haath Gaddi). As a practice all waste after sweeping is mixed and containerized in the Barrow. This barrow is emptied near the tractor trolley or Bins located on main roads .The trolley and the bins are filled with a spade. This mechanism leads to multiple handling of waste and also mixing of compostable, dry and inert waste. In some wards waste is collected in plastic bags and manually carried to the nearest bin. There are no binned hand carts for collection and segregation of waste which help in containerizing different streams of waste separately for end use disposal through recycling and composting.

The collected waste is transported for dumping by a tipper tractor trolley. The ULB does not have Binned jeeps and modern vehicles for containerizing waste and scientific end use disposal. The Nagar Palika Parishad Gopeshwar is in the process of procuring hoppers and bin lifters through the SPA funding. The following table and figure depicts the collection and transport equipment availability with the ULB:-

Table 17

Waste collection equipment	Wheel Barrow	Bag/Basket	No equipment
	80%	12%	8%
Waste transport	Tractor trolley	By wheel barrow	No proper vehicle
	90%	5%	5%

Figure 24

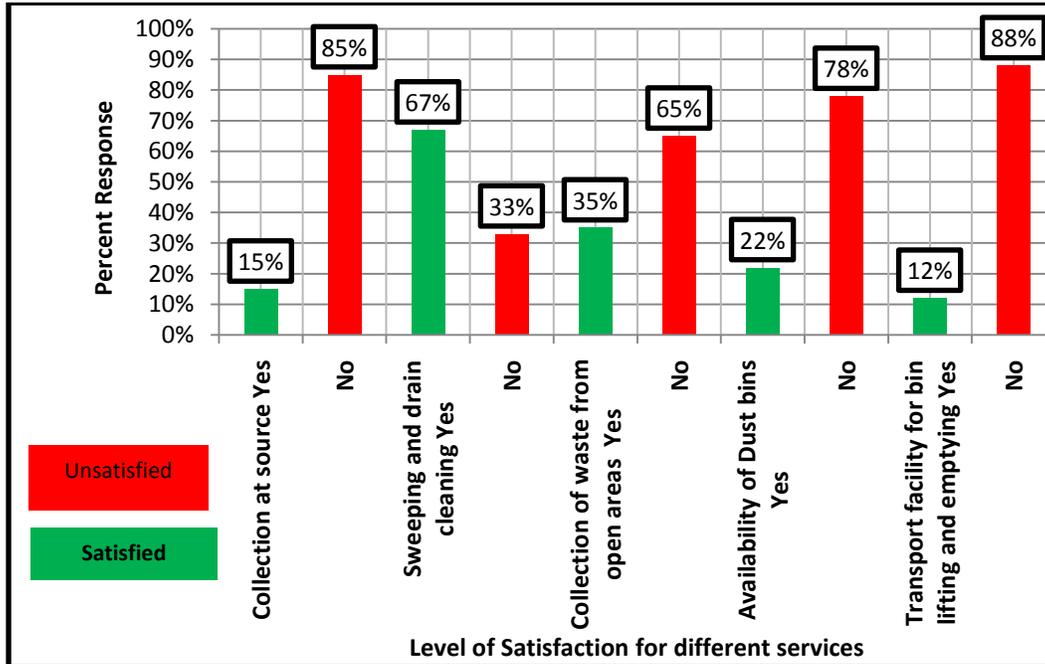


3.4.6. Level of satisfaction for SWM service provided by the ULB

In response to the level of satisfaction for SWM services provided by the ULB 31 % of the respondent on an average expressed satisfaction while 69% on an average expressed dissatisfaction. The respondents felt that sweeping of roads and drains was the only activity which helped the town look clean. In terms of waste collection the respondents felt that a lot has to be done by the Nagar Palika.

The residents felt that there are not enough bins for containerization of waste and so is the transport facility which is far from being satisfactory. On an average 83% of the respondents felt that mechanization for waste containerization and transportation for the wards abutting the main road will improve waste management in Gopeshwar. In response to the litter in open spaces and its collection the respondents felt that since there is no door to door collection they dispose their garbage in the open. The accumulation of waste on the hill slopes is on account of surface run-off during monsoons which blocks the rain water drains. It was observed that due to lack of communication regarding the various services provided by the ULB the residents feel irresponsible towards garbage management. The following figure shows the responses of the interviewees spread over all 9 wards:-

Figure-25

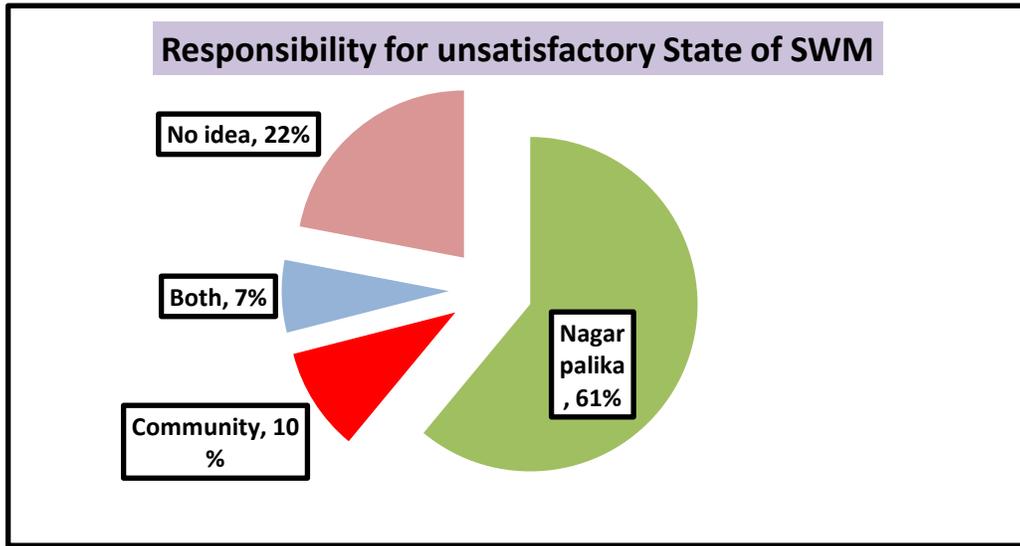


3.4.7. Responsibility for Unsatisfactory State of SWM

In response to the question of who is responsible for unsatisfactory state of solid waste management in Gopeshwar 61% of the respondents held the Nagar Palika responsible for not providing adequate services. The municipal staff complained about the non-cooperative attitude of the residents. In some wards the respondents felt that the community and both the stakeholders are responsible for unsatisfactory waste management practices. It was surprising to note that 22% of the respondents had no idea, as to, who is responsible?

The ULB has not initiated a concerted awareness programme on Municipal Solid waste Management Rules -2000 which make Waste management an Environment Protection activity with cleanliness as a bye product. The ULBs continue to provide services under the Municipal Act 1916 which is aimed to improve the aesthetics of the town without considering the life cycle aspect of garbage. The Municipality has only focused on elimination of plastics bags which in spite of all regulations have continued to remain in the system with microns being discussed as a waste management strategy. This mindset has to be changed and a holistic approach needs to be adopted by the ULB. The following figure reflects the attitude towards the state of SWM in Gopeshwar:-

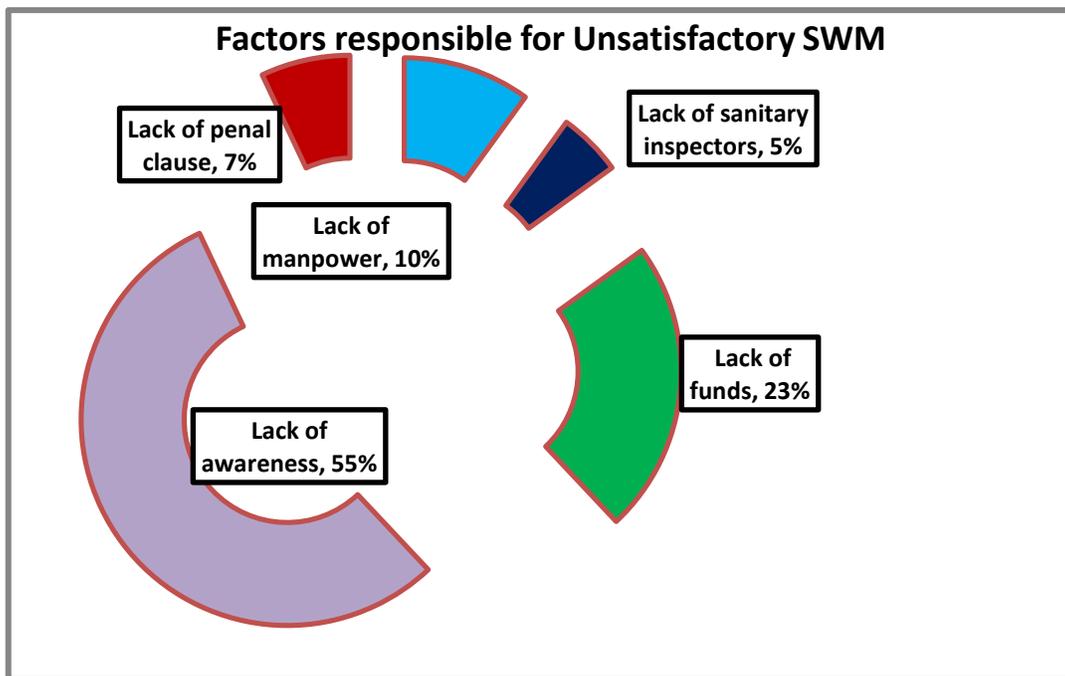
Figure -26



3.5.8. Factors Responsible for Unsatisfactory SWM

In response to the question of factors responsible for unsatisfactory SWM , the ULB feels that lack of funds, man power and sanitary inspectors are the main reasons for unsatisfactory level of service in SWM. The residents feel that lack of awareness regarding source separation followed with collection needs to be pilotised in one ward through citizen's participation. This they feel will help replicate the model in other wards

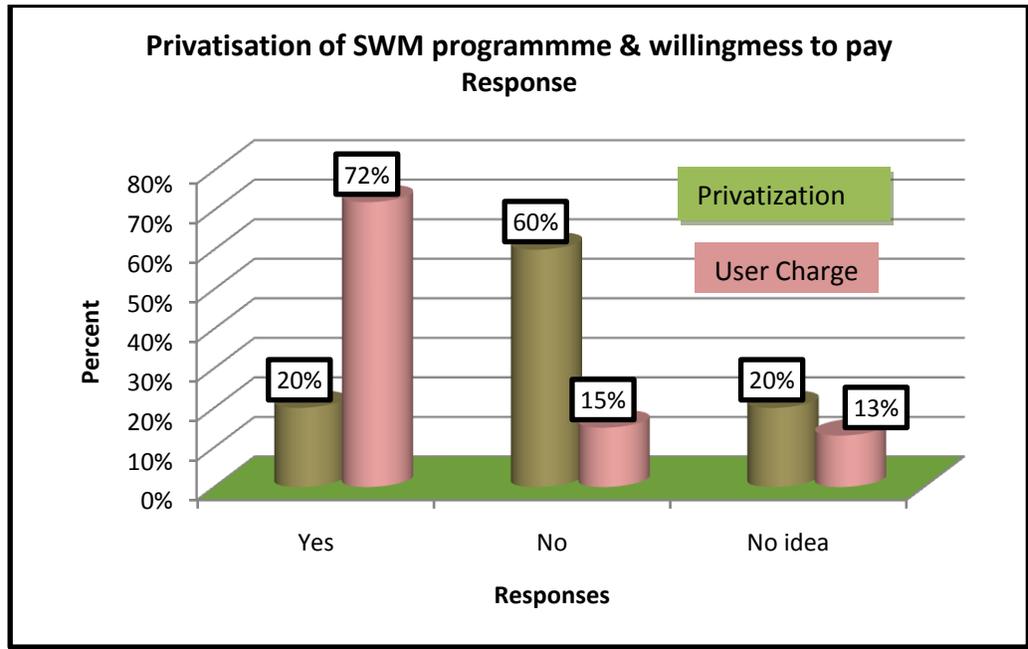
Figure 27



3.5.9. Privatization of SWM and Willingness to Pay user Charge

In response to the privatization of SWM services 60% of the residents refused the idea and wanted the ULB to improve its services. 20% responded in affirmation while 20% had no idea to the question. On the issue of willingness to pay the user charge 72% agreed to pay on the condition of regularity of services. 15% felt that they pay house tax and user charge shall be an additional liability on them. 13% had no idea to what user charge means.

Figure 28



The behavioral study indicated that the citizens are prepared to accept the new arrangement provided it improves their quality of life through proper management of waste. The ULB on its part will have to restructure and re-orient their attitude towards the waste problem. The participation of the community is indispensable for SWM to succeed in Gopeshwar. A series of public consultations need to be organized to put the system into place. The ULB has to transform the entire exercise of waste management into a people's programme. The Nagar Palika Parishad has to improve its communication skills and IEC campaign to reach out to all citizens of the Town.

4. Managerial Aspects of Solid Waste Management

4.1. Structure of SWM Organization at the ULB level

SWM is one of the basic essential services that need to be provided by municipalities to keep the town clean under the Municipalities Act 1916 and Solid Waste Management Rules of 2000, being revised as SWM Rules 2015. There is no separate organized structure at the ULB level looking into waste management in compliance of the SWM rules.. The Municipality only has sweepers who provide aesthetics to the town by sweeping the main roads and the markets and wards which are approachable. The concept to address the life cycle of waste has yet to be adopted by the Nagar Palika.

4.2. Allocation of Resources for Waste Management

SWM is a very important municipal function that requires substantial human and financial resources. However, often due to financial constraints and technical knowhow , municipalities are unable to provide adequate services. Furthermore, due to managerial inefficiencies, the available resources are not utilized effectively. Based on the information provided by Gopeshwar municipality about 15% of the total municipal budget is spent on SWM.

The Nagar Palika spends nearly 60% of the total SWM budget on collection of waste through street sweeping, 20% on diesel and petrol and the rest on maintenance of tractors and equipment. These figures reflect the need to improve Door to Door collection services so that the costs incurring on sweeping can be minimized. This in turn will generate surplus both in terms of man hours and finance which can be utilized for effective disposal of waste.

Since there is no weighing bridge it is difficult to estimate the cost incurring on managing one ton of waste at Gopeshwar. However, about Rs.3 to 4 thousand per ton is estimated as the cost of collection and disposal of waste. As a part of effective strategy user charge needs to be imposed for minimizing collection costs through partnership with the Nagar palika. The provision of Extended Producer's Responsibility in the plastic waste management and handling rules 2011 being modified as 2015, empowers the ULB s to elicit support of the company's marketing their products in their municipality. This will further help in reducing SWM costs.

Regular training of SWM staff which is area specific is very important to enhance their capacity for effective and sustainable SWM. However, the Nagar Palika has not initiated regular capacity building training for their SWM staff. The training component should include collection mechanism for source separated waste followed with segregated containerization and end use disposal through recycling and composting.

4.3. Planning Solid Waste Management at the ULB level

SWM is more of a managerial issue than a technical one which implies 70% community participation and 30% technical aspect for collection and disposal. In the Gopeshwar Municipality lack of appropriate planning and sustainable management has created environmental and social problems. However, with the funding of the ULB under SWM plan a treatment site is in the process of being developed at Chamoli Kshetrapal. The compactor is

diverting the voluminous low value added dry waste through recycling. As a step forward the Nagar palika will have to prioritise SWM services for a clean and environmentally safe town.

4.4. Actors Involved in Solid Waste Management

The various stakeholders involved in municipal SWM, includes the Central Government rules, the state Government orders, bilateral development partners, the private sector, NGOs, CBOs and citizens. The municipality has formal working relations with government institutions, but has not forged partnership with the CBOs, NGOs and the citizens. This has led to disconnect between the local self government and the stakeholders.

4.5. Solid Waste Management Rules and Government orders

The Solid waste management Rules 2000 and the State Government order of April 2007 are relevant in the context of SWM programme at Gopeshwar. The SWM rules formulated in 2000 (Under Environment Protection Act 1986) address the SWM problems in the urban areas in a holistic and simple manner:

Its main objectives are to

- (i) Make SWM simple and effective,
- (ii) Minimize the impact of solid waste on the environment and public health,
- (iii) Treat solid waste as a resource, and
- (iv) Improve public participation by increasing public awareness about sanitation.

The Uttarakhand Plastic usage and Disposal of Other Non- biodegradable Act.2013 is of special relevance as it has the provision of imposing penalties on the use of plastic bags less than 40 micron thickness. The Act prohibits the user and the supplier of such material which do not meet the norms of the Government. However, the waste analysis reveals the use of illegal plastic bags in Gopeshwar. The Nagar Palika needs to take the strictest action against the offenders to minimize the impact of one time used bags which as a rule are discarded after packing it with waste material.

5. Challenges and recommendations

The following key issues are an outcome of the study for improving SWM in Gopeshwar:-

5.1. Evolving a Policy, Strategy and an action plan

The SWM rules 2000 amended and upgraded to SWM Rules 2015 along with the Plastic Waste Management rules 2011- 15 are a major step toward improving across the country. Unfortunately, the SWM rules 2000 have not been translated into actions and results on the ground. The JnNurm and UIDSSMT funded towns have had some level of deliverance. But, for some towns and cities the programme has not succeeded as planned by the Government.

On the basis of major learning from previous SWM programmes the state needs to formulate a policy, which addresses area specifics, policy objectives, technical guidance, an implementation strategy, a time line and a monitoring and an evaluation mechanism for the Hills and Plain ULBs. The bottom line for the same shall be consistent with the SWNM rules but will need to be modified in the case of Hill towns.

The state Directorate needs to formulate key performance indicators as a measuring tool for the different objectives to be achieved by the local bodies. It will be a good idea to provide the ULBs of the Hill region technical guidance regarding composting, procurement of equipment and Resource generation through the Material Diversion Programme.

5.2. Promotion of Refuse, Reduce, Reuse, Recover and Recycle

The MSW of Gopeshwar has a large content of wet compostable waste of which 74% is generated by the households. The large proportion of reusable and recyclable materials generated by the households, commercial establishments and Institutions needs to be recovered under the Material Diversion programme for generating employment and promoting recycling. It is being done by the compactor use at Chamoli .The same needs to be improved and strengthened by adopting a pragmatic approach in terms of management of skilled labour and their output.

A focused programme for refusal of plastic carry bags less than the prescribed norms needs to be launched by the ULB. The thin HM (HDPE) bags are a nuisance as they are used as disposal bag after one use. This is not only creating problem with the aesthetics of the town but works for breeding of bacteria and its likes, with the decomposition of the containerized waste. It needs to be kept in mind that the bags of 40 and 50 microns thickness are not discarded after one use due to better quality and look.

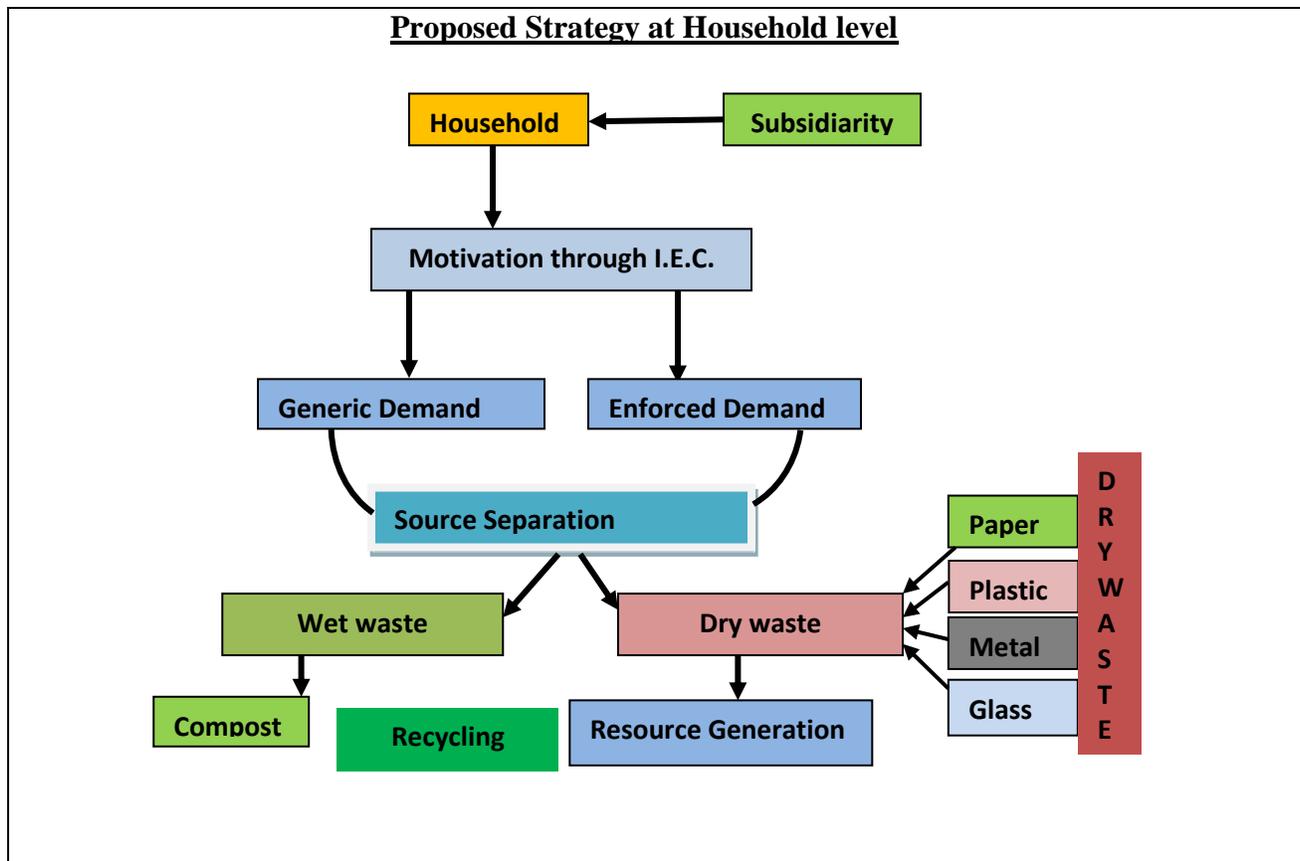
The adoption of reducing waste is the golden principle of minimizing the final volumes of waste from going to landfills. This strategy significantly reduces the amount of waste to be finally disposed thereby saving costs and huge quantum of congealed energy which can be conserved through recycling. The added benefit is in terms of reducing health and environmental risks. The key to success lies in segregation of waste at source, followed with separation at the collection time and segregation during the Material Diversion Programme as per the principle of value chain in Dry waste. This would require better awareness of the benefits of segregation and recycling. The municipal staff also needs to be better equipped and trained for the purpose. Once

the life cycle of waste falls in place it will lead to recovery of the so called non-usable material. This will help in recovering significant quantities of waste

The government needs to promote the use of compost in the agriculture sector at par with chemical fertilizers. Composting units based on static pile of NADEP system can be developed in communities and municipalities. Aerobic composting is less complex, as it does not generate methane a green house gas.

5.4. Strengthening Capacity of Local Bodies

In the course of study it was observed that the Nagar Palika Gopeshwar suffers from shortage of financial and human resources. They also lack in technical and managerial skills to tackle MSW. It is essential to develop the in house capacity of municipalities by re-structuring the present setup. The approach for strategy is based on the following principle:-



Source: Key issues in SWM-Vipin Kumar

The same principle needs to be replicated at institutional, commercial and market set ups.

5.5. Public Participation and Consultation

The ULB alone does not have the capability for providing clean and livable township. The community has to be taken into confidence though structured awareness campaign. It was noted at Gopeshwar that the ULB has launched an awareness programme against plastic bags which is

welcome but it does not address the issue of waste and its impact on the citizens. Why? It needs to be answered while drafting Information Education and Communication (IEC) material. The first step could be to stop “littering” waste in public places. This will help in evolving a sense of ownership. It should be gradually stepped up for the need of source separation for understanding the 5R concept.

Adopting appropriate methods for waste segregation and collection also requires close consultation and collaboration from the communities so that their “needs” are incorporated into the arrangements. The ULB should immediately constitute a citizen council to address the waste problem. It should be followed by constituting the Mohalla Swachta Samitis as was done successfully under the “Mission Butterfly” SWM programme at Nainital. A bottom to top approach should be adopted for managing solid wastes.

5.6. User Charge

The SWM Rules 2015 has the provision of imposing a User Charge in lieu of SWM service to the community. The Municipality finds itself in a dilemma as this step will not be welcome by the community. It is here that the citizen's council and the Sanitation committees will take responsibility for convincing and eliciting support from the community. The present study shows that more than 70% of the residents are willing to pay provided the level of service is improved. The fee shall be based on the premises of mini waste generator to bulk waste generators. The urban poor will have to be provided a subsidized service. The ULB will have to adopt a cluster approach of considering households as a unit aggregated into 100 to 160 households per cluster.

Proposed formula for clusters

Ward	Population	No. of HH	Proposed cluster @ 160 H.H.	Proposed cluster @ 120 HH	Proposed cluster of 100 HH
Gangol Gaon	2445	612	4		
Kund	2074	518	3		
Upper Bazaar	2397	600		5	
Lower Bazaar	2365	592		5	
Subhash Nagar	3703	926			9
Negwaad	2466	617		5	
Paduli-Papadiyana	2332	583	4		
Kothiyal sain	1847	462	3		
Chamoli-Kshetrapal	1815	454	3		
Total	21444	5364	17	15	9

5.7. Improvements toward Integrated Solid Waste Management

The bad practices of collecting waste from road side piles needs to be stopped. Lack of awareness leads to the dumping of garbage in roadside drains, which clogs drainage systems. Open burning emits hazardous gases, including dioxin which has been banned all over the country by the National Green Tribunal. Mixed solid waste that contains high organic content produces, a large amount of methane, through anaerobic digestion, a powerful greenhouse gas that is a cause of climate change.

An integrated approach needs to be put into place beginning from segregation at source followed with collection to resource recovery and final disposal.

5.8. Data Management, Updating, and Dissemination

The survey conducted has provided very useful data and information on the state of SWM in Gopeshwar, which can be used for planning SWM. Key performance indicators (KPIs) for municipal SWM, which may include waste collection efficiency, rate of resource recovery, efficiency of User charges need to be identified and data compiled using a uniform methodology. The sharing of the findings with public shall help in eliciting their support for SWM programme. The possibility of linking performance with budget allocation by the State Government will help improve the State of SWM in the State of Uttarakhand.