URBAN HOUSEHOLD SOLID WASTE MANAGEMENT IN AIZAWL, MIZORAM

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URBAN HOUSEHOLD SOLID WASTE MANAGEMENT IN AIZAWL, MIZORAM

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Declaration

I, Sarah V.L.Rindiki, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

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This is to certify that the thesis of *Urban Household Solid Waste Management inAizawl, Mizoram* submitted by Mrs*Sarah V.L.Rindiki* for the award of Master of Philosophy in Social Work is carried out under my guidance and incorporates the student's bonafide research and this has not been submitted for award of any degree in this or any other university or institute of learning.

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LIST OF ABBREVIATIONS

AMC	:	Aizawl Municipal Council
BMW	:	Biodegradable MunicipalWaste
CPCB	:	Central Pollution Control Board
EPA	:	Environment Protection Act
GOI	:	Government of India
HHSW	:	Household Solid Waste
HHW	:	Household Waste
HMGN	:	His Majesty's Government of Nepal
LCA	:	Life Cycle Assessment
MHIP	:	MizoHmeichheInsuihkhawm Pawl
MoEF	:	Ministry of Environment and Forest
MoPE	:	Ministry of Population and Environment
MSWM	:	Municipal Solid Waste Management
MT/day	:	Metric Ton per Day
MUP	:	Mizoram Upa Pawl
NEERI	:	National Environmental Engineering Research Institute
NGO	:	Non-Governmental Organization
OECD	:	Organization for Economic Co-Operation and Development
PPP	:	Public Private Partnership
SPSS	:	Statistical Package for Social Sciences
SW	:	Solid Waste
SWD	:	Solid Waste Disposal
ULB	:	Urban Local Bodies
UNCHS	:	United Nations Commission on Human Settlements
UNDP	:	United Nations Development Programme
VC	:	Village Council
WTP	:	Willingness to Pay
YMA	:	Young Mizo Association
LAD	:	Local Administrative Department

CHAPTER I

INTRODUCTION

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INTRODUCTION

The present study probes into the patterns of domestic solid waste management in Mizoram from a social policy and social work perspective.

Solid waste is non-liquid material that no longer has any value to the person who is responsible for it. The words rubbish, garbage, trash, or refuse are often used as synonyms of solid waste (Zhu et al., 2008). Also energy and matter/material in a non-ordered or non-useful form and in the wrong place are normally referred to as waste (Stokoe and Teagu, 1995). Byrne (1997) considered the waste as material, which has no direct value to the producer and so must be disposed off. Bailie declares that ‘‘for practical purposes, the term ‘waste’ includes any material that enters the waste-management system’’, i.e. organized program and central facilities established not only for final disposal of waste but also for recycling, reuse, material reclamation, composting and incineration (Bailie et al., 1996). Solid Waste Management refers to all activities pertaining to the control, collection, transportation, processing and disposal of waste in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes (Sujauddin et al., 2007).

1.1. Solid Waste Management : The Global Scenario

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. Where intense human activities concentrate, such as in urban centers, appropriate and safe solid waste management (SWM) are of utmost importance to allow healthy living conditions for the population. This fact has been acknowledged by most governments, however many municipalities are struggling to provide even the most basic services. Typically one to two thirds of the solid waste generated is not collected (World Resources Institute 1996).

Statistics show that the world population reached six billion in 2001 with 46% of this population residing in urban areas (HMGN and MoPE, 2003). Global municipal solid waste generated in 1997 was about 0.49 billion tons with an estimated annual growth rate of 3.2–4.5% in developed nations and 2–3% in developing nations (Suocheng et al., 2001). Cities in the world are facing a high level of pollution; the situation in developing countries is more acute, partly caused by inadequate provision of basic services like water supply, sanitation facilities, transport infrastructure and waste collection (UNCHS (Habitat), 2001). According to a United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNDP 1997). There is a tremendous increase in the amount of solid waste generated in the cities due to a more affluent lifestyle. Municipal corporations in developing countries are not able to handle increasing quantities of waste, which results in uncollected waste on roads and in other public places. Typically one- to two-thirds of the solid waste that is generated is not collected. The uncollected waste is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insect and rodent vectors, and spreading of diseases. Even waste that is collected is often disposed of in uncontrolled dumpsites or burned, polluting water resources and the air. There is a need to work towards a sustainable waste management system. Industrially developed countries produce large quantities of wastes. On the other hand, developing countries generate less solid waste (SW) per capita because of their lower purchasing power and the consequent lesser consumption (Cairncross and Feachem, 1993).

Solid-waste management is a major challenge in urban areas throughout the world. Without an effective and efficient solid-waste management program, the waste generated from various human activities, both industrial and domestic, can result in health hazards and have a negative impact on the environment. Understanding the waste generated, the

availability of resources, and the environmental conditions of a particular society are important to developing an appropriate waste-management system. MSW collection schemes of cities in the developing world generally serve only a limited part of the urban population. The inhabitants who are left without waste collection services are usually in the low-income population. Lack of adequate resources and planning capacity to cope with increasing urban population growth affects the availability or sustainability of a waste collection service. Operational inefficiencies, inappropriate technologies, or deficient management capacity of the institutions involved also give rise to inadequate service levels.

1.2. Solid Waste Management: The India Scenario

The continuous deterioration of quality of life in urban areas has underlined the need to create better environmental conditions and evolve a workable national strategy for solid waste management. Urban India generates about 1.0 lakh MT/day of Municipal Solid Waste and it requires more than 1500 Acres of land/year for land fill. This is a very imposing land demand, in a land- scarce India. The big cities of the region generate about 4372 tons per day, medium size cities generate solid waste to a tune of about 4137 tons per day (14% of the total solid waste generated in the region). The total solid waste generation in the small cities is about 27% of the generation in the region, which is about 8063 tons/day (Ojha, 2010). Despite the fact that the urban local bodies utilize major part of its staff and resources for collection and disposal of MSW, nearly half of MSW generated remains unattended in many cities. Out of the funds spent on MSW management, ULBs typically spend about 65% funds on collection, 30% on transportation and a mere 5% on waste disposal. There is thus an urgent need to address the problem with a more scientific approach than the commonly adopted; crude dumping of municipal solid waste (Il & IF IDC, 2008).

The government of India has enacted Environment Protection Act 1986 (EPA) and under the provisions of this act has framed rules for managing and handling municipal solid

waste, biomedical waste, hazardous waste, and so on. Pursuant to the EPA, a National policy and legislation for MSWM, titled the Municipal Solid Waste (Management and Handling) Rules, was notified in 2000 (GOI, 2000). This is available to the Urban Local Bodies and other User Agencies to guide them for planning, designing and implementation of solid waste management projects in urban areas. SWM is left to the states and passed on to the ULBs by state governments. The role of central government is principally to frame laws and rules, which it does through the Ministry of Environment and Forests, and to provide guidelines, technical assistance, financial support, and so forth, which it accomplishes through other ministries such as the Ministry of Urban Development and Poverty Alleviation. Solid Waste Management is a part of public health and sanitation, and according to the Indian Constitution, falls within the purview of the State list. Since this activity is non-exclusive, non-rivaled and essential, the responsibility for providing the service lies within the public domain. The Central Pollution Control Board (CPCB) is the apex regulatory body in environmental matters. Its principal role is to monitor the implementation of the rules. However, the CPCB has taken several proactive measures by issuing guidelines and manuals and has also supported several training programs and pilot projects.

Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in India. The 23 metro cities in India generates about 30,000 tonnes of such wastes per day while about 50,000 tonnes are generated daily from the Class I cities. Municipal agencies spend about 5-25% of their budget on MSWM. In spite of such heavy expenditure, the present level of service in many urban areas is so low that there is a threat to the public health in particular and the environmental quality in general. Several steps are being taken towards improving the situation (Shekdar et al, 1991). In 2005/2006 Central Pollution Control Board (CPCB) in association with National Environmental Engineering Research Institute (NEERI) carried out detailed field studies with the purpose to

establish a database on a national level for 59 cities selected in India (35 metro cities and 24 state capitals)Studies revealed that waste generation rate varies from 0.12-0.6 kg/capita/day(CPCB,2004).MSW collection schemes of cities in the developing world generally serve only a limited part of the urban population. In India organic and inert materials tend to dominate the waste composition in terms of weight. The physical composition has a high percentage of compostable (30-55%) and inert materials (40-55%), which is mainly due to the inclusion of street sweepings, drain, silt, construction and demolition debris.

1.3. Solid Waste Management: Mizoram Scenario

Mizoram is undergoing rapid urbanization and a huge number of rural people are migrating to urban areas each year. According to 2001 census nearly one half of its population resides in urban areas. Over one half of the urban population is housed in Aizawl its capital city. In the state, Urban Development and Poverty Alleviation Department takes the sole responsibility for collecting and dumping of community waste since October 2010. It covers 19 municipal wards consisting 60 local councils in Aizawl. In Public-private Partnership mode, wastes are collected once or twice in a week, and Rs 22, 64, 000 per month had been sanctioned for this purpose in the budget. The rest of the communities which are not included in Aizawl Municipal Council are covered by Local Administrative Department, 9 tipper trucks of the department collect garbage from households periodically. At present, crude dumping is the only method used for the disposal of MSW in Mizoram, which pose serious environmental and social threats. The department has two dumping sites at the fringe of Aizawl city of 20-25 Kms away from the centre. There is no further processing in these sites. They do not weigh the refuse vehicles regularly but estimate the quantities on the basis of number of trips made by the collection vehicle. It is estimated that 106.02 tons of waste is collected daily. In this context the present study attempts to probe

into the patterns of solid waste management at household and community levels and the problems therein.

1.4. Overview of Literature

Review of literature forms the foundation of quantitative social work research. This section presents an overview of literature and research gaps identified therein from the point of social policy and social work practice.

There is copious literature on solid waste management at multilevel. There are a number of studies comparing the solid waste management in different countries or regions (see Mwanthi, 2010; Simões, 2009; Manaf, 2009; Weng, 2008; Karani and Jewasikiewit,z 2006; Zurbrugg, 2003; Al-Momani, 1994). There are empirical studies on the impact of globalization and increasing urbanization on the management of municipal solid waste (Achankeng, 2003, Johnstone and Labonne, 2004).

Several case studies of solid waste management by urban local bodies have been documented (see for example Ojha, 2010; Esakku, 2007; Zia and Devadas, 2006; Kumar 2005; Mathew, 1999). These studies evaluate the efficiency and adequacy of administrative arrangements for solid waste management and the challenges faced by the municipal organizations all over India.

Many studies examined the patterns and determinants of solid waste disposal practices at household level (see for instance Abebaw, 2008; Manyanhaire et al., 2009; Mengistie and Baraki, 2010). Per capita solid waste generation by residents, its composition, and the households' attitudes towards waste management had been studied (for example Purcell and Magette, 2010; Sajauddin et al., 2007 Hockett et al, 1995). Satisfaction over the municipal solid waste management is another aspect studied (see Pap, 2001; Altaf and Deshazo, 1996).

Problems of waste disposal at household level and the constraints faced by waste management services and an alternative approaches that encompasses resource conservation and employment generation also studied (Kaundal and Sharma, 2007; Venkateswaran, 1994). Willingness-to-pay for improved solid waste disposal systems by urban was also studied (Niringiye and Omortor, 2010; Rahiji and Oloruntoba, 2009). The generation of household waste was studied and individual waste treatment approaches were assessed. Household level studies of conditions of households, their awareness and perceptions (Mosler et al.2006; Rahman et al.2005, Longe et al, 2009; Sessa et al, 2009; Centre for Environment and Development, 2003).

In spite of the existence of copious literature on household solid waste management, a few research gaps could be identified.

Firstly, most of the studies were institutional in nature and macroscopic in orientation. There are a few studies which focus on the household waste management behavior and practices and microscopic in orientation. Secondly, a few studies were attempted in the context of North east India though urbanization is taking place over the decades and the seriousness of the problem of solid waste management is widely recognized. Thirdly, there is only one study conducted in Mizoram (see Lalhruaitluanga, 2006). Though the study explores into most aspects of household solid waste management, methodologically it suffers from inadequate sample size. Fourthly, the choice of household in using different modes of disposal and its determinants has not been adequately probed into.

Lastly, the household's willingness to pay for improvement in the municipal solid waste management has not been adequately studied in the context of India, north east and Mizoram. The present study tries to fill these research gaps.

1.5. Statement of the Problem

The purpose of the present study is to probe into patterns of household solid waste management in Mizoram in its multiple dimensions. The study focuses on the collection, storage, and disposal of solid waste at household level. It attempts to estimate the extent of domestic solid wastes generated by the households and determine the demographic, socio economic factors associated with it. It tries to identify the strategies followed by households in storage and disposal of the solid wastes generated and the factors associated with their choices. It will probe into the popular satisfaction over solid waste management in Aizawl city especially the recently introduced public-private mode. It will probe into the willingness of the household to pay for improved waste disposal system and the factors affecting the same. It will also try to identify constraints in the household management of solid waste. Finally, in the light of the findings it will offer suggestions for policy makers and social workers interested in urban management and development.

1.6. Objectives

The following are the objectives of the present study

1. To probe into the patterns of collection, storage and disposal of solid waste by urban households.
2. To examine the patterns of solid waste generated by urban households and to determine the demographic, social and economic factors associated with the magnitude of solid waste generated.
3. To appraise the user's satisfaction over the existing modes of solid waste management.
4. To assess the willingness of the households to pay for improved municipal solid waste management in Aizawl.
5. To suggest measures for policy making and social work intervention.

1.7. Hypotheses

The following hypotheses were formulated to provide focus to the above objectives.

1. Education status of the respondent, size of family, and annual household income are indirectly related to the magnitude of household solid waste generated.
2. The household's choice of the mode of solid waste disposal depends upon gender of head of the family, education of the respondent and family size.
3. The willingness of the respondent to pay for improved municipal solid waste management depends upon the age group, education, per capita household income, and per capita household assets of the respondent.

The first hypothesis originates from the findings of earlier studies (see Lalhruaitluanga, 2006; Sujauddin et al 2007). Though there are studies which report a diametrically opposite relationship between the magnitude and the other variables (see Chang et al., 1993; 1993; Richardson and Havlicek, 1978; Wertz, 1976), in line with the lone study in Mizoram (see Lalhruaitluanga, 2006), indirect relationship is hypothesized.

The second hypothesis draws its inspiration from the similar studies in Urban Areas of Ethiopia (Pek chuen Khee and Oathman, 2009; Tadesse, Ruijs and Hagos 2008).

The source of the third hypothesis is the findings of earlier studies (Niringiye and Douglason, 2010 Rahiji and Oloruntoba, 2009).

1.8.Chapter Scheme

The study is organized into the following six chapters

1. Introduction
2. Review of Literature
3. Methodology
4. Results and Discussion
5. Conclusions

CHAPTER II

REVIEW OF LITERATURE

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REVIEW OF LITERATURE

Literature review helps in identifying substantive research questions, theoretical and conceptual issues, as methodological insights. Hence, in this chapter a critical review of literature on urban solid waste management is attempted. The chapter is presented into three major sections viz., national level studies, studies on urban municipal solid waste management and studies on urban household solid waste management.

2.1. National Level Studies on Solid Waste Management

In attempts to examine how globalization and increasing urbanization have impacted on the management of municipal solid waste sector in Africa and more particularly in Cameroon using the cases of Bamenda and Yaounde cities, the study by Achankeng (2003) finds that in regular African household waste generation, plastics, paper and cartons, tin cans, glass, bottles and fiber are on the increase. The waste stream is mostly made up of garbage, which constitutes 50-80 per cent of all the waste. Garbage includes wastes from household preparation, cooking and serving of food; market refuses handling, storage and sales of produce and meals, Non-biodegradable solid waste or rubbish. Their rates of generation have a relationship with the different socio-economic parts of the city- a trend that suggests the increasing influence of globalization and changing consumption habits. Generation rates for the continent' s major cities are estimated to range from 0.3-1.4 kg per capita per day This gives an average of 0.78 compared to an average of 1.22 kg per capita for developed countries Field experiments show that the per capita per day generation for Yaounde and Bamenda, Cameroon are 0.8 and 0.5 respectively. There is a positive correlation between city population size and both the per centage of waste moved and rate of households enjoying regular waste collection.

This suggests that increasing city size poses a greater problem to the solid waste management in Africa.

Hockett, et al,. (1995) attempted to identify factors which influence per capita municipal solid waste generation in the south-eastern U.S., using the 100 counties of North Carolina as a data set and regression models for statistical analysis. Variables are selected to capture the residential, institutional and commercial components of the municipal solid waste stream, as well as the overall structure of waste management through inclusion of waste disposal fees. An additional goal of this study is to examine the influence of the components of retail sales, including sales of restaurants, merchandise, food stores and clothing stores, on per capita municipal solid waste generation, as it has been suggested that retail industries contribute significantly to waste generation. The results indicate the retail sales and the waste disposal fee are significant determinants of waste generation, while variables to account for manufacturing, construction, personal income, and degree of urbanization did not prove to be significant. This study finds that per capita retail sales and tipping fees are the significant determinants of per capita waste generation while other variables, particularly demographic ones, prove to not be significant as correlates of waste production. The finding that the tipping fee is important is particularly valuable as it stresses the relative importance of waste management structural characteristics in influencing waste generation and disposal, rather than socio-economic ones alone. The study suggests that the retail sector, including eating establishments, should be a prime target of waste reduction efforts. These findings can be extended beyond the population of the counties of North Carolina. Many of the states in the south-eastern U.S.A. and in the U.S. Environmental Protection Agency's Region IV (including South Carolina, Georgia,

Tennessee and Kentucky) share similar economic and population characteristics to North Carolina and it is likely that the results are also relevant to these states.

Sessa et al. (2009) investigated knowledge, perceptions of the risks to health associated with solid waste management using a cross- sectional study. They also investigated the practices about domestic waste and their associations with several characteristics in an adult population in Italy. Among the respondents, differentiate household waste collection in containers or recycling bins was regularly performed by 60.7per cent for glasses to 68.3per cent for plastic and only 46.3per cent for all materials (glasses, paper, plastic, etc.). Respondents who more frequently perform with regularity differentiate household waste collection had a university educational level, perceived a higher risk of developing cancer due to solid waste burning, had received information about waste collection and did not need information about waste management. The majority of the respondents had sought information about waste management (70.3%) and mass-media was the major source (69.8%) followed by scientific journals (24.2%), educational courses and meetings (15.7%) and health professionals (9.3%). The large majority would like to receive more information (74.3%). important implications because collaboration between policy makers and public health professionals is critical in educating the general population and in providing innovative, accurate and detailed information.

The regional inequalities in socio-economical characteristics such as income, population density, age composition, unemployment rate and the education level may bring about variation in waste generation, recycling and collection. Using environmental Kuznets curve, Chen, C. C., (2010), examined the factors affecting municipal solid waste disposal in Taiwan. This paper finds each per cent increase in the education level results in a decrease in MSW disposed of 0.01556 kg/day. Rising education levels may be an

effective tool to enhance recycling behaviors, to modify consumption pattern, and eventually to reduce MSW disposal. As personal disposable income increases, per capita municipal solid waste disposed firstly declines, then grows at the second stage and finally decreases again. All the explanatory variables including economic factors, social characteristics and geographical barriers are found to influence municipal solid waste disposal significantly. Result implies that income can only explain a portion of variation while other social and geographical factors contribute a lot to identify the variation in municipal solid waste disposal between urban and rural regions. The MSW disposed in urban regions increases as personal disposable income increases, and then starts declining after the maximum point of personal disposable income (NT$ 313,500). As personal disposable income moves beyond the turning point (at NT$ 313,500), a natural force will push MSW disposal decreasing to improve environmental quality. In other words, the economic development may play a self-regulation role in affecting the urban regions towards a clean economy.

Mwanthi et al. (2010) carried out a study with a view to establishing the factors of problems in management of domestic solid waste using a descriptive study carried out in Nairobi, the capital city of Kenya. A sample of 662 Nairobi residents and technical staff of NCC were interviewed in March and April 1994. Overall, 90per cent of the households were not provided with the NCC waste storage bins nor was the waste collected regularly from the point of generation. The respondents offered several reasons which they suggested were contributing factors to the poor management of solid waste. In this study most of the respondents were from the lower and middle socio-economic strata. Education was an important variable in assessment of behavior and knowledge. The fact that more than 40% had primary and secondary level of education appears to explain why the majority of the respondents knew the definition of the term `solid waste'. The study

established that 97% of the waste was generated from residential houses, and commercial premises were the secondary sources of solid waste. Ninety-three per cent of the respondents agreed that solid waste was a real problem in Nairobi. However, based on their suggestions and the technical staff in charge of the NCC Cleansing Section, poor management of resources by NCC, lack of strong leadership, inadequately skilled technical staff, de-motivated workers and lack of involvement of the residents were the major contributing factors. In order to alleviate the problem, transparency in resources accountability and the involvement of the residents were highly recommended by the respondents.

Zurbrügg (2002) studied the urban solid waste management in low income countries of Asia. In many cities of Asia, citizens involvement is seen result of inadequate financial resources, lacking management, and technical skills of municipalities and government authorities to deal with the rapid growth in demand for service, their concept was that waste management is seen as meeting citizens' needs therefore citizens are entitled to transparency in decision making; Waste management is not merely a service delivered by urban authorities but a cooperative undertaking that requires the coordination of informal behaviors and conventional management approaches. With this concept, citizens can perform some of the work, and people should assess the performance of municipal staff and have the right to raise questions about decisions on, for instance, the siting of dumps and transfer stations. Watchfulness and peer pressure of citizens is then also crucial to monitoring solid waste management activities. Typical schemes often observed in Asian cities provide primary collection service (house to house waste collection and transport to an intermediate collection point). Such primary collection, often managed by community-based organizations or small enterprises, is often initiated by the residents desperate need for a collection service for which the

residents are also willing to pay monthly collection fees. A recurring problem with such small scale waste management schemes is that the waste usually needs to be handled by another entity – often the municipality – from the intermediate collection point for further transport to the far away disposal site. A solution is to recycle as much of the waste locally – with a decentralized approach - so that there is very little need for on-going transport of collected waste.

Pap (2001) studied the household disposal methods and levels of satisfaction with and impacts of the SWM system in Jamaica. This research in Jamaica concentrated on both institutional and citizen/household behaviors with respect to SWM. This paper considers citizen/household SWM behavior and the relationship between citizens and local government in implementing new SWM technology. It also examines SWM institutional arrangements and relationships between the central and local government in formulating and implementing these new technologies. It finds that the level of trust in local government influences citizen/household SWM behavior and acceptance of new technologies. This level of trust is influenced by the behavior and performance of local government in respect to SWM, which is, in turn, is influenced by its relationship with central government, and historical and current problems within the SWM institutional sphere. These influences are circular in nature. Household survey shows that Open dumping and regular burning responses were common. Although citizens have a wide variety of disposal methods, many are not happy with the job local government has been doing. Even those that receive neighborhood service are not altogether satisfied, and don't always utilize the service. Thirty-four people were satisfied with the garbage system. Despite the existence of the new dumpster, 53% of respondents weren't satisfied. Those living closest to the dumpster dumped all of their household garbage into it. People living furthest away either carried all their garbage down to the dumpster, or separated out the

'non-burnable' (such as glass, tin, and sometimes plastic although plastic was often considered burnable) materials, carried them to the dumpster, and burned the rest.

Sudhir et al 1997 felt that planning for sustainable urban solid waste management (USWM) in developing countries has to address several interdependent issues such as public health, environment, present and future costs to society and the livelihood of the "actors" in the informal recycling sector. This article presents a system dynamics model which captures the dynamic nature of interactions among the various components of the USWM system in a typical metropolitan city in India. The model provides a platform for debate on the potential and systemic consequences of various structural and policy alternatives for sustainable USWM.

2.2. Studies on Urban Municipal Solid waste management

Callan and Thomas (1998) assessed the environmental and aesthetic damages of municipal solid waste pollution that have triggered policy reform at all levels of government. As part of this effort, public officials are integrating market-based policy instruments such as unit pricing into their solid waste plans. Despite the economic advantages of unit pricing, constituency response has been mixed and hence adoption rates have been below expectations. If the associated gains are to be realized, public officials must identify the key factors that influence this decision. To that end, this research empirically estimates the determinants of unit pricing adoption at the community level of analysis. Based on data for all cities and towns in Massachusetts, the results indicate that demographics, socio-economic attributes, fiscal capacity, and policy instruments influence this decision. Socio-economic variables, they find that income, housing value, education, age, and the rural classification variable are statistically significant determinants of unit pricing adoption. The parameters on education are

significant, and it indicates that higher education levels in a community increase the probability of adoption but at a decreasing rate.

Anand (1999) has examined the issues of waste management from the viewpoint of households in Madras using a contingent valuation survey. It includes a comparison between areas served and not served by Civic Exnora units where neighborhoods organize their own primary collection; such units now provide services for close to half a million people. The findings are drawn from focus group discussions, household interviews from across a range of income levels and spatial locations (within Madras City, within the nine towns around the city and other settlements within the metropolitan area) and in-depth interviews with those who manage the Civic Exnora units. The Civic Exnora model of primary waste collection was used in the survey to identify people's preferences for such a waste management approach. The survey indicates that people are willing to cooperate and pay substantial amounts for waste collection – some of them mainly for primary collection, others for transport and disposal which are "public goods". This reinforces the master plan proposals for using this model as the central tenet of waste management in Madras Metropolitan Area. At the same time, few people are aware of what happens to the waste and are also reluctant to contribute to such improvements unless there is provision for private benefits (such as those provided by a refuse-derived fuel scheme based on membership). The result shows that 75 per cent of households would be interested in joining a scheme for improving waste collection, transport and disposal. Of these households, nearly half would be interested in joining a scheme that provided primary collection services only. Although the other two schemes (transport and disposal of wastes) are hypothetical, compared to the actuality of Civic Exnora, and their benefits of a public goods nature, 41 per cent of all households would join such schemes

and would be willing to pay substantial amounts. Notwithstanding the merits of vermi-composting, there were few takers for such a scheme.

Rathi (2005) explored the alternative approaches to municipal solid waste (MSW) management and estimated the cost of waste management in Mumbai, India. Two alternatives considered in the paper are community participation and public private partnership in waste management. Data for the study were from various non-governmental organizations (NGOs) and from the private sector involved in waste management in Mumbai. Mathematical models are used to estimate the cost per ton of waste management for both of the alternatives, which are compared with the cost of waste management by Municipal Corporation of Greater Mumbai (MCGM). It is found that the cost per ton of waste management is Rs. 1518 (US$35) with community participation; Rs. 1797 (US$41) with public private partnership (PPP); and Rs. 1908 (US$44) when only MCGM handles the waste. The PPP system focuses on processing of waste without improving the collection and transportation activities, which leads to a higher cost per ton of waste management. Hence, community participation in waste management is the least cost option and there is a strong case for comprehensively involving community participation in waste management. The author suggested that there has to be concerted efforts from urban local bodies and NGOs to build up an informed community and overcome the bottlenecks for community participation in waste management and there is a need to further analyze the role of PPP in waste management.

2.3. Household Level Studies on Solid Waste Management

In this section the review is presented in terms seven subsections viz., Household Solid Waste Generation and Characteristics, Solid Waste Disposal, Solid Waste Management service, People's Attitudes and Perception, Household/ Community Participation in Solid waste Management and Willingness to Pay for SWM.

2.3.1. Household Solid Waste Generation and Characteristics

Johnstone and Labonne (2004) assessed the economic and demographic determinants of generation rates of household solid waste using a cross-sectional time-series database of solid waste in 30 countries that are part of the Organization for Economic Co-operation and Development (OECD). The result showed that the composition and size of the household seems to have an effect on household MSW generation, with a significant and negative influence. In terms of trends in waste generation rates, the average of total MSW in the period 1980-2000 for re-porting countries. Over that period, waste generation has increased from 420 kg's per annum to 560 kg's per annum, an average annual increase of just less than 1.5per cent. The study provided evidence on the economic and demographic determinants of generation rates of both total and household municipal solid waste. Household MSW generation rates are relatively inelastic with respect to household final consumption expenditures.

Ojha (2011) attempted to understand the issues in collection, transportation and disposal of municipal waste in Northern India with the help of field studies. According to the author households and institutions generate mostly organic with some plastics, glass, metals, inert materials and hazardous waste like batteries and paint, etc. The big cities of the region generate about 4372 tons per day, medium size cities generate solid waste to a tune of about 4137 tons per day (14% of the total solid waste generated in the region). The total solid waste generation in the small cities is about 27per cent of the generation in the region, which is about 8063 tons/day. The existing solid waste management system in the region is found to be highly inefficient. Primary and secondary collection, transportation and open dumping are the only activities practiced that too in a non-technical manner. Many cities in region face serious problems in managing solid wastes.

The annual waste generation increases in proportion to the rises in population and urbanization.

Urban Development Sector Unit East Asia and Pacific Region (1999) reported that the urban areas of Asia now spend about US$25 billion on solid waste management per year; this figure will increase to at least US$50 billion in 2025. Today's daily waste generation rate is about 760,000 tonnes. By 2025, this rate will be increased to about 1.8 million tonnes per day. The waste components requiring priority attention in Asia are organics and paper. Urban residents generate two to three times more solid waste than their fellow rural citizens.

The prominent problem in current solid-waste management is the rapid increase in amounts of solid waste and the extensive environmental pollution. A detailed monthly examination of constituents of refuse was made in the year 1992 .Al-Momani (1994) in his study focuses on several topics: First, a detailed monthly examination of constituents of refuse is presented and compared with other industrialized and developing countries. Second, total refuse quantities and per capita production for two different communities are analyzed. The per capita production of solid waste in Amman is less than any industrialized countries, and two to three times higher than middle income countries. Third, the volume and weight of solid waste generated varies seasonally. These variations exhibit strong diurnal and seasonal dependence on population growth, density and interrelated socioeconomic characteristics of people. Fourth, an assessment of solid waste to the year 2000 is made using a solid-waste sub-model. The estimated quantity for the year 2000 is 3668.5 tons per day, which would imply an increase of 5.38% per year. Food waste always ranked as the major component (39.72%), followed by paper (28%), plastics (15.7%), dust and sand (9.4%), metal (2.18%), glass (2.6%) and textiles (2.4%),

which indicates that local waste has a higher proportion of organic material than reported for other countries.

Sujauddin et al (2007) investigated per capita waste generation by residents, its composition, and the households' attitudes towards waste management at Rahman Nagar Residential Area, Chittagong, Bangladesh. The study involved a structured questionnaire and encompassed 75 households from five different socioeconomic groups (SEGs): low (LSEG), lower middle (LMSEG), middle (MSEG), upper middle (UMSEG) and high (HSEG). Wastes, collected from all of the groups of households, were segregated and weighed. Waste generation was 1.3 kg/household/day and 0.25 kg/person/day. Household solid waste (HSW) was comprised of nine categories of wastes with vegetable/ food waste being the largest component (62%). Vegetable/food waste generation increased from the HSEG (47%) to the LSEG (88%). By weight, 66% of the waste was compostable in nature. The generation of HSW was positively correlated with family size, education level and monthly income of the households. Municipal authorities are usually the responsible agencies for solid waste collection and disposal, but the magnitude of the problem is well beyond the ability of any municipal government to tackle. Dwellers were found to take the service from the local waste management initiative. Of the respondents, an impressive 44per cent were willing to pay US$0.3 to US$0.4 per month to waste collectors and it is recommended that service charge be based on the volume of waste generated by households. A large per centage of the sample households (80%) were found to dispose their waste through the waste collector. Almost 11% of the households dispose their waste to open places and 7% throw the waste into drains. Only 1% of the household dispose their waste in their own compound. The study has also revealed that the households that have larger earnings generate more waste. But usually, in the case of

waste collection, all types of socioeconomic groups are charged the same amount of payment.

Moslera et al (2006) analyzed the current consumption and waste disposal patterns of households in Santegio de Cuba, Cuba, and focuses on recyclable materials such as glass, aluminium, metal, organics and PET. The project team used a stepwise approach to assess the generation of household waste and individual waste treatment approaches. The standardized questionnaire, comprising a comprehensive set of structured questions to assess quantitative and qualitative data with the SPSS software is used. The result shows that the average amount of waste generated amounts to 86 g per capita and day. The correlation analysis also reveals that total waste per cap/day is negatively correlated to several socio-demographic factors and concludes that waste generation does not necessarily increase with higher income. The household waste compositions are mainly Glass (22%) and organic waste (34%) which constituted the bulk of the household waste. Forty per cent of the households feed organic waste to animals like pigs and chickens. Plastic, aluminium and glass are separated at household level and stored until CDR conducts one of its infrequent collection campaigns. Only about one-third of the interviewed households do not separate recyclables like glass and plastic. A relatively high fraction is reused, sold or transformed.

2.3.2. Solid Waste Disposal

Mengistie and Baraki (2010) study Household waste disposal method in Kersa Demographic Surveillance and Health Research Centre (KDS-HRC) project site, Kersa Woreda, Eastern Ethiopia. It aimed to assess the status of waste management and hygiene practices. A cross sectional study was conducted; subjects were randomly selected 444 households. Data were collected through interview and observation. They found that only very small proportion of the households had temporary storage for solid waste, the

majority of the households, (66%) disposed solid wastes in open dumps and only 6.9% of the households had temporary storage means for solid waste. About 98.4 % of the respondents revealed that the responsibility of waste management is left for women and girls.

Kaundal and Sharma (2007) studied the problem of Household waste Disposal in Palampur, Himachal Pradesh. Descriptive survey design was used to achieve the objectives. The study was conducted in a multi-stage stratified random sampling was used to select residential sites, residential colonies and ultimate 108 female respondents from teaching and nonteaching communities. Both primary and secondary data were collected. The primary data were collected with the help of structured and pre-tested interview schedule through personal interview method. The data were tabulated and analyzed with the help of appropriate statistical tools. That all the respondents disposed off the polythene in the open and used to burn them along with other waste. All the respondents considered the public garbage and its disposal a problem. About seventy per cent of respondents agreed for effective waste management at community level instead of domestic level. The possible reason for this may be attitude of an individual to escape from the responsibilities. Nearly ninety four per cent of respondents were in favor of providing education for waste management to keep the campus clean and environment sound. Some of the respondents in teaching community suggested need of financial help from university/ government for construction of pits or community bins for waste disposal at community level.

Abebaw (2008) examined the patterns and determinants of solid waste disposal practices adopted by families using a random sample of 200 households from Jimma town. The descriptive results revealed that open-dumping, burying, burning and composting are the four most important kinds of household solid waste disposal practices.

Estimation results of a reduced-form multinomial log it suggest that household choices of these practices are determined by a certain combination of family size, gender of household head, length of residence, age and education of the head of household, and education of children.

Manyanhaire et al (2009) analyzed the domestic solid waste management system in Sakubva High Density Suburb of the City of Mutare. One hundred heads of households participated through answering a pretested questionnaire, which was triangulated with field observations, interviews, and secondary data sources, such as maps and official documents. A stratified sampling method was then used to select targeted houses. They found that The City Council was able to collect only 40% of all the waste generated by residents in Sakubva. The rate of waste generation in Sakubva was 0.80 kg per day and the total amount of waste produced was 49.9 tons. The waste components found in Sakubva included food residue, paper, plastics, metals, glass, textiles, rubber, and wood. Residents used disposal methods that included burning (19%), burying (19%), and dumping in open spaces (38%), rivers (2%), and drainage basins. Residents used different types of waste receptacles, which were either formal or informal. Hard plastic bins were used by 60% of the residents, 17% used sacks, 9% cardboard boxes, 4% metal bins, and 1% bulk containers. The waste receptacles differed in type, shape, size, and nature of material they were made of and on average were filled in 7 days.

The Demand for Solid Waste disposal had been studied by Strathman (1995). His paper estimated the elasticity of demand for landfill disposal of municipal solid waste using data from the Portland, Oregon metropolitan area. Efficiency losses associated with deviations from marginal cost pricing of disposal services are then derived. The efficiency losses of small deviations from long-run marginal disposal costs are not large. However, many municipalities finance solid waste services from general tax revenues, in

which case waste generators effectively face zero marginal costs. Here, the efficiency losses are much larger indicating that communities would benefit from introducing volume or weight-based pricing.

Pek chuen Khee and Oathman (2009) conducted an econometric study on the household demand for municipal solid waste disposal service improvements in Malaysia and also ranking them using choice experiment. Municipal solid waste in Malaysia which comprises mainly of garbage, plastics, bottle or glass, paper, metals and fabric are getting more complex and sophisticated in their compositions. This study also reveal several crucial and interesting behaviors of the Malaysian public regarding the solid waste disposal issues, such as the perception of the public, commonly nurtured by their socio-economic background and, distance factor have great impacts on the choice of disposal options, the Not-In-My-Backyard (NIMBY) syndrome is still by and large present in the society, the public demands transparency and open consultations with the government on issues related to SWD facilities, and sanitary landfill is better received than incineration by the society as the alternative to control tipping. The results of the study show high influence of perception and distance factor on the public choice pattern for waste disposal options. These propose that the government should have more open consultations with the public to understand their perspectives and needs before attempting to announce any solid waste management and disposal policies. It is also shown that the authorities have to be more transparent in the future proposed waste disposal technology in order to convinced the public of their advantages but not leaving the public to guess and presume the negativities due to lack of knowledge and access to information.

Industrialization and urbanization result in significant changes in lifestyle. These lifestyle changes seem to lead to unsustainable consumption patterns and increase the generation of various kinds of environmental loads, especially the amount of municipal

solid waste (MSW). Taiwan is a small island with scarce natural resources. The economic development in Taiwan has resulted in the generation of large amounts of MSW. Weng et al (2009)

2.3.2. Solid Waste Management service

Report of the APO Survey on Solid-Waste Management (2007) reveals that the average MSW generation in India is approximately 100,000 MT/day. Out of that, only 60% (60,000 MT/day) is collected by municipal corporations and councils. The rest is disposed of in an unscientific manner. Typical municipal solid waste has the following composition percentages: inert matter (54%), vegetative matter (31%), paper, cardboard, and plastics (6%), glass and crockery (0.94%), metal scrap (0.8%), bioresistant, e.g., leather and rubber (0.28%), and other (7%). The processing technologies currently adopted are composting, biomethanation, and waste to- energy. The disposal by landfill is considered here. Although the landfill sites are government owned, the operation of landfills in some cities is a public-private partnership, whereas in other cities it is by the government only. Waste minimization is happening in India in two ways. At the household level, newspapers, bottles, plastic, cardboard, etc. are sold directly to Kabariwala. Plastic and other recyclable items are sorted out and segregated by rag pickers from municipal receptacles/dhalaos and landfill sites, and are then sold in the recycling market.

Simões et al (2010) assessed the influence of the operational environment on the efficiency of the Portuguese urban solid waste services. A sample of 29 solid waste utilities encompassing the whole continental country was used for this purpose. They particularly apply the non-parametric double bootstrap model to estimate the effect of various explanatory factors on robust data envelopment analysis estimates. They find a significant influence of the environmental context on the solid waste utilities'

performance. GDP and population density have a positive relationship with efficiency and the distance to the sanitary landfill has a negative influence. This means that, in general, solid waste utilities can obtain better results (performance) with higher GDP and population density, and, in contrast, a higher distance to the landfill has a negative effect on efficiency. The result reveals that The negative sign for management and the positive one for regulation indicate that the private utilities seem to have better performance than the public ones and the regulated utilities appear to be less efficient than the non-regulated ones, but with less statistical significance. The environmental context is characterized by gross domestic product per capita, distance to treatment facilities, population density, regulation, type of management, composting and incineration services

Altaf and Deshazo (1996) studied an area of Gujranwala, Pakistan with household survey. The municipality of Gujranwala claims to provide solid waste service to 80% of the city population. Only one-tenth of sample households in low-income neighborhoods, one-fifth in middle- income neighborhoods and one-third in high income neighborhoods reported regular municipal collection of solid waste. The most common disposal site, reported by 30% of households, was an empty plot in the neighborhood. Most other households used either a garbage heap or a sewage pond in the neighborhood or simply threw the waste into the street. Only 7% of households indicated that solid waste was disposed of by being burnt in their neighborhood. Households were also asked their opinion regarding the respective merits of public and private provision of solid waste management services. Slightly more (49%) preferred public to private provision (44%) with more educated and affluent households favoring the latter. The results of the contingent valuation survey show that of the 968 households in the sample, 794 (82%) were interested in the improved solid waste service offered and 695 (7 1%) were willing to pay a positive amount for it. The mean willingness to pay of the latter was Rs. 11.20

per month. Of the 99 households who were interested in the service but not willing to pay anything for it, a majority (84%) considered the provision of such a service to be a responsibility of the government. The average stated willingness to pay of all those who were interested in the service offered was Rs. 9.80 per month. If a zero willingness to pay is assumed for households not interested in the service, the average willingness to pay over the entire sample was Rs. 8.04 per month.

Houtven and Morris (1999) conducted a household-level analysis of the unit-pricing demonstration project in Marietta, Georgia, which required residents to pay by the unit for waste disposal services. The result shows that rather than pay a fixed monthly fee for collection, half of the residents paid a fee per reusable trash can, and half paid for each non-reusable trash bag collected. Urban households and households with a higher per centage of full time workers generate significantly less waste**.** Data from both a sample of households and city-wide totals indicate that the programs significantly reduced waste set-outs, even after accounting for increases in (unpriced) recycling. The bag program caused larger reductions (36%) than the subscription can program (14%). Rough estimates of the program indicate both savings for residents and social welfare increases.

Rigamonti et al (2009) attempted a LCA analyses together material and energy recovery within integrated municipal solid waste (MSW) management systems, i.e. the recovery of materials separated with the source-separated collection of MSW and the energy recovery from the residual waste. The final aim is to assess the energetic and environmental performance of the entire MSW management system and, in particular, to evaluate the influence of different assumptions about recycling on the LCA results. Materials and methods The analysis uses the method of LCA and, thus, takes into account that any recycling activity influences the environment not only by consuming resources and releasing emissions and waste streams but also by replacing conventional products

from primary production. Different assumptions about the selection efficiencies of the collected materials and about the quantity of virgin material substituted by the reprocessed material were made. Moreover, the analysis considers that the energy recovered from the residual waste displaces the same quantity of energy produced in conventional power plants and boilers fuelled with fossil fuels. The analysis shows, in the expanded model of the material and energy recovering chain, that the environmental gains are higher than the environmental impacts. However, when we reduce the selection efficiencies by 15per cent, the impact indicators worsen by a percentage included between 10per cent and 26per cent. This phenomenon is even more evident when we consider a substitution ratio of 1 :< 1 for paper and plastic: The worsening is around 15–20per cent for all the impact indicators except for the global warming for which the worsening is up to 45per cent.

Esakku et al (2007) attempted a study of Municipal Solid Waste (MSW) generation in Chennai, the fourth largest metropolitan city in India. According to them MSW has increased from 600 to 3500 tons per day (tpd) within 20 years in Chennai. The highest per capita solid waste generation rate in India is in Chennai (0.6 kg/d). Chennai is divided into 10 zones of 155 wards and collection of garbage is carried out using door-to-door collection and street bin systems. The collected wastes are disposed at open dump sites located at a distance of 15 km from the city. Recent investigations on reclamation and hazard potential of the sites indicate the need for the rehabilitation of the sites. Chennai is the first city in India to contract out MSWM services to a foreign private agency- ONYX, a Singapore based company. The scope of privatization includes activities such as sweeping, collection, storing, transporting of MSW and creating public awareness in three municipal zones. ONYX collects about 1100 Metric tons of waste from three zones per day and transports it to open dumps. Various Community Based

Organizations (CBO) are also involved in the MSWM of the city. A high rate biomethanation plant for power generation is in operation at the Koyembedu market. Total cost for street sweeping, collection and transportation per Metric ton of waste by Corporation of Chennai (CoC) and Onyx is approximately USD 33 and 25, respectively. The experience from Chennai in waste management shows that cost effective waste management is provided by the private sector. CoC has implemented the seven important mandatory requirements of the MSWM Rule (MoEF, 2000) such as Source Segregation, Door to door collection, Abolition of open storage, daily sweeping of the street, Transportation in covered vehicles, Wastes processing by energy recovery or composting, Sanitary landfilling in most part of the city. It has also initiated the upgradation steps to convert the open dumpsites to sanitary landfills. However, CoC requires addressing problems due to financial support, political issue, public support and lack of CBOs participation to provide a better MSWM for the city.

2.3.4. People's Attitudes and Perception towards SWM

Purcell and Magette (2010) assessed the attitudes of residents towards waste management in general, and BMW management in a select number of representative electoral districts in the Dublin, Ireland region. A total of 850 survey responses were collected. Door-to-door interviews produced 688 responses in the residential sector; these were supplemented by 162 responses to a web-based survey. Logistic regression (Agresti, 1996) was used to determine the strength of relationships between factors. Most respondents in each local authority use local authority waste collection services rather than private collection or personal management. The vast majority (73%) of respondents were 'Satisfied' with their waste collection service, while approximately 14per cent were 'Not Satisfied'. there were more people responding ''Yes" than ''No" to the question of advertisements having an influence on their waste management behaviour; however, there

were approximately the same number saying ‘‘Yes” and ‘‘No” in areas surveyed within the Dublin City local authority. In all local authorities, there were more people responding ‘‘No” than ‘‘Yes” to political party being an influence on their waste practice; Regardless of type of dwelling, few respondents rated themselves as poor managers of waste. Approximately 80% of terrace and apartment dwellers rated themselves as ‘‘Good” managers, while approximately 20per cent rated themselves as ‘‘Excellent” managers of waste. Approximately 60per cent of the detached and semi-detached house dwellers rated themselves as ‘‘Good”, and approximately 40per cent rated themselves as ‘‘Excellent” managers of household waste. The results of a chi-square test of independence suggested a significant association between respondents’ dwelling type and their reasons for composting or not composting. The majority of respondents citing a ‘‘pro-active environmental action/attitude” reason for composting (such as environmental benefit, garden resource, less waste to residual bin, feel better) as their live in semi-detached houses. More than 55per cent of Apartment and Flat dwellers responded that the ‘‘Facilities/Dwelling Situation” deters them from composting at home, while only 8per cent of Terrace respondents cited ‘‘Facilities/ Dwelling Situation” as a deterrent to backyard composting activity.

Centre for Environment and Development (2003) studied households of focused on the solid waste generation, collection, transportation, treatment, disposal, perception, attitude of people towards solid waste management and also various associated problems in Thiruvananthapuram area Kerala, India. The results show that generally people are not willing to do any segregation except newspapers. One of the major observations of this study is that, people are willing to co-operate with the solid waste management programme, if appropriate technology and technical support are provided. They are even willing to pay for proper services, especially for proper collection and management of

waste is carried out. Generally the communities is aware about the problems of solid waste mismanagement and are also very much concerned about the lack of proper system of collection, transportation and management of solid waste of Thiruvananthapuram city by the Corporation authorities. This shows that the attitude and perception of people have changed a lot during the last five years. The analysis of the study shows that now most of the people think that they too have a major role to play in waste management programme, as they are the generators of waste. This it shows the drastic change in the attitude of the people towards solid waste management as compared to the situation during the first phase of the study when most of the people were reluctant to accept their role.

Lalhruaitluanga (2006) studied the problem of domestic solid waste management in its various dimensions in Aizawl and identified the constraints of households in managing solid waste and their expectations from the state and national level urban authorities. The components of solid waste management for which the level of satisfaction of the respondents assessed were adequacy of dust bins, frequency of visit by LAD vehicle, capacity of vehicle, number of workers. On the whole the respondents from the central as well as fringe localities were not satisfied with the way solid wastes are collected and disposed in Aizawl. The dissatisfaction was found to be greater among respondents of the central locality as compared to the fringe locality. The respondents of fringe locality were satisfied with the adequacy of dustbins, capacity of vehicle and number of worker while those from central locality were satisfied with only the frequency of visit of LAD vehicle, which was regular. Household income was found to have significant and negative relationship with the respondent's satisfaction over solid waste management in Aizawl city. As the level of household income increased the satisfaction of the respondent over solid waste management in Aizawl city has declined. On the other

hand the variables like location, gender, educational status, size of family, and percapita domestic solid waste had no significant relationship with the respondents' satisfaction.

2.3.5. Household/ Community Participation in Solid waste Management

Generation of solid waste (SW) is a major problem in urban areas, thus its management is one of the important obligatory functions to not only urban local authority but also for the urban peoples. Rahman et al(2005) focused on existing solid waste management (SWM) system of Khulna City Corporation (KCC) area for improving its inhabitant's environmental health and how peoples perceived on SWM activities of the KCC areas. The household sector is the primary source of Municipal solid wastes in Khulna city. About eighty per cent wastes are coming from domestic sources. These are includes organic, inorganic non-hazardous and inorganic hazardous among the house holders, about 60% gives their waste to the waste collector or dumps into the city corporation collection bin. The rest 40% had thrown their waste into roadside, lowland, canals, drains or house premises (Figure 14). House to house collection system supports 80%, communal 10% and others 10%. In Khulna City waste from the house are collected during day time. This system support 80% householder, the rest 15% night and 5% during afternoon. About 80 per cent people known about resource recovery from the solid waste but they don't collect because in some household these materials cause dirty, odor, risky for children etc. More than 40per cent people separate resource such as paper, bottle, Plastic container, old cloth from the waste More than 80per cent people of House holder, educated person, student, roadside shopkeeper, people around the disposal site, scavenger etc. face several types of problem such as odor pollution, air pollution, traffic jam, dirty roadside etc. In Khulna the city wards are divided into small areas called primary collection blocks. These consist of approximately 500 households which are all served by one rickshaw van. Waste generated in the home is stored in a bin, basket or bag and

collected everyday by a primary collector who transports the waste to nearby transfer points, normally in a rickshaw van. This is primary collection and is the responsibility of the community. Transfer points are places where waste is unloaded from primary collection vehicles to be taken away by secondary transport. Several primary collection blocks are served by a transfer point. The waste is then collected from the transfer points and taken to the final disposal point by a large truck. This is secondary collection and is the responsibility of the city corporation. He concluded that if solid waste management is not a felt need, this will have consequences for their participation in the service and their willingness to pay.

Srinivasan (2006) explored equity, accountability and environmental concerns in solid waste management in Chennai city. Through the study of the urban local body, a private agency and a civil society organization engaged in this activity, it highlights issues related to effectiveness and equity, role of the urban poor in this service, and the relevance of an effective policy framework. In the context of increasing private sector participation in public service provision, and global awareness related to the impact of urban footprints on the planet, the study brings out some interesting lessons on the nature of public-private partnerships in SWM, and the role of the state in guaranteeing social and ecological equity and accountability. It also points to the urgent need for a change in the way the state itself approaches solid waste management, stressing policy mandates that will enforce equitable and ecologically sustainable waste management practices across the country. The study is based on qualitative research methodology, and involved in-depth interactions and discussions with residents, agency officials and conservancy workers, detailed examinations of secondary literature on SWM systems, and intensive field observation of SWM processes in the three agencies in Chennai.

Memon (2002) analysed the community driven composting in Dhaka city. The main focus of this practice analysis is capacity development for urban environmental governance. Due to limited resources and organizational capacity, it is hard for Dhaka City Corporation (DCC) to ensure efficient and appropriate delivery of solid waste collection and disposal services to the entire city population. Therefore, DCC is encouraging community based organizations and local NGOs to organize and carryout community waste management program (mainly house to house collection and disposal). The major success is due to public awareness to separate compost material at source and then civil society's role to take a well planned and well researched composting with sustainable financial mechanism and by selecting an appropriate technology to avoid bad odor. The major success is due to innovation in the marketing through a national fertilizer company, which enriches the compost to meet the requirements of the crops and local soil conditions, based on the research outcome for increased yield and for improved soil fertility. This has increased the demand multifold and provided an incentive for various community based composting plants. On the other hand, an NGO buys the compost and provides the farmers, who grow organic fruits and vegetables, which are being marketed by that NGO in the city and due to increased awareness for organic fruits and vegetables, the demand for the compost is on the rise. Communities carry out their own composting activities. DCC is in negotiations to a lot a piece of land at the landfill site for composting. Therefore, it is evident that communities can pressurize the governments, not only through protests, but also by showing their successful efforts. Hence, this will be a triangular partnership among public, private, and communities.

Karani (2007) reported that in South Africa, the private sector is doing a lot more in the waste management sector especially in recycling. This is done because of the incentives and existing demand from the packaging industry that to some extent has to

comply to international standards that require the industry to meet certain environmental criteria. At grassroots level there are ad hoc initiatives through NGOs and CBOs that encourage waste separation and recycling to generate income and employment for poor communities and contribute to cleaning up of the environment. Issues of concern and lessons that have been identified and require significant attention in development of Integrated Waste Management Planning include recognition and support of community waste management and servicing as well as trans-boundary effects on environmental quality. There is a need to enhance private and public sector partnerships in waste management initiatives. Therefore, support to capacity building is critical to strengthening institutions and legislative framework that would encourage effective waste management systems.

Vyas (2009) found in his study that Unionization of workers and struggles for their entitlements has been an important strategy while the emergence of privatizing SWM sector in urban areas has several dimensions including that of job security, and conflicts between permanent and contractual workers and other groups who work with waste. As privatization of SWM continues, community mobilization to assert the rights of those who would otherwise get further marginalized by state policies becomes imperative. Informal employment which is the mainstay of the majority of the jobs is in fact likely to grow further in developing countries as forces of globalization and privatization make their impact felt. The need for creative and strategic partnerships and alliances is felt more than ever before to support demands for entitlements of the people and advocate for social security. The report argues that, NGO as well as private sector participation may be encouraged in such a way that it does not affect the interests of the existing labor; it does not violate the provisions of the law, does not exploit the private labor and yet reduces the burden of the ULB. This will substantially help in improving the quality of service of the

ULBs, effect economy in expenditure and also give scope to the private sector to enter the waste management market.

2.3.6. Willingness to Pay for SWM

Longe et al. (2009) examined the structure of household waste management system, collection and disposal within the context of a wider research on integrated solid waste management in Ojo Local Government Area, Lagos State, Nigeria households. Public opinion and perception on solid waste management system is characterized with irregularity and inefficient collection system; with poor monitoring of the private waste service providers by the local authority. The data on age shows that subjects are matured adults whose reasoning level as regard household waste and management is expected to be high and thus facilitate public involvement in solid waste management process. The influence of educational attainments could as well be an important factor that could influence people's perception on HHW management. Only 13% of the respondents had no form of education. This per centage even though small, could negatively influence their perception and attitude on HHW management in general and affect recovery cost of waste management services in particular. The poor average income of respondents is considered a very important variable that could influence people's perception and attitudes negatively on solid waste management system Willingness to pay for waste management services provided by the private service providers, the Private Sector Participation operators is higher among the middle and high income socio-economic groups than in the low income group. This survey results indicate that the rate of willingness to pay is relatively high across the three socio-economic strata. It clearly show that the people of Ojo are ready to pay for the services if regularly provided and this perceived rate of willingness is bound to increase with higher income earnings and adequate environmental education of the populace.

Niringiye and Omortor (2010) conducted a study on willingness to pay for improved solid waste management in Kampala city, Uganda. A multi stage sampling technique was employed. A dichotomous choice contingent valuation technique was used to elicit households' willingness to pay for improvement in management of their solid waste. They used a logistic equation model to establish the determinants of willingness to pay for solid waste management. The logistic regression estimates, revealed that the age of the household head is negatively associated with the willingness to pay for solid waste management and respondents level of education, marital status, quantity of waste generated, household size and household expenditure do not significantly influence willingness to pay for improved waste management, and that the demand for improved waste management is only significantly related to the age of the household head. There is a positive relationship between income and demand for improvement in environmental quality. They suggested that the government should concentrate first on awareness campaigns about the consequences of waste mishandling and benefits of payment for proper waste management before building up the commercialization plan for solid waste management in Kampala city.

Rahiji and Oloruntoba. (2009) examined the determinants of willingness-to-pay for private solid waste disposal systems by urban households in Ibadan, Nigeria. A multistage random sampling technique was used to select 552 households for the study. Data obtained from survey were analyzed using a logit model-based contingent valuation. Evidence from the logit model indicated that seven variables had significant influence on the households' willingness-to-pay. Of these, income and asset owned were positive and significant but amount of willingness-to-pay and firm services were negative and significant. Education and occupation were positive and significant while age was

negative and significant. The implication is that households have certain socio-economic characteristics, which influence their willingness-to-pay for solid waste disposal.

In spite of the existence of copious literature on household solid waste management, a few research gaps could be identified. Firstly, most of the studies were institutional in nature and macroscopic in orientation. There are a few studies which focus on the household waste management behavior and practices and microscopic in orientation. Secondly, a few studies were attempted in the context of North east India though urbanization is taking place over the decades and the seriousness of the problem of solid waste management is widely recognized. Thirdly, there is only one study conducted in Mizoram (see Lalhruaitluanga, 2006). Though the study explores into most aspects of household solid waste management, methodologically it suffers from inadequate sample size. Fourthly, the choice of household in using different modes of disposal and its determinants has not been adequately probed into. Finally, the household's willingness to pay for improvement in the municipal solid waste management has not been adequately studied in the context of India, north east and Mizoram. The present study tries to fill these research gaps.

In this chapter an attempt has been made to present critical review of literature on household solid waste management. In the light of the review the next chapter presents the methodological aspects and the setting of the present study.

CHAPTER III

METHODOLOGY

CHAPTER III

METHODOLOGY

The earlier chapter presented a critical review of literature and the major research gaps therein. In this chapter the setting of the present study and methodology are presented, description of the studying process and the interview technique that was used. This chapter has been structured into two major sections. The first section deals with profile of the study areas including the profile of the High and the Low Development Localities. The second section deals with the methodological aspects of the present study such as objectives and hypotheses, research design, sampling, tools of data collection, data processing, analysis and limitations of the present study.

3.1. The Setting: Profile of the Study Area

The present study was conducted in the urban localities of Aizawl city, the capital of Mizoram state. The profile of the studied areas is presented in two subsections viz., the Aizawl Town and the localities.

3.1.1. The Aizawl Town

Aizawl is a bustling town in the remote northeast part of India. It is the scenic capital of the northeastern state of Mizoram. It is the largest city in the whole state with an area of 3576 square kilometers. Aizawl literally stands for "the home of the highlanders", which has been rightly proved by the beauty and people of the city. Twenty six per cent of the population of Mizoram resides in the city. The city comes under the administrative district of Aizawl and is thus, the center of all prominent government offices, state assembly house and civil secretariat. Aizawl is positioned at an altitude of 1,132 meters above the sea level, on the north of Tropic of Cancer. The city makes a nature delight with River Tlawng flowing softly in the east and serrated hills of Durtlang in its north. Aizawl has a rich tribal cultural burlesque and is blessed with natural beauty.

It is well known for its exotic handicrafts worldwide. As of 2001 India census, Aizawl had a population of 228,280. Males constitute 50.80 per cent of the population and the remaining 49.20 per cent constitutes females. Mizos from various tribes make up the majority of the population. Due to its location, Aizawl has a humid subtropical climate with mild summers (20^0 C - 30^0 C) and cool winters (11^0 C - 21^0 C).

The solid waste being generated in Aizawl area is now dumped at Tuirial, about 20 kilometers from the heart of the town. Before Aizawl Municipal Council exist, it was used as a composting place, since at that time the solid waste contained only organic, putreceable matter. But later on, as a result of the change in the contents of the waste, composting became difficult and no effective processing was introduced, resulting in just dumping of the waste. At times the garbage is burnt, resulting in the pollution of the surrounding areas. So it is clear that the existing system of solid waste management is totally unscientific and unhygienic. The other dumping area was at Sakawrhmuituai, due to the resistance from the community near this site, it was cease for the present.

In 2010 PPP mode was introduced in different part of the community in Aizawl which came under jurisdiction of Aizawl Municipal Council. Narrowness and steepness of roads make collection of wastes and transportation very difficult. As a result, LAD and Municipal waste collection vehicle are not covering most of the residential regions. The AMC does not provide waste treatment services but provides collection and disposal services only.

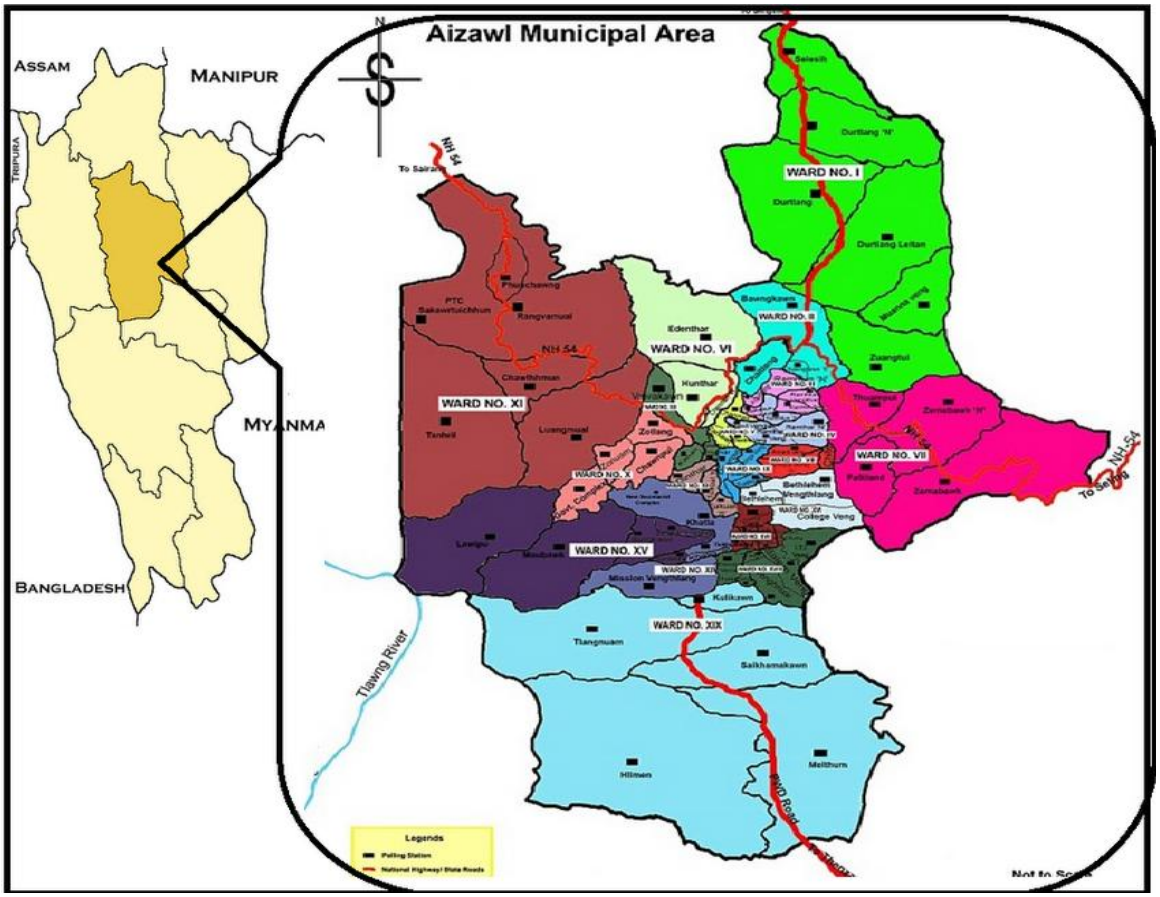

Figure 3.1 Aizawl Town

3.1.2. The Localities Studied

The present research was carried out in two localities of Saron Veng which represents the locality with high level of development and the other locality was Durtlang North veng which represents the locality with low level of development. For better understanding of the locality participatory approach was adopted by conducting Social map and Services and Opportunities Map in the two localities, the participants were the members of these two localities itself. Secondary information through unstructured interview was also gathered from the community members. The detailed descriptions of the two localities were discussed below.

3.1.2.1. Saron Veng

This community represents locality with high level of development. Saron Veng established in the year 1954, as time passes by, with the growing of population and demand for development; they acquired separated Village Council Court in 1982. At present there are 715 households in the community, out of which 94 households belong to BPL/AAY, and the rest 621 belongs to APL households. The locality bear its name from Saron Flower, which has thorn and can bloom for a long time compared to other flowers, Many wealthy people used this Saron to decorate their gates and house compound, the flowers bloom in different color, so the locality name came into existence. Many organization had established in this community, Young Mizo Association (YMA) was established in 1st, October 1962, Saron Welfare Society was established in 1996, Mizo Hmeichhe Insuihkhawm Pawl (MHIP) was established in 1979, Police Welfare was established in 28th July, 1992.Mizo Zirlai Pawl (MZP) was established in 12th, November 2003, Mizo Cultural Organization (MCO) was established in 26th March 2009, Saron Arm wrestling Club (SWAC) was established in 8th, May, 2008. Saron literature club was established in 15th, October, 2006.

Besides these there were many important places within the community, there is a Police Quarter consisting five buildings in which 61 household has been living. There are one Indoor Stadium and two YMA Buildings. There are two Churches, One Baptist Church and the other one Presbyterian Church. There are three Motor workshops, two Steel Fabrications, two Carpentry Workshops. The community also has Four Printing Press. Regarding educational institution, there are two Anganwadi Centers, two Primary schools and one Middle School. There are 4 springwell/ tuikhur in the community.

For better understanding of Saron Veng, Social Map and Services and Opportunities Map were drawn with the community people. Saron Veng is one of the

clients of Aizawl Municipal council PPP mode of waste service. Within a week waste collection vehicle collects three times- on Tuesday, Thursday and Saturday. Before AMC introduced Waste collection service in their area, people used to dump their waste at open drains near their house which often cause overflow in these drains and pose problems for the community. Since then the local council took initiatives by covering all the drains which eliminated the said problems in the community.

Figure 3.2 Social Map of Saron Veng

From the Services and Opportunities map (see table 3.3), it can be seen that the community is endowed with some of the important infrastructure and institution, there are seven springwell/tuikhur in the community, the community is well linked with metal road, steps and unmetalled road. Since Saron Veng is under IX ward of Aizawl Municipal council administration, sanitation and waste collection is started in the year 2010 by the AMC. Five sanitation points used as a collection point of household waste more

concentrating on the Northern side of the community, which is due to the inconvenient of waste vehicle to visit and collect garbage in the other part of the community because of its geographical condition. 407 truck vehicle (heavy medium vehicle) visits these points accompanied by two workers

Figure 3.3. Services and Opportunities Map of Saron Veng

From the secondary information gathered, SIPMIU agency has taken steps to aware the community people regarding Waste management which also include liquid waste as well as human excreta. They organized community meeting, and taught the new waste processing design which is soon to be launched. There is some disadvantages in the locality since it exist in the centre of Aizawl, Bazaar area is close by, which add the magnitude of waste generated at a community level and not necessarily at household level.

3.1.2.2. Durtlang North

Durtlang North (formerly known as Durtlang Vengthar) represents low development community. Social map and services and Opportunity map were conducted to support the better understanding of the community. The community separated from Durtlang in 1966. It was first called Melruk (i.e. six mile from Aizawl centre), there were only 20 household at that time. In February 20, 1979 Presbyterian Church was established and named the community as 'Durtlang Vengthar'. Many organizations were emerging after its establishment, such as Y.M.A in 1992, Village council in 1997. In 2009, the community gets its name 'Durtlang North' under an official declaration of Government of Mizoram. At present there are 332 households in the community, out of which 117 households belong to BPL/AAY, and the rest 215 belongs to APL households. It can be seen that there are two important roads passing through the locality connecting Aizawl to neighboring state of Assam. There are government institutions such as Educational schools, Remand Home, Hindi Training College, MPRO as well as private institutions such as ICFAI University, BSNL and other correctional home/institute for the destitute such as Jericho Khualbuk and Servants of God camping centre.

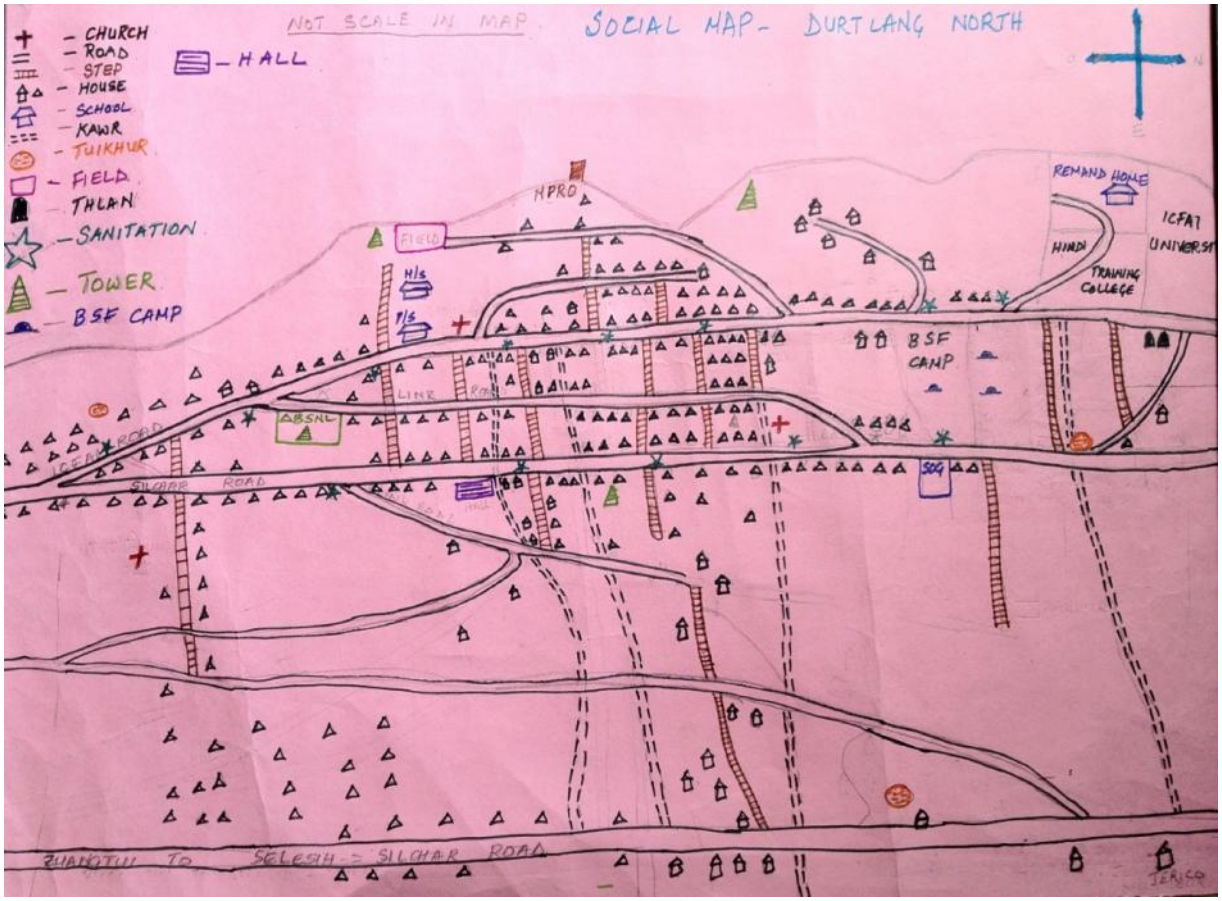

Figure 3.4. Social Map of Durtlang North

From the services and opportunities map drawn by the locality members, the map shows that waste collection point are evenly distributed in the densely populated area of the locality. There are thirteen waste collection points in the upper and middle road within the locality. There are five spring well, three big water tanks and three Public Health Engineering department hand pumps existed in the locality. There is one hall community hall for public convenience, three churches, and three communication tower which belongs to BSNL and Airtel Company. The locality belongs to Ward no. I of AMC, from the secondary information gathered while conducting the PRA, the locality people were not given an adequate service regarding SWM, only one vehicle truck is allotted to collect wastes from house to house, sometimes it visits only once a week, which inculcate not willing to depend on the vehicle for household waste disposal. The locality people tend to

throw their waste at their neighboring open land or drain whichever is convenient for them.

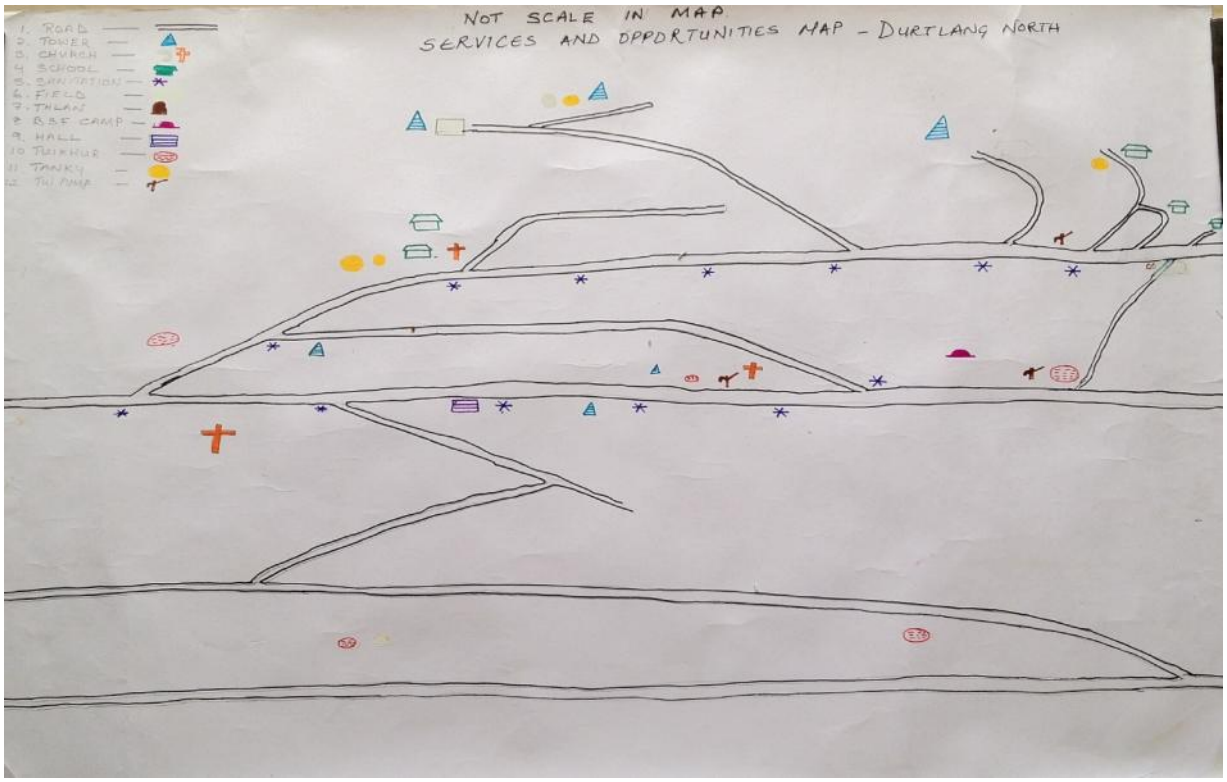

Figure 3.5. Services and Opportunities Map of Durtlang North

3.2. Methodology

The present study is cross sectional in nature and descriptive in design. The study is based on primary data collected through field survey with pretested structured household interview schedule. Participatory methods such as social map and services and opportunities map were employed in order to understand the community contexts of solid waste management in the study area. Field survey was conducted during the months of October-November 2010.

3.2.1. Sampling

A multi stage sampling procedure was followed to select urban area, localities and households.

Firstly, from the eight urban areas in Mizoram, Aizawl, the capital city of Mizoram, was purposively selected as it houses 52 percent of the urban population in the state. Secondly, The localities of Aizawl city was classified into high and low levels of development on the basis of three household indicators namely proportion of poor households, proportion of households with telephone, and proportion of households having LPG connection (GOM, 2004). Two representative localities were selected on the basis of composite index of development of aforesaid indicators. To represent the High Development Community Saron Veng was chosen and for representing Low Development Community Durtlang North was selected. Thirdly, in the two selected localities, the lists of poor and non-poor households were collected from the Village Council President. Finally, in each of the category, using systematic random sampling procedure households were selected from the lists of poor and non-poor households. Sample size was 134 household.

3.2.4. Tools of Data Collection

Structured pre-tested household interview schedule was used for collection of data for the present study. The interview schedule contains ten sections with a number of sub-sections. The major sections are demographic profile, socio-economic profile, Waste collection, storage, method of disposal and frequency of waste disposal, perception on existing waste management system, willingness to segregate waste by its characteristics(i.e. Biodegradable and non-Biodegradable waste), willingness to pay for improving waste management system (see appendix) and perceived problems and suggestions. Pilot study was firstly conducted in one community and in the light of that a structured interview schedule was framed. It was pre-tested in a community and in the light of the pre test modifications were made in the interview schedule (see appendix). Then final survey was conducted on the sample of households selected.

3.2.5. Data Processing and Analysis

The primary data collected through field survey was processed with the help of Microsoft Excel and analysed with SPSS package. Apart from simple percentages, ratios, percentages and averages, the study used Coefficient, t test, Kendall's W, and Spearsman's rho for analysis. Karl Pearson's Product Moment Correlation was used for testing the hypotheses.

3.2.6 Limitation

The limitation of this study is that solid wastes generated are not measured and accounted by the households, hence majority of the respondent could only tell the approximate value from their memory.

This chapter has presented the setting and methodological aspects of the present study. The next chapter presents results and discussion of the study.

CHAPTER IV

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

In the present chapter an attempt has been made to present the results of the analysis of data collected through field survey in two urban localities of Aizawl. This chapter has been presented in seven major sections each with sub-sections. The patterns of sections arrangement are profile of respondents and their households, patterns and magnitude of household solid waste, pattern of storage of waste, pattern of disposal of waste, satisfaction with the existing solid waste collection and disposal services, willingness to pay for solid waste management and respondents perceived problems in solid waste management and suggestions for improvement.

4.1. Profile of Respondents and Their Households

The profile of the respondents is presented in five subsections viz., demographic characteristics of the two localities, family characteristics, social characteristics, economic characteristics and Annual Household Income and Total Household Assets

4.1.1. Demographic Characteristics

The demographic characteristics comprises of gender, age group, marital status, and educational status of the studied communities (see Table 4.1).

In respect to gender of household head, Male constitutes a higher percentage in both the communities. Male percentage in the locality with low level of development was 95.2 per cent and 90.2 per cent in the High Development Community, whereas in the High and locality with low level of development, female comprised of less than one tenth (8.2) of the total population.

The age group were classified into Youth (below 35 years), Middle (35-59 years) and Old (60 years and above). From the findings, middle age constitutes a higher percentage in both the communities. More than two third of the population (80.4%) in the

High Development Community were in the age group of the middle category. Also in the locality with low level of development more than half of the populations (64.3%) were in the age group of middle category. The age group of the Old category in both the communities however had a variation, in the locality with low level of development it is higher constituting 21.4 per cent and 6.5 per cent in the High Development Communities.

As far as marital status is concerned almost all (92.9 %) of the respondent were married in the locality with low level of development and a little less than almost all (87 %) were married in the High Development Community followed by widowed i.e. less than one tenth (8.9 %) in the High Development Community and only 4.8 per cent in the locality with low level of development. The percentage of divorce/separated however was low (1.1%) in the High Development Community and nil in the locality with low level of development. Overall in both the communities married constitutes the highest percentage followed by unmarried which was again followed by widowed and remarried and then finally followed by divorce/separated.

The educational status of the respondents was classified six levels viz., into illiterate, primary (1-4), middle (4-7), high school (8-10), higher secondary (11-12), and college (13-Above). In the locality with low level of development illiterate constitutes percentage of 4.8 per cent, while the locality with high level of development does not have illiteracy. However in the primary level and middle level, the locality with low level of development had a slightly higher percentage. In both the primary level and middle school level the percentage was 14.3 per cent when to that of 1.1 per cent of the High Development Community. And in the High School level the locality with high level of development held a higher percentage of 56.5 per cent to that of 33.3 per cent. However, the High Development Community had a higher percentage from higher secondary level to collegiate i.e. one-tenth (13%) in the higher secondary to that of 11.9 per cent of the

locality with low level of development and more than one-seventh (19.6%) for college in the High Development Community to that of one-tenth (11.9%) of the locality with low level of development. A similar finding was also evident in an earlier urban study in Aizawl (see Chhangte, 2010).

4.1.2. Social Structural Characteristics

The social structural characteristics include sub-tribe, type of clan, and denomination. Such were discussed below (see table 4.2).

In respect to sub-tribe the respondents' households belonged to Lusei, Ralte, Hmar, Paihte, and Non-Mizo communities. Lusei is the predominant tribe in both the studied communities i.e. more than half (64.3%) in the locality with low level of development and more than seventh tenth (73.9 %) in the High Development Community followed by Ralte i.e. a little less than one-fifth (19.6 %) in the High Development Community and one-seventh (14.3%) in the locality with low level of development which was followed then by Hmar and Paihte sub-tribe i.e. Both the sub-tribe constitute less than one tenth (9.5 %) in the locality with low level of development and 4.3 percent in the High Development Community falls in Hmar and 2.2 percent falls in Paihte category. However, not belonging to Mizo sub-tribe constitutes a higher percentage (2.4%) in the locality with low level of development to that of the High Development Community which holds nil per cent. Similar observation on sub-tribe in Aizawl was also observed in the earlier study too (Chhangte, 2010)

The type of clan was divided into ruling and commoner. Mostly commoner clan dominate in both the High and locality with low level of development comprising a little less than fourth fifth (71.4%) and two third (65.2%) in locality with low level of development and locality with high level of development respectively. At the same time ruling clan constitute a significant percentage in the community, 28.6 percent in locality

with low level of development and 34.8 per cent in locality with high level of development.

With regards to religious denomination, Presbyterian was the dominant denomination within the studied communities i.e. more than four-fifth of the population in the High Development Community (88.1%) and in the locality with low level of development (78.3 %). Similar observation was also made in the earlier studies (see Chhangte, 2010). It was followed by The Salvation Army (9.5% and 8.7%) in both the communities. In the locality with low level of development Roman Catholic denomination comprises 2.4 percent of the total population. But in locality with high level of development Methodist church came next to the Salvation Army (4.3%), it is followed by United Pentecostal Church (3.3%), while Roman Catholic, Lalchhungkua Unity, Baptist Church, Kohhran Thianghlim and Seventh Day Adventist share the same percentage of 1.1 out of the total population in locality with high level of development.

4.1.3 Economic Characteristics of Respondents

The economic characteristics of households of the studied communities comprised of Earner or Dependent category, primary occupation and secondary occupation, Assessing the economic characteristics was also important in order to find if there was any positive or negative relationship in households' solid waste generation and households' willingness to pay and willingness to participate in community's solid waste management (see table 4.3).

In the locality with low level of development (88.9%) most of the respondents belongs to Earner category of households. The locality with high level of development with almost the same amount (89.1%) of the total population falls in the same category. The Dependent category has one tenth of the total respondent both in locality with low level of development (11.9%) and locality with high level of development (10.9%).

Primary occupations were categorized into dependent, Government officer, Government workers, cultivators, Animal Husbandry, Private worker, petty business, Wage Laborer, Skilled laborer and large Business. Government workers comprise the largest primary occupation in both locality with low level of development and locality with high level of development. More than one-fifth (26.5%) of the total population of locality with low level of development engaged in this category, and almost two fifth (38%) of the population in the locality with high level of development. Dependent category and Private worker follows with 14.3 per cent each in locality with low level of development. Each One-tenth of the population distribute among cultivators (9.5%), Animal Husbandry (9.5%), Skilled laborer (11.9%) in locality with low level of development. On the other hand in locality with high level of development, large business category comprises one-fourth (25%) of the population.

In Secondary occupation category, almost all(91.8) of the total population don't have secondary occupation, the locality with low level of development has more diverse secondary income to that of locality with high level of development, comprising petty business (9.5%) and cultivator (7.1%).

4.1.4. Family Structure of Respondents

The family structure of Respondents includes type of family, form of family and size of family, the details were discussed below (see table 4.4).

In reference to type of family, nuclear family constitutes a higher percentage in both the studied communities. It constitutes nine-tenth (90.5%) in the Low Development Communities, and fourth-fifth (78.3%) in the locality with high level of development. Joint family constitutes one fifth (21.7) in the High Development Communities, in locality with low level of development it only constituted only one tenth (9.5%) of the population. The form of family in the locality with low level of development was 100 per

cent stable and almost 100 per cent stable (96.7%) in the High Development Community. Broken family and reconstituted family holds 2.2 per cent and 1.1 percent respectively in the High Development Community however the locality with low level of development had a zero per cent in both category. The size of family is an important variable for assessing household solid waste generation, determinants of waste, disposal of waste and willingness to pay for improved household waste management even at the community level. The size of family was divided into three categories viz small (1-3), medium (4-6), large (7 and above). The medium size of family was a dominant size in the two communities' i.e. three-fifth (64.3 %) in the locality with low level of development and fourth-fifth (79.3%) in the High Development Community. The percentage of small family was again slightly higher in the locality with low level of development i.e. one-sixth (14.5%) to that of less than one-tenth (7.6%) of the High Development Community, however large family was again higher in percentage in the locality with low level of development i.e. one-fifth (21.4%) to that of one-tenth (13%) of the locality with low level of development. The mean size of family was 5.1 in the locality with low level of development and 5.5 in the High Development Community. This means that there is not much variation in the mean size of the family. However, we can see that the High Development Community has slightly higher family members.

4.1.5. Living Conditions of Respondent Households

Living condition of the respondent household are measured in terms of annual households' income, Per capita household Income, total value of household Assets and Per capita Household assets in both Low and High Development community. The minimum annual income of locality with low level of development was Rs.32000, whereas in the High Development Community it falls down at Rs.26000. However the maximum annual household income was Rs. 13200000 for the locality with low level of

development and Rs.1644000 for the High Development Community. Thus, the average households' annual income in the High Development Community was Rs.283305 and Rs.553438 for the locality with low level of development (see table 4.5). The average of the total population of both the community is Rs.367974. The minimum per capita household income in locality with low level of development is Rs 4571 and Rs 5200 in locality with high level of development, the maximum per capita household income is Rs 1885714 and in locality with high level of development the maximum is Rs328800. The Average per capita household income is less in locality with high level of development (Rs.55874) to that of locality with low level of development (Rs.90146).

The maximum total value of household Assets in locality with high level of development is Rs.10105000 and in locality with low level of development the maximum is Rs.5804000. the overall average total value of household assets in both community is Rs.881758. While the average per capita household assets in locality with low level of development is Rs 153513, in locality with high level of development the average Per capita household assets is Rs 182694.

4.2.1. Patterns and Magnitude of Household Solid Waste

The process of consumption of products results in the formation of solid waste in urban areas. The household solid waste is composed of two types of wastes viz., biodegradable and non-biodegradable wastes. Biodegradable waste includes vegetables, paper, wood and textile, and Non biodegradable waste include plastic, glass and can. In this section the results of the analysis of differential pattern of household solid waste generated in two localities as well as the differences in the actual magnitude of household solid waste have been presented.

The pattern of solid waste indicates the relative position or ranking of the various components of solid waste generated at household level. The major question that arises

here is that whether is there any similarity in the pattern of solid waste generated in among the households of each of the localities studied and between the localities themselves. To study similarity or agreement in the pattern of solid waste generated among the households, Kendall's W was used while to probe into the question of similarity of pattern of solid waste between the localities at different levels of development Spearman's rho was used (see table 4.6).

There is a moderate level of agreement among the households of each of the localities in the pattern of solid waste generated. The Kendall's W worked out for locality with low level of development(0.45), locality with high level of development(0.63) and the total(0.41) were moderate and significant at 1 percent level. Further, the pattern of household solid waste generated differs significantly between the localities at different levels of development. More than half of the household solid waste generated in the locality with low lever of development was biodegradable (54%) in nature while one half of the solid waste was of non-biodegradable in nature (50%). In the locality with low level of development, plastic constituted the greatest share (25.2%) which is closely followed by paper(21.%), vegetables(13.8%), can(10.9%),glass(9.9%), wood(9.6%) and textile(9.2%) respectively in order. On the other hand, the pattern of household solid waste generated in the locality with high level of development was Vegetable(31.8%),Plastic(29.4%),Glass(19%),Wood(6.5%),Textile(5%), Paper(4.2%), and Can(4.1%) respectively in the order.

As regards the magnitude of solid waste generated there was no significant difference between the localities at high and low levels of development. The per day per capita solid waste generated in the locality with low level of development was worked out to 244.3 grams while that of the locality with high level of development was 260.4 grams. However, this difference in per day per capita solid waste was not even significant at 5

percent level. Similarly, the magnitude of solid waste per household was not significantly different between these two localities. In the locality with low level of development the mean quantity of solid waste generated was worked out to 7489.7 grams while that of the locality with high level of development was 8646.7 grams. Likewise, the magnitudes of biodegradable and non-biodegradable components of solid waste also do not differ significantly between the localities at two levels of development. The magnitude of biodegradable solid waste generated by a typical household in the locality with low level of development was 4821.4 grams while that of locality with high level of development was 4104.8 grams. Similarly, the non-bio degradable solid waste in the locality with low level of development was on an average 4104.8 grams per week while that in the locality with high level of development was worked out to 4321.4 grams per week.

Though there was no significant difference between them in the overall magnitude of solid waste generated among the most of the components of biodegradable waste and some of the components of non-biodegradable waste significant differences in the magnitude were observed. Among the components of biodegradable solid waste, there was significant difference in wastes of vegetable, paper, and textile between the localities at different levels of development while no such difference was observed in wood waste. Significantly greater quantum of vegetable wastes is generated in locality with high level of development as compared to that of locality with low level of development. On the contrary, the quantities of wastes generated in the form of paper, and textile were significantly greater in the locality with low level of development as compared to the locality with high level of development. However, in wood waste no significant difference was observed between the localities at different levels of development.

In spite of the fact that there was no significant difference in magnitude of non-biodegradable wastes between the localities at different levels in two of its components

there was a significant difference. The solid waste generated in the form of glass was significantly greater in the locality with high level of development as compared to that of locality with low level of development. On the other hand in terms of can the locality with low development generated significantly greater waste as compared to the other locality. However, there was no significant difference in the waste generated in terms of plastic between these two localities.

4.2.2. Determinants of Magnitude of Solid Waste

The major research question the present study tries to answer is that what are the factors determining the magnitude of household solid waste. To answer this question and provide focus to the present study the first hypothesis was formulated. It reads that 'Education status of the respondent, size of family, and annual household income are indirectly related to the magnitude of household solid waste generated'. To test this hypothesis Karl Pearson's product moment correlation was used. The dependent variables were the quantity of solid waste generated in terms of biodegradable, non-biodegradable components, the total solid waste and per day per capita solid waste. The independent variables were demographic and economic structural bases of the respondent and their household. The demographic variable were age group, gender, education status, size of family and household mean years of adult education while the economic variables were per capita household assets and per capita annual household income (see table 4.7).

Among the demographic variables size of family, and mean years of adult education are significantly associated with the magnitude of solid waste generated by the households. On the other hand, age group of respondent, education of the respondent and gender of respondent had not significantly associated with any of the components of solid waste or the per day per capita solid waste which is contradict to the result found in the study of Sujauddin et al (2007) the generation of HSW was positively correlated with

family size, education level and monthly income of the households. Though size of family had no significant effect on the magnitude of biodegradable solid waste it has significant positive relationship with the magnitude of non-biodegradable solid waste (0.25) and total magnitude of solid waste (0.23). Interestingly, it has negative relationship with the per day per capita solid waste of household (-0.40). Similar negative effect of family size on per capita solid was reported in an earlier study in Mizoram (Lalhruaitluanga, 2006).

Though respondents education has no effect on the magnitude of solid waste generated the education status of its members have significant positive effect on the magnitude of non-bio degradable solid waste (0.33), total solid waste (0.28), and per day per capita solid waste (0.17).

Both the economic factors per capita household income and per capita household assets have significant effect positive effect on the magnitude of household solid waste generated. The per capita household income has no significant relationship with biodegradable waste (0.03), and per capita solid waste (0.10). Yet it has significant positive effect on the magnitude of non-bio degradable solid waste and so total solid waste. On the other hand, a per capita household asset has significant positive effect on bio-degradable (0.19), total magnitude of solid waste (0.18) and per capita solid waste (0.19).

As the results of correlation analysis show direct relationship between the magnitudes of solid waste on the one hand and education, size of family, annual household income the hypothesis that education status of the respondent, size of family, and annual household income are indirectly related to the magnitude of household solid waste generated has been rejected. The similar result is found in previous study (Akther 2009). The results imply that as economic and social development takes place the

magnitude of solid waste generated especially non-bio degradable waste increases even in the urban context of tribal society of Mizoram.

4.3. Pattern of Storage of Waste

The pattern of household biodegradable and non biodegradable solid waste storage is divided into three main group of none, dustbin and gunny bag of containers which were differed in type, shape, size and nature of material they were made of.

4.3.1. Pattern of Storage of Biodegradable Solid Waste

The patterns of storage of biodegradable waste reveals that paper were stored mostly in dustbin (82.84%). However in the degree of dustbin storage is much higher at high development community (90.22) than locality with low level of development (66.67%) followed by Gunny bag (12.69%) storage. In locality with low level of development almost one third (30.95%) of the respondent used gunny bag while in locality with high level of development only 4.35% used it.

Majority (53.73%) of the respondent did not store wood. In locality with high level of development three fourth (77.17%) of the respondents did not store wood waste, while only 2.38 percent did not store their wood waste in locality with low level of development. while two third (66.67) of the respondent in locality with low level of development stored wood waste in dustbin, only 17.39 per cent in locality with high level of development stored wood waste in Dustbin. In locality with high level of development more than fourth fifth (85.87%) of the total respondent use nothing to store their textile waste, one tenth (10.87%) of the respondent use dustbin and only 3.26% use gunny bag. In locality with low level of development two third (66.67%) of the respondents use dustbin, while only almost one third (30.95%) of the respondent use Gunny bag to store textile wastes. In locality with low level of development, Vegetable waste is stored

mostly in dustbin (66.67%). Followed by gunny bag comprising of 30.95 per cent of the respondents. More than two fifth (42.39%) of the Respondents from locality with high level of development use dustbin to store vegetable waste and more than one third (34.78%) of them use gunny bag (see table 4.8).

4.3.2. Pattern of Storage of Non-biodegradable Solid Waste

In both the communities, Dustbin is commonly use by respondent to store can (55.97%) and Plastic (85.07%). Almost two third (60.45%) of the respondents use no separate storage for glass waste. In high development community 51.09 percent use dustbin to store Can followed by none storage (46.74%). In locality with low level of development two third of the respondents use dustbin to store can waste followed by gunny bag (30.95%). In locality with high level of development, more than almost all(93.48%) of the respondent use dustbin, while in locality with low level of development, dustbin is used by two third (66.67%)of the respondent, and 30.95 percent use gunny bag to store plastic waste. More than fourth fifth (86.96%) of the total respondent use nothing to store their glass waste followed by dustbin (8.7%) and Gunny Bag (4.35%) (See table 4.9).

4.4. Pattern of Disposal of Waste

The pattern of disposal of biodegradable and non biodegradable waste is divided into five categories, None, Burning, Open dumping, Vehicle and sale**.**

4.4.1. Pattern of Disposal of Biodegradable Solid Waste

In both the communities, the result shows that disposal of paper waste through vehicle service is widely (72.4%) utilized by the respondent, next by none disposal of textile (58.2%) and wood (52.2%). In locality with high level of development fourth fifth (80.4%) of the respondent use vehicle service to disposed off their paper waste. followed by none (6.5%), Burning (5.4%), open dumping (4.3%) and sale (3.3%) of their paper

waste. In locality with low level of development, more than half (54.8%) of the respondent use vehicle service to dispose off their plastic waste, Open dumping by more than one fifth (23.8) of the respondents and sale of their paper waste by 2.4 percent of the respondent. Wood waste has not been disposed in locality with high level of development by majority (76.1%) of the respondent. More than one tenth (14.1%) of the respondent deposited their wood waste in waste collection vehicle, and 8.7percent of them burn their wood waste. In locality with low level of development, majority (59.5%) of the respondent dispose wood waste in vehicle service, followed by open dumping (26.2) and burning (14.3). While More than fourth fifth (84.8%) of the total respondents use none and only 9.8 percent use vehicle to dispose their textile waste in locality with high level of development, in locality with low level of development vehicle is mostly used by 59.5 percent of the respondents. Open dumping is prevalent for textile disposal (28.6%) followed by burning (11.9%). For vegetable waste disposal majority (59.5%) of the respondent use vehicle in locality with low level of development, followed by open dumping (28.6%). In locality with high level of development, more than one third (42.4%) of the respondent deposited vegetable waste in vehicle and almost the same percent (40.2%)of the respondent use none to dispose their vegetable waste.(see table 4.10)

4.4.2. Pattern of Disposal of Non-biodegradable Solid Waste

With regards to the storage of non biodegradable waste vehicle service is used by more than two third (77.6%) of the respondent in both the studied communities. For disposal of can waste majority of the respondent from locality with low level of development (59.5%) and locality with high level of development (55.4%) uses vehicle service. None mode of disposal is use by two fifth (42.4%) of the respondents in locality with high level of development. In locality with low level of development majority

(59.5%)of the respondent use vehicle followed by 28.6 percent use open dumping to dispose their can waste. Plastic waste has been disposed off at vehicle service by more than fourth fifth (85.9%) of the respondent in locality with high level of development. In locality with low level of development half (59.5%) of the respondent use vehicle to dispose their plastic waste. For Glass disposal, while 85.9 per cent use none mode of disposal, in locality with low level of development 59.5 percent dispose in vehicle service.(see table 4.11)

4.4.3. Determinants of Choice of Mode of Disposal of Solid Waste

An important question in the context of the present study is concerning the factors affecting the household's behavior of properly depositing the solid waste with the waste collection vehicle of the municipal council. Hence, in the present study it is hypothesized that the household's choice of the mode of solid waste disposal depends upon gender of head of the family, education of the respondent and family size. To test this hypothesis Kendall's tau_b was used (see table 4.12).

The dependent variables were the choice of depositing solid waste with LAD/PPP vehicle, choice of depositing biodegradable waste with the vehicle, and choice of depositing non-bio degradable solid waste with LAD/PPP vehicle. The independent predictor variables were locality development, age group, gender, education, mean years of education, per capita household income, and per capita household assets (see table 4.12).

As expected the locality development has significant positive effect on the disposal of biodegradable, and non-biodegradable solid wastes. The households of the locality with high level had greater likelihood of depositing both types of waste with PPP vehicle and follow proper waste management practice.

Among the demographic variables age group, education, mean years of adult education have significant effect on the choice of disposal of solid waste while gender of the respondent has no significant effect. Age group has significant negative effect on disposal of biodegradable, non-biodegradable solid wastes. As the age of respond increases the chance of depositing the biodegradable and bio non-degradable solid waste with the vehicle decreases. Respondent's education status as well as mean years of adult education have significant positive effect on the choice of mode of disposal both the types of solid waste. Higher the education status of the members of the household higher is its likelihood of depositing the waste with the LAD/PPP waste collection vehicle. On the contrary to the expectation, the family size has no significant effect on the choice of mode of disposal.

The economic variables per capita household income and per capita assets have no significant effect on the household choice of mode of disposal of biodegradable and non-bio degradable solid waste.

4.4.4. Frequency of Waste Disposal

The number of times of different types of waste Disposal were assessed with the help of a four scale (Thrice a week =5, Twice a Week= 4, Weekly =3, Fortnightly =2, Sometimes =1, Never =0). From Table 4.13 it could be observed that the frequency of waste disposal Households differs between the communities at different levels of development. While in locality with low level of development scores the mean average of 3.5, in locality with high level of development the mean average score is 2.3. In locality with low level of development paper, wood, textile, vegetables, can, plastic and glass wastes were dispose twice a week. But in locality with high level of development, frequencies of waste disposal differ according to types of waste, while paper, wood and textile wastes were disposed fortnightly. Vegetable waste is disposed sometimes; can and

plastic waste are disposing weekly. On the average locality with low level of development has a permanent frequency mode of wastes disposal i.e. twice a week, the respondents from locality with high level of development has a low and fluctuate frequency of waste disposal according to their wastes, which constitute the average of fortnightly.

4.4.5. Storing of Biodegradable and Non-biodegradable Wastes Separate.

The major problem in solid waste management is the existing pattern of storage of bio-degradable and non-biodegradable wastes together. Hence, in the present study it was enumerated that whether the households are storing separately and if appropriate disposal services are provide whether they will be willing to store them separately.(see table 4.14)

Regarding the segregation of Non-biodegradable waste and Non biodegradable waste, more than fourth fifth (88.8%) of households from both the communities are not storing their wastes separately. Similar findings are found in the study of Kaundal and Sharma (2007). While in locality with low level of development, almost all (90.5 %) of the respondents did not store their waste separately, and the rest (9.5 %) segregate their waste according to types. In locality with high level of development more than fourth fifth (88%) of the respondent do not store wastes separately and the rest of the household (12%) segregate their waste at source.

Respondents from both the communities were asked to answer if they are willing to store biodegradable and non-biodegradable waste, while almost two third(61.2%) of the respondent willing to store their waste separately, more than one third (38.8%)of the respondents are not willing to do so. In locality with low level of development, more almost all(90.5%) households were not willing to store their waste separately according to their types, and only less than one tenth (9.5%) of the respondent willing to store their waste separately. In High development community more than fourth fifth (84.8%) of the

respondent willing to store separately, and 15.2 percent of them were not willing to store biodegradable and non-biodegradable waste separately.

4.5. Satisfaction with the Existing Solid Waste Collection and Disposal Services

This section discusses the households' satisfaction on the existing collection and disposal service provided within the community. Respondents were asked to answer their satisfaction level using the satisfaction scale (Highly satisfied=4, Satisfied= 3, dissatisfied =2, highly satisfied= 1). Satisfaction with the existing service was assessed in terms of adequacy of dustbins, Regularity of waste collection, capacity of vehicle to transport wastes, efficiency of man power/labor, distance to waste collection point, maintenance of the vehicle and workers behavior. In locality with low level of development, the respondents are dissatisfied with adequacy of dustbins and regularity of waste collection, and they are satisfied with capacity of vehicle to transport wastes, efficiency of man power/ labor, distance to waste collection point, maintenance of the vehicle, workers behavior. The respondent from locality with high level of development is satisfied with all the existing services. Overall satisfaction scale indicates that both the communities have satisfied with the solid waste disposal services (see table 4.15).

4.6. Willingness to Pay for Solid Waste Management

Respondent's willingness to pay for solid waste management services are generally studied with a view to identify the improvements needed in the existing services. Also willingness to pay is used to increase the people's financial contribution to solid waste management in urban areas. It is from the point of view of identifying and prioritizing the improvements needed in the existing solid waste collection services WTP is probed in the present study.

Regarding the respondents willing to pay for better solid waste management, they are asked to put it in rupees for existing service of AMC/LAD and some specific

improvements in the waste collection practice. The improvements suggested were collection of wastes separately, increasing the vehicle visits to two times weekly, increasing the number of collecting points, increasing the number of dustbins and increasing the number of workers. In locality with low level of development, the mean amount for willingness to pay is higher than that of locality with high development. While willingness to pay for all improvements is Rupees 42.3 in Locality with low development, in locality with high development the amount can only raise up to Rupees13.1 only. Households in locality with high development are mostly willing to pay mean amount of Rupees 16.1 for existing service of AMC/LAD and rupees 8.9 for collecting wastes separately. In locality with low development the mean amount of households' willingness to pay is equally distributed in all the specific improvements (see table 4.16).

In respect to number of households' willingness to pay for improved solid waste management. almost all of the total population in both the communities willing to pay for existing service of AMC/ LAD (95.5%) and collecting wastes separately(90.3%). In locality with low level of development 90.48 percent willing to pay for existing service of AMC/LAD, More than fourth fifth (83.33%) of the total household from locality with low level of development are willing to pay for collecting wastes separately, increasing the vehicle visit to two times per week and increasing the number of collecting points. Majority of the households in locality with low level of development are also willing to pay for increasing the number of dustbins (78.57%) and increasing the no of workers (52.38%). In locality with high level of development more than almost all of the total households are willing to pay for existing service of AMC/LAD and collecting wastes separately. Less than one third (30.43%) of the household in locality with high level of development are willing to pay for increasing the number of dustbins and less than one

tenth of household are willing to pay for increasing the vehicle visits to two times per week, increasing the number of collecting points and increasing the number of workers. The result indicate that number of households in locality with low level of development is larger than locality with high level of development who are willing to pay for improved solid waste management, which shows that the services provided by AMC/ LAD are found better in locality with high level of development (see table 4.17).

4.6.1. Determinants of Willingness to Pay for Improved Solid Waste Management

An important question raised in the context of willingness of people to pay for solid waste management services in Aizawl are that the factors determining the willingness to pay for the existing services and various improvements. To provide focus the hypothesis that the willingness of the respondent to pay for improved municipal solid waste management depends upon the age of the respondent, education, per capita household income, and per capita household assets of the respondent. To test this hypothesis and identify the determinants of WTP Karl Pearson's coefficient of correlation was used. The dependent variables were the amounts of WTP for existing services, collecting wastes separately, increasing the number of vehicle visits, increasing the number of collecting points, increasing the number of dustbins and increasing the number of workers (see table 4.18).

The hypothesis that willingness of the respondent to pay for improved municipal solid waste management depends upon the age of the respondent, education, per capita household income, and per capita household assets of the respondent has been rejected in view of the results of correlation analysis presented. The independent variables age group, education, gender, size of family, per capita household income, and per capita household assets had no significant on the respondents WTP for existing services, improvement of collection wastes separately, increasing vehicle visits, dustbins and workers. One

exception to this broad pattern is that education of the respondent had negative effect on willingness to pay for increasing the number of collecting points.

4.7. Respondents Perceived Problems in SWM and Suggestions for Improvement

This section presents discussion on the respondent's perceived problems in solid waste management and suggestions for Improvement. An overall the main problem found in locality with high level of development is that the dumping of waste together (89.1%). Almost fourth fifth (78.3%) of the respondent perceived inadequate personnel and a little less than half of the respondent perceived inadequate number of dustbin(47.8%) and lack of public awareness (48.9%) as hindrance in solid waste management. Among the possible problems in SWM, the respondents in locality with high level of development perceived lack of systematic effort to recycling (38.%), poor quality of service by LAD (17.4%), Far distance to collection point (4.3%) and lack of water (3.3%) as the problem in their community. In locality with low level of development more than fourth fifth (88.1%) of the respondent perceived lack of public awareness as the problem and more than half (61.9%) of the respondents felt inadequate number of dustbin in the household and community level as the problems in SWM. More than one third of the respondents perceived dumping of waste together (38.1%) and poor quality of service by AMC/LAD (42.9%) as the problem SWM. The other perceived problems in SWM are inadequate personnel (4.8%), far distance from collection point (4.8%), lack of water (2.4%) and waste negligence/bad odor (7.1%) in locality with low level of development. An overall major perceived problems find in both the communities are 73.1 per cent of respondent perceived dumping of waste together as problem in SWM, and the majority of the respondent have a consensus on lack of public awareness, inadequate personnel and inadequate number of dustbins as hindrance to SWM.

With regards to suggestions made by the respondents, almost fourth fifth (79.9%) of the respondents are suggesting prohibition of open dumping for better SWM. 64.9 percent are suggesting appointment of local monitoring committees and more than half (52.2%) of the respondents suggest increased number of dustbin/trailers. The suggestions received from the respondents are awareness generation (47.8%), distribution of containers for storage (44.8%), prohibition of plastic bags (42.5%), increased frequency of vehicle visits (37.3%), increased number of workers (25.4%), systematic recycling (21.6%), clear information of waste collection (3.7%), involvement of community base organization (3%), appointment of supervisor at community level (0.7%) and increase number of vehicle (0.7%) (see table 4.19). While 71.4 per cent of the respondents in locality with low development are giving 'awareness generation' as their main suggestion for better SWM in the locality, 91.3 per cent of respondent in locality with high development are to prohibition of open dumping.

In this chapter attempt has been made to discuss the results of the analysis of primary data household solid waste management. The next chapter presents the major conclusions, policy implications of the present study.

Table 4.1 Demographic Profile of Respondents

Sl.No	Characteristic	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Gender**			
	Male	40 (95.2)	83 (90.2)	123 (91.8)
	Female	2 (4.8)	9 (9.8)	11 (8.2)
II	**Age Group**			
	Youth (18 - 35)	6 (14.3)	12 (13.0)	18 (13.4)
	Middle (36 - 59)	27 (64.3)	74 (80.4)	101 (75.4)
	Old(60 and Above)	9 (21.4)	6 (6.5)	15 (11.2)
III	**Marital Status**			
	Unmarried	1 (2.4)	3 (3.3)	4 (3.0)
	Married	39 (92.9)	80 (87.0)	119 (88.8)
	Divorced/separated	0 (0.0)	1 (1.1)	1 (0.7)
	Widowed	2 (4.8)	8 (8.7)	(7.5)
IV	**Education Status**			
	Illiterate	2 (4.8)	0 (0.0)	2 (1.5)
	Primary(1- 4)	6 (14.3)	1 (1.1)	7 (5.2)
	Middle (5 -7)	10 (23.8)	9 (9.8)	19 (14.2)
	High School(8 -10)	14 (33.3)	52 (56.5)	66 (49.3)
	Higher Secondary (11 -12)	5 (11.9)	12 (13.0)	17 (12.7)
	College(13 and above)	5 (11.9)	18 (19.6)	23 (17.2)

Source: Computed Figures in parentheses are percentages

Table 4.2 Social Structural Characteristics

Sl.No	Characteristic	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Sub-Tribe**			
	Lusei	27 (64.3)	68 (73.9)	95 (70.9)
	Ralte	6 (14.3)	18 (19.6)	24 (17.9)
	Hmar	4 (9.5)	4 (4.3)	8 (6.0)
	Paite	4 (9.5)	2 (2.2)	6 (4.5)
	Non-Mizo	1 (2.4)	0 (0.0)	1 (0.7)
II	**Type of Clan**			
	Ruling	12 (28.6)	32 (34.8)	44 (32.8)
	Commoner	30 (71.4)	60 (65.2)	90 (67.2)
III	**Denomination**			
	Presbyterian	37 (88.1)	72 (78.3)	109 (81.3)
	The Salvation Army	4 (9.5)	8 (8.7)	12 (9.0)
	Methodist	0 (0.0)	4 (4.3)	4 (3.0)
	UPC	0 (0.0)	3 (3.3)	3 (2.2)
	Roman Catholic	1 (2.4)	1 (1.1)	2 (1.5)
	Lalchhungkua Unity	0 (0.0)	1 (1.1)	1 (0.7)
	Baptist	0 (0.0)	1 (1.1)	1 (0.7)
	Kohhran Thianghlim	0 (0.0)	1 (1.1)	1 (0.7)
	Seventh Day Adventist	0 (0.0)	1 (1.1)	1 (0.7)

Source: Computed Figures in parentheses are percentages

Table 4.3 Economic Characteristics of Respondents

Sl.No	Characteristic	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Earner or Dependent**			
	Dependent	5 (11.9)	10 (10.9)	15 (11.2)
	Earner	37 (88.1)	82 (89.1)	119 (88.8)
II	**Primary Occupation**			
	Dependent	6 (14.3)	10 (10.9)	16 (11.9)
	Government Officer	2 (4.8)	1 (1.1)	3 (2.2)
	Government Workers	11 (26.2)	35 (38.0)	46 (34.3)
	Cultivators	4 (9.5)	1 (1.1)	5 (3.7)
	Animal Husbandry	4 (9.5)	0 (0.0)	4 (3.0)
	Private Worker	6 (14.3)	7 (7.6)	13 (9.7)
	Petty Business	1 (2.4)	12 (13.0)	13 (9.7)
	Wage Laborer	3 (7.1)	0 (0.0)	3 (2.2)
	Skilled Laborer	5 (11.9)	3 (3.3)	8 (6.0)
	Large Business	0 0.0	23 (25.0)	23 (17.2)
III	**Secondary Occupation**			
	None	32 (76.2)	91 (98.9)	123 (91.8)
	Government Officers	1 (2.4)	0 (0.0)	1 (0.7)
	Cultivator	3 (7.1)	0 (0.0)	3 (2.2)
	Wage Laborer	1 (2.4)	0 (0.0)	1 (0.7)
	Petty Business	4 (9.5)	1 (1.1)	5 (3.7)
	Animal Husbandry	1 (2.4)	0 (0.0)	1 (0.7)

Source: Computed Figures in parentheses are percentages

Table 4.4 Family Structure of Respondents

Sl.No	Characteristic	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Type of Family**			
	Nuclear	38 (90.5)	72 (78.3)	110 (82.1)
	Joint	4 (9.5)	20 (21.7)	24 (17.9)
II	**Form of Family**			
	Stable	42 (100)	89 (96.7)	131 (97.8)
	Broken	0 (0.0)	2 (2.2)	2 (1.5)
	Reconstituted	0 (0.0)	1 (1.1)	1 (0.7)
III	**Size of Family**			
	Small (1- 3)	6 (14.3)	7 (7.6)	13 (9.7)
	Medium (4 - 6)	27 (64.3)	73 (79.3)	100 (74.6)
	Large (7 and above)	9 (21.4)	12 (13.0)	21 (15.7)

Source: Computed Figures in parentheses are percentages

Table 4.5 Living Conditions of Respondent Households

Sl.No		Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Annual Household Income**			
	Minimum	32000	26000	26000
	Maximum	13200000	1644000	13200000
	Mean	553438	283305	367974
	Std. Deviation	2020347	298322	1155428
II	**Percapita Household Income**			
	Minimum	4571	5200	4571
	Maximum	1885714	328800	1885714
	Mean	90146	55874	66616
	Std. Deviation	286633	58517	167106
III	**Total Value of Household Assets**			
	Minimum	10000	8000	8000
	Maximum	5804000	10105000	10105000
	Mean	797286	920322	881758
	Std. Deviation	1193388	1397414	1333573
IV	**Percapita Household Assets**			
	Minimum	2000	1800	1800
	Maximum	895000	2526250	2526250
	Mean	153513	182694	173548
	Std. Deviation	207404	311950	282892

Source: Computed

Table 4.6 Patterns of Household Solid Waste

Sl.No	Type of Waste	Locality Development				Total N = 134		t	Sig.
		Low n = 42		High n = 92					
		Mean	S.D.	Mean	S.D.	Mean	S.D.		
I	**Biodegradable Waste**	4821.4 (54.0)	3583.2	4104.8 (47.5)	1488.4	4329.4 (49.6)	2363.3	1.64	0.10
	Vegetable	1228.6 (13.8)	1390.8	2750 (31.8)	1041.1	2273.13 (26.0)	1356.4	7.04**	0.00
	Paper	1916.7 (21.5)	1477.1	362.5 (4.2)	330.2	849.627 (9.7)	1127.4	9.62**	0.00
	Wood	857.1 (9.6)	1156.6	560.33 (6.5)	657.1	653.358 (7.5)	852.6	1.89	0.06
	Textile	819.05 (9.2)	1014.1	431.96 (5.0)	358.7	553.284 (6.3)	661.5	3.25**	0.00
II	**Non-biodegradable Waste**	4104.8 (46.0)	4321.4	4542 (52.5)	1811.9	4404.93 (50.4)	2836.3	0.83	0.41
	Plastic	2245.2 (25.2)	1996.1	2545.1 (29.4)	1498.8	2451.12 (28.1)	1668.8	0.96	0.34
	Glass	885.7 (9.9)	1305.3	1638.8 (19.0)	1488.3	1402.76 (16.1)	1471.0	2.82**	0.01
	Can	973.8 (10.9)	1282.3	358.04 (4.1)	655.2	551.045 (6.3)	939.6	3.68**	0.00
	Magnitude of Solid Waste	8926.2 (100)	7489.7	8646.7 (100)	2344.6	8734.33 (100)	4590.3	0.33	0.75
	Percapita Solid Waste per day	244.3	163.8	260.4	124.7	255.4	137.7	0.62	0.53
	Test Statistics								
	Kendall's W	0.45		0.63		0.41			
	Chi-Square	114.2**		347.1**		332.0**			
	df	6		6		6			
	Asymp. Sig.	0.00		0.00		0.00			
	Spearman's rho								
	Low	1		0.21		0.61			
	High	0.21		1		0.86**			

Source: Computed (Figures in parentheses are percentages) * $P < 0.05$ ** $P < 0.01$

Table 4.7 Determinants of Magnitude of Solid Waste

Sl.No	Variable	Biodegradable Waste	Non-biodegradable Waste	Magnitude of Solid Waste	Per Day Percapita Solid Waste
1	Age Group	0.10	0.04	0.07	0.01
2	Education	0.14	0.28*	0.24*	0.10
3	Gender	-0.14	-0.06	-0.11	-0.11
4	Size of Family	0.15	0.25**	0.23*	-0.40**
5	Percapita Household Income	0.03	0.26**	0.17*	0.10
6	Mean Years of Education	0.15	0.33**	0.28	0.17*
7	Percapita Household Assets	0.19*	0.13	0.18	0.19*
8	Biodegradable Waste	1	0.56**	0.86**	0.51**
9	Non-biodegradable Waste	0.56**	1	0.90**	0.56**
10	Magnitude of Solid Waste	0.86**	0.90**	1	0.61**
11	Per Day Percapita Solid Waste	0.51**	0.56**	0.61**	1

Source: Computed * $P < 0.05$ ** $P < 0.01$

Table 4.8 Pattern of Storage of Biodegradable Solid Waste

Sl.No	Type of Waste/ Storage	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Paper**			
	None	1 (2.38)	5 (5.43)	6 (4.48)
	Dustbin	28 (66.67)	83 (90.22)	111 (82.84)
	Gunny Bag	13 (30.95)	4 (4.35)	17 (12.69)
II	**Wood**			
	None	1 (2.38)	71 (77.17)	72 (53.73)
	Dustbin	28 (66.67)	16 (17.39)	44 (32.84)
	Gunny Bag	13 (30.95)	5 (5.43)	18 (13.43)
III	**Textile**			
	None	1 (2.38)	79 (85.87)	80 (59.70)
	Dustbin	28 (66.67)	10 (10.87)	38 (28.36)
	Gunny Bag	13 (30.95)	3 (3.26)	16 (11.94)
IV	**Vegetables**			
	None	1 (2.38)	21 (22.83)	22 (16.42)
	Dustbin	28 (66.67)	39 (42.39)	67 (50.00)
	Gunny Bag	13 (30.95)	32 (34.78)	45 (33.58)

Source: Computed Figures in parentheses are percentages

Table 4.9 Pattern of Storage of Non-biodegradable Solid Waste

Sl.No	Type of Waste/ Mode of Disposal	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Can**			
	None	1 (2.38)	43 (46.74)	44 (32.84)
	Dustbin	28 (66.67)	47 (51.09)	75 (55.97)
	Gunny Bag	13 (30.95)	2 (2.17)	15 (11.19)
II	**Plastic**			
	None	1 (2.38)	3 (3.26)	4 (2.99)
	Dustbin	28 (66.67)	86 (93.48)	114 (85.07)
	Gunny Bag	13 (30.95)	3 (3.26)	16 (11.94)
III	**Glass**			
	None	1 (2.38)	80 (86.96)	81 (60.45)
	Dustbin	28 (66.67)	8 (8.70)	36 (26.87)
	Gunny Bag	13 (30.95)	4 (4.35)	17 (12.69)

Source: Computed Figures in parentheses are percentages

Table 4.10 Pattern of Disposal: Biodegradable Solid Waste

Sl.No	Type of Waste/ Mode of Disposal	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Paper**			
	None	0 (0.0)	6 (6.5)	6 (4.5)
	Burning	8 (19.0)	5 (5.4)	13 (9.7)
	Open	10 (23.8)	4 (4.3)	14 (10.4)
	Vehicle	23 (54.8)	74 (80.4)	97 (72.4)
	Sale	1 (2.4)	3 (3.3)	4 (3.0)
II	**Wood**			
	None	0 (0.0)	70 (76.1)	70 (52.2)
	Burning	6 (14.3)	8 (8.7)	14 (10.4)
	Open	11 (26.2)	1 (1.1)	12 (9.0)
	Vehicle	25 (59.5)	13 (14.1)	38 (28.4)
III	**Textile**			
	None	0 (0.0)	78 (84.8)	78 (58.2)
	Burning	5 (11.9)	4 (4.3)	9 (6.7)
	Open	12 (28.6)	1 (1.1)	13 (9.7)
	Vehicle	25 (59.5)	9 (9.8)	34 (25.4)
IV	**Vegetable**			
	None	0 (0.0)	37 (40.2)	37 (27.6)
	Burning	5 (11.9)	6 (6.5)	11 (8.2)
	Open	12 (28.6)	10 (10.9)	22 (16.4)
	Vehicle	25 (59.5)	39 (42.4)	64 (47.8)

Source: Computed Figures in parentheses are percentages

Table 4.11 Pattern of Disposal: Non-biodegradable Solid Waste

Sl.No	Type of Solid Waste/ Mode of Disposal	Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Can**			
	None	0 (0.0)	39 (42.4)	39 (29.1)
	Burning	5 (11.9)	1 (1.1)	6 (4.5)
	Open	12 (28.6)	1 (1.1)	13 (9.7)
	Vehicle	25 (59.5)	51 (55.4)	76 (56.7)
II	**Plastic**			
	None	0 (0.0)	4 (4.3)	4 (3.0)
	Burning	6 (14.3)	5 (5.4)	11 (8.2)
	Open	11 (26.2)	3 (3.3)	14 (10.4)
	Vehicle	25 (59.5)	79 (85.9)	104 (77.6)
	Sale	0 (0.0)	1 (1.1)	1 (0.7)
III	**Glass**			
	None	0 (0.0)	79 (85.9)	79 (59.0)
	Burning	5 (11.9)	4 (4.3)	9 (6.7)
	Open	12 (28.6)	1 (1.1)	13 (9.7)
	Vehicle	25 (59.5)	8 (8.7)	33 (24.6)

Source: Computed Figures in parentheses are percentages

Table 4.12 Determinants of Choice of Mode of Disposal of Solid Waste

Sl.No	Variable	Disposal of		
		Biodegradable Solid Waste	Non-biodegradable Solid Waste	Solid Waste
1	Locality Development	0.44**	0.46**	0.46**
2	Age Group	-0.14	-0.18*	-0.18*
3	Gender	-0.01	0.05	0.05
4	Education	0.20*	0.24*	0.23*
5	Mean Years of Education	0.14*	0.13	0.17*
6	Annual Household Income	0.00	0.06	0.03
7	Percapita Household Income	0.00	0.03	0.02
8	Total Value of Household Assets	0.03	0.01	0.01
9	Percapita Household Assets	0.02	-0.01	0.00

Source: Computed * P < 0.05 ** P < 0.01

Table 4.13 Frequency of Waste Disposal

Sl.No	Type of Solid Waste	Locality Development				Total N = 134	
		Low n = 42		High n = 92			
		Mean	S.D.	Mean	S.D.	Mean	S.D.
1	Paper	3.5	1.1	1.5	0.7	2.1	1.2
2	Wood	3.5	1.1	1.7	0.9	2.3	1.3
3	Textile	3.5	1.1	2.1	0.9	2.6	1.2
4	Vegetable	3.5	1.1	1.3	0.8	2.0	1.3
5	Can	3.5	1.1	3.0	1.1	3.1	1.1
6	Plastic	3.5	1.1	3.2	1.0	3.3	1.1
7	Glass	3.5	1.1	3.5	1.0	3.5	1.0
8	Frequency of Disposal of SW	3.5	1.1	2.3	0.5	2.7	0.9

Source: Computed Figures in parentheses are percentages * P < 0.05 ** P < 0.01

Table 4.14 Storing Separately Biodegradable and Non-biodegradable Wastes

Sl.No		Locality Development		Total N = 134
		Low n = 42	High n = 92	
I	**Storing Bio- degradable and non-biodegradable Separately**			
	No	38 (90.5)	81 (88.0)	119 (88.8)
	Yes	4 (9.5)	11 (12.0)	15 (11.2)
II	**Willing to Store Waste Separately**			
	No	38 (90.5)	14 (15.2)	52 (38.8)
	Yes	4 (9.5)	78 (84.8)	82 (61.2)

Source: Computed Figures in parentheses are percentages

Table 4.15 Satisfaction with the Existing Collection and Disposal Services

Sl. No		Locality Development				Total N = 134		t
		Low n = 42		High n = 92				
		Mean	S.D	Mean	S.D	Mean	S.D	
1	Adequacy of Dustbins	2.1	0.4	2.9	0.7	2.7	0.7	6.80**
2	Regularity of waste collection	2.2	0.4	3.2	0.4	2.9	0.6	11.59**
3	Capacity of Vehicle to transport wastes	2.5	0.5	3.2	0.5	3.0	0.6	8.12**
4	Efficiency of man power/labor	2.6	0.5	3.1	0.5	3.0	0.5	5.74**
5	Distance to waste collection point	2.7	0.6	3.3	0.7	3.1	0.7	5.01**
6	Maintenance of the Vehicle	2.7	0.5	3.1	0.7	3.0	0.6	3.79**
7	Workers Behavior	2.7	0.5	3.3	0.6	3.1	0.6	6.80**
	Satisfaction	2.5	0.4	3.2	0.4	3.0	0.5	11.75**

Source: Computed * P < 0.05 ** P < 0.01

Table 4.16 Willingness to Pay for Solid Waste Management

(Value in Rupees)

Sl. No	Willingness to Pay For	locality Development				Total N = 134		t
		Low n = 42		High n = 92				
		Mean	S.D.	Mean	S.D.	Mean	S.D.	
1	Existing service of AMC/LAD	9.9	7.1	16.1	5.7	14.2	6.8	5.36**
2	Collecting wastes separately	9.1	7.3	8.9	5.1	8.9	5.9	0.22
3	Increasing the vehicle visits to two times Weekly	10.3	11.0	0.8	3.7	3.8	8.1	7.41**
4	Increasing the no of collecting points	8.7	7.1	0.3	1.8	3.0	5.8	10.68**
5	Increasing the no. of Dustbins	7.8	7.2	2.6	4.1	4.2	5.8	5.41**
6	Increasing the no. of Workers	6.3	11.2	0.5	5.2	2.4	8.0	4.09**
7	All Improvements	42.3	40.4	13.1	11.5	22.2	27.9	6.39**

Source: Computed * P < 0.05 ** P < 0.01

Table 4.17 Willingness to Pay for Solid Waste Management: No. of Households

Sl.No	Willingness to Pay For	Locality Development		Total N = 134
		Low n = 42	High n = 92	
1	Existing service of AMC/LAD	38 (90.48)	90 (97.83)	128 (95.52)
2	Collecting wastes separately	35 (83.33)	86 (93.48)	121 (90.30)
3	Increasing the vehicle visits to two times per week	35 (83.33)	6 (6.52)	41 (30.60)
4	Increasing the no of collecting points	35 (83.33)	3 (3.26)	38 (28.36)
5	Increasing the no. of Dustbins	33 (78.57)	28 (30.43)	61 (45.52)
6	Increasing the no. of Workers	22 (52.38)	1 (1.09)	23 (17.16)

Source: Computed Figures in parentheses are percentages

Table 4.18 Determinants of Willingness to Pay for Existing and Improved Solid Waste Management

Variable	Willingness to pay					
	For existing Services	Collecting Wastes Separately	Increasing the Number of			
			Vehicle Visits	Collecting Points	Dustbins	Workers
Age Group	0.00	-0.07	0.04	0.04	0.09	0.02
Education	0.00	-0.05	-0.15	-0.21*	-0.13	-0.12
Gender	-0.01	0.04	-0.07	0.00	-0.11	-0.05
Size of Family	0.07	0.10	0.04	0.12	0.04	0.08
Per capita Household Income	-0.04	0.01	0.07	0.07	0.07	0.07
Per capita Household Assets	0.13	0.01	-0.09	-0.10	-0.04	-0.10
Biodegradable Waste	-0.1	0.0	0.0	0.0	0.1	0.0
Non biodegradable Waste	0.04	0.01	-0.02	-0.04	-0.05	-0.10
Magnitude of Solid Waste	-0.03	0.01	0.00	0.00	0.04	-0.06
Per Day Per capita Solid Waste	-0.10	-0.11	-0.05	-0.13	-0.05	-0.09

Source: Computed * P < 0.05 ** P < 0.01

Table 4.19 Respondents Perceived Problems in SWM and Suggestions for Improvement

Sl.No		Locality Development		Total
		Low	High	N = 134
I	Problems			
	Dumping of different Wastes Together	16 (38.1)	82 (89.1)	98 (73.1)
	Lack of Public Awareness	37 (88.1)	45 (48.9)	82 (61.2)
	Inadequate Personnel	2 (4.8)	72 (78.3)	74 (55.2)
	Inadequate Number of Dustbins	26 (61.9)	44 (47.8)	70 (52.2)
	Lack of Systematic Effort to Recycling	5 (11.9)	35 (38.0)	40 (29.9)
	Poor Quality of Service by LAD	18 (42.9)	16 (17.4)	34 (25.4)
	Far distance to collection point	2 (4.8)	4 (4.3)	6 (4.5)
	Lack of water	1 (2.4)	3 (3.3)	4 (3.0)
	Waste negligence/ bad odor	3 (7.1)	0 (0.0)	3 (2.2)
II	Suggestions			
	Prohibition of Open Dumping	23 (54.8)	84 (91.3)	107 (79.9)
	Appointment of Local Monitoring Committees	8 (19.0)	79 (85.9)	87 (64.9)
	Increased Number of Dustbins/Trailers	27 (64.3)	43 (46.7)	70 (52.2)
	Awareness Generation	30 (71.4)	34 (37.0)	64 (47.8)
	Distribution of Containers for Storage	15 (35.7)	45 (48.9)	60 (44.8)
	Prohibition of Plastic Bags	9 (21.4)	48 (52.2)	57 (42.5)
	Increased Frequency of Vehicle Visits	19 (45.2)	31 (33.7)	50 (37.3)
	Increased number of Workers	9 (21.4)	25 (27.2)	34 (25.4)
	Systematic Recycling	4 (9.5)	25 (27.2)	29 (21.6)
	Clear information of waste collection	3 (7.1)	2 (2.2)	5 (3.7)
	Involvement of CBOs	0 (0.0)	4 (4.3)	4 (3.0)
	Appointment of Supervisor at Community Level	1 (2.4)	0 (0.0)	1 (0.7)
	Increase number of vehicle	1 (2.4)	0 (0.0)	1 (0.7)

Source: Computed

CHAPTER V

CONCLUSIONS

CHAPTER V

CONCLUSIONS

In this chapter an attempt has been made to present the salient conclusions, policy implication and suggestions for social work intervention.

5.1. Conclusions

In Aizawl, solid waste management is solely mandated to AMC. Although PPP mode was approved there has been delay in putting it into practice. The AMC still faces many common solid waste management problems, as it does not have enough capacity and resources in terms of manpower, finance, infrastructure or machines to deal with the masses of wastes in the streets and residential areas as well as weak institutional arrangements have resulted in an erratic and ineffective domestic waste management service. And yet there is no private agency established in Mizoram or from outside the state to assist the AMC in SWM.

5.1.1. Pattern of Household Solid Waste

The pattern of household solid waste generated differs significantly between the localities at different levels of development. The major portion of solid waste in low level of development is constituted by Biodegradable waste while in locality with high level of development it is Non-Biodegradable waste.

Actual quantity of solid waste generated at household level does not differ between locality with high level of development and locality with low level of development. The per capita solid waste per day and magnitude of solid waste are not different between the localities. Magnitudes of biodegradable and non- biodegradable wastes are not statistically significantly different. Among biodegradable waste significant differences were found between vegetables, paper and textile between the two localities. But between them the

magnitude of wood is not statistically different. Vegetable waste, paper waste, and textile waste generated in locality with low level of development were greater than those generated in locality with high level of development.

Among non-biodegradable waste there is no significant difference between these localities in plastic, but there are differences in glass and can. The magnitude of glass waste generated in is higher than that of locality with low level of development. Magnitude of can waste generated in Locality with low level of development is higher than locality with high level of development.

5.1.2. Determinants of Magnitude of Solid Waste

Size of family per capita household income, years of adult member education, per capita household assets were found to have significant effects on magnitude of solid waste generated. Age group and gender have no significant effects on magnitude of solid waste. Higher the education of respondent, higher was the magnitude of solid waste generated. Higher the family size, higher was the magnitude of solid waste generated while lower was per day capita solid waste. Among the demographic variables size of family, and mean years of adult education are significantly associated with the magnitude of solid waste generated by the households. On the other hand, age group of respondent, education of the respondent and gender of respondent had not significantly associated with any of the components of solid waste or the per day per capita solid waste

5.1.3. Patterns of Solid Waste Storage

Dustbin and gunny bag were used to store biodegradable solid waste and non biodegradable solid waste together. Dustbin is mostly used in Locality with low level of development to store bio-degradable and non biodegradable waste. Household of locality

with high level of development do not use any storage to store wood, textile and glass. Households of both localities deposited bio degradable solid waste with vehicle.

5.1.4 Determinants of Choice of Disposal

Locality, age group, education were the significant variables associated with the depositing of solid waste with vehicle. Greater proportion of household in locality with high level of development has deposit waste in vehicle than Locality with low level of development. Younger respondents deposited solid waste with vehicle. Higher the education, higher was the livelihood of depositing solid waste with vehicle. Household income, per capita income, total value of Household assets, per capita household assets have no significant effects on choice of disposal.

5.1.5. People's Satisfaction with Existing Services

Most of the respondents in both localities were satisfied with the existing waste collection and disposing services. Respondents of locality with high level of development had greater satisfaction as compared to Locality with low level of development. Most of the respondents of Locality with low level of development were dissatisfied with the adequacy of dustbin and frequency of waste collection visits. They were all satisfied with capacity of vehicle to transport wastes, efficiency of man power/labor, distance to waste collection point, maintenance of the vehicle and workers behavior.

Locality and Educations were the two factors having significant positive relationship with respondent satisfaction over solid waste management services. Age group, gender, annual household income, per capita household income, total value of household assets, etc have no significant influence on satisfaction. Magnitudes of bio degradable and non biodegradable solid wastes have no effects on satisfaction.

5.1.6. People's Willingness to Pay for Solid Waste

Almost all the respondents in both the localities are willing to pay for the existing services of AMC/LAD. The amount willing to be paid by the members of locality with high level of development is significantly greater than that of Locality with low level of development. For making improvements the respondents of Locality with low level of development were willing to pay more than locality with high level of development. Members of locality with high level of development were willing to pay greater amount to increasing vehicle visits, no of collecting points, no. of dustbins, and no. of workers.

Willingness to pay was found to have no relationship with age group, education, gender, size of family, annual household income, per capita household income, per capita household assets etc. for existing services have significant positive value of total value of household assets.

The quantum of solid waste generated does not differ between high and low level of localities. However the pattern of solid waste generated differs between the localities. Differences could be noted in case of non-biodegradable waste such as glass and can. Solid waste generated was found to be associated with economic development. As such the economic development is taking place in Mizoram, there is need for improving solid waste collection and disposal. The people were mostly depositing bio-degradable and non-biodegradable wastes with LAD/AMC vehicle. There is greater degree of awareness on the need for depositing and storing separately. In spite of these there is difference in user's satisfaction of solid waste disposal services and it seems the services such as dustbins and regularity of waste collection were poor in low level of community development. Hence there is a need for improving the quality of the services in Aizawl.

4.6. Perceived Problems and Suggestions for Improvement in Solid Waste Management

An overall the main problem found in locality with high level of development is that the dumping of waste together. In locality with low level of development more than fourth fifth of the respondent perceived lack of public awareness as a problem in SWM. The other perceived problems are inadequate personnel, inadequate number of dustbins, lack of systematic effort to recycling, poor quality of service by LAD/AMC. Far distance to collection point, lack of water and waste negligence which cause bad odor in its surrounding areas. An overall major perceived problems find in both the communities perceived dumping of waste together as problem in SWM, and the majority of the respondent have a consensus on lack of public awareness, inadequate personnel and inadequate number of dustbins as hindrance to SWM.

With regards to suggestions made by the respondents, almost fourth fifth of the respondents are suggesting prohibition of open dumping for better SWM. And are suggesting appointment of local monitoring committees and more than half of the respondents suggest increased number of dustbin/trailers. The suggestions received from the respondents are awareness generation, distribution of containers for storage , prohibition of plastic bags , increased frequency of vehicle visits , increased number of workers , systematic recycling , clear information of waste collection , involvement of community base organization , appointment of supervisor at community level and increase number of vehicle. While majority of the respondents in locality with low level of development are giving 'awareness generation' as their main suggestion for better SWM in the locality, almost all of respondent in locality with high level of development are to prohibition of open dumping.

Solid waste management is definitely not only a technical challenge. Understanding and taking into account the environmental impact, financial and economic calculations, social and cultural issues, and the institutional, political and legal framework, is most crucial for planning and operation of a sustainable solid waste management scheme (Zurbrügg, 2002).

5.2. Policy Implication

In order to develop appropriate waste management strategies, the municipal council has to be cognizant of the environmental impacts of waste; this can be achieved through working with local universities. There is also a growing realization that communities themselves can be the drivers in waste management, departing from the traditional way when they were viewed as beneficiaries and the councils as service providers. Community Based Solid Waste Management has contributed in the improvement of waste management elsewhere and, thus, can be adopted. The people can contribute in the identification of waste problems, proposal of workable solutions, and formulation of locally understood policies of waste management.

There is need for implementation of PPP mode of solid waste collection throughout Aizawl town under AMC's management. Although it has been approved by the state government there are peripheral areas of the city which are out of the purview of PPP.

In areas where already PPP mode is the functional also, there are some improvements necessary solid waste collection services. The improvements necessary in the order of priority are collection of bio degradable and non bio degradable solid wastes separately at source, increasing the number of dustbins, increasing the vehicle visits to two times weekly, increasing the number of collecting points and increasing the number of workers.

SWM needs to be professionalized, and solid Waste departments should be managed by those trained to handle these systems. Due to lack of enthusiasm and professional ethic among the workers and the managers, proper SWM is neglected.

Systematic and scientific processing of solid waste is still unknown in the Aizawl area. It is suggested that collected waste should be managed with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations. Recycling of non-degradable waste can reduce the magnitude of solid waste, plastics, can, glass etc., can be recycled. Hence, the AMC needs to developing plans for recycling of non-bio degradable solid wastes. Utilization of biodegradable waste is advantageous as it would generate manure for organic farming; biodegradable waste can be used as fertilizers.

A major problem found during field work is that of uncontrolled open dumping of solid waste especially plastic. Hence, there is need for banning the use of plastic bags and prohibition of open dumping. In this involvement of community especially the GROs like YMA, MHIP, MUP in monitoring and supervision in waste management is needed to sustain solid waste management at community level.

5.3. Suggestions for social work intervention in Solid Waste Management

The professional social workers interested in urban development need to advocate speedy implementation of PPP mode all over the Aizawl town and necessary changes. Social workers also need to advocate for segregation of solid waste at source and collection of same at source separately by the AMC. Social workers need to involve awareness generation among the people regarding separation of biodegradable and non biodegradable waste. As social work intervention, social workers can also observe and learn the problems and

challenges face by the people in their contribution and participation in improved solid waste management. They can intervene as a mediator between the authority and the people for more effective solid waste management in Mizoram.

APPENDICES

URBAN HOUSEHOLD SOLID WASTE MANAGEMENT IN AIZAWL MIZORAM

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Household Interview Schedule

(*Confidential*)

I. Identification Information.

Schedule No.: Date of Interview:

Locality: Investigator:

II. Profile of Respondent

Name:

Ethnicity/Tribe 0. Non-Mizo; 1. Mizo

Sub-Tribe 0. Non-Mizo; 1 Lusei; 2 Paite; 3 Ralte; 4 Hmar

Type of Clan(Specify Clan) 1. Ruling ; 2 Commoner

Religion 1 Christian; 2 Hindu; 3 Buddhist

Denomination

Type of Family 0 Nuclear; 1 Joint

Form of Family 1. Stable; 2. Broken; 3. Reconstituted

Socio-economic Category 0 AAY; 1 BPL; 2 APL

Length of Residence

III. Household Particulars

1. Kindly furnish the details of your household.

ID	Name	Age	Sex #	Marital Status***	Clan	Education	Earner/ Dependent**	Relation*

Codes: ***1.Unmarried; 2 Married 3. Divorced/Separated 4. Remarried 5.Widowed

** 0. Dependent 1. Earner

*0. Head; 1. Wife; 2. Son; 3. Daughter; 4. Parents; 5. Others # 0. Male; 1. Female

2. Please give us the details of the occupation of the earning members of your household

ID	Sex	Primary Occupation		Annual Income	
		Primary	Secondary	Primary	Secondary

3. Kindly mention the details of Household assets

Asset	Number	Value (in rupees)
Land		
Agricultural implements		
Pigs		
Poultry birds		
Television		
Transistor/Radio		
House, buildings		
Cars		
Household furniture		
Household utensils		
Savings and Investments		
Others (specify)		

4. What is the main construction type of the dwelling?

Multifamily residential building	
Individual house	
Prefabricated building	
Other	

IV. How much waste are you generating weekly in your household and how do you store, and dispose them off?

Type of Waste	Approximate Weight (Gs)	Storage	Method of Disposal	No of times
Paper (Paper/Book/Printed Materials)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Wood (Wood/Grass/Leaves)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Textile (Textile/Rags/Jute)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Vegetable (Vegetable/Food Waste)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Can (Can/Jar/Tin/Metals)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Plastic (Plastic/Polythene/Rubber)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5
Glass (Glass/Ceramic)		0 1 2 3	0 1 2 3 4	0 1 2 3 4 5

Storage: 0 None 1 Dust Bin 2 Gunny Bag **Disposal:** 0 None; 1 Burning; 2 Open; 3 Vehicle 4 Sale
No. of Times: 5 Thrice a week, 4 Twice a Week , 3 Weekly ,2 Fortnightly , 1 Sometimes , 0 Never

4.2. Are you storing the biodegradable and non bio degradable wastes separately Yes /No

4.3. As the separate storage and disposal will improve the urban environment are you willing to store separately and deposit them with the AMC/LAD vehicle? Yes/No

4.4. If No kindly list out the reasons for the same and what can be done to separate them.

Sl.No	Reason	Suggestion

4.5. In case you are not depositing the solid wastes with the LAD/AMC Vehicle kindly list the reasons.

Sl.No	Reason

4.6. How far are you satisfied with Solid waste management in your Locality?

Service	Highly Satisfied	Satisfied	Dissatisfied	Highly Dissatisfied
Adequacy of Dustbins	4	3	2	1
Regularity of waste collection	4	3	2	1
Capacity of Vehicle to transport wastes	4	3	2	1
Efficiency of man power/labor	4	3	2	1
Distance to waste collection point	4	3	2	1
Maintenance of the Vehicle	4	3	2	1
Workers Behavior	4	3	2	1

4.7. Kindly rate the responsibility of different agencies for solid waste management in Aizawl.

State Government	Full 3	Most 2	Some 1	None 0
Aizawl Municipal Council	Full 3	Most 2	Some 1	None 0
Local Council	Full 3	Most 2	Some 1	None 0
Voluntary Organizations in community	Full 3	Most 2	Some 1	None 0

Households	Full 3	Most 2	Some 1	None 0
Women	Full 3	Most 2	Some 1	None 0
Men	Full 3	Most 2	Some 1	None 0

4.8 have you receive any training or awareness on waste management? (a)Yes/No

(b) If yes who offered such training or awareness?_____

(c)What are the content of such training?

4.9. How much rupees per month are you willing to pay for solid waste collection?

Condition	Rupees per Month
With the existing collection and disposal service of AMC/LAD	
Collecting Biodegradable and non biodegradable wastes separately	
Increasing the vehicle visits to two times per week	
Increasing the no of collecting points	
Increasing the no. of Dustbins	
Increasing the no. of Workers	
Any other(specify)	

4.10 Kindly tell me the problems faced in management of solid waste at your community and suggest measures for improving.

Problem/Difficulty/Challenge	Yes	Suggestion	Yes
Inadequate Number of Dustbins		Increased Number of Dustbins/Trailers	
Poor Quality of Service by LAD		Awareness Generation	
Lack of Public Awareness		Increased Frequency of Vehicle Visits	
Inadequate Personnel		Systematic Recycling	
Dumping of different Wastes Together		Involvement of CBOs	
Lack of Systematic Effort toRecycling		Increased number of Workers	
Others(specify)		Prohibition of Open Dumping	
		Appointment of Local Monitoring Committees	
		Distribution of Containers for Storage	
		Prohibition of Plastic Bags	
		Others(specify)	

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