Chapter One

Introduction

Throughout the world the municipal authorities are generally entrusted with the responsibility of solid waste management (SWM) in towns and cities. This issue is the key to determining the overall levels of well-being, satisfaction, happiness and welfare of people dwelling in towns and cities. However it is apparent that the majority of municipal corporations and boards in India are at present in capable of managing urban waste in an environmentally ethical, sustainable and efficient manner. Ideally municipal authorities must ensure environmentally ethical and sustainable ways of dealing with waste collection, transportation, treatment and disposal. The letdown of municipal solid waste management (MSWM) can result in serious health hazards and severe environmental degradation in towns and cities. Because of irregular and unplanned waste collection services of municipal authorities, uncollected waste that is dumped haphazardly by the roadside clog the drains during periods of heavy downpour, thereby resulting in frequent flooding or water logging and consequent breeding of insects and rodent vectors. Evidently the failure of municipal authorities in this regard is to a large extent responsible for the spread of diseases in urban and semi-urban areas. In addition even the collected waste is disposed off in uncontrolled and unplanned dumpsites or sometimes burnt openly, thus contributing to relentless environmental threats including pollution of water and air.

A research on the environmentally safe and ethical solid waste management system in Silchar municipal area must be justified. Silchar is the second largest city of Assam after the twin cities of Guwahati and Dispur (the state capital) both in terms of population as well as in terms of area covered under the jurisdiction of the municipal board. It is the largest city in southern Assam and is the district headquarters of Cachar. Located on the banks of the river Barak, it covers an
area of about 15 square kilometers only but accommodates a population of almost 1,80,000 thousand people. This makes Silchar the most congested city of southern Assam. Moreover being the business capital of the region it acts as a transit point for transportation of enormous volume of goods to Manipur, Mizoram and Tripura. Unplanned growth and development of the town in recent years in the form of new housing constructions, has led to over-crowding and has created difficulties in construction of a planned drainage system. Being an old and ingenuous town that did not have any planned drainage system since the pre-independence era, Silchar still suffers immensely today due to the lack of a smooth sewage outflow system. The problem is clearly most acute during the monsoons. Coupled with the faulty drainage system, environmentally unlawful and unsafe disposal of urban solid wastes by residents over the last two decades have been a major cause of the life threaten health hazards in the town.

In this backdrop the focus of the present study is to provide answer to the following fundamental questions:

- To what extent are current solid waste management practices in Silchar Municipal Area threatening our environment?
- Is the households’ lack of awareness and consciousness the true reasons for the current state of affairs?
- Are the households willing to co-operate, contribute and adopt a sustainable urban waste management strategy?

In sum, this study attempts to capture the possible socio-economic roles of the stakeholders in controlling environmentally unethical, unsafe and unsustainable management of solid waste in Silchar Municipal area.
The present study has been carried out with a few specific objectives and these are listed in an order of priority.

(1) To estimate and analyze the demand for a safe and sustainable urban solid waste management in Silchar municipal area.

(2) To identify and assess the impact of selected socio-economic factors and environmental awareness levels on the demand for improved urban solid waste management services in Silchar municipal area.

(3) To recommend a tariff system (policy) to be imposed on households such that the proposed sustainable urban solid waste management system is economically viable.

(4) To suggest an environmentally desirable scheme of urban solid waste management in Silchar Municipal Area.

Chapter Two

Review of literature

The studies reviewed in this chapter are categorized into three groups: i) Contingent Valuation Method (CVM) and its applications in valuing in environmental benefits and costs, ii) Studies conducted on urban solid waste management in foreign countries covering almost all continents and regions and iii) studies on urban solid waste management conducted in India in particular. In conclusion the research gaps are identified and presented.

From the reviewed studies, it has been established that CVM have been decently placed in environmental valuation of goods and services when open to trade. Economic Valuation is about “measuring the preferences” of people for an environmental good or against an environmental bad. The economic value of something is measured by a summation of many individuals’ willingness to pay (WTP) for it. The WTP reflects individuals’ preferences for the good in
question. Valuation is in money terms because of the way in which preference revelation is sought, i.e., by asking people how much they are willing to pay. Many of environmental goods and services are provided freely. Therefore, they have zero prices because no market place exists in which their true values can be revealed through acts of buying and selling. Projects and programs appraisal cannot be sufficient or adequate without valuation. National priorities for environmental policies are better informed if economic values are known with a degree of certainty.

Globally, urban development and growth has triggered a host of problems since the rapid growth of urbanization of the early 1970s. The diverse environmental problems associated with urban growth in developing countries are partly due to "excessive scale" (calculated as population times the per capita use of resources), which strains the natural resource base in and around cities. The strain on the natural regenerative capacity of the land can be lessened up to a certain extent by importing resources from outside. But the ever-increasing amounts of waste that urban areas generate far exceed the assimilative capacity of nature - and, in many cases, the disposal facility of urban waste management authorities. Other urban systems and services, such as water supply, sanitation, public transportation, and roads, are increasingly hassled as well due to growing urban conglomerations in terms of housing, construction and the industrial boom (which obviously requires land) as well as population expansion. Population in the big cities is ever increasing mainly on account of in-migration from rural, semi-urban as well as smaller urban regions. Housing, sanitation, roads and transportation, fuel and power (i.e., energy) and finally the waste disposal and management (which is perhaps most vital from the point of view of environmental sustainability) remains an incommodious challenge for urban authorities in both developed and developing nations.
The reviews pertaining to Municipal Solid Waste Management (MSWM) for Indian cities has been carried out to evaluate the current status and to identify the major problem areas. It can be said that the lack of resources such as financing, infrastructure, suitable planning and leadership are the main obstacles in MSWM. The increase of service demands combined with the lack of resources for municipalities are putting a huge strain on the existing MSWM system.

In north eastern states of India very few studies have been conducted on the WTP for safe and sustainable waste management system. Only a couple of studies are reported in literature - one conducted in Guwahati city (Das, 2011) and another study conducted in Tinsukia Municipality (Das and Gogoi, 2010).

Application of CVM to understand and enumerate the willingness of residents to adopt a safe and sustainable waste management system in Silchar town has not been done before. Thus a very large research gap exists in this area on the topic in question and consequently it is a sufficient justification for undertaking the present research problem. Therefore, in this study, willingness to pay for sustainable waste management scheme is estimated by using single bounded dichotomous choice contingent valuation method. Such an approach to this problem has never been under taken in any city or town of the northeastern part of India and hence this study is the result of a pioneering effort.

Chapter Three

Theoretical and Conceptual Framework

The purpose of this chapter is to present a theoretical and conceptual framework of the study under a conventional utilitarian framework. A preliminary model of valuation of environmental
goods is presented in this study. The theoretical and conceptual framework is to a great extent influenced by the findings presented in the literature reviewed earlier.

Environmental valuation is mostly based on the assumption that individuals are willing to pay for environmental gains and, on the other hand are willing to accept compensation for some environmental hazards or losses. The individual demonstrates preferences, which, in turn, put values on environmental resources. Environmental economists have developed a number of market and non-market-based techniques to assess the environment.

The Contingent Valuation Method (CVM) is a non-market-based technique that elicits information concerning environmental preferences from individuals through the use of surveys, questionnaires, and interviews. When deploying the contingent valuation method, the examiner constructs a scenario or hypothetical market involving an improvement or decline in environmental quality. The scenario is then posed to a random sample of the population to estimate their willingness to pay (e.g., through local property taxes or utility fees) for the improvement or their willingness to accept monetary compensation for the decline in environmental quality. The questionnaire may take the type of a simple open-ended question (e.g., how much would you be willing to pay) or may involve a bidding process (e.g., would you pay Rs. 10, would you pay Rs. 20) or take-it-or-leave-it propositions. Based on survey responses, examiners estimate the mean willingness to pay for an environmental improvement or willingness to accept compensation for a decline in environmental quality.
Chapter Four
Models Methodology and Data

The purpose of this study is to determine whether household in Silchar are willing to pay for improved waste collection and disposal facility. The survey is in the quest of finding out the monetary value that households are able and willing to attach for an improved waste management service. The study determines the coping mechanisms adopted by households in Silchar to alleviate the impacts of unreliable waste collection and poor or unsafe disposal facility, and the related costs incurred.

In the present study, primary data are used to estimate the willingness to pay (WTP) for sustainable urban waste management scheme in Silchar municipal area. Silchar Municipal Area, an area with a high concentration of the working population was purposively selected. It is implicitly assumed that Contingent Valuation would be appropriate to apply in this area, as the population is relatively more educated. This is mainly because Contingent Valuation works effectively if it is applied to a more educated and informed population.

Willingness to pay for improved waste management is estimated in this study by two types of contingent valuation methods (CVM) – dichotomous choice and open ended of CV methods. The dichotomous choice (DC) or referendum approach is recommended by the NOAA (U.S. National Oceanic and Atmospheric Administration) Panel for CV type study; because they thought it minimizes possible bias and is also familiar to the respondents who often vote yes/no on public decision making process. In this study, both the DC CVM and open ended CVM are used to estimate the WTP for improved waste management in Silchar Municipal Area. The hypothetical market scenario of the present study is constructed according to the recommendations of the U.S. National Oceanic and Atmospheric Administration (NOAA).
Chapter Five

Empirical Results and Discussions

This chapter presents the empirical findings of the present study. It is categorized into two different sections, namely, descriptive statistical analysis and econometric analysis. The logical conclusions drawn in this chapter form the basis of the policy prescriptions and recommendations which is dealt with in the last chapter.

Descriptive statistical analysis revealed that the clearance of bins and drains are not regular in most of the wards. The problem of urban waste has manifested itself as a threat to the city. The performance of MSW disposal system has been observed to be miserably poor. There is neither the system of segregation nor the arrangement to facilitate easy transportation of solid waste. Very little has been done in waste disposal options. Land filling and incineration have not adopted till date. Open dumping is practiced by the municipality at present. The existing status of waste management and littered streets all over the city clearly speaks about the poor environmental health of the city.

Econometric analysis section presents the empirical results of the CVM exercise. The major findings are presented as follows:

The mean willingness to pay of the household for improved solid waste management was estimated to know the economic value of the proposed improvement. A binary logit regression model is used for this purpose. Following Hanemann (1989), the calculated mean willingness to pay is Rs. 160.64. The result shows that the mean willingness to pay is both positive and satisfactorily high. This is indicative of the voluntary commitment in monetary terms for an
improved environmental quality by means of better SWM practice in the town. If all the houses are ready to pay the amount than total revenue of Rs. 31, 56,897 can be accumulated.

Multivariate logit regression was used to determine the factors that influence the probability of households’ willingness to pay for improvement in their solid waste management. Expectedly the coefficient of price is found to be negative and statistically highly significant in other words as the offer price of the improved waste collection and disposal increases the estimated probability of households’ willingness to pay for the hypothetical service decreases. Households paying a given price for improved waste collection and disposal increases as household monthly average expenditure increases. The likelihood of households paying a given price for improved waste collection and disposal increases as household size increases but the z value is low which implies household size is statistically insignificant for determining the probability of WTP. The likelihood of household paying a given price for improved waste collection and disposal decreases as the household’s average education level increases. However the z value is low implying that educational attainment at household level is statistically insignificant in explaining the probability of WTP. A larger sample covering more houses per ward is likely to give different result. Likelihood of households paying a given price for improved waste collection and disposal increases as respondents’ awareness level increases. This is an expected result as because environmental awareness is most likely to influence the probability of WTP in a direct and positive way. The likelihood of households paying a given price for improved waste management decreases with the number of working woman in the household. This result is somewhat unexpected as because working woman find lesser time to manage the home and the surroundings of the house that may include gardens and backyards. It is quite possible that households with working woman are more informed about the corruption and malpractices of the
town administrators that also includes the municipal authorities. Thus these household may be more frustrated with the present state of affairs with regard to collection and spending of public money on SWM practices in town. Likelihood of households paying a given price for improved waste collection and disposal decreases when the household has informal waste disposal arrangement (IWDA). However the coefficient of IWDA is statistically insignificant although the marginal effect is economically significant. Reason behind this observation is rather straightforward. Some households have already subscribed to some type of IWDA, it is expected that such households would rather be unwilling to pay any additional sum for any improvement in current state of SWM practices. Satisfaction from municipal solid waste management services (SSWM) has a negative influence on the probability of WTP for the hypothetical SWM scheme at a given bid value or level. Moreover the coefficient is found to be statistically significant. In other words the more satisfied households have lower chances of paying the proposed bid price.

OLS regression is used to estimate the average level of maximum WTP (open ended CVM) for the proposed SWM scheme and also to determine the partial effects of socio economic variables on the open ended maximum WTP. The coefficient of Monthly per capita household expenditure (MPHE) has the expected positive sign and is statistically significant. This implies that with increased monthly expenditure, the household’s maximum WTP amount will increase. The coefficient of Household size (HSZ) is significant and is positive. This suggests that the bigger the family size more would be the volume of waste generated daily and higher would be the difficulties encountered in terms of waste disposal in the urban set up, and hence that would result in a higher WTP. The coefficient of Average Education (AE) has an expected positive sign and it is the most significant variable. This means that the higher the number of years of formal education, the more the WTP amount. The coefficient of Environmental Awareness (EA) is
significant and has the expected positive sign. The variable awareness positively affects maximum WTP amount for improved waste management. This suggests that the more aware the person the more he/she willing to pay for improved waste management. The coefficient of the Number of working women (NWW) variable is also significant and has the expected positive sign. This suggests that the presence of working women in the family does affect the WTP amount for improved waste management. The coefficient of Informal waste disposal arrangement (IWDA), a dummy variable, is statistically insignificant. According to the estimated results this variable does not significantly explain the maximum WTP. The coefficient of IWDA is negative and thus the presence of IWDA negatively influences maximum WTP. Finally the coefficient of Satisfaction from Solid Waste Management (SSWM) is negative and significant. Thus SSWM negatively influences maximum WTP.

In the probit model the coefficient of MPHE is small in absolute value but at the same time it is statistically highly significant. The household size is found to influence the probability of payment positively although the coefficient is statistically insignificant. Average number of years of formal education in the household is found to have a negative impact on the probability of payment for the hypothetical scheme. Environmental awareness also has a negative impact on Pr (WTP) but the coefficient is found to be statistically insignificant for the present sample. NWW is found to influences the probability of payment of the monthly per household average cost (Rs. 135/-) negatively. Informal waste disposal arrangement (IWDA) dummy coefficient is found to be positive. The positive sign of the IWDA coefficient signifies that subscription to some waste disposal arrangement positively influences the probability of payment of the average cost per month. The coefficient of SSWM negative and is statistically significant. The estimated coefficients of the logit model are very similar in nature when compared with those of the probit
model estimates. MPHE, HSZ and IWDA positively influence the probability of WTP. Education, awareness, number of working women and satisfaction on municipal waste management services, is found to have negative influences on the probability of payment of the average cost of the hypothetical project.

Chapter Six

Summary Conclusions and Policy Prescriptions

Although India has one of the most comprehensive MSW (management and handling) Rules 2000, it is just a directive on paper without any enforcement and implementation in Silchar. There are all kinds of excuses for its letdown. Silchar Municipality is currently facing MSW dilemma. Considering this, the study in this field has been undertaken highlighting the serious problems with urban waste collection and its disposal. The study also stresses need for proper government intervention and awareness program at all levels to improve the present scenario.

A number of suggestions are made for the improvement of urban waste management in Silchar. Currently at the level of waste generation and collection there is no source segregation of compostable waste from the other non-biodegradable and recyclables waste. About 93 per cent of the total household waste generated in Silchar municipal area is covered by biodegradable waste but only 47 per cent of the households separate it before dumping. Therefore, source segregation of the waste under various heads- biodegradable, recyclable and hazardous should be implemented properly. Proper isolation would lead to better options and opportunities for scientific disposal of waste. Bio-degradable waste can be used as compost in the agricultural production process. It has important economic benefit. To improve awareness among the residents about the importance of source-segregation, a proper informational campaign through
print and electronic media must be initiated. Educational campaign in schools and colleges etc is simultaneously required. So that non-biodegradable waste can be recycled and biodegradable waste can be land filled systematically.

To make urban waste management in Silchar municipal area more economically sustainable, it is required to introduce a user fee for waste collection and management. However, the fee must be charged in accordance with the income groups so that the poor section is not deprived of the facilities as most of the people are willing to pay if the waste collection facility is improved.

A number of policies are prescribed here, aimed at the development of a sustainable system for urban waste management in Silchar.

The role of environmental awareness is crucial for the present study. It has been observed and understood from the field survey that many of the respondents are aware of the hazardous fallouts of environmentally unsustainable dumping of household daily solid waste. Awareness is primarily determined by education and exposure to mass media. Although the urban residents covered under the present study are more or less aware about the pros and cons of unethical waste dumping practices, there still remains ample scope for awareness build up.

People have supported all types of campaigning programs and hence these may be pursued by the municipal authorities. Mass media may also be used. NGOs may be invited to take some initiates in this regard.

Waste has to segregate at source. Bio-degradable and bio-non-degradable wastes have to be separately kept in different containers and have to be treated differently.
Admittedly any econometric study based on firm level empirical data is bound to suffer from certain limitations or drawbacks. These lacunae or gaps may either be theoretical (i.e. conceptual) or empirical (i.e. either statistical/econometric or data related).

**First,** the study considers a limited number of samples in relation to the population of Silchar Municipal Area. A larger sample would have provided statistically superior estimates of parameters. Considering the nature of the CVM exercise at least 10% households should be selected for statistical validity especially for convergent validity test (Hanley, Shogren and White).

**Second,** Hospital waste- government and private, waste of business establishment like petty shops, departmental stores, etc. are not covered in the study. Since they are municipal tax payers and bigger polluters compared to the individual households, their payment for a safe and sustainable waste management has to be more compared to households and hence if their voluntary payment is considered, average payment per household will come down considerably from the proposed sum of Rs. 160.64. This is the most serious drawback of the present study.

**Third,** during survey weighing of daily waste as par waste category is not conducted. Optimum tariff should be definitely and positively related to volume of waste generation at the household level. If this is not implemented, then all houses are charged equally which is wrong on the grounds of environmental ethics.

**Fourth,** aspects like constant waster logging near the household, very poor drainage system etc. are not incorporated in the CVM exercise. Logically willingness to pay would be more for houses situated in disadvantageous location.
Fifth, detailed information regarding expenditure on waste management in Silchar Municipal Area could not be collected due to lack of accessibility of official data which would have provided a deeper picture of overall SWM at the municipality level.

If some or all of the above aspects are incorporated in future research works then it would obviously make the study more comprehensive with deeper policy implications on economic as well as environmental grounds.

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