Chapter 2

Review of Literature

Extensive literature exists in urban solid wastes management. These studies help us to understand the issue and its impacts on the environment. Majority of the studies conducted in this area of research is in respect of developed countries As regards Kerala, the impact assessment studies have done by researchers which highlight the seriousness of the issue. More micro level studies are needed to address the issue. A brief review of the available literature sheds light into this area of research.

Wertz (1976) analysed the economic factors influencing household production of refuse considering two Detroit suburbs in the U.S and estimated the income elasticity of demand for household waste management services as 0.27.

Richardson et al (1974) and Richardson (1978) analysed the seasonal household solid waste generation and an economic analysis of the composition of households solid wastes respectively. They examined the influence of seasonal variations on solid waste generation along with other factors like household income, household size and age structure at Indianapolis, U.S.A. The income elasticity of demand for household waste management services was estimated as 0.24.

Baldismo (1988) while analysing scavenging of municipal solid waste in Bangkok, Jakarta and Manila, observed that the quantities and characteristics of solid waste produced vary from country to country and identifies the factors that influence it as the average level of income, the sources, population, social behaviour, climate, industrial production and the market for the waste materials.

Jenkins (1993) in his study on American municipalities and found that waste generation increased with increase in the percentage of population in the age group between 18 and 49. She also developed a model where households maximize utility, which positively depends on the consumption of goods and negatively on the quantity of recycling. The budget constraint included a disposal charge for municipal solid waste collection. The quantity of municipal solid waste generated was found to be sensitive to the price of municipal solid waste collection. Analysing data for in American municipalities, she found that a $1.00 dollar fee per 32-gallon trash bag would reduce waste generation by 15 percent. She estimated that such a pricing system would improve social welfare by $650 million per year ie around $3 per person per year. The average price elasticity for municipal solid waste collection was -0.12.

Mclain (1995) identified the changes in lifestyle in the last 50 years as the main cause for the increased solid waste generation in the U.S.A. The increase in nuclear families, increase in women's participation in work and the usage of modern kitchen equipment has increased the need for packaged foods which has accelerated the rate of after consumption waste. It was found that, in the U.S about 33% of the waste consisted of containers and packaging materials.

Beede and Bloom (1995) assessed the relative importance of growth in real per capita income and population in determining municipal solid waste generation rates. Analysing data from a cross section of 36 countries the income elasticity of was estimated as 0.34 and population elasticity as 1.04. Again using time series data for the U.S. (1970-1988) and for Taiwan (1980-1991), they found the income elasticities as 0.86 and 0.59 and population elasticities as 0.63 and 1.63. Using data set for households, they found that household waste generation as income inelastic and an approximately unit elasticity with respect to population.

De Konning H et al (1995) surveyed 21 Latin American countries and showed that the per person generation rate of industrial hazardous waste sludge and solids is a function of the country's industrialization. Countries like Brazil and Mexico had high rates of over 0.3tons/person/year and countries like Bolivia and Equador had lower rates of less than 0.1tons/person/year.

Dennison et al (1996) while conducting a survey of household waste characteristics in the city of Dublin, Ireland, showed the relationship between socio-economic factors and the composition of the waste generated in Dublin. Using a sample of 857 households, the study identified prosperity and household size as the important variables. The data showed substantial differences in the relative composition of the waste stream as compared with the earlier studies undertaken in the late 1970s. The proportion of organic waste was found to be in excess of 45% by wt. in the study as compared with 34% in 1977/78. The results showed a big difference between the prosperous and the less prosperous section of the city's population with regard to individual and overall waste generation.

Martin Medina (1997) analysed the relationship between the municipal solid waste generation rates and income for 123 countries. A curvilinear shape was found for the relationship between the two variables which shows that as a country develops its waste generation rate increases but as it reaches the middle income and upper income range the generation rate decreases.

Podolsky and Spiegel (1998), analysed municipal waste disposal, unit pricing and recycling opportunities on 149 municipalities in New Jersey in the U.S and identified a negative relation between average household size and waste generation rates indicating a possibility of household diseconomies of scale in waste generation. They also found that urban households generated less solid waste when compared with rural households mainly due to the space constraint in the urban areas.

Hong (1999) examined the effect of unit pricing system upon household solid waste in Korea. He used a data set of 3017 households from 20 cities in Korea and estimated the household solid waste generation being income inelastic at 0.10. Kinanman and Fullerton (1997), Hong et al (1999) and Jenkins et al (2003), in their respective studies found a negative relation between household size and solid waste generation.

Houtven and Morris (1999) in their study examined household behaviour under alternative pay-as –you-throw systems for solid waste disposal and observed that the amount of mixed waste increased considerably with the number of small children and adults between the age group 25 to 64 years. They also found that urban households generated less solid waste when compared with rural households.

Sterner and Bartelings (1999) considered the attitudinal variables that influenced the quantity of municipal solid waste generated by households in Swedish municipalities. It was found that apart from economic incentives a proper recycling structure would induce the households to invest more time in recycling and composting.

Bhattarai.R.C. (2000) analyzed the household behavior on solid waste management in Kathmandu metropolitan city and found household size and income as the major determining factors for the total quantity of wastes generated.

Salhofer (2001) has dealt with four different approaches to analyze waste generation rates. i) Input –output models: In input –output models the input of the waste generator is assessed by using production, trade and consumption data about products related to the specific waste stream; ii) Factor models: These models consider analyzing factors like income, housing types etc

which describe the processes of waste generation; iii) Region specific classification iv) Single point of generation based classification and v) Macro level classification.

P.Beigl et al (2003) has identified the parameters that explain the present situation and to assess the future amount of municipal solid waste generated per capita in different European cities. Gross domestic product was found to be a significant factor in cities with high prosperity but not for cities with a lower economic output. Of the social indicators, a positive relationship existed between the percentage of the medium age group (15-59) and municipal solid waste generation while a negative relationship existed between the average household size and the solid waste generation.

Hong et al (1993) has examined the solid waste generation and recycling behaviour of the households within a household Portland, Oregon, U.S.A, by developing a household recycling choice model and a demand function for municipal solid waste disposal. The model was applied to a sample of households from the Portland, Oregon metropolitan area. It was found that the marginal pricing with zero charges for recyclables may provide incentives for households to dispose of less waste through garbage collection services which may be done by generating less total waste or by increasing recycling effort. A positive but small relation was found between an increased price of waste collection and the quantity of municipal solid waste generated.

Morris et al (1994) considered the effectiveness of marginal cost pricing of garbage on waste generation and recycling. They identified that price increase on disposal did not affect recycling as it reduced the household's increased total waste generation.

Miranda et al (1994) found that introducing unit pricing and recycling programs can affect significantly the quantity of municipal solid waste

generated. They also found that market based incentives on the management of residential municipal solid waste will improve the efficiency of residential solid waste management.

Fullerton and Kinanman (1996) has analysed the effect of volume based pricing program in Charlottesville, Virginia, U.S and found that the programme had a substantial effect on the volume but no effect on the weight of waste as the weight per bag increased. Volume based collection fees will result in practices called 'Steatle Stomp' as the households compact garbage into fewer bags. It was estimated that there was a 28% reduction in garbage but it may be due to illegal dumping.

Ackerman (1997) found that the initial introduction of unit pricing system results only in slight reduction in waste disposal through dumping. Kinnaman and Fullerton (2000) finds that if illegal disposal or burning options exists as a choice for the households to dispose waste then unit pricing will increase illegal dumping. Jenkins (1993), Blume (1991) and Miranda and Aldy (1998) have also come up with the same conclusions. Dinan (1993) argues that a uniform tax on all types of garbage might be inefficient if materials within the waste stream produce different social costs.

Bruvoll A. (1998) analysed the effect of income, waste management fees and population density on the overall amount of waste generated and of income, fees and recycling services on the choice of waste management methods. It was found that the overall quantities of municipal solid waste are not influenced by income. Economic incentives were found to be effective in influencing the selection between different waste management methods. Landfill fees reduce the waste amounts landfilled and increase recycling and incineration. But the effect of landfill fees on total waste generation is negative but not significant.

Pratt.R.M. et al (2000) has analysed the impact of Waste minimization clubs on waste minimisation. Waste minimization clubs are formed to encourage industry and commerce to adopt waste minimization methodology. A good majority of the clubs have helped in achieving a significant reduction in solid, liquid and gaseous waste along with financial savings due to higher efficiency.

Mongkolnchaiarunya, J. (2005) explains the new practices that were introduced in the city of Yala in Southern Thailand to deal with the problem of solid waste management. One of the practices was known as 'Garbage for Eggs' in which the residents were allowed to exchange recyclable material for eggs. The important objectives of the project were waste reduction, community empowerment through self reliance, establishing new relationships of equality and less dependence between poor communities and the municipal administration.

Kaseva et al (2005) considered the effect of privatization on solid waste collection and disposal in Dar es Salaam city, Tanzania. The total solid waste generation was around 2425 tons/day. It was found that with privatisation the solid waste collection improved by 10% to 40% of the total waste generated in the city daily in 2001. The study recommends the use of waste recycling and composting activities in order to attain sustainability in waste management.

A good number of studies have considered the effects of landfills and incinerators on property value decrease, ground water contamination and health. One can find a number of studies dealing with the property value decrease due to the proximity to landfills. The observation is that as the distance from the landfill increases, the property value increases. Hedonic property price study were done to estimate the disamenity costs.

Havlicek et al (1971), used hedonic method to consider the effect of five landfills on property values in Fort Wayne, Indiana, USA. The price survey of 182 house sales from 1962-70, within the neighborhood of the landfill showed that there was a $9800 increase in house price per mile from the landfill. A study done at same place by Havlicek (1985) found that the house price rose by 5% per mile away from the landfill.

Gamble et al (1982) analysed the effect of water contamination due to the presence of a hazardous waste site in Pleasant plains, New Jersey, U.S.A using hedonic method. A price survey of houses sold both before and after 1974 found a 10% fall in house prices for 1.5 –2.25 miles from the landfill. Baker (1982), in his study estimated a 21% to 0.55% fall in the house prices as the distance from the land fill increased from 0.5 miles to 1.25 miles from the site.

Michaels et al(1990) using hedonic method, examined the effects of 11 hazardous waste sites on property values in the suburban Boston, U.S.A, during the time period 1977-81. The average increase in property values was found to be $253 dollars per house with increased distance from the waste site.

Nelson et al (1992) examined the effect of landfill in Ramsey, Minnesota, USA on property values. Using hedonic method, the price survey of 708 house sales during 1979-1989, within 2 miles close to the landfill was considered. The house price was predicted to rise by an average of $4896 or by 6.2% as the distance from the landfill increases by a mile. Hirshfeld et al (1992) using hedonic method found a value reduction of 30% to 13% as the distance increased from 0.5 miles to 1.25 miles from the landfill site.

Keil et al (1995), analysed the effect of incinerators on property value in Massachusetts. The study used hedonic method and covered a period of 18 years and 2593 house sales within that time period. It was found that during the

construction of the site there was a reduction of 1.7% per mile in the house value had increased to 3.2% per mile when it was completed.

Ogedengbe et al (2006) has examined the effect of waste management method on property values in Ibadan city, Nigeria. Eleven firms of estate surveying and valuation out of thirty-six registered estate surveying and valuation firms in the study area were selected using systematic random sampling technique. In addition, 15 properties within the axis of three refuse dump sites were selected using stratified random sampling technique to know how their rental values are affected by the generation and management of these dump sites. The results showed that the waste dumps have significant negative impact on the property values in the area.

Bacud et al (1994), analysed the water quality of drinking wells around the Payatas dumpsite in Quezon City, Manila, Philippines and has shown the acidification of ground water and the increased presence of nitrates and Coliform bacteria.

Pushpakumari (1997) analysed the effects of pollution of Travancore Titanium Products and brings out the adverse impacts of pollution from the factory. The areas very close to the factory were more prone to the pollution hazards. It was found that 19% of the people in the experimental group were affected by respiratory and related diseases. Other effects include low coconut yield, declining fish yield and fish species, corrosion of fishing crafts and gears, increasing trend of the locals leaving their traditional fishing to other occupations.etc.

Shameer Das et al (2000) in their study examined the health impacts of environmental pollution by solid waste disposal from Grasim Industries, Kerala. The effluents from the industry were found to pollute the river Chaliyar and thus directly affecting the population living nearby. It was also found that the

discharges from the factory was degrading the ecological quality of the area in the form of contaminated water, polluted air, solid wastes and noise. Around 56% of the people surveyed were affected by some diseases caused by pollution. The lower and lower middle income group were most affected. The main health problems were in the form of the occurrence of diseases like persistent coughs, bronchitis, asthma, headache, cancer and eye irritation.

Nilanthi et al (2003) has analysed the environmental impacts associated with current waste disposal practices in Moratuwa, Sri Lanka, a suburb municipality in SriLanka. Municipal officials, over 300 households and landfill operators were interviewed to examine current practices and related environmental problems. Groundwater samples from the vicinity were analyzed and it showed levels of certain chemical parameters well above acceptable limits. Landfill gas emissions and possible green house gas contributions were theoretically calculated using Scholl Canyon Model for gas estimations. The main environmental problems identified in the study were the release of landfill gas and leachate. The significant amount of landfill gas which is generated from the site is released to the atmosphere contributing to global warming. Leaching of pollutants into ground water has also been found to be a significant concern due to the high use of ground water for residential purposes and due to the possible illegal disposal of industrial waste along with MSW. From the public perception worst impacts of present solid waste disposal practices are seen as direct social impacts such as odor, breeding of pests and loss in property values.

Elma Torres et al (2004) has analysed the health risk perception of communities located in Metro Manila airshed in Philippines. Majority of the respondents recognized environmental factors as sources of various disease symptoms and illness. The community considered proper disposal of solid waste as more important than clean air. The respondents had a positive attitude towards pollution control as majority of them were willing to pay for clean air.

N.Raman et al (2008) have analysed the impact of solid waste on ground water and soil quality on places closer to Pallavaram solid waste landfill in Chennai. The physical and chemical parameters like Ph, electrical conductivity, total dissolved salts, total suspended solids, alkalinity calcium, magnesium, chloride and metals like sodium, potassium, lead, cadmium were studied. It was found that parameters like pH, hardness of water, calcium, and manganese were beyond the acceptable limits in accordance with the IS 10500 drinking water quality standards. In the case of alkalinity, and metals like copper, manganese, cadmium, nickel and chromium their presence were beyond the acceptable limits.

Utpal Goswami et al (2008) analysed the impact of municipal solid waste dumping on soil quality in Guwahati city. Soil samples were collected from different depths of the abandoned municipal solid waste dumping ground at Adabari in Guwahati city. The study found that the experimental value for the physico-chemical parameters increased for the solid waste treated soli when compared with the control soil. The soil pH and electrical conductivity were high and the presence of phosphorous pentoxide and calcium carbonate were found to be high.

Altaf et al (1996) studied the household demand for improved solid waste management at Gujranwala, Pakistan using C.V method. The approach of the study was to integrate demand side information into the planning process. The average willingness to pay was estimated as Rs.8.04 per month per household. The significant variables affecting the WTP were education, household expenditure discretionary income and wealth.

Willis and Garrod (1997) estimated the WTP using C.V method to reduce noise, odour and windblown dust and litter from a landfill using a choice experiment study. The study used a sample of 79 residents around the chosen landfill. It was found that the Marginal WTP to reduce the number of days when

respondent suffers from dust and windblown litter from the site is £0.12 to £0.19per day and the Marginal WTP to reduce the number of days when respondent can smell the site from their home: £0.10 to £0.15 per day.

Rogier Marchand (1998) analysed whether demand side information along with WTP and affordability to pay will prove to be the most important factors to improve the solid waste management in the urban areas of developing countries. A study on the affordability and WTP for solid waste management services in Tingloy, Philippines using C.V method was conducted and the average WTP for an improved solid waste management system was found as15.75 Pesos per month per household.

Viniegra et al (2001) determined the economic value of an improvement in environmental quality due to an alternative household garbage collection and selection system for the inhabitants of San Pedro Choula in Central Mexico using C.V. method. The average monthly willingness to pay (WTP) for the improved collection system was estimated at $1.85 /month /household. The income elasticity for environmental quality was found to be 0.13. The significant variables affecting the WTP were income, age and trust in government. Education, wealth, children, gender and environmental ethic were found non-significant.

Chutrat et al (2007) estimated the willingness to pay (WTP) to pay environmental taxes and their opinions on the environmental management of the households of Khon Kaen in Thailand using C.V method. It was found that the households were willing to pay taxes for their environment up to 20.88 Thai Baht per month. Their willingness to pay the taxes depended upon the education and income levels.

Reyer Gerlagh et al (1999), has proposed a new paradigm of SWM, to achieve a socially and environmentally responsible solid waste management in

India. A range of activities, issues and processes like the types of waste generated, the number of stakeholders and economic activities involved, and the various economic, social and environmental effects of SWM which includes legitimisation of the informal system, public participation and partial privatisation are considered. A linear programming model to evaluate the effectiveness of different SWM alternatives is applied to the city of Bangalore with the main objective to minimise the overall system costs and to identify low cost alternatives to manage household, institutional and industrial waste. The model incorporates social and environmental objectives associated with SWM to find sustainable solutions. The model is comparable with input-output modeling with additional objectives given as side constraints. The significance of the model is in showing the important interdependencies in the waste management sector and is an important step in evaluating integrated SWM in developing countries.

P.B.Anand (1999), examined how households in Madras view garbage problems, their preferences for improved services and the extent to which they would pay for them. It also includes a comparison between areas served and not served by Civic Exnora units where neighborhoods organize their own primary collection. Information was collected from focus group discussions, household interviews from across a range of income levels and spatial locations and in-depth interviews with those who manage the Civic Exnora units. The findings highlight that people are willing to cooperate and pay only for waste collection. Analysis also shows that concern for waste management cuts across all income groups. Of all the waste management services, households seem to be least concerned with final disposal. They also show how the financial viability of neighbourhood collection schemes such as the Civic Exnora units depends on having transfer stations close by, to which the collected wastes can be taken.

Babu Ambat (2000), identified the types and estimated the quantities of waste generated in each ward of Thiruvananthapuram City Corporation. It was

estimated that a total of 290-300 tons of solid waste were generated in the city. The contribution of the households was 181 tons followed by markets (40 tons) and hotels and restaurants (30 tons).The medical waste was about 13 tons. The non-degradable waste like plastics, paper, metals and glasses were collected from the source or from the disposal sites by a group of rag pickers. They sell these wastes to the wholesale dealers who will transport these wastes to Salem and Coimbatore for recycling. The technology optimization study considered composting as the best method for disposing waste in Trivandrum since the degradable waste content (50%) is high in the solid waste stream. Biomethanation was suggested for institutions, hotels and marriage halls. The important aspects of the solid waste management action plan included a) segregation and characterization of the wastes at the source itself b) decentralized collection from the primary source and centralized collection from secondary sources c) strengthening the existing informal waste collection sector d) detailed transportation network planning.

Reghunandhan (2001) studied the generation, composition, disposal methods and collection and transportation problems of solid waste management in Chalakudy town and Pattambi town. The Chalakudy Municipality generated on an average 1.5 to 2 tones of waste per day which was dumped on two open landfills.. The proportion of organic waste was found to be around 73%. Pattambi town generated around 2 tones of waste per day whose organic component was found to be 66%. Slaughter houses (35%) and shops (21%) were the main sources of waste while households contributed around 6% to the total waste generated. The main methods of disposal of wastes were by dumping in pits (49%) and into common bins (22%).

P.R.SreeMahadevan Pillai (2002) in his study on the disposal and management of waste in Palakad municipal area analysed the composition of waste, waste generation and disposal habits of the people. Laboratory experiments were done on the waste to understand the chemical composition of

the waste. The proportion of organic waste was found to be 35.4%. Dumping of waste in ones own premise was found to be very common in Palakad (around 65% of the households did that). The utilization of municipal waste bins was considered to be very low at 15%. The study recommends the installation of a completely mechanized solid waste treatment plant for processing mixed waste.

C.N.Ray (2003), examined the present solid waste management scenario in the city of Ahmedabad and has identified the problems of the existing systems and analysed the steps taken by the city corporation to rectify the problems.

Babu Ambat (2003), analysed the current practices of solid waste storage, the present waste management practices, the communities perception on the existing collection and management system in Thiruvananthapuram city. The study also examined the changed attitude of the community, people's preference and willingness to cooperate and pay for an improved solid waste management practice and also identified the new initiatives at the local level for waste management. Lack of space and practice are considered to be the main reasons why wastes are not segregated and thrown on the road side. People are not willing to do any segregation of waste except the news papers. Majority of the hospitals dump the waste in the dumper placer containers or burn it in the hospital premises. It was found that 55% of the households reduce, reuse and recycle the waste materials. Majority of the low-income and middle income houses burn 60% of the waste generated and sell the rest for a nominal rate. 88% of the people feel that they have a role to play in solid waste management showing the change in the attitude of the people towards solid waste management. People prefer a door to door collection system and were willing to pay for an improved service of solid waste collection.

Varkey Mathew (2003), examined the quantity and quality of the solid waste generated in Kottayam town. Random and cluster sampling methods were

used for selecting the households. The total waste generated per day was about 52.3 tons and the per capita generation was 0.62 kg/per day. It was found that the storage capacity of the community bins being inadequate. Vermicomposting was considered as the most effective method for organic wastes.

Madhushree Sekher (2004), analysed the process of municipal waste management in the city of Bangalore while focusing on the situation in Karnataka. The paper considers the characteristics of municipal waste generated, the management practices involved and the role of the stakeholders in the overall process. Inadequate municipal service, unscientific disposal system, lack of civic awareness in waste management lack of a proper market for recycled waste products .etc. are found as the most important deficiencies in the waste management system.

The review shows that solid waste management has emerged as a subject of great interest and various aspects of the issue have been looked into. One of the glaring deficiencies is the lack of studies focusing on densely populated small towns in developing countries and the absence of studies analysing the socio economic and environmental impacts of solid waste management. In this context, the present study intends to bridge a gap in this area of research.

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