CHAPTER-II
REVIEW OF LITERATURE

Environmental economics is a fast developing area of knowledge in economics in the recent past. Formerly economists viewed environment as resource supplier but free from all the limitations of supply. Things being so, there arose several of the symptoms of resource waste mainly due to the fact that formal prices were not assigned to them. Generation of waste and its disposal has assumed greater concern, and the persons concerned, particularly economists have given much attention to study the reasons for resource waste, the impacts waste and the price that the society needs to shoulder for its disposal. All these ideas have grouped into the study of environmental economics.

As already pointed out waste is a crucial issue among all the countries of the world. Waste disposal is not very easy when we consider the social, economic, health impacts of it. It is in this background the researcher has prepared to study the various aspects of waste and its management. Since this is a relatively new subject, research students are scanty. However all the leading studies prepared in the form of articles, study notes, books, research publications etc. have been reviewed with a view to know the methodology of studies, the various tools being applied, and the conclusions drawn in order to identify the area where research vacuum is seen.

Chongwoo Choe and Iain Fraser\(^1\) in their paper *An Economic Analysis of Household Waste Management* provides a comprehensive model of household waste management policy incorporating the possibility of waste reduction effort by firms and households and of illegal waste disposal by the household. When household waste reduction effort is insignificant, the first-best optimum can be achieved using various combinations of environmental tax on the firm and waste collection charge on the household. However, when household waste reduction effort is significant, the first-best optimum is not achievable and explicit monitoring of illegal waste disposal

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\(^1\) Chongwoo Choe and Iain Fraser(1999) *An Economic Analysis of Household Waste Management* Journal of Environmental Economics and Management Volume 38, Issue 2, September, Pages 234-246
is needed, rendering a simple Pigouvian tax sub-optimal. This paper solves for the second-best optimal policy and provides some comparative statics of the optimal policy.

Beede and Bloom² in their article *The Economics of Municipal Waste*, examines the generation and management of municipal solid waste through the lens of economics. Industrial countries account for a disproportionately high share of the world’s waste relative to their share of world population, while developing countries account for a disproportionately high share of the world's waste relative to their share of world income. Analyses across countries and over time reveal that the generation of municipal solid waste is positively related to variations in per capita income and that the generation of municipal solid waste per capita does not vary with population size among countries with comparable per capita income.

Scott Callan Janet Thomas³ in their paper adopting *A Unit Pricing System for Municipal Solid Waste: Policy and SocioEconomicDeterminants* Concerns about the environmental and aesthetic damages of municipal solid waste pollution 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.


Rob F.T. Aalbers Herman R.J. Vollebergh\textsuperscript{4} in their paper \textit{An Economic Analysis of Mixing Wastes} using a general equilibrium model with heterogeneous waste, this paper studies optimal waste policy when households have to exert separation effort to produce near-homogeneous waste streams suitable for recycling. This model explicitly allows for changes in the composition (quality) of waste streams depending on how much effort households are willing to spend on separating different types of waste. Accordingly, this paper is able to generalize some earlier contributions to the waste management literature and demonstrate that with mixing and effort included, a first-best optimum is feasible under reasonable conditions. In particular, they find that a (modified) deposit-refund system still provides the optimal incentives to guide recycling as well as legal disposal (land filling) and illegal dumping.

Shinkuma\textsuperscript{5} in his study \textit{On the Second-best Policy of Household's Waste Recycling} analyzes the second-best household's waste recycling policy. If they assume the first-best economy with no illegal disposal or transaction costs, then unit pricing, an advance disposal fee and a recycling subsidy are required in order to achieve the social optimum such that both the sum of unit pricing and an advance disposal fee and the sum of unit pricing and a recycling subsidy are equal to the marginal disposal cost. Furthermore, the first-best outcome can also be obtained by a producer take-back requirement system. In the real economy, however, various factors prevent the first-best optimal outcome. In this study authors consider two factors, one being the transaction cost associated with a recycling subsidy (or refund) and the other being illegal disposal by the consumer.


David N. Beede and David E. Bloom in their paper *Economics of the Generation and Management of Municipal Solid Waste* examines the generation and management of solid waste (MSW) through the lens of economics. Considerable evidence indicates that the generation and management of MSW is sensitive to income and price variables, natural incentives to overuse common property and the presence of intergenerational externalities both suggest that private economic behavior will not yield socially optimal outcomes in this area. Community intervention may thereby promote the social good; with evidence accumulating that favors arrangements involving the private firms.

Goddard H. C in his paper *The Benefits and Costs of Alternative Solid Wastes Management Policies* analyzes the role of waste management fees or user charges in rationalizing investment in waste management technology and finds that, while there is wide agreement that the prices are not right in this environmental area, there is little focus on the role that such fees can play in motivation source reduction at the consumer or household level.

Palmer et al. in their paper *Upstream Pollution, Downstream Waste Disposal, and the Design of Comprehensive Environmental Policies* develop a model of production and consumption that incorporates life-cycle environmental externalities—specifically, an upstream manufacturing byproduct, air or water pollution from manufacturing, and downstream solid waste disposal. This paper uses the model to derive optimal government policies to address all three externalities. The authors assume throughout that a Pigouvian tax on waste disposal is precluded because of the potential for illegal

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dumping. This paper also discovers that a so-called "integrated" approach to policy appears to be important, no matter what policy options are adopted. And finally, find that there is only a limited role for product "life-cycle assessments"—enumerations of all of the resources used and pollutants emitted throughout an entire product life-cycle.

Thomas and Fullerton\textsuperscript{9} in their paper \textit{The Economics of Residential Solid Waste Management} provides a broad overview of recent trends in solid waste and recycling, related public policy issues, and the economics literature devoted to these topics. Public attention to solid waste and recycling has increased dramatically over the past decade both in the United States and in Europe. In response, economists have developed models to help policy makers choose the efficient mix of policy levers to regulate solid waste and recycling activities. Economists have also employed different kinds of data to estimate the factors that contribute to the generation of residential solid waste and recycling and to estimate the effectiveness of many of the policy options employed.

Steven G. Thorpe\textsuperscript{10} in his paper \textit{Integrating Solid Waste Management: A Framework for Analysis} \textit{Journal of Environmental System} provides a comprehensive framework by combining the traditional economic method of benefit-resulting in a framework based on the flow of waste materials through generation, collection, processing, recovery, and/or disposal. The framework presented in this article is valuable to decision makers, and others who are interested in identifying and analyzing the large number and types of benefits and costs associated with integrated solid waste management systems.


Miranda et.al\textsuperscript{11} in their article \textit{Market-Based Incentives and Residential Municipal Solid Waste} explains coalitions of free-marketers, politicians, and environmentalists increasingly are turning to the use of market-based incentives in formulating environmental policy. One promising application of market-based incentives is in the management of residential municipal solid waste. This article focuses on unit-based pricing programs established in conjunction with community recycling programs. Using data gathered through telephone and mail surveys of 21 cities, they demonstrate the strong potential for unit pricing to improve the efficiency of residential solid waste management.

Kinnaman, and Fullerton\textsuperscript{12} in their paper \textit{Garbage and Recycling in Communities with Curbside Recycling and Unit-Based Pricing}, estimates the impact of a user fee and a curbside recycling program on garbage and recycling amounts, allowing for the possibility of endogenous policy choices. Previous estimates of the effects of these policies could be biased if unobserved variables such as local preference for the environment jointly impact the probability of implementing these policies and the levels of garbage and recycling collected in the community. A simple sequential model of local policymaking is estimated using original data gathered from a large cross-section of communities with user fees, combined with an even larger cross-section of towns without user fees but with and without curbside recycling programs.

Pearce and Turner\textsuperscript{13} in their paper \textit{Market-based Approaches to Solid Waste Management}, briefly reviews the failures that have inhibited efficient waste


management policy and practice in the past. It then goes on to provide an economic analysis of the comparative merits and limitations of the regulatory approach to waste management policy and the market-based approach. The latter approach is examined in the context of three typical economic policy instruments: packaging taxes, deposit-refunds and marketable permits.

Turner et.al\textsuperscript{14} in their paper \textit{Green Taxes, Waste Management and Political Economy}, focused interest among policymakers has recently focused on the role, efficiency and effectiveness of so-called green taxes. This paper surveys recent developments in the context of waste management policy and the emergence of resources such as recycling credits and the landfill tax. It is concluded that there is an important role that economic instruments can play in this policy area.

Kerry\textsuperscript{15} in his work \textit{Packaging Waste and the Polluter Pays Principle: a Taxation Solution} argued that the full social cost (particularly environmental damage costs) is not currently reflected in the prices of packaged products. This market failure means that the receiving capacity of the environment is under priced and the full cost of packaging waste and litter disamenity ought to be reflected in packaged product price. Either an input package tax or an output packaging tax could be imposed to correct for market failure. These market-based instruments offer a more cost-effective solution to the problem of packaging waste and litter than regulatory legislation.


Colangelo\(^{16}\) in his work *A Theoretical Approach to the Policy of Municipal Solid Waste* set up three analytical frameworks dealing with the problems of M.S.W. The first one waste is generated through household’s consumption activity. In order to reduce this externality, a Pigouvian tax on each household is to be levied. In the second model a certain amount of waste is generated by firm’s packages policies and in the third model intertemporal relation between waste flows/ stocks and environmental resources.

Pearce and Brisson\(^{17}\) in their paper *Using Economic Incentives for the Control of Municipal Solid Waste* explore some of the fundamentals of using economic instruments and offer an example of waste tax that serves a number of environmental objectives.

Deborah and Michael\(^{18}\) in their study *Assessing Incentive-Based Environmental Policies for Reducing Household Waste Disposal* deal with residential solid waste management, the United States has a great deal of experience in applying incentive-based environmental policy in the form of unit pricing. This study examines the two most common forms of unit pricing practiced in the United States. It offers intuition and empirical evidence suggesting divergence of theoretical expectations and actual outcomes regarding the effects of switching to unit pricing. Data collected from households in Marietta, Ga. during a solid waste pricing experiment serve as the basis for the analysis.


Heleen Bartelings and Thomas Sterne\textsuperscript{19} in their paper *Household Waste Management in a Swedish Municipality: Determinants of Waste Disposal, Recycling and Composting* analyzes waste disposal, recycling and composting in a municipality in southwest Sweden. This study had access to actual measured data on waste disposal at the household level for a residential area called Tväåker, in addition to survey data for the same households. The most important determinants of each individual household's waste were composting of kitchen waste, living area, age and attitudes concerning the difficulty of recycling various materials. Separate sections look at composting behaviour, as willingness to pay for sound waste management and for the sake of comparison, three other municipalities are also studied. The main finding is that economic incentives, although important, are not the only driving force behind the observed reduction in municipal waste: Given the proper infrastructure that facilitates recycling, people are willing to invest more time than can be motivated purely by savings on their waste management bill.

Shylajan and Bhattacharya\textsuperscript{20} in their work *Economic Instrument for Managing Municipal Solid Waste in India* present a critical review of waste management policies with in India. On the basis of case study carried out in three major metropolitan cities in the country—Kolkata, Delhi, and Chennai. A comparative analysis of municipal solid waste management practice with in the country shows that a huge amount of waste is generated and a substantial amount of annual budget is spent on waste management especially during waste collection. The authors strongly suggested that proper waste management in the country requires an implementation of incentive-based economic instruments backed by proper institution and improved regulatory mechanisms.


Urvashi Dhamija in her work *Sustainable Solid Waste Management* explores the structure, policies and issues relating to waste management, in Delhi during the period 1998-2003. It examines 4 types of waste: hazardous, non-hazardous waste, human waste and biomedical waste. It explores issues of policy institutional reform and innovation in governance, participation of non-governmental organization, and of citizen groups in the Bhagidari initiative of the Delhi government. In the conclusion, it urges the custodians of Delhi, Govt. of India, Delhi Govt, and the sub authorities particularly the municipal corporation of Delhi and Delhi Jal Board to move in tandem to manage the city’s waste, supportive of both the precautionary and ‘polluter must pay’ principles.

Sukanya et al. in their paper *Informing Efficient and Effective Solid Waste Management to Improve Local Environmental Quality and Public Health: Application of the Choice Experiment Method in West Bengal, India* employ the choice experiment method to estimate residents’ willingness to pay (WTP) for improvements in the solid waste management (SWM) services provided in Chandernagore and South Dum Dum municipalities of Greater Kolkata in West Bengal, India. 101 randomly selected residents took part in a choice experiment survey. The results reveal that on an average residents of these municipalities are WTP significant amounts, in terms of higher monthly municipality taxes, to increase the frequency of waste collection, and to ensure that the waste is collected by covered trucks. Differences in WTP values across residents, however, should be taken into consideration to ensure social equity. The results reported in this paper have important policy implications for informing efficient, effective and equitable SWM services aimed at reducing local environmental pollution and the consequent public health risks.


Vanitha\textsuperscript{21} in her article \textit{Determinants of Willingness to Pay for Household Solid Waste Management} an attempt is made in this paper to estimate the household’s willingness to pay and the determinants of willingness to pay for the household solid waste management in Tamil Nadu for obtaining better environment. As nearly 70\% of the people were WTP a minimum amount, garbage fee can be collected from people, to get used to paying for pollution control.

Report\textsuperscript{24} of \textit{Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes} is an extensive and very detailed analysis of the emissions from various waste management methods (incineration, land filling, etc.), their health effects and their environmental impacts, in relation to other human activities. Emissions from landfill differ from other waste management processes because they occur over a period of years. For most of the municipal solid waste facilities studied, and found that health effects in people living near waste management facilities were either generally not apparent, or the evidence was not consistent or convincing.

The article\textsuperscript{25} \textit{Awash with Waste} explains many citizen- sector initiatives have demonstrated that waste reduction can be achieved through simple, low-cost methods. However, even where such social capital is available, the municipal bodies and the state governments have not come forward to help community organizations set up composting and waste sorting centers. Without strong Laws on the use of non-toxic chemical in manufacturing, eco-friendly package, and ‘take back’ mechanisms for plastics and strict enforcement of such laws, the waste management problem is bound to get even more serious.

\textsuperscript{21}Vanitha.B(2009) Determinants of willingness to pay for household solid waste management, Southern Economist,April&15 p-5-7

\textsuperscript{24}Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes by Enviros Consulting Ltd and University of Birmingham, with Risk and Policy Analysts Ltd, Open University and Maggie Thurgood Department for Environment, Food and Rural Affairs, U.K. Excerpts from: http://www.defra.gov.uk,

\textsuperscript{25}“Awash with waste” (2007), The Hindu, Aug.2.
Shiva Sankara Menon in his paper *Ferrocement Vermi Compost Tanks for Residential Solid Waste Disposal* argue that vermi compost system will be very ideal, it will require only less than two cents of land and this can be found out anywhere very easily, and compared to open disposal system the hygiene and health condition of surroundings will also have a tremendous improvement.

Lyle in his *Work Sustainable Abundance-Environmental Performance in Industrial Democracies* pointed out that, all disposal methods, including burial in landfills and incineration, have some negative environmental consequences. The material that becomes ‘Waste’ must be created, transported, collected after use, and disposed of. Author prefers recycling as the best solution after source reduction.

Shaleen Singhal and Suneel Pandey in their Paper *Solid Waste Management in India: Status And Future Directions* discusses various future projections for estimating the growth of MSW and the impacts of such growth, and discusses possible intervention(s) to mitigate such adverse impacts. The projections have been made under the BAU (business as usual) scenario for the year 2047 taking 1997 as the base year. It is evident that the total waste quantity generated in 2047 would be approximately above 260 million tonnes—more than five times the present level.

Misra, V. and S.D. Pandey in their paper *Hazardous Waste, Impact On Health And Environment for Development of Better Waste Management Strategies in Future in India*, outlines the nature of the wastes, waste generating industries, waste characterization, health and environmental implications of wastes management practices, steps towards planning, design and development of models for effective hazardous waste management, treatment, approaches and regulations for disposal of

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hazardous waste. Appraisal of the whole situation with reference to Indian scenario is attempted so that better cost effective strategies for waste management are evolved in future.

Surya Rao\textsuperscript{30} in his article \textit{Solid Waste Management- A Study of Municipalities in West-Godaveri District, Andhra Pradesh} reveals that solid waste management has become a challenging task to the civic bodies as it costs public health due to environmental implications. The problem is much more pronounced in urban centers compared to rural pockets. People living in urban areas are subjected to health hazards such as viral fevers, tuberculosis, high infections, skin diseases etc. On account of all these hazards, not only the people are expected to spend lot of money for medical treatment but also their productivity in the work place will be affected to a large extent. The role of public authorities to mitigate solid waste is seen omitted in this research work.

Girish Karnad\textsuperscript{31} in his article \textit{planning for Solid Waste Management in Mysore} finds that there is acute shortage of waste collection bins in the city. House to house collection system is not being practiced widely. The study observed that the waste disposal is not timely due to shortage of manpower and vehicles, and also improper waste collection create environmental problems.

Bhubaneswar Municipal Corporation (BMC) in general has not been able to provide satisfactory waste management system in Bhubaneswar. In most of the areas of Bhubaneswar, S.W has become a serious problem for the health and hygiene consequence of city dwellers. The uncontrolled disposal of untreated waste emanating from all sources human, medical, commercial and industrial centers into primitive drainage systems or any available open space as a result poses serious hazards to


human health as noted by Rout\textsuperscript{32} in his article *Urban Solid Waste Management in Temple City Bhubaneswar: Options for improvement in Urban Environmental service*.

The average waste generation per capita of the state is much higher than the national average with the state producing around 6,000 tones of waste per day. This is revealed in the first ever state of *Environmental Report, Kerala 2005*\textsuperscript{33} (SoER). The total quantity of hazardous waste generated and handled in the state is around 82,724 tones a year, the SoER States.

Krishna Iyer\textsuperscript{34} in his article *Disasters of Distorted Urban Development* revealed the garbage crisis in Kochi. Currently the cities of Kochi are the victim of a garbage macro-crisis. It phases imminent peril of fatal fevers. There is even the potential for a plague out break.

McDougall\textsuperscript{35} *Integrated Solid Waste Management: A life cycle inventory*, the first edition described the concept of Integrated Waste Management (IWM) and the use of the life cycle inventory (LCI) to provide a way to assess the environmental and economic performance of solid waste systems. The 2nd edition focuses on case studies - both of IWM systems - and of where LCI has been used to assess such systems. It includes updated chapters on waste generation, waste collection and, central sorting, biological treatment, thermal treatment, landfill and materials recycling. It also provides a more user friendly model (IWM-2) for waste managers.

Mongkolnchaiarunya,\textsuperscript{36} in his work *Promoting A Community-Based Solid-Waste Management Initiative in Local Government: Yala Municipality*, reveals


\textsuperscript{34} Krishna Iyer, V.R (2007). “Disasters of distorted urban development” The Hindu August-8, P-13


Yala has experienced problems in waste disposal and has sought ways of addressing these through alternative techniques, including recycling. A package of new practices was introduced, one of which ("Garbage for Eggs") is described here. Residents were encouraged to bring recyclable material to exchange for eggs, at monthly exchanges in local communities, with emphasis on poorer communities. The project aimed not only at garbage reduction, but also at community empowerment through self-reliance, establishing new relationships of more equality and less dependence, between poor communities and the municipal administration.

One of the key factors necessary to ensure the success of the sustainable waste management initiatives, as advocated by this paper, is the involvement of the civil society. This would mean enhancing the communities' contribution to the operational processes; strengthen educational programmes on waste-health related issues at school, and examining the proper role of women within the waste management sector as noted by *Assessment of Solid Waste Management in Liberia*[^37]

Kaseva and Mbuligwe[^38] in their paper *Appraisal of Solid Waste Collection Following Private Sector Involvement in Dar Es Salaam City, Tanzania*, presents findings of a study, which was carried out in Dar es Salaam city to assess post-privatization of solid waste collection and disposal. Prior to the assessment, fieldwork studies indicated that current solid waste generation rate in the city is 0.4 kg/cap/day and total waste generation is within the range of 2425 tons/day. Findings suggest that as a result of privatization of solid waste collection activities in Dar es Salaam city, solid waste collection has improved from 10% in 1994 to 40% of the total waste generated in the city daily in 2001. The paper recommends that waste recycling and composting activities be encouraged since this approach is considered to be the right measure in attaining sustainability in waste management.

[^37]: Assessment of Solid Waste Management in Liberia United Nations Environment Programme (2007) Post-Conflict and Disaster Management Branch in collaboration with the Environmental Protection Agency of Liberia July

Ghorbani et.al in their work *House Hold Waste Management in Mashad: Characteristic and Factors Influencing on Demand for Collecting Services* evaluate factors which asset on demand for waste collecting services. The study emphasized on components of pricing and economic motivation as well as education and socio-economic factors for decreasing of household waste production. The findings of the present study suggest that improving household waste management in Mashad (North East of Iran) requires further efforts by municipality, Government, and even environmental NGOs.

Helen Spiegelman and Bill Sheephan in their work *Unintended Consequences: M.S.W Management and the Throw Away Society* examine the success and failure of Integrated Waste Management in those public policy objectives. The key findings is that M SW system has been least effective in reducing manufactured product waste, and most successful in managing certain community generated bio-wastes.

*Sustainable Urban Development in the Third World: Proceedings of a Seminar Held in Utrecht* dealt with urban livelihood issues in developing countries. A good diagnostic approach to urban development is no easy undertaking in the light of its multidisciplinary character. During the seminar matters like: indicators for urban sustainability, the integrated relationship between health, environment, culture and political development, and the role of different factors in integrated waste management were addressed.


Review of the Literature

Eriksson\textsuperscript{42} in his work \textit{Environmental and Economic Assessment of Swedish Municipal Solid Waste Management in a Systems Perspective} reveals the best alternative to land filling is incineration, but also material recycling and biological treatment are possible. Recycling of plastic has slightly less environmental impact and energy consumption than incineration.

Eriksson et al\textsuperscript{43} \textit{Municipal Solid Waste Management from a Systems Perspective} different waste treatment options for municipal solid waste have been studied in a systems analysis. Different combinations of incineration, materials recycling of separated plastic and cardboard containers, and biological treatment (anaerobic digestion and composting) of biodegradable waste, were studied and compared to -landfilling. The evaluation covered use of energy resources, environmental impact and financial and environmental costs. In the study, a calculation model (Orware) based on methodology from life cycle assessment (LCA) was used. Case studies were performed in three Swedish municipalities: Uppsala, Stockholm, and Älvdalen. The study shows that reduced land filling in favour of increased recycling of energy and materials lead to lower environmental impact, lower consumption of energy resources, and lower economic costs.

Anne\textsuperscript{44} in her work \textit{Building a New South Africa} reveals South African municipal authorities do not offer incentives to households or industry to recycle waste; instead, it is simply “disposed of.” Several problems arise from this approach to waste. The first is that most solid waste ends up in landfill sites. These sites are often located close to black residential areas, and many are poorly managed and controlled. Poor people, particularly black women, scavenge on the sites without fully understanding the dangers of doing so. The Author suggests that municipalities

\textsuperscript{42} Environmental and Economic Assessment of Swedish Municipal Solid Waste Management in a Systems Perspective, Eriksson, Ola Theses from KTH Stockholm: KTH, Chemical and Engineering and Technology 2003


\textsuperscript{44} Anne.V.Whyte (1995)”Building a new South Africa”, Environment, Reconstruction and Development-A report from the International Mission on Environmental policy, Published by International Development Research Centre, Canada.
should be required to create mechanisms and offer incentives (such as recycling credits) to facilitate and encourage the recycling of wastes, including separation of wastes at source at both the household and the industrial level. This should also include the separation of toxic waste at the household level.

Samorn Muttamara et.al in their work *Solid Waste Recycling, Disposal and Management in Bangkok* pointed out that, waste recycling should be integrated with other solid waste management options to abate degradation in urban environment. This can be achieved through promotion of economically efficient and environmentally sound practices in managing municipal waste. Recycling can be promoted by encouraging separation at source. The best way of waste separation at source can be stimulated by financial incentives, legislation and rising of environmental awareness. In Bangkok, 90% of the solid waste is disposed of by open dumping. Around each disposal site, there are a number of small scale recycling shops (SSR) where collected materials are sold by the collection crews and the scavengers.

Lardinois et.al in their work *Source Separation of Household Waste Materials: Analysis of Case Studies From Pakistan, The Philippines, India, Brazil, Argentina And The Netherlands* explains in the context of sustainable development, separation at source has proven to be valuable in many reuse and recycling programmes. Separation systems exist in many Northern cities and 'wet-dry' separation (involving the collection of separated organic wastes) are now being promoted in a number of cities. Keeping organic wastes pure by practicing 'separation at source' is seen as the best procedure in the composting of urban organic wastes. Such compost, if efficiently produced and marketed, can be a valuable

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46 Lardinois et.al (2000). “Source separation of household waste materials: analysis of case studies from Pakistan, the Philippines, India, Brazil, Argentina and the Netherlands” Urban Waste Series no. 7The Netherlands
resource in urban and periurban agriculture, while contributing to more effective urban solid waste management.

Pratt and Phillips\textsuperscript{47} in their work \textit{The Role and Success of UK Waste Minimization Clubs in the Correction of Market and Information Failures} Waste minimization clubs are a key component of the UK waste strategy and an essential vehicle for encouraging industry and commerce to undertake waste minimization methodology. There have been 75 such clubs and they receive support from a wide range of sources, including the Environmental Technology Best Practice Programme and Environment Agency. Academic literature claims that waste minimization clubs are highly successful, but this has never been quantified. To address this, the study identifies economic reasons leading to excess waste production, namely market and information failure and then evaluates the role of waste minimization clubs in overcoming these failures.

Kumar et.al\textsuperscript{48} in their study \textit{Cost-Benefit Analysis of Landfill System with Gas Recovery for Municipal Solid Waste Management: a Case Study}, discussed the advantages and disadvantages of alternatives for urban solid waste management. Landfill is considered to be a suitable and simple technology for tropical countries such as India. The recovery and reuse of landfill gas generated in MSW landfills is economically viable in most situations. A case study of cost-benefit analysis of landfill system with gas recovery option has been carried out for Port Blair City, Andaman Islands, and India. A saying of about Rs 0.09 billion per annum with reference to existing system of MSW disposal is evaluated.


Sudhakar and Jyothi⁴⁹ in their work *Economic Evaluation of Landfill System with Gas Recovery* for Municipal Solid Waste Management⁵⁰ various technological alternatives for solid waste management have been touched upon for their merits and demerits. Landfill technology, is the most widely employed and regarded as the most suitable and simple mechanism especially for India. The cost benefit analysis of LFSGR carried out for Mumbai city’s solid waste; found that it could make a huge difference of savings with reference to the existing system of waste disposal.

Sudhir et.al⁵⁰ in their article *Planning for Sustainable Solid Waste Management in Urban India* 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.

Gupta et.al⁵¹ in their work *Solid Waste Management in India: Options And Opportunities* in India, the collection, transportation and disposal of MSW are unscientific and chaotic. Uncontrolled dumping of wastes on outskirts of towns and cities has created overflowing landfills, which are not only impossible to reclaim because of the haphazard manner of dumping, but also have serious environmental implications in terms of ground water pollution and contribution to global warming. Composting-aerobic and anaerobic, both the options are available to the country for

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scientific disposal of waste in future. However, the country also needs something in terms of policy and guidelines to enable the municipal corporations to run the waste services efficiently.

Gidde and Sabnis\textsuperscript{52} \textit{Municipal Solid Waste Management with Geo Synthetics} reviews the Indian scene of solid waste generation. It states and suggests the use of geo synthetics in solid waste management. Geo synthetics landfill design greatly reduces the cost and construction time. It offers an excellent protection to environment.

Sanjay\textsuperscript{53} \textit{Rethinking Waste Management in India} pointed out Urban India is likely to face a massive waste disposal problem in the coming years. Till now, the problem of waste has been seen as one of cleaning and disposing as rubbish. But a closer look at the current and future scenario reveals that waste needs to be treated holistically, recognizing its natural resource roots as well as health impacts. Waste can be wealth; which has tremendous potential not only for generating livelihoods for the urban poor but can also enrich the earth through composting and recycling rather than spreading pollution as has been the case.

Satchitanand\textsuperscript{54} in his article \textit{Problem Universal, Solution Indigenous} highlights NEERI’s innovative methods for controlling pollution. Indian municipal waste has a very high proportion of biomass; it has inherent energy content, making it a viable source of fuel, made in to pellets. The cost effective process deals with the waste. Biomass needs no complex equipment and virtually no energy. It involves the lowly earthworm, which is an excellent bio-reactor.


\textsuperscript{53} Sanjay K.Gupta (2001) Rethinking waste management in India, Published in Humanscape

Shylajan in their work *Managing Municipal Solid Waste in India: Some Issues* pointed out that unmanaged urban solid waste poses a threat to public health and the quality of life for urban people, especially for the socially and economically weaker sections of society. In this paper, the problems of solid waste and environmental policies related to waste management in India have been critically examined. The existing policies in India are mostly regulatory in nature and they focus on command and control approach. A few policy recommendations have been made here, which can assist policymakers in implementing waste management strategies in India.

Radhika in her article, *It's Money, Stupid* reveals that the Indian Cement industry can use Municipal solid waste for its energy requirements. Estimates made by Centre for Science and Environment’s green eating projects say that 28 percent of energy requirements can be met by using S.W. Some Cement companies have taken an initiative to use MSW as fuel for the Kilns. Jaiprakash Associates Ltd plans to set up an Rs.23.28 Crore waste processing plant at Chandigarh. The plant will produce fuel pellets from municipal waste that will then be used for its Cement plant. Grasim for instance is setting up a 500 tones per day waste processing unit in Jaipur.

Satpal in his work *Solid Waste Management in Re-Settlement Colonies of Delhi-A Study of Peoples and Urban Policies* looks at the level of peoples’ participation in the three cases of Trilokpuri, Dakshinpuri and Tigri, all resettlement colonies. The study concludes that whilst no single approach can provide a satisfactory solution to the problems of solid waste in the cities, it is imperative that peoples’ participation plays a crucial role and without peoples’ participation, it would be very difficult to manage solid waste in the city.

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57 Satpal (2005) “solid waste management in re-settlement colonies of Delhi-a study of peoples and urban policies” New Delhi, Book well.
Madhushree Shekhar\textsuperscript{58} in his article \textit{Keeping Our Cities Clean: Urban Solid Waste Management in Karnataka} broadly examines the process of Municipal waste management in our cities focusing on Karnataka. It highlights the characteristics of municipal waste generated, the management practices involved and the stakeholders in the refuse collection and disposal services. This paper attempts to identify future interventions to strengthen the delivery of public municipal services.

Ravikiran\textsuperscript{59} in his work \textit{Vijayawada–Profiting from Waste} reports that, the Vijayawada Municipal Corporation (V.M.C) has launched two projects, one is run by Excel Industries Limited to generate manure from waste and the other by Sriram Energy System Private Limited to generate power from waste. The VMC is using these two projects to dispose off 350 tones of the total 500 tones of waste generated everyday within city limits.

Snigdha\textsuperscript{60} in her article \textit{Cost Benefit Analysis of a Bio-Gas Project at Calcutta Preliminary Findings} concluded that disposal of a garbage is vital problem for the cities of Calcutta. The adoption of the bio-gas technology based on the phenomenon of anaerobic decomposition of organic materials, resulting in methane production which serves as source of fuel and residual organic matter as rich manure. It is proved that both from the social as well as economic point of view it is desirable to implement the bio-gas project.

Mumbai’s most famous temple generates an average 120Kg. of nirmalaya every day – peaking at 200kg on tuesdays. Nirmalaya, floral offerings made by devotees, is composted at these temples and the manure is sold for Rs.20 per


\textsuperscript{60} Snigdha Chakraborty “Cost benefit analysis of a bio-gas project at Calcutta preliminary findings”, Urban waste recycling –Economic and practical options, Nodal Research centre.p-48.
Kilogram. Nirmalaya manure has become quite a hit among devotees as noted by Nidhi in his article *Holy Manure*.

Ashly Jose (2005) *Waste is Wealth* state that we can change the garbage into organic manure, North Paravur municipality is an ideal example and also show Bangalore had become the first city to use the plastic waste as they had constructed a one kilometer road in 2002.

The IRTC Study has identified that aerobic composting is the most promising method for processing biodegradable waste in Kerala. Of this, windrow composting was found suitable for towns with waste generation in the range of 1-5 tones per day. Vermi-composting is suggested as a good method for household waste management in small communities as noted by Nair & Sridhar in their work *Cleaning up Kerala*.

Meera Bai (2008) in her work *Kerala Economy-Slumber to Performance* revealed that series of health and environment issues emerge from the poor service and management of solid waste disposal. Out of the three major option of disposal, incineration is to be ruled out as the waste has low calorific value and high moisture content. Hence sanitary land filling, with due consideration to ground water, supported by compost plants would be the ideal disposal option. Kerala has recently installed bio-technologically managed compost plants in a few place on an experimental basis. Installation of such plants in each neighborhood seems to be the ultimate solution on the garbage disposal problems, which again will reduce the transportation cost.

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64 Meera Bai.M (2008) Kerala economy-slumber to performance, Serials Publications-New Delhi,p-91
Sridhar & Shibu\textsuperscript{65} in their project \textit{Zero Waste Kovalam and Employment Opportunities August 2004} aims at studying the employment generating activities in the area, vis-a-vis the condition that was prevailing in the area and to document the process, change and results. It aims to determine and develop the Local-level employment opportunities opened up by the implementation of the Zero Waste Kovalam programme in Venganoor and Vizhinjam Panchayaths.

George and Prakasan\textsuperscript{66} in their work on \textit{Socio-Economic and Health Status of Waste Collection of Kollam Corporation and Their Involvement in Waste Recovery and Reduction} presented that an attempt has been made to assess the role of waste collectors in the recovery and reduction of solid wastes in Kollam Corporation; which indirectly leads to reduction in the quantum of non-bio degradable wastes to be managed by the Corporation.

Thippaiah\textsuperscript{67} in his article \textit{Economics of Waste collection and Recycling in Urban Informal sector} pointed out that in the informal sector, waste recycling is one of the important segments which is playing a major role in generating employment and income to the weaker sections of the urban society. The rag pickers are working for the organized industries indirectly by way of extracting ores from garbage and efficiently managing the urban solid waste.

Furedy, Christine\textsuperscript{68} in their work \textit{Social Considerations in Solid Waste Management in Asian Cities} pleads for a socially-aware approach to solid waste management. The article suggests how concepts pertaining to solid waste management should be reformulated in such a way as to include the social contexts of


\textsuperscript{68} Furedy, Christine (1989).” Social considerations in solid waste management in Asian cities” In: Regional Development Dialogue vol. 10 no. 3. p-13-41
waste recovery in Asia. The distinction between a formal and informal system, so important in employment, marketing and housing, also applies to waste management. Distinguishing between officially sanctioned or mandated city systems and those systems that develop in the margin of 'normal' collection and disposal procedures, e.g. street pickers. The underlying article looks at this informal resource recovery, in particular.

Haan et.al\(^\text{69}\) in their work *Municipal Solid Waste Management, Involving Micro and Small Enterprises: Guidelines for Municipal Managers*, presents solid waste management in cities in low-income countries face ever increasing problems in solid waste management services because of the uncontrolled growth of these cities. Not surprisingly, poor city areas are first and most affected. Causes are manifold: lack of funds; low workforce productivity; inadequate management, often through failing bureaucratic procedures; and inappropriate equipment given the existing infrastructure. By involving the private sector, however, a number of successes have been obtained, resulting in higher quality of services in connection.

Klundert\(^\text{70}\) et.al *Integrated Sustainable Waste Management: A Set of Five Tools for Decision-Makers. Experiences from the Urban Waste Expertise Programme Management (ISWM)* presents a unique approach to municipal waste management. Integrated Sustainable Waste Management is a concept; analytic framework and assessment that pay attention to aspects often neglected in-conventional municipal waste management. It covers institutional, social, environmental, political, technical and financial aspects, while emphasizing the critical role that a variety of stakeholders - including waste pickers, women and micro- and small enterprises - play every day in waste management operation such as collection, treatment, reuse, recycling and prevention.


Peters and Kim\textsuperscript{71} \textit{Community-Based Waste Management for Environmental Management and Income Generation in Low-Income Areas: A Case Study of Nairobi, Kenya} focuses on community based waste management in Nairobi, Kenya. Women groups started composting organic waste as a means of improving community environmental conditions and generating income through the sale of compost. Through this composting, significant environmental improvements have been achieved including health, agricultural opportunities, and improved drainage. It is recommended that local authorities should focus on regulation and co-ordination while NGOs could provide advice and training for local authorities. (NB)

Article\textsuperscript{72} \textit{Solid Waste Management} emphasizes the role of informal sector in waste management. It emphasis that sanitary landfills sites is a problem for most Indian cities. Finally an important aspect of sound waste management strategy is awareness generation.

Sunil Kumar\textsuperscript{73} in his work \textit{M.S.W.Management in India, Present Practices and Future Challenge} focus on the present situation of MSW Management in India based on published information & NEERI’ expertise towards MSW Management. An approach to design a sustainable MSW Management system to meet the future challenge is presented. The efforts by a community –based organization to promote a sustainable integrated waste management in mega cities and lessons learnt from EXNORA’S Zero waste management scheme in South Indian Cities has also been outlined.

Delhi’s Municipal Corporation inefficiency in waste management has meant that almost 20 per cent of Delhi’s waste passes through the informal waste – Collection and recycling net work at some stage. Waste management processes are


\textsuperscript{72} Looking back to change track Green India 2047(2006) –The Energy and Resource Institute, New Delhi.

\textsuperscript{73} Sunil Kumar (Aug 2005) “M.S.W.Management in India, Present practices and Future Challenge”NEERI.
Review of the Literature

routinely carried out by Delhi’s informal network of Pheriwallahs, boriwallahs, thiawallahs, binnewalahs, khatnewallahs, kabariwallahs, godown owners, suppliers and recyclers as observed by Amen Sethi\textsuperscript{74} in his work \textit{Waste and Wealth}.

Agarwal\textsuperscript{75} et.al in their work \textit{Municipal Solid Waste Recycling and Associated Markets in Delhi, India} was found that an informal sector comprising waste recyclists and a hierarchy of recyclable dealers plays an important role in the management of solid waste. The associated activity transports nearly 17\% of the waste to the recycling units (RU). In this process an entire market is created for the recycle trade. The present work covers an extensive study of this waste trade with emphasis on the most important unit of the waste chain, the recyclists. Through a number of field interviews undertaken on recyclists, recyclables dealers and municipal authorities, a complete hierarchy from recyclists to the final sellers of the recycled is established.

Kamna Lal\textsuperscript{76} in his work \textit{Discerning the Solid Waste Economy-A Case study of Jabalpur Urban Agglomeration}, two categories of agencies are identified which are the formal and the informal solid waste sectors. Informal solid waste sector is a widely marked urban character in the developing countries, which due to its activity, partially eases the solid waste management burden of the formal sector.

Krithika\textsuperscript{77} in her article \textit{Public, Private and Voluntary Agencies in Solid Waste Management} explores equity accountability and environmental concerns in solid waste management in Chennai City. The paper highlights issues related to effectiveness and equity, role of the urban poor in this service, and the relevance of an effective policy framework. This study brings out some interesting lessons on the nature of public private partnership in S.W.M.


\textsuperscript{76} Kamna Lal (June-2001) “Discerning the Solid Waste Economy-A Case study of Jabalpur urban agglomeration”, M.Phil programme in Applied Economics, C.D.S.

\textsuperscript{77} Krithika Srinivasan (June-2006) “Public, Private and Voluntary Agencies in Solid waste management” a study in Chennai City, EPW Vol.XLI no-22, p-2259
Baud et al. in his paper *Solid Waste Management: Modes, Assessments, Appraisals and Linkages in Bangalore* provide a detailed description of actors and factors involved in solid waste management in Bangalore, India. One of the main issues raised in this book is whether local authority should create a complete new network for handling solid waste, or improve the already existing one. There are many actors in the network of solid waste production, collection, reuse and recycling, and their roles are described in detail in the book. The authors highlight the status of city waste pickers, mainly poor women and children. The future of these people, whose survival largely depends on the way the future waste network will be organized. The attitudes of local authorities with regard to waste problems are examined. The authors stress the need for better networking and information exchange.

Dhanalakshmi and Iyer *Solid Waste Management in Madras City* explores Madras and finds that the city is deteriorating on account of rapid growth of population, slums, production and consumption. Authors suggest that a more extensive and imaginative organizational framework needs to be devised with which many existing official and non-official organizations can be brought together for launching a combined plan of action.

Poornalingam in his article *Solid Waste Management in Chennai* details the various steps taken to improve Solid Waste Management in Chennai. Author also emphasizes the role of EXnora and rag pickers in Chennai’s Solid Waste Management.

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81 Krithika Srinivasan (June-2006) “Public, Private and Voluntary Agencies in Solid waste management” a study in Chennai City, EPW Vol.XLI no-22, p-2259
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Namakkal, a Southern district in Tamil Nadu with a population of 53,000 took
three years to put in place a system that brought it international recognition.
Namakkal privatized garbage collection and trained a group to form ‘Annamalai
Associates’. Annamalai Associates segregates garbage prepares vermin compost and
recycles non-biodegradable waste such as tyres and tubes littered around this town
known for its lorry “body building” units as noted by Sujatha\(^2\) in his article The
Making of an Eco-City

Ray\(^3\) in his article *MSW Management in Ahmedabad* reveals that, the disposal
system adopted in Ahmedabad is landfill and microbial composting. About 30
tonnes of waste is daily given to Agro Excel Industries composting plant at Pirana for
composting. About 50 to 60 tone of waste are delivered by AMC to the Company
named AGROCEL, which makes CELRICH from the waste. In addition to its own
administrative capacity AMC has made attempts to involve NGOs in Ahmedabad
for Solid Waste Management as well.

Shameer\(^4\) in his research work paper *Economics of Solid Waste Management in
Calicut Corporation* analyses the Economic and Social implementation of S.W.M
system in Calicut Corporation. The study attempts to analyze the socio-economic
condition of waste collectors within the study area. The major theme of the study is
the estimation of various kinds of costs involved in collection, processing and
reprocessing of waste in the informal sector of the study area.


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\(^4\) Shameer Das. T. (Dr.) (2002)‘Economics of solid waste Management in Calicut
Corporation’ PhD thesis. Submitted to Pondicherry University (Unpublished)
Nadkarni in his article, *Poverty, Environmental, Development – A Many Patterned Nexus* pointed out that, vulnerability to environmental degradation induces women to become agents of eco-restoration in organized efforts. Women’s participation is valuable for improving sanitary condition in rural areas and urban slums. Since women are closely linked with health & the environment, they represent a constructive & protective force for the Environment. They can play a crucial role in turning vicious circles into virtuous ones.

The Hindu article, *Spinning a Success Story* pointed out that Kudumbashree is about to bring in a revolution in the field of S.W.M in Kerala. It has always been the grievance of the residents that cities lacks proper amenities to remove waste. When waste was dumped on road sides and vacant plots causing health hazards and the Government did precious little to contain the situation, Kudumbashree saw an opportunity and grabbed it with their success groups from Guruvayoor and Alappuzha have also taken training here. In North Paravur, S.W is converted into compost & sold at Rs.5 per kg.

A study on the women involved in the model S.W.M Project of Kozhikode Corporation focuses on the health, social & financial problems faced by the women self-help groups (SHGs) engaged in collection of waste. The study found that women from the poorest segments of society have been employed in this type of labour as noted by Ambikabai in her article; *Women Engaged in Waste Collection Get a Raw Deal.*

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In spite of a plethora of studies avail on the general aspects of solid waste management both at the international level and national level, specific studies concentrating on at the micro level are found relatively fewer. The literatures reviewed in the preceding pages are articulating the need and significance of solid waste management. It is identified that serious research at the micro level on the various aspects of solid waste collection, and disposal are insufficient to submit an alternative solution to mitigate environmental issues of solid wastes. The researcher therefore seeks an alternative model to the conventional methodology of waste management, which is pro people, pro development, and sustainable. The present research work is mainly concentrated on this line of SWM.