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WASTE AS A SOCIAL DILEMMA

**ISSUES OF SOCIAL AND ENVIRONMENTAL JUSTICE AND THE ROLE OF RESIDENTS IN
MUNICIPAL SOLID WASTE MANAGEMENT, DELHI, INDIA**

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People will need to readopt this sense of rarity that has been lost or forgotten over the last two centuries. Humans will need to collect, sort, recover and recycle, going back to the old ideal of alchemists: complete the material cycle, turn waste into a resource, reduce all forms of predatory behaviour as much as possible.
(Lacoste & Chalmin 2006)

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Abstract

In Delhi, as in many other large cities in developing countries, the inappropriate management of municipal solid waste is a significant flaw in the quality of life of its residents, and a serious threat to the environment. Taking the integrated approach to solid waste management as its point of departure, this thesis focuses on city residents as waste producers and their role in municipal solid waste management (MSWM). It argues that the waste problem is caused by human behaviour and therefore the solution lies in changing that behaviour.

The aim of this project is to identify the city residents' current attitudes and behaviour related to waste and waste management in Delhi and the factors influencing them. Based on that, the paper proposes several recommendations on the best ways to change behaviours towards more environmental-friendly and socially equitable ones. Methodologically, a triangulation of key informant interviews, statistical analysis based on a survey with 99 city residents, and observations of everyday practice was employed.

The findings of this thesis point out that, although garbage is perceived as a big problem in Delhi by the majority of respondents, there is little awareness on the ways one could contribute to solving it. The sense of responsibility for one's waste was found to be the major factor determining littering and waste separation but waste minimization is mainly associated with income and not perceived as part of the waste problem. As for ways out of the problem, it is suggested that public campaigns should emphasise residents' responsibility for their waste and the importance of each and every citizen's cooperation, thus creating a sense of a shared social goal around solving the waste problem. The information and motivation campaign should be supplemented with measures that would facilitate citizen participation.

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I. Introduction

I.1 Problem statement

Waste is a relative concept. What is waste for one could be a resource for another. What is valueless for some could be useful for others. The richer the person, the higher the quantity of waste he or she produces (Medina 2008:40). It was demonstrated, using OECD data, that there is a positive correlation between the GDP and the municipal waste generation (Rekacewicz 2004). Generally, wealthier people consume more than the poor and therefore throw away more¹. Besides the volume of the waste produced, there is another very important aspect to waste: its composition. The percentage of non-biodegradable waste produced today is unprecedented. Today we live in an era of packaging (Clapp 2002:9), of plastics and electronics, when values as such durability and products' long-life are no longer prioritized (Clapp 2002, Strasser 1992). Therefore we throw away not only much more but also much more non-biodegradables than people did 100 years ago. The difference between the rich and the poor is not only in regards to the quantity of waste, but with its composition as well. The rich throw more non-biodegradables than the poor (Medina 2008:41).

As people become richer, the amount of garbage produced in the world is increasing alarmingly. The world produces at the moment more than 2 billion tons of garbage every year (Medina 2008: 40). High income countries are leading when it comes to per capita garbage generation², but middle income countries such as India and China are catching up as a result of the emergence of a strong middle class and changing patterns of consumption in these rapidly growing economies (ibid). China overtook the United States in 2004 as the world top trash producer. India produces today more than 105 million tons per year; the per capita generation in its major cities is 0,2 to 0,6 kg per day, and only 70 to 90% of the waste is collected in the largest cities, according to Medina³ (2007:199). Moreover, the yearly average increase of solid waste in Indian cities is estimated at almost 5% (Devi and Satyanarayana, 2001, in Agarwal et al 2005:75). If the developing countries produced the same amount of waste per capita as the developed countries, the world would sit in trash up to its knees.

¹ Mazzanti et al (2008) tested whether the Environment Kuznets (inverted U) Curve applies to the relationship between waste generation and income, using data for 103 provinces in Italy. They found some evidence of a curve but the turning point (where waste generation decreases with income) was a very high income level, reached by only a few of the provinces. Moreover, instead of a decoupling, they found a stabilization of waste generation for some of the richest areas (ibid:63).

² High income countries produce in average 1,4 kg of trash per capita per day, whereas middle income countries produce 0,8kg, and the least developed countries 0,6 kg (Medina 2008:40).

³ A well-known consultant on waste management for the World Bank and the United Nations

In the developed world, growing recycling rates and new technologies such as digestion with biogas production, composting and incineration, divert significantly garbage from landfills and save resources from being wasted. Landfills are considered the most undesirable way of managing waste because no material recovery takes place. Additionally, poorly equipped landfills have great polluting effects through leakage of landfill water into the soil and ground water, and through the release of ozone-depleting gases such as furans and dioxins into the atmosphere (Naturvårdverket 2008, Medina 2007, ISWA 2007a). Unfortunately, developing countries like India lack the resources, technological capacity or know-how, and sometimes even the political will to manage their waste in a way that will keep the environmental, social and health impacts to a minimum. In Delhi, waste collection done by the municipalities cannot keep pace with the amount of waste produced by a growing population which consumes and thus throws away more. Consequently, waste is often dumped improperly, affecting the quality of life of its residents.

Moreover, there is a social and power-relation aspect to the waste problem, since waste is most of the time dumped nearby poor or marginalised communities or groups unable to protest (Clapp 2002). This is unfortunately not the end of the story. What is usually not mentioned is the presence of a huge informal sector involved in waste collection and recycling in many cities, using garbage as a source of income, and bearing the burdens of the city's waste. The people collecting recyclable waste are commonly called scavengers and the World Bank estimated that about 1% of the urban population in developing countries survive by scavenging (Medina 2007: vii), value which is also valid for Delhi (ibid: 202).

1.2 Purpose and objectives

This being said, it becomes evident that waste is a serious multi-faceted development problem, especially relevant in countries with relatively poor economies, with direct implications on the achievement of the Millennium Development Goals (MDGs). Solving the waste problem is a very complex endeavour, especially in impoverished cities where resources are few and the systems very complex. Taking the integrated approach to solid waste management as its point of departure, this study focuses on city residents as waste producers, and their roles and responsibilities in municipal solid waste management (MSWM). While it is acknowledged that their actions are partly determined by all the other actors and structures in the system, nonetheless the paper sees the urban residents as endowed with agency and being able to bring about change.

Focusing on city residents' role in MSWM is an unstudied angle in the context of developing countries. Waste management has been traditionally seen simply as a public service provided by the local government bodies to the citizens and the blame for its imperfect functioning is most often put on the municipalities, whereas individuals as waste-producers are perceived as having little or no responsibility in the process. However, the new *integrated waste management (IWM)* approach does emphasise the roles and responsibilities of the waste producers in waste management. Aspects of the IWM approach have been internalized in MSWM initiatives by some municipal bodies and NGOs in parts of Delhi, in the form of decentralised solid waste management programmes. These programmes, so far less successful, require the active participation of the citizens, supposed to separate their domestic waste into different categories. In most cases no studies were done beforehand to determine the feasibility of such initiatives and to discover to what extent the residents were ready to cooperate. Additionally, no studies were undertaken to determine how residents could be motivated to cooperate. It is particularly these gaps that this study is intending to fill. In doing so, this thesis will contribute to the body of research on citizens' participation in waste management in developing country context and on the role of the informal sector in waste management, thus help NGOs and/or local municipal bodies in Delhi wishing to influence the residents' waste behaviour develop informed public awareness campaigns.

Therefore the first objective of this study is to determine to what extent the residents of Delhi are already participating or are ready to do so in the future in the matter of MSWM in their city. Secondly, it strives to discover ways to motivate them to begin or increase their cooperation.

More specifically, the *research questions* are:

1. *What are the city residents' knowledge, attitudes and behaviour towards waste and MSWM in Delhi?*
2. *What are the factors influencing their behaviour related to MSWM?*
3. *How can the Delhi city residents be motivated to contribute in improving MWM and in this way reduce their environmental, health and social impact through waste?*

As for the structure, chapter II gives the theoretical perspectives in the field of waste management. In chapter III, MSWM in Delhi is described based on already existent literature and my own findings from the field work done in Delhi. Chapter IV deals with methodology and in chapter V the findings related to the first two research questions are presented. The discussion in chapter VI deals with the third research question and finally, chapter VII presents the conclusions.

II. Theoretical framework

Municipal waste covers waste from households, commerce and trade, office buildings, institutions and small businesses, yard and garden, street sweepings, litter containers, and market cleansing⁴ (OECD, in UNEP 2009). This paper deals primarily with household waste.

Instead of focusing on a single theory, this section will present a variety of perspectives that relate in different ways to the topic of this research. First the research frontier on waste management as a development issue is presented to highlight why the topic is worth attention from a development and justice perspective. Second, I turn to theories that help answering the research questions and which will act as an analytical framework.

II.1. Waste Management and Development – the rationale of this research

This section places MSWM within the development discourse and points out the reasons waste management is worth attention on the development agenda.

II.1.1 MSWM, Sustainable Development and the MDGs

Sustainable development is most often referred to as “development that meets the need of the present without compromising the ability of future generations to meet their own needs” (Brundtland Commission, 1987). As it will be shown in this chapter, an appropriate approach to solid waste management is essential for achieving sustainable development. Municipal waste generation was listed among the “red light” pressures on the environment, i.e. problems that need to be addressed urgently by the OECD Environment Outlook 2020 (2001). A waste management policy towards waste minimization and changing patterns of consumption was recognized among the solution to the environmental problem by the same publication (OECD 2001:20).

Since 2008, for the first time in history more than half of the world population resides in urban areas (WB 2009) and according to the UN Population Division (2007), urban areas are likely to absorb not only all the population growth expected over the next four decades but also some of the already existing rural population. Everywhere in the developing world cities grow very fast, but in many cases employment, housing and public services cannot keep pace with the urban growth rate. Insufficient

⁴ And it excludes waste from municipal sewage networks and treatment, as well as municipal construction and demolition (UNEP 2009).

collection and inappropriate disposal and treatment are sources of water, land and air pollution, posing risks for human health and the environment (see, among others: Medina 2007 49, Moreno-Canachez et al 2006: 371).

When improperly managed, waste has very serious implications on people's well-being and implicitly on the achievement of the MDGs (Gonzenbach & Coad 2007, Coad 2006). As a recent international workshop on solid waste management reminds us, the initial reason for taking care of solid waste is to protect health (Coad 2006). Uncollected or improperly stored waste makes a good breeding place for houseflies, which are a major vector for gastro-intestinal and other diseases that particularly affect young children and can cause outbreaks of plague. Furthermore, drains blocked by dumped waste cause flooding and are favourable breeding places for mosquitoes spreading Malaria, dengue, and other diseases and burnt waste causes respiratory illnesses, especially affecting waste workers and those living in vicinity of dumps. (Coad 2006: 6, Gonzenbach & Coad 2007: 15-21) Additionally, waste causes water pollution, one of the major sources of health problems in the developing world.

Although indirect, the impact of bad waste management on poverty is even more insidious and long-lasting. It has been proven that healthier people are more likely to escape poverty. Thus removing the effects of waste on health would have positive implications on poverty reduction, the first of the eight MDGs. Furthermore, waste management provides employment opportunities to a great many of cities' poor in activities such as sweeping, collection and recycling (Gonzenbach & Coad 2007: 6-9). By improving their working conditions and productivity, waste management can contribute to reducing poverty and improving the quality of life.

Sound solid waste management can contribute also to the achievement of the MDG of environmental sustainability. Recycling reduces the demand for raw materials and saves energy. Forests are protected by using recycled pulp and use of biogas produced through anaerobic digestion of biodegradable waste instead of fire-wood for cooking. Proper disposal and treatment would avoid water pollution created through dumping waste into water rivers and lakes, and leachate from landfills (also a source of methane emissions) (Gonzenbach & Coad 2007: 21-25). Uncollected waste can be carried away to rivers, lakes and sea and affect those ecosystems. Bad waste management practices need to be replaced by good ones. Composting is also one of them as it reduces the need for chemical fertilizers, eliminates no methane and has positive spill-over effects on health, as the use of good quality compost in food production improves nutrition (Coad 2006: 7).

II.1.2 Environmental ethics

Environmental ethics is understood here as “the moral relationships between human beings and nature” (Lundmark 2008: 330). The contemporary ethical discourse focuses on two systems of belief: anthropocentrism and ecocentrism.

Anthropocentrism views human beings as separated from nature and more worthy than other organisms. The values associated with nature are instrumental: the natural environment is seen as providing resources that can be used for human purposes and our acts towards nature are judged on the basis of how they affect us, not on how they affect other beings. It is also an optimistic view seeing humans as “largely in control of the surrounding world and that problems arising from modern living can be taken care of, primarily through technological development” (Lundmark 2008: 331). This attitude has its roots in the Judeo-Christian idea of pre-eminence of man over nature, on which the traditional development discourse is also based, coming from the enlightenment definition of progress through technological advancement and the subjugation of nature (ibid:331).

In contrast, an *ecocentric* worldview sees the natural environment consisting of “complex webs of ecological interdependence”. Nature and each organism are given intrinsic value. Therefore, pollution and other forms of human intervention can have multiple ecological effects. Also, it does not agree with the anthropocentric idea that there is an absolute dividing line between human beings and nature (Lundmark 2008:332).

This thesis is written from an ecocentric standpoint, as it is my strong belief that all living beings have the same right as humans to inhabit our planet. In my opinion, development and humanitarian work should be grounded in the conviction that it is our moral duty to help those in need, especially those that are weaker than us, including all segments of the ecosystem, not only mankind.

II.1.3 Environmental justice theory

Generally, the environmental and health problems related to waste affect to the highest extent those inhabitants who have the least resources and therefore, very little power to change their situation, as they do not affect policy-making (Forsyth, 2002:294). The environmental justice discourse started in the United States in the 1980s founded an anthropocentric view on nature stressing the rights of those affected by pollution rather than the rights of nature (Hannigan 2006: 47). In contrast, in the title of this thesis, by “environmental justice” I refer to the rights of nature and by “social justice” to

the rights of people. It was the result of the growing frustration of the African-Americans in the US with the placement of toxic landfills and garbage incinerators in the neighbourhoods or communities of predominantly minority population. Therefore, environmental equity was presented as a fight against environmental racism. (Hannigan 2006: 49). It argues that all people have a right to clean air, land, water and food, and the right to live and work in a clean and safe environment, regardless of their degree of wealth.

As Clapp (2002: 21) points out, waste often “takes advantage of economic inequalities making their ways to disadvantaged communities”. As the powerful communities externalise their environmental impacts, wastes will end up in remote rural areas and in the least fashionable urban neighbourhoods (Ackerman & Mirza 2001). This is definitely the case in Delhi, where waste is generally dumped where poor groups live, poor communities suffer most from improper waste collection services, and the workers involved in the waste recycling and reprocessing, often informally performed and leading to grave health hazards, come from the most marginalised social groups - the very picture of deeply embedded social inequality.

In sum, making waste management a priority makes sense regardless of the environmental ethical position assumed. Simply put, for anthropocentrists it makes sense because it safeguards human health, whereas for ecocentrists because it safeguards the environment as a whole. Moreover, it addresses issues of social inequality and helps achieve the MDGs.

II.2. The Integrated Waste Management Approach

The first international agreement to recognise the urgency of dealing with waste *in “achieving environmentally sound and sustainable development in all countries”* was Agenda 21, the result of the 1992 *UN Conference for Environment and Development* in Rio de Janeiro. The conference also acknowledged that waste management “must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption” (UNCED 1992: chapter 21).

This approach is referred to as the Integrated Waste Management (IWM). Waste prevention is given the highest priority and it refers to minimizing the waste produced by individuals, businesses and other organizations. The hierarchy continues with reuse, recycling, composting, incinerating and last on the list dumping waste into sanitary landfills (Medina: 2007: 97-104).

The International Solid Waste Management Agency has recently elaborated a set of technical policy papers to guide the elaboration of national waste management plans worldwide (ISWA 2007). One drawback of the ISWA policy papers is that they do not emphasize the hierarchy of waste management actions in regards to their contribution to sustainable development. Also, as Medina (2007: 107) points out, this approach cannot be simply copied in the developing countries, but should be adapted to local conditions, for example by taking into account the existence of an informal recycling sector.

Directly derived from the integrated approach comes the ambitious *Zero Waste* policy, already considered by many municipalities in developed countries, emphasising the importance of reducing the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them (Zero Waste International Alliance 2009). The *3 R Model*, which envisions a waste management process based on reducing, reusing, and recycling, is also a popular vision for municipalities and NGOs working in the field.

The integrated approach, addresses for the first time the role of waste producers, as the waste problem is seen through what Clapp (2002) calls a “consumption lens”. Waste management is not any longer a technological or logistics matter, the responsibility of the municipality alone. On the contrary city residents and their behaviour come increasingly into play.

II.3. The waste problem as a social dilemma

I have argued above that the waste is primarily an anthropogenic problem, i.e. caused by human behaviour, and therefore behavioural change would be a significant contribution to solving it, as it addresses its root causes. If each of us produced little or no garbage, there would be no waste to manage and hence no waste problem. But there is little incentive for us to act alone as single separate contributions are perceived to be too small to make a difference. However, we suffer together from pollution due to our failure to cooperate, as put by Weber (Gertner 2009). Therefore the waste problem can be viewed as a social dilemma.

Prothmann (2008) provides a very good overview of the theories on social dilemmas. What is common to social dilemma situations is that our individual interest is at odds with the collective interest. The distinction is made between common-pool resource dilemmas and public good dilemmas (Gardner et al 1990). What distinguishes the two is the subtractability of use. Common resource are subtractable in the sense that whatever one person takes out is not available for the

others, whereas public goods are not (ibid:336, Becker & Ostrom 1995:114). Our case, like pollution in general, falls under the common-pool resource dilemmas. By littering with one unit, I take one unit of the others' cleanliness. Referring to the waste quantity problem, by producing more waste I consume what Clapp (2002) calls "waste-sink capacity", both socially, in the sense of landfill space that could be used for others to live on, and ecologically as I contribute to pollution. Extrapolated to encompass the environmental justice discussion and inequality, by producing more waste and not segregating it, I take from the cleanliness of others, in the first case of those located where the waste is dumped, in the second, of those that will have to do it instead.

Some effects are easier to grasp than others. Many would argue that the contributions mentioned above are so small that would not make any difference. However, if no one would contribute, the results would be disastrous. Concerning waste production, this is regulated by economic means in both quantity and composition, as shown earlier. However, in Delhi, for example, the economic barriers are becoming looser and looser as people can afford to consume more, and an explosion of packaging seems to take place. Therefore other barriers need to replace the economic barriers. Waste generation needs to be decoupled from its income drivers, as Mazzanti et al (2008:65) put it. Their findings also imply that "developing countries in particular should not wait to implement waste reduction policies until household incomes and consumption levels increase" (p.51). India should strive not to become a "throw away society" (Spiegelman et al. 2006).

It could also be argued, from a typical anthropocentric view, that the resource we are talking about, clean environment is to some extent renewable, either naturally or through the new waste treatment technologies such as recycling, gas and energy production from waste. However, these technologies are themselves a source of pollution and a danger for the human health (Sharad Gaur, interview), especially of those working with them and especially in developing countries where work safety regulations are loose.

The distinction between a common pool *dilemma* and a simple common pool *situation* must also be noted, to avoid confusion. A dilemma must fulfil two conditions according to Gardner et al (1990:337): suboptimal outcomes for the resource appropriators, making the situation problematic, and an alternative strategy that would result in better outcomes for the collective using the resource. Translated to our case, this is a dilemma because choosing to collaborate would decrease one's own immediate comfort (each will have to put additional time in waste segregation, for example), but if every single individual would do it, everyone's long term comfort would increase. Let us consider here that the cleanliness of the city is the common pool resource and a defecting behaviour means

littering or throwing garbage on the streets or other public places. Obviously, it is easier and more convenient for one to just discard his garbage whenever and wherever it is produced than to carry it to a dustbin or a specially designated place. However, if all city residents would do the same, today's urban agglomerations would become simply uninhabitable.

Similarly, producing less waste, choosing products made from recycled materials, avoiding packaging and recycling can also be characterized as a social dilemma, although in a more abstract sense. It is evident that an additional individual effort is necessary. It is much easier not to care about how much one throws away, and what one buys than to pay particular attention to these aspects, and it is more trouble to segregate one's waste for recycling than to simply dispose of it unsorted. Additionally, there could also be a social cost attributed to these decisions in some cultural contexts: one might be looked down upon by the society if doing so. Packaging and plastic bags seem to be seen as luxury or at least a sign of economic well-being, comfort and modernity in India, as per my observation. Therefore the cost is not only a loss in comfort, but also in social appreciation and this makes convincing people to give them up even more difficult. However, if no one would care and moreover, if the entire world population would consume and throw at the rate the west does, life on earth would simply become unsustainable. Therefore by choosing to cooperate in these resource dilemmas, one contributes to environmental sustainability, which is beneficial for all people, including future generations.

II.4. Literature review on factors influencing decisions related to waste issues

I will draw here from both theories on factors influencing decision in common-pool dilemma situations and theories directly dealing with behaviour either in waste issues or environmental issues in general.

Having demonstrated that citizen's participation in the waste problem⁵ can be discussed in terms of a social dilemma, it becomes apparent that solving it is a matter of cooperation. What then makes people cooperate? Cardenas and Ostrom (2004) propose a framework based on three layers: identity, group-context and material payoffs. They found *wealth, occupation, gender, age, education, shared norms, and reputation*, among others, to make a difference in social dilemma decision. They also found that players would decrease their cooperation, if they noticed others defecting. The best

⁵ I do acknowledge, as stated in the introduction, that citizens alone cannot solve the entire problem, as they are not the only stakeholders involved. This is also not to say that the blame for the waste problem is on the citizens, but it is to say that nevertheless without involving the citizens little can be achieved.

way to make people collaborate is to make them feel a part of the group and take into account social goals, so that the group becomes the decision-making unit (Weber, in Gertner 2009; Krantz et al 2008).

Clapp (2002:2) argues that distancing, geographically as well as mentally between consumers and their waste, is a very important dimension when talking about the waste problem. When decision-makers have little knowledge about the social and ecological impacts of the waste associated with the products they purchase or their waste-related habits, they have little incentive to change their behaviour (ibid). Taking this one step further, Lundmark (2008:344) mentions that "responsibility for the potentially negative consequences of one's actions [...] is both a central aspect of contemporary environmental ethics and of current political efforts to reach sustainability". Hage et al. (2009:162)⁶, found from a study on motives of household recycling in Sweden, that people who feel particularly responsible for the environmental impacts of waste disposal and believe that their recycling efforts can mitigate any negative impacts on environmental quality, are also more likely to undertake such efforts, showing that moral norms do have a large impact. Convenience was also found to make a difference in recycling outcome, and the authors conclude that information campaigns could stimulate further recycling efforts and maintain existing collection levels, but policy should preferably be "presented in 'packages' emphasizing both the moral obligations, as well as measures introduced to facilitate households' efforts" (Ibid:163-4).

Taylor (2000:417) concluded a study on policy incentives to minimize municipal waste generation in the USA, by arguing that including social-psychological and economic incentives in such legislation can overcome problems of implementation, thereby reducing the resources required for enforcement. By social-psychological incentives he refers to changing attitudes and behaviour through disseminating information, persuasion by relating waste minimisation to the achievement of valued goals and making use of social pressure, among others. Economic incentives include getting paid for recyclables or paying waste disposal by unit, in weight or in volume (Ibid:409-412), Hage et al (2009:156,162) found that weight-based fees are more effective in Sweden, but he mentions that both have been questioned on effectiveness and for inducing improper disposal.

To sum up, this section provides the theoretical framework according to which the empirical data is analysed. It demonstrates why MSWM needs attention from an international development

⁶ Hage et al (2009) also apply social dilemma theory to explain people's behaviour related to waste management.

perspective and why the participation of individuals as waste producers is important. It also introduces the social dilemma theory as a way to look at decisions regarding waste behaviour. Finally, it lists the factors discovered by other research to be relevant to improve people's behaviour in waste management and the various strategies used elsewhere to achieve citizens' cooperation in waste management issues.

III. Municipal Solid Waste Management (MSWM) in Delhi

This chapter combines information from secondary sources with primary data from key-informant interviews and observations done during the field-study in Delhi to describe the functioning of the MSWM system in Delhi and to demonstrate the importance of residents' participation for solving the garbage issues there.

III.1. Municipal solid waste quantity and composition in Delhi

In 2006, Delhi was the sixth largest urban area in the world with ca. 16 million inhabitants, and the second in India, after Mumbai (City Mayors 2009). The most recent estimates show that Delhi produces 12 million tons of waste per day, comparing with the same quantity in New York, 13 million tons in Cairo and 14 in Buenos Aires (2008: 41). In Delhi it is estimated to reach 23000 metric tons by 2020 (Chintan N.D.:2). According to the Central Pollution Control Board 2004 data, the per capita generation of waste in Delhi was 0,475 kg (see Sharholy et al. 2008:461), However, other estimations from the same year mention ca. 0,61 kg/capita/day (Chintan N.D.:5), compared to an average of 1,4 kg per person per day produced in 2007 in the European Union (Eurostat 2009). Regarding waste composition in Delhi, there is little correspondence between sources and no recent estimates. Talyan et al. (2008:1279) present the data in Table 1.

Physical composition (as wt.%) of MSW in Delhi			
Parameters	2002	1995	1982
Biodegradable	38.6	38.0	57.7
Paper	5.6	5.6	5.9
Plastic	6.0	6.0	1.5
Metal	0.2	0.3	0.6
Glass and Crockery	1.0	1.0	0.3
Non-biodegradable (leather, rubber, bones, and synthetic material)	13.9	14.0	5.1
Inert (stones, bricks, ashes, etc.)	34.7	34.8	28.9

Sources: TERI (2002), NEERI (1996), IHPH (1982).

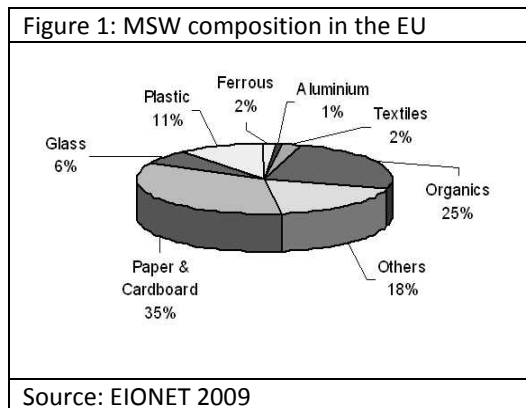
Source: Talyan et al. (2008:1279)

However, Sharholy et al. (2008:461), based on Central Pollution Control Data 2000, presents a different picture in which the main differences are regarding plastic (1,5%), compostable matter (31,8%), and metals (2,5%). Srivastava (2008) argues that the plastic content of the waste is 2.74%, of paper

29.50%, and food 36.37%.

For comparison, Figure 1 shows the composition of municipal waste in the EU (EIONET 2009). It shows that 55% of the waste in the EU is recyclable. For Delhi, this value varies from 10% to over 32%, depending on the source. No matter the real value at the moment, the recyclable share in Delhi

is expected to grow and so is the quantity of waste produced.



According to the Union Ministry of Environment and Forests' *White Paper on Pollution in Delhi (N.D.)*, due to pressures on land and pollution of ground and surface water from landfills in Delhi, other disposal technologies than landfilling will have to be adopted on a large scale.

Composting is considered the most viable option,

whereas incineration is not recommended due to the low heat value of waste in Delhi. In order for composting to be possible, waste segregation at source is a must. The data presented here shows the urgency of changing the way MSWM is done in Delhi by involving city's inhabitants.

III.2. Policies and legislation on MSWM in Delhi

There is no policy document in India which looks at waste as a part of a cycle of production-consumption-recovery or through a lens of overall sustainability (Chinan 2005: 2). The integrated waste management policy does not seem to be legally recognised. Although the Ministry of Environment webpage mentions waste minimization as a programme area under prevention and control of pollution, no policy paper promotes it explicitly. However, the Government of the National Capital Territory of Delhi adopted the Delhi Plastic Bag (Manufacture, Sales and Usage) and Non-Biodegradable Garbage (Control) Act, 2000, which prohibits the "sale, sell or use" of other plastic bags than degradable.

Waste reuse, recycle and segregation are mandated by *Solid Waste Management and Handling Rules 2000*, developed by the Union Ministry for Environment and Forests (MoEF 2000). Additionally, the rules make it the responsibility of the municipal authority to organise awareness programmes for segregation of wastes and to promote recycling or reuse of segregated materials. The *Delhi Plastic Bag Act* makes it compulsory for the authorities to provide the infrastructure for waste segregation. It also makes littering an offence. A minus of the rules and act, widely emphasised by the NGOs

working on waste management issues is the absence of the informal sector, the primary actor in waste recycling in India (Chintan 2005:3). The National Environment Policy 2006 (MoEF 2006) promotes segregation, recycling and reuse of municipal wastes and moreover, and recognises the informal sector working in collection and recycling. However, the integrated waste management does not emerge as a policy vision and composting is not even mentioned.

III.3. Actors in MSWM in Delhi

III.3.1. Municipal bodies

In the National Capital Territory (NCT) of Delhi there are three local bodies responsible for MSWM, according to Chintan⁷ (N.D.:2, and personal communication with staff):

- Municipal Corporation of Delhi (MCD) is the largest, providing services in both rural and urban areas within the National Capital Territory,
- New Delhi Municipal Committee (NDMC),
- Cantonment Board (CB) which manages the area used by the Defence Forces.

These actors are not collaborating in any way; they are simply managing different areas, historically delineated. Moreover, at MCD, civil engineers are in charge of MSWM, whereas at NDMC this falls under medical officers' responsibility (interviews with officials from both bodies).

At the moment, none of municipalities does more than collecting and transporting waste to landfills (interviews with Chintan staff, NDMC and MCD officials). Dumping space is a big concern with all three existent landfills close to exhaustion (Chintan N.D.:2). There is no municipality involvement in recycling and no plans for it. There are however plans for introducing waste treatment technologies such as composting, refuse derived fuel⁸ and biomethanisation⁹ (MCD and NDMC interviews). According to NDMC (interview), composting is done in Delhi only with garden waste, not household waste.

⁷ The NGO that hosted me during the research.

⁸ To be used for energy generation. It is better than dumping waste into landfills but "recent studies suggest that moving material away from incineration and into recycling is likely to be the more favourable treatment for materials when these treatments are assessed in terms of their global warming impacts" (European Commission, Directorate General Environment 2003:2).

⁹ Conversion of organic waste into biogas and manure (IDS – Power/Energy website 2009).

Garbage is the property of the municipality once it reaches the garbage bins, before that, it is the property of the garbage generator¹⁰ (interviews at Chintan and ToxicsLink). However, improper disposal is very common. In richer areas and on main roads, street sweeping facilities are provided by the government, but poor areas do not enjoy such luxury. In addition, due to the large quantity of waste, collection is very slow in some places, especially poorer one (Ibid).

NDMC is involved in a project with Chintan in which door-to-door collection is provided by waste-collectors supervised by the NGO. Residents are given two bins for storing separately biodegradable and non-biodegradable wastes. Although many people separate glass, paper, etc. to sell to itinerant buyers (kabaries), only a limited number actually give away segregated waste to the waste-collectors (interview with NDMC). MCD is not collaborating with any NGO and is not interested in doing so in the future due to negative previous experience. They have privatised MSWM in designated areas and plan to extend this in the future, action heavily criticised by NGOs due to possible neglect of environmental priorities and social implications¹¹ (interviews with Chintan and ToxicsLink).

There is a lack of coordination between the three Delhi institutions responsible for waste management. Some of these are interested in collaborations with NGOs and others prefer privatization of waste services as ways to improve collection and segregation. Obvious is also the lack of programmes targeting the impoverished city areas.

III.3.2. The informal sector¹²

Many studies¹³ have been done on the informal waste-picking activities of poor urban residents of cities in developing countries. The first conclusion to be drawn from them is that informal waste-

¹⁰ Also, the NDMC Act 1994, Section 264 (a&b): "It is the responsibility of the Citizen to deposit the waste collected in their own receptacles at NDMC dust bins, responsibility of owner to have their own premises swept and cleaned".

¹¹ Waste becomes the property of the private company and waste-pickers are not allowed to collect recyclables which are their only sources of income. This problem could be resolved if the private contractor would employ waste-pickers in for example door-to-door collection, which according to MCD (interview) is planned to be done. However, no such clause will be introduced in the contract, although MCD hopes the private contractor will employ waste-pickers (Ibid).

¹² There is no consensual definition of the informal sector. However, according to Chant (2002:208-209) the demarcation of the informal and formal sectors is about legality: legal recognition of a business, as well as legality concerning payment and labour matters (such as compliance to official regulations regarding working hours, minimal pay). It plays an important and controversial role: it reduces unemployment and underemployment, but in many cases the jobs are low-paid and the job security poor (WB 2008).

¹³ To mention just a few: Medina 2007, Wilson 2006, Moreno-Canchez et al 2006, Fahmi 2005 and Fahmi et al 2006 (on Cairo), and Ojeda-Benitez et al 2002 (on cities in Mexico).

picking for reuse or selling is widespread and it is the only earning opportunity available to many low-skilled inhabitants. Moreno-Canchez et al (2006) and Wilson et al (2006) found a beneficial role of the informal waste-recyclers and emphasized the importance of integrating or organizing them into the formal waste management scheme¹⁴ in order to reduce their vulnerability and improve their livelihoods, working conditions and efficiency in recycling.

Informal recycling has been traditionally practised by outcasts and marginal groups (gypsies, rural migrants, immigrants and members of religious minorities). Poor living conditions, limited access to facilities and infrastructure, no provision of water supply and sewerage, and absence of social safety networks are typical of scavenging communities, especially those living in shanty towns, or around dumps (Wilson 2006:803). In India, *dalits* (schedule castes¹⁵ or “untouchables”) “have been scavengers for centuries, and their scavenging activities are perceived by the Indian society today as being their exclusive responsibility and duty” (Medina 2007:210,201).

In Delhi, waste recycling is done overwhelmingly by the informal sector. Recyclable waste ends up at recycling units through a hierarchy of waste-pickers and dealers. Waste-pickers collect and classify various materials that have recyclable value and can be sold. Some collect mixed waste directly from resident's houses and sort the recyclables, others collect recyclables from streets or dust bins, and yet others from landfills or open dumps. Most walk carrying a sack, while a few own bicycles and tricycles. At the end of the day, they sort the waste into different types and sell it to small dealers in recyclables. From here, waste is transported to bigger dealers, usually specialised in only one type of material, who in turn sell it to the recycling industries. (Agarwal et al.2005, Sarkar 2003, Chintan N.D.)

¹⁴ However, from the waste-pickers' point of view, formalisation seem problematic. A discussion with four waste-pickers at a junk shop in Delhi revealed that although they are not satisfied with their job, they do prefer it to any other job that would bring similar economic returns but without the freedom they benefit from by not being tied to a formal job (when one is obliged to work when the employer says so). They manage to save INR 2000 per month at the moment and would accept a formal job only if they were given INR 7000 per month, which is a large sum for unskilled work.

¹⁵ “Scheduled Castes” (SC), “General Castes” (GC), “Scheduled Tribes” (ST) and “Other Backward Classes” (OBC) are legal classifications in the Indian quota system of affirmative action. Scheduled castes are comprised largely by the previously called “untouchables”, or “underprivileged”, groups that were outside the caste system comprised of four varnas: *Shudras* (agricultural workers) and *Vaishyas* (merchants) (now comprising the OBC), and *Kshatriyas* (warriors) and *Brahmins* (priests) (now falling under GC). The untouchables have traditionally performed undesirable jobs associated with pollution and subsequently were themselves considered unclean. (Ahuja 2007: 228-268)

Agarwal et al. (2005:82) estimated that there are nearly 89600 waste-pickers in Delhi, whereas Medina (2007:202) mentions 167000¹⁶. Most of them are migrants from poorer Indian states¹⁷ or Bangladesh (20%), unemployment and poverty being the prime reasons of migration; around 80% are illiterate (Agarwal et al 2005:81). They live in slums, in huts or tin sheds, and earn low incomes, sometimes insufficient for their daily needs for accommodation and food. Many turn to recyclable dealers for borrowing money in times of hardship as many do not own identity cards and therefore cannot open bank accounts. They work in very unhygienic conditions and are subject to many health hazards (Ibid 2005:80-81). A study undertaken by Chintan (N.D.: 9) in 2002 showed that the income of the waste-pickers varies according to the means of transporting waste available to them. Those owning a cycle earn in average INR 100 per day, whereas those operating on foot only 50.

Their work is very beneficial for Delhi's environment because it reduces the impact of uncollected waste and increases the percentage of recycled waste. Nearly 17.4% of municipal solid waste generated is recycled by waste-pickers according to a study done by Agarwal et al. (2005:83), which if true is comparable to the 22% of the municipal waste recycled in the EU¹⁸ in 2007 (Eurostat 2009), taking into consideration that the proportion of recyclable waste is in EU much higher than in Delhi.

III.3.3. NGOs working on waste management in Delhi¹⁹

Several NGOs work with waste management issues in Delhi. Chintan is the one that supported most my research. The largest is probably CEE (Centre for Environment Education), a nation-wide agency that has a Waste and Resource Management Division. Their visions are somewhat similar taking into account both the environmental and social problems related to waste. Chintan's work is however focused more on the informal sector, trying to make it recognised and to improve their living and working conditions. They also organise door-to-door waste collection services in some areas where waste-pickers are employed to collect waste from people's door. They transport it to a place where they can segregate it, keep the valuable recyclables, and throw the rest in trash bins. In some areas, where space was found, composting of biodegradables is done as well. Convincing people to segregate their waste was tried but remained unsuccessful in most cases²⁰. Sycom and Toxics Link

¹⁶ According to him, India is the country with the second largest number of scavengers in the world, after China.

¹⁷ Such as West Bengal, Uttar Pradesh, and Bihar

¹⁸ Germany has the highest recycling rates in the EU (46%) and it is followed by Belgium (39%), Sweden (37%), Estonia and Ireland (both 34%) (Eurostat 2009).

¹⁹ All the information provided in this section was collected directly from the NGOs themselves.

²⁰ Most NGO and government officials interviewed blame this failure on too little awareness about the impacts of waste among residents. NDMC recognised that they should put much more effort in raising awareness

have been or are running similar *decentralised solid waste management projects* in Delhi. Tariq from ToxicsLink (personal communication) thinks composting is very important and should be done in Delhi where the percentage of organic waste is relatively high, either in a centralised or decentralised manner.

III.3.4. Individuals as producers of waste

As mentioned earlier, the individual, as generator of household waste, is the actor most often forgotten in waste management. Residents are fully responsible for the waste to reach garbage bins, and partly for their waste's impact on the environment and the others. However they cannot control the whole process and although the success of MSWM projects depends on their full participation, the good planning and implementation of projects are also essential.

It is now recognized that source segregation of garbage plays a very important role in improving waste management in Delhi to reduce the environmental, health and social impacts. Government and NGOs alike emphasise its importance and new MSWM projects and programmes in Delhi, in progress or in planning stage, rely on source segregation for their success. MCD plans to privatise MSWM in another two zones, and says that source segregation will be introduced there. But why is source segregation of waste important in Delhi?

- a. More waste can be recycled and therefore resources are being saved and less waste ends up in landfills, preventing associated environment pollution and social impacts²¹.
- b. Waste-pickers' working conditions can improve as they will not have to dig into wet wastes to find recyclables and be exposed to hazardous wastes (as it also appeared from interviews with door-to-door collectors H and O).
- c. Waste-pickers will be able to sell clean recyclable materials of a higher quality for a better price (Rodic-Wiersma:4).
- d. Composting can be introduced, decreasing substantially the quantity of wastes ending up in landfills (ToxicsLink interview).

(interview) and the same seems to be the case for all other similar projects as per my observation. One resident in the area where NMDC-Chintan are running the door-to-door collection said that they were given the different bins for storing biodegradable and non-biodegradable wastes by the waste-collector but it was unclear what to do with these.

²¹ Because waste-pickers will not have to spend time segregating and washing and therefore can collect more recyclables than otherwise

- e. The compost and recycled materials will not become contaminated by hazardous wastes²², posing the risk of entering food chains (ToxicsLink and CEE interviews).
- f. As the quantity of recyclables ending up in landfills decreases, so will the need for landfill scavenging (Rodic-Wiersma:4).

As already mentioned some households in Delhi do segregate their garbage and recyclables are sold to itinerant buyers. There is however no information about the number of those doing it²³. Waste minimization seems to be absent from the public discourse at the same time as rather contrary messages promoting a consumption culture seem to prevail (Sharad Gaur, interview). Littering is condemned by many public signs, but still widely practised as per my observation.

In Delhi, three municipal bodies are in charge of MSWM, but most of the recycling is done by the informal sector. Waste-pickers, coming from the most impoverished and marginalized social strata collect and sell recyclable garbage to specialized dealers. However, the system is neither efficient, nor socially just and there is no sense of responsibility of waste-producers.

IV. Methodological discussion

IV.1. Meta-science position

Overall, the meta-science position that best describes the underlying assumptions and goals of my study is *critical theory* with its emancipatory interest (Mikkelsen 2005:136). I start from the assumption that people's actions related to how they handle waste may lead to unjust consequences, social and environmental. Their actions are determined by historically constructed structures and by their knowledge and values. The goal is to explain and understand their actions in order to change them, therefore to create knowledge that can be used to "counteract irrational and repressive social structures and processes" (Ibid). The research is therefore normative, as it views the reality as inherently bad and seeks to produce knowledge that would help bring about social change by interfering in the way people negotiate their realities and by influencing their decisions.

²² The issue of separating hazardous waste from both biodegradables and non-biodegradables although very important, does not fall under the scope of this paper.

²³ Also, only specific wastes with higher monetary value are sold. One household sold newspapers, glass and plastic bottles and iron scrap (interview O), the rest of recyclable were thrown together with the rest of the garbage, although they were provided with different bins for different types of waste.

IV.2. Research typology, strategy and approach

My research is primarily an *applied research*, one of the first and foremost concerns of development work (Mikkelsen 2005:125). The key assumption is that “human and societal problems can be understood and solved with knowledge” (ibid:133). Therefore, my study seeks to “contribute to theories that can be used to formulate problem solving programmes and interventions” (ibid:132). It is intended to feed into designing the best strategies to convince people to change their behaviour towards participating in improving the waste situation of their city and fight injustice. (ibid:133). Additionally, my study has characteristics of both *descriptive and explanatory research*. It seeks to describe people’s knowledge, values and attitudes, but also the identify the factors influencing their actions, and therefore to explain their decisions and behaviours (Ibid:125-126).

As Bryman (2004:16,438) says, “principles and research practices do not necessarily go hand in hand in a neat and unambiguous manner”. In my case, the pluralism defining the meta-theoretical position does undoubtedly translate into employing “*methodological pluralism*” in this study (see Little 1991: 23, in Mikkelsen 2005:144). It is my belief that there is no strict division between the qualitative and quantitative research strategies and indeed many studies do combine elements of both (Bryman 2004:443-445; Mayoux 2006:116-123; Overton and Dierman 2003:72). I therefore utilize mixed methods. The role of quantitative methods was to provide a general picture of the situation, and to account for as many as possible of the variables thought to have a role to play in the behaviour of city residents regarding waste. Qualitative methods were used for exploring the subject in the initial stage, and later for building further on the results obtained via statistical methods and digging deeper into the reality (Creswell 2007: 17-18,40). Quantitative and qualitative methods were combined for two reasons: complementarity and triangulation (Bryman 2004:455).

In regards to the research approach, this is primarily *deductive* as the departure point of the study is existing theory and one of the goals is to test hypotheses derived from theory (Bryman 2004:8). There is of course an element of inductiveness, as the research is striving for building up or revising theory based on the empirical data collected.

IV.3. Choice of methods – multiple methods

In regards to multiple methods, many authors warn about the care that must be taken when combining data collection methods, but at the same time encourage it (Silverman 2005:121-122; Mikkelsen 2005:143,149; Bryman 2004:464). A mix of methods was considered to serve my research

needs best. Table 2 above summarises the methods used to answer each research question. The collection of the primary data was done during November and December 2008.

Table 2: Data collection methods used

Research question	Data collection method
1. <i>What are the city residents' knowledge, attitudes and behaviour towards waste and waste management in Delhi?</i>	Survey with city residents; observations; and key informant interviews with garbage collectors, government officials and NGO staff.
2. <i>What are the factors influencing the behaviour related to solid waste management?</i>	Literature review; and key informant interviews with government officials and NGO staff; and survey with city residents.
3. <i>How can the Delhi residents be motivated to contribute to improving solid waste management and so reduce their environmental, health and social impacts?</i>	Literature review and interviews with key informants involved in such attempts in Delhi.

Literature review is used to determine the possible factors influencing people's behaviour related to waste handling based on previous studies and theories (mainly social dilemma theory) and to answer the third research question.

Non-participant observations of the city residents' behaviour in regards to waste handling and particularly to littering and segregation of waste were also conducted for the purpose of describing the everyday reality of the city. These were sometimes combined with informal interviews on the subject.

Survey based on enquete

The survey was deemed the best data collection method due to the generalisation needs of the study and due to my familiarity with the method. Also, surveys are the most suitable way to collect quantitative data and test hypotheses based on previous research. However, as Mayoux (2006:119) points out, qualitative information can be obtained as a part of quantitative surveys. Indeed, some of the data collected through my survey is qualitative in nature, such as that collected through open questions and referring to city resident's attitudes towards waste-pickers.

The decision to design a self-completing questionnaire came after a small pilot survey was conducted with a structured interview schedule as the instrument (Bryman 2004:84) and me or my Hindi speaking research assistant asking the questions and writing down the answers. It was observed that people tended to give "socially right" answers for sensitive questions. Similarly, there was a high

degree of respondent fatigue due to the length of the questionnaire and the amount of open questions and also difficulty in answering the open questions.

Therefore it was decided that a self-completing questionnaire with predominantly closed questions would be more appropriate to counterbalance the difficulties and biases observed during the pilot survey. Moreover, a self-completing questionnaire is less time-consuming for the researcher and fitted well with the limited time I had available for the study. (ibid:133-134)

I have distributed the questionnaire personally, accompanied by my assistant. In order to reduce non-response, the respondents were allowed at least one day for completion of the questionnaire. They were explained what the questionnaire was about and how to fill it in and told that the questionnaire will be collected at any time convenient for them. Another limitation of the self-completing questionnaire is that it excludes the illiterate. However, when the respondents mentioned this as the reason they refused to participate, my assistant would read the questions to them and write down the answers. Nevertheless it is possible that some did not admit that illiteracy was the reason for refusal, which leads to a bias in the sample that must be taken into account.

The respondents were given the choice of an English or a Hindi questionnaire. Care was taken to make all questions simple to understand and unambiguous and to avoid concepts that are not familiar to the population (Overton and Dierman 2003:39). The pilot survey served well this purpose. Also, NGO staff, supervisors and colleagues were asked to review the questionnaire and their feedback has been incorporated.

Sampling

The survey aimed at a reasonable representation for the Delhi population was aimed. Given the limited resources at my disposal, the intended sample size was 100. Around 130 questionnaires have been distributed and a total of 99 have been returned.

I employed a combination of random and convenience sampling. Multi-stage cluster sampling with stratification elements proved to be the best way to go about issues of time, resources and unavailability of data about the population (Bryman 2004:92-94, Neuman 2007:231-234). In the first stage, colonies²⁴ were the clusters opted for. As they differ greatly from one another in terms of

²⁴ Term for "neighbourhoods" or residential areas used in Delhi; they are administrative units of varying sizes, geographically delineated often by big roads.

income, but are rather homogenous internally, the income level of the inhabitants was the stratification element introduced and it was decided to include three colonies with different income levels. In the absence of demographic data at colony level, the particular colonies were selected based on convenient location and consultations with key informants and experts on the matter²⁵. These were: Safdarjung Enclave – an upper/upper-middle income colony, R. K. Puram – a middle income colony, and Dakshinpuri – a lower-middle income and resettlement colony (i.e. built by the government to resettle the slum inhabitants) (Appendix II). All three fall under the MCD area. The populations of these colonies are not homogenous internally but do follow in broad lines the above criterion. In the second stage, particular Blocks have randomly been chosen in each colony. A detailed plan of the city was used for this purpose. Rich colonies such as Safdarjung Enclave most often comprise poorer areas where the service providers live. These areas have been excluded from the sample. Inside each block houses to be visited were sometimes randomly selected while walking around, sometimes based on convenience - because it happened that a person was sitting outside.

All in all, it is difficult to claim that the sample is representative for the entire Delhi population because the very poor were not included in the sample and the rich are most probably over-represented. However, the results can be generalised to the three colonies chosen and the groups they have been drawn from.

Key-informant interviews

In addition to the informants already mentioned, waste-pickers, as well as staff from relevant government departments and NGOs, were also interviewed (see Appendix I). Interviews were used in my research to gain specialised knowledge I could not have acquired otherwise.

IV.4. Reliability and validity

Inter-observer reliability has been assured by using just one assistant and the researcher maintaining strict control over the entire data collection process. Additionally, although some of the issues inquired in the questionnaire are sensitive, there is no reason to believe that people lied.

Measurement validity has been assured during the design of the questionnaire and during the analysis stage by consulting relevant theory and having key informants review it. Internal validity

²⁵ These were: my supervisor at Chintan, a professor in economics with wide experience in doing surveys in Delhi, the director of the Residents Welfare Association of the upper class colony chosen, an NGO with experience in working in resettlement colonies, and my research assistant - a PhD student in Sociology.

was dealt with by cross-checking conclusions about causality with theory. Also, the data and conclusions of the survey were triangulated with the data from interviews. External validity, which deals with generalisability, has already been discussed in the sampling section.

IV.5. Ethical considerations

The informed consent of all the participants in this research was obtained and the names of key informants are given only if they specifically agreed on their names to be disclosed. As per my knowledge, this research cannot harm any of the participants. Another issue that needs to be addressed here is whether this study has anything to give back to those who gave their time to participate in it. It is my belief that it will provide valuable information to MSWM planners and will hopefully lead to a better MSWM to the residents.

V. Analysis and findings

The variables explored in the questionnaire were selected based on theory and discussions with key informants (especially Chintan's director). The way I operationalised the nominal concepts is seen in the questionnaire (Appendix III), with which the reader is encouraged to become familiar before continuing. Section V.1 provides a demographic description of the sample and Section V.2 answers the first research question, both employing mainly univariate statistical analyses. Section V.3 utilizes bivariate and multivariate statistical analysis to answer the second research question.

V.1 Demographic characteristics of the sample

Regarding the *location*, 28 of the respondents reside in Safdarjung Enclave, the upper-middle income colony; 35 in RK Puram, the middle income colony; and 34 in Dakshinpuri, the lower income, resettlement colony (with 2 missing cases). The smaller number of respondents in Safdarjung Enclave is due to the higher non-response rate here.

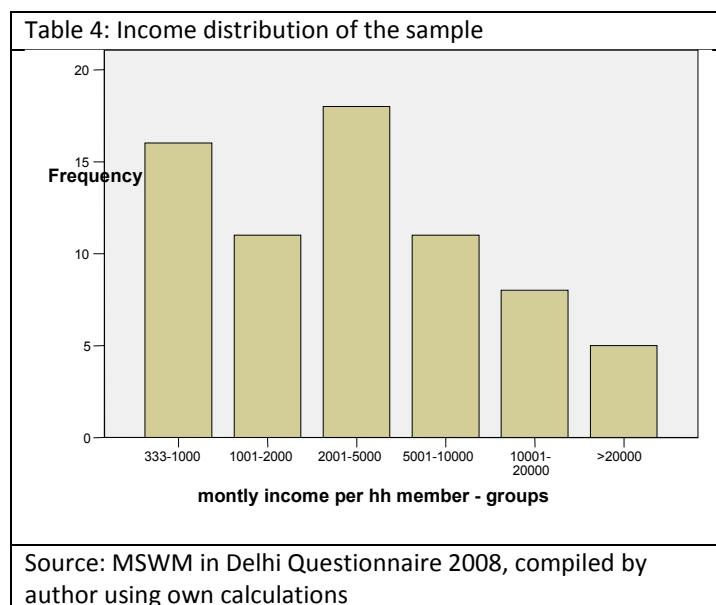
Income per household member without outliers >25000			
respondant location	Mean	N	Std. Deviation
Safdarjung	9235,7143	15	5493,69098
RK Puram	4171,5761	24	2477,48489
Dakshinpuri	1904,0890	23	3403,16894
Total	4555,6062	62	4638,20354

Source: Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

As expected, the monthly income per household member varies between these three locations with the highest in Safdarjung Enclave, followed by RK Puram and Dakshinpuri. However, the differences in income are statistically significant only when controlled for

outliers²⁶. Income is a strong explanatory factor for residence (37% of the difference in residence is explained by income²⁷). Table 3 shows the differences in income for this case. Caste is another determinant of location (at a 0,016 significance level): the poorer the location, the more schedule caste people live there. Education also correlates with location at a 0,001 p-value, showing the same pattern as caste and income. In conclusion, location appears to be a good approximation of socio-economic status. People residing in Safdarjung Enclave have generally a higher income, belong to a higher caste and are more educated. RK Puram comes next, and Dakshinpuri last.

In terms of *age*, the mean is 35 and half of the respondents are below 32, with a high percentage of them below 25. The high number of cases below 25 is because in households where the adults are illiterate, the responsibility for all written matters falls on the children and youth²⁸.



Among the respondents 56 are women and 41 are men, with 2 missing cases. The average *number of household members* is 5, ranging from 2 to 12. In terms of *religion*, the distribution of the sample follows roughly that of the Delhi population and is: 85,6% Hindus, 6,7% Sikhs and 5,6% Muslims and 2% Christians²⁹.

The average *monthly income per household member* is 8144 INR, whereas

the median is 3333 INR. In comparison, the average per capita income in Delhi was 5560 INR in 2006-07³⁰, more than double that of the national average and it is likely to have been increased close to the average found by my survey based on the current trend. Another characteristic existent both in

²⁶ Five outliers with values over 25000 INR were removed.

²⁷ At a 0,0001 significance level. Although the posthoc Scheffe test shows that there is no statistically significant difference in income mean between Dakshinpuri and Safdarjung Enclave, the differences between the other locations are significant at a 0,01 level.

²⁸ This is well illustrated in Dakshinpuri where the mean age is significantly lower than in the other two colonies (25 as opposed to approximately 40) and where it was observed during the survey process that many women would give the questionnaire to their children for completion.

²⁹ The religion of the household head is distributed in the Delhi population: 85.9% Hindu, 8,6% muslim, 1,6% Christian, 3,3% Sikh, 0,0% Budhist, 0.6% Jain (International Institute for Population Science and Macro International 2007).

³⁰ According to the 2007-08 Economic Survey of Delhi (Business Outlook India 2008),

my sample and in the Delhi population in general is the very wide dispersion in income and the existence of outliers, a few individuals that have relatively very high income values (Table 4).

Approximately 62% of the respondents have at least 12 years of *education*, as opposed to 38% in the Delhi population³¹. The main cause is that within households, those with higher levels of education are more likely to fill in the questionnaire.

In terms of number of *rooms per household member*, 80% of the respondents have less than one room for themselves with an average of 0,6 rooms per household member and a median of 0,5. There is a strong correlation between this variable and the monthly income per household member.

V.2 Knowledge, attitudes and behaviour towards waste and MSWM

This section combines data from the survey with the city residents, observations, and key informant interviews to answer the first research question, as the section title illustrates.

V.2.1 *Waste disposal facility*

67 of the respondents have their waste picked up from their door by someone, 28 take it to the locality dustbin themselves, and 3 declare that they dump it on the roadside as there is no dustbin in their locality (all 3 residing in Dakshinpuri), with 1 missing case. Crosstabulation shows that door-to-door collection services are most common in Safdarjung Enclave, where 90% of the respondents benefit from it, as opposed to 60% in RK Puram, and 57% in Dakshinpuri.

When asked what waste disposal facility they would prefer, only 21 out of the 95 respondents who answered this question declared they would choose to dispose off their waste themselves, whereas the rest would choose some sort of door-to-door service³². 13 of the 29 respondents who do not benefit from the service would prefer it, which shows that there is room for extending this service.

V.2.2 *Knowledge on waste and waste handling*

The open question: "Could you please describe in a few words what you think happens to your waste once it leaves your home?" measuring the depth of people's knowledge about waste disposal. It

³¹ According to International Institute for Population Science and Macro International 2007: 63.

³² 45 would prefer the government to take the initiative, 20 would like the local association to arrange the service, and only 9 would choose an informal waste-picker.

received only 53 responses which were subsequently coded. 16 of the respondents stopped in their description at disposal into waste bins and the garbage being transported away. Some even mentioned that waste is transported “away from the city” or “in a place free of people”, in tone with Clapp’s (2002) waste-distancing theory. 8 responses focused on landfilling, 3 on burning, 2 on gas making, and 17 on recycling and/or manure. Another 7 responses were more complex and close to reality, mentioning that some waste is recycled whereas some ends up in landfills. All in all, most descriptions were rather realistic, but some seemed taken from environment manuals, describing technologies that are not in use in Delhi at the moment, such as gas or energy production. Only 5 respondents mentioned waste-pickers as involved in segregation and recycling of waste, a sad number having in mind the huge role the waste-pickers play, as already described in large earlier.

Table 5: Knowledge on biodegradable and non-biodegradable waste

Q:	correct	incorrect	Don't know	Total valid cases
What is biodegradable waste?	60	18	14	92
What is non-biodegradable waste?	56	26	10	92

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

When asked what biodegradable and non-biodegradable waste is, the answers were as in Table 5. Only 50 respondents answered both questions correctly as shown by crosstabs and can be said to have consistent knowledge on the matter. This consistency is further explored by checking if the respondents know what waste materials are biodegradable and what are recyclable. 25 to 32% of the respondents, varying according to the material, gave wrong answers in identifying the biodegradables. It is interesting that in the case of paper and cardboard, 52 percent of the respondents considered it as being biodegradable. In total, it appears that only 18 of the respondents gave a perfect correct answer³³. For the second question, the answers were distributed as in Table 6 and only 22 of the respondents answered correctly in all cases. Glass was the waste type least often recognized as being recyclable.

Table 6: Knowledge on different waste types

Q:	No %	Yes %	Total valid cases
Is plastic recyclable?	23.5%	76.5%	81
Is metal recyclable?	37%	63%	81
Is glass recyclable?	48.1%	51.9%	81
Is paper recyclable?	32.1%	67.9%	81

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

³³ The others either did not circle all the biodegradable materials or they circled non-biodegradables among them.

Additionally, 72 of the respondents thought recycling and composting are the best ways to manage waste, whereas 24 answered dumping into landfills and/or burning (3 missing cases). In conclusion, people are aware that it is best if waste re-enters the production circuit, but lack information on the details of the process in which this is done, including on what could be done with different types of waste.

V.2.3 Perception on the waste problem

The majority of respondents (72%) agree that waste is a big problem in their locality³⁴. Surprisingly, there is no statistically significant correlation between this variable and place of residence, although as per my observation, Safdarjung Enclave is cleaner than RK Puram, which is cleaner than Dakshinpuri. This shows that the perception of the waste problem is very subjective. When asked whether waste was a big problem in Delhi in general, the number of those agreeing³⁵ was even higher, 88%. It was found that there is a correlation between this variable and place of residence³⁶. The respondents residing in Safdarjung Enclave tend to agree more often that waste is a big problem in Delhi than those residing in RK Puram, followed by Dakshinpuri. This is the exact same order of cleanliness of these respective areas: the cleaner one's locality the more likely the person will be to recognize waste as a big problem in Delhi.

V.2.4 Moral norms related to waste and waste management

When asked how *important it is for them to know what happens to their waste*, 43 respondents said it was very important, 34 that it was fairly important, 13 opined "not very important" and 4 chose "not at all important" (5 missing cases). This shows that most respondents do care about what happens to their waste but as it will be showed in chapter V.3., they do so only in what littering is concerned, in the sense that they do not want it to lie on the streets. Another aspect mentioned in the literature as an important determinant of waste behaviour is the responsibility felt for one's waste. It was found that a large proportion of the respondents feel responsible for managing their own waste, although the majority of those who do, think that the local government has an equal responsibility (Table 7). Interestingly, there is no correlation between the two variables showing that caring does not necessarily translate into feeling responsible for action.

³⁴ 29 "strongly agree" and the same number "agree", whereas 15 and 7 "disagree" and "strongly disagree" respectively (18 missing cases).

³⁵ The number of those strongly agreeing and agreeing was 47 and 31 respectively, whereas only 7 disagreed and 4 strongly disagreed (10 missing cases).

³⁶ P-values 0.028

Table 7: Responsibility about managing one's waste

		Frequency	Percent	Valid Percent
Valid	managing waste is the local govt's responsibility, not mine	6	6,1	6,1
	managing waste is 1st the local govt's resp, then mine	5	5,1	5,1
	managing waste is both my responsibility and the local govt's	46	46,5	46,9
	managing waste is first my responsibility, then the local govt's	33	33,3	33,7
	managing my waste is my responsibility	8	8,1	8,2
	Total	98	99,0	100,0
Missing	System	1	1,0	
Total		99	100,0	

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

Table 8 shows in what way respondents thought they themselves could *contribute to solving the waste problem*. Not littering is the most considered contribution to solving the waste problem, whereas segregation of waste and reducing waste quantity are the least popular, showing that littering is much more present in public discussions and the media than the other two. Additionally, the majority of the respondents considered educating others to be a very important contribution.

Table 8: Considered contribution to the waste problem

I can contribute to the waste problem by:	agree	Total valid cases
Not throwing waste on the street	69%	96
Segregating waste at home	46%	96
Producing as little waste as possible	44%	96
Informing others about the waste problem	56%	96
Educating my children about waste	62,5%	96

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

V.2.5 *Decisions on waste matters*

Most often women decide on waste management matters in our sample, as 71% of the respondents answered. 11% said it was men and 14% thought that most household members have a say in the matter. Interestingly, only 3 respondents mentioned house maids. In contrast, both the official from NDMC interviewed and the senior programme officer from Toxics Link thought that maids have an important role in waste management in rich colonies, such as the NDMC managed area and Defence Colony, where Toxics Link has done one of the decentralized waste management projects. It is interesting that only one of the respondents from Safdarjung Enclave mentioned maids, although it was observed during the survey that many did have such household helps.

V.2.6 *Waste segregation behaviour and attitudes*

Let us look now at the *segregation behaviour*, as self stated by the respondents: 40% of the 93 valid responses said they never segregate their waste in biodegradable and non-biodegradable materials;

33% say that they do it sometimes, 9% that they do it most of the times, and 18% that they always do it. In total 60% do more or less often segregate their waste, as per their statement.

Table 9: Waste materials stored separately

Waste materials stored separately:	yes	Total valid cases
Glass	62.2%	90
Paper	35.6%	90
Plastic	46.7%	90
Metal	61.1%	90

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

The picture looks similar when looking at the waste materials the respondents store separately (Table 9), as seen in table #. It is surprising that only 36% store waste paper separately.

The data below explores the *attitudes related to segregation*. Table 10 shows that in theory home segregation is important for the great majority of respondents, although the answers to this question do not correlate with the actual segregation behaviour, as it will be shown in the next chapter. People do consider these issues in theory and agree with their importance but it does not mean that this translates in actual behaviour. It is interesting to note that one questionnaire respondent commented: “home segregation is unrealistic to even expect” and “should be done only at main bin and by hired rag pickers giving them extra source of income too”. The same respondent voices another problem: the infrastructure barrier of segregation: “what's the point, collection boy is uneducated [...] he won't carry separate vans for me”. This shows that some are not aware of the change they could make by segregating their own waste and that the “collection boy” would actually benefit from it, as it was shown in the previous chapter. One interpretation is that the caste thinking has a lot to do with the way things are. It is the waste-pickers job to do, it is polluting, and he makes money from it, so why do it myself?

Table 10: Attitudes towards waste segregation

Home segregation of waste...	Strongly disagree	Disagree	Agree	Strongly agree	Total valid cases
Is important for me because it provides financial returns	10%	22%	39%	29%	79
Is important for me because it is beneficial for the environment	7%	6%	51%	36%	81
Is important for me because it makes the waste-pickers' job easier	10%	11%	49%	30%	81
Is complicated	15%	46%	33%	6%	79
Is untidy	33%	40%	20%	7%	72

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

Going back to waste infrastructure, Table 11 shows that the infrastructure available is in theory very important in determining people's choices with 54% of the respondents saying that they would

segregate more if there were two separate trash-bins on the street where to throw it. It is interesting to note that 14% of the respondents see no point in segregation and only 4% would do it for money, although 68% stated that they segregated due to financial returns (Table 10).

Table 11: Conditions for which one is ready to do waste segregation

I would segregate my waste (more) if...	agree	Total valid cases
Someone would pick the segregated waste from my door	24%	90
There were 2 separate bins on the street where to throw it	54%	90
I was given special containers for my home	24%	90
I was explained why to do it	14%	90
I was given money for it	4%	90
I am not willing to segregate (more)	8%	90

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

V.2.7 *Littering behaviour and attitudes*

Turning to *littering behaviour*, we see that 67% respondents out of 96 declare that they never throw garbage on the street or road side. 28% admit that they sometimes litter, only 5% say they do it most of the times and no respondent says "always". It is very hard to judge just how much these values approximate the actual behaviour and if people really do what they say. Looking at the perceived acceptability of littering (Table 12), we see that in general this kind of behaviour is not considered acceptable. However, only 47 to 59% of the respondents *strongly* disagree. In such delicate cases where sensitive questions are asked one has to be very careful with interpreting a *weak* disagreement. It is interesting to note that littering is most acceptable in the case when there is a pile of trash on the spot already, with 13% of respondents agreeing that it is alright to do it in such a case and 40% disagreeing but not strongly. This finding supports Ostrom & Cardenas' (2004:312) theory that people decrease their cooperation in common resource dilemma situations if they observe others free-riding.

Table 12: Acceptability of littering

Statement:	Strongly disagree	disagree	agree	Strongly agree	Total valid cases
It is acceptable to litter when there is no dust bin around	50%	42%	7%	1%	88
It is acceptable to litter when you are in a hurry	59%	36%	5%	1%	87
It is acceptable to litter when there is a pile of trash already	47%	40%	12%	1%	85
It is never acceptable to litter, one should carry garbage to a dustbin always	7%	11%	40%	42%	85

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

V.2.8 Waste minimization

When asked if they take any actions to *reduce the quantity of the waste* they produce, 61,5% of 91 respondents answered “yes”. Looking deeper into waste minimization aspects (Table 13) we see that the percentage of those agreeing that waste minimization is important for them is higher than the percentage of respondents who actually do take actions to reduce their waste, showing again that attitude do not necessarily translate into behaviour. Moreover, we see that plastic bags are much more present in the discourse than packaging, not surprising considering the 2000 ban on plastic bags and its presence in the media and no attention given to minimising packaging, as shown in section III.2.

Table 13: Attitudes towards waste minimisation

Statement:	Strongly disagree	disagree	agree	Strongly agree	Total valid cases
Producing as little waste as possible is imp. for me	7%	13%	57%	23%	87
Using as few plastic bags as possible is imp. for me	6%	8%	55%	31%	87
Avoiding products excessively packaged is imp. for me	11%	29%	41%	18%	70

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

V.2.9 Attitudes towards waste-pickers

Due to their important role in waste-segregation and recycling, it was deemed important to take a look at the attitudes towards waste-pickers. The respondents were first asked to describe the first images that come to their minds when hearing the word waste-picker and this question got only 42 valid answers, which were then coded. 4 respondents felt pity, 9 described a negative image of poverty and/or misery, 9 referred to the waste-pickers' usefulness, 5 to their untidiness, 2 though they were thieves and 13 of the descriptions were neutral, describing the waste-pickers' work. Another open-ended question inquired about the role of waste-pickers in waste management in Delhi. Among the 39 valid answers, 9 referred to collection of waste, 3 to segregation, 5 to both the previous two, 6 to their contribution to cleanliness, one to their contribution to recycling, 14 did not describe their role but just mentioned that they do a good or important work, and one respondent complained that they should “pick all varieties of waste and not just what is important to them and earn them money rest they just leave behind not even on the side”.

In addition to the open questions, Table 14 shows the results of the closed questions exploring the attitudes towards waste-pickers further. It is interesting to note that although the majority (88%) think that waste-pickers are useful, 44% consider they are not reliable. The usefulness is further confirmed by the fact that the majority agrees that waste-pickers should be employed in waste

management in Delhi and even their locality. The fact that 89% agree that “the government should take action and employ them” shows that most would support the formalisation of the sector.

Table 14

Statement:	Strongly disagree	Disagree	Agree	Strongly agree	Total valid cases
Waste-pickers are useful in Delhi	5%	7%	59%	29%	73
Waste-pickers are reliable	12%	32%	40%	17%	69
Waste-pickers are dirty	18%	47%	26%	9%	78
Waste-pickers are thieves	30%	50%	14%	6%	66
Waste-pickers are poor	11%	20%	43%	26%	74
Waste-pickers save money for the city	14%	24%	48%	14%	66
Waste-pickers should be employed in waste management in Delhi	5%	8%	48%	39%	79
Waste-pickers should be employed in door-to door collection in my locality	9%	9%	38%	44%	80
The local government should take action and employ waste-pickers in Waste Management in Delhi	9%	2%	32%	57%	82

Source: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations

V.2.10 Summary

In this chapter the attitudes and behaviour of Delhi residents vis-à-vis waste and waste management were described, including those towards waste-pickers. It was found, among others, that: the majority recognise recycling and composting as best ways to manage waste, but lack detailed knowledge on waste types; the waste problem in Delhi and their respective localities is recognised by the majority; littering is very present in the discourse on how to solve the waste problem, whereas waste segregation and minimization do not get as much attention; 60% of the respondents segregate their waste, 67% never litter, 61% minimises their waste; and last but not least, the great majority does consider waste-pickers useful and would like to see them formally employed in the waste management of Delhi. This information is not only valuable in itself, but will be very useful in the discussion on best ways to motivate people to change their behaviour.

V.3 Factors influencing Delhi residents' behaviour related to waste and MSWM

Three decisions related to municipal waste management will be explored here: waste segregation, littering and waste minimisation, the depended variables and the contributions residents can have in making municipal waste management socially and environmentally just. The variables included in the explanatory models of these three types of behaviour are drawn from the literature. Appendix IV presents the detailed results of the bivariate (crosstabs, compare means and binary logistic regression) and multivariate (binary logistic regressions) statistical analyses employed for each

dependent variable, which due to space reasons could not be included here. The independent variables included in the tables are the only ones found to correlate with the respective dependent variables. Only a summary of the results will be presented here. The independent variables can be divided into:

- demographic (age, income per household member, education, occupation, location, caste, sex, religion and room per household members),
- knowledge on waste and waste management,
- perception of the waste situation in one's locality/Delhi in general,
- moral norms (responsibility for what happens to one's waste, for managing one's waste, and whether considers waste segregation, avoiding littering and waste minimization as contributing to solving the garbage problem),
- attitudes towards different aspects of waste segregation, littering and waste minimisation respectively.

Each dependent variable will be discussed separately.

V.3.1 Factors influencing household segregation of waste

Norms seem to have the highest impact on the decision to segregate one's waste. Segregating one's waste correlates positively with considering sorting a contribution to solving the waste problem and feeling responsible for managing one's waste. Similarly, convenience seems to influence segregation, in the sense that those not finding household segregation complicated, are more likely to do it. All these results confirm Hage's et al (2009) findings for Sweden.

None of the demographic variables seems to correlate with waste segregation, contrary to the findings of Cardenas and Ostrom (2004). However, the perception about the cleanliness of one's locality does influence waste segregation in a counterintuitive way: those considering garbage a problem in their locality are less likely to segregate their waste. Looking at the relationship with knowledge, we discover another counterintuitive relationship: the more precisely one identifies biodegradable and non-biodegradable waste materials, the less likely one is to segregate waste. Also, interestingly, considering recycling as the best way to manage waste does not correlate with waste segregation. All these surprising results could be explained by the fact that one variable with a possible big influence was not included in the model. Although the felt responsibility for managing one's waste was introduced in the model, this explored only the contrast: my responsibility – the local government's responsibility, and did not include the waste-pickers. It could be that although

people know what types of waste are recyclable and that recycling is the best way to manage waste, although they consider their locality dirty and know that segregating waste can contribute to solving the waste problem, respondents think it is the waste-pickers job to segregate, not theirs. Further studies are needed to test this relationship.

Because the multivariate logistic regressions run have many missing cases and therefore are not very reliable (Djurfeldt, personal communication), the results presented above rely mostly on the bivariate analysis. It must be noted though that when all the variables are introduced in the regression, considering waste segregation as a contribution to solving the waste problem seems to have the higher impact, increasing the odds that one would segregate waste almost four times.

V.3.2 Factors influencing littering

Residing in RK Puram, considering important to know what happens to one's waste, feeling responsible for managing one's waste and considering littering an unacceptable behaviour, all decrease the odds for one to litter, as seen in the multivariate logistic regression results. Although income was found to correlate with littering from the bivariate analysis, when it was introduced in the logistic regression with the other variables, the relationship became statistically insignificant. However, when income is removed, all remaining four variables have significant coefficients, the omnibus test shows only a 0,0001% chance that the four variables taken together do not have an impact on littering, and Nagelkerke R square increases from 0,246 to 0,367. This shows that this model is much better at explaining littering and the effect of income was probably done through location (as it was already shown in the Chapter V.1 that income is a determinant of location).

The reason why those residing in RK Puram are less likely to litter could be the large proportion of government employees of all ranks residing here and possibly having a higher than average civic sense. Overall, the results show that norms are very important in determining littering (in tone with Cardenas and Ostrom 2004, Hage 2009 and Lundmark 2008).

Surprisingly, education does not seem to influence littering. One explanation could be that being more educated does not necessarily translate into having more civic sense. Another explanation, in a country like India, could be that more education does not imply that one feels more responsible to handle one's waste. Those more educated are often from higher strata of the society which traditionally relied on the "untouchables" to do the cleaning, as pointed out by Medina (2007:201), shown in chapter III.3.2. The same could be the explanation for the fact that interest in the garbage

problem, perception on the waste problem in one's locality/ Delhi, and seeing littering as a contribution to solving the waste problem – do not correlate with littering. Being aware of the problems does not necessarily mean that people find it their responsibility to solve them.

V.3.3 Factors influencing waste minimization

Minimizing waste does not correlate with considering important to minimize waste, to use few plastic bags, or to avoid products excessively packaged, showing a possible inconsistency between the attitudes towards minimization and the actual behaviour. Additionally, the variables measuring moral norms (responsibility for what happens to one's waste, responsibility for managing one's waste, and considering minimization as a contribution to the waste problem) do not correlate with waste minimization, showing that there are not norms making one minimise waste production.

It seems that the lower the income and number of rooms per household member the more likely the person will minimize waste production. Therefore minimization can be seen as a mere sign of frugality. Additionally, it was found that the importance of using few plastic bags does not correlate with income, whereas the importance of using products that are not excessively packaged does, at the same time as plastic bags are given for free in shops, whereas packaged products are more expensive than buying loose products, thus confirming that waste minimisation is done due to economic considerations.

As in the case of waste segregation, more knowledge on waste types, which also implies more awareness on the impact of waste on the environment, counter-intuitively decreases the likelihood for waste minimisation. This is not surprising considering that knowledge on waste types was found to correlate with income. It supports the previous findings and it also shows that being aware of the impacts of waste, does not mean that people see the connection with the waste quantity or see waste minimisation as a contribution to reduce those impacts. Again, the multivariate logistic regression results have a large number of missing cases and therefore we rely on the bivariate analyses to discern factors influencing waste minimisation. However, they do suggest the same interpretation³⁷.

The desire to reduce waste for economic reasons appears in the results and confirms earlier research. What is interesting is that the waste quantity produced does not seem to be perceived in

³⁷ And moreover, show that the impact of number of rooms per household member on waste minimisation is done through income.

the public mind as part of the waste problem, unsurprisingly though, considering that waste minimization is not present in the policies on waste in India and messages in the media are rather contrary.

VI. Policy implications: How can Delhi residents be motivated to participate in MSWM?

Increasing people's cooperation towards the achievement of a common goal, in this case a better MSWM in Delhi, that will not only benefit each and every one of the city inhabitants (in social dilemma terms), but also be more socially and environmentally just, can be done in three ways: 1) by making it easier and more convenient for people to participate, in other words by creating an infrastructure that will make cooperation more accessible (Hage et al 2009) (for example, providing with easily accessible dust bins to avoid littering, and with easily accessible separate dust-bins for the collection of sorted garbage to enhance recycling and composting); 2) through economic incentives, by giving financial rewards for cooperation and/or punishments for non-cooperation (Taylor 2000, Hage et al 2009); and 3) through what Taylor (2000) calls social-psychological incentives, or moral and social motivation in Hage's and al (2009) words; public campaigns aimed at changing attitudes and norms, which would have the most long-lasting effect but are also the most difficult to achieve. Perhaps a combination of the three would bring the best results; however, some measures can be more effective than others in different contexts.

Perhaps the first point that needs to be discussed here is whether residents can be motivated to participate in MSWM, or the forces against it are so deeply rooted, in this case in social inequality, that change seems difficult to reach. The empirical findings of this thesis seem to suggest that change is possible, especially because some of the residents are already cooperating in the three dilemma situations described above, but it will take time and effort. This is also the opinion of most key informants interviewed.

Feeling responsible for managing one's waste seems to be the vital factor determining one to participate in household waste segregation and keeping the city clean, and should be given the highest attention in policies, programmes or projects seeking behavioural change in this direction (as also suggested by Hage 2009). Public campaigns should target women particularly, as it seems that they are the ones most often deciding on waste handling issues within the household.

The evidence shows that the level of education and knowledge on waste and waste management do not translate into more own contribution in waste management issues and therefore awareness

campaigns limited to this would not have much effect. Information is not enough. People have to believe that the particular action is a contribution and feel it is their own responsibility to do it. These are the missing links between information and behaviour that need to be filled in order to make people participate. Making one feel it is his/her moral duty (in Hage's et al 2009 words) to participate in the improvement of MSWM would stimulate such behaviour. This is of course more difficult to do than just provide information and it is perhaps even more problematic to convince people that it is their responsibility to maintain cleanliness and sort their waste in a cultural context where cleaning is done traditionally by a sweepers' caste. However, the empirical evidence shows that it is happening and it is also recognised today that the caste thinking in India is declining, and therefore effort must be taken to expand the sense of responsibility.

Although the influence of social norms on waste segregation was not tested, it was found that social norms, here in the form of acceptability of littering, do impact littering behaviour. This supports Weber's theory (Gertner 2009) that social goals determine collaboration in social dilemma situations. It shows the potential in using social constraints to change the behaviour on waste issues in general not only in regards to littering, although further studies are needed to explore these links. Making waste segregation, not littering and waste minimisation socially desirable and the contrary behaviour socially condemned has the potential to regulate the respective behaviours. Therefore awareness campaigns should strive to create the sense of a common goal around solving the waste problems and be very clear on how people can contribute in this and why it is urgent and important to do so. As Taylor (2000:409) suggested, relating waste issues to already valued goals can make a difference.

Because convenience (here in the sense of considering household segregation complicated) was also found to influence waste segregation, and 54% of the respondents said they would segregate waste if the infrastructure encouraged it (section V.2) it becomes obvious that social-psychological incentives cannot succeed alone, but need to be supplemented with measures that would make waste segregation more practical and available (as also suggested by Hage et al 2009) and possibly incorporate messages that would convince people that it is indeed not that complicated. The existence of the appropriate and easily accessible infrastructure has the potential to make a big difference. Although the relationship convenience-littering was not explored, the same is probably valid for it. However, further studies are needed to confirm it.

In regards to economic incentives for improving people's waste management behaviour, the evidence from the survey is contradictory. Only 4% of the respondents declared that they would segregate (more) if they were given money for it. However, 68% of them stated that segregation is

important for them due to financial reasons, and in the NDMC area, people sell recyclables to kabaries but give mixed waste to the waste-collectors. Further studies are needed to explore this link. In any case, for some, economic incentives do matter and this issue should be considered by policy makers. In regards to unit charges for disposal of households waste, in my opinion these are not a solution in Delhi (contrary to Taylor's suggestions for the USA) as it can cause improper waste disposal, already widespread in Delhi. In regards to littering, however, fines could be introduced to punish those doing it, and this way reinforcing a law that is already there.

Regarding waste minimisation, this should be brought into the public discourse and made part of waste and environmental policies so it will be decoupled from income and done for environmental and social justice considerations. Special emphasis should be given to minimising packaging. The social justice considerations should also be incorporated much more in all discussions and efforts to improve the residents' participation in MSWM. Chintan has done much effort on bringing up the social justice issues related to waste-pickers, however, the link between people's behaviour in regards to waste and their impact on the lives of waste-pickers should be strengthen and made more clear. Further studies should also explore whether it is social or environmental justice considerations that would be more effective in convincing people to change their behaviour related to waste.

All in all, this study suggests that public campaigns combined with measures to make resident's participation in waste management in Delhi more convenient do have the potential to bring about change in this direction. Municipalities, the Department of Environment and NGOs alike should put much more effort than presently in creating a sense of responsibility for the garbage problem. As Tariq from Toxics Link pointed out, a huge campaign should be initiated and waste management should be made a priority not only in Delhi but at world level. This is also the opinion of Sharad Gaur from CEE, who considers the media should be employed much more for such goals. Moreover, the cooperation between the stakeholders (Municipalities, Department of Environment, NGOs, Residents Welfare Associations, the informal sector) should be strengthened, and this is particularly important for MCD, who manages the largest area (95%) but is very reluctant to cooperation with other actors. It is also sad that no experience sharing is done between the three municipalities.

VII. Conclusions

The objectives of this thesis were to explore the knowledge, attitudes and behaviour related to waste and waste management in Delhi, discern factors influencing people's decisions related to the same issues and discuss the policy implications of those findings. It was found that although garbage is

perceived as a big problem in Delhi by the majority of respondents, there is little awareness on the ways one could contribute to solving it. The perception of responsibility for one's waste was found to influence both littering behaviour and waste separation, but minimization of waste is mainly associated with income and is not perceived as part of the waste problem. As for ways out of the problem, it is suggested that public campaigns should emphasise residents' responsibility for their waste and the importance of each and every citizen's cooperation, thus creating a sense of a shared social goal around solving the waste problem, but should also be supplemented with measures that would make participation more convenient.

This study has recommended ways in which people can escape the social dilemma of being buried under their own trash. It also underscored the relevance of waste for development and social and environmental justice. For all these reasons, it is time waste is placed at the top of policy agendas instead of, yet again, being swept under the carpet.

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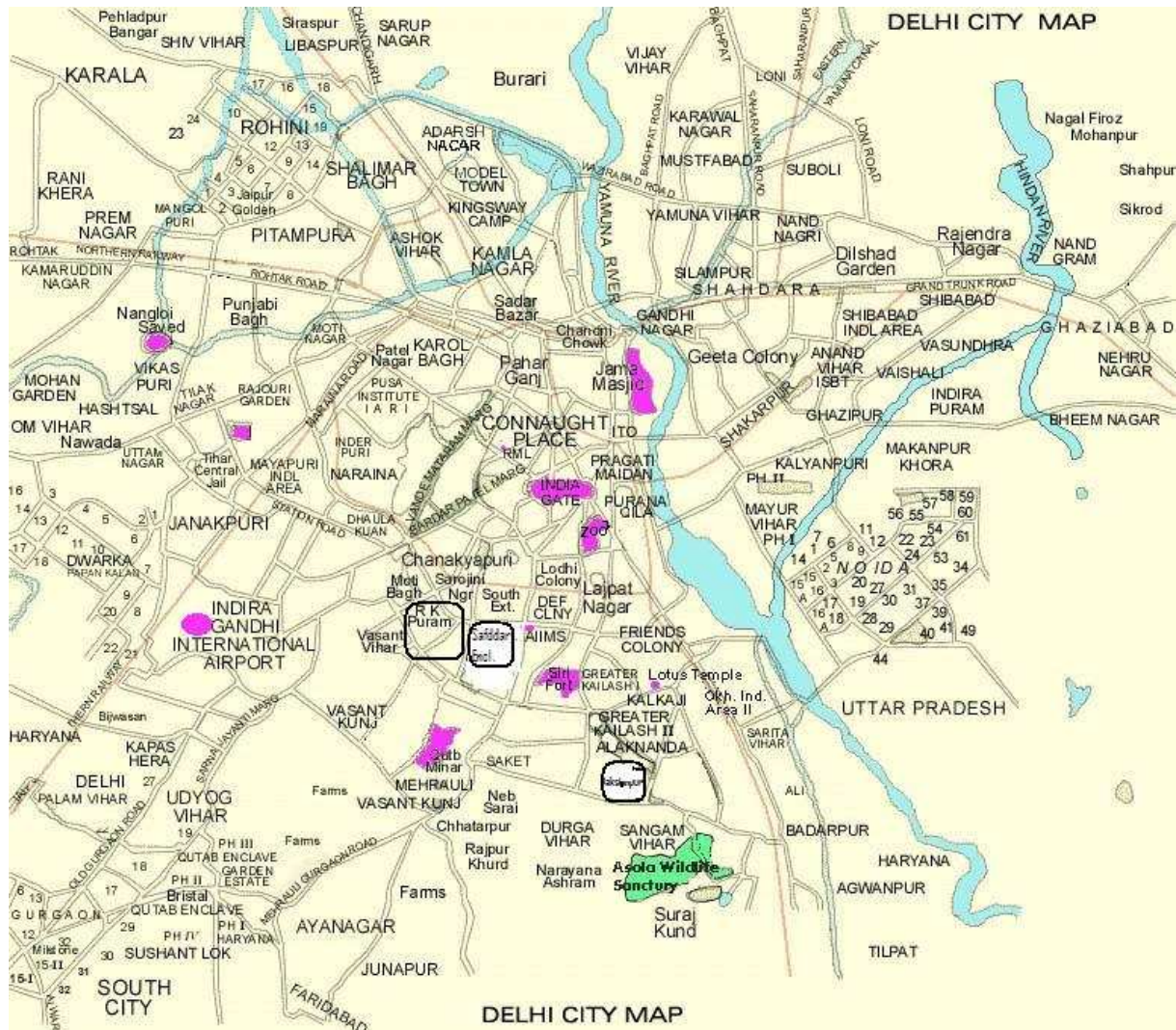
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Appendix I - Map of Delhi



Source: *This is my India* website. http://www.thisismyindia.com/about_delhi/delhi-map.html, retrieved on May 12, 2009.

Appendix II – List of Interviews

- A. October to December 2008 - Informal discussions with Chintan staff (the NGO that hosted me during the field work) and email communication with Chintan's director.
- B. 8.11.2008 – Discussion with the waste-picking community at a landfill site; non-participant observation of their work at the site.
- C. 12.11.2008 – Shyamala Mani, Department of Waste and Resource Management, Centre for Environment Education (CEE), Delhi. Notes taken during a visit.
- D. 12.11.2008 – Sharad Gaur, Regional Director CEE, Delhi. Notes taken during a visit.
- E. 11.12.2008 – Senior Scientific Officer, Department of Environment, Govt. Of National Capital Territory of Delhi. Oral communication during a visit and email communication.
- F. 13.12.2008 – Civil engineer at Department of Environment Management Services, Municipal Corporation of Delhi (MCD). Recorded Interview.
- G. 13.12.2008 – Baghidari (the Citizen-Government Partnership), Office of Chief Minister, Govt. Of National Capital Territory of Delhi. Oral communication during a visit.
- H. 13.12.2008 - informal interview with a door-to-door waste-collector working in South Delhi.
- I. 14.12.2008 – group discussion with four waste-collectors and waste-sorters at a junk shop (place where recyclable waste is brought to be segregated and sold) in South Delhi. Notes taken during the visit.
- J. 15.12.2008 – Mohd. Tariq Gaur, Senior Programme Officer, Toxics Link, New Delhi. Recorded interview.
- K. 16.12.2008 - Department of Public Health, New Delhi Municipal Council (NDMC). Oral communication during a visit.
- L. 17.12.2008 – Pradeep Dadlani, Director, Sycom Projects Consultants Private Limited. Recorded interview.
- M. 17.12.2008 - Project Executive for the Community Waste Management Project in a resettlement colony, Sycom Projects Consultants Private Limited. Recorded interview.
- N. 17.12.2008 – group discussion with waste-collectors, waste-sorters, and residents in a resettlement colony, Sycom project area. Recorded group interview.
- O. 18.12.2008 – informal interviews with waste collectors, their supervisor, and residents in one of the several locations where Chintan is coordinating door-to-door waste collection in collaboration with NDMC. Recorded interview.

Appendix III - Questionnaire on Municipal Solid Waste Management (Delhi, December 2008)

The answers you provide are completely anonymous and will only be used for research purposes. Please answer the questions honestly and remember that there are no right or wrong answers. We are only interested in your personal opinion. Thank you for your cooperation!

Let us start with a few questions about you:

<p>A1) Your location: _____</p> <p>A2) Age: _____</p> <p>A3) Education:</p> <ol style="list-style-type: none"> 1. Primary 2. Secondary (10th) 3. Higher secondary (12th) 4. Graduation 5. Above graduation <p>A4) Caste:</p> <ol style="list-style-type: none"> 1. General: _____ 2. Other backward caste 3. Schedule caste 4. Schedule tribe 5. Outside the caste system 	<p>A5) Sex: 1. Female 2. Male</p> <p>A6) Profession: _____</p> <p>A7) Number of household members: _____</p> <p>A8) Monthly household income: _____</p> <p>A9) Position in the household: _____</p> <p>A10) Housing type:</p> <ol style="list-style-type: none"> 1. Own 2. Rented <p>A11) Number of rooms: _____</p> <p>A12) Religion: _____</p>
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B1) How do you dispose off your waste?

1. Someone is collecting my waste from my door
2. I take it outside to the dust bin myself
3. There is no dust bin in my locality and therefore I dump it on the roadside
4. Other (please specify) _____

B2) If you could choose, what facility would you prefer?

1. Door-to-door collection by a government employed person
2. Door-to-door collection by a person employed by my local association
3. Informal door-to-door collection by a waste picker
4. To dispose off my waste myself
5. Other (please specify) _____

C1) How often do you watch TV or Radio programmes, or read magazine or newspaper articles about the environment? (Please circle the option that describes you best)

1. Never	2. Rarely	3. Sometimes	4. Every time I find them
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C2) Do you discuss environmental problems with:

a) Your family?	1. Never	2. Rarely	3. Sometimes	4. Often
b) Friends?	1. Never	2. Rarely	3. Sometimes	4. Often
c) At work?	1. Never	2. Rarely	3. Sometimes	4. Often

C3) What is the environmental problem most often discussed?

1. Climate change/global warming
2. Pollution

3. Garbage
4. Resource depletion
5. Other: _____

D1) Could you please describe in a few words what you think happens to your waste once it leaves your home?

D2)What is biodegradable waste in your opinion? (Please circle one answer only)

1. Organic waste that decomposes (breaks down) naturally in the environment
2. Waste that does not decompose naturally in the environment.
3. I don't know

D3) Which of the following materials are biodegradable? (Circle as many options as you like)

- | | |
|---------------------|----------------------------------|
| 1. leaves and grass | 5. glass |
| 2. plastic | 6. vegetable and fruit leftovers |
| 3. metal | 7. paper, cardboard |
| 4. leftover food | 8. I don't know |

D4) Which of the following materials are recyclable? (Circle as many options as you like)

- | | |
|---------------------|----------------------------------|
| 1. leaves and grass | 5. glass |
| 2. plastic | 6. vegetable and fruit leftovers |
| 3. metal | 7. paper, cardboard |
| 4. leftover food | 8. I don't know |

D5) What is non-biodegradable waste in your opinion?

1. Organic waste that decomposes (breaks down) naturally in the environment
2. Waste that does not decompose naturally in the environment.
3. I don't know

D6) In your opinion, what is the best way to manage waste? (Please circle only one option)

1. Dumping waste into landfills
2. Burning the waste
3. Recycling the non-biodegradable waste and making of manure (which can be used as fertilizer) out of the organic waste
4. I don't know

E1) Do you strongly disagree, disagree, agree or strongly agree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
a) Garbage is a big problem in my locality	1	2	3	4	99
b) Garbage is a big problem in Delhi	1	2	3	4	99

E2) Please order the following options according to how important they are for you. Please place 1 near the most important, 2 near the second in importance and 3 near the third in importance.

1. Garbage is a problem in Delhi because it creates health problems	
2. Garbage is a problem in Delhi because it pollutes the environment	
3. Garbage is a problem in Delhi because it makes the city look dirty and ugly	

E3) How important is it for you to know what happens to your waste?

1. Very important
2. Fairly important
3. Not very important
4. Not at all important

E4) How can you contribute in solving the garbage problem? (Please circle the answers you think are relevant, you may circle as many answers as you like)

1. By not throwing garbage on the street/roadside
2. By segregating waste at home into biodegradable and non-biodegradable waste and therefore contributing to recycling and composting of waste
3. By producing as little waste as possible
4. By informing others about the waste problems
5. By educating my children about the waste problems
6. Other. _____

E5) Which of the following best describes how you feel about managing household waste?

1. Managing waste is the local government's responsibility, not mine
2. Managing waste is first the local government's responsibility, then mine
3. Managing waste equally my responsibility and the local government's
4. Managing waste is first my responsibility, then the local government's
5. Managing the waste I produce is my responsibility

E6) In your opinion, what is the importance of managing waste? (Circle only one option)

1. To save natural resources
2. To reduce the environment pollution
3. To avoid any public health problems arising from poor waste management
4. To protect the environment for future generations
5. I don't think it is important to manage waste

E7) Who in your household decides on waste handling issues?

1. Husband 2. Wife 3. Maid 4. Other _____

Home segregation (Home segregation of waste refers to storing the biodegradable waste in a separate bin/bag from the non-biodegradable waste in your house)

F1) Do you segregate your home waste in biodegradable and non-biodegradable materials?

1. Never 2. Sometimes 3. Most of the times 4. Always

F2) Which of the following wastes do you store separately? (circle as many options you wish)

1. Glass
2. Paper
3. Plastic
4. Metal
5. Other _____

F3) Do you strongly disagree, disagrees, agree, or strongly agree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
a) Home segregation of waste is important for me because it provides financial returns from selling the recyclable wastes	1	2	3	4	99
b) Home segregation of waste is important for	1	2	3	4	99

me because it is beneficial for the environment					
c) Home segregation of waste is important for me because it makes the work of waste-pickers easier and cleaner	1	2	3	4	99
	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
d) Home segregation of waste is complicated	1	2	3	4	99
e) Home segregation of waste is untidy	1	2	3	4	99

F4) If you do not segregate, in what conditions would you be willing to segregate your waste at home? If you do segregate, in what conditions would you agree to segregate more? Please indicate one or two options that are most important for you.

1. If someone would come and pick up the segregated waste from my door
2. If there were two separate bins on the street where to throw the segregated waste
3. If I was given separate containers for my home
4. If I was explained why to do it
5. If I was given money for it
6. I am not willing to segregate (more)

F5) Have you noticed the separate blue and green dust bins on the streets? 1Yes 2.No

F6) If you have noticed the bins, do you know what the blue bin is for?

1. Biodegradable waste
2. Non-biodegradable waste
3. I don't know

F7) Do you use the separate bins for different types of waste?

- 1 Never 2 Rarely 3 Most of the times 4 Always

Littering

G1) Does it ever happen that you to throw garbage on the street/road side while moving around the city?

- 1Never 2 Sometimes 3 Most of the times 4 Always

G2) Do you strongly disagree, disagree, agree, or strongly agree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
a) It is acceptable to throw garbage on the street when there is no dust bin around	1	2	3	4	99
b) It is acceptable to throw garbage on the street when you are in a hurry	1	2	3	4	99
c) It is acceptable to throw garbage on the street when there is already a pile of trash there	1	2	3	4	99
d) It is never acceptable to throw garbage on the street. One should always carry the garbage with him/her until a dust bin is found or	1	2	3	4	99

otherwise carry it home					
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Waste minimisation

H1) Do you take any actions to reduce the quantity of the waste you produce?

1. Yes 2. No

H2) Do you strongly disagree, disagree, agree or strongly agree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
a) Producing as little waste as possible is important for me	1	2	3	4	99
b) Using as few plastic bags as possible is important for me	1	2	3	4	99
c) Avoiding products which are excessively packaged is important for me	1	2	3	4	99

I. Waste pickers

I1) What are the first images or words that come to your mind when you hear the word "waste-picker"? _____

I2) What is the role, if any, of waste pickers in waste-handling?

I3) Do you strongly disagree, disagree, agree, or strongly agree with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
a) Waste pickers are useful in Delhi	1	2	3	4	99
b) Waste pickers are reliable persons	1	2	3	4	99
c) Waste pickers are dirty	1	2	3	4	99
d) Waste pickers are thieves	1	2	3	4	99
e) Waste pickers are poor	1	2	3	4	99
f) Waste pickers are saving money for the city through their work	1	2	3	4	99
g) Waste pickers should be employed in waste management (collection, transportation, and segregation of waste) in my locality	1	2	3	4	99
h) Waste-pickers should be employed in the door-to door collection of waste in my locality	1	2	3	4	99
i) The local government should take action in employing waste-pickers in the waste management of Delhi	1	2	3	4	99

Thank you so much for your time!

Appendix IV – Results of bivariate and multivariate statistical analyses

Legend for all tables here:

* significance level < 0.01;

** significance level < 0.05;

*** significance level < 0.1;

No star means significance level > 0.1.

Source for all tables: MSWM in Delhi Questionnaire 2008, compiled by author using own calculations.

Dependent variable: Waste segregation

Table 15: Bivariate analysis results for “waste segregation” as dependent variable				
<i>Independent Variable</i>	<i>Dependent variable</i>	<i>Crosstabs or compare means results (measure of association and level of significance)</i>	<i>Bivariate logistic regression results</i>	<i>No. of cases</i>
Responsibility for managing one's waste (from “govt. has full responsibility” to “respondent has full responsibility”)	Segregation binary(0 – no; 1 – yes)	Crosstabs: positive correlation. The more one feels responsible for one's waste, the more likely that person is to segregate; gamma=0,277**	dummy: Nagelkerke R square=0,046*** B=0,789*** Exp(B)=2,2	93
Segregation is complicated (disagree to agree, 4 steps)	Segregation binary	Crosstabs: negative correlation. Those that do not consider segregation complicated are more likely to segregate; chi2; p=0,04	Dummy: Nagelkerke R square=0,074** B=-0,994** Exp(B)=0,37	76
Home-segregation of waste is a contribution to solving the waste problem (0-no; 1-yes)	Segregation binary	Crosstabs: weak correlation. Those considering segregation as an important contribution are more likely to segregate their waste. fisher's exact test 1 sided=0,077	Dummy: Nagelkerke R square=0,039 B=0,714 Exp(B)=2,041	92
Perception on the waste problem in one's locality (disagree to agree, 4 steps)	Segregation	Crosstab: weak negative correlation. Those that consider garbage less of a problem in their locality are more likely to segregate; Chi2, p=0,08	dummy: Nagelkerke R square=0,106** B= -1,519** Exp(B)=0,219	76
Knowledge on waste types (-4 through 7; where 7 means answering the most precisely)	Segregation binary	Compare means: significant negative correlation. The higher the knowledge, the less likely one is to segregate waste. Eta2=0,142*	Nagelkerke R square=0,199* B= -0,331* Exp(B)=0,718	72

Independent variables	Multiple binary logistic regression models					
	Model 1		Model 2		Model 3	
	B Coef.	Exp (B)	B Coef.	Exp (B)	B Coef.	Exp (B)
Dummy – feels primarily responsibility for managing one’s waste (reference group: local government is equally to fully responsible)	0,160	1,173	0,683	1,981	1,030***	2,800
Dummy – considers household waste segregation complicated	-0,305	0,737	-0,524	0,592	-0,707	0,493
Dummy – considers home segregation of waste a contribution to solving the waste problem	1,319***	3,740	1,414**	4,112	1,009***	2,742
Dummy – agrees waste is a big problem in one’s locality	-1,365	0,255				
Knowledge on waste types score	-0,409**	0,665	-0,298**	0,742		
<i>Nagelkerke R square</i>	0,379*		0,309*		0,178**	
<i>No. of valid cases</i>	54		61		75	

Dependent variable: Littering

Independent Variable	Dependent variable	Crosstabs or compare means results (measure of association and level of significance)	Binary logistic regression results	No. of cases
Location	Littering (4 steps: never-always)	Crosstabs: Statistically significant correlation; those residing in RK Puram answer that they never litter significantly more often than those residing in the other two colonies. The difference in percentages between the other groups is very small. $p=0,01$	With RK Puram dummy, Nagelkerke R square=0,102* B=-1,358** Exp(B)=0,256	94
Monthly Income per household member with 6 groups	Littering binary (0=no, 1=yes)	Crosstabs: Negative correlation; generally, the more one earns the more likely it is that he/she would answer never. Gamma=-0,314; $p=0,054$	Regression not sign with income scale; with income groups: Nagelkerke R square=0,08** B=-0,354*** Exp(B)=0,702	67
How important it is to know what happens to one’s waste(4 steps: very – not at all important)	Littering	Crosstabs: Positive correlation: those for which it is important to know what happens to their waste are less likely to litter; Gamma=0,337**	When run with dummy (reference being those that consider waste not at all important): Nagelkerke R square=0,084** B=-1,094** Exp(B)=0,335	91
Responsibility for managing one’s	Littering	Crosstabs: negative weak correlation: those that fell more	Not statistically sign. when in regression with dummy	95

waste (from "govt. has full responsibility" to "respondent has full responsibility")		responsible for their waste are less likely to answer that they litter; Gamma=-0,281***	for responsibility: Nagelkerke R square=0,034 B= -0,693 Exp(B)=0,500	
Acceptability of littering if there is no dustbin around (from totally disagree to totally agree in 4 steps)	Littering	Crosstabs: Positive correlation: those that disagree that it is acceptable to through trash in public places although there is no dustbin around are less likely to litter; Gamma=0,389**	Logistic regression was run with a composite measure: "Mean acceptability of littering" (number of valid cases – 88): Nagelkerke R square=0,119* B=-1,195* Exp(B)=3,3	88
Acceptability of littering if one is in a hurry	Littering	Crosstabs: Positive correlation: those that disagree that it is acceptable to through trash in public places when one is in a hurry are less likely to litter; Gamma=0,566*		87
Acceptability of littering if is a pile of trash already	Littering	Crosstabs: Positive correlation: those that disagree that it is acceptable to through trash in public places although there is a pile of trash there already are less likely to litter; Gamma=0,396*		85

Table 18: Results of multiple logistic regression analysis

Dependent variable: Littering (no - 0; yes - 1)

<i>Independent variables</i>	<i>Multiple binary logistic regression models</i>			
	<i>Model 1</i>		<i>Model 2</i>	
	<i>B Coef.</i>	<i>Exp (B)</i>	<i>B Coef.</i>	<i>Exp (B)</i>
dummy – feels primarily responsibility for managing one's waste (reference group: local government is equally to fully responsible)	-,897	,408	-1,403**	,246
Index - mean acceptability of littering (from strongly disagreeing that littering is acceptable in any case to strongly agreeing that littering is acceptable in all cases)	,368	1,444	1,148**	3,151
Dummy – considers important to know what happens to one's waste	-1,342***	,261	-1,709*	,181
Income per household member groups (1 to 6 with 6 being the group with the highest incomes)	-,233	,792		
Dummy –residing in RK Puram (reference group: those residing in Dakshinpuri and Safdarjung Enclave)	-1,493***	,225	-1,968*	,140
<i>Nagelkerke R square</i>	0,246***		0,367*	
<i>No. of valid cases</i>	57		81	

Dependent variable: waste minimization

Independent Variable	Dependent variable	Crosstabs or compare means results (measure of association and level of significance)	Binary logistic regression results	No. of cases
Monthly Income per household member	Reduces waste quantity (0-no; 1-yes)	Compare means: Significant negative weak correlation: the lower the income, the more likely the person is to minimize waste; eta2=0,068**	Nagelkerke R square=0,198; B= 0,000**; Exp(B)=1,000; The low value of B is due to the large span in the income values. When run with income groups: Nagelkerke R square=0,147; B= - 0,467** and Exp(B)=0,627, showing that belonging to a higher income group decreases the odds to minimize	65
Number of rooms per household member	Reduces waste quantity	Compare means: Significant positive correlation; eta2=0,263**	Nagelkerke R square=0,09 B=-1,541** Exp(B)= ,214	82
Knowledge on waste types index	Reduce waste quantity	Compare means: Negative correlation: the more knowledge on waste, the less likely the person is to minimize waste production; eta2=0,018*	Nagelkerke R square=0,168 B= -0,303* Exp(B)=0, 397	71

Independent variables	Multiple binary logistic regression models			
	Model 1		Model 2	
	B Coef.	Exp (B)	B Coef.	Exp (B)
Income per household member groups (1 to 6 with 6 being the group with highest incomes)	-,097	,907	-,468***	,626
Knowledge on waste types index	-,250***	,779	-,297**	,743
Number of rooms per household member	-1,798	,166		
Nagelkerke R square	0,288*		0,285*	
No. of valid cases	50		53	