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SOLID WASTE, IT'S MANAGEMENT AND HEALTH OF THE SAFAI KARMACHARIS: A CASE STUDY OF DELHI

Dissertation submitted to the Jawaharlal Nehru University in partial fulfilment of the requirements for the award of the Degree of

MASTER OF PHILOSOPHY

NAGENDRA. M.P.

CENTRE FOR SOCIAL MEDICINE AND COMMUNITY HEALTH
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI – 110067
INDIA

2000

CENTRE OF SOCIAL MEDICINE & COMMUNITY HEALTH
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY
New Delhi-110067

CERTIFICATE

This is to certify that this dissertation entitled **"SOLID WASTE, IT'S MANAGEMENT AND HEALTH OF THE SAFAI KARMACHARIS: A CASE STUDY OF DELHI"** submitted by **NAGENDRA M. P.** in partial fulfilment of the requirements for the award of the Degree of **MASTER OF PHILOSOPHY** has not been previously submitted for any other degree of this or any other University and is his own work.

We recommend that this dissertation may be placed before the examiners for evaluation.

27/7

Prof. GHANSHYAM SHAH
(Supervisor)

Dr. K. R. NAYAR
(Chairperson)

Tel. : (011) 6107676, 6167557/2420, 2492 Gram : JAYENU Fax : 91 (011) 6165886, 6198234

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NAGENDRA M.P.

Dedicated to My

Parents

&

Teachers

"The air we breathe is full of the dust and fragrance of the past, as also of the fresh and piercing winds of the present. We face the good and bad of India in Delhi."

-- Jawaharlal Nehru

CONTENTS

CHAPTER - I

INTRODUCTION

The Solid Waste materials are not prime products, they arise from industries both as the by-products of manufacturing processes and as consumer discards of manufactured products. A material becomes waste when the owner or generator of the material discards it without expecting to be compensated for its inherent value. Most civic authorities consider wastes to be their responsibility only after they have been placed on the kerb or street for collection and disposal. The generation of solid waste is not a new phenomenon. It is as old as the human civilization. In the early days, before the advent of the industrial revolution, the major constituents of solid waste were domestic refuse and agricultural residues which were biodegradable in nature. Since there was less population and much fallow land, solid waste could be conveniently disposed of in the countryside either on open ground or were placed in pits covered with layers of earth. Because of their biodegradable nature they used to get decomposed and assimilated in soil. But in the modern era it is evident fact that urbanisation is a natural out growth of socio – economic development in general and industrialisation in particular. As urbanization increased, so also does the extent and dimensions of solid waste problem. So the spectacular population growth and increasing sprawl of cities made it impossible to ignore the problem of solid waste. The quantum and type of solid waste generated in any urban centre are mainly house – hold and commercial refuse, street sweepings, construction and demolition debris, etc. So with progress in industrialization and

consequent organisation not only has the quantity of solid waste increased but its quality has also changed. Though rural solid waste continue to be made up of domestic wastes and agricultural residues mainly, wastes from urban areas contain diverse types of materials which include toxic and hazardous materials which may cause pollution in water, soil and air.

Solid waste is also called as 'Municipal solid waste'. And the quantity of municipal solid waste generated depends upon a number of factors such as food habits and standard of living of the people, degree of commercial and industrial activities. Municipal solid wastes includes waste generated in residential and commercial areas, where as wastes from industrial and agricultural operations are separately considered. Out of the waste that is produced in residences, a part is recycled within the premises, a part reclaimed by the sweepers and unauthorised scavengers during collection and transportation stages and another part at the disposal site by unauthorised persons, leaving only a portion to reach the disposal site various commercial establishments generate different categories of wastes depending upon the type of activity. Shop and other establishments generate waste containing large amount of paper, straw, card-board packing cases which are generally non-decomposable. Small commercial establishments may discharge the waste alongwith the municipal waste.

SOURCES OF SOLID WASTE

The solid waste which is generated within municipal boundaries comes from a number of sources. Local ordinances specify which categories of waste are the responsibility of local authorities. In developing countries, cities tend to be responsible for different types of waste categories and of them important ones are :

Firstly–House-hold waste : In developing countries, this category consists largely of organic kitchen waste. In poor heighbourhoods, traditional cooking may also produce ash. Where bucket latrines are used, house-hold waste includes faecal matter. In wealthier areas, discarded furniture, appliances, and gardening wastes are included.

Secondly, commercial refuse : In developing countries, markets are a major source of commercial waste, much of it is organic matter. Other sources include modern stores, offices, restaurants, warehouses and hotels. Large offices or hotels may arrange for private hauling, but most commercial waste is handled by municipal authorities.

Thirdly–Institutional refuse : It includes sources ranging from hospitals and schools to government offices and police barracks. Hospital wastes are sometimes handled privately. In general, the municipality should employ a

separate system of collection for institutional waste, using portable metal bins that can be lifted onto trucks or trailers for transport to a dumpsite.

Fourth one is street refuse which includes dirt and litter. It may also include house – hold refuse, drain – cleanings, animal manure and human faecal matters.

Fifthly, construction and demolition debris includes heaps of soil and stone often are dumped into the streets by builders.

Sixthly, industrial waste includes packaging materials, food wastes, discarded metal, plastic and textiles, fuel–burning residues, and spent processing chemicals are among the waste in this category. The composition varies considerably from one source to another. Small-scale industries tend to dump their wastes into the general municipal refuse. Larger industries usually contract for private disposal or are charged a fee for special municipal services.

WHAT IS WASTE MANA GEMENT ?

With regard to the twin objectives, 'resource conservation' & 'protection of the environment and health', the policy of waste management has the following aims:

Firstly, reduction of waste generation at the production and consumer levels through more efficient and environmentally sound production techniques extending the life of products and increasing recycling. Secondly, substitution of scarce raw materials by more easily available ones in the production process. Thirdly, increased utilisation of waste by recycling during the production process (recovery of materials), recovery of the energy content of waste and feedback into biological cycles, and fourthly, environmentally sound and safer disposal methods from health point of view. These objectives and aims are not separate and isolated tasks. They are part of a joint approach, taking into account the materials concerned. Thus, for example, increased recycling of waste does not replace efforts made towards direct saving of raw material but only complements such efforts as part of raw material management and environmental policy. The direct reduction of consumption of materials by producers and consumers must be considered as the most urgent challenge both on a medium and long term basis. In this regard the curtailment of absolute consumption and appropriate application of raw – material saving technologies have a much more positive effect on the conservation of raw material resources than recycling. The purpose of solid waste management is to provide hygienic, efficient and economic collection, transportation, treatment and disposal of solid waste without polluting the atmosphere, soil, water system and health. In this regard careful identification of present and future waste disposal problems is necessary to establish the objectives of proper management, be it at local, regional, or country-level. In some countries where the generation of solid waste is low, the main objective

many be to achieve adequate disposal of all wastes. The objectives becomes more extensive in countries where waste generation rates are high, where many communities maintain separate collection and disposal systems, where there are competing demands for the use of land, or where certain methods of disposal are prohibitive, such as composting and incineration. But all these objectives, whether considered separately or in combination, aim essentially at protection of health and prevention of degradation of the environment.

Most of the countries are having the following objectives in relation to solid wastes. The objective of protection of health has two aspects : protection against short-term direct and indirect health risks due to improper waste collection and disposal, as well as protection from the long term effects on public health of possible ecological changes resulting from unsafe disposal methods. Next to healthy environment is aesthetic beauty. Disposal methods must not mar beauty. On the contrary, every opportunity must be sought to use solid waste as materials for the correction of former mistakes e.g. for restoring the landscape where there are disused opencast mines. Thirdly, it is necessary to create conditions for the reduction of refuse production at source by incentives or legislative restrictions. Fourthly, because of solid waste, services may absorb local or national funds and it is important to provide an efficient collection and disposal service at minimum cost. Fifthly, there is a need to recycle and conserve certain raw materials in some countries. But in all countries there exist

opportunities to re-use solid waste as land-filling materials as a source of compost, or as a low-grade fuel.

HEALTH ASPECTS IN DEVELOPING COUNTRIES IN RELATION TO SOLID WASTE

In regard to public health, the primary consideration in the treatment and disposal of solid wastes is the prevention of enteric, parasitic and vector – borne communicable, diseases. These dangers are far greater in developing countries than in industrialised ones because of the greater prevalence of disease organisms. For example if we illustrate the impact of public health measures on human life, it may be noted that life expectancy at birth in developing countries rarely exceeds 60 years, and infant mortality rate commonly surpasses 75 to 100 deaths per 1000 live births. Lack of healthful environment is a major cause of high morbidity and mortality along with poverty coupled with malnutrition particularly for the deprived sections who are directly exposed to pollution and garbage. And those responsible for the treatment and safe disposal of solid waste must therefore be fully aware of potential health hazards and the need for precautions. It is known fact that most deaths in developing countries are caused by diseases transmitted by human waste (intestinal parasitic and infectious diarrhoeal diseases), by air-borne infections (TB and pneumonia) and by malnutrition. So the basic health problems of the third world countries, problems likely to prevail for some time to come, are essentially those related to faecal-oral transmission (diarrhoeal diseases, dysentery, cholera, shigellosis, typhoid), and

vector-borne diseases. More specifically, in tropical and sub-tropical countries, higher temperature and humidity favour the proliferation of insects and accelerate the decomposition of organic matters. Consequently, more frequent waste collection and exceptionally careful storage is required. Densely populated areas in which direct access by vehicles is difficult necessitate the use of hand collection methods.

There are problems concerned to waste collection which are more obvious at present in the industrialised countries. However, they are latent in several developing countries, which should seek to avoid some of the mistakes made by the industrialised countries by planning for solid waste disposal at an early stage of industrialisation. For this, proper solid waste management is required. Solid waste management involve interplay of six functional elements – generation of waste, storage, collection, transfer and transport, processing, recovery and disposal. In most of the developing countries, the existing methods of collection, processing and disposal are labour intensive and large amounts are spent directly and indirectly on this activity. The level of service provided does not meet sanitary requirements as well as citizen's satisfaction. With the passage of time, the waste quantities will increase, become more complex and the degree of mechanisation will increase needing skilled personnel. As in other technological developments, the professionals should anticipate the future requirements and plan appropriate programmes well suited to the local requirements at low cost.

PLANNING

In addition to the above activities, a separate planning section should be provided, and day to day planning must be chalked out by the respective sub-sections. The planning section should be assigned with special technical service tasks. In the case of small civic agencies, instead of a separate planning unit, the central planning unit of the agency could provide required support. Decision on short term (3-5 years) and long term (10-12 years) design period, planning on various operational elements of the system should also be the functions of this section. It should work in close collaboration with other planning agencies at local, state & national levels to ensure better coordination in allocation of priorities and resources.

ORGANISATION

The basic principles of sound organisation in other fields of activities are equally applicable to solid waste management. However, no single type of organisational structure and no standard distribution responsibilities can be considered to be the best as the conditions vary from city to city in respect of quantity and quality of solid waste, population, and its area, type of collection system, codes and bye-laws. The main objective is to collect, process and dispose of the solid waste effectively at low cost. This task should be divided logically into different workable parts such as section and division with specific authority and responsibility assigned to each with coordination of all functions. Solid waste management basically involves management of the activities which

are mainly engineering functions such as collection, transportation, operation of processing and disposal facility. It is hence desirable that necessary professional leadership is provided for good organisation. In most of the Indian towns (90 percent of towns and cities) the health officer has been assigned to manage this activity. It is the same case in most of the other developing countries. The recent trends is towards entrusting this work to a qualified engineer, for example in the cities of Bombay, Calcutta & Delhi etc. It might have an independent position in the metropolitan areas, where it may be under a chief engineer in municipal agencies. The solid waste group has to seek help from other specialised agencies for doing relevant tasks.

WHO IS MANAGING SOLID WASTE?

Managing solid waste is an inescapable requirement of urban life – a job that nearly everywhere fall to municipal authorities. Waste management is a costly service to provide, typically absorbing 30 to 50 percent municipal operating budget. Solid waste management is an obligatory function of urban local bodies especially in India. However, it is service is poorly performed resulting in problems of health, sanitation and environmental degradation. With over 3.6 percent annual growth (in India) in urban population and the rapid pace of urbanisation, the situation is becoming more and more critical with the passage of time. Infrastructure development is not in a position to keep pace with population growth owing to the poor financial health of most of the urban local bodies. Solid waste management is one among the essential services, which

suffers the most in such a situation. Lack of financial resources, institutional weakness, improper choice of technology and public apathy towards solid waste management have made this service far from satisfactory.

EXISTING PRACTICES OF SOLID WASTE MANAGEMENT

COLLECTION OF SOLID WASTE

Solid waste produced from individual household is removed initially by the owner or an employee and later by municipal staff. In the case of community bin system adopted in most of the developing countries, waste is collected and taken to the community bin by the house owner or an employee from where it is removed by conservancy staff. Wastes from the streets are collected and removed by the conservancy staff. In house to house collection system as adopted in most of the developed countries, the workman collects the waste from individual premises where it is stored by the owners in standardised containers. If wastes have to be stored in individual houses, as in house-to-house collection method, every premises must be provided with specific containers having specific size and air tight lids. When these are provided and located at specified points in individual premises the house-to-house collection system would be effective. Cities in developing countries being out growth of small towns with narrow streets and crowded localities, it is difficult to provide specific locations outside the house for the refuse containers and it will be necessary to store them in side the houses. This poses a number of problems from aesthetic and

sociological aspects. Further, if the house-to-house collection system is to be effective, standard containers have to be used by individuals. This is quite difficult to achieve because of comparatively low purchasing power of majority of citizens. The citizens should fully cooperate for which extensive health and environmental education will be required. In place of house – to – house collection method, a modified form i.e., 'Block collection' can also be adopted in which a collection vehicle stops at selected locations on specific days. The house owner empties the waste into the vehicle which then moves ahead.

Another waste collecting method is Community Bin systems, in which workers sweeps the roads and collect the material at specific points. If the point has not been marked, depending upon the convenience of local citizens, a suitable point gets fixed. The capacity of community bins should be atleast 50 percent in excess when collection is daily and 100 percent in excess for 6 days a week collection. The spacing of the containers has to be accordingly fixed which in no case should be more than 100 meters apart.

COLLECTION OF WASTE FROM STREETS

In most of the developing countries, collection from streets is by manual labour while in developed countries mechanical equipment is used. When mechanical equipment is used it sweeps the road, collects the waste and takes it away for disposal. In manual methods, the collection from the streets is

deposited in communal storage bins from where separate vehicles collect for transport to processing or disposal site.

FREQUENCY OF COLLECTION

The municipal agencies assume the responsibility for removal of solid waste from domestic and commercial areas. Domestic waste and street sweepings represent the predominant fraction in the total municipal solid waste. Though the constituents of refuse do not change much, their proportion changes from city to city. It has been observed that the percentage of paper, glass, plastics, etc., increases with increase in the population of the city and standard of living. The organic matter in solid waste from India and other developing countries is much higher than that of the waste from developed countries. This large organic fraction tends to decompose at a faster rate. It is thus necessary to collect and remove this material as quickly as possible. Another potential problem is the possibility of fly breeding. The eggs of mosquito domestically match in 1-2 days, and the larvae feeds for about 5 days before pupation. The adult emerges from the pupa after 3 more days. The weekly collection prevents the production of adult flies as the waste is stored in airtight containers from where the larvae cannot migrate. In India and other developing countries the waste stored at individual house (for a few days) is deposited in community bin. The house owners can ensure that fly larvae do not migrate, but it is difficult to achieve this in community dustbin system. It is, hence, necessary to remove the waste from the site as early as possible, daily or at least thrice in a week.

CURRENT PRACTICES OF WASTE DISPOSAL

Disposal of waste is carried out through various processes, such as uncontrolled dumping, controlled tipping at landfill sites, mechanical composting, and incineration. The most common of these is dumping at landfill sites located around the city where an estimated 90 percent of the collected waste is disposed. Significantly, most landfill sites in India are uncontrolled dumps and not sanitary landfills. Domestic, commercial and even hospital and industrial waste are dumped together. No daily cover is applied (a higher of construction debris) to the waste. Dumping is also sometimes carried out illegally on the private property of farmers. Disposal of waste in this manner then leads to a range of problems–ground water pollution through leachate and other problems associated with flies, rats, rodents and odours are common. Very rarely do local bodies carry out an environmental impact analysis in selecting a disposal site. Any site with depressions which can hold waste is usually used for disposal. The landfill method is the most easily adopted and the least expensive of the various disposal methods. But now-a-days the distance of landfill sites from the collection areas is increasing. Another mechanism of resource recovery is composting, where the organic manure so produced can be used as a soil conditioner by the municipal authorities in public parks etc., by individual households, and by farmers. However, mechanical composting has met with little success primarily because of the high capital and operating costs which increased the sale price of the compost making it less attractive to the purchasers.

The energy recovery from waste also takes place in the form of biogas, through anaerobic decomposition of the organic component of waste deposited in landfills, as well as power generation from incineration of domestic and trade waste. However, given the high organic content and the high content of dust/ earth in Indian waste, burning of waste has been possible only with the use of extra fuel, making the entire process of incineration too expensive. The actual recovery of energy for cooking and power, through anaerobic decomposition, is not carried out on any significant scale in the country as yet.

URBANISATION : A SPECIAL ASPECT OF WASTE GENERATION

Since their earliest origins, cities have been centres of education, religion, commerce, record keeping, communication and political power. As craddles of civilization, cities have influenced culture and society far beyond their proportion of the total population. Until recently, only a small percentage of the world's population lived permanently in urban areas and even the big cities of antiquity were small by modern standard. Since the beginning of the Industrial Revolution cities have grown rapidly in both size and power. In every developing country, the transition from an agrarian society to an industrial one has been accompanied by urbanisation, an increasing concentration of the population in cities and a transformation of land use and society to a metropolitan pattern of organisation. Industrialisation and urbanisation bring many benefits, but they also cause many problems. Large cities in both developed and developing countries face similar challenges in accommodating the needs and by-products of dense populations.

The problems are most intense, however, in rapidly growing cities of developing nations. The 90 percent of human population growth in the next century is expected to occur in the developing world. Almost all of that growth will occur in cities especially the largest cities which already have trouble supplying food, water, housing, jobs and basic services for their residents. The unplanned and uncontrollable growth of those cities cause tragic urban environmental problems including the problem of solid waste.

Development priorities in India and other developing nations across the world, have over the last few decades resulted in unfaltering urban growth associated with increasing rural-urban migration. Rural urban migration is estimated to account for 40 percent of urban growth. Whereas these development processes have led to an overwhelming growth of urban centres, the have not simultaneously created the capacity to deal with growth, in turn creating a situation which has threatened the very development of urban centres. Increasing population has caused severe pressure on basic infrastructure and amenities creating large areas unserved by public services. The municipal authorities are unable to deliver the various sectoral services for want of funds, man-power, technology or efficiency in systems. Due to this cause as much as 30 percent of municipal waste are left uncollected in urban centres. The labour market, whether it be the formal or informal sector, finds itself increasingly pressurised by the consistent inflow of migrants into urban centres. While here industrialisation has created jobs, the increase in employment opportunities has

failed to strike a balance with the additions to the labour force and even the informal sector is often unable to engage substantial sections of the population in gainful employment. Basic services and employment opportunities then emerge as the most prominent and immediate needs of most urban centres today. The thrust of urban policies has largely been characterised by a compartmentalised approach where by each distinct issue or need is dealt within isolation, rather than adopting an approach that integrates different needs.

PUBLIC HEALTH ASPECTS OF SOLID WASTE MANAGEMENT

Rising urban population growth, dwindling municipal resources, and complexity of solid waste management have complicated the relationship between environmental management and urban health. The combined effects of uncollected wastes, poor handling and inadequate disposal safeguards for municipal wastes have always had implications for public health. Among these are the direct transmission of diseases and the spread of epidemics, loss of healthy urban and amenable environment and most importantly, the social reinforcement of poor hygienic habits and practices, all of which contribute to a vicious circle. On the other hand the inclusion of hazardous wastes in the urban waste stream complicates the search for practical responses to the problem. The implications for public health of inadequate solid waste management can no longer be ignored.

OCCUPATIONAL HEALTH HAZARDS ASSOCIATED WITH WASTE

It is well understood that more acute health hazards from solid waste result from long time direct contact with waste. Workers handling wastes are exposed to different types of impacts of waste. Firstly, impact on health because of accidental injuries such as individual cuts from sharp waste, to which workers who handle waste regularly are especially vulnerable. Small amounts of hazardous chemical waste in garbage may result in an accidental wounds but may also leads, in some extreme cases, to poisoning. The second type of health impacts is infections. Blood infections such as tetanus, resulting from injuries caused by infected sharp wastes are common. Ophthalmologic and dermatological infections from exposure to infected dust are also possible. Infections may also be transmitted through rodents and insects feeding on waste and acting as passive carriers of disease germs. Many tropical diseases transmitted by vectors such as mosquitoes have their origins in breeding ponds created by indiscriminate waste disposal. Zoonosis, a disease carried by stray, wild and scavenging animals feeding on waste, is also reported in many parts of the world.

OBJECTIVES OF STUDY

The working conditions in waste collection had received my attention during my course-work on urban health in the last year (1998-99). The topic on solid waste management and occupation health aspects of working with waste is relatively unexplored by social scientists. This is an explorative study with a view

to get acquainted with secondary literature and also to have the glimpse of situation in the field. While exploring the subject, I came across several newspaper reports and studies by journalists, town-planners, engineers, and administrators. I got interested and decided to review so as to learn the nature of information available on the subject. I also decided to do field-work to understand the problem of solid waste at its grass-root level and to understand the nature and conditions in which safai karmacharis are working. Because of limitation of time and resources, I have confined field-work to a small area and samples.

METHODOLOGY

In the methodology, I have prepared Interview-schedule which contains open ended questions which are put to safai karmacharis i.e. workers collecting the waste . I have selected 30 workers for the interview and are to be divided into 3 groups. These workers are working in 3 different areas of diverse economic background.

HYPOTHESIS

1. Urbanisation process may be responsible for the massive generation of solid waste.
2. Organisational structure of waste management may not be so efficient, if the workers are diseased.

3. Solid waste management technology may not be sufficiently developed due to which workers are getting diseases.
4. The socio-economic status of workers in the system may have correlation to their health hazards.
5. The existing insurance system in the MCD may have the direct role in improving the workers well being.

AREA OF STUDY

South Zone of Municipal Corporation of Delhi (MCD)

- Chatterpur Mandir Circle
- Green Park Circle

CHAPTER - II

REVIEW OF LITERATURE

The earth is considered as the final resting place for all the wastes that our civilization generates. It is true that all wastes are not necessarily pollutants. Rather, it can be seen that natural systems are capable of diluting, dispersing and decomposing many wastes so that their level of concentration is no threat to the biosphere in general and humans in particular. Yet if the volumes of wastes are very large, the systems into which they are dumped will be overwhelmed and consequently the wastes can not be diluted, dispersed, or decomposed. Then, of course pollution results. It is known fact that all human activity carries with it some risk-taking. So the real issue is not eliminating risks altogether and it is impossible also, because, wastes are inevitable by-product of living just as floods, landslides, and earthquakes are inevitable accompaniments to geology activity–but instead intelligently calculating the degree of risks involved and estimating to what extent some risks are worthwhile and others unacceptable.

The management of solid wastes is one of the earliest of man's branches of knowledge. In some ways it is also one of the latest. The reasons for this seeming paradox is the success which rewarded the efforts of public-health specialists and sanitary engineers in overcoming the abysmally unhygienic conditions into which man has allowed his habitations to degenerate at different times in history. This was particularly so during the latter part of the last century, when the study and practice of public health grew upto ameliorate, in particular,

the housing and living conditions of the working poor in British cities. The public health movement spread rapidly to Europe and to the United States. The need for improvement in USA was not as strong as in Europe, but where danger signs were visible in the increasingly crowded conditions of the eastern cities. The improvements which were brought about has such strikingly good effects, i.e., noticeable in the reduction in disease rates and in the cleanliness of the cities, codes of good practice were established, handbooks were written, schools of public health were established and the general population relaxed under the belief that the problems associated with solid wastes had been banished.

Further, this state of mind lasted for two generations, long enough for most research groups to die out or be disbanded. An approach tied to tradition and unresponsive to change was followed. But change came, in the form of increased intensity of the very industrial revolution which had enabled the problems of the last century to be resolved with such relative ease. These new problems included fundamental changes in the nature of domestic refuse, which in the days of coal fires had consisted predominantly of ashes and food wastes and which became increasingly composed of large quantities of paper, plastic and glass packaging materials. The problems also included changes in industrial wastes, which began to incorporate a previously unknown variety of substances with, in many cases, still unknown properties and hazards. Other substances which were disposed of with relative safety in minute quantities by the industrialists of the last century began to be discharged in vast tonnages with

immediate catastrophic effects in many cases, and disturbing implications for the longer term in others. Our complacency resulted in our being caught virtually unawares by these new problems. The last few decades have seen an increasingly rapid growth in, first, concern and, later, action, which has transformed the whole field of solid waste management.

The field of solid waste management is a large one and the changes in this field have been wide spread and are continuing. Therefore, without reviewing the available literature, it is not possible to understand each area of this field. So in the following pages I have reviewed number of studies, so that each area will be knowledgeably reviewed, and predictions for future developments can be made.

NATURE, SOURCES & COMPOSITION OF SOLID WASTES

Materials discarded all across our globe range from items that easily dissolve and decompose and soon disappear, to those essentially inert and long lasting. There is some overlap between the solid and liquid wastes and the boundary between the two is not sharp. For example, organic sludge from sewage is solid, although initially it is waterborne from household plumbing to septic tanks or sewage plants. Conversely, solid wastes buried in a dump may be leached by ground water and produce contaminants in solution that become liquid wastes. Solid waste production in the home, public and private institutions,

and commercial enterprises accounts for only 6 percent (Laporte, 1975)[1] of our annual solid waste. Despite this relatively small fraction of the total, most discussions of solid waste emphasise residential, institutional and commercial aspects of the problem. Reasons for this pre-occupation are several, they are, firstly, this waste category has shown the fastest yearly growth, i.e., around 4 percent per year. A two percent per capita per year increase was compounded, until recently by a two percent per year rise in total population – Laport, (1975)[2] observes that they arrive at a doubling time of solid waste production in 18 years. Secondly, the solid waste is concentrated in highly populated areas and for public health reasons, requires rapid and efficient removal. Finally, the current disposal of these wastes is considered inadequate by the Bureau of solid waste management of Department of Health, Education and Welfare. This Bureau estimates that 94 percent of the dumps and 75 percent of the incinerators are below standard, although recent requirements of the federal Environmental Protection Agency will improve the situation.

While discussing the nature of solid wastes Laporte (1975)[3] classifies solid wastes according to their degree of chemical stability, for example, organic wastes are all by-products of animals and plants, whether living (as with excrement) or dead (as with wastes from canneries or wood pulp mills). These

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1 Pointed out by L.F. Laporte (1975) *Encounter with the Earth, Wastes and Hazards*, San Francisco, Canfield Press, pp. 40-41.

2 ibid, p. 138 and p. 140.

3. ibid, p. 36.

wastes generate a high 'Biological Oxygen Demand (BOD)" when micro-organism decompose them. Furthermore, the chemical oxidation of organic wastes without the intervention of organisms creates a "Chemical Oxygen Demand (COD)", which like BOD, uses oxygen dissolved in water. Secondly, paper, wood and natural fibres i.e., waste material from fibres like linen and cotton is also organic, but is largely composed of cellulose, a starchy, chemically resistant compound that forms the membrane of plant cells. Thirdly, leather and rubber products are also solid wastes composed of natural or man made organic substances. They are physically and chemically resistant and consequently endure a longtime. These solid wastes have no special harmful impact on the environment other than a visual one. Fourthly, ash type of solid waste is produced by burning wood, coal and paper products in homes, apartments house incinerators, power plants and open dumps. When these materials burn, carbon, hydrogen, and sulphur in the organic matter are converted to carbon dioxide, sulphur dioxide, and water vapour that diffuse into the atmosphere. The incombustible residue or ash, is rich in mineral substances like pottassium, nitrogen, phosphorus, and iron and can be easily leached of some of its mineral matter by surface water and ground water.

The biggest proportion of solid waste (in U.S.A.) comes from agriculture and virtually all of it is organic. Harvesting and processing crops, alongwith raising livestock for food, generates two billion metric tons annually. But this is not the case with the Gulf and Third World countries, where inorganic material is

found more. In country like America electric power generation alone produces about 30 million metric tons of ash (Laporte, 1975)[4] from the burning of coal. Greater demands for electricity accompanied by gas and oil shortage mean that more and more coal will be used for power generation yielding greater amounts of ash. The American experience can be a good lesson to third world countries, which are rapidly building thermal power projects. The ashes from these power plants are not only posing solid waste problem but also they create environmental problems and it helps to increase the global warming.

While explaining the sources of solid waste Gordon Wilson (1977)[5] opines that solid wastes arise in association with almost every activity of man. The composition and properties of these wastes reflect the full diversity of man's actions. For convenience, however, waste characterisations are usually associated with broad descriptors of the sources of the waste. According to him, domestic sources of wastes includes wastes generated by individual family dwellings, apartment houses etc. And wastes from institutional sources includes wastes from schools, offices, hospitals etc. The commercial sources includes wastes produced by retail stores, offices, service stations, warehouses etc. Industrial sources includes wastes from consumer sources and industrial goods, and lastly municipal sources means construction and demolition debris, street

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4 ibid, p.39

5 D. Gordon Wilson, ed. (1977) *Handbook of Solid Waste Management*, New York, Van Nostrand Reinhold Company, p.12

and alley cleaning, tree and land scaping activity, park and beach operation, sewage treatment solids. So Gordon Wilson (1977)[6] further observes that the weight percent of two refuse categories are highly dependent on local conditions. For example 'yard waste' is very sensitive to both geographical location and the season of the year when the sample was taken.

The studies done by Anon (1967), Miller, (1969) and Matou Moto, (1968)[7] provide the comparison between US and other of countries in refuse – composition estimates. In case of US refuse data, the great decline in the use of coal for home heating is shown in the change in ash content between 1939 and 1970. But use of coal was continued in European countries like Norway and Czechoslovakia which can be seen to significantly affect refuse composition and thus heat content. Further, the effect of the socio-economic strata of the waste generator on domestic waste composition is studied in Berkeley city, California City in 1967; Cincinnati city, Ohio & Jefferson country city, Kentucky city, in 1970-1971; & Boston city, Massachusetts city in 1969-1970 by Anon (1972) Davidson (1972). Portridge (1971)[8] respectively. Although the data of these studies are too

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6 ibid, p. 12.

7 For the details of the studies see, Anon, "World Survey Finds Less Organic Matters", *Refuse Removal Journal,* Vol. 10, No. 26, 1967, F.H. Miller, "Conversion of Organic Solid Wastes into Yeast; an Economic Evaluation", *PHS Publications,* 1969, p. 21; and Matoumoto and others, "The Practice of Refuse Incineration in Japan – Burning Refuse with High Moisture Content and Low Calorific Value," *ASME Incinerator Conference*, 1968, p. 180.

8 Anon, "Analysis of Composition of Rubbish in the United States", *Solid wastes Management,* Vol 9, No. 15, 1972; G.R. Davidson Jr., "A Study of Residential Solid Waste Generated in Low-income Areas", EPA Report SW-83ts, 1972; and L.J. Patridge, Jr. and J.J. Harrington, "Quantitative Estimates for Solid Waste Management in Boston", *Discussion Paper, 71-4, Environmental Systems Program,* Harvard University, December 1971.

limited to support definitive conclusions, it would appear that refuse from low-income domestic sources contains more glass, metal and food waste than average refuse; and it contains less paper, textiles, plastics, leather and rubber than average refuse. These conclusions are consistent with qualitative estimates that low-income apartment house refuse contained 50 percent rubbish and 50 percent garbage whereas middle-range to luxury apartment house refuse contained 80 percent rubbish and 20 percent garbage (Govan, 1967)[9]. The conclusions are consistent with lesser use of heavily packaged prepared goods; enhanced use of canned versus frozen foods; and the consumption of less clothing and shoes by individuals of lower income.

Sometimes parks, homes and commercial enterprises generate substantial quantities of solid wastes which are too large in characteristic dimension to be burned in conventional incinerators and which are wasteful of landfill space. Wastes falling into this category include furniture, appliances, pallets, tree trimmings and logs, pilings, construction and demolition debris. Since these wastes are often too large for typical collection vehicles or disposal systems, they are usually collected separately from the domestic/ commercial refuse described above. These oversized wastes, usually called 'bulky waste', vary widely in composition depending upon their source.

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[9] F.A. Govan, "High Rise Disposal Problems", *Refuse Removal Journal,* Vol. 10, No. 6, 1967.

In the composition of street sweepings has been reported for a variety of characteristic areas. It was noted by APWA (1969)[10] that the quantity of vegetation was highest during the fall (Oct & November) when it comprised 53 percent of the total (Primarily leaves). During the period March to September vegetation comprised only 10 percent of the street cleaning material and almost none in the winter months. But the case is almost different in tropical countries where the quantity of dry leaves is more during the month of December.

The commercial and institutional solid wastes (those generated in stores, offices buildings, hospitals, & schools), are important contributors to the waste handled by Municipal governments. Since commercial and institutional wastes are often collected and processed with domestic refuse by municipal agencies, such information would require special sampling and analysis efforts. Such tests should be extensively conducted. Further when compared with mixed municipal refuse, it can be seen that the amount of paper in commercial waste is significantly greater. This is expected as the largest fraction of waste from a commercial establishment would consist of packaging materials which are predominantly paper based. The high fraction of plastics observed in the commercial waste studied in Kentucky further suggests the important contributions of packaging materials. The Kentucky data are in agreement with

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[10] "Water Pollution Aspects of Urban Runoff", *Report by the APWA to the FWPCA*, January. 1969.

data from New Orleans (Switzger, 1969)[11] which showed 84 percent combustibles for mixed commercial wastes. Bulky wastes generated by commercial establishments have been studied by Baffo (1968)[12] in the New York City. It was observed that these wastes approximated 65 percent combustible matter, most of which was Shreddable. The remaining 35 percent non-combustible material was noted to be almost entirely unshreddable.

The characteristics of solid wastes in Istanbul City are unusual in the extremes of composition in different seasons. Patrick (1979)[13] observed that during summer waste is very high in organic and moisture content, while in winter ash content predominates. In Turkey, domestic heating is mainly produced from burning of a low-grade coal. This is because of the high cost of oil which is to be imported. So as the use of coal for this purpose will increase and he result will be even more ash in the domestic wastes. So here this situation is a good example of the influence of national economic factors on waste characteristics.

In the late 1970's Americans produced almost 5 billion metric tons of solid wastes with most of the increase coming from the rapid rise in residential wastes. Out of the total solid wastes in US 6 percent originates in the home and includes

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11 Albert Switzger and Associates," Master Plan for Solid Waste Collection and Disposal, Tri-Parish Metropolitan Area of New Onleans", USDHEW, BSWM, 1969.

12 J.J. Baffo and N. Bartilucci, "Bulky and Semolition Wastes", *Report to the City of New York,* New York, 1968.

13 P.K. Patrick, "Metropolitan Waste Management Planning in Developing Countries – A Case Study of the Istanbul Metropolis" in Holmes, John R (1983) *Practical Waste Management,* Avon, John Wiley & Sons Ltd., p. 493.

garbage, glass, metal containers, plastics and paper. In this connection a significant factor determining how solid wastes are disposed of, is the disproportionate cost of their collection. In US in 1970's it cost 14 $ to collect one metric ton of residential, commercial and institutional wastes and only 4 $ was spent on their disposal. As the draw backs of improper solid waste disposal become better known and as cheap resources become scarce, the cost of collecting and properly disposing of solid wastes may seem more reasonable.

The Indian cities have a striking similarity when it comes to heaps of garbage and overflowing bins – a sign of the municipalities inefficiency in managing wastes in most of the towns and cities. Further, with the country population set to cross the one billion mark, coupled with unplanned development and urbanisation, one thing is for certain – an enormous amount of waste is going to be generated. The situation is no better at present. The urban population was 217 million in 1991 and the total quantity of solid waste generated in urban areas was estimated at 20.71 mn tonnes per year. This is expected to cross 56mn. Tonnes by 2011, says Iqbal Malik Director, Vatavaran, a Delhi-based NGO involved in waste management), "In the 1980's a family's weekly garbage production used to be about 7 kg and now it is 20-30 kg. So, further, the per capita waste generation in urban areas with a population less than 0.1 mn. people, the per capita waste generated is 0.21 kg. per day, while in areas with a

population of more than 5 mn. people, I goes upto 0.5 kg. per day, says a study by Nagpur based National Environmental Engineering Institute (NEERI).[14]

COMMENTS

Growing population and rising per capita consumption are multiplying solid wastes, which range from biologically and chemically active animal refuse and garbage to virtually inert glass and plastics. So the first step in solving waste management problems is to discard the belief that 'waste' is so heterogeneous in its composition and so variable in its properties that problems cannot be defined, let alone solved. To be sure, waste streams exhibit great variability. The design of waste management systems must, therefore, provide for more operating flexibility, reserve capacity and materials 'stamina' than conventional process equipment. Nonetheless, characterisations of the average composition and properties of waste streams provide the starting point for design. Further, it can be useful in alerting the waste manager to processing constraints and opportunities or safety hazards. And also knowledge of the factors influencing the generation rate and composition of solid waste can be of great assistance in predicting waste characteristics within homogeneous generation zones.

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14 Kazimuddin Ahmed and Nidhi Jamwal, *"A Heap of a Problem", Down to Earth*, Science and Environment Fortnightly, New Delhi, Centre for Science and Environment, 31 January 2000, p. 32.

PLANNIGN & MANAGMENET

In the earliest days of man, the problems of solid waste management were dealt with at the lowest political level – each man took care of his own, usually with a dump at the back of his cave. Subsequent centuries saw increases in the quantity and diversity of waste; and with increasing urbanisation the problem came to be considered as a responsibility of the Municipal Governments. Further municipal practices with respect to solid wastes vary widely across the world. In some areas, almost all wastes are collected by the municipality. In others, all or portions of the industrial and community must provide for the disposal of their own wastes. Because of this diversity in the responsibility of municipal solid waste management agencies and because of the different levels of on-site disposal or salvage activity, 'typical municipal solid waste' appears to be inherently an ambiguous concept. From the earliest civilizations burial of wastes has always been comparatively easy in rural areas. But solid waste treatment has necessarily always been more advanced in the largest cities. Disposal problems become difficult with increase of population density. Simultaneously there is a greater production of waste per unit area and a decreased proportion of land available for it's disposal. Therefore the history of solid waste is largely connected with the histories of largest cities. Further, the history of solid wastes in general has not been written. There is no tradition of scholarly research into solid waste treatment. What we have given have been extracts from occasional articles which have provided no more than reference points.

In designing waste – processing systems it will often be found that desired data are lacking. Many municipal waste studies have demonstrated the large errors possible from armchair estimates of the generation rate composition or properties of waste. It is strongly recommended, therefore, that the results of especially commissioned waste surveys analysis be incorporated in the problems-definition phase of the design effort for waste management systems. For systems disposing of municipal waste, for example, the local Unix of waste generator types, climate, level of construction and demolition activity and existing waste – management practices and expectations can greatly affect the characteristics of the wastes which are collected.

Large variations in solid waste quantities have been observed (Coad, 1973)[15] across the world. These differences are linked to differences in prosperity, climate, industrialisation, community size, and consumption habits. The design of an efficient solid waste collection and disposal service requires data on refuse weights, composition and volumes and an understanding of local customs and so it is necessary to obtain information from the area concerned; global values cannot be assumed. For Eg : (Chicago, 1966),[16] The percentage of vegetable found in Municipal waste in different cities of the world are different

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15 Adrian Coad, "A Case Study in Solid Waste Generation and Characteristics in Iran", in Holmes, J.R., Opcit, p. 503.

16 American Public Works Association, *Municipal Refuse Disposal*, 2nd ed., Public Administration Service, Chicago, 1966.

i.e., the percent of vegetable in Poona (India) is 68 percent , Benghazi (Libya) – 42 percent, Britain – 14 percent, Arizona (USA)-23 percent etc. So it is important to gather the information from the area concerned.

Further, although transfer of technology is an important aspect of aid to developing countries, it is essential to propose measures which are within the economic and technological abilities of the country concerned, even if they don't measure upto hygienic and environmental standards expected in developing countries. The addage 'the best is the enemy of the good' is particularly relevant to attitudes to waste management projects in developing countries. And again one of the difficulties of "master plans', aimed at some speculative and undeterminable future, is to make assumptions on long-term conditions in countries where the political and economic development is full of uncertainty. For example, it might seem advantageous to propose a plant or equipment of high capital cost because the investment cost will be financed by a long-term low-interest loan provided by one of the international funding agencies. But the key question is whether the municipality or other operating authority will have the financial and technical resources to operate and maintain the facility through its lifetime. Great metropolitan authorities, tend to want and expect modern technological solutions to their problems. These hopes and expectations are not always realizable within the realities of economic constraints.

The established social customs are a further important consideration. In Istanbul City, for example, there is a well organised system of salvaging (i.e., collecting of solid waste by rag pickers in the morning before the arrival of municipality men) where the very large quantities of material are recovered and sold to salvage industry or recovery shops. The system operates through a number of entrepreneur activity. At base level, scavengers clean the waste put out in bin and boxes for collection. These men and women go round the streets early in the morning before the collection vehicles arrive. Material thus collected is sold to merchants, who carry out some preliminary sorting before selling it to other merchants, who do further sorting cleaning prior to sale to industry. The whole range of activity, though deficient in many aspects of hygiene and public amenity, gives employment and a living for hundreds of people, provides industry with low cost secondary raw material, and saves the national economy considerable sums of foreign currency for imported materials. It is easy enough to say that the practice of salvaging (totting) and manual sorting in open yards is undesirable and should be stopped, but what is to be put in its place? A mechanised sorting plant under municipal control would be a tidier and more environmentally acceptable alternative, but the consequential reduction in employment and higher costs to industry must be weighed in the balance.

COMMENTS

Solid waste management is nothing but the purposeful, systematic control of the generation, storage, collection, transport, separation, processing recycling,

recovery and disposal of solid wastes. And in developing countries, it is often found that institutional factors give rise to more difficulties than technical problems. Success in solving the latter can only be achieved by devising systems acceptable to the population of large and within the political will and the ability of the government to implement recommended measures. Master plans are often prepared more in a spirit of hope than of expectation and long range economic forecasting. Priority in solid waste management projects may be given to measures which will bring about environmental and health improvements to population sorely in need of both.

Long-term solution to solid waste disposal problems can be foreseen, but their implementation would require a strong engineering and organisational capacity, which at present is lacking. In planning and implementation of solid waste collection system for any particular area, collection-system design and operation parameters need to be carefully considered. Once implemented, a collection system must be continually monitored to assure that maximum cost effectiveness can be realised. And proper collection – equipment maintenance reduces annual system operating costs. Using inefficient equipment past its useful life should be avoided. Further, solid wastes management services should be self-financing by means of direct charges for waste collection and disposal. Various methods of collecting the charges can be discussed and put forward for the government's consideration.

HEALTH ASPECTS

The ever-increasing degradation of the urban environment is seriously affecting health and well being, especially in the developing countries where urban populations are growing rapidly. The most seriously affected are the urban poor living in the slums or in the shanty towns and squatter settlements that surround many urban conglomerations. In many cities in developing countries, moreover, administrations lack the resources to meet existing needs for basic water supply and sanitation systems and health services, let alone those of the future.

Further rising urban population growth, dwindling municipal resources, and the complexity of municipal solid waste management in both industrialised and developing countries have complicated the relationship between environmental management and urban and occupational health. The combined effects of uncollected wastes, poor handling, and inadequate disposal safeguards for municipal wastes have always had implications for public health. Among these are the direct transmission of diseases and the spread of epidemics, loss of healthy urban and amenable environment, and most importantly the social reinforcement of poor hygienic habits and practices, all of which contribute to a vicious cycle. The inclusion of hazardous wastes and excreta (although in small quantities) in the urban waste stream complicates the search for practical responses to the problem. The potential spread of AIDS and other infections diseases through the discharge of health care wastes in general

urban waste streams is a growing threat. The implications for public health of inadequate solid waste management can no longer be ignored.

The waste categories with potential public health impacts, as given by United Nations Environment Programe-6 (UNEP, 1996)[17], are firstly, domestic waste which includes general house-hold wastes with used batteries and drugs containers, street sweepings with small quantities of excreta. Secondly, special and hazardous wastes includes health care waste (sharp and infections components) toxic chemical, pharmaceutical and other industrial wastes, as well as radioactive wastes. Thirdly, other bulky wastes include unrelated abattoir waste, construction wastes with asbestos components and sludges for treatment plants. Further, the same book talks about the groups which are at risks from adverse public health impact of solid waste management and they are firstly, the population of unserved areas, especially pre-school children. Secondly, waste operators and waste pickers. Thirdly, workers in facilities that produce infectious toxic, and cancer – causing material. Fourthly, people living close to waste disposal facilities. Fifthly, the population supplied with water polluted by waste dumping or by inadequately protected landfill sites.

17 "International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management," UNEP – *Technical Publication Series* –6, Osaka, Japan, 1996, p. 396.

Solid wastes may be, Laporte, (1975)[18], argues, intentionally discarded or simply allowed to accumulate where produced. For example, house-hold garbage and trash may be collected and buried or burned at local dumps. When solid wastes are burned, gaseous by-products enter the atmosphere and disperse widely; small ash particles eventually settle down wind of the incinerator. When solid wastes are left on the ground surface or buried, natural surface and underground water may be contaminated by substances leached from the refuse. Because overwhelming burdens of solid wastes are generated every year & because air and water pollution are associated with these wastes, more attention is now being paid to their disposal in soils and sediments that will safely contain them.

The aim of occupational health, K Park (1995)[19] mentions, is "the prevention of disease and maintenance of the highest degree of physical, mental and social well being" of workers in all occupations. According to Gupta, (1961)[20], the comparative accident rate per 1000 workers in municipalities in India is 0.30 percent per 1000 in 1957 and 0.09 percent per 1000 in 1958. Further, workers handling waste are exposed to the impact of wastes. According to a study conducted by NEERI (National Environment Engineering Research

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18 Laporte, Opcit, p. 35.

19 K. Park (1995) *Textbook of Preventive and Social Medicine*, Jabalpur, Banarsidas Bhanot Publishers, p. 455.

20 M.N. Gupta (1961) *Swasth Hindh*, reproduced in Park, K., Opcit, p. 461.

Institute, cited by Venkateshwaran (1994)[21], it is found that workers suffered from skin and eye infection, respiratory diseases, jaundice etc. Further, a study conducted (Venkateshwaran, 1994)[22], in Ahmedabad found that more that 15 percent of sweepers suffered from 'Tuberculosis and that prevalence of Tuberculosis among sweepers was three times higher than the national average. By going through these studies we can judge how the aims of occupational health are safeguarding the health of the workers.

The utility of garbage in energy generation has been overlooked by authorities. The result is that landfill sites are tossing up poisonous gases in air, which accelerates the pollution level. At least two cubic metres, (Shunglu, 1993)[23], of poisonous methane (55 percent methane and 40 percent of carbon dioxide) is generated by one metric ton of garbage. By a conservative estimate over 7000 cubic metres of gas is pumped in to the air every day. The gas creates a green house effect. Gases such as methane, carbone dioxide, and carbon monoxide, creates a screen in the air and prevent radiation. The layer of gases hangs in the air posing a health hazard for the citizens.

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21 Sandhya Venkateswaran, "Managing Waste: Ecological, Economic and Social Dimensions", *Economic and Political Weekly*, Vol. 29, Nos. 45 and 46, November 5-12, 1994, p. 2909.

22 ibid, p. 2909.

23 Prabhat Shunglu, "Garbage's Potential Overlooked", *Times of India* (New Delhi), 3 November 1993.

Further, over the past decades, researchers have reported a dramatic increase in the number of over weight Americans (Hindu, 1999)[24] reproductive deformities and the number of youth reaching puberty at early ages. In the past, these findings have been attributed to nutrition, life-style and genetics. But, however, researchers note that a chemical estrogen that is used to make plastics could be a contributing factor to this health deterioration. The reason behind including this findings is that, the percentage of plastics in garbage is increasing rapidly. Further, researchers have found that Bishphenol A (BPA. is a compound that was originally made as a chemical estrogen) is used as a 'building block' for the production of polycarbonate plastic products such as baby bottles, tin can linings, certain toys and certain types of food storage containers.

COMMENTS

The existing patterns of development are unlikely to slowdown the pace of urbanization. This would undoubtedly lead to far greater pressures on basic services, infrastructure and resources than at present. The waste management technologies must take account of ecological, economic, political, cultural and behavioural considerations, in addition to the technical problems. Further, the inadequate disposal of solid wastes is a major factor in the spread of gastro-intestinal and parasitic diseases and leptospirosis, primarily as a result of the proliferation of insects and rodent vectors. The risk of injuries and poisoning at garbage dumps also increases. And the gas generated by waste creates a green house effect, and creates a screen in the air which prevents radiation.

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[24] "Plastics Cause Health Problems", *The Hindu* (Delhi), 2 December 1999.

In developing countries waste picking is widely practiced and socio-economic conditions do not allow abolition of its prohibition. Waste pickers are very vulnerable because they are exposed to serious health hazards from waste. Waste pickers may be protected in the same way as regular waste workers, but in low-income countries occupational health and safety services are most often deficient for waste workers, and waste pickers can expect none of those services. However, the waste pickers' situation may be improved if they are organised and receive assistance to improve both working condition and their housing and sanitation.

From the preceding paragraphs, it is very clear that adverse health impacts can and do result along the whole cycle of the solid waste management process. A proper understanding by municipal waste managers and workers of the health impacts and the conditions of transmission is the basis for confronting these problems. Three types of waste-linked health impacts and their conditions of transmission are noted : injuries and exposure to chronic diseases; bacterial, viral, or parasitic infectious; and indirect creation of endemic conditions for specific tropical water borne diseases. So there fore the safe handling and appropriate disposal of all municipal waste streams will go a long way in ensuring a healthy living environment. This is easier said than done. Given the poor state of the economies of most of developing countries and the sheer magnitude of the waste management problems, only strategies based on incremental improvements on the existing situation are practicable in most cases. So the first

priority for minimizing the public health impacts of solid waste management should be to ensure, at the community level, hygienic and safe management of domestic waste, and at the city level, complete coverage of the population by an efficient but appropriate municipal waste collection service.

CHAPTER - III

SOLID WASTE MANAGEMENT IN DELHI

While India is known as a land of villages, it also has an ancient tradition of urban centres. The Indus valley civilization was primarily urban in character. Foreign travellers have mentioned several flourishing cities located in different parts of the country. And the powerhouse quality of the cities, however, has always been recognised, atleast tacitly. They have been seats of learning and industry, and have provided political leadership and shaped public opinion, and have set styles of life to be emulated by the rural population. Powerful impulses for change have almost always emanated from urban centres.

Further, class polarisation in many urban centres is sharp and striking. A few live a life of opulence, with every comfort that money can buy and with spare resources that they do not know how to use. Many live a life of abject poverty and degradation, facing problems of unemployment, housing, health and education. And they often live in a cultural and spiritual void. They have dreams and hopes, but are uncertain about their realization. In between these polar opposites there is the amorphous middle class. The upper half of this class lives in a make – believe world; it tries to emulate the life – style of the rich, but finds itself constrained by non-availability of adequate resources.

PATTERN OF URBANISATION IN CONEMPORARY INDIA

The new process of urbanisation which began with the advent of the British received a momentum at the beginning of 20th century. And now, India is passing through a phase of rapid urbanisation in the contemporary phase of the transition of society. The modern urban centres perform diversified functions in terms of economic, administrative, political, cultural and so on. Here, it is very difficult to classify the towns and cities in terms of a single activity. Generally, people classify urban areas on the basis of some prominent socio – economic and political features. But sociologists classify the patterns of urbanisation in terms of its demographic, spatial, economic & socio–cultural aspects. Therefore, the demographic and economic indexes are important in defining specific areas as town and city.

After discussing how urban area in India is classified, now we can discuss some aspects of the pattern of urbanisation in India. Firstly, if we see the demographic aspect in India, the population concentration has been one of the key features of urbanisation. There has been a steady increase in the urban population in recent years. The percentage of urban population has been little more than doubled from 10.8 percent in 1901 to 25.71 percent in 1991. Urban population has significantly increased in the post independence period. For the 40 years period from 1901 to 1941 the increase of urban population from 25.85 to 44.15 million has been quite modest compared to the 62.44 million of the next decade. There has been an increase of more than 175.05 million in urban

population from 1941 to 1991. Note that 70.8 percent of this population has grown in the last three decades between 1961 and 1991. [1]

The rapid growth of urban population during 1941-1951 has been mostly due to partition of the country and other political reasons which led to refugee migration in the urban areas. The steady increase in the urban population in the last few decades came about not so much because of planned economic development and industrialisation, but due to imbalanced agricultural development.

Secondly, if we see the aspect of spatial pattern, the spatial disparities have marked the Indian urban scenario. These disparities, emerged mainly due to regional disparities, imbalanced population concentration and some times because of the change in the census definition of 'urban areas'. Further, we can look at some of the variations in spatial disparities found in the pattern of urbanisation in India.

i) **Variation In Urbanisation Among The States :** The urbanisation pattern among different states in India shows an interesting features of urban dominion in some states. For example, five states namely, Maharashtra, U.P. Tamil Nadu, West Bengal and Andhra Pradesh altogether accounted for 56 percent (in 1961)

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1 Social Structure, Rural and Urban Society in India, *IGNOU Materials, ESO-2,* No.-1, 1997, p. 49.

to 55 percent (in 1971) of the total urban population of India. In contrast six states of Orissa, Haryana, Assam (including Meghalaya), Jammu & Kashmir, Himachal Pradesh and Nagaland account for 5 percent (in 1961) to 5.5 percent (in 1971) of the total urban population of India.[2]

ii) Growth Of Metropolitan Cities : The population in the larger urban centres has constantly been growing in India. For example, Calcutta was the only city with a population of over a million in 1901, at the time of 1991 census 30 percent of the total urban population was concentrated in 12 million-plus cities. And it is important that except Delhi (which forms part of Union Territory of Delhi), the remaining 11 cities (Bombay, Madras, Hyderabad, Ahmedabad, Bangalore, Kanpur, Pune, Lucknow, Nagpur, Jaipur, Calcutta) are in 8 states.

Thirdly, if we observe the economic aspect of urbanisation, one can easily understand that urbanisation is a natural & inevitable consequence of economic development. Urbanisation accompanies economic development. Because economic development entails a predominantly rural sectors to those predominantly urban. While talking about the economic features of urbanisation in contemporary India, occupational diversifications and migration appears to be the key aspects.

Further, the current process of urbanisation has faced many problems in different parts of India. The most important of these has been the development of

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2 ibid, p. 50

slums in the urban areas. Slum population accounts for a substantial share of urban population in all types of cities in India. Even a planned city like Chandigarh has not escaped slums. Slums are characterised by sub-standard housing, over crowding and lack of electrification, ventilation, sanitation, roads and drinking water facilities. Slums have been the breeding ground of diseases, environmental pollution, demoralisation and many tensions. Crimes like juvenile delinquency, gambling have also increased in number of slum areas. Signs of poverty are most visible in these places. On the other hand the extent of facilities like medical, sanitation, drinking water, power-supply have remained insufficient in a majority of the urban centres in India. Therefore after examining the extent of availability of civic amenities to public, one may say that there has been a tendency of over-urbanisation in India.

URBANISATION IN DELHI

Delhi lies on the Western Bank of Yamuna River in North India. Delhi is one of the most ancient cities of India. It has a recorded history of more than a thousand years. But, certainly, the historic town was in existence, even before that, perhaps for several thousand years. The earliest reference to a settlement at the site is to be found in the famous epic Mahabharata, i.e., the 1st significantly large settlement in the Delhi area was Indraprastha, settled about 1400 B.C. It means that the growth of Delhi and its planning as urban settlement date back to

about 1500 B.C.[3] That is, in the course of the past 3500 years, Delhi has been a participant witness to the rise and fall of kings and kingdoms. It began as Indraprastha and then governed by the Tomar Rajputs and the Chauhans followed by the slave dynasty who in turn succeeded by the Khiljis, Tughlags, Sayyeds, Lodis, Moghuls and the British. The more recent history of the city dawned during the reign of Emperor Shahjahan when he in 1638 moved back the capital to Delhi. He commenced the construction of Red Fort and the walled city of Shahajahanabad on the site adjacent in the north to the city of Firozabad. It is this Shahajahanabad that has survived the fabulous Moghul property and the subsequent long period of its decline to become the old Delhi of the present day.

BEFORE MODERN TOWN PLANING BEGAN - 1912-1935

The British established Delhi first as an embassy of the East India company in 1714 and then in 1911, shifted their capital from Calcutta to this city and planted the seed of British Raj. In 1912, the British Government decided to build a new capital city at Delhi, separate from the existing city of Delhi. The new city was planned as a garden city with conscious symbolisation of British Imperial power in India. The theme of colonial rule was evident : the Viceregal House and Secretariat Blocks commanded like an autocrat with his two fists, the view of India Gate, symbolising India.[4] The founding of New Delhi had resulted in a rapid

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3 Urban & Regional Planning & Development in India Town & Country Planning Organisation, *Ministry of Urban Affairs & Employment, Government of India,* New Delhi, 1996, p. 337.

4 Ritu Priya, "Town Planning, public health & urban poor: some explorations from Delhi", *Economic & Political Weekly*, April 24, 1993, p. 825.

increase in the population of Old Delhi, an estimated 28 percent addition to the erstwhile population. The already crowded city became even more congested or for housing the new entrants. Those evicted from areas acquired for building New Delhi and the skilled and unskilled workers brought in for construction of New Delhi were not provided for in any manner. Lutyens's plan dwelt on Old Delhi very marginally. It included a scheme for reconstruction of Paharganj. It also stipulated acquisition of some lands for expansion of Old Delhi to the west and for the civil lines to the North-East. The only other plan for Old Delhi was a suggestion to cut a few roads across Shahjahanabad for opening out of the population. The scheme for restructuring of Paharganj was later abandoned by Lutyens himself due to resources constraints. The lands meant for the expansion of Old Delhi were some how later taken over to serve New Delhi. Thus, there was increasing congestion with little done towards the expansion of the old city. The poor families were huddled together in small rooms. The old buildings were poorly maintained and became dilapidated.

PERIOD 1936 – 1950

The official recognition of the deteriorating environmental condition in Old Delhi came only in 1936 when pressure of the national struggle forced the British Government to give some concessions to the Indians. For example, the Municipal act of 1935 gave more powers to Municipal bodies and brought elected representatives of Indians on their board. And in 1937 Delhi Improvement Trust

(DIT) was setup under the department of education, health and lands. The main objectives of this trust were primarily administrative and only secondarily to deal with public health, of carrying out the dual scheme of administration of a large government estate (a) as an agent of government (b) in the interests of the city and also of dealing with the problems of slum clearance, recommendation of dispossessed population and town planning.[5] Further a look at the whole improvement effort of the DIT during its active life span of over a decade displays an absence of vision in city development and a marked pro-affluent bias. Adhoc schemes, badly planned and executed seemed to be the overall record of the DIT from 1937 to 1950. With increasing rural to urban migration, the DIT did nothing towards increasing housing for the previous poor inhabitants or for the new migrants. As a result squatter settlements and the jhuggi-jhoupori, bastis, started coming-up in and around the new extension areas and at the periphery of New Delhi.

POST INDEPENDENCE PERIOD

The partition of the Indian sub-continent in 1947 witnessed one of the largest refugee movements recorded in the world history. About 8 million, Hindus and Sikhs left Pakistan to resettle in India.[6] And in this background the post independent Delhi was immediately over whelmed by the unending stream

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5 ibid, pp. 824-834.

6 Mahendra Lama, "Refugees in South Asia", *World Focus*, monthly discussion Journal, January, 1999, p. 3.

of refugee immigrants from West Pakistan. The demographic profile of Delhi changed dramatically after partition. The population had doubled in less than 2 months. A number of colonies came up in no time – Lajpat Nagar, Kailash Colony, Kalkaji, Malaviya Nagar in the South, Moti Nagar, Kirti Nagar, etc in the west, around Kings Way Camp in the North and Gandhi Nagar in the Shahdara area. And thus began, a gigantic organised city development process. And it was backed by wide ranging statutory powers and large financial resources. There was political will behind it to develop the modern capital city of Independent India. Further, by this time, Delhi ceased to exist as a state in 1956. Its administration was then entrusted to a chief Commissioner. In 1966 the Delhi Metropolitan Council was set-up to manage the affairs in collaboration with the Executive Council. And at the end of year 1955, the Delhi Development (Provisional) Authority (DDA) was set-up till the definitive authority could come into being to initiate the process of planned development of Delhi. At the same time, the town planning organisation was established by the Ministry of Health to prepare the Master Plan. And in December 1957, the Delhi Development Authority (DDA) was constituted through an act of Parliament. It evolved a draft plan in June 1960 and submitted it to the public for objections and suggestions. With due changes, the final Master Plan was ready in November 1961 and in 1962 it was made law.

THE DELHI MASTER PLAN 1962 –1981

The plan was basically a land management plan. It took into consideration, the increase in Delhi's employment potential in government, trade

and industry. On that basis it projected an increase in population of upto 50 laks by 1981 (which has proved to be very low) and set urbanisable limits for 1981 which were to be enclosed by 1 km wide green belt to restrict further urbanisation and prevent surrounding urban areas from merging with Delhi

In 1972-73 the Town & Country Planning Organisation (TCPO), the new version of Town Planning Organisation undertook a major review of evaluation of the Master Plan. It noted that the 1961 housing deficit of 1,50,000 dwelling units was shown to have increased to 3,80,000 by 1970. Very little progress had been made in providing housing for the low income groups. There was extensive unauthorised residential construction. And plan for development of urban villages never really got under way. However, density in Old Delhi was increasing, there was a failure to relate employment centres to housing. But overall the Master Plan 1962 was hailed as an important step in city planning and managed to outline Delhi's importance as a national capital. But it failed to create mechanisms to check the population growth or the city getting congested. Those who had designed the Master Plan 1962 miscalculated its feasibility.

Since the time frame of Delhi Master Plan was set upto September 1981, in October 1977, the government asked the DDA to undertake the preparation of new Master Plan. However, the date for completion of the new Plan went on being postponed. Ultimately in April 1985, a revised plan for Delhi for the year

2001 was envisaged and National Capital Region Planning Board was constituted.

THE SECOND MASTER PLAN 1985 – 2001

This plan envisaged a holding capacity of 112 lakhs population in Union Territory of Delhi – including Noida and 130 lakhs for Delhi Metropolitan Area. It proposed the development of counter magnets, each having population of 10 lakhs by the year 2001 A.D. They were to be located at Meerut, Rewari, Khurja, Rohtak and Panipat.[7] The objective of NCR was to contain Delhi's population by minimising intra-regional disparities by a selective approach to the decentralisation of industries and directing them towards the backward areas. But since the satellite towns in the National Capital Region (NCR) have not been properly developed and lack of adequate infrastructure, migrants inevitably make their way to Delhi. The dispersal of population, industrial and governmental activities from Delhi remained a dream. The disorderly growth of Delhi continue unabated and the resulting problems have become a nightmare. The multiplicity of organisations responsible for the affairs of Delhi (including the DDA, the MCD, the NDMC, Delhi Cantt. Board, Delhi Milk Scheme, the DTC, the MTNL and recently Delhi State Government etc.) are largely bureaucracies with separate financial administrative and managerial responsibilities. Often there is lack of coordination and clash of interests between these agencies. The Delhi

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7 A.K. Jain, "Delhi Master Plan", in Patwant Singh & Ram Dhamija, ed. (1989), *Delhi:The Deepening Urban Crisis,* Delhi, Sterling Publications.

government does not have control over some of these important organisations which are directly under the central government control. The end result; it is the people ultimately suffer. The bold solutions to known problems appear to be outside the scope and constraint of the policy makers and administrators.

Further, the recent, rapid and relentless process of urbanisation has contributed in creating visible and measurable scarcity of essential resources like land, water, electricity, housing, health facilities, employment opportunities, law and order and environment, etc. Delhi's population is growing at a very high rate. According to the figures released by the census authorities, Delhi's population in 1991 stood at 93.7 lakhs, an increase of 31.5 lakh over the 1981 figure. This represents a decadal growth rate of between 50-64 percent compared to 53 percent in the previous decade when the city population increased by 21.5 lakhs. Delhi recorded 90 percent increase in the population, since independence. It is estimated that by 2001 A.D. Delhi's population will become 143 lakhs. The density of population in Delhi per square km. in 1991 was 6,319 in comparison to 267 of India. It is more than twenty folds. There are residential areas in the city with population density exceeding one lakh persons/ sq. km. There are 10-15 persons/ sq. km on Prithvi Raj Road in New Delhi and as compared to 1,400 persons/ sq. km. in Dariba Kalanin Old Delhi. The contrasting figures speak of the haphazard growth of the city.

SOLID WASTE PROBLEM IN DELHI

Today, Delhi manifests the symptoms of uncontrolled growth – distinct shortfall in the infrastructural provisions of sewerage and water supply. Unauthorised and uncontrolled land use, inadequate residential and commercial space, land speculation, unbalanced growth and social compartmentalization are other problems that the city faces. The Master Plans of Delhi were meant to prevent or contain these problems. Instead, even after so many years of planning, not only have these problems multiplied, but other major ones have been added and one such problem is problem of solid waste. With the advent of industrialization and urbanisation in Delhi, the problems of waste disposal increased.

Studies have shown that, out of total solid waste generated, collection of solid waste is only 83 percent in class-I towns, 63 percent in Class-II towns, 56 percent in class – III towns & 50 percent in class-IV towns. Among metros, highest collection efficiency is of Mumbai, where 97 percent solid waste is being collected and lowest in Kanpur and Pune where only 70 percent solid waste is being collected. And on the Delhi's solid waste front, it is estimated that the city will be generating over 2.6 million tonnes of solid waste every year, out of the 39 million tonnes generated by the total urban population of India.[8] With the collection rates at around two – thirds of the total waste generation, the problem

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8 Presidential Speech of V. Suresh, Chairman & Managing Director, HUDCO, at *Regional Meet on Community Action for Environmental Management,* December 3, 1999, New Delhi, p. 5.

of solid waste management is one of the most critical issues faced by Delhi today. Though solid waste management consumes as much as 25 percent or more municipal revenue, not enough attention is paid to this sector. Efforts of people employed to collect, dispose and recycle waste are rarely appreciated.

Today, Delhi's population stands at more than 12 millions and another half – a million or so visit Delhi every day for business, medical aid, sight-seeing etc. There are also other features of Delhi which add load to its civic services. There are about 1600 markets, each with hundreds of shops, 26,600 whole-sale establishments, 100 weekly markets which are held on approximately 6000 make-shift shopping spaces, 1,40,000 informal retail units also exists, besides hundreds of offices of central and state governments and local bodies which employ near by a million people. There are more than 1,25,000 industrial units, 10,000 electroplating industries causing a huge quantity of toxic waste. The vehicular population has increased phenomenally, from 2.35 lakhs in 1975 to 26.29 lakhs in 1996, and is expected to touch 60 lakhs in 2011. Today, Delhi has 3 times more vehicles than Mumbai. Vehicular pollution contributes 67 percent of the total air pollution load (approximately 3,000 metric tonnes per day) in Delhi. Another 25 percent of air pollution is generated by industries and coal based Thermal Power Plant. The three power plants in Delhi generate 6000 metric tonnes of fly ash/ day 16 big drains are discharging about 1,900 million litres/ day of municipal sewage and waste water into the river Yamuna. There are 80 hospitals and 1,000 nursing homes in Delhi. It is estimated that 30 metric tonnes

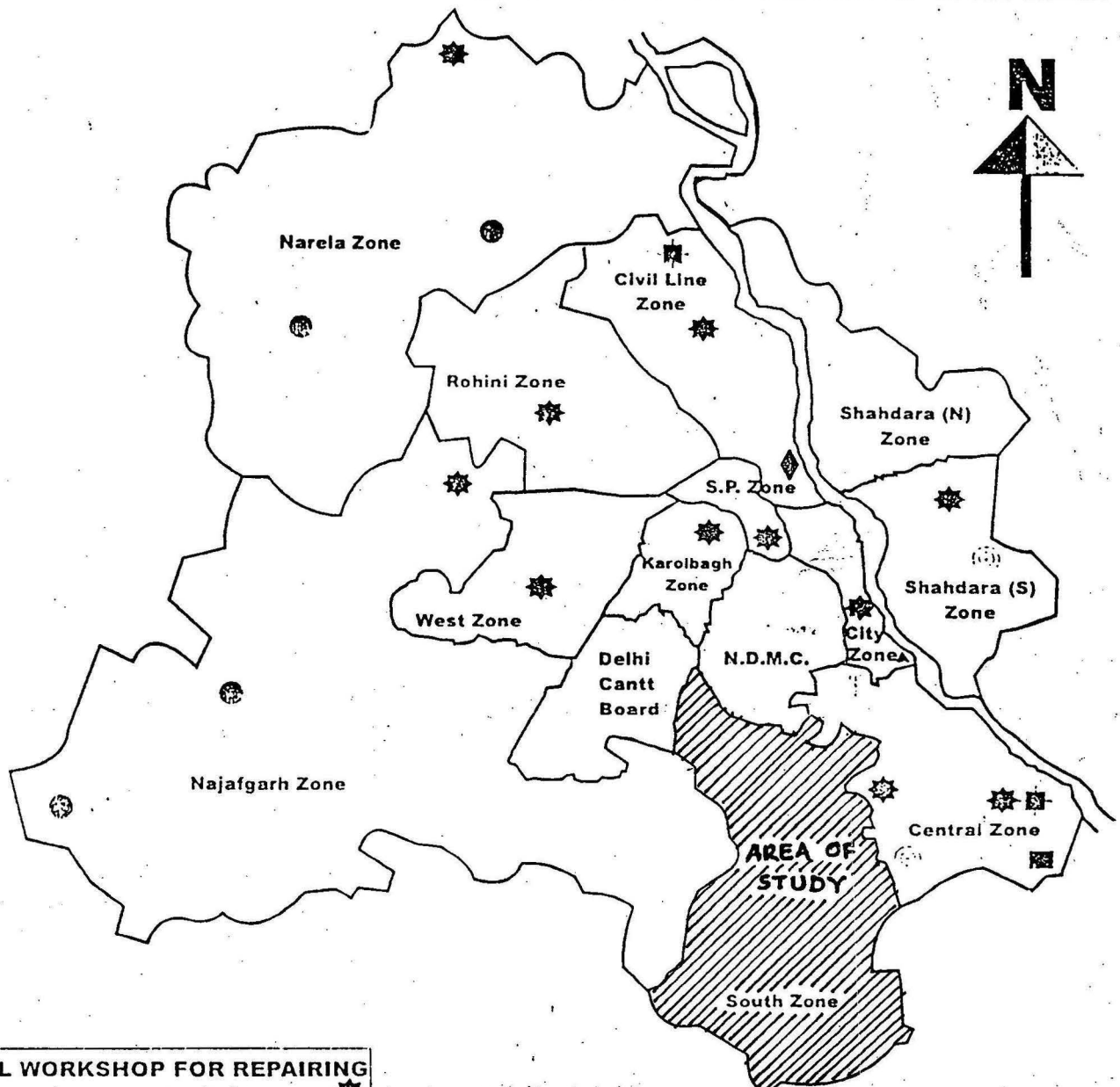
of medical waste is generated every day.[9] Though, some hospitals have disposal facilities with incinerators, the substantial portion of the medical waste is disposed off along the domestic waste with attendant danger of serious infection. Further, around 2,500 goats, sheep and buffaloes are slaughtered in the single authorised abattoir in Delhi, generating 50 metric tonnes of waste/ day. The number of small slaughter houses in Delhi is about 400. It is estimated that the total number of animals slaughtered in Delhi is about 15,000 to 20,000/ day. The quantity of plastic wastes generated in Delhi is estimated to be 300 metric tonnes/ day. The problem pertaining to the management of plastic waste is its non-biodegradability. The plastic waste reprocessed is about 1000 metric tonnes per day, a substantial amount of which comes from sources outside Delhi.

9 "White paper on pollution in Delhi", *Union Ministry on Environment & Forests, Government of India, New Delhi, 1997, p. 4.*

MUNICIPAL CORPORATION OF DELHI

CONSERVANCY AND SANITATION ENGINEERING DEPTT.

HOT SPOT IN M.C.D. AREA



ZONAL WORKSHOP FOR REPAIRING OF REFUSE REMOVAL VEHICLES

1. CITY ZONE	ON RING ROAD, I.P. ESTATE
2. SADAR PAHARGANJ	QUTAB ROAD
1. KAROL BAGH ZONE	CENTRAL WORKSHOP JHANDEWALAN
I. CIVIL LINE ZONE	MUBARAK BAD ON RING ROAD
5. WEST ZONE	SUBHASH NAGAR
6. ROHINI ZONE	SECTOR 3 ROHINI
7. NAJAFGARH ZONE	MANGOL PURI
8. NARELA ZONE	NARELA
9. CENTRAL ZONE	UNDER FLYOVER BRIDGE LODHI ROAD
10.SOUTH ZONE	COMPOST PLANT OKHLA
11.SHAH. (N) & 12.SHAH. (S) ZONE	JHILMIL COLONY IN EAST DELHI

WHEEL BARROWS REPAIR WORKSHOP	SLF, RING ROAD NIZAMUDDIN	A
CENTRAL STORE	NIGAM BODH	◇
COMPOST PLANT		■
1. OKHLA		
2. SLF BHALSWA, UNDER CONSTRUCTION		
SLF SITES		
1. GAZIPUR	EAST DELHI	
2. OKHLA PHASE-I	SOUTH DELHI	
3. BHALSWA/CROSSING ON G.T. KARNAL ROAD & OUTER RING ROAD	NORTH DELHI	

SLF SITE UNDER DEVELOPMENT AS ENGINEERED SLF SITE
1. ON JAITPUR/TAJPUR ROAD NEAR BADARPUR THERMAL POWER HOUSE IN SOUTH DELHI

PROPOSED SANITARY LAND FILL SITES
1. NEAR GAUSHALA ON BAWANA NARELA ROAD
2. NEAR VILLAGE SULTANPUR DABAS ON BAWANA KANJHAVALA ROAD
3. NEAR VILLAGE KAIR
4. NEAR VILLAGE DEORALA

HOW DELHI IS MANAGED ?

Solid waste management is an obligatory function of urban local bodies in India. The total area of Union Territory of Delhi is 1484.46 sq. km. And the following three statutory bodies are functioning within their respective territories in Union Territory of Delhi covering areas :

(1) Municipal Corporation of Delhi (MCD) – 1399.26 sq. km

(2) New Delhi Municipal Committee (NDMC) – 42.40 sq. km

(3) Delhi Cantonment Board (DCB) –42.80 sq.km

From the above, the Municipal Corporation of Delhi (MCD) has a total area of 1399.26 sq.km. within its jurisdiction, covering about 94.27 percent of the total area of Union Territory of Delhi. And one of the civic functions of MCD is the 'solid waste management' produced by various sources in Delhi. MCD has divided its entire area into 12 zones, namely, city zone, Sadar Paharganj Zone, Karolbagh Zone, Civil Line Zone, West Zone, Rohini Zone, Najafgarh Zone, Narela Zone, Central Zone, South Zone, Shahdara (North) Zone and Shahdara (South) Zone. The sanitation department i.e., conservancy and Sanitary Engineering (CSE) Department of MCD looks after the sanitation work within the jurisdiction of MCD in rural and urban villages, resettlement colonies, JJ Clusters, regularised and unauthorised colonies, roads, streets and various public conveniences. It also undertakes the work of cleaning of public toilets, urinals, etc., through its sanitation staff. Sufficient quantities of insecticides and disinfectants are used for up keeping the sanitation in these complexes. This

CSE department is also entrusted with responsibility of solid waste management. This includes collection, transportation and disposal of solid waste and desilting of storm water drains.

SWEEPING & COLLECTION OF SOLID WASTE

The CSE department's Safai Karmacharis who are appointed by the MCD, use brooms, wheel barrows, hand carts, Belcha etc. for sweeping and depositing solid waste in receptacles / dhalaos/ dustbins. As per Delhi Municipal Corporation (DMC) Act, 1957, it is the duty of the residents to deposit solid waste from their houses into Municipal receptacles.

The community bin system is used in the MCD area. Street sweeping work is carried out manually by Safai Karamcharis and the collected waste is deposited in community bins i.e, dust bins/ dalaos/ open sites, located at different parts of Delhi. A 'dalao' is a big collection chamber for garbage duly covered and garbage from these dalao is loaded to the tipper truck through a loader. A dust bin is a small size chamber for collection of garbage covered or uncovered from where the garbage is generally loaded into truck by loader manual labour. At some sites the waste accumulates in the open place due to non-availability of dust-bins in the vicinity and these are referred to as 'open sites' or 'spots'. From these dust-bins/ dalaos the garbage is transported and dumpted/ levelled at Sanitary Land Fill (SLF) sites situated in different ports of the city. The public participation in the collection work is minimal and concerted efforts are required to be made to seek their cooperation in the disposal work.

At present CSE department is collecting about 5500 metric tonnes to 6000 metric tonnes of solid waste daily from various collection receptacles and presently CSE department have about 2,400 receptacles i.e,. dalaos/ dustbins/ open sites in different parts of the city. Two Directors are working – one to look after the Trans-Yamuna area and other for the rest of the MCD area. The Directors are given overall responsibility for execution of all activities of the department. The total number of Safai Karmacharis is 43,362 which includes 6500 Safai Karmacharis for work other than solid waste management. There are 120 loaders on road and also 26 bulldozers are working at different SLF sites. The vehicles used for transportation of waste comprises 689 tippers. Of these, 123 vehicles are being replaced/ maintained at 9 workshops for 12 zones (including one central workshop), more often than not in the open, due to shortage of parking sheds. Major repair work is carried out at the central workshop while, minor repairs and maintenance work is carried out in the other workshops. The total expenditure on solid waste management during 1998-99 was Rs. 226 crores which is Rs. 174 per capita per year.

Presently, solid waste management in Delhi, is disposed off at three sites.

Sl. No.	Nameof the SLF Sites	Area	Expected Life
1.	SLF Bhalshwa SLF on crossing at G.T. Karnal Raod, Opp. SLF Bhalshwa, in North Delhi	40 Acres 8 Acres	6 Months 1 Year
2.	SLF Ghazipur in East Delhi	70 Acres	4 Year
3.	SLF Okhla Phase – I, in South Delhi	32 Acres	2 Year

In these sites, the incoming vehicles, loaded with solid waste, are directed to deposit the waste at a given location which is thereafter levelled by a bulldozer maintained at the site. However, in past 16 SLF Sites had been filled up with garbage and the same are being developed into forestry/ gardens/ parks/ green areas. And MCD has planned to start few more SLF sites for the future purposes, and they are at :

1.	Jaitpur	24.6 Acres
2.	Narela Bawana Road	150 Acres
3.	Sultanpur Dabar	100 Acres
4.	Near Kair Village	10 Acres
5.	Near Daurala Village	12 Acres

The SLF method is the commonest and cheapest method of waste disposal. In essence, landfill involves usually infilling of holes, old quaries and valleys with layers of compacted waste which are then 'sealed' with a layer of top soil. But it has associated problems of land and subsoil water contamination besides availability of land is becoming scarce from year to year for filling waste. Efforts have therefore to be made to minimise the wastes going to the land fill by resorting in to composting of organic waste and other methods and only rejects/ other inert waste should be land filled.

The MCD has a semi mechanised compost plant at Okhla on Mathura Road for making compost from solid waste of capacity of 150 metric tonnes/ day and it is being augmented to 300 metric tonnes/ day through private participation. The composting method is better for countries which are predominantly practicing agriculture. It can be done by aerobic and anaerobic processes. The aerobic process – is a biological oxidation process where the organic portion of the waste is decomposed and a material useful to agriculture is produced. This process can be completed in 45 to 50 days. On the other hand anaerobic processes of composting are very slow. It takes about 180 days to make compost. It is therefore not desirable to go for anaerobic composting. Besides it does not kill pathogens. Therefore, aerobic composting is more suitable to Indian conditions. Indian waste generally contains 30 percent to 50 percent of organic wastes. It also has the required moisture content. It is a low cost option and does not require high skills. It has a market potential and land requirement for disposal of waste get reduced. However, experience has shown that compost plants run by the municipalities are prove to failure in the long run because of poor organisation and management practices and lack of marketing skills to sell the compost. These plants should, therefore, be run under public – private partnership. Various possibilities like 'Build-own & operate (BOO), 'Build-own-operate and Transfer (BOOT) etc. can be utilised. This will remove a cumbersome responsibility from the municipality which instead of making a loss, will be assured of a small profit. Further, MCD has awarded a contract for installation of new compost plants at :

Compost Plants (Proposed)

1.	At SLF Bhalshwa	500 tonnes/ day
2.	At SLF Ghazipur	500 tonnes/ day
3.	At Narela Bawana Road	500 tonnes/ day
4.	At Sultanpur Dabas	500 tonnes/ day

(All above projects are to be alloted on 'BOT' basis)

The MCD is planning to extract energy from solid waste. At present three projects are at final stage of allotment. These plants are planned to be set–up at :

1.	At SLF Okhla	80 Percent work completed
2.	At SLF Ghazipur	Work awarded
3.	At SLF Bhalshwa	Work awarded

If sufficient quantity of methane gas is not available later on electricity may be produced. And it has been estimated that, two cubic metres of methane gas generates from one tonne of garbage. That means, the total methane released into the air every day in Delhi is about 12000 cubic metres. And it is established fact that, Methane is harmful and contributes substantially to the green house effect unless it is tapped for energy.[10]

Another method of waste disposal is incineration. It's a thermal process for burning the waste at a very high temperature. This is used to generate electricity through steam turbines and generator sets. Incineration requires high calorific value of the waste which could burn without any external fuels. But Indian waste contains only 3 to 7 percent of paper and plastics etc., when the waste reaches

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10 Sandhya Venkateswaran "Managing Waste : Ecological, Economic & Social Dimensions", *Economic & Political Weekly*, Vol. 29, Nos. 45 &46, November 5-12, 1994, p. 2909.

the disposal site. Its calorific value is found to be ranging from 800 to 1000 kilo calory/ kg. which is very low. The system of incineration is therefore not suitable under the Indian conditions on account of low calorific value of waste as well as on account of other constraints like (a) high capital cost (b) high operation and maintenance cost (c) the system requires high technical skill to man it. (d) system is not environmentally friendly (e) high ash and dust content. But, on the other hand, incineration of bio-medical waste is however strongly recommended for the maintenance of health of the citizens.

Another form of waste disposal is vermi-composting or vermi-culture. It is the process of producing manure from the casts of earthworms feeding on organic garbage. Here, earthworms are used for converting the wastes into compost (vermi-castings). This process has been successfully used in a limited scale in Bangalore, Pune, Mumbai, etc., but there are no large-scale centralised plant experiences in India.[11] This technology has a very good potential in the cities like Delhi where decentralised disposal (more number of disposal sites) is possible. It can be carried on even when small amounts of space, even on upper floors and roof tops, are available. Further, this technology has very good potential for introduction to slum areas and may also contribute to earnings of poor people.

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11 The theme paper presented at *South Asia Regional Meet on Community Action for Environmental Management : Special Focus on Urban Solid Waste Management* (hereafter referred as CAEM99), Organised by Delhi Action Group, New Delhi, 1999.

COMMENTS

Urbanisation is a natural out-growth of socio-economic development in general and industrialisation in particular. As urbanisation increases, so also does the extent and dimension of solid waste problem. And the urban solid waste management has remained one of the most neglected areas of urban management in India. With the rapidly swelling urban population, the requirement for infrastructure and services increases manifold. Solid waste collection and disposal is one such service, which needs to be adequately provided to ensure an urban environment conducive to the well-being and productivity of residents. The heavy concentration of population in megacities such as Delhi raise urban management issues of unprecedented proportions. On the solid waste front, it is estimated that by 2001, the Delhi city will be generating over 2.6 million tonnes of solid waste every year, out of the 39 million tonnes generated by the total urban population of India.[12] In Delhi the daily waste generated has been increasing by about 200 tonnes every year.[13] With collection rates at around two-thirds of the total waste generation, the problem of solid waste management is one of the most critical issues faced by Delhi today. Though solid waste management consumes 25 percent or more of Municipal revenue,[14] not enough attention is paid to this sector, and the situation has reached a crisis stage with the city landfills topping up fast, and not enough efforts being put in place to deal with the increasing volumes and toxicity of the waste, which is posing grave threat to the

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12 ibid, p.3.
13 Sandhya Venkateswaran, Opcit, p. 2907.
14 CAEM99, Opcit, p. 3.

health of the city inhabitants in general and safai karmacharis, who are engaged in solid waste management activities, in particular. (There is separate chapter i.e., 4th chapter, which deals with health aspects).

The urban population in Delhi growing at an annual rate of more than 3.8 percent and it is facing with multiple and complex environmental problems.[15] The MCD's areas have approximately 49 percent of population (including 26.7 percent in slums) in slums, JJ clusters and unauthorised colonies. A survey carried out by the National Institute of Urban Affairs (NIUA, 1989) found that waste collection in different cities in India ranges from 66 percent to 82 percent of waste generated. In other words we can roughly estimate that as much as 30 percent of municipal wastes are left uncollected. Quite apart from the overall shortfalls in collection, a look at the spatial coverage of solid waste management services reveals that in most of urban areas only about 70 percent of population is served.[16] That means, significantly, it is the poorer communities, the slums settlements or other areas of recent rural migrants, who have little political influence in demanding any service, which are left out. The result is clogged sewers, littered waste everywhere and rampant disease caused by the unhygienic conditions created by uncollected waste.

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15 Compendium of Environment Statistics, *Central Statistical Organisation, Ministry of Planning & Programme Implementation, Government of India,* New Delhi, 1998, p. 162.

16 Sandhya Venkateswaran, Opcit. P. 2909.

On the other hand slums and other low income areas are more congested and their density of population is very high and even then, they are not getting proper municipal service. In some places, even if they are getting municipal services, it's not adequate to meet the requirements. (Because, in most of the places, allotment of Safai Karmacharis is based on the size of the area and not on the density of population of that area).

According to the Interim Report for the supreme court, there is one dustbin for 130 persons, and this goes upto 2,389 in some places. And density of population in areas of MCD is 12,361 persons per sq. km. in urban areas and 1196 persons/sq. km. in rural villages in Delhi (in 1991). And the distance between the house hold and the dustbin varies between 50 to 100 metres. No compatible ratio has been maintained and it may adversely affect the efficiency of MCD. Besides, the design of the bins is also found to be inappropriate. According to a central pollution control Board survey – it reported that of the 984 receptacles, 370 were either dilapidated or not being properly managed, while 426 of them had garbage spilling over.[17] It also made an observation that the unhygienic condition compelled people to throw the waste from distance.

The street sweeping is another common method of collection of municipal wastes especially since most of the waste is disposed off on the streets. However, supreme court's Interim Report says that "Certain important roads and

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[17] Kazimuddin Ahmed & Nidhi Jamwal, "A Heap of Problems", *Down to Each*, Science and Environment Fortnightly, New Delhi, Centre for Science & Environment, January 31, 2000 p. 34.

markets are swept daily; some are swept on alternate days, twice a week or once in a week depending on the concentration of population / activity. Further, the road length for which a sweeper is responsible, is also not standardised. At some places, it is on the basis of sq. meters, ranging form 3,000 sq. mts. to 10,000 sq. mts., and at some places it is on a population basis – one sweeper per 500 to 1,000 persons.[18] It is no surprise, therefore, that street sweeping as a means to clean cities has failed miserably in urban India.

Further, after the garbage is collected, it needs to be transported to a safe disposal site. Here, too, there is no dearth of problems – inadequate fleet, out dated vehicles, no monitoring of vehicles movement and lack of coordination between the primary collection and transport department / sections.

Further, in the parlance of municipal officials, disposal of waste means dumping. Besides open dumping, the most commonly practiced methods for disposing of waste are SLF and composting. SLF is a scientific method by which refuse is reduced to the smallest practical volume and covered with a layer of earth. However, in India, Sanitary Landfilling refers to the crude dumping of wastes. There are no scientific methods involved in making or maintaining landfills. In most cites, the waste deposited at landfills is generally neither spread out nor compacted on a regular basis. During the rains, toxins presents in the garbage dissolve and mingle with ground water. According to Srishti, an NGO, says "it must be remembered that all landfills, no matter how well they are

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18 ibid, p. 34.

constructed, leak over time and there is a high risk of contaminating the ground water. According to Mr. A. K. Lal, planning engineer, Town and country planning Organisation, New Delhi, says "properly designed and monitored sanitary landfills with layers of impermeable linings at the bottom and piping to relieve the methane gas pressures, as also to drain off leachate, are almost non-existent in India".

The second method is composting. Here, the problem arises when the composting process is not followed properly. Because, unsegregated waste is just dumped in a pit and allowed to decay. The entire operation is unhygienic, unscientific, foul-smelling and very slow, because one has to wait for 40-45 days.[19] A report prepared by central Pollution Control Board in March 1998 pointed out that, "the Okhla compost plant in Delhi, though operating, cannot be considered good. The existing machinery needs over-hauling and effective maintenance. The compost quality needs to be analysed for health safety before selling it to private users.

From time to time, studies have been carried out, and recommendations have been made to solve the problem of solid waste management. Some of the short comings of the solid waste management system in the country are :

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19 ibid, p. 35.

Institutional Deficiencies : Though MCD is responsible for solid waste management system, there is no proper accountability. For example, in MCD, out of more than 43,000 Safai Karmacharis, only 33,000 are available daily in the field and rest serve as domestic servants at the residents of politicians and bureaucrats. The absentee rate is 25 percent. But even then these absentees are getting their attendance. On the other hand the division of responsibility among the various sections in the solid waste management department is also not well defined. As a result, coordination among section is often lacking.

Productivity Of Solid Waste Management Staff : In the absence of work norms and effective monitoring systems, the productivity of labour and equipment is very low. Further, the mismanagement is also due to lack of expertise and sometimes, municipal health officers do not have any expertise in the science of solid waste management. They then pass on the work to sanitation officers, who are even worse.

Financial Aspects : Solid waste management service has never caught the attention of decision makers. It is no surprise, therefore, that it suffers from an acute lack of funds. But it is also true that whatever limited funds it get is also not utilised optimally. Rampant corruption is eating into the solid waste management system.

Finally, it is known fact that, Delhi is suffering from shortages of basic infrastructure facilities and services such as water supply, sanitation and solid waste disposal. Not only are there shortages but there also exists unfair distribution among the different parts of the city as well. Peripheral areas lack these services. Although the major impact of unfair distribution of these services is absorbed by urban poor and low-income areas it is not restricted at that level and impacts are felt at all sections of society and in industry and the urban economy as a whole.

Infra-structure inadequacies have resulted primarily on account of ineffective planning and management coupled with non-involvement of community in these processes. This has also resulted in service leakages and financial losses due to non-revision of their tariffs over several years. It is not well understood that preventive action such as the setting up of sewerage and solid waste systems can go a long way in reducing health problems of the populations. In fact one crore of investment in urban infrastructure can save more than ten crores in medicine and treatment cost. In effect the price people pay for these service is minimal leading to much higher costs in health treatment at a later date.

CHAPTER - IV

HEALTH ASPECTS OF SOLID WASTE MANAGEMENT

Despite measures solid waste generation continues to grow at the global level. Indiscrimine dumping of solid waste around waste bins, on the streets, in water bodies, give rise to air and water pollution. Unlifted waste from storage points causes health risks. Because solid waste may potentially contain any of the solid materials found in nature and in addition to many of the man-made materials they constitute the most heterogeneous collection of substances possible. Laws and ordinances may prohibit certain materials from being put into the solid waste stream, but these regulations are no guarantee that occasionally prohibited substances might not appear. The solid waste has been found to contain, in some instances, toxic substances or diseased cultures. Therefore, whoever is charged with responsibility for solid waste management, must / should take proper steps to tackle any of the specific dangerous substances.

The disposal of solid wastes was not a serious problem so long as population was small and the land available for assignment of wastes was large. However, the practice of dumping solid waste on roads, unpaved streets, and vacant land in medieval towns served to swell the population of rodents, and fleas associated with them functioned as carriers of germs. For example, the out break of plague, the black death – killed 50 percent of the European population in the 14^{th} century and claimed many more lives in subsequent years by repeated

outbreaks than in the two world wars together.[1] Further, improper management of solid waste adversely effects ecology as well. For instance, leachates from waste dumping sites contaminate surface water and ground water in the neighboring areas with such elements as copper, arsenic and uranium etc, which pose serious risks to health. While the capacity of natural processes to dilute, disperse, degrade, absorb, or otherwise dispose of the unwanted residues or waste is well known, but this capacity of natural disposal process is under tremendous stress given the enormous quantities of waste now generated. A prime example of enormous quantity of solid waste accumulating to disturb the national economy is the case of Surat City. Surat city which is one of the most affluent second range city[2] with assets of over 1000 crores did not even invest Rs. 80 lakhs in 1994 on its solid waste management system. The plague struck Surat and the city stopped functioning, this affected the state of Gujarat and India too. In effect not only Surat but the whole country had to pay a much higher cost in terms of both human life and resources. In the same manner, many of Indian towns and cities are virtually sitting on volcanoes of epidemics which may break out at any time as we have seen in Surat and as experts warned about Delhi. Because, in most of the Indian cities nearly half of solid waste generated remains unattended. This gives rise to insanitary conditions specially in densely populated slums. This in turn has resulted in increase in morbidity and mortality especially

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1 Presidential speech of V. Suresh, Chairman and Managing Director, HUDCO, at *Regional Meet on Community, Action for Environmental Management,* December 3, 1999, New Delhi.

2 All four megacities, Bombay, Calcutta, Chennai and Delhi are considered as first range cities.

due to infections in all segments of urban populations, with the urban slum dwellers and waste handlers beings the worst affected, because of periodic out breaks of food-borne, water-borne and vector borne diseases. And environmental consequences of ground and sub-soil contamination is also very important to be considered. It is therefore important that, necessary steps should be taken immediately, to improve urban solid waste management, environmental hygiene and sanitation, so that the adverse health and environmental consequences of rapid urbanisation are minimised.

In regard to public health, the primary consideration in the treatment and disposal of solid waste is the prevention of communicable diseases transmitted by enteric, parasitic and vector borne diseases caused by toxic substances. These dangers are far greater in developing countries than in the developed ones because of the greater prevalence of disease organisms. In March 1980 the World Bank published a policy paper on health[3] which reported that the most deaths in developing countries are caused by diseases transmitted by human wastes (intestinal, parasitic and infectious diarrhoeal discusses), by airborne infections (tuberculosis and pneumonia) and malnutrition.

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3 Health Sector Policy paper, 2nd ed., World Bank Report, Washington D.C., March 1980.

Percentage distribution of deaths, by cause, in developing and developed countries.

	Causes of Death	Developing Countries	Developed Countries
1.	Infectious, parasitic and respiratory diseases	43.7%	10.8%
2.	Cancer	3.7%	15.2%
3.	Circulatory diseases	14.8%	32.2%
4.	Traumatic injuries	3.5%	6.8%
5.	All other causes	34.5%	35%

Source : Health Sector Policy paper, World Bank, 1980.

As seen in the above table, the basic health problems of the less developed countries are essentially those related to faecal-oral transmission[4] and vector borne diseases. More specifically, in tropical country like India, higher temperature and humidity favour the proliferation of insects and accelerate the decomposition of organic matter in solid waste. Consequently, more frequent waste collection is required.

The night soil or human excreta disposal is a specific aspect of solid wastes disposal. Handling such waste involves serious health hazards. Because, human excreta is the principal source of the pathogenic organisms carried by water, food and insects. More than 100 different virus types are known to be present in human faeces. More than 1,000,000 infectious virus particles may be

4 Like diarrhoeal diseases, dysentery, cholera, shigellosis, typhoid etc.

excreted per gram of faeces by infected persons, regardless of whether or not they manifest illness. Concentrations as high as 100,000 infections virus particles per litre have been detected in raw sewage. These viruses many survive for several months in waste water, tap water, soil and shell fish. Further more, they may resist conventional water waste water treatment procedures, including chlorination.

From public health point of view solid waste can be categorised into three categories, with sub-categories that are based largely on their sources i.e., their processes of generation. And three categories are (a) domestic wastes like house hold refuse, street sweepings, and human excreta etc. (b) special and hazardous wastes like health care wastes, toxic chemicals, pharmaceutical and other industrial waste and (c) other bulky wastes like, untreated abattoir waste, construction and demolition debris. With asbestos components and sludges of treatment plants etc. Most of these wastes can be isolated at the source of generation and managed in a rational way. But in practice, the Municipal waste stream is usually a mixture of two or more of the categories. This is the reality in most of the developing countries, where to a large extent waste management systems have generally broken down.

POTENTIAL HEALTH IMPACTS IN THE WASTE CYCLE[5]

The public health impacts of solid waste can occur along all stages of waste cycle. Mismanagement of waste at each point along the cycle has the potential of introducing both short and long term health impacts and these call for serious attention. Some of these potential impacts are, firstly, the accidental injuries such as individual cuts from sharp waste to which people who handle waste regularly are especially vulnerable. There have been huge piles of waste that have become destabilized, in the process collapsing and burying workers or even a number of shacks with their inhabitants. Small amounts of hazardous chemical waste in garbage may result in accidental wounds but may also lead, in some extreme cases, to poisoning. Many cases are on record of children playing with radio-active hospital waste illegally collected and dumped from hospitals, with the eventual result that the children contract cancer.

Secondly, we shall discuss about infections. Blood infections such as tetanus, resulting from injuries caused by infected sharp wastes, are common. Ophthalmologic and dermatological infections from exposure to infected dust are also possible. Enteric infections may result from accidental ingestion of waste, but more often such infections occur from drinking water from unconfined aquifers or nearby streams polluted by leachate from waste, from consumption of raw vegetables produced in fields irrigated with contaminated leachate from

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5 Here 'waste cycle' refers to different stages of waste management i.e., from waste generation to collection, transportation & various disposal methods.

waste piles, and from eating food in garbage.[6] Worm infestation among children results mainly from direct contact with human excreta. Infections may also be transmitted through rodents and insects feeding on waste and acting as passive carriers of disease germs. Many tropical diseases transmitted by vectors such as mosquitoes have their origins in breeding ponds created by indiscriminate waste disposal. Zoonosis, a disease carried by stray, wild, and scavenging animals feeding on waste, is also reported in many parts of the world.[7]

GENERATION & STORAGE LEVEL

The production and storage of all kinds of waste provides the first point of contact with human beings and the environment. The concern is more on special and hazardous waste, especially during the production of industrial products with toxic by-products, whereas the attitude to domestic and bulky waste is usually casual. But the inclusion of relatively small quantities of infectious and toxic waste, such as bottles containing hazardous pharmaceutical products, photographic material, batteries, infectious health care wastes and sharps, excreta, and other such substances, can turn seemingly ordinary domestic waste into potentially dangerous waste which may cause serious health impacts on both public as well as workers who handle the waste. Further, storage conditions are important sources of public health impacts arising out of exposure to

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6 As we generally seen of scavengers & ragpickers use to take their food at the waste disposal sites.

7 International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management", UNEP – Technical Publication Series-6 (Hereafter referred as UNEP Series), Osaka, 1996., p. 397.

contaminated waste, which creates fertile grounds for the breeding house-hold pests, and the obstruction of natural drainage channels which leads to flooding and environmental damage. Back yard dumping or storage of waste often creates harmful odours from decomposition and breeding grounds for insects and rodents that are potential carriers of infectious diseases.

WASTE RECOVERY, RECYCLING & REUSE

Solid waste picking is widely practiced in developing countries and socio-economic conditions of these waste pickers will not allow for its abolition or prohibition. Waste pickers are very vulnerable because they belong to the most under privileged groups of the population and are most often illiterate. They are exposed to serious health hazards from waste and are also exposed to social and economic abuses from waste recycling traders. In some cities waste picking families build their huts near the dumping sites. Some may be born, live, work and die in these sites. Street children very often survive through waste picking. Health surveys have shown that the health status of waste pickers is very low, and that they suffer from a lot of infections, including persistent skin infections. Their life expectancy is far below the average in their respective countries. Further, these waste pickers can be protected in the same way as regular waste workers are being protected, at least, to some extent. But in developing countries, occupational health and safety services are rarely sufficient for these waste workers and obviously waste pickers can expect none of those services or facilities. However, if waste pickers are organised and receive assistance, their

situation can be improved, both their working conditions as well as their housing and sanitation.

COLLECTION AND TRANSFER

One important hygienic requirement in public health is that solid waste produced, even in low income areas, be collected and carried away from direct human contact. If uncollected garbage piles up in human settlements, inhabitants will be exposed to direct health impacts. Domestic solid waste properly handled at home but inadequately stored prior to collection will also expose people to negative health impacts.

In Indian cities local governments are often unable to collect most of the solid waste produced in their cities. Collection rates below 50 percent are common for most of the cities & towns, which means practically no collection in low-income neighborhoods. This situation results in waste piling up in those neighborhoods. All inhabitants of unserved settlements are exposed to direct contact with waste, but pre-school children are the most exposed as they seldom move out of their neighbourhood and are more likely to play around the uncollected waste heaps. Further, the organic fraction of uncollected waste undergoes fermentation[8], which creates conditions favourable to the survival and growth of micro biological pathogens, especially if wastes are mixed with human excreta due to lack of latrine facility. If anaerobic fermentation takes place, this

8 Fermentation is the chemical change which takes place when exposed to air.

results in methane gas generation which with temperature, increases inside the waste, can lead eventually to the start of a fire. Organic waste is also the feeding stock and natural environment for insects and rodents, which are potential carriers of enteric pathogens. Such waste is also ideal for stray and scavenging animals which are potential carriers of zoonosis disease. Uncollected waste might also contain sharp objects which are potential sources of infective wounds and also small amounts of hazardous chemical waste.

Finally, inadequate collection of waste means open and indiscriminate dumping, which tends to obstruct storm water run-off. This results in flooding and creation of ponds during the rainy season that become habitat and breeding places for water-borne vectors of tropical diseases. Parasitic worms such as hook worm survive on soil polluted by waste and will infect barefooted people. Waste collection or disposal operators are exposed to direct impacts from waste. Waste handling workers are particularly vulnerable because of their low educational status, and are therefore difficult to reach by health education and preventive actions. Waste handling workers are exposed to health hazards resulting from direct handling of and contact with waste. Further more, many public health problems are arising from transfer and transportation of waste. They are related to improper safeguards in the transfer or transportation process. Uncovered transportation containers cause littering of the waste and the possible spread of airborne contaminants and leachates from trucks used for transportation are another source of pollution. And worst-case scenarios are

enroute accidents that result in ground and surface water contamination. Therefore the choice of low-risk transportation routes are better than high risks ones.

TREATMENT & DISPOSAL

Waste treatment and disposal facilities have the potential to create health hazards for waste (handling) workers and they also create health hazards and nuisances to populations living in their vicinity. For this reason the location of such facilities to be reasonably far away from human habitat is desirable. Waste disposal facilities also create wide-ranging environmental impacts. The most significant of these indirect impacts are ground water pollution by leachates from waste landfill, and air pollution by municipal incinerators' exhaust gases. Further, waste disposal operators, waste pickers, and occasional visitors are exposed to infectious wounds, inhalation of infected dust, skin contacts with infected material, bites from disease transmitting insects or animals, and burns or injuries from many kinds of accidents. These accidents may result from the movement of trucks and bulldozers on the site, from spontaneous fires started inside the waste, from methane gas explosions inside the dump, or from the collapse of waste hill slopes. Nearby populations are exposed to high noise levels from disposal operations, to air pollution from dust and smoke produced on the dump, to strong odours, and to infective bites from animals and insects that live and breed on the dump. Human habitation should thus not be permitted close to treatment and landfill sites. Unfortunately, in some cities, waste pickers and their

families tend to build their huts very close to if not on landfill sites, and their removal may be a very sensitive issue. An example is the lengthy negotiations over the closure of the "Smoky Mountains" dump in outskirt of Manila City of Philippines. Further more, recently, (July 2nd week, 2000)[9] in Manila City, at least 135 people were confirmed killed and upto a hundred remained missing after the massive pile of garbage collapsed on a community of scavengers living in shanty dwellings at the dumpsite.

HEALTH AND DIFFERENT DISPOSAL METHODS

COMPOSTING & REUSE :

Composting and reuse are, if improperly carried out may generate some health hazards. Composting workers, when poorly protected, are exposed to infected dust inhalation and to infective wounds from sharp waste. They are also exposed to occupational accidents during waste shredding operations. In developing countries like India, farmers working barefoot are exposed to infective wounds from small sharp waste included in poorly processed compost. Separately collection of small amounts of hazardous waste does imply some health hazards to poorly protected or poorly trained workers. These hazards may be infectious or toxic. Any recycling or non-disinfected infections waste and composted heavy metals does imply health hazards for the operators and for the general population. In particular, no discarded medical equipment such as

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9 "*Garbage avalanche hits Shanties*", The Hindu (Delhi), Series of articles on July 11, 12 & 14, 2000.

syringes and scalpels[10] should be reused. They should be prevented from entering the waste stream where waste pickers operate.

INCINERATION

Municipal incinerators become feasible when land appropriate to land filling is scarce and or extremely expensive. Incineration is also cost-efficient when the waste is of a high calorific value and the thermal energy production is recovered for energy generation. Proper siting and proper emission control facilities are very important to limit population exposure to air pollution, particularly in densely inhabited large cities. Besides air pollution, environmental impacts of incinerators result from the need to dispose of bottom ash, fly ash and waste water produced by exhaust gas cleaning processes. Fly ash and acid waste water from gas cleaning are hazardous chemical wastes. Incinerator operators are exposed to occupational and industrial accidents. They are also exposed to high levels of noise, temperature and air pollution. The population living near by incinerators will not only be exposed to the consequences of any industrial accidents, but also to significant levels of noise and air pollution.[11] The best way to protect the populations is to allow settlements only outside the perimeter of fallout from the incinerator stack plume[12], which requires expert calculation. The general population of the incinerator exhaust gases are not

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10 Small surgical knife.

11 UNEP Series, Opicit, P. 400.

12 Stack plume is a brick pillar type structure which housing the chimney.

properly treated. They may also be affected by water pollution if ash and waste water from the incinerator is not properly treated and disposed of.

Further, dioxins emitted by incinerators when poor combustion conditions prevail are included in particulates which settle on the fields located within the perimeter of the incinerator stack plume. Animals grazing in those fields may ingest dioxin particulates. If those animals are milk producers, dioxin, which is liposoluble, will concentrate in the milk. To avoid potential human toxication, it is recommended that grazing of cows and other milk producing animals be forbidden on any field included in the perimeter affected by particulate fall out below the plume of the incinerator stack.

Ash from incinerators has been reused in civil engineering works in some countries. However, the trend is to dispose of such ash in leachate proof landfill sites to avoid any risk of underground pollution by soluble toxic chemicals washed out from ash. Fly ash is very hazardous as it concentrates most heavy metals and toxic chemicals emitted by the incinerators. Fly ash, usually containing alluminium, may cause explosions due to the generation of hydrogen gas. It should thus be combined with wet solid ashes and stored in closed containers. Fly ash may either be treated like other hazardous chemical waste, or it may be solidified either in cement mortar, ceramics, bituminous sand, or plastic foam. When solidified it may be disposed of in leachate proof landfill sites together with bottom ash. Waste water produced by incinerator gas cleaning

facilities has a high acidity content. This acidity must be neutralised with alkali before discharging such waste water into any sewerage system for treatment. Under no circumstances should the effluent be discharged into the environment without prior treatment.

DUMPS & SANITARY LANDFILL SITES

Dumps i.e., open dumps and waste landfill sites have a major impact on both surface and ground water quality with subsequent potential health hazards for people who depend on such sources. Rain water run off from landfill sites or open dumps will reach nearby streams after having been heavily polluted through contact with waste. But the most serious threat comes from leachates infiltrating into unconfined acquifers below a dump or landfill sites. This results in chemical and viral pollution of ground water is far greater than from polluted surface water, because rural populations around the landfill sites may drink from shallow wells without treatment. Even where the well water or the receiving river is subjected to treatment, this treatment may not be efficient against some of the chemical pollutants from landfill leachates.

To protect surface water quality it is necessary to prevent water flowing over or infiltration through the landfill sites is essential in order to divert runoffs directly into a surface water treatment arrangement. To protect underground water quality an impermeable layer of clay or high density plastic must be engineered on the bottom of the landfill sites. A drain layer linked to leachate extraction pipes should also be engineered above the impermeable layers. Extracted leachate is then sent to a treatment plant designed for treatment of highly polluted wastewater.

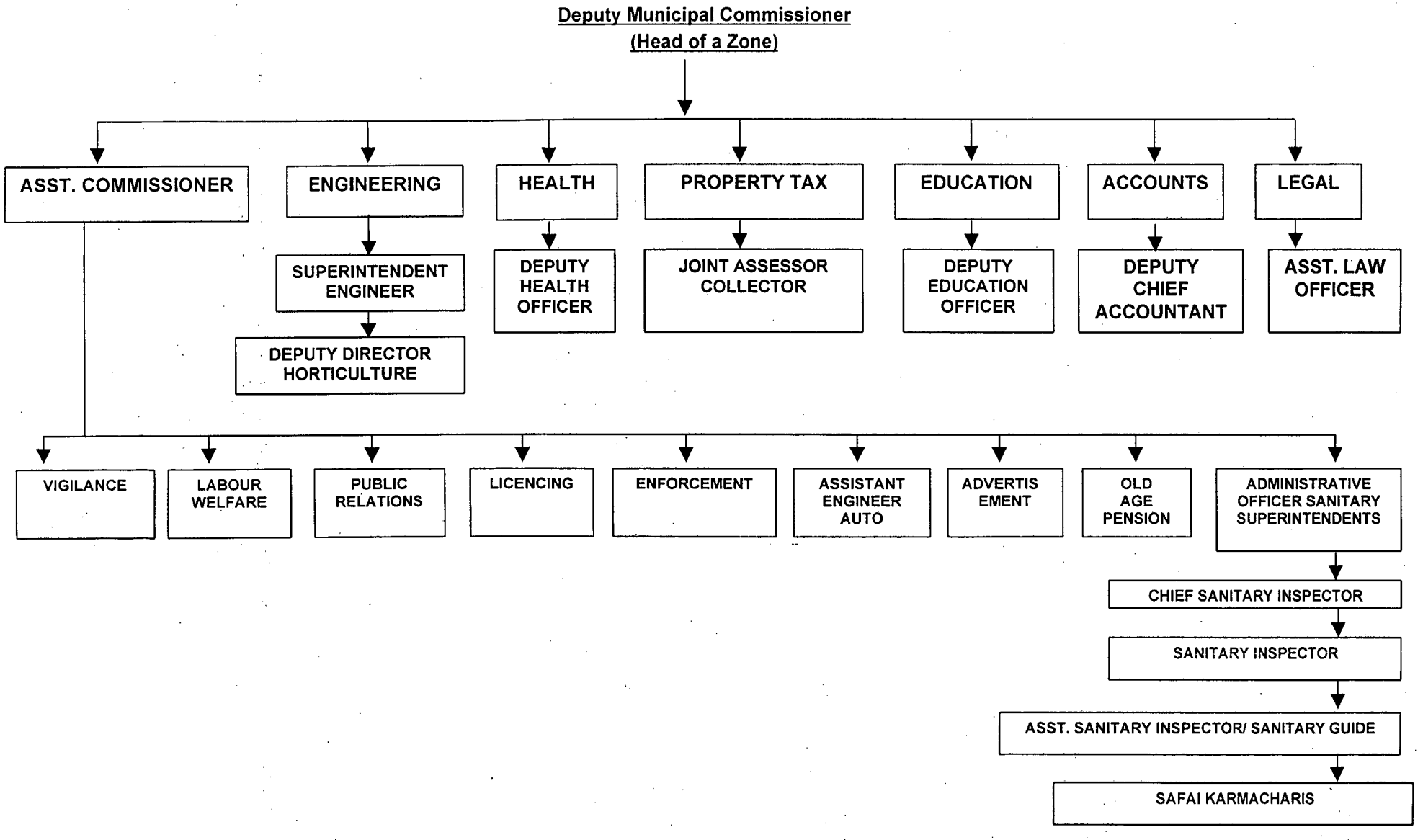
DELHI - A CASE STUDY

With the formation of Municipal corporation of Delhi in 1958, the area of MCD has been divided into 12 different zones. Among these, the third largest zone (in area wise) is South Zone, where the present fieldwork for this study was conducted. The Head Office for this Zone is situated in Green Park area near Hauz Khas in Delhi. The population of this Zone, according to a rough estimate, is more than 20 lakhs. Further, this Zone is divided into 19 circles. The number of Safai Karmacharis in South Zone are about 1470 who are working on the basis of daily wages and about 3089 are working as permanent safai karmacharis. The following chart **(See the Chart),** presents the organisational set-up of a Zone. The Deputy Commissioner is the head of the Zone and Chief Sanitary Inspector (CSI) is head of the circle. Further this hierarchy ends with the designation of Safai Karmacharis, whose health aspects is focused in this fieldwork.

Two circles - Chattarpur circle and Green Park circle, have been selected for fieldwork in which 30 Safai Karmacharis (Workers)[13] were interviewed in three groups. In each group ten Safai Karmacharis were interviewed. These three groups[14] of Safai Karmacharis were working in three different residential areas having different income level, i.e., Group-1 in lower middle and middle class area, Group-2 in slum area, and Group-3 in posh middle class area. First two groups were working in Chattarpur circle and third group

13. I have used the word 'workers' as synonym for 'safai karmacharis' in some places.
14. Which are referred to as Group-1, Group-2 and Group-3.

MCD–ZONAL SET-UP (GENERAL)



in Green Park circle. The reasons to select these 3 different localities, of different income level, are.

To observe the type of solid waste generated in localities of different income groups.

- To observe the different proportion of solid waste in the localities.
- To observe the perception of Safai Karmacharis about solid waste management.
- To observe the impact of waste on health of safai karmacharis who are handling different types of solid wastes, generated in different localities of varying income level.
- To observe the variation in waste management in these localities.

GROUP - 1

GENERAL INFORMATION OF GROUP-1 SAFAI KARMACHARIS

In Chattarpur circle No. 58 of MCD, ten Safai Karmacharis were interviewed and out of them 8 were male and their age range was 25 to 50 years. And the two females were 30 years old. Educationally, only 3 persons were literate, who are male safai karmacharis. All most all safai karmacharis belonged to Valmiki caste except one who belongs to Jatav caste. In their family structure, only one family was nuclear type having six members and others were of joint type having 6 to 31 members. In big joint families there were more number of earning members i.e., upto 4 members. Out of 10 cases, 4 were working on temporary basis (daily wages) and rest were permanent. The temporary safai

karmacharis[15] get Rs. 2400 to 2600 per month as their salary. While permanent safai karmacharis (also known as Pakka Workers) get around Rs. 5000 per month. Both the female safai karmacharis have migrated from Uttar Pradesh for the sake of this job. Only after working for 10 years, a (Kachcha) safai karmachari becomes a permanent employee (i.e., Pakka safai karmachari). Those working in Chattarpur circle were mostly staying outside the locality and five of them were coming for the work from a distance of 8-12 Kms., taking a minimum average of 30 minutes by bus or by bicycle to reach their place of work.

GROUP - 1 SAFAI KARMACHARIS PERCEPTION ABOUT SOLID WASTE MANAGEMENT

The area in which Group-1 safai karmacharis were working, consisted of middle class and lower middle class. Most of the safai karmacharis in Group-1 said that the people are throwing solid wastes which includes polythenes plastic bottles, polythenes full of house hold refuse, human excreta etc. Only one worker complained about throwing of dead animals like Cat, Dog, Rats, etc. Another worker complained that public are throwing waste on streets and drainage's resulting in disruption within few days. Regarding different proportion of solid waste, most of the safai karmacharis talked about municipal waste only in general terms. Although they mentioned polythene, human excreta etc, they did not differentiate household

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15. Temporary workers are also known as 'Kachcha workers'.

refuse on the basis of its constituent materials. But one worker talked about vegetable waste, and seasonal waste like groundnut shells, etc. Only one safai karmacharis talked about glass pieces. Further, the occupation of the residents in this area was small business, jobs in factories, shops, etc. Two of the safai karmacharis were not aware of the occupation of the residents. Out of ten safai karmacharis only one worker said that the size of dustbins kept in the area are not in appropriate size, infact he suggested for bigger ones. Three safai karmacharis said waste bins are of inappropriate size, and rest of them do not know whether waste bins are in proper size. Daily, waste is being lifted from waste bins to trucks. If in case waste bins are bigger, the JCB loaders will lift the waste and transfer it to trucks or otherwise beldars[16] do that job. After lifting the waste, trucks carry this waste to land filling site situated in Okhla Phase-I. In fact, the solid waste from whole South Zone of MCD is dumped in this hand fill site. Only truck beldars are, for past one year, getting hand gloves and gum boots. Remaining others are using equipment's like Kolchi, Pachangda, Belcha, Kasoli, Favdi, Jhadu and Wheelburrow etc. Not all equipments are used at one place and time. They use them according to the requirement of the tasks. When asked about the safety of equipments, 5 safai karmacharis said that they are satisfied, and 3 of them considered the handling of equipment's to be unsafe. According to them if provided all the equipments that are meant for them, it will then be safer. But MCD is not providing most of the equipments. After completing their work all safai karmacharis take both in their home, and bathing facility is not available

16. Who use to lift the waste from waste bins.

in office premises of whole MCD. All the safai karmacharis are using soaps to clean their body and clothes. Out of ten only 5 are satisfied with ongoing process of solid waste management, 2 were not satisfied because of lack of proper equipment and remaining don't know whether the process is good or not. They said that except in compost plant, there is no sorting out process of solid waste before dumping of solid waste at land filling sites.

HEALTH INFORMATION OF GROUP - 1 SAFAI KARMACHARIS

In the last one year among the ten workers of Group-1, Six suffered from fever, one from malaria, one safai karmachari was suffering from asthma for past two years and two of them have not suffered any disease. The safai karmacharis felt that because of their nature of work they are getting diseases. But two workers said that they don't know the cause of fever. Those who suffered from fever considered their sickness to be non-serious when compared to the safai karmacharis suffering from Asthma. Fever is irregularly reappearing with no fixed time gap. When they get fever they go to a private clinic. In the process of treatment doctors advise the workers not to go for work but Kachcha Workers said that it they don't go to work, they don't get salary of that day. Because, they are working on temporary basis. Pakka Workers are getting medical allowance but that procedure is lengthy so usually, they said they don't avail medical allowances. Further, apart from the chronic / communicable diseases there are also other possible risks / injuries which frequently occur at the workplaces. All the workers reported that injuries are caused by glass pieces, wails, blades, etc. Only one worker, suffered due to glass piece 6 months back, and he took treatment and injection in a private

clinic near his house, and he didn't go to work for 2 days. Workers are getting compensation for the severe injuries resulting in death, or permanent handicap. Kachcha Workers, don't get any compensation from MCD. There is no separate hospital which is meant only for safai karmachari. In event of sickness, they have to go to government hospitals which are meant for public also. These workers are having Safai Karmachari Unions. Out of 10 workers, in Group-1, 5 were satisfied with working of the unions. And 3 complained about the corruption in Unions. One did not give his opinion and said unions are doing something.

INDIVIDUAL CASE STUDIES

1. Case No. I, Tularam, Asthma, Age 49, Male :

Tularam is a resident of Hosala Fatehpur and is working in MCD for the last 22 years. Two years back he came to know that he has asthma disease. He says that because of the nature of his work, particularly exposure to dust at work-place, he got this disease. He consulted government hospital, but doctors did not take much interest or care on him so he went to private clinic. Doctors are giving tablets and tonics. Whenever disease become severe he stops going to work, otherwise there is no reason for his absence from work. He said that the MCD is providing medical leave but one has to submit medical reports. Now he has changed his work from waste lifting to spraying DDT powder at different waste bins, streets, lanes etc.

2. Case No. 2, Rakesh Kumar, Malaria, Age 30, Male :

Rakesh Kumar is resident of Chatturpur and working in MCD for the last 8 years. Three months back he suffered from Malaria. He is of the view that solid waste is the main agent which caused the malaria. He consulted private nursing homes where he was treated with medicines. Within few days (in one week) he was cured. Since then malaria has not re appeared. Rakesh Kumar stopped working till he got well. He paid medical charges on his own. He considered the delayed payment of salary (after 10th day of the every month) to temporary workers to be the main cause of their financial difficulties which hindered them in taking immediate remedial steps in case of illness and other emergencies. The unions were seen as unresponsive to the problems of temporary workers.

GROUP - 2

GENERAL INFORMATION OF GROUP -2 SAFAI KARMACHARIS :

In second group of Safai Karmacharis, interviewed in Chattarpur Circle No. 58, except two, one female and one male, both of 45 years age, rest were below 36 years. And of them 5 were literate and others are illiterates. Here in this group, all the 10 Safai Karmacharis belonged to valmiki caste. When their family structure is analysed, it is seen that 3 families were nuclear, whose members vary from 3 to 9 and rest were joint families whose members vary from 10 to 35. In some joint families there were 5 earning members. Salary

wise, 4 Safai Karmacharis, are getting around Rs. 2400 as compared to 6 permanent workers getting around Rs. 5000 per month. Out of ten workers, five were locals and rests were imigrants, i.e. 3 were from Haryana and 2 from Uttar Pradesh. Kachcha workers have been working in MCD for the last 5 to 8 years. And remaining permanent workers have been working for the past 11 to 26 years. Except 4 workers rest were living in their own houses. And 8 workers were availing bus facility to go to their work place daily. Of the remaining two - one goes by walk and other by bicycle. The distance between the workers' residence and their work place varied from ½ km. to 60 kms. The person who was coming from a distance of 60 kms was travelling in truck for first 50 kms (from his residence in Uttar Pradesh border), and for remaining 10 kms, he comes by bus. The time taken to reach their workplace, from their residences, varied from 15 minutes to 3 hours.

GROUP -2 SAFAI KARMACHARIS PERCEPTION ABOUT SOLID WASTE MANAGEMENT

The area in which Group-2 Safai Karmacharis were working is a slum area (locality) In this area, the waste thrown by people includes, ash, cow dung, human excreta[17], polythenes with full of household refuse, vegetables, waste paper, soil in polythene etc. The different proportion of solid waste in this area includes mostly of ash from choollah, cow dung, human excreta. Polythene bags etc. vegetable refuse is also a major content. Further the

17. Because of shortage of latrine facilities, the proportion of human excreta is more.

occupation structure of the residents in this area shows that most of them are labourers, some are do in petty shop business, few are doing animal husbandry, some are working in factories. Out of 10 workers, 4 were satisfied with the size of waste bin kept in this area. But 3 complained that population is more as compared to other residential areas, so bigger waste bins are needed. The remaining workers did not know about the appropriateness of size of waste bin in the area. Further, regarding safety of the equipment's provided to workers by MCD, almost nine are satisfied but their argument is that the equipment are very old and they do not work properly. Only one safai karmachari said that they are not safe and wanted more advanced equipment. Workers take bath after completing their work in their houses. And regarding the waste management, almost all the workers are satisfied with the ongoing process of solid waste management. Because after loading the waste into trucks, they forget the loaded waste and loaded trucks will go and dump the waste, mechanically, at and full sites. And most of them don't know whether the dumping sites are safe or not.

HEALTH INFORMATION OF GROUP-2 SAFAI KARMACHARIS :

From the health information of safai karmacharis in Group-2, it is found that out of 10 safai karmacharis, 2 were affected with stomach ache, 4 with fever, one was affected with asthma, one with skin disease and 2 have not been affected by any disease.[18] Out of 4 fever affected patients, 2 said that

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18. Cases of severe diseases are discussed in case studies.

they did not know why they were affected by fever. But one said that its because of dust and another was of the view that its because of waste. All the 4 fever affected safai karmacharis said that they get fever once in 3-4 months but its not regularly occurring. And none of them visited government hospital and they consulted private clinics where treated with medicines like injections and tablets. They said that even if they go to government hospital they won't be treated well and no medicine will be given. Even though the doctors of government hospital give some tablets they are not much effective. Out of 4 fever patients 3 did not go to work when they had fever but one did go for work, because he said that the fever was not so acute. All the ten safai karmacharis agreed with the possibility of injuries / risk at the work place, and said that possible risks are from glass pieces, mails, blades, metal pieces etc. But only 3 safai karmacharis got leg injuries in work place. All the 3 got injury within one year span. One worker got a cut on the leg by glass piece, another by mail, third person did not known the material that caused injury. All the 3 went to private hospital for treatment. They remained absent for 2-3 days, from the work. Further, all safai karmacharis were of the opinion that Safai Karmachari Unions are not helping the safai karmacharis to the fullest extent (i.e., Union are not dealing more with individual cases or not fighting for individual cases).

INDIVIDUAL CASE STUDIES

1. Case No. 1, Raju, Skin Disease, Age 26, Male :

Raju is a resident of Lado Sarai, of Delhi, and working in MCD for the last 7 years. Nine months back, he was affected by skin disease[19]. He got infected this disease from handling garbage daily. He said that usually in summer he gets this disease. He consulted private clinic where doctor gave some ointment and tablets. Because of his temporary worker status he could not stop his routine work.

2. Case No.2, Madanlal, Asthma, Age 36, Male :

Madanlal is a Pakka worker and resident of Chattarpur of Delhi. He is working in MCD for the last 17 years. Three years back he as affected with asthma. Basically he was a road sweeper, and because of dust on the road, he said, he got this disease. He consulted a private hospital where he was advised to take tonic called 'cofaid' and tablets called 'Betash'. He is taking them regularly and they are effective. Whenever he stops these medicines disease will reappear. Sometimes he stops his routine wok when disease increases but usually he goes for work but regularly takes medicines.

3. Case No. 3, Brijmohan, Stomachache, Age 25, Male :

Brijmohan is a resident of Budwal Village, Haryana. He says that because of regular contact with waste he got this disease and it reappears once in 3-4 months. He consulted a private doctor who gave some tablets

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19 He don't know the technical name of the disease

and advised him not to do heavy and hard work and asked him to take rest. The tablets are effective to some extent, but it has not permanently cured him. He would not go to work if his stomachache become acute but he would try to join as early as possible, otherwise he will be marked absent. He will not get salary when he is absent on medical grounds.

4. Case No. 4, Kiran Pal, Stomachache, Age 30, Male :

Kiran Pal is resident of Aaya Nagar of Delhi, who is working in MCD for the last 11 years. He is suffering from stomachache which he got 5 years back. He said, waste is responsible for his disease, and it reappears once, in 4-5 months but was not regular. He consulted private clinic where he was advised to take some tablets and asked to do light work and take rest. He takes rest when the pain of stomachache increases. And MCD pays medical charges.

GROUP -3

GENERAL INFORMATION OF GROUP-3 SAFAI KARMACHARIS :

The third group of safai karmacharis interviewed was in Green Park Circle in South Zone of MCD. Here, except one female worker all are males and their age range was from 22 to 30 years. Out of ten safai karmacharis 5 were illiterate and all the ten belong to valmiki caste. From the structure of their family it is seen that, 3 were nuclear families and rest were of joint type. The number of members in nuclear families varied from 2 to 5. But on the other hand number of members in joint families varied from 5 to 24. But an

interesting thing in joint families was that the earning members vary from a minimum of 3 to maximum of 5. Eight safai karmacharis were working on temporary basis and other 2 were permanent. Out of ten, 6 were locals living in Delhi since 2-3 generation. And others immigrated into Delhi in search jobs. Of these 3 were (including one female worker) from Haryana and one from Mehrauli. Except 2 safai karmacharis, who were working in MCD for the last 13 and 10 years, remaining 8 safai karmacharis were working for the past 3 to 8 years. Only one person i.e., female worker is living rented house, remaining others were having their own house. Two safai karmacharis were coming to work directly from their native place i.e., one from Haryana and other from Mehrauli. Except one person, who comes to work by scooter, other were coming in Bus. The distance between their residence to work place varied from minimum of 8 kms to maximum of 70 kms. The person, who travels a distance of 70 kms, first avails train from Haryana and then comes by bus to reach his workplace. Their travelling time varied from 20 minutes to 3 hours.

GROUP - 3 SAFAI KARMACHARIS PERCEPTION ABOUT SOLID WASTE MANAGEMENT :

The green park area consists of middle and upper middle class people with business streets and shopping complexes etc. The solid waste thrown by the people of this area includes food stuffs, vegetables, plastic tea cups, biscuit wrappers, tube light pieces, bottles, and hospital wastes like bandages, syringes, body fluids, human excreta, human body parts, some times even dead animals like rats etc. There are about 9 hospital/ nursing homes in this

circle. Two big hospitals, namely, All India Institute Medical Sciences (AIIMS), and Safdarjung Hospital are situated very near to this locality.[20] Because of these two big hospitals, other nursing homes/ clinics have concentrated near the Green Park locality. The different proportion of solid waste of this area includes largely of polythene full of house-hold refuse, hospital waste, food suffs, and vegetables, etc. The occupation of the residents of this area are business and government jobs. The safai karmacharis were satisfied with the size of the waste bins kept in this locality. Daily waste is removed without fail. So there is no problem of overflow of waste bins. Half of the safai karmacharis were satisfied about safety of equipments provided by MCD. But other half says that, they are not getting gumboots, hand-gloves and so were more prone to health hazards. They ask for masks, helmets, and over coats to wear especially during rainy season when waste becomes wet. After completing their work, all safai karmacharis take bath with detergent soap. Further, all safai karmacharis were satisfied with ongoing solid waste management except 2 who claimed that they need sign boards on roads while sweeping the streets, to avoid accidents.

HEALTH INFORMATION OF GROUP-3 SAFAI KARMACHARIS

In the health information of safai karmacharis of Group-3, out of 10 safai karmacharis interviewed - 4 suffered from fever, 3 from stomachache, 1 of cough and eye itching and 2 were not affected by any disease. Out of 4

20. Both the hospitals (AIIMS & Safderjung) comes under New Delhi Municipal Council (NDMC) area, but are situated very near to the Green Park locality.

fever affected safai karmacharis 2 said that waste is the main reason for falling ill. One worker said that waste might have caused fever. And another worker did not know the cause of disease. According to them usually fever appears once in 4-5 months but not with exact time gap. All the four consulted private doctors and were advised to take medicines. Because of inefficiency in government hospitals they did not visit these. The medicine suggested by private doctors, they said, were effective. Doctors asked them not to go for work but, they could stop the routine work only for one or two days. Out of 10 safai karmacharis 7 got injuries.[21] Because of the concentration of more number of hospitals/ nursing homes in this (Green Park) circle safai karmacharis are suffering from the injuries caused by hospital wastes like syringes, blades, glucose bottle pieces etc..

INDIVIDUAL CASE STUDIES

1. Case No. 1, Sunil, Cough & Eye Itching, Age 22, Male :

Sunil is resident of Godiapur, Mehrauli. He is working in MCD for the last 3 years. Since last one year he has been suffering from cough and eye itching. It is reappearing once in 2-3 months. He considered that his regular contact with garbage and the gas which is produced from the waste were the reason for his disease. Sunil consulted private doctor who gave some tablets

21 Injury cases discussed in case studies.

and eye drops and advised him not to go for work. He stopped going to work only for one or 2 days.

2. Case No. 2,3 & 4, All are Stomach ache Cases :

2. Ashok Kumar, Age 24, Male.

3. Rajpal, Age 32, Male .

4. Veersingh, Age 30, Male .

All the three safai karmacharis were residents of Delhi & were suffering from stomachache. They have been working in MCD for the last 3, 13 & 10 years respectively. Regarding the root cause of their illness they had different opinion, one said it is because of gas which is produced from waste, 2nd worker said its because of nature of work and 3rd worker said that he did not know the reason. All the 3 complained that stomachache reappeared once in 3-4 months. They consulted in private clinics, where doctors advised them not to go for work for some days and asked one of the worker not to lift heavy weights at the work place. They use to stop working for 2-3 days, when pain subsides, they return to work. They said that regularity of stomachache has made this illness a fate of their life.

CASES OF INJURIES

1. Case No.1, Ashok Kumar, Syringe Injury, Age 24, Male :

Ashok Kumar got a Syringe injury in his left leg 2 months back. Which later became septic. And he took one month rest. He took treatment in a

nursing home where doctor gave him injection and tablets and bandages. He lost one month's salary.

2. Case No. 2, Satpal, Glass Piece Injury, Age 22, Male :

Two years back Satpal got a glass piece injury on his right leg. It was nearly half an inch in depth. He consulted private doctor who gave some tablets and tied bandage. He did not go to work for 15 days. It was a septic injury and he also remained absent from the work.

3. Case No. 3, Veer Singh, Tube Light Piece Injury, Age 30, Male :

One year back Veer Singh got a tube light piece injury on his left leg. The broken piece of tube light pierced his (canvas) shoes and entered into the flesh causing half an inch cut. From these injury cases, it is evident that not all safai karmacharis are getting gunboots. They were all wearing their own shoes or many of them wear even Hawai Chappals. He took treatment in a private clinic and remained absent, for one week, from work. But he got medical leave, because he is a permanent worker.

4. Case No. 4, Rajpal, Glass piece injury, Age 32, Male :

5. Case No. 5, Dheer Singh,Syringe injury, Age 22, Male :

Two-three months back, Dheer Singh was affected by a syringe injury. The syringe penetrated into middle finger of right hand. And it became septic. He went to clinic where he got injection along with bandage for that swollen finger. He did not take rest, and joined for work.

6. Case No. 6, Ajay, Tube light piece injury, Age 25, Male :

Five months back Ajay got tube light piece injury on his left leg. He said that heavy bleeding took place. He consulted private doctor who gave injection, tablets and put the bandage. Ajay took 3 days rest and joined the work. He said during rainy season, their (safai karmacharis) condition becomes pathetic as waste becomes wet and increases the chances for infection.

7. Case No., Naresh glass piece injury, Age 30, Male :

Nine months back, Naresh got a glass piece injury on his right leg. He got stitches also. First he went to a private clinic and from there he went to Safderjung Hospital where he got his wound bandaged. He said glass piece entered his (leg's) flesh cutting into the canvas shoes. He remained absent from the work for more than one month. When I asked him whether he got any compensation for that injury, he harshly told me, 'forget about compensation, MCD[22] officials asked me to bring a (rejoining) letter from court

22 He already finished his 7 years of service in MCD as Kachcha worker.

for my one month absence. Within 2 years I will become permanent worker in MCD and if I lose this job, then it will be a greatest loss to me."

OBSERVATIONS AND REMARKS

When I interviewed the 3 groups (of MCD) of Safai Karmacharis working in 3 different income localities. I found so many similarities as well as dissimilarities in respect to nature of waste, peoples attitude, safai karmacharis perception and differences in potential health risks of safai karmacharis in these 3 localities.

In all the 3 groups, when education trends are studied, it is found that more than 60 percent of the safai karmacharis are illiterate. Out of 30 safai karmacharis, only one has passed 10th class. Again there is difference in level of education among safai karmacharis themselves. That is, almost all senior safai karmacharis are illiterate.[23] Literate are more among young safai karmacharis who have joined MCD in recently years.

It has been found that, the only caste group which is serving in MCD as Safai Karmacharis is Valmiki caste of Hindu religion. It has become a traditional occupation as this community is serving in this field since many centuries. No doubt, people from other castes, religions, like Brahmins, Muslims etc. are there in MCD, but they

23 Senior workers are those aged workers who have crossed 35-40 years of age.

are all in other positions as supervisors, sanitary inspectors, engineers etc. but no one joined as Safai Karmacharis. Valmiki have become exclusive caste group to do this occupation. Even the poor from other castes do not take this occupation.

Even though safai karmacharis are living in big city like Delhi[24], except 5-6 safai karmacharis, all are living in joint families whose membership varies from 9 to 35 and nuclear families membership is upto 9 members. In some big joint families there are more than 2 earning member. 50 percent of the safai karmacharis are working on the basis of daily wages.

Most of the safai karmacharis immigrated into Delhi long back i.e,, about 3-4 generation back. They came to Delhi in search of jobs. And hardly 10 to 15 percent of safai karmacharis have migrated in their own generation. They migrated to Delhi from only surrounding states, especially from Haryana and Uttar Pradesh. Since most of them have migrated long back, more than 90 percent of safai karmacharis live in their own houses in different villages and low income localities. No worker is living in official quarter of MCD which are provided only for the 5 percent of the total safai karmacharis in MCD. Further, Kachcha safai karmacharis will be

recruited as permanent worker after 8-10 years of temporary service. More than (out of 30 safai karmacharis) 70 percent of the safai karmacharis are traveling in bus to reach their workplace, from their homes. Their journey period varies from 15 minutes to 3 hours for few safai karmacharis who are coming from far off places.

ABOUT SAFAI KARMACHARIS PERCEPTION ABOUT SOLID WASTE MANAGEMENT

The waste generated in all the three localities[25] differs (not completely different) from one area to another. For example, in slum area's waste includes ashes of choollah, chocolate wrappers[26], human excreta, etc. which are not found in posh middle class locality like Green Park. In Green Park locality, solid waste includes, garden waste, mineral water bottles, biscuit wrappers and package materials of eatables, hospital waste[27], etc. The solid waste in another lower middle and middle class locality[28] of Chatterpur circle

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25. Out of 3 localities, 2 are in Chattarpur circle & one is in Green Park circle of MCD.

26. In some families of slums, women & children do the work of wrapping the chocolate wrappers on chocolates (local chocolates) for which they earn Rs. 2-5 per kg. Of chocolates.

27. Number of hospitals are more in Green Park area, which are adding their medical waste to the municipal waste of the area.

28. Even though its middle class locality, it's not as posh as Green Park area. Lover middle class people also living here.

includes ash of choollash, cow-dung[29], etc. So therefore, waste may differ from one place to another in the same city. Even occupation of the residents may also differs. For instance, in slum area, we can find more number of labourers, petty shop owners, small scale factory's safai karmacharis etc. And the occupation of Green Park residents is different. Most of them are businessmen, few are running hotels, shops, automobiles shops etc. and few are bureaucrats, and some are in private firms. In middle class locality in Chatarpur circle, we can find some of the occupational characteristics of other two (slum and Green Park area) localities, like factory safai karmacharis, clerical job holders, businessmen, etc. This locality is, I found, in between the other two localities occupation wise.

Very few waste bins are kept in slum locality, almost all are open dumps where usually people throw every house - hold refuse. Because of high density in slum, the waste bins are always overflowing. MCD safai karmacharis are also not collecting he waste properly sometimes then come to work and sometimes they do not. No one questioning the concerned authority, because its unathorised colony. In other middle class locality of Chattarpur circle, waste bins are there but are not properly maintained. Waste bins are not in good condition, stray animals always move around them in search of food/ vegitables. Actually, these animals scatter the waste by spreading the

29 Many residents in this locality doing animal husbandry.

waste around the waste bins. In Green Park Area, waste bins are in good condition. They are maintained properly. Because, the residents of this locality are influential and they pressurise the officers (of MCD) and in turn officers insist their lower cadre i.e., subordinates to take care of the locality. Waste bins are compatible with the generation of the waste, which may be because of the locality's low density of population as compared to slum and other middle class locality. The other reason for the efficiency in Green Park area is - the Zonal head office (south Zone's) is very near to this locality (i.e., about one kilometre).

In slum area, MCD trucks cannot go inside because of congestion. So safai karmacharis transfer the waste with the help of wheel burrows from waste bins/ open dumps to trucks. But it is not the case with middle class locality of Chattarpur and Green Park locality. There trucks directly go near the waste bins and beldars[30] transfer the waste into trucks. In some big dumps in Chattarpur circle, JCB loaders[31] are being used to collect the waste. So if there is enough space (for trucks to enter), we can minimise the energy of safai karmacharis, which can be utilised in other purposes or places.

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30 Safai Karmacharies who transfer the waste from waste bins to trucks are known as 'Beldars'.

31 JCB loader is a buldozer type vehicle which mechanically transfer the waste from waste bins to trucks, without the help of Beldars.

ABOUT SAFAI KARMACHARIS HEALTH INFORMATION AND TREATMENT

About the health information of safai karmacharis of all the 3 groups, there is no much difference in symptoms of fever and number of fever cases. Among safai karmacharis of group-1[32], I found one asthma and one malaria case. And in group-2[33], two safai karmacharis suffered from stomachache, one affected with skin disease and one was suffering from asthma. Here I am not including fever patients, because fever is not regular with certain time gap. In Group-3[34], three suffered from stomach ache and one of cough and eye itching. Each patient of serious diseases, complained that their nature of work is responsible for their disease. Further, when safai karmacharis disease aggravates, they claimed to visit private clinic for their treatment. But I think, this may not be true in every case. Because private medical facilities are costly, especially in Delhi.[35] So these safai karmacharis can't afford, in every case, these health facilities in private hospitals. I think, safai karmacharis are

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32 Those 10 workers who are working in slum area.

33 Those 10 workers who are working in middle class area of Chattarpur circle.

34. Those 10 workers who are working in middle class residential area of Green Park.

35. As I observed, in South India, health facilities are not as costly as in Delhi. It may be because of fewer medical colleges in North. India. So most of the north Indian doctors get their medical education in Southern states which is very costly for other than the students of native state.

consulting illegal practitioners like quacks who are practicing in villages, slums and low income residential areas. In Delhi, as compared to other parts of India, illegal medical practitioners are more. And irrespective of their area of work, if safai karmacharis disease becomes acute they stop their routine work. If Kachcha worker stops his work, he will get leave without pay, and they won't get any compensation even for severe injuries at the work place.

Apart from the chronic/ communicable diseases there is possibility of risks and injuries occurring at the workplace. Comparatively safai karmacharis of Group-1 have got less injuries as of Group-2 and group-3, the reason may be the type of waste generated in slum or otherwise safai karmacharis may be getting handgloves and gunboots etc. because in MCD not all safai karmacharis are, at all time and place, getting proper safety equipments. But the condition of safai karmacharis of Group-3, are pathetic. Among all the 3 groups, group-3 has got highest number of injuries at the workplace. Near Green Park locality 2 big hospitals - All India Institute of Medical Sciences (AIIMS) and Safderjung are situated. Around these 2 big hospitals there are many private clinics/ hospital/ nursing homes are concentrated.[36] And these hospitals are disposing their bio-medical waste into Municipal waste bins, which is illegal. This waste includes, importantly syringes, broken pieces of glucose and blood bottles, bandages, body fluids, some times human body

36 Because of over-crowding in 2 big hospitals, the next alternate option for the public is to rush to a near by hospitals. This is a logic behind their concentration.

parts, et. So these syringes and glass pieces are resulting in sharp cuts and other medical waste causing communicable /infectious diseases. When I asked safai karmacharis about this medical waste, they said that "there is an understanding (corruption) between hospital management and MCD officials, so we are helpless. But when I asked about this with senior officers, they are having heir own version. They said to me" there is a rule in MCD that the hospitals which are having the facility of 60 or more beds, should maintain their own system of disposal of bio-medical waste. And what is happening is, the hospital management bribe the concerned authorities and get the certificate of having less than 60 beds in their hospitals, and are continuing their activities of disposing the hospital waste into Municipal waste bins, so we are helpless.

CHAPTER – V

CONCLUSION & RECOMMENDATIONS

Urban waste disposal is not a problem of recent origin. It is as old as the process of urbanisation. And all levels of development human beings produce solid waste. The quality of urban environment is a matter of growing concern and importance of efficient solid waste management is in recent times increasingly recognised by urban administrators and planners. The quantity of municipal solid waste generated depends upon a number of factors such a food habits, standard of living, degree of commercial and industrial activity. The waste characteristics in developing countries are known to differ considerably from that in developed countries due to differing food habits, culture, traditions and socio-economic aspects. The organic matter is found to be higher due to the use of fresh and unprocessed vegetables and has a high moisture content. Unpaved roads and seasonal variation in climatic condition tend to increase the ash and soil content increasing the density of the waste and correspondingly lower calorific value has been observed. Urban centers in developing countries are mostly modern outgrowth of ancient cities with narrow winding streets requiring small slow moving vehicles for collection and transport. Further, the quantity of urban solid waste is known to vary seasonally. During festive occasions, the amount of refuse shows an increase, for example, the rubbish generated during Diwali festival is considerably higher than other seasons. During monsoon, tree and hedge cuttings have been recorded to be high. Quantity generated during winter and summer seasons also vary. During winter months (October-

February) in Delhi, on an average more than 300 tonnes of dry leaves are generated each day[1].

The collection, transport, processing and disposal of solid waste involve a large expenditure but it received scant attention. The citizens get accustomed to live with this nuisance, though avoidable. The attention provided falls far short of the known and desired practice which could be attributed to public apathy, entrenched habits and traditions and vested interests leading to ineffective management. The developed countries have often been able to provide developing countries with technical guidance in environmental matters, but, solid waste may prove to be an exception. Because too many climatic, economic and social differences make it difficult for systems to be successfully transplanted. Even the technical literature of the developed countries may be of little use for either training or operational guidance. Some of the obstacles to use the western methods in developing countries are:

- Climate and seasonal variations,
- Budget and foreign exchange limitations,
- Economy of the region,
- Physical characteristics of the cities,
- Social and religious customs,

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1. MCD's Horticulture Department is supposed to look after parks in Delhi : "The sleeping gaint awaketh?" Times of India, 20-11-1999, Delhi

- Public health awareness,
- Quality of management and technical capacity.

Against this background, the importance of the following issues can be stressed.

- Protection of health and environment at a level of cost that can be sustained locally.
- Development of systems, based on local climatic, physical, economic and social factors.
- Production of efficient and indigenous tools and equipment.
- The achievement of high productivity from labour and equipment, especially motor transport
- Education of the public
- Vocational or professional training for all level of staff in the management.

We have to recognise the fact that the fastest growing phenomenon in Delhi today is urbanisation. Its scale and speed of organisation is markedly different from other metropolitan cities of India. Delhi has witnessed one of the fastest growth rates when compared to other metropolitan cities. Since 1941 Delhi has grown 427 percent, Bombay 227 percent, Madras 49 percent and Calcutta 39 percent.[2] The density of population in Delhi is getting steadily worse. The variations in terms of density within the city are enormous and the

2 Delhi : A Tale of two cities, 1993, VHAI Publication, New Delhi.

implications of such trends appear to be alarming, particularly for health services. Further, the formation of innumerable unauthorised settlements in the city is an integral part of Delhi's urbanisation. This inevitable and irreversible process is perhaps a lot more uncontrolled in Delhi than in other metropolitan cities. Adhoc and directionless policy decisions and their uneven and unjust implementation are amongst the major contributors to the growth of slums in cities. But, however, these squatters/ slums in the deprived areas should not be considered as marginal to Delhi. On the other hand, they should be considered as members of emerging groups with considerable potential to find a place for themselves in the activities of this city. Their environment must be improved for they have arrived in Delhi to stay and are an integral part of it. The relationship between health and residential environment is basic. If the authorities in Delhi neglect this fact and fail to act now, the result would be propagation of diseases, health hazards and a range of other problems associated with rapid urban growth. According to an estimate, in Delhi, more than 2000 tonnes of solid waste, generated daily, is unattended by Municipal authorities. And out of this 2000 tonnes, more than 90 percent of waste is generated in unauthorised settlements/ slums, which in turn, may cause severe health hazards to the slum dwellers. Further, it is an evident fact that squatters/ slums are illegal. But if authorities turn a blind eye to their illegality it may unreasonably turn a blind eye to their need for basic civic services including refuse removal.

There are potential risks to health from improper handling of solid waste. For the general public, the main risks to health are indirect, and arise from breeding of disease vectors, primarily flies and rats. Improper storage and disposal provide the conditions under which these risks arise. Therefore, any solid waste produced at home must be collected and stored in a safe container. Organic waste must not be kept indoor for more than 48 hours. Dust bins and other waste containers are better stored out doors or in special waste storage places. Any infectious waste, sharps, or chemical waste must be properly packed before being put in the dust bin. Highly hazardous chemical waste must not be put in large quantities in domestic waste containers, but should be stored separately. In neighbourhood organic waste must be collected prior to reaching an advanced stage of fermentation and this stage is indicated by strong odour. The population of domestic stray animals must be controlled in urban areas to prevent zoonosis (disease) and to avoid damage of waste containers such as plastic bags, with subsequent scattering of garbage on the pavement. Any waste spread on streets and pavement must be removed during public cleansing operations.

Any litter or illegal waste-dumping place should also be cleaned up and littering offender prosecuted. In Delhi, during winter season, on an average 150-200 tonnes of dry leaves are burnt each day and its resulting pollution is equivalent to the daily exhaust (smoke) of 50,000 vehicles.[3]

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3. The sleeping gaint awaketh": Times of India, Nov. 20, 1999, New Delhi.

Further, more accute health hazards from solid waste result from long time direct contact with waste. So the direct health risks concern the safai karmacharis in the waste collection and disposal field. The methods by which wastes are removed from street bins and loaded in to vehicles involve soiling the hands, arms and feet of the safai karmacharis and the squatting or stooping posture adopted to fill baskets causes the inhalation of contaminated dust and droplets. When safai karmacharis are exposed to this type of infection they suffer a higher than normal incidence of intestinal parasites. However, although it is certain that vector insects and rodents can transmit various pathogenic agents of diseases and it is often difficult to demonstrate the precise relationship between the sources of infection and the health of the safai karmacharis.

To reduce the above said risks, worker must be provided with protective clothes, gunboots hand-gloves and facemasks or simple scarves wrapped around the face should be used. Waste safai karmacharis should receive health education and be trained in accident prevention and emergency measures. They should be provided with showers and cleaning facilities after work. Even though Municipal Corporation of Delhi (MCD)is providing oil and soaps to clean safai karmacharis hands and body, its not providing in sufficient quantity/ quality and in time. Now, the time is ripe, in city like Delhi, to introduce professional management systems in the handling of health care wastes. In all cases, discarded syringes must be packed in a puncture-proof box or tight-lid tins before being put into any waste bins or otherwise there should be separate method of collection of medical and other

infectious waste from small sources at a designated hospital waste disposal facility. Further, occupation health and safety services must also be extended to waste pickers. Waste pickers could be brought into the waste management system through appropriate design measures and socio-economic policies. These might include the recognition and organisation of waste picking cooperatives, promotion of source separation, collection by waste pickers at the house-hold level, provision of sorting platforms, introduction of occupational health standards, and provision of cleansing facilities at transfer stations and disposal sites. Authorities should provide a legislative frame work to promote a safety awareness and prevent risks/ injuries to safai karmacharis/waste pickers. Because health and safety of safai karmacharis/ waste pickers is an important factor which contribute to the well-being and efficiency of any work/ task or organisation.

The other requirements and safety measures which I found in the field-work are:

- To avoid road accidents, sign-boards (like-Go slow men at work', etc), should be kept on roads, during road sweeping work.
- First aid facility, to tackle the workplace injuries should be provided at the circle office premises.
- A Gynecologist should be appointed, to look after the women safai karmacharis, atleast at the zonal office.

performance. Because municipal services suffers from serious shortage of resource (like, staff, fund and equipment). It is almost impossible to stretch the existing services to cope with ever increasing requirements of a fast growing (Delhi's decennial growth rate between 1980-91 is 50.46 percent)[4] city like Delhi.

- Monthly salary of Kachcha (temporary) safai karmacharis should be increased and salary should be provided within third day of every month (presently, they are getting their salary on 13th or 14th day of every month).

- Kachcha safai karmacharis should be provided medical allowance and also salary should given, when they are on medical leave and more important is compensation should be given for permanent injury or disability occurred at the workplace.

- Educational level of the safai karmacharis must be increased.

- All types of equipments must be provided.

- There should be a well equiped separate hospitals, which is meant only for Safai Karmacharis.

4. Delhi : A tale of two cities, 1993, VHAI Publication, New Delhi.

- Official quarters, if possible, can be provided to more number of safai karmacharis wear their work place. By this efficiency of safai karmacharis increases. Presently, few safai karmacharis are travelling upto 3 hours, to reach their workplace from their residences.

- All safai karmacharis should be immunised against Tatanus & Hepatitis B and hepatitis -B and periodical medical examination screening tests should be carried out.

- Presently, after working for ten long years on daily wages, kachcha worker will become permanent worker of MCD. So this ten year long gap must be reduced, and can make upto 5-7 years.

- Proper mechanism should be adopted to dispose dead animals like rats, cats, dogs, etc. otherwise, it may cause serious diseases like plague etc.

- There is a need to develop a culture of waste management among consumers as well or responsible in varying degrees for waste creation and disposal.

Further, development does not necessarily guarantee rapid growth. But there is no doubt that education does improve the quality of life. Kerala is one such example. There is massive unemployment, limited land and a very slow rate of development. But Kerala is clean - the roads are clean and stagnating sewage is rare. This is, I think, probably due to very high levels of

education. About 60 percent of Kerala's budget[5] goes for primary education. If people are educated, there is some hope that they may also find some solutions to their increasing garbage.

There is no single factor responsible for waste mismanagement. While the pathetic effort by municipalities is a major reason, public apathy towards the management of wastes is another. For example, municipality safai karmacharis pick - up waste at a specific time from community waste bins, for instance, 7 a.m. However, an hour later, heaps of garbage are visible again. Because people throw waste at their own convenience. So this calls for raising awareness among the people about ill-effects of improper solid waste management practices. Another reason to involve people is, most of the solid waste generated is kitchen waste, these people should be taught segregation at source level and also minimisation of waste at generation level. Without people's involvement , no one can do miracles.

In most of the cases, just as people are excluded in solid waste management, the rag pickers, another very important link in the chain, are a neglected lot. The local people view these rag pickers with suspecion. Hardly any one understands this importance of their work. Rag pickers, infact, do the MCD a big favour by collecting recyclable wastes from the dump to sell it to the recycling industry. It is estimated that these rag pickers collect about 12-

5. Nandita Krishna, " Wanted clean cities", Econews, Environmental Quarterly, Volume 1, No. 2, July-Sept. 1995. P. 5.

15 percent of the total waste produced/ daily and they save the amount between 3.72 to 4.5 lakh Rs. per day. Besides there are several waste purchasers, better known as 'Kabariwallahs', who buy this recyclable materials from rag-pickers and pass on the material to the industry at a high price. An extensive network of rag pickers exists in the informal sector. However, an effort to organise the waste-pickers is a difficult tasks as the people involved in purchasing the materials work against the interest of waste pickers. Therefore , NGO's should be involved in this and efforts should be made to organise them, and make them to involve in the tasks of managing the Delhi's solid waste.

Further, the new age of convenience - consumerism has brought about a sea - change in the composition of wastes. In earlier decades, one-third of the municipal waste was used to be dust and mud and the biggest shore was combustible kitchen waste. But now, with the Pepsi - Coke culture coming-in, the waste problem is going to be bigger and different from the past. And with the invasion of consumerist life style, which led to a 70 percent in the volume of solid waste has also taken away the 'clean' and easily manageable elements (i.e., easily bio-degradable or organic) from solid waste.

While doing my field-work, I could not find out more number of (i.e., data as given by various sources) patients suffering from servere diseases like TB, asthma's etc. among MCD safai karmacharis. I found more than 80

percent of safai karmacharis in the work place are kachcha safai karmacharis. It means that rate of absenteeism (of permanent safai karmacharis, who may be actually patients, because of their long years of service in MCD) in MCD is very high. When I enquired about this with an officer in MCD he said "the rate of absenteeism(including 5% on medical leave)is more than 40 percent". He further said "actually, these senior safai karmacharis surrounded half of their monthly salary to their senior officers and get their full attendance and they do business or different activities and remain absent from work. Further few safai karmacharis working lawns of politicians and bureaucrats houses. Because of their absence more temporary safai karmacharis are available at the workplaces and they are not suffering from any servere diseases, because, they joined MCD in recent years.

Finally, still today it is said that Delhi is the filthiest city of India. Delhi's solid waste disposal problem can be easily managed if we get rid of the highly bureaucratized, incompetent, corrupt municipal collection system and make it the responsibility of urban house-holds and communities. Because, in the past, the problem of solid waste management has been approached from many angles. Several studies have been carried out and recommendations made. However, the solid waste is still a problem to contend with. As a rule, the responsibility of solid waste management lies with the MCD. But despite the legal frame work that empowers them to keep the Delhi City clean, the system is not working efficiently. Therefore, the community - level management of solid waste is the key to over come the solid waste problem. Only a sustained programme involving citizens NGO's and other organisation

along with MCD, can solve the problem effectively. And more importantly, such programmes should include all sections of the society, including poor people living slums.

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ANNEXURE – I

INTERVIEW – SCHEDULE

Serial No. : **Sample No. :**
Date of Survey : **Place of Survey:**

SECTION –A
1. GENERAL INFORMATION

1.1 Name of the informant :

1.2 Age:

1.3 Education:

1.4 What is your religion?

Caste :

1.5 Family structure :

a) No. of family members:

b) No. of earning members:

1.6 How much is your salary?

1.7 Where are you from (native place)?

a) Village:

b) District:

c) State:

1.8 What is your designation?

1.9 Since how many years you are working in MCD?

1.10 Housing conditions:

a) Where is your home?

b) Whether living in a -- Rented house

-- Owned house

-- Official quarter

1.11 How will you go to work?

a) by walk d) by autorickshaw

b) by Scooter e) by bicycle

c) by moped

1.12 At what time you start your work and at what time you complete your work?

1.13 Do you work continuously or do you get break in between for rest, taking tea, smoking, etc?

1.14 What is the distance between your home and workplace?

1.15 How much time it take to reach that place?

SECTION –B

2. WORKER'S PERCEPTION ABOUT SOLID WASTE MANAGEMENT

2.1 In your area, what type of waste people throw?

2.2 In your area, what are the different proportion of solid waste?

2.3 In your area, what type of occupation do the people doing?

2.4 The dust-bins kept in your area are in appropriate size or not?

2.5 How is solid waste transporting from dust-bins?

2.6 And where it is being dumped?

2.7 What are the equipments used by you to collect solid waste?

2.8 Whether you are using handgloves and gumboots while working at the sites?

2.9 How safe are those equipments, from the workers' health point of view?

2.10 Do you think more advanced equipments must be provided to workers? If so what are they?

2.11 After completing your work (in the evening) whether you take bath or not? If so, what are you using (soap/detergent) to clean your body/ clothes etc.?

2.12 Whether bathing facility is arranged in your office premises or you have to go home?

2.13 Whether you are satisfied with the on going process of solid waste management?

2.14 If not, then what are the changes, do you feel, one should bring in it?

2.15 Before dumping of solid waste, whether sort out of different materials is taking place? And how?

2.16 What are the difficulties that you are facing while sorting out the solid waste?

SECTION –C

3. HEALTH INFORMATION AND TREATMENT

3.1 In the last one year, did you suffer from any illness? If so what happened?

3.2 How did you get this disease?

3.3 Whether this disease is recurring again and again?

3.4 How oftenly it is reappearing?

3.5 Did you consult any physician?

3.6 What is doctor's opinion and advise?

3.7 What are the medicines suggested by doctor? And how far they are effective?

3.8 Did you stop your routine work, while you were undergoing medical treatment?

3.9 Whether you people get salary when you are on medical leave?

3.10 Who is paying for your medical charges in the hospital?

3.11 Apart from the chronic/ communicable diseases, which are the possible risks/ injuries oftenly occurring at the work place?

3.12 Did you have any injury?

3.13 When?

3.14 And what kind of injury/ what happened?

3.15 Whether workers are getting compensation for the severe injuries occurred at the workplace?

3.16 Is there any hospital which is meant only for workers? And where it is?

3.17 Whether you are having Safai Karmachari Unions? If so, how far they are helping the workers when they are suffering from health problems?