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# Health and environmental impact of improper solid waste management in Faridabad city

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**Abstract**
Present paper describes the impact of improper management of solid waste on health and environment on the people of Faridabad city. It is based on the field survey conducted in 2012 wherein 701 samples were collected from household, commercial establishments, industries, MCF/NGO workers, health institutions and rag pickers by adopting multi stage sampling technique, giving the proportional representation to different groups of stakeholders in diverse regional setting. The opinions of the stakeholders were evaluated qualitatively. Severe impact on air quality is considered more as compare to water and soil it may be because of the pathogens contained in the blood and body parts which stinks if not disposed timely. Burning of solid was teem it odor and air contaminates such as small solid particles, $Co^2$ and $No^2$ etc. Improper waste management create number of health problems which needs to be addressed. The solutions lies in making waste technologies more contained, reducing contaminant emissions, changing working methods, use of protective clothing, and keeping the public and residents a safe distance away from operations.

**Keywords:** solod waste management, pathogens, health, environment, odor

## Introduction

Economic development, rapid industrialization, urbanization and population growth have accelerated the dynamics of the urbanization process in developing countries (Suocheng *et al.*, 2001) [15]. In India alone, the urban population has increased from 26 percent in 2001 to 32 percent in 2011 (Census of India, 2011). The rapid growth rates of population in many cities raise deficient in infrastructure services like water supply, sewerage and solid waste management. Municipal solid waste management, like most of other infrastructural services has come under great stress, consider low priority areas, solid waste management was never taken up seriously either by public or by concerned agency or authorities and now the piled up waste is threatening our health, environment and well being (Chouhan and Reddy, 1996) [2].

Cities in all over the world arefacing high levels of solid waste; the situation in developing countries is moreacute due to inadequate provision of basic services (Senkoro, 2003) [12]. Improper Municipal Solid Waste (MSW) disposal and management causes all types of pollution: air, soil, and water. Dumpsites emit obnoxious odors and smoke that cause illness to people living in, around or closer to them (Marshal, 1995) [6]. Contamination of soil and groundwater may lead to direct contact or pollution of indoor air (Wrensh, 1990) [17]. The U.S. Public Health Service identified 22 human diseases that are linked to improper Municipal Solid Waste Management (MSWM). Waste workers and pickers in developing countries are seldom protected from direct contact and injury, and the co-disposal of hazardous and medical wastes with MSW poses serious health threat (Singh *et al.*, 1998 and Tchobanoglous *et al.*, 1993) [13].

It causes environmental pollution and health problems and proliferation of disease by viruses and micro-organism and contamination of ground water by untreated medical waste in landfills (Patil and Pokhrel, 2008) [8]. Weak and inappropriate management may create serious repercussions on the public health and a significant impact on the environment (Pescod and Saw, 1998) [9]. Such amount of waste presents treatment and disposal challenges. Besides preventing cross contamination during the management process, selecting a suitable and environmentally friendly method is a top challenge. In developing countries, methods such as dumping in open landfills, surface dumping and use of sub-standard incinerators are common (Coker *et al.*, 2009; Hassan *et al.*, 2008; Mbongwe *et al.*, 2008 and Sawalem *et al.*, 2008) [3, 5, 7, 11]. According to United Nation Development Programme (UNDP) survey report, solid waste disposal is the second most pressing problem facing urban city dwellers after unemployment (Da Zhu *et al.*, 2008). There are environment and health hazard from improper handling of solid wastes. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from contact with wastes. There are also specific risks in handling wastes from hospitals and clinics. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats (Royal Commission on Environmental Pollution, 1984) [10].

Unregulated clinical waste treatment and disposal has been linked to several public health threats. Solberg (2009) disclosed that in March 2009, 240 people in the Indian state of Gujarat contracted hepatitis B after receiving medical care with previously used syringes acquired through the illegal trade of clinical waste. Epidemics and environment impacts of medical solid waste are largely considered as moderate and small group of respondents considered it as severe. However, odor impact

is considered severe by larger group. Respondents from bigger health institutions considered severe impact more than the smaller one and it is invariably same across the zones. Ground and surface water pollution e.g., runoff during the monsoon season causes surface water pollution, while percolation often causes groundwater contamination. Unaesthetic appearance shows because of litter (Gotoh, 1989).

Improper waste management is the main cause affecting the environment. India generates about 188,500 tons per day of domestic solid wastes in urban areas. Open dumping and open burning of waste results in air pollution, contaminated land and surface and ground water in additions to foul odour (The Pioneer, 2013). Faulty method of disposal can play health havoc. Sub-standard incineration results in the release of toxic chemicals into the environment capable of travelling long distances in the air before eventually depositing to earth (Singh and Prakash, 2007) [14]. Most of the cities and municipalities in developing countries like India are struggling with improper disposal of waste. Poor collection and inadequate transportation are responsible for the accumulation of solid waste at every nook and corner (Latif, *et al.*, 2013). Unscientific disposal causes an adverse impact on all the components of the environmental and human health (Rathi, 2006).

**Objectives**

This paper aims to assess the health and environmental impact using various criteria which have been selected in order to evaluate the impact of improper solid waste management in Faridabad City.

**Study Area**

Faridabad is the major industrial city in the state of Haryana, India. Being the administrative headquarter of Faridabad district, it is one of the most rapidly developed urban areas of the state. Faridabad is identified as one of the Delhi Metropolitan Area (DMA)/National Capital Region cities and accordingly it has strong linkages with Delhi. NH 2 from Delhi to Kolkata passes through the central axis of the city. The present geographical area of Faridabad is 207.88 sq. km. The population in Faridabad city is estimated to be about 16.62 lakh in 2011. The NCR regional plan for 2021 has projected the population of Faridabad as 25 lakhs. The Development Plan for Faridabad was prepared for the erstwhile municipalities of Faridabad Township/ NIT, Old Faridabad, Ballabgarh and 38 revenue villages, altogether referred to as the Faridabad Controlled Area. The rapid urbanization, increasing commercial and industrial activities and changing life styles in Faridabad are leading to a steady increase in the generation of solid waste.

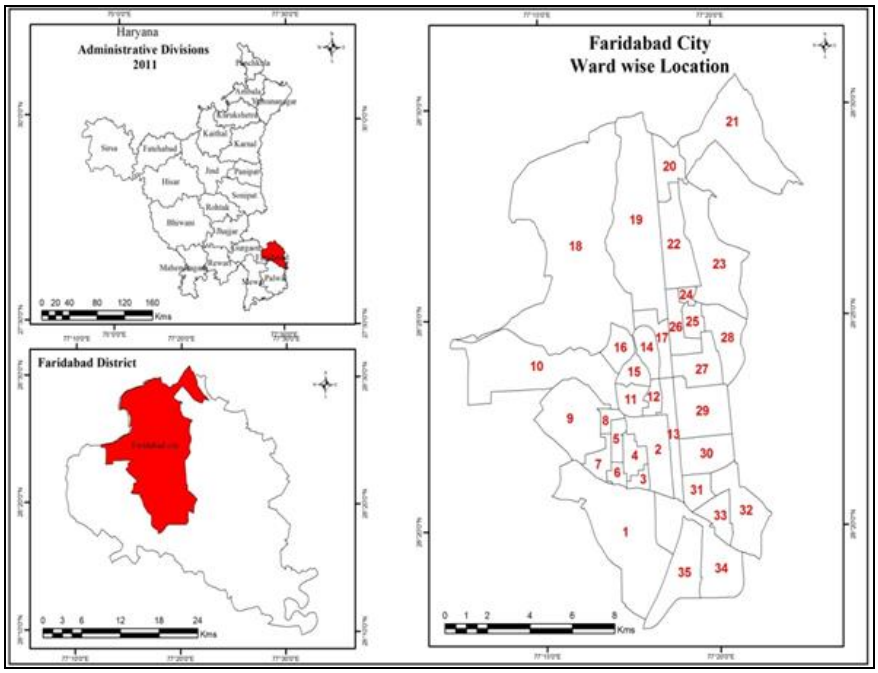


**Fig 1**

**Data and Methodology**

It is mainly based on the field enquiry conducted through questionnaire/schedule, field observation and Focused Group discussion (FGD). An interview-schedule with open-ended questions is used to collect the information from the group of society about the generation of solid waste, its different sources, contents, public opinion about solid waste and its impact on health and surrounding environment. The study is based on multilevel stratified sampling. Multilevel sampling is done on stratified, random and proportionate basis. Purposive random samplings are done at category level and within each category sample were taken randomly. In survey an interview-schedule with open-ended questions has been used to collect the information about the generation of solid waste, its different sources, contents, public opinion about solid waste and its impact on health and surrounding environment. It included those workers who are working in Faridabad Municipal Corporation and NGOs working for this purpose are

namely private firms such as Ramki (NIT), Vishal Protection Force (Old Faridabad) and International Academy (Balllabhgarh). Primary survey also included survey of collection points, dumping site/landfill site and transfer stations.

**Selection of sample**

The study is based on sample survey of 701 from household, commercial establishments, industries, MCF/NGO workers, health institutions and rag pickers. These includes 432 sample households, 73 samples of commercial activities and 16 sample of industry which were selected proportionately (according to size of households, commercial establishments and industries) from the localities of different income level groups i.e. very low (slum), low, medium and high income group. Interview- schedule was used to collect data from the workers who were involved in the process of solid waste collection and disposal mechanism. It also includes 30 samples of those workers who were working in hospitals to collect information about bio-medical waste. MCF/NGO workers samples have been taken five percent of the total workers. Higher categories officer's sample are not taken proportionately because their number is low. Only one sample of these categories from each administrative zone has been taken 24 private hospitals and clinic and 6 out of 15 govt. hospitals and dispensaries samples have been taken. One sample each of govt. and private hospital, two samples of dispensaries and six samples of clinics have been taken from each administrative zones of MCF. Apart from that 30 samples of rag pickers have been taken who were involved in the collection of recyclable waste.

**Table 1:** Selection of sample from residence, commercial establishment and industrial units

| Name of zone | Residence | | Commercial | | Industrial | | Total samples |
|---|---|---|---|---|---|---|---|
| | Total number of houses | Number of samples | Total number of commercial establishment | Number of samples | Total number of industrial unit | Number of samples | |
| NIT | 81132 | 183 | 13539 | 43 | 1969 | 05 | 231 |
| Old Faridabad | 56913 | 128 | 6644 | 19 | 2263 | 06 | 153 |
| Balablgarh | 54221 | 121 | 3921 | 11 | 1887 | 05 | 137 |
| Total | 192266 | 432 | 24104 | 73 | 6149 | 16 | 521 |

**Table 2:** Zone-wise sample selection of residence, commercial establishments and industrial units

| Zone | Category | | Samples |
|---|---|---|---|
| Old Faridabad | Residential | Very low income group (slum area) | 13 |
| | | Low income group (Up o100 sq.yds.) | 52 |
| | | Medium income group (100 – 250 sq.yds.) | 38 |
| | | High income group (> 250 sq.yds.) | 25 |
| | | Total number of samples | 128 |
| | Commercial | Informal sector | 04 |
| | | Up to 200 Sqft. | 04 |
| | | 200 – 500 Sqft. | 05 |
| | | Above 500 Sqft. | 06 |
| | | Total number of samples | 19 |
| | Industrial | Up to 500 Sq. yds. | 3 |
| | | 500 – 1000 Sq.yds. | 1 |
| | | 1000 Sq.yds.- 1 Acre | 1 |
| | | Above 1 Acre | 1 |
| Zone | Category | | Samples |
| | | Total number of samples | 06 |
| NIT | Residential | Very low income group (slum area) | 22 |
| | | Low income group (Up o100 sq.yds.) | 90 |
| | | Medium income group (100 – 250 sq.yds.) | 54 |
| | | High income group (> 250 sq.yds.) | 17 |
| | | Total number of samples | 183 |
| | Commercial | Informal sector | 13 |
| | | Up to 200 Sqft. | 13 |
| | | 200 – 500 Sqft. | 08 |
| | | Above 500 Sqft. | 09 |
| | | Total number of samples | 43 |
| | Industrial | Up to 500 Sq. yds. | 02 |
| | | 500 – 1000 Sq.yds. | 01 |
| | | 1000 Sq.yds.- 1 Acre | 01 |
| | | Above 1 Acre | 01 |
| | | Total number of samples | 05 |
| Ballabgarh | Residential | Very low income group (slum area) | 15 |
| | | Low income group (Up o100 sq.yds.) | 58 |

| | | | |
|---|---|---|---|
| | | Medium income group (100 – 250 sq.yds.) | 39 |
| | | High income group (> 250 sq.yds.) | 09 |
| | | Total number of samples | 121 |
| | Commercial | Informal sector | 02 |
| | | Up to 200 Sqft. | 02 |
| | | 200 – 500 Sqft. | 03 |
| | | Above 500 Sqft. | 04 |
| | | Total number of samples | 11 |
| | Industrial | Up to 500 Sq. yds. | 01 |
| | | 500 – 1000 Sq.yds. | 01 |
| | | 1000 Sq.yds.- 1 Acre | 01 |
| | | Above 1 Acre | 02 |
| | | Total number of samples | 05 |

**Table 3:** Zone-wise sample selection of MCF worker

| Zone | Sample selection of MCF worker | Samples |
|---|---|---|
| Old Faridabad | Senior Sanitary Inspector | 01 |
| | Sanitary Inspector | 01 |
| | SafaiDaroga | 01 |
| | Sweepers (Safaikaramchari) | 27 |
| | Total number of sample | 30 |
| NIT | Senior Sanitary Inspector | 01 |
| | Sanitary Inspector | 01 |
| | SafaiDaroga | 01 |
| | Sweepers (Safaikaramchari) | 27 |
| | Total number of sample | 30 |
| Ballabhgarh | Senior Sanitary Inspector | 01 |
| | Sanitary Inspector | 01 |
| | SafaiDaroga | 01 |
| | Sweepers (Safaikaramchari) | 27 |
| | Total number of samples | 30 |

**Table 4:** Zone wise sample selection of health institutions

| Zone | Sample selection of health institutions | Samples |
|---|---|---|
| Old Faridabad | Govt. hospital | 01 |
| | Private hospital | 01 |
| | Dispensary | 02 |
| | Small clinic | 06 |
| | Total number of samples | 10 |
| NIT | Govt. hospital | 01 |
| | Private hospital | 01 |
| | Dispensary | 02 |
| | Small clinic | 06 |
| | Total number of samples | 10 |
| Ballabgarh | Govt. hospital | 01 |
| | Private hospital | 01 |
| | Dispensary | 02 |
| | Small clinic | 06 |
| | Total number of samples | 10 |

**Opinion about precautionary measures taken for the safety of workers**

Lack of safety precautions increase risk of accidents for workers which are involved in handling of waste. Table5 describes precautionary measures/safeguards used by the workers. Mask, Knee shoes and antiseptic is used by all most all the respondents but gloves are used by less than sixty percent of the workers of commercial establishments. Ignorance as well as non - availability of certain equipments such as mask, knee shoes or gloves are the main causes. In the absence of the use of precautionary measures, sweepers in particular take the risk of health hazard. Infact many of them suffered from related ailment such as chest infections, asthma etc.

Essential precautions are necessary to reduce and minimize hazards associated with manual handling of industrial waste. Personnel handling hazardous waste should wear appropriate protective safeguards. It was found that most of people in industrial sector are not adopting mechanical methods for handling waste, and moreover, they are not aware of the danger of manual handling of hazardous waste. Respondents asserted that all the industrial workers use hand gloves and antiseptic whereas knee shoes and mask is used by 62.50 and 50.00 percent of workers only. Their use is more common in large size industries.

Hand cloves and antiseptic are provided to all the health workers across all the health institutions but mask and knee shoes are provided to three-fourth of workers only. However, there is wide difference in it since all the workers in big hospitals get these but only fifty to sixty percent of those from smaller one received such facilities in MCF.

Lack of safety precautions increase risk of accidents for workers which are involved in handling of waste. Precautionary measures are essential for workers to save health and occupational hazard concern with handling of waste. Waste collection workers face particular occupational hazards, including strains from waste lifting, injuries from sharp objects and traffic accidents. Dangerous items (such as broken glass, razor blades, other healthcare waste, aerosols cans and potentially explosive containers and chemical from industries) pose risks of injury of poisoning, particularly to the workers who sort out waste. All the respondents were getting hand gloves and antiseptic i.e. Dettol and sevlon etc. which are provided by the MCF whereas in the case of mask and knee shoes, all except the sweepers get it. One third of them do not get these. Its bit surprising also that it is the sweepers who require these two items the most. It is noted that MCF provide a special allowance for *safaikaramchari* which is known as *GandaBhatta* (Washing Allowance). MCF pays this allowance only for permanent sweepers whereas sweepers on contract and daily wages do not get this type of concession aid.

**Table 5:** Faridabad City: Precautionary measures for the safety of workers, 2012 (Percent of respondents)

| | Hand Gloves | Mask | Knee Shoes | Antiseptic |
|---|---|---|---|---|
| Commercial establishments | | | | |
| Informal Sector | 63.16 | 100.00 | 100.00 | 89.47 |
| Up to 200sqft. | 36.84 | 94.74 | 94.74 | 100.00 |
| Above 200-500sqft. | 50.00 | 87.50 | 87.50 | 100.00 |
| Above 500sqft. | 68.42 | 94.74 | 94.75 | 94.74 |
| Grand Total | 58.90 | 94.52 | 94.52 | 95.89 |
| Industrial units | | | | |
| Up to 500 Sq.yds | 100.00 | 33.33 | 33.33 | 100.00 |
| Above 500-1000 Sq.yds | 100.00 | 0.00 | 100.00 | 100.00 |
| Above 1000 Sq.yd. - 1 Acre | 100.00 | 100.00 | 100.00 | 100.00 |
| Above 1 Acre | 100.00 | 100.00 | 100.00 | 100.00 |
| Grand Total | 100.00 | 50.00 | 62.50 | 100.00 |
| Health Institutions | | | | |
| Govt. Hospital | 100.00 | 100.00 | 100.00 | 100.00 |
| Private Hospital | 100.00 | 100.00 | 100.00 | 100.00 |
| Dispensary | 100.0 | 66.67 | 66.67 | 100.0 |
| Small Clinic | 100.00 | 72.22 | 72.22 | 100.00 |
| Grand Total | 100.0 | 76.67 | 76.67 | 100.0 |
| MCF workers | | | | |
| Senior Sanitary Inspector | 100.00 | 100.00 | 100.00 | 100.00 |
| Sanitary Inspector/A.S.I. | 100.00 | 100.00 | 100.00 | 100.00 |
| SafaiDaroga | 100.0 | 100.0 | 100.0 | 100.0 |
| SafaiKaramchari (Sweeper) | 100.00 | 62.96 | 62.96 | 100.00 |
| Grand Total | 100.0 | 66.67 | 66.67 | 100.0 |

***Source*:** Field survey, 2012.

**Respondent's opinion about solid waste impact on public health: Epidemic Diseases, Environmental Pollution and Smell:**

Table 6 describes household's opinion about solid waste effect on public health with respect to epidemic diseases, environmental pollution and smell. Severe health impact has been opinioned by the respondents in case of environment pollution and smell generated from the solid waste whereas majority of the respondents are of the view that the impact of epidemic diseases is negligible to moderate.

Further, low income group see health hazard as the consequences of epidemic diseases, environmental pollution and smell as negligible or moderate whereas medium and high income group feels severe impact. Similar trends have been observed in different administrative zone of city. It may be because very low income group mainly consist of slum population and hence because of low level of education and income either they are unaware of the health hazard of solid waste in term of the above cited parameters or they have no choice of being poor. Since, they are leaving close to such waste in unhygienic conditions for quite some time, they become habitual to pollution and unsanitary conditions. Moreover, it seems that they have adapted to live in such conditions and thus do not see any health hazard. Contrarily, higher income group is better educated and hence more aware about the importance of health and sanitation. Secondly, they are leaving in planned area where sanitary conditions are far better and have become habitual to leave in such condition. Any adverse environment changes affect their health thus majority of them have considered solid waste components cited above as severe health hazard. Rats, flies and other pests feed on the wastes and carry diseases.

Table 6 describes commercial unit's opinion about solid waste effect on public health with respect to epidemic diseases, environmental pollution and smell. One-fourth to one-third of the respondent's opinioned severe health impact whereas majority of the respondents are of the view that the impact is moderate. Only about one-fourth of them observed that there is no adverse impact of solid waste. Further, majority of the low income group consist of small commercial activities either do not see any health hazard as the consequences of epidemic diseases, environmental pollution and smell or its impact is moderate whereas medium and large size.

**Table 6:** Faridabad city: Respondents opinion about solid waste effect on public health: Epidemic Diseases, Environmental Pollution and Odor, 2012 (Percent of respondents)

| | Epidemic Diseases | | | Environmental Pollution | | | Smell | | |
|---|---|---|---|---|---|---|---|---|---|
| **Residential** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| Very Low Income Group | 58.00 | 34.00 | 8.00 | 46.00 | 54.00 | 0.00 | 46.00 | 54.00 | 0.00 |
| Low Income Group | 15.50 | 47.00 | 37.50 | 12.00 | 35.00 | 53.00 | 6.00 | 29.00 | 65.00 |
| Medium Income Group | 12.21 | 61.07 | 26.72 | 8.40 | 26.72 | 64.89 | 0.76 | 34.35 | 64.89 |
| High Income Group | 23.53 | 52.94 | 23.53 | 23.53 | 29.41 | 47.06 | 0.00 | 45.10 | 54.90 |
| Total | 20.37 | 50.46 | 29.17 | 16.20 | 34.26 | 49.54 | 8.33 | 35.19 | 56.48 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Commercial establishments | | | | | | | | | |
| Informal Sector | 84.21 | 15.79 | 0.00 | 57.90 | 36.84 | 5.26 | 0.00 | 63.16 | 36.84 |
| Up to 200sqft. | 10.53 | 84.21 | 5.26 | 5.26 | 73.68 | 21.06 | 0.00 | 63.6 | 36.84 |
| Above 200-500sqft. | 18.75 | 31.25 | 50.00 | 31.25 | 25.00 | 43.75 | 0.00 | 62.50 | 37.50 |
| Above 500sqft. | 0.00 | 47.37 | 52.63 | 0.00 | 36.84 | 63.16 | 0.00 | 78.95 | 21.05 |
| Total | 28.77 | 45.20 | 26.03 | 23.29 | 43.84 | 32.87 | 0.00 | 67.12 | 32.88 |
| Industrial units | | | | | | | | | |
| Up to 500 Sq.yds | 83.33 | 16.67 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 33.33 | 66.67 |
| Above 500-1000 Sq.yds | 0.00 | 66.67 | 33.33 | 0.00 | 100.00 | 0.00 | 0.00 | 33.33 | 66.67 |
| Above 1000 Sq.yd. - 1 Acre | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| Above 1 Acre | 0.00 | 25.00 | 75.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| Total | 6.25 | 50.00 | 43.75 | 0.00 | 43.75 | 56.25 | 0.00 | 18.75 | 81.25 |
| Health institutions | | | | | | | | | |
| Govt. Hospital | 0.00 | 66.67 | 33.33 | 0.00 | 66.67 | 33.33 | 0.00 | 0.00 | 100.00 |
| Private Hospital | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| Dispensary | 0.00 | 50.00 | 50.00 | 0.00 | 50.00 | 50.00 | 0.00 | 33.33 | 66.67 |
| Small Clinic | 0.00 | 83.33 | 16.67 | 0.00 | 83.33 | 16.67 | 0.00 | 80.00 | 20.00 |
| Grand Total | 0.00 | 90.00 | 10.00 | 0.00 | 90.00 | 10.00 | 0.00 | 33.33 | 66.67 |
| MCF workers | | | | | | | | | |
| Senior Sanitary Inspector | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| Sanitary Inspector/A.S.I. | 0.00 | 33.33 | 66.67 | 0.00 | 100.00 | 0.00 | 0.00 | 33.33 | 66.67 |
| SafaiDaroga | 0.00 | 33.33 | 66.67 | 0.00 | 100.00 | 0.00 | 0.00 | 33.33 | 66.67 |
| SafaiKaramchari (Sweeper) | 0.00 | 74.07 | 25.93 | 0.00 | 51.85 | 48.15 | 50.62 | 35.80 | 13.58 |
| Grand Total | 0.00 | 72.22 | 27.78 | 0.00 | 56.67 | 43.33 | 45.56 | 34.44 | 20.00 |

***Source*:** Field survey, 2012.

Note: Where, 1 denote No effect, 2 denote Moderate and 3 denote Severe.

Establishments feels severe impact. Similar trends have been observed in different administrative zones of city. It may be because very low income group mainly consist of informal sector and hence because of low level of education and income either they are unaware of the health hazard of solid waste in term of the above cited parameters or they have no choice of being poor. Since, they are leaving close to such waste in unhygienic conditions for quite some time, they become habitual to pollution and unsanitary conditions.

Moreover, it seems that they have adapted to live in such conditions and thus do not see any health hazard. Contrarily, big establishments have higher income and are better educated and hence more aware about the importance of health and sanitation. Secondly, they are leaving in planned area where sanitary conditions are far better and have become habitual to leave in such condition. Any adverse environment changes affect their health thus majority of them have considered solid waste components cited above as severe health hazard.

Solid waste from non hazardous industries produces health problems, not only to the workers and handler of waste, but also to general population. Cotton dust is one example of this. There are many problems related with improper disposal of waste. Hazardous chemical materials cause skin burns or even loss of consciousness; chronic hazards include respiratory problems from dust inhalation and potential carcinogenicity from toxic chemicals produced by industries. Table 6 shows industrial firm's opinion about improper management of solid waste effect on health with respect to epidemic diseases, environmental pollution and smell. Severe health impact has been opined by the respondents in case of environment pollution and smell generated from the solid waste whereas majority of the respondents are of the view that the impact of epidemic diseases has either no or moderate effect. Further, workers of industry concerned with size up to 500sq.yds see health hazard as the consequences of epidemic diseases, environmental pollution and smell as negligible or moderate whereas respondents from medium and large size units feels severe impact. Similar trends have been observed in different administrative zones of the city.

Improper waste management create number of problems which needs to be addressed. In solid waste management this can be achieved by making waste technologies more contained, reducing contaminant emissions, changing working methods, use of protective clothing, and keeping the public and residents a safe distance away from operations. For example, risk of respiratory infection or allergic response to organic dusts can be greatly reduced if transfer stations, composting and recycling process systems are enclosed or ventilated and if worker swear respiratory masks. Table 6 describes the effect of epidemics, environment pollution and odor on human health. It is observed that first two factors are causing more moderate to severe effects on health than the odor. Moreover, the higher level workers and official considers more severe impact of these parameters as compare to the sweepers who are more directly exposed to the hazardous waste. This may be because they become habitual to work in such conditions and thus have indifferent attitude towards appalling sanitary conditions. Comparatively, in Ballabgarh zone workers considers less severe impact.

**Respondent's opinion about solid waste impact on public health: water pollution, air pollution and soil pollution**

Table 7 describes household's opinion about solid waste impact on public health with respect to water pollution, air pollution and soil pollution. There is contamination of underground water due to leachate at the dumping site. Secondly, many water bodies or low laying areas become polluted because of dumping of solid waste especially by

slums dwellers and low income group people. Half of the respondents considered it as severe, 1/3rd as moderate and the remaining 1/6th of the residential respondents do not see any impact on health. Generally, opinion of the people increases towards severity of the health impact of solid waste with increase in income whereas low income H.H especially the slums dwellers either see negligible or moderate impact. Higher proportion of respondents reveals severe impact on health because underground water is saline in most of the Faridabad city. Technically it is not due to leachate of solid waste but perhaps respondents have failed to differentiate it.

Burning of solid waste by the sweepers in the morning hours is very common phenomena in Indian cities and MCF is not an exception to it. Secondly, decomposition of organic materials at collection points and dumping sites which emit odour and air contaminates such as small solid particles, $Co^2$ and $No^2$ etc. Though, fairly high proportion of respondents observes severe or moderate impact of solid waste in creating air pollution but it is far lower than their opinion about water pollution. However, there is significant increase in the proportion of the respondent's opinion with negligible impact. Overall, there is increasing views of the respondents towards the severe impact of solid waste in all the zones expect in the middle income group.

**Table 7:** Faridabad city: Respondents opinion about solid waste impact on public health: water pollution, air pollution and soil pollution, 2012 (Percent of respondents)

| | Water Pollution | | | Air Pollution | | | Soil Pollution | | |
|---|---|---|---|---|---|---|---|---|---|
| **Residential** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| Very Low Income Group | 26.00 | 42.00 | 32.00 | 46.00 | 54.00 | 0.00 | 84.00 | 16.00 | 0.00 |
| Low Income Group | 14.50 | 39.00 | 46.50 | 14.50 | 41.5 | 44.00 | 46.5 | 44.00 | 9.50 |
| Medium Income Group | 19.08 | 23.66 | 57.25 | 16.79 | 29.01 | 54.20 | 60.30 | 31.30 | 8.40 |
| High Income Group | 9.80 | 23.53 | 66.67 | 9.80 | 23.53 | 66.67 | 39.22 | 45.10 | 15.69 |
| Total | 16.67 | 32.87 | 50.46 | 18.29 | 37.04 | 44.68 | 54.17 | 37.04 | 8.80 |
| Commercial establishments | | | | | | | | | |
| Informal Sector | 36.84 | 47.37 | 15.79 | 84.21 | 15.79 | 0.00 | 100.00 | 0.00 | 0.00 |
| Up to 200sqft. | 5.26 | 68.42 | 26.32 | 10.53 | 84.21 | 5.26 | 21.06 | 73.68 | 5.26 |
| Above 200-500sqft. | 31.25 | 62.50 | 6.25 | 12.50 | 43.75 | 43.75 | 43.75 | 43.75 | 12.50 |
| Above 500sqft. | 15.79 | 68.42 | 15.79 | 0.00 | 68.42 | 31.58 | 21.06 | 73.68 | 5.26 |
| Total | 21.92 | 61.64 | 16.44 | 24.66 | 53.42 | 21.92 | 46.58 | 47.94 | 5.26 |
| Industrial units | | | | | | | | | |
| Up to 500 Sq.yds | 0.00 | 33.33 | 66.67 | 0.00 | 50.00 | 50.00 | 100.00 | 0.00 | 0.00 |
| Above 500-1000 Sq.yds | 0.00 | 33.33 | 66.67 | 0.00 | 0.00 | 100.00 | 66.67 | 33.33 | 0.00 |
| Above 1000 Sq.yd. - 1 Acre | 0.00 | 33.33 | 66.67 | 0.00 | 0.00 | 100.00 | 0.00 | 100.00 | 0.00 |
| Above 1 Acre | 0.00 | 50.00 | 50.00 | 0.00 | 0.00 | 100.00 | 0.00 | 100.00 | 0.00 |
| Total | 0.00 | 37.50 | 62.50 | 0.00 | 18.75 | 81.25 | 50.00 | 50.00 | 0.00 |
| Health institutions | | | | | | | | | |
| Govt. Hospital | 0.00 | 100.00 | 0.00 | 0.00 | 66.67 | 33.33 | 0.00 | 100.00 | 0.00 |
| Private Hospital | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 100.00 | 0.00 |
| Dispensary | 0.67 | 66.67 | 16.67 | 0.00 | 50.00 | 50.00 | 50.00 | 50.00 | 0.00 |
| Small Clinic | 16.00 | 44.44 | 38.39 | 0.00 | 55.56 | 44.44 | 27.78 | 44.44 | 27.78 |
| Total | 13.33 | 60.00 | 26.67 | 0.00 | 46.67 | 53.33 | 26.67 | 56.66 | 16.67 |
| MCF workers | | | | | | | | | |
| Senior Sanitary Inspector | 0.00 | 100.00 | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| Sanitary Inspector/A.S.I. | 0.00 | 100.00 | 0.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| SafaiDaroga | 0.00 | 100.00 | 0.00 | 66.67 | 33.33 | 0.00 | 66.67 | 33.33 | 0.00 |
| SafaiKaramchari (Sweeper) | 0.00 | 51.85 | 48.15 | 91.36 | 8.64 | 0.00 | 91.36 | 8.64 | 0.00 |
| Total | 0.00 | 56.67 | 43.33 | 91.11 | 8.89 | 0.00 | 91.11 | 8.89 | 0.00 |

***Source*:** Field survey, 2012.

Note: Where, 1 denote No effect, 2 denote Moderate and 3 denote Severe.

Since commercial activities by and large do not contain hazardous material hence its impact on the above cited parameters are not severe as it is considered in case of industrial waste. Still, about one fifth of the respondents see its impact as severe on the air quality and further about one-seventh considered it severe on the water quality. Severe impact on the soil is relatively far less. Instead, about half of the respondents think its impact as moderate on all the parameters. Comparatively, informal sector and small commercial unit's workers opined for very severe impact. They are of the view that its impact is either moderate or there is no adverse impact at all. Contrarily, majority of the medium and large size unit's workers feels that its impact is moderate.

The solid waste generated from industries contains a large number of chemicals, some of which are toxic. Any mismanagement of such waste can create hazardous conditions detrimental to the human or animal's health. Impact of air and water pollution are considered severe by great majority of the respondents while none of the respondents considered impact of soil pollution as severe. Instead half of the respondents see its impact as moderate and other half as no impact. General trend is that small size units have higher

response indicating either no (soil) or moderate(air and water) impact and respondents from large size units across the zones considered either moderate (soil) or severe impact(air and water) of the above cited pollution on human health.

Table 7 further shows the opinion of the health workers of MCF about solid waste effect on public health. Majority of them considered its impact moderate in all the parameters but severe impact on air quality is considered more as compare to water and soil it may be because of the pathogens contained in the blood and body parts which stinks if not disposed timely. Severe impacts are more a response of workers from smaller institutions whereas from bigger one considered its impact as moderate. Uncontrolled dumping and improper waste handling causes a variety of problems, including contaminating water, attracting insects and rodents and increasing flooding due to blocked drainage canals or gullies. Improper waste management also increases greenhouse gas emissions, which contribute to climate change. It is observed that most of the respondents do not see any adverse impact on air and soil quality, however, there is significant number of respondents who feels moderate to severe impact on the quality of water particularly ground water in the vicinity of the dumping site. Higher order official do not see any impact on air or soil quality and moderate impact on the water quality. Contrarily, lower level workers opinion is more for moderate to severe impact which is almost same in all the zones.

## Conclusion

Essential precautions are necessary to reduce and minimize hazards associated with manual handling of industrial waste. In the absence of the use of precautionary measures, sweepers in particular take the risk of health hazard. Infact many of them suffered from related ailment such as chest infections, asthma etc. Personnel handling hazardous waste should wear appropriate protective safeguards. It was found that most of people in industrial sector are not adopting mechanical methods for handling waste, and moreover, they are not aware of the danger of manual handling of hazardous waste. Waste collection workers face particular occupational hazards, including strains from waste lifting, injuries from sharp objects and traffic accidents. Dangerous items (such as broken glass, razor blades, other healthcare waste, aerosols cans and potentially explosive containers and chemical from industries) pose risks of injury of poisoning, particularly to the workers who sort out waste. All the respondents were getting hand gloves and antiseptic i.e. dettol and sevlon etc. which are provided by the MCF whereas in the case of mask and knee shoes, all except the sweepers get it. One third of them do not get these. Its bit surprising also that it is the sweepers who require these two items the most. It is noted that MCF provide a special allowance for *safaikaramchari* which is known as *GandaBhatta* (Washing Allowance). MCF pays this allowance only for permanent sweepers whereas sweepers on contract and daily wages do not get this type of concession aid.

Further, low income group see health hazard as the consequences of epidemic diseases, environmental pollution and smell as negligible or moderate whereas medium and high income group feels severe impact It may be because very low income group mainly consist of slum population and hence because of low level of education and income either they are unaware of the health hazard of solid waste in term of the above cited parameters or they have no choice of being poor. Since, they are leaving close to such waste in unhygienic conditions for quite some time, they become habitual to pollution and unsanitary conditions.

Moreover, the higher level workers and official considers more severe impact of the environment pollution as compare to the sweepers who are more directly exposed to the hazardous waste. This may be because they become habitual to work in such conditions and thus have indifferent attitude towards appalling sanitary conditions. Generally, opinion of the people increases towards severity of the health impact of solid waste with increase in income whereas low income H.H especially the slums dwellers either see negligible or moderate impact.

Burning of solid waste by the sweepers in the morning hours is very common phenomena in Indian cities and MCF is not an exception to it which emit odor and air contaminates such as small solid particles, $Co^2$ and $No^2$ etc. Overall, there is increasing views of the respondents towards the severe impact of solid waste in all the zones expect in the middle income group.

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