Appendices

APPENDIX A. PUBLIC HEALTH ASPECTS

Rising urban population growth, limited municipal resources, and the complexity of municipal solid waste management (MSWM) in both industrialised and developing countries have complicated the relationship between environmental management and the health of urban inhabitants. The combined effects of casual disposal of wastes, insufficient waste collection service, and inadequate waste disposal facilities have always had serious, adverse implications for public health. Among these are the direct transmission of diseases and the spread of epidemics, degradation of the quality of the urban and natural environments and, most importantly, the social reinforcement of poor hygienic habits and practices, all of which compose a vicious cycle.

The inclusion of hazardous waste, health care waste, and excreta (although in small quantities) in the urban waste stream complicates the search for practical responses to the problem of maintaining the health of the public. For example, the potential spread of AIDS, SARS, and other infectious diseases through the discharge of health care wastes into the general urban waste stream is a continuous and growing threat. The implications of inadequate municipal waste management upon the health of the public are serious and they cannot be ignored.

This appendix focuses on the public health implications of generating, collecting, processing and disposing solid waste in developing counties, and on methods of managing the risks to the health and safety of the general public and of the personnel involved in collection and disposal of solid waste. The approach adopted for this discussion is to follow the various key stages, from generation through final disposal of municipal solid waste (MSW), and in the process to discuss common public health impacts on both the public and on the workers who directly handle the wastes. The impacts on the environment in general are mentioned where relevant. Some attention is also given to the topic of special and hazardous wastes.

A. The nature of municipal solid waste

From the public health point of view, MSW can be divided into three categories, with subcategories that are based largely on their sources and/or processes of generation: 1) domestic wastes; 2) special and hazardous wastes; and 3) other wastes, as shown in Table A-1. While most of these wastes could be isolated at the source of generation and managed in a rational way, in practice, the municipal waste stream is usually a mixture of two or more of the categories. This is the reality of most developing countries and some of the emerging or transition economies of Central Asia and Eastern Europe, where waste management systems have generally broken down.

Table A-1. Waste categories with potential public health impacts

Category	Description
Domestic wastes	General household wastes with used batteries and drugs containers, street sweepings with small quantities of excreta
Special and hazardous wastes	Health care waste (sharp and infectious components), toxic chemical, pharmaceutical, and other industrial wastes, as well as radioactive wastes
Other wastes	Untreated abattoir waste, construction wastes with asbestos components, and sludges from wastewater treatment plants

B. Potential health impacts in the waste cycle

Public health impacts of MSW can occur along all stages of the waste cycle. Mismanagement of waste at each point along the cycle has the potential of introducing both short- and long-term adverse health impacts; these call for serious attention. Groups at risk from adverse public health impacts associated with MSW are listed in Table A-2. Some types of potential health impacts associated with solid waste are discussed below.

Table A-2. Groups at risk from adverse public health impacts associated with MSW

- The population of unserved areas, especially pre-school children and the elderly
- Waste operators and scavengers
- Workers in facilities that produce infectious, toxic, and cancer-causing materials
- People living close to waste facilities
- The population supplied with water polluted by waste dumping or by inadequately protected landfill sites

B1. GENERAL

The first type of health impact is accidental injuries, such as cuts and punctures from sharp objects in the waste. Workers and other persons who manually collect and process solid waste regularly are especially at risk. Fires in collected and disposed waste also represent potential health and safety hazards to workers as well as the public. Another hazard is that which manifests itself when large volumes of disposed waste become unstable and, in the process, collapse and bury workers, scavengers, or shacks on or near the site containing their inhabitants. Small amounts of hazardous chemical waste in garbage may result in accidental injuries, but may also lead, in some extreme cases, to poisoning. Also, some cases are on record of children playing with radioactive waste illegally collected from health care facilities and land disposed, with the eventual result that the children contract cancer.

The second type of health impact is infections caused by exposure of humans to solid waste or its products of decomposition. Blood borne infections such as tetanus, resulting from injuries caused by infected sharp items in the waste, are common. Ophthalmologic and dermatological infections from exposure to contaminated 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 on fields irrigated with contaminated leachate from waste piles, and from eating food in garbage. 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.

B2. GENERATION and storage

The production and storage of waste represents the first points of physical contact and other routes of exposure between the waste and humans or the environment. The exposure and potential for adverse human health risks are particular concerns in the case of special or hazardous waste, especially during the production of industrial products with toxic byproducts. While the risk is generally less in the case of generation and storage of domestic solid waste, the inclusion of

relatively small quantities of infectious and toxic waste, such as bottles containing hazardous types of pharmaceutical products, photographic material, batteries, infectious health care wastes and sharps (e.g., syringe needles and scalpels), excreta, and other such substances, can turn seemingly benign domestic waste into potentially dangerous waste, with attendant serious public health impacts.

Storage of waste can also lead to adverse public health effects by: 1) creating fertile grounds for the breeding of household pests; 2) animals feeding on the waste; and 3) obstructing natural drainage channels, leading to the formation of ponds that then serve as breeding grounds for insects and other carriers of human pathogens. Backyard dumping or storage of waste often creates noxious odours that results from decomposition of biodegradable materials, and breeding grounds for insects and rodents that are potential carriers of infectious diseases.

B3. WASTE recovery, recycling, and reuse

In developing countries, scavenging is widely practiced and socioeconomic conditions do not allow its abolition or prohibition. Scavengers are extremely vulnerable because they belong to one of the most underprivileged 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, scavengers live in shacks built on the disposal sites. Some may be born, live, work, die, and be buried in the dump. Street children very often survive by scavenging materials from waste set out for collection. Health surveys have shown that the health status of scavengers is very low, and that they suffer from infections, including persistent skin infections. Their life expectancy is far below the average in their respective countries.

Scavengers may be protected in the same way as regular solid waste crews, but in low-income countries, occupational health and safety services are most often deficient for such crews, and scavengers can expect none of those services. However, the scavenger's situation may be improved if they are organised and receive assistance to improve both working conditions and their housing and sanitation, as the Zabbaleen communities in Cairo, Egypt have demonstrated.

B4. COLLECTION and transfer

One important hygienic requirement in public health is that all MSW produced, even in low-income areas, be collected and removed from the point of generation. These sanitation activities minimise or eliminate the potential of humans coming into direct contact with putrefying waste. 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 cities of low-income developing countries, local governments are often unable to collect most of the MSW produced in their cities. Collection coverage below 50% is common for several cities, which means that there is practically no collection in low-income neighbourhoods. This situation results in waste piling up in those neighbourhoods. 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.

The organic fraction of uncollected waste undergoes uncontrolled fermentation, which creates conditions favourable to the survival and growth of microbiological pathogens, especially if wastes are mixed with human excreta due to lack of proper and adequate sanitary facilities. If the waste undergoes anaerobic fermentation, methane gas, which is combustible, is generated, which with a source of ignition can expose humans to fire, smoke, or even an explosion. 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 feeding and harbouring stray and scavenging animals -- potential carriers of zoonosis. 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. One public health consequence of open dumping can be obstruction of stormwater runoff. This results in flooding and creation of ponds during the rainy season, which become habitats and breeding places for waterborne vectors of tropical diseases. Helminths, such as hookworm, survive on soil polluted by waste and will infect barefooted people. Waste collection or disposal operators are exposed to direct impacts from waste. Solid waste workers are particularly vulnerable because of their low educational status, and are therefore difficult to reach by health education and preventive actions. As shown in Table A-3, waste workers are exposed to a multitude of health hazards that result from direct handling of and contact with waste.

The most practical public health problems arising from transfer and transportation of waste are related to improper safeguards in the transfer or transportation process. Uncovered transportation vehicles or containers cause littering of the waste and the possible spread of airborne contaminants; leachates from trucks used for transportation are another source of pollution. Worst-case scenarios are en route accidents that result in ground and surface water contamination. The choice of low-risk transportation routes is very important.

Table A-3. Occupational hazards associated with waste handling

Accidents

- Muscular-skeletal disorders resulting from the handling of heavy containers
- Wounds, most often infected wounds, resulting from contact with sharp waste
- Intoxication and injuries resulting from contact with small amounts of hazardous chemical waste collected with garbage
- Trauma, burns, and other injuries resulting from occupational accidents at waste disposal sites, or from methane gas fires or explosions at landfill sites

Infections

- Dermal and blood infection resulting from direct contact with waste and from infected wounds
- Ophthalmologic and respiratory infections resulting from exposure to infected dust, especially during landfilling operations
- Zoonosis resulting from bites by wild or stray animals feeding on wastes
- Enteric infections transmitted by insects feeding on wastes

Chronic diseases

- Incineration operators are especially exposed to chronic respiratory diseases resulting from exposure to dust, to toxic and carcinogenic risks resulting from exposure to hazardous compounds, to cardiovascular disorders and heat stress resulting from exposure to excessive temperature, and to loss of hearing function due to exposure to excessive noise

B5. TREATMENT and disposal

Waste treatment and disposal facilities have the potential to create health hazards for waste workers; they also create health hazards and nuisances to populations living in their vicinity. For

this reason, the location of such facilities 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 groundwater pollution by leachate generated as a result of uncontrolled land disposal of waste, and air pollution caused by uncontrolled incineration of waste.

Waste disposal operators, scavengers, and occasional visitors to solid waste facilities are exposed to infectious wounds, inhalation of infected dust, skin contact with infected material, bites from disease-transmitting insects or animals, and burns or injuries from many kinds of accidents (see Table A-3).

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 or adjacent to land disposal sites, or from the slides of unstable slopes. Nearby populations are exposed to high noise levels from disposal operations, to air pollution from dust and smoke produced at 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 land disposal sites. Unfortunately, scavengers and their families tend to build their domiciles very close to if not on waste disposal sites; their removal may be a very sensitive issue. An example is the lengthy negotiation over the closure of the "Smoky Mountain" dump in Manila, Philippines.

The above-listed hazards may be mitigated by the practice of modern sanitary landfilling, discussed in the main body of this publication. Due to modern landfill design and operation, odours, dust emissions, fires, the proliferation of insects, rodents, and stray animals, and other impacts are controlled.

B5.1. Composting and reuse

Composting and reuse are largely environmentally friendly operations; however, if improperly carried out, they may generate some health hazards. Workers at composting facilities, when poorly protected, are exposed to infection from dust inhalation and to infective wounds from sharps. They are also exposed to occupational accidents during waste shredding operations. In developing countries, farmers working barefoot are exposed to infective wounds from small sharps included in poorly processed compost.

Separate collection of even small quantities of hazardous waste can expose poorly protected or poorly trained workers to health and safety hazards. These hazards may be infectious or toxic. Recycling of non-disinfected infectious waste represents serious health and safety risks to both operating personnel and the public. Discarded medical equipment such as syringes and scalpels should not be reused. Precautions should be taken such that these items are prevented from entering the waste stream where there is potential for contact by scavengers plying their trade.

The indiscriminate reuse of contaminated containers, particularly for the storage of drinking water, beverages, and food items, can lead to health and safety issues.

B5.2. Incineration

Proper siting and proper emission control facilities are very important in limiting exposure of humans to air pollution produced as a result of incineration of solid waste, 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 wastewater produced by exhaust gas cleaning processes. Fly ash and acidic wastewater from gas cleaning systems 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.

Nearby populations will not only be exposed to the consequences of any industrial accidents, but also to significant levels of noise and air pollution. The best way to protect the public from incinerator air emissions is to limit settlements to beyond the boundary of minimally acceptable air quality. The determination of this boundary requires qualified and experienced professionals to analyse many issues, including types and levels of emissions emitted at the facility and dispersed downwind, meteorological conditions, applicable routes of human exposure, and types of health risks. The public may also be affected by water pollution if ash and wastewater from the incinerator are not properly treated and disposed. Many industrialised countries, as well as the European Union and the Nordic Council, are enforcing standards limiting incinerator emissions; those standards cover HCI, HF, particulates, NO_x, CO_x, SO_x, Pb, Cd, Hg, As, Zn, dioxins, furans, and other compounds.

Ash from incinerators has been reused in civil engineering works. However, in industrialised countries, the most prevalent method of management is disposal of the ash in lined landfills to control the risk of underground pollution by soluble toxic chemicals leached out of the ash. Both fly ash and bottom ash contain chemical constituents that pose potential serious risks to operating personnel and the public. The chemical constituents of concern include heavy metals, dioxins, and furans. Fly ash in particular tends to be very hazardous because of its fine particulate size distribution and the fact that heavy metals and other non-combustible toxic chemicals in the waste are concentrated in the mass remaining after combustion of the waste. Proper methods of transporting, treating, and disposing of bottom and fly ash are required to minimise health and safety risks to both operating personnel and the general public.

Untreated wastewater produced by incinerator gas cleaning systems is highly acidic. To protect both the public and the environment, this acidity must be neutralised with alkali before discharging such wastewater into any sewer system for treatment. Under no circumstances should the effluent be discharged into the environment without prior treatment.

B5.3. Open dumps and landfills

Dumps and landfill sites can have a substantial impact on both surface and groundwater quality, with subsequent potential health hazards for people who depend on such resources for subsistence. Rainwater runoff from poorly designed and operated landfills or from open dumps can reach nearby streams after having been heavily polluted through contact with waste. However, the most serious threat usually is that associated with leachate generated within the waste and its subsequent infiltration into unconfined aquifers below or adjacent to disposal sites. This results in chemical and viral pollution of groundwater. The health hazard from polluted groundwater is far greater than from polluted surface water, because rural populations around the landfill may drink from shallow wells without treating the water. Even if the well water or surface water source is subjected to treatment, the treatment may not be effective against some of the chemical pollutants contained in leachate produced from solid waste.

To protect surface water quality, it is necessary to prevent water flowing over or infiltrating through waste before reaching the surface source. Proper location and design and operation of land disposal facilities is required in order to minimise the risk of pollution of ground and surface waters by solid waste leachate.

Communities near the disposal sites also are impacted by the traffic in and out of the facility.

C. Special and hazardous wastes

In most communities in the developing world, small amounts of infectious material, sludge, sharps, chemical waste, and waste with high heavy metals content are regularly collected together with normal municipal waste. These categories of wastes create special health hazards for waste management operators, scavengers, and eventually the general population. While exposure to solid waste is frequent in poor neighbourhoods, the quantities of hazardous waste that are present in the waste are usually low. On the other hand, people in wealthy neighbourhoods tend to use more chemical consumer products and store medical products at home. The likelihood, therefore, of the presence of small amounts of hazardous waste in their garbage is high.

C1. INFECTIOUS waste

Infectious waste generated from health care activities performed in hospitals, veterinarian offices, and small clinics are most often disposed together with regular garbage. This situation can create particularly serious health hazards, of which the transmission of viral blood infections (such as AIDS and hepatitis B and C, through wounds caused by discarded syringe needles) is but one example.

C2. HAZARDOUS chemicals

Chemical consumer products used at home are often hazardous; they may be flammable, reactive, or corrosive, or they may be toxic and carcinogenic. At home, these products should be stored in a safe place, out of reach of children. If stores of domestic chemicals are adequately managed, the resulting waste will be only the packaging, with residues of chemicals, and it will be acceptable to dispose those small amounts of hazardous waste in the garbage container. Unfortunately, oftentimes a large quantity (e.g., a half-full bottle) of hazardous chemicals, whether solvents, pesticides, or varnish, finishes in the garbage container. The collection, handling, and improper disposal of even small amounts of dangerous chemicals represent substantial hazards to the health and safety of both the waste generators and the waste collectors.

D. Suggested public health and occupational safeguards

D1. OVERVIEW

From the information presented in the preceding sections, it is clear that adverse health impacts can and do result along the whole cycle of the MSWM process. A proper understanding by municipal waste managers and workers of the health and safety impacts associated with solid waste and the methods of exposure is the basis for confronting these problems. Three generic types of waste-linked health impacts have been identified, as summarised in Table A-4: 1) injuries and exposure to chronic diseases; 2) bacterial, viral, or parasitic infections; and 3) indirect creation of endemic conditions for specific tropical waterborne diseases.

From the lists of impacts, the conclusion can be drawn that safe handling and appropriate disposal of all municipal waste streams are paramount in ensuring a healthy living environment. Given the poor state of the economies of most developing countries and the sheer magnitude of their waste management problems, only strategies based on incremental improvements to the existing situation are practical in most cases.

E. Hygienic requirements at home

Any solid waste produced at home must be collected and stored in a safe container. Organic waste must not be kept indoors for more than 48 hours in a warm climate, or 5 days in a cool

climate. Containers for storing waste are best placed outdoors or in a space dedicated only to waste storage. Any infectious waste, sharps, or chemical waste must be properly packed before being put in storage containers. Large quantities of highly hazardous chemical waste, such as solvents, should not be put in domestic waste containers, but should be labelled, packaged properly, and stored separately for collection and disposal.

Garbage chutes must be avoided or bypassed in low-cost, high-rise apartments when regular maintenance is uncertain, because waste will accumulate. Existing chutes and indoor waste storage rooms of apartment houses must be kept clean and periodically disinfected. Visual evidence of insects and rodents in the building is an indicator of mismanagement of waste.

Urban populations must be educated in hygienic waste management at home and in the neighbourhood. Community leaders in low-income settlements must be motivated to contribute to hygienic waste management in their neighbourhood. Selection of safe and appropriate garbage containers in developing countries is not always easy. Uncollected waste from suburban areas may be temporarily managed by either recycling on the plot or buried onsite, but every effort must be made to put in place an appropriate collection system for all sections of the population.

Table A-4. Summary of waste-linked diseases and conditions, with their causes or pathways of transmission

Injuries and chronic diseases

- Cuts and infective wounds from sharp waste
- Burns and respiratory trauma from burning waste
- Trauma from collapses of large volumes of disposed waste
- Burns or wounds from hazardous chemicals in waste
- Toxication and cancers from exposure to hazardous waste
- Chronic respiratory diseases from exposure to dust

Bacterial, viral, or parasitic infections

- Bacterial (tetanus, staphyloco ccus, streptoco I ccus) or viral (hepatitis B, AIDS) blood infections resulting from injuries caused by infectious sharp waste
- Eye (trachoma, conjunctivitis) and skin (mycosis, anthrax) infections from waste-generated infected dust
- Respiratory infections (bacterial or viral pneumonia) from exposure to waste-generated infectious dust
- Vector-borne diseases, viral (dengue, yellow fever) or parasitic, (malaria, filariasis, schistosomiasis), transmitted by vectors living or breeding in waste-generated ponds; and worm infestation, transmitted by contact with polluted soil (hookworm)
- Bacterial (cholera, diarrhea), viral (dysentery), or parasitic (helminthiasis, amoebiasis, giardiasis) enteric diseases, transmitted:
  - by insects and rodents feeding on wastes
  - by accidental ingestion of waste food
  - through drinking water contaminated by leachate from waste
  - through eating food contaminated by leachate from waste
- Zoonosis carried by stray animals and rodents feeding on waste (rabies, plague, leishmaniasis, hydiatasis, tick-borne fevers)

Tropical diseases transmitted by waterborne vectors in urban areas

- Malaria transmitted by anopheles mosquitoes
- Dengue and yellow fever transmitted by aedes mosquitoes
- Filariasis (Bancroftian) transmitted by culex mosquitoes
- Schistosomiasis harbored by bulinus and other snails

F. Hygienic requirements in the neighbourhood

As a primary goal, all municipal waste generated in any neighbourhood should be collected and removed promptly for proper disposal. Garbage and organic municipal waste must be collected prior to reaching an advanced stage of fermentation; this stage is indicated by strong odours.

Suggested collection frequencies that are consistent with good sanitation practice are listed in Table A-5. These collection frequencies should be goals. It is recognised that limitations of human and financial resources in developing countries may limit the ability to achieve the goals. A range of values is given in the table for each type of climate because waste stored in tightly

closed containers can be collected less often than waste stored in open containers, exposing them to the elements and vectors.

Table A-5. Collection frequencies commensurate with good sanitation practice

Area	Collection Frequency
Tropical countries	Daily or every other day collection
Warm-temperate countries	Every two or three days in summer, every three or four days in winter
Cool-temperate countries	Once or twice a week in summer, once a week or biweekly in winter

If waste containers are handled manually, their size and weight should be limited to avoid muscular-skeletal disorders among waste collectors. The use of 200-L drums should be avoided. Waste containers with tight fitting lids should be used to store waste for collection, thus serving as a deterrent to human or animal intrusions, and minimising exposure of the waste to precipitation. The highest safety level is reached through the use of closed and puncture-resistant garbage containers. The use of plastic bags for storage of waste is risky to the solid waste personnel, who may be exposed to protruding sharps, etc. during the collection activity, and is problematic because the bags can be punctured or opened when handled by the collector or by rodents and stray animals. Populations of domestic stray or wild animals must be controlled in urban areas to prevent zoonosis and to avoid damage to waste containers such as plastic bags, with subsequent spreading of garbage on the roadway. Any waste spread on roadways must be removed by street cleaning operations.

G. Occupational health and safety requirements

To reduce the risks listed above, waste workers must wear protective clothes, boots, and gloves. At waste disposal sites, facemasks or simple scarves wrapped around the face should be used. Incinerator operators must also be protected against excessive noise and temperature. Waste workers should receive health education and be trained in accident prevention and emergency measures. They should have access to showers and cleaning facilities after their work shift and be immunised against tetanus and hepatitis B. Periodic medical examinations or screening should also be carried out on waste workers.

Where affordable, there should be separate collection of domestic chemical waste and waste with high heavy metal content, such as batteries, broken thermometers, and infectious and other toxic health care wastes. Used syringes should be packed in tamper-proof, puncture-resistant plastic containers or metal containers before being placed into a trash container. In countries and health care facilities that can afford it, segregation and separate collection of infectious waste should be employed to reduce to a minimum the quantities of infectious waste that require management and to render the waste more suitable for disinfection or sterilisation at a designated infectious waste disposal facility.

Waste managers in developing countries may also wish to use chemical encapsulation to encapsulate and immobilise discarded sharps, and to serve as a form of protection against the risk of injury and infection to humans. In this process, sharps are placed into a metallic barrel or a tough plastic drum. When this container is approximately 70% full, fluid cement mortar is poured into the container until all of the sharps are engulfed. After the mortar has solidified, the sharps are immobilised and the container may be disposed in a landfill. After a few weeks, due to natural mortality of microbiological pathogens, the sharps so treated will have lost their infective nature.

In case hazardous waste or health care wastes are intended for composting, it is necessary to collect the biodegradable materials separately or to carefully monitor for and segregate any hazardous chemical waste or infectious waste that could adversely affect the bacteriological processes during composting and/or the characteristics, quality, and use of the compost. These admonitions limit the exposure of the compost facility operators, the public, and the environment to dangerous and toxic waste. The segregated hazardous waste and infectious waste must then be properly collected, treated, and disposed.

H. Management framework for the minimisation of health impacts

Since many serious public health problems are directly or indirectly related to poor management of solid waste, good solid waste management practice serves to protect the public health and, therefore, the overall well being of communities. Consequently, the first two priorities should be to ensure: 1) complete coverage of the population by an appropriate and efficient municipal waste collection service, and 2) proper disposal of the collected waste in a suitable processing or disposal facility.

During the planning and implementation of the first two priorities, those in charge of waste management should also develop occupational health and safety procedures and services for solid waste workers, including not only waste collection and disposal operators but also scavengers.

The only rational way of dealing with the public health aspects in a comprehensive way is to put the health impacts into a strategic planning context for the overall MSWM system. In this way, planning can take due cognisance of causalities and mitigation measures required to prevent the adverse impacts from occurring in the first place. A comprehensive public health impact assessment should be made at the project design stage, either separately or as part of the environmental impact assessment. The process should be repeated every five years to keep track of unforeseen developments and to establish the information base for rational decision-making in the future. In the final analysis, public education and consciousness raising should be the cornerstone of any mitigation effort.

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