

CHAPTER 22

ENVIRONMENTAL AND HEALTH IMPACT ASSESSMENT

22.1 INTRODUCTION

There are potential risks to environment and health 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.

The most obvious environmental damage caused by municipal solid wastes is aesthetic, the ugliness of street litter and degradation of the urban environment and beauty of the city. More serious, however, and often unrecognised, is the transfer of pollution to water, ground water. Air pollution can be caused from the inefficient burning of wastes, either in open air, or in plants that lack effective treatment facilities from the gaseous effluents.

Uncontrolled hazardous wastes from industries mixing up with municipal wastes create potential risks to human health. Traffic accidents can result from toxic spilled wastes. There is specific danger of concentration of heavy metals in the food chain, a problem that illustrates the relationship between municipal solid wastes and liquid industrial effluents containing heavy metals discharged to a drainage/sewerage system and /or open dumping sites of municipal solid wastes and the wastes discharged thereby maintains a vicious cycle.

Municipal Solid Waste Management System involves various activities like storage, collection, transportation, disposal etc. These activities even if properly controlled and with proper precautionary measures adopted, may have adverse impact on land, water and air environment, human and environmental health, aesthetics and quality of life. The Environmental and Health Impact Assessment may help in assessing the potential adverse effects of these activities and in formulation of precautions which could prevent these effects from taking place.

There are already several World Health Organization documents that describe or review the potential environmental and health impacts of development activities and environmental change.

22.1.1 Need for Environmental And Health Impact

Epidemiological studies have shown that a high percentage of workers who handle refuse, and of individuals who live near or on disposal sites, are infected with gastrointestinal parasites, worms and related organisms. Contamination of this kind is likely at all points where waste is handled.

Although it is known that vector insects and rodents can transmit various pathogenic agents (amoebic and bacillary dysentery, typhoid fever, salmonellosis, various parasites, cholera, yellow fever, plague and others), it is often difficult to trace the effects of such transmission to a specific population.

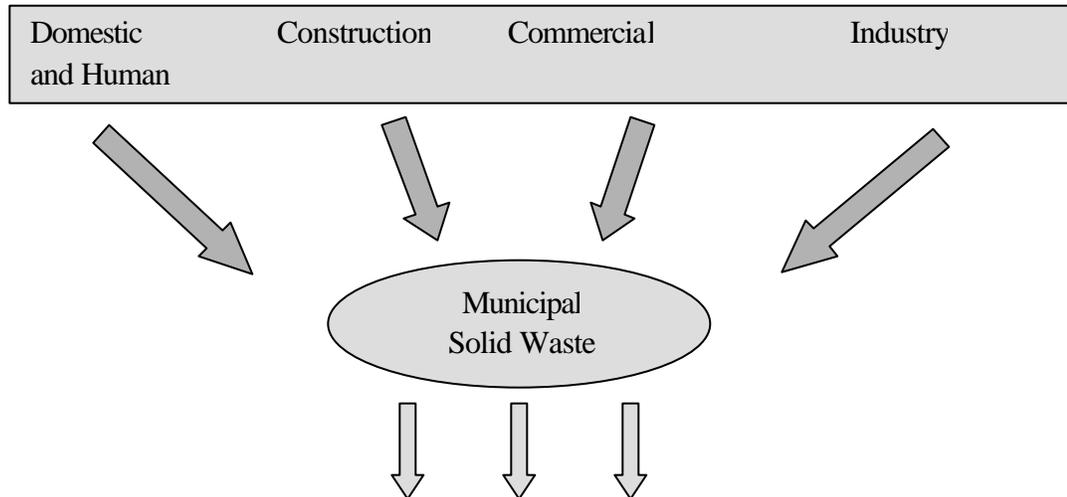
During the last decade of the 19th century as well as during the 5 initial years of 20th century, millions of people died due to Bubonic Plague in India, which had linkages to poor management of Solid Waste. More recently a study by the US Public Health Service has demonstrated the relationship of 22 human diseases to improper solid waste management⁶.

The organic fraction of Municipal Solid Waste is an important component, not only because it constitutes a sizable fraction of the solid waste stream, but also because of its potentially adverse impact upon public health and environmental quality. A major adverse impact is due to its attraction of rodents and vector insects for which it provides food and shelter. Impact on environmental quality takes the form of foul odors, unsightliness, land, water, air and noise pollution. These impacts are not confined merely to the disposal site. On the contrary, they pervade the area surrounding the site and wherever the wastes are generated, spread or accumulated.

Unless an organic waste is appropriately managed, its adverse impact will continue until it has fully decomposed or otherwise stabilized. Uncontrolled or poorly managed intermediate decomposition products can contaminate air, water and soil resources.

Most development activities are expected to have a beneficial effect on human health by increasing the resources available for food, education, employment, water supply, sanitation and health services. Proper management of municipal solid waste should have minimum effects on environment and health impacts.

Activities Generating Municipal Solid Waste



Environmental and Health Impact

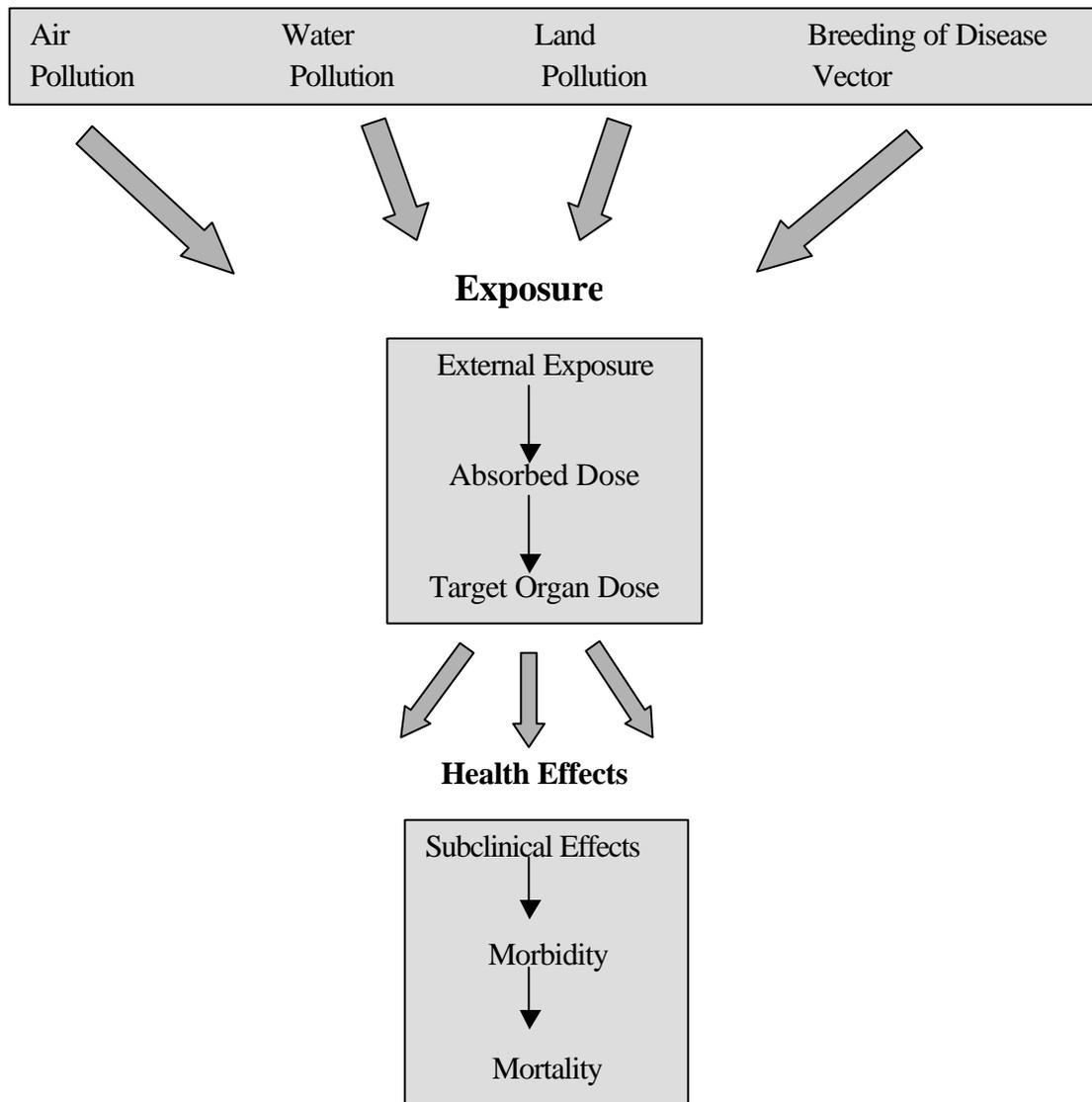


Fig.22.1 Impact of Municipal Solid Waste on Environment & Health

Environment and Health Impact Assessment of Municipal Solid Waste Management is intended to identify and predict the impact of these activities and to suggest preventive measures as appropriate on the environment and on people's health and well being and to interpret and communicate information about the impacts.

22.2 THE SIGNIFICANCE OF ENVIRONMENTAL AND HEALTH IMPACT ASSESSMENT (EHIA)

The significance of Environment and Health Impact Assessment is aimed at improving the information support for proper management of municipal solid waste.

Infrequent collection and rapid decomposition of wastes provide an attractive feeding and breeding site for flies, rats and other scavengers. Human and animal faecal matter or hospital wastes are often mixed with the refuse. Vectors and pathogens multiply. Domestic and on occasion industrial, solid wastes are disposed of in open spaces within residential areas.

Collection and disposal of refuse can consume up to 50% of a municipal operating budget. In many otherwise good systems, only 50-70% of the refuse is regularly collected. The problem is organizational rather than technical. Refuse disposal is often a non-profit making business and thus is treated as an unwanted side-effect of development. Attention should be paid to storage, collection, transport, and intermediate transfer to bulk transport and final disposal.

Estimated Number of rag-pickers (waste collectors) in a few cities in India

- Mumbai : 100,000; Delhi : 75,000; Calcutta: 40,000; Ahmedabad: 30,000; Chennai: 30,000; Bangalore: 25,000; and Jaipur: 10,000.

In many places waste recovery is an important unorganized private industry employing many thousands of scavengers who may live or work on refuse dumps. They are referred to as human scavengers or waste pickers and are frequently ignored in urban project plans although their activities may be vital to the life of the city. Many consist of abandoned children and destitute families. They live and work under extensive health risks, which are largely undocumented, and suffer severe exploitation and deprivation. Possible health hazards include raised levels of infant mortality, hand and leg injuries, intestinal and respiratory infections, eye infections, lower back pain, malnutrition, skin disorders and exposure to hazardous waste^{7,8}. Water supply, for drinking and washing, and sanitation facilities are usually very poor at dumpsites. Health and welfare facilities are required.

Health Status of the Refuse Workers

No. Examined	Refuse Workers 50		Control Group 70	
	Incidence		Incidence	
Disease	No.	%	No.	%
Aneamia	12	24	11	16
Gastrointestinal Diseases	19	38	18	26
Respiratory Diseases	31	62	17	24
Skin Diseases	16	32	10	14
History of Jaundice	21	42	4	6
Trachoma	11	23	-	-

Source : CIPHERI (NEERI) Report (1971): Studies on health of refuse workers in Trivandrum

Waste collectors may make a substantial contribution to urban waste management. They may reduce the volume of waste by 10-20%. However, private collection at source may only operate in the wealthy areas where refuse contains items of value. Observers agree that the issue of waste collectors cannot be evaded. Their positive role in the management of municipal solid waste should be recognised and their lot improved.

COMMUNICABLE DISEASE

Houseflies may be important in the transmission of enteric infections, particularly those responsible for infantile diarrhoea and dysentery.

Disease transmission by houseflies is greatest where inadequate refuse storage, collection and disposal (leading to increased breeding) is accompanied by inadequate sanitation. Thus flies gain greater access to human faeces and then to food. Refuse must be collected daily to prevent fly breeding.

NON-COMMUNICABLE DISEASE

Once collected in poorly operated disposal sites, rubbish may contaminate groundwater with nitrates, heavy metals and other chemicals. Incineration of wastes may pollute the air with particulates and oxides of sulphur and nitrogen. The slag and ashes from incinerators may result in leachates that are rich in heavy metals and other potentially toxic substances.

INJURY

Combustible gases will be generated from waste tips for more than 20 years and these travel under roads and through ducts to create a hazard in buildings and land fill sites.

People collecting rubbish may be injured by sharp objects including glass, metal and wood. These may lead to puncture wounds and lacerations which may become infected and cause serious morbidity. Composted solid waste can cause injury to farmers as sharp objects are not always properly removed.

AESTHETICS ASPECTS

Foul odor is emitted at the disposal site due to continuous decomposition of organic matter and emission of methane, hydrogen sulphide, ammonia, etc. The problem is intensified if proper mitigation measures are not adopted.

Odor is also emitted at the collection points if quick removal of wastes is not practised. Spreading of the waste in the area adjacent to the dustbin due to activity of ragpickers cause degradation of aesthetic quality. Uncontrolled disposal and open burning of wastes at the landfill sites create poor vision.

Domestic rats, birds and other scavenging animals act as reservoirs for many organisms transmissible to people, including plague, forms of typhus, leptospirosis, trichinosis, psittacosis, salmonella infection and bovine tuberculosis.

Chemical control of both houseflies and rodents is not very effective because of widespread resistance. The essential basis of control remains denial of access to food and harborage, by covered storage and efficient removal.

Aedes mosquitoes, vectors of dengue and yellow fever, breed prolifically in discarded containers that trap rainwater. Culex mosquitoes, vectors of filariasis, breed in polluted stagnant water. Such breeding sites often occur where drains are choked by solid waste.

22.2.1 EHIA broadly involves:

1. Identification of environmental and health hazards;
2. Interpretation of environmental and health risk;
3. Management of environmental and health risks.

The 3 steps as outlined above need to be followed for all the five main project stages of the municipal solid waste management. These are:

1. Pre-project;
2. Implementation/Construction;
3. Early Operation;
4. Late Operation (after 10 years)
5. Closing and final treatment of the site.

The Operational procedures required by a regulating agency as prescribed by Government to achieve these steps are:

1. Initial screening of the project for environmental and health hazards;
2. Initial environmental impact statement;
3. Initial health examination, or rapid appraisal;
4. Health Impact assessment
5. Prospects for environmental management plan; and
6. Prospects for health risk management

The initial screening process identifies the environmental and health hazards normally associated with the kind of municipal solid waste management project in its stages as appropriate in the specified location. For example higher incidence of anaemia, gastrointestinal diseases, respiratory diseases, skin diseases, jaundice, trachoma, and eosinophilia was reported by the National Environmental Engineering Research Institute, Nagpur in 1970 as per a short term study of the health status of municipal refuse workers in Trivandrum in Kerala. The system of storage, collection, transportation and disposal of hospital waste was observed to be far from satisfactory.

The initial environmental impact statement by the project proponent should include a project screening procedure to prevent planning delays and establish priorities and scoping procedure to ensure that all interested parties are consulted and all aspects of impact as required are included. The next activity will lead to the Environment Impact Assessment based on initial environmental impact statement report and need for a full health impact assessment.

The Initial Health Examination (IHE) or rapid appraisal, uses existing information to interpret the health hazard as a health risk. It should be carried out

by a qualified medical officer responsible for health impact assessment. The distinction between a health hazard and a health risk is important and is discussed below. At the end of this step, the project receives a health impact classification. The classification may indicate the need for a full health impact assessment.

A full environmental and health impact if required is to be carried out by specialist consultants as appropriate according to terms of references (TORs) to be drawn up by the authorised municipal solid waste management manager. It involves detailed field studies and is more rigorous, expensive and specific form of assessment as would be required as per initial environmental impact statement and initial health examination, or rapid appraisal report.

The steps discussed above need to be followed and applied as would be necessary for a particular project in a particular location keeping in view that the development project on municipal solid waste management are not delayed unnecessarily by lengthy or expensive investigations.

Environment and health risk management should include both health safeguards and mitigation measures. Project monitoring and health surveillance are also required and should be ensured as a part of operation and maintenance of municipal solid waste management.

22.3 TYPES OF ENVIRONMENTAL AND HEALTH HAZARDS

Municipal Solid Waste Management activities have a potential to cause air, water, land and noise pollution besides affecting aesthetics and creating health hazard which again has a potential to cause disease or infirmity. Potential contribution of field parameters and matrix indicating site effect on each of six basic environmental and health parameters are depicted in **Table 22.1**.

Health hazards may be further ranked according to the magnitude of their consequences. A **major consequence** would include multiple loss of life and chronic disability. A **moderate** consequence would include some loss of life and extensive temporary disability. A **semi-moderate** consequence would include illness and temporary disability. A project activity which has a high risk of major hazard would be unacceptable. A minor hazard of low risk may be unimportant.

Although health must be viewed in its totality, for the purposes of impact assessment, it is necessary to consider specific hazards and their components. The process of assessment consists of ranking these as likely to increase or decrease in magnitude as a result of improper or proper management of municipal solid waste. The economic cost of the change in health hazard may be viewed as the additional

cost of restoring to their previous state of health all the concerned individuals who succumb to the additional hazard, plus the loss of production and productivity.

It would be convenient to divide the environmental and health hazards associated with solid waste into five main categories as listed in Table 22.2.

Table 22.1: Proportional Contribution of Field Parameters (Matrix)

Sl. No.	Factor (1)	Air quality (2)	Water quality (3)	Land use (4)	Aesthetics (5)	Noise (6)	Health (7)
1.	Refuse placement			0.7	0.3		
2.	Compaction			1.0			
3.	Periodic cover	0.3.	0.3		0.4		
4.	Final cover			0.8	0.2		
5.	Surface finish		0.2	0.4	0.4		
6.	Blowing litter				1.0		
7.	Bulky items			0.4	0.6		
8.	Burning	1.0					
9.	Vectors						1.0
10.	Toxic hazardous waste	0.1	0.5	0.4			
11.	Ground water		1.0				
12.	Surface water		0.8		0.2		
13.	Drainage	0.2	0.6	0.2			
14.	Dust	0.6			0.4		
15.	Site visibility				1.0		
16.	Approach to site				0.5	0.5	
17.	Site noise					1.0	
18.	Land type			0.6	0.4		
19.	Organization			1.0			
20.	Precautions against fire, wind etc.	0.3	0.3		0.3		0.1

Source: Manual on SWM prepared by NEERI, November 1996

Table 22-2: Types of Environmental & Health Hazards

Environmental & Health Hazards	Examples and Causes
Environmental Pollution	Air quality, water quality, land use, noise
Communicable disease	Gastrointestinal disorders, diarrhoea, respiratory infection, skin diseases, jaundice, trachoma, eosinophilia etc.
Non-Communicable disease	Poisoning, hearing defects/loss, dust
Injury	Occupational injury by sharps, needles, glasses, metals, wood, violence etc.
Aesthetics	Odour, visibility, dust etc

Each stage of proper project cycle provides opportunities to safeguard environment and health. For example:

- Location vis-à-vis vector borne disease
- Design affects abundance of vector breeding sites
- Construction may mix communities in ways that favour a range of communicable/non-communicable disease transmission.
- Improper collection, storage, transportation and disposal create conditions for environmental pollution, communicable, non-communicable disease, injury and occupational health risks.

22.4 ENVIRONMENTAL AND HEALTH HAZARDS IDENTIFICATION

For environmental and health hazards identification two basic questions should be kept in view:

1. Is the activity in a health sensitive location? (to be identified from existing information, maps, foci and provincial/local health records);
2. Does the activity contain health hazardous components (such as hazardous and hazard causing activities/operations, materials, equipment etc.)

Existing local reference information that can be consulted to answer these questions.

Environmental and health identification of the following activities/components need to be carefully examined:

1. Design, storage methods of collection bins;
2. Frequency of collection particularly putrescible organic matter;
3. Environmental status of collection points and disposal sites;
4. Loading/unloading of wastes in the vehicles at the collection points and disposal sites;
5. Sorting out the recyclable materials;
6. Open burning of solid waste; (whether the practice leads to increase in concentration of suspended particulate matter carbon monoxide, sulfur dioxide, hydrogen sulphide, nitrogen oxide, dioxins and furons in the surrounding area);
7. Design of and operation collection vehicles;
8. Design and operation of landfill sites
9. Compaction and coverage of solid wastes at the landfill site (to prevent escape of methane gas at the landfill site);
10. Breeding of flies, mosquitoes, cockroaches, rodents, pigs, stray dogs (they play important role in the spread of disease)
11. Activities generating odor and aesthetic problems;
12. Activities/components which are potential cause of injury, violence etc.
13. Activities/components which are likely source of air, water, soil and noise pollution.
14. Periodical Personal Protective Clothings (PPC), Personal Protective Equipment (PPE) and health checkup of workers/staff engaged in various/activities of solid waste management

22.5 INITIAL ENVIRONMENTAL AND HEALTH EXAMINATION (IEHE)

After the project officer has expressed a concern about environmental and health impacts, an initial environment impact statement and initial health examination, or rapid appraisal, is required to classify the health impacts according to **Table 22.3**.

Table 22-3: Health Impact Classification

Classification	Interpretation
A	Significant environmental and health impacts, mitigation difficult or requires special budget
B	Significant environmental and health impacts, mitigation practical without special budget
C	No significant environmental and health impacts to local communities and affected populations

The process uses available information such as published and unpublished reports and interviews with local specialists. It may involve a site visit. It should be undertaken by a team of experts including also a medical officer responsible for impact assessment.

In order to make this classification it is necessary to:

- Rank the change in health risks attributable to the project for a range of health hazards;
- Consider possible mitigation measures;
- Rank the possible mitigation measures by cost, practicality and acceptability.

In order to rank environmental and health risks associated with environmental and health hazards it would be appropriate to construct a project profile. The profile would identify the current status of the community, their environment and their health services. It would also identify how the status may be changed by proper solid waste management. The three main sub-components should be considered. These are:

1. **Vulnerable communities:** Identify the communities who may be exposed to the environmental and health hazards and why they are vulnerable;
2. **Environmental factors:** Identify the pathways by which the exposure to the health hazards may occur;
3. **Capability of health protection agencies:** Identify the agencies with a responsibility for safe guarding health together with their strengths and weaknesses.

The conclusion of this process can be recorded in a summary health impact assessment as outlined in **Table 22.4**.

Table 22.4: Summary Health Impact Assessment Table

Health Hazard	Community Vulnerability	Environmental factors	Capability of health protection agencies	Health risk attributable to the project
Communicable disease				
Non-communicable disease				
Injury				
Aesthetics aspects				

Table 22.4 can be expanded as appropriate to include a list of specific health hazards under each hazard category.

22.5.1 Vulnerable Communities

Proper management of municipal solid waste at all stages of the project is expected to be overwhelmingly beneficial to the health and sustainable development as well as economic well-being of many communities. Others, the vulnerable communities e.g. waste collectors, field staff to be engaged in different activities relating to solid waste management such as collection, storage, transportation and at disposal sites, may experience some adverse health consequences. **Table 22.5** indicates the nature of some vulnerable communities.

Community vulnerability is determined by factors such as :

- Natural and acquired immunity to communicable diseases;
- Poverty
- Hazard avoidance behaviour
- Social status
- Personal hygiene

Table 22.5: Examples of Vulnerable Communities

Vulnerable groups	Health Hazards or exposure
Project workforce	Communicable disease, non-communicable disease, injury
Migrant workers	Communicable disease, non-communicable disease, injury
Rag-pickers	Communicable disease, non-communicable disease, injury
Beggars/street children	Communicable disease, non-communicable disease, injury
Sweepers	Communicable disease, injury
Field staff for collection, storage, loading and unloading of solid wastes	Communicable disease, injury
Field staff engaged in sorting of solid wastes	Communicable disease, injury
Vehicle drivers	Communicable disease, injury
Field staff engaged in sorting of solid wastes	Communicable disease, injury
Field staff engaged in recycling/re-use of solid wastes	Communicable disease, non-communicable disease, injury
Field staff engaged in sanitary landfilling sites	Communicable disease, non-communicable disease, injury
Workforce engaged in handling Bio-medical waste	Communicable disease, non-communicable disease, injury
Field staff engaged in operation of incinerators, Auto-calve, microwave etc. for treatment of bio-medical wastes	Communicable disease, non-communicable disease, injury
Local dependents of field staff engaged in solid waste management	Communicable disease
Distant dependants	Communicable disease imported by circulating labour
Slum dwellers	Communicable disease, non-communicable disease, injury
Periphery	Non-communicable disease due to pollution
Down stream/down wind	Non-communicable disease due to pollution

Immunity is affected by factors such as prior exposure, vaccination, age and gender. Poverty affects health services, hazardous occupations. Hazard avoidance behaviour is partly determined by knowledge, attitude, belief and practice (KAP). Short surveys provide a practical tool for determining this component of community vulnerability.

CHECKLIST

- Have all communities associated with pre-project, implementation/construction, early operation, late operation phases of municipal solid waste management been identified?
- Do any of them appear to be especially vulnerable to the project as a result of location, behaviour, exposure, age, gender or cultural reasons?

22.5.2 Environmental Factors

The community is exposed to the environment through location, occupation and behaviour. The environment is changed by the project. New health hazards may be introduced and old health hazards may disappear. The changes may take place immediately or over a timescale of ten or more years.

Hot, humid and moist environment is congenial for most of the disease causing organisms. Various components like air, water, land, noise and socio-economic are considered during environmental and health impact studies.

Environmental factors which have potential linkages with solid waste management at its different phases and health are:

1. Temperature;
2. Rainfall;
3. Humidity;
4. Wind (speed and direction);
5. Air quality;
6. Water quality;
7. Physical and chemical properties of soil; (particularly for minimising leaching from landfill sites, soil-microbe activities for composting)
8. Land use
9. Noise
10. Aesthetics

CHECKLIST

- Are there any features of the environment which promote exposure to health hazards?
- Are there any practical environmental changes that provide safeguards and mitigations?

22.5.3 Responsibilities of Protection Agencies

For protection of environment and health in India several agencies are jointly responsible. The health service is responsible for human health including routine health data collection, collation, analysis, interpretation, curative and preventive measures. Environmental protection agencies (Central and State Pollution Control Boards) regulate, enforce implementation and monitor compliance with water and air quality, waste emissions, noise regulations. Ministries of health and labour are responsible for occupational health and safety regulations.

Municipalities and Urban Local Bodies are responsible for proper management of municipal solid waste. At State and Central levels urban development departments and Ministry of Urban Affairs and Employment are the nodal agencies at the respective levels.

Environmental protection agencies' main function is enforce implementation of the regulations. They are best at regulating and enforcing pollution prevention and control regulations. They have little or no experience of regulating communicable, non-communicable diseases, occupational health, injury and safety. Health agencies have a little regulatory function.

Health impact assessment of development projects including municipal solid waste management needs a coordinated multi-disciplinary approach and missionary zeal. Keeping in view serious health risks of municipal solid wastes, several expert committees recommended strengthening capabilities of the health agencies to take active part and responsibility for health impact assessment..

CHECKLIST

- Do staff engaged in municipal solid waste management have realistic access to preventive and curative health services based on distance, cost and time travel, opening times, protective clothing supplies, training facilities, trained personnel availability etc?

- Are health centre diagnostic facilities, for staff engaged in municipal solid waste management, functional, quality controlled, timely?
- Does the staff engaged in solid management activities have functional water supplies and latrines, access to facilities for cleaning/disinfection of implements/ equipment/vehicles and are personnel paid regularly?
- Is routine health surveillance data accurate, displayed, used in decision-making?
- Are the health services oriented towards monitoring, evaluation and responding to field needs?
- Do the capabilities of health and environmental protection agencies require strengthening?
- Is the Ministry of health represented in procedure, project design, implementation, operation and maintenance, monitoring and evaluation, health and environment impact assessment?

22.6 PROJECTS REQUIRING DETAILED ENVIRONMENTAL AND HEALTH IMPACT ASSESSMENT

At this stage project can be classed into the categories listed in **Table 22.5.1** keeping in view proportional contribution of field parameters and matrix list in **Table 22.2.1**.

The screening process would help to establish as to whether the project would require a full EHIA. Various methods for screening are available.

The project officer must decide whether a full environment and health impact assessment (EHIA) requiring the service of a specialist consultant, is necessary. The decision will depend on the available experience and expertise within the responsible agency.

The project threshold method relies upon the establishment of threshold values for key factors of the project such as size, cost, infrastructure requirements etc. which if exceeded, qualify the project for a detailed EHIA.

The sensitive area method involves screening of projects based on carrying capacity of the environment in relation to the degree of disturbance of the location of the project in an identified environmentally sensitive area and initial environmental and health examination as discussed in para 22.4.

In the positive-negative list approach, projects are screened with the help of positive list that identifies activities which require detailed EHIA if significant impacts are indicated.

The screening test method comprises questionnaires in which likely impacts of projects are identified by seeking answers to a series of questions relative to impact types.

If an EHIA is required, appropriate (TORs) need to be prepared for a specialist consultant. The Initial Environmental Impact Statement and Initial Health Examination would have identified the environmental and health hazards and communities that the TORs should address. The Environment and Health Risk Assessment would seek to establish in more detail whether changes in the principal health risks can be attributed to the project. Mitigation measures should be considered.

Possible mitigation measures could be grouped into the following classes:

- Opportunities for modifying project location
- Opportunities for modifying project design
- Opportunities for modifying project operation and maintenance.
- Opportunities for incorporating environmental management measures
- Opportunities for strengthening health services
- Need for monitoring and surveillance (how will the data be used?)

Each mitigation measure on the list should be roughly classified in terms of:

- Affordability (is it cheap to build?)
- Sustainability (is it cheap to maintain? Is it easy to operate?)
- Acceptability (is it socially acceptable to the local community?)
- Accessibility (is it physically, socially or economically accessible to the vulnerable communities?)
- Cost-effectiveness (could the resources needed for this mitigation measure be more effectively employed elsewhere?)

22.6.1 Components of EHIA

As a result of the identification of environmental and health hazards and Initial Environmental and Health Examination as outlined in paras 22.1.3 and 22.2, 22.3 and 22.4, the EHIA can focus in depth on a small number of significant health hazards. During the feasibility study, the consultant should assess the health risk associated with each health hazard at each project stage and for each vulnerable community. The assessment is concerned with the change in exposure associated with the project: identifying the communities that will be exposed and the nature, magnitude and likelihood of that exposure. The consultant should also establish the capabilities of existing protection agencies, including the health service, to monitor, inform, safeguard and mitigate environmental & health risk. The description of the existing conditions is often referred to as profiling.

The conclusions of the assessment must be presented to the decision-makers in a format which will enable them to use the information effectively. The Summary **Table 22.4** used for Health Impact Assessment is recommended for EHIA

The cycle of hazard identification and risk interpretation may have to be repeated. First, as a rapid appraisal and second as a detailed study of the major risks. The feasibility study should provide the information required for negotiating changes in project plans or operation to safeguard health.

22.6.2 Scope

The primary consideration in effective and timely EHIA is to limit the scope of study to the range of relevant project alternatives and issues. This activity is called as scope and involves identification of the most significant impacts from an exhaustive list of various impacts. Criteria such as magnitude, extent, significance and sensitivity are used to arrive at an appropriate decision.

Terms of Reference (TORs) for EHIA will include the hazards to be addressed, the communities of interest, the effects likely to be felt by the communities within and without the neighbourhood, the spatial boundaries (since the influence of the project may extend far beyond the project site e.g. formal and informal labour having linkages with distant communities, vector breeding on site may disperse downwind, effluent discharge into streams and air flows may be carried many kilometers, toxins may accumulate in food-chain and affect health of communities) and temporal stages for which a prediction is required.

Discussions may be held with agencies concerned with the project. Public meetings may be organised. Community participation should be actively sought out.

22.6.3 Steps involved in EHIA studies

Steps involved in EHIA studies include:

1. Initial Screening
2. Scope
3. Collection Baseline Data
4. Identification of Impact
5. Prediction of Impact
6. Evaluation of Impact
 - a) Primary
 - b) Secondary

The networks showing probable impacts identified due collection and disposal activities are depicted in **Annex-1** and **Annex-2**.

22.6.4 Model Terms of Reference(s) for EHIA

A Model Terms of Reference for Environmental and Health Impact Assessment could include the following components:

Introduction

This states the purpose of the terms of reference, the type of project to be assessed, and the implementing arrangements for the environmental and health impact assessment.

Background Information

This provides a brief project description with the objectives, the status and timetable, and the project proponent. Related projects within the region must be identified.

Objectives

This states the general as well as specific objectives of the environmental and health impact assessment in relation to the project preparatory activities such as feasibility studies (planning, design and execution, operation and maintenance).

Environmental Requirements

This section identifies regulations and guidelines that will govern the assessment such as operational directives, municipal, state, national laws or regulations, and specific regulations of other funding organizations involved in the project. The requirement for health impact studies should be included in the EIA regulations.

Study Area

This specifies the boundaries of the study area for the assessment. It should include the human communities downstream and downwind of the project. The EHIA boundaries could go beyond the EIA boundaries, which are usually the watershed or airshed.

Scope of Work

The health hazards and communities that require particular attention are obtained from the Summary **Table 22.4**. The consultant could be asked to refine the scope of work for contracting agency review and approval. Other agencies may be invited to comment and public meetings be held.

Health Risk Assessment

The consultant will assess the health risk associated with each environmental & health hazard at each activity. The assessment will include the following considerations:

Community Vulnerability

Identify each vulnerable community (examples of vulnerable communities listed in **Table 22-5**) to be affected by the project and assess the nature, magnitude and likelihood of exposure. Estimate the prevalence rate of each hazard in each vulnerable community from health sector records and/or special survey.

Environmental Factors

Consider the environmental factors that may contribute to an increase in health risk and define mitigating measures as input to project planning, implementation, operation and maintenance. Estimate the magnitude of the factors.

Capability of Protection Agencies

Establish in more detail the capabilities of existing protection agencies, such as the environmental and health agencies, which have jurisdiction over the project site. The consultant should assess the limitations of existing data and recommend how to strengthen health information systems to meet requirements for health risk management.

Health Risk Management

The consultant may be asked to formulate a monitoring programme during the construction and operational stages that includes: a description of the work tasks, skills/tests/interviews, frequency, institutional and financial arrangements, justification/use of the monitoring data. The consultant should define the safeguards and mitigating measures required as inputs to the feasibility study.

Context for Health Risk Management

Account should be taken of the availability of resources and funds, whether there are any interest groups actively concerned about the project and its health impact, whether local environmental lobby groups exist, the attitudes of local authorities and government, and whether meetings have been held to promote changes in the project. Consideration should be given to any groups that may oppose change, and any groups whose support could be obtained in order to increase the prospect of protective/mitigating measures being applied.

Consultant Requirements

Ideally, the consultant would have previous experience of assessing the health impacts of development projects. However, the consultant must have specialist knowledge of the most significant health risks were identified during the Initial Environmental and Health Examination. If diverse health risks were identified then additional consultants may be required with specialist knowledge of each.

Reports, Duration and Schedule

This will specify the total period of the study, staff-months of experts, dates for consultation, periodic reports and other target dates.

Other Information

This will provide the consultant(s) with preliminary information on data sources, background reports and studies, and other relevant publications.

22.7 EHIA STATEMENT

The output from an EHIA will be EHIA Statement. This should be modeled on the Initial Health Examination. It should include a Summary Table similar to **Table 22.4**. This table should be supported by an explanation of each item.

22.8 ENVIRONMENT AND HEALTH RISK MANAGEMENT

The environment and health risk assessment should be presented to the project approval committee who must evaluate relative importance of the impacts which have been identified in a wider context, This will decide the priority to attach to the recommended safeguards and mitigation measures, negotiate resources and assign monitoring and surveillance tasks.

22.8.1 Environmental Management Plan

Environmental management plan is delineated in order to minimise adverse impact on the environment due to various activities involved in solid waste management. The various mitigation measures to be adopted during collection and disposal of wastes are as follows:

- It is preferable that the container and bins used for collection of waste should be of closed type so that the waste is not exposed and thus the possibility of spreading of disease through flies and mosquitoes is minimised
- Collection system should be properly supervised so that quick and regular removal of waste from the dustbin is practised
- The workers directly involved in collection and disposal activities should be provided with goggles, gum boots, hand gloves, mask, etc.
- Soil cover should be applied over the compacted waste at the disposal site. The cover will prevent breeding of disease vectors and escape of gases of decomposition; minimise leaching, suppress foul odour, and provide better aesthetics
- Regular monitoring of carbon monoxide, methane and hydrogen sulphide should be carried out to check the emissions of such pollutants

- Open burning of waste should be discouraged
- Arrangement should be made for biogas recovery at the landfill site. The gases can be flared or utilised
- Piped water supply should be provided at the site for sprinkling of water to keep down the dust and for fire-fighting
- Continuous monitoring of ground water quality adjoining the landfill site should be carried out
- The surface water run-off should be collected and safely treated and disposed off. This will prevent accumulation of water and avoid breeding of flies, mosquitoes
- Liners should be provided at the landfill site
- Leachate collection and treatment system should be provided at the landfill site
- Tree plantation on the completed section of the landfill site as well as around the landfill site should be carried out to reduce the dust emission and minimise adverse aesthetic impact. It will also help in minimising noise level in the surrounding
- Necessary first aid facilities should be provided to the working staff

Environmental management of waste to energy projects as described in Para 12.5 of chapter 12 and various environmental management issues relating to municipal solid waste landfills such as EIA for site selection, environmental investigation for site investigations and site characterization, design of environmental monitoring system, pollution prevention during operation, landfill quality assurance and quality control as highlighted in Paras 14.4.8, 14.5.5, 14.6.19, 14.8.4.6, 14.9.3 and 14.10 of the chapter 14 need to be properly addressed as appropriate for effective environmental management of municipal solid waste.

Municipal solid waste management projects, in particular, provide an opportunity for vector-borne disease control through environmental management. Environmental management for vector control consists of deliberate alteration of the environment, environmental factors or interactions between people and the environment designed to limit vector breeding, survival or human contact. The environment includes soil, water, vegetation and urban and rural settlements. The environmental factors include microclimate, chemical composition and vector behaviour.

Environmental Management for Vector Control can be summarized as follows:

- Permanent modification to the environment to inhibit vector breeding.
- Repetitive actions, to inhibit vector breeding.
- Changes in human behaviour and habitation which reduce breeding or exposure.
- Timely assessment of the health hazards to ensure that design changes can be incorporated in project plans and operations.

Some elements of the first three are discussed in WHO's "Manual on Environmental Management for Mosquito Control"¹⁷. They include the following measures:

- Drainage of urban and rural settlements and irrigation systems;
- Alteration of river, reservoir and other water impoundment levels by sluicing and flushing;
- Alteration of water salinity;
- Removal of favourable and planting of unfavourable vegetation for vector breeding;
- Changing conditions of exposure to sunlight and shade;
- Land filling and leveling;
- Alternate flooding and drying of rice fields;
- Destruction of water-filled containers; screening of cisterns;
- Improvements in sanitation, sewerage and solid waste management systems;
- Siting human settlements 2km or more from vector sources;
- Land zonation;
- Using livestock as diversionary hosts;
- Using bednets and house screens;
- Management of irrigation water;
- Avoidance of infested water for domestic use or recreation.

Many of these measures cannot easily be incorporated in project design or operation unless previously identified through health impact assessment. Environmental Management requires collaboration at all levels between different stakeholders, the pooling of expertise and involvement of the community.

22.8.2 Health Risk Management

Health risk management consists of incorporating safeguards and mitigation measures in project design and operation. Safeguarding entails proposing modifications to project plans and operations and ensuring that the capability exists for effective mitigation. This could include strengthening of protection agency capabilities.

Mitigation entails vigilant monitoring for the lifetime of the project accompanied by appropriate and timely response to increasing health risks. Monitoring depends on an adequate health information system. Response may depend, for example, on stocks of protective equipment and their dissemination and use.

In Municipal Solid Waste Management project a hierarchy of risk management has been defined. These are:

- Elimination of the source of hazard;
- Substitution of hazardous processes and materials by those which are less hazardous;
- Geographical or physical isolation of hazards from vulnerable communities, for example by land zonation;
- Use of engineering controls to reduce the health risk. For example, collection containers and bins should be closed type so that spreading of disease through flies and mosquitoes is minimised;
- Adoption of safe working practices such as regular equipment maintenance;
- Use of personal protective equipment, such as rubber gloves.

Table 22-6 indicates some of the actions and concerns that should be addressed during each project stage. The objective is to alert the development planner to issues that should be addressed at each project stage.

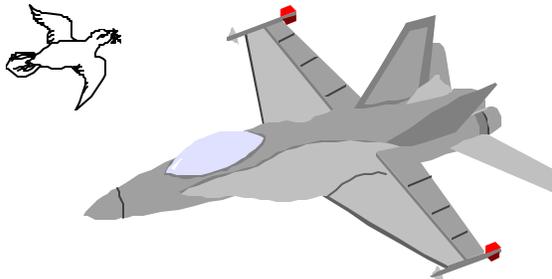
Where the community is exposed to a hazard as a result of occupation, mitigation may be achieved primarily by occupational safety measures and continuous health education. Where the community is exposed through its location, mitigation may be achieved primarily by reducing the hazard or relocation. At the planning stage land-use zonation and resettlement siting could be considered.

Table 22-6: Health Risk Management: some possible actions at different project stages

Project Stage	Surveillance and monitoring	Health service provision	Safety provision and preventive measures	Obtaining advice from the health sector about:
Location	Site specific health hazards, general health status of local communities, most common causes of morbidity and mortality, location and functioning of health services	Access to health services	Settlement siting	Disease foci, vector biology
Planning and design	Improve routine health service surveillance by retraining health information system, laboratory services	Health centre, trained personnel, drug supply, equipment maintenance , housing for health workers, casualty/ emergency unit as appropriate	OHS planning, traffic routing, environmental management	Communicable disease control, environmental management for vector control, environmental manipulation, environmental health
Construction	OHS monitoring, environmental health, water supply, sanitary system, drug supply, vector monitoring	STD clinic, distribution of condoms, health training casualty/ emergency unit, vector and other communicable disease control	Safety measures consistent with local economy, OHS training, traffic routing	Communicable disease control, environmental health
Operation	Routine medical examination, action oriented disease trend analysis, child growth monitoring, OHS monitoring, infant mortality monitoring, vector monitoring, casualty rates	Health education, immunization, obstetrics, training traditional health workers, food supplement programme, casualty/ emergency unit, access to health service outside working hours, vector and other communicable disease control	Safety measures consistent with local economy, OHS implementation environmental management	Communicable disease control, environmental management for vector control, environmental manipulation, environmental health, human behaviour modification
Opportunities for project enhancement	Health information system, diagnostic/ laboratory services	Healthy workforce is more productive and vice versa	Safer working methods, training, injury compensation	Intersectoral collaboration

22.8.3 Risk to Human Life and Property

Indiscriminate disposal of wastes attract birds, resulting episodes of bird hits to the aircrafts which in turn result in environmental risk to human life and property as can be seen from the data reproduced in the box shown below.



Solid waste dumped in an indiscriminate manner do attract various kinds of birds (vultures, kites etc) which float around for hours close to the air fields in search of food, thereby posing a serious hazard to aircrafts, operating at these airfields. The degree of hazard varies with the size of the bird and the speed of the aircraft. As most defence aircraft are single engined and fly at high speeds, they face maximum risk. At an average speed of about 900 kms per hour (which works out to about 15kms per minute) if a bird and an aircraft are on a collision course, the changes of sighting the bird and avoiding it are practically nil. Since most fighter aircraft are single engined, damage to the engine invariably implies loss of the aircraft and at times even of the pilot. Each year 3 to 4 aircraft are lost and 35 to 40 engines withdrawn. In fact in the last 5 years alone IAF has lost 12 aircrafts due to bird hits imposing a replacement cost of Rs. 2860 million. Besides this, bird hits also pose a threat to the life of the pilot and damage to life and property at the site of the crash.

22.9 PUBLIC INFORMATION AND PARTICIPATION FOR EHIA

22.9.1 The public should be made aware on the following aspects for environment and health surveillance:

- As far as possible faecal matter should not be allowed to mix with municipal refuse
- Hospital and municipal wastes should be handled separately

- Burning of refuse should not be permitted
- Discharging of waste into drains and open areas should be prohibited by law
- Solid waste should be handled once and its contact with workers minimised as much as possible
- Efforts should be made to remove solid waste from habitations regularly
- Regular medical check up of personnel handling solid waste should be carried out
- Health records should be maintained for the areas served under municipal solid waste management programme.

22.10 FINANCIAL ASPECTS

The ultimate goal of municipal solid waste management is to improve the quality of life of people, especially the underprivileged, the ignorant and the poor who cannot exercise their right to human dignity. The lack of attention given to human health, environment and safety issues cannot be attributed to cost factors.

22.10.1 Suggested Investment

Generally there has been a tendency to set up curative services to deal with problems created by a development project instead of setting in place appropriate preventive strategies as an integral part of the original development as has been amply demonstrated in the major development projects like irrigation and industrial projects which have propensity for creating malariogenic conditions. It is, therefore, recommended that generally about 1% of the project investment on MSWM may be considered for environmental and health impact assessment of municipal solid management.