

MANUAL ON WATER AND ENVIRONMENTAL SANITATION FOR DISASTER MANAGEMENT



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WATER AND ENVIRONMENTAL SANITATION FOR DISASTER MANAGEMENT

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New Delhi

Acknowledgement

This document is one in a series produced through collaborative efforts between the Sustainable Development and Environmental Health unit of WHO India Country Office and the Faculty of Rural Health and Sanitation, Gandhigram Rural Institute (Deemed University) to help the affected communities cope with the Disaster and after effects.

We put our records of appreciation of Dr S Ponnuraj, Public Health and Sanitation expert, Mr. K. Narayanasamy, the environmentalist and Mr. A K Sengupta, Sector Coordinator (SDE) from WHO India Country Office, for their contribution towards the production of this manual.

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PREFACE

Natural and man made disasters exert enormous toll on development in India. They pose significant threat to prospects for achieving the Developmental goals. Annual economic losses associated with such disasters are very high. These losses are associated with the regions where the community preparedness is poor.

Today more people are exposed to hazards. While humanitarian action to mitigate the impact of disasters will always be vitally important, the community is facing critical challenge- how to better anticipate, manage and reduce – disaster risks by integrating the potential threat into its planning and policies at the community level. This manual aims to improve the capacity of the Panchayati Raj Institutions - the local self government and communities that face hazards.

To help such capacity development efforts, we need learning materials focusing key areas – water supply, environmental sanitation for better disaster management and preparedness that contribute better rescue effort, relief and rehabilitation. The manual can be translated into local languages so that the community can develop capacity to face disasters.

The manual is born out of the support given by the WHO and their staff in the India Country office, New Delhi. I take this opportunity to thank them for their support in making the manual.

The manual is dedicated to those who lost their lives in the 2004 Tsunami.

Dr Subbiah Ponnuraj
Gandhigram, Tamil Nadu
4-02-06

Acronyms

ANM Auxiliary Nurse
AWW Angan Wadi Worker
BDO
BP Bleaching Powder
CBOs Community Based Organizations
CBDRM Community-Based Disaster Risk Management
CDRMO Community Disaster Risk Management Organization
CMDRR Community-Managed Disaster Risk Reduction
CVA Capacity and Vulnerability Analysis
F diagram – Faecal - oral Rout Transmission
HCW Health Care Waste
IEC Information Education and Communication
ISDR International Strategy for Disaster Reduction
LPM Litres per Minute
NGO Non Governmental Organization
OHT Over Head Tank
OM Operation and Maintenance
PDRA Participatory Disaster Risk Assessment
PME Participatory Monitoring and Evaluation
PHC Primary Health Center
PLA Participatory Learning and Action
PRA Participatory Rural Appraisal
PRI Panchayati Raj Institution
PVC Poly Vinyl Chloride
RO Reverse osmosis
SHGs Self Help Groups
SWOT Strength, Weakness, Opportunity and Threat
VDMS Village Disaster Management Committee
TDS Total Dissolved solids
TWAD Tamil Nadu Water and Drainage Board
UNICEF United Nations Children Fund
WHO World Health Organization

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1. ABOUT THE MANUAL

1.1 Introduction

Indians are exposed to multitudes of natural and man-made calamities and their vulnerability to disasters has always been exceedingly high due to high density of population. The number of people exposed to such disasters is increasing year after year for want of preparedness. The dislocation of large numbers of people during and after disaster necessitated us to provide basic amenities like drinking water and sanitation to prevent further hazards and risk for the displaced community. The experience of Tsunami in east coast, the earthquake at Kashmir and Gujarat taught us that micro level community based preparedness in water and environmental sanitation are very important in reducing the adverse impact of a disaster.

1.2 Effect

Disasters are events that occur when significant numbers of people are exposed to extreme events to which they are vulnerable. Consequences of disasters in India, trigger chain of events and reactions in our socio-political, cultural and geophysical environment for want of community based mitigation plan or preparedness.

Disasters may cause, or worsen emergency situations through the damage to the environmental health facilities and services which include:

- the provision of emergency water and sanitation services;
- the burial or cremation of the dead;
- vector and pest control, etc.

Since water is essential to life and health, in emergencies, it is often not available in adequate quantity and of good quality, thus creating a major health hazard. People can survive longer without food than without water. Therefore, planning an emergency water supply system requires preparedness at community level. The provision of water demands immediate attention from the start of an emergency relocation.

The preparedness in the community aims at:

- assuring availability of enough water
- allowing its effective distribution in the required quantities,
- providing water safe to drink.
- Providing for safe disposal of excreta.

This is despite the fact that many of the most common diseases occurring in emergency situations are caused by inadequate sanitation facilities and poor hygiene practices. In the Tsunami affected region, it was felt that the sanitation in temporary shelters was hampered by lack of experience and resources to support the field staff in providing facilities for huge displaced population. Unless the people are conscious and bold enough to face the situation, this basic infrastructure development or disaster management cannot be fruitful during and after the calamity. Preparedness at the community level is much more effective than that of the individual level during actual calamity. Community preparedness facilitates community to face boldly the situation and overcome the shock of the disaster by minimizing the loss of lives and properties. They need not wait for the assistance to come from government/NGOs and they can do better if they are prepared.

1.3 Role of Panchayati Raj Institutions

It is possible to equip local community with knowledge and skill for disaster management. As a result, the community need not wait passively for the arrival of government machinery to manage the disaster.

Since India is a vast country with many villages, it is better to equip the Panchayati Raj Institutions to have the capacity to mitigate the disaster. The need for learning material has been realized in the last Tsunami and post Tsunami periods in Tamil Nadu.

1.4 Capacity of the Community

The capacity of the local people could be improved by providing adequate learning materials. Such materials can be used at village level with a little training & they would facilitate local community to reduce the

impact of disasters on environmental health infrastructure, such as water supply and sanitation facilities.

Apart from natural disasters, in mega-cities environmental health conditions are poor at the best of times and catastrophic at times of man-made emergencies. They occupy increasingly dangerous places – e.g, on steep, unstable slopes, in flood plains and near hazardous factories (Bhopal, 1985)! Political turbulence in many regions of the country has also increased. Today, greater care is taken to avoid creating unnecessary dependence among affected communities and there is greater emphasis on supporting people to rebuild and recover as soon as possible by their own efforts after a disaster.

1.5 Purpose of the Manual

This manual will serve as a practical guide, calling attention for the need to link emergencies, disasters and development, at Block/ Panchayat level and identifies physical and social factors, processes determining disaster vulnerability and offers the reader a range of vulnerability-reduction options in development and disaster mitigation.

The manual presents a process, which can be followed to assess the water supply and excreta disposal needs and priorities, and to design an appropriate program to respond to those needs. It can also be used to select appropriate excreta disposal technologies, systems, and hygiene promotion interventions. The manual provides guidance on how to plan, design & construct systems and how to promote and maintain appropriate use of those systems.

1.6 Who Can Use this Manual?

This manual will provide local community and middle level program managers and field staff for preparedness in disasters emergencies with an overview of the technical aspects of environmental health management. These personnel may include, but are not restricted to, the following:

- **Community leaders,**
- **NGO leaders and workers,**
- **PRIs**

This manual is divided into several units with built-in exercise so that each unit can be taught or learnt with in local community and can be taught at the Village, Primary and Health sub-center levels.

This manual

- Emphasizes the immediate and long-term health priorities in emergencies and disasters
- Considers environmental health needs in emergencies and disasters in terms of a set of interventions aimed at reducing community vulnerability.
- Provides guidance on environmental health actions in the prevention, preparedness, response and recovery stages of the disaster-management cycle.
- Provides approaches to decision-making.
- Describes simple, practical, technical interventions which can be implemented at local level by the community.
- Describes related aspects including training programs, information systems and community involvement.
- Outlines the need for the approaches of coordination and collaboration between all sectors.

2. DISASTER

2.1 What is a Disaster?

A disaster is an unwanted event causing widespread devastation to life, property and environment. The damage caused by disaster is immeasurable and varies with the geographical location, climate and the type of the earth surface. This influences the mental, socio-economic, political and cultural state of the affected area.

Generally, disaster has the following effects:

- ***Box 2.1 Disasters are a shared reality –spanning individual, hamlets, village, block, district, state, nation and regions and have to be responded to with a multi-pronged approach***
 - *Affects people*
 - *Usually triggered by a hazard*
 - *Directly related to vulnerability*
 - *Exceeds capacity of household, community or group of people to cope*

the normal and routine day to day life

- Causes damage to life and property
- It adversely influences basic facilities like shelter, water, sanitation and health.
- Affects Normal communication process

2.2 Types of disaster

2.2.1 Disasters are of two types

1. Natural.
2. Man-made

2.2.2 Major natural disasters

- Cyclone
- Flood
- Drought
- Earthquake and
- Tsunami

2.2.3 Major man-made disaster

- Fires
- Epidemic
- Chemical - like Bhopal Tragedy.
- War

2.2.4 Minor man-made disaster

- Road and train accidents
- Accidents due to festivals
- Industrial disaster/ crisis
- Terrorism

2.3 Hazards

Hazards are known as potential threat to humans and their welfare. Vulnerability means exposure and susceptibility to loss of life and property.

A hazard is a natural or man-made event that can potentially trigger a disaster.

Possible Hazards and Emergencies in Indian sub continent are as follows:

2.4 Natural Hazards

1. Floods
2. Cyclones
3. Thunderstorms and Lightning
4. Winter Storms and
5. Extreme Cold
6. Extreme Heat
7. Earthquakes
8. Landslides and Debris Flow
9. Tsunami
10. Fire
11. Man-made disasters- terrorism

The ingredients of disaster are:

Hazard x Vulnerability – Capacity of the Community = Disaster, the realization of risk.

Hazard = Potential threat to humans and their welfare

Vulnerability = Exposure and susceptibility to loss of life or dignity

Capacity = Available and potential resources and capacity

Risk = Probability of disaster occurrence

DISASTER = Realization of a Risk

Capacity of the community is the available and potential resources of the community to prevent disaster or mitigate disaster or disaster preparedness.

Box 1 Preparedness

This protective process embraces measures which enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster. Preparedness therefore encompasses those measures taken before a disaster event which are aimed at minimizing loss of life, disruption of critical services and damage when the disaster occurs.

Disaster preparedness starts from learning about the hazards that may strike our community, the risks we face from these hazards and community's plans for warning and evacuation. We can obtain this information from our local emergency management office in the district. Some of the hazards are illustrated in the subsequent pages. The community may analyze such hazards and the risk attached to the hazards. The trainer may facilitate the community to identify hazards, risks and disasters they experienced in the recent past.

Disasters can set back development, but they can also provide new development opportunities. Strategic planning to increase the capacity of people to withstand disaster hazards must therefore include concerns for environmental health. Environmental health activities are interdisciplinary, involving engineering, health sciences, chemistry and biology, together with a variety of social, management and information sciences. In times of disaster and recovery, people from many backgrounds engage in activities designed to monitor, restore and maintain public health. Likewise, health workers find themselves cooperating with others to help with non-health-related work, such as search and rescue, or work that is only indirectly related to health, such as public education.

Box 2. Mitigation

Mitigation embraces all measures taken to reduce both the effect of the hazard itself and vulnerable conditions in order to reduce the scale of a future disaster. Therefore mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include modifying the occurrence of the hazard, e.g., avoiding the hazard by shifting people away from the hazard and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should also be aimed at reducing the physical, economic and social vulnerability to threats and the underlying causes for this vulnerability.

Box 2.3

What are Floods?

When there is heavy rainfall in the drainage basin of a river, the quantity of water exceeds the capacity of the river. This results in water overtopping the river banks and flooding the adjacent areas. Generally the deltaic plains of the major rivers of India & in particular of Tamil Nadu are flooded.

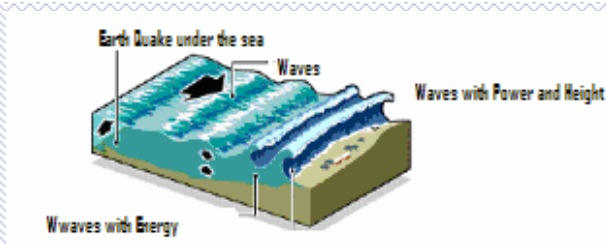
What are Cyclones?

A sudden depression develops in the warm seas and violent whirl winds and clouds are formed around it. This is a cyclone. A fully-grown cyclone has a body of high-speed winds and clouds of a size ranging from 150 to 1000 km. radius. The wind speed varies between 150 to 250 kmph. It has a central low pressure core of 20 to 50 km. This wind-cloud mass moves towards the shore and brings along heavy rains, thunderstorms with high speed winds and surges i.e. tidal waves of 3 to 12 metres height splashing sea water on to the land, sometimes up to 30 km. leaving behind death and destruction.

Cyclones are unpredictable as they change their path suddenly, become more violent or fade away. Hence the warnings and the news bulletins of TV & Radio need to be closely monitored to be able to carry out timely safety measures like evacuation, to minimize the loss of life etc. Community can draw the seasonality of the occurrence of floods/ Cyclones/ Landslides, etc. The trainer can facilitate the village community to feel the seasonality of the disasters

Months

Disaster	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Dec



Box 2.3 Facts about Tsunami

Tsunamis are seismic sea waves.

They are often incorrectly called tidal waves (rare events linked to tides). A tsunami is a series of traveling ocean waves of extremely long length and period. They can be caused by undersea events like earthquakes, landslides and volcanic eruptions, or by other rare natural events such as ocean meteorite impacts. (Not all undersea earthquakes etc. cause tsunamis). As a tsunami crosses the deep ocean, the length from crest to crest may be 150 kilometers but the height may be under a meter, not felt by the ships nor seen from the air, and may reach speeds up to 1000 kilometers per hour.

Effect on Coastal Regions

As tsunamis enter shallow water near coastlines, wave speeds drop and energy is rapidly reduced. Wave heights increase dramatically (up to 40 meters), threatening life and property. They strike the shore with devastating force even though they may have been caused thousands of kilometers away from the shore.

Where Do They Occur?

The tsunami threat to India varies from relatively low for most of our coastline, to relatively high on the eastern and western coast of India and all coastline of Andaman. In December, 2005, great earthquake in Sumatra region generated largest recorded tsunami along the east coast of Southern India, Sri Lanka and Indonesia.

Analysis of Tsunami can be facilitated to understand the hazards, risk and vulnerability.

Exercise. 1:

The participants may be divided into groups. Each group may be facilitated with the Analysis of the Hazards that the participants have experienced in their towns/villages

Table 1 Hazards - Matrix analysis for Hazard and risk analysis		
Possible Hazards and Emergencies	Risk Level (None, Low, Moderate, or High)	How can I reduce my risk?
Natural Hazards		
1. Floods		
2. Hurricanes		
3. Thunderstorms and Lightning		
4. Tornadoes		
5. Extreme Heat		
6. Earthquakes		
7. Landslides and Debris Flow		
8. Tsunamis		
9. Fires		
Technological Hazards		
1. Hazardous Material Incidents		
2. Nuclear Power Plants		
Terrorism		
1. Explosions		
2. Biological Threats		
3. Chemical Threats		

Any other Hazards. Share your experience

Exercise 2. Hazard and Effect Matrix Analysis Illustration						
Hazard	Effect					
	Human Injury	Death	Live stocks	Property	Livelihood	Drinking Water Supply
Flood	🌊		🐄	🏠	🌾	💧
Cyclone	🌊		🐄	🏠	🌾	💧
Tsunami	🌊			🏠	🌾	💧
Landslide					🏠	
Blast				🏠		
Fire	🔥			🏠		
Earthquake	Not narrated by the Village community at Nagai Districts of TN					



Indicator – Ground nuts - Community may choose any indicator available with them – examples: Stones, shells etc

2.6 Tamil Nadu and Disaster

The Indian sub-continent is highly vulnerable to **droughts, floods, cyclones and earthquakes**. Of the 35 States/Union Territories in the country, 22 are disaster prone.

River **Floods** are the most frequent and often the most devastating. The cause of flood is mainly the peculiarities of rainfall in the country. Out of the total annual rainfall in the country, 75% is concentrated over short monsoon season of two to three months.

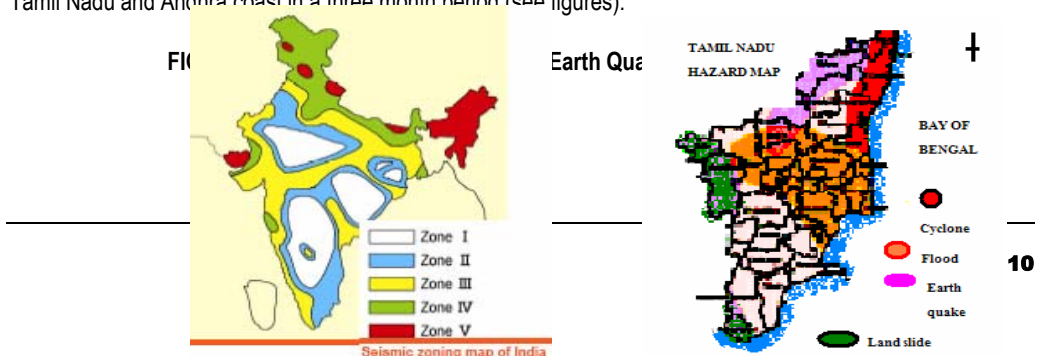
Earthquakes are considered as one of the most dangerous and destructive natural hazards. The impact of this phenomenon is sudden with little or no warning, making it just impossible to predict or make preparations against damages/collapses of buildings and other man-made structures. About 50-60% of total area of the country is vulnerable to seismic activity of varying intensities.

The Bay of Bengal and Indian Ocean are part of the six major cyclone-prone regions of the world. In India **cyclones** occur usually between April to May and October to December. The coastal line in the east is more prone to cyclones as about 80% of the total cyclones generated in the region hit there.

2.6.1 Disasters in Tamil Nadu

Tamil Nadu lies in the southern part of Indian peninsula and has a long east coast. The east coast is more vulnerable to cyclones and floods. The unique geo conditions of the State make this region the most vulnerable to natural disasters. Tamil Nadu is highly vulnerable to Drought, Cyclones and Floods.

Though the earthquakes are rare in Tamil Nadu, recent happenings have brought the state under seismic zone. Tamil Nadu has a very long coastline of about 800 kms, which is exposed to tropical cyclone arising in the Bay of Bengal and has seasonal character to Tamil Nadu. In 2005, 9 cyclonic storms crossed Tamil Nadu and Andhra coast in a three month period (see figures).



River

Floods are the most frequent and often the most devastating. The cause of flood is mainly the peculiarities of rainfall in North east monsoon period in the state. Out of the total annual rainfall in the state, 90% is concentrated over short monsoon season of three months. As a result, heavy discharges from the rivers during this period causing widespread floods in the delta regions. Floods occur mainly in the coastal districts basin that carries 100% of the state total river flows.

Drought is a perennial feature in some parts of the state. In fact drought is a significant environmental problem too as it is caused by rainfall less than the average of the year and no/less rainfall extending over a long period of time.

2.7 The effects of disasters on Environmental Health

Disasters may cause, or worsen calling emergency situations damages for rectifying the environmental health facilities and services. **Table 3** summarizes the common effects of various natural disasters on environmental health services. Flooding, power failures, broken pipes choked roadside drains and blocked roads can all disrupt water, waste and food-handling services for hours or days.

Source: Pan American Health Organization (2000).1 - Severe possible effect.2 - Less severe possible effect.3 – Least or no possible effect.

Table 2 Common levels of impact of natural disasters on environmental health services ¹				
Services	Most common effects on environmental health	Cyclone	Flood	Tsunami
Water supply and wastewater disposal	Damage to civil engineering structures	1	1	3
	Broken mains	2	2	1
	Damage to water sources	2	2	3
	Power outages	1	2	2
	Contamination (biological or chemical)	1	1	1
	Transportation failures	1	1	2
	Personnel shortages	2	2	3
	Equipment, parts, and supply shortages	1	1	2
Solid waste handling	Damage to civil engineering structures	2	2	3
	Transportation failures	1	1	2
	Personnel shortages	1	1	3
	Water, soil, and air pollution	1	1	2
Vector control	Proliferation of vector breeding sites	1	1	1
	Increase in human/vector contacts	1	1	2
	Disruption of vector-borne disease control programs	1	1	1
Home sanitation	Destruction or damage to structures	1	1	1
	Contamination of water and food	2	1	2
	Disruption of power, heating fuel, water supply	1	1	2
	Overcrowding	3	3	3
Sanitation	Destruction of Sanitation facilities	1	3	3
	Displacement of Population and sanitation facilities demand	3	3	3

Exercise 3. Matrix Ranking

Ranking tools are used to prioritize hazards or disaster risks, needs or options.

Description

There are many variations of ranking. The example below uses a set of criteria to determine the impact of the disasters on people's lives. The community members use stones/beans to rank the hazards. Number of stones/beans indicates the relative risk and significance of indicator. (0-5 point beans/stones ideal)

Objectives

To determine the hazard that has the most serious impact on the community

Sample Key Questions

- What are the hazards the community faces?
- What is the impact of each hazard?
- Which is the most destructive of all the hazards?

How to Facilitate

- Facilitate community members list down the hazards.
- List can be extracted from the seasonal calendar and mapping activities.
- The facilitator then asks the community members for the impact of the hazard. Broad categories are: impact on life, property, critical facilities like water, food, shelters, live stocks, public buildings
- For example, the facilitator can ask: "What happens to your house when there is a flash flood?"

Hazard	Life		Shelter			Drinking water		
	Death	Injury	Damaged	Washed away	collapsed	Not available	Polluted	Damaged
Flood								
Cyclone								
Tsunami								
Fire								
Blasts								

3. PLANNING WITH THE COMMUNITY

3.1 Introduction

Each village in the disaster prone area shall prepare and have a contingency plan i.e.

- A list of activities a village agreed to carry out
- Series of tasks to prevent loss of life, livelihoods and property in case of a cyclone /flood or other disaster.
- It also identifies in advance, action to be taken by individuals in the community so that each one knows what to do when a cyclone / flood warning is received.

Every village is different in terms of its inhabitants, its geography, its resources and its ways of making community decisions. The contingency plan will differ from village to village.

3.2 Who makes the plan

It is the community that makes contingency plan. The village or the Panchayati Raj Institution may form committees having representatives of women, youth, the elderly, the disabled, artisans, fisher folk, marginal farmers, wage laborers and other vulnerable groups.

Social Organizations or NGOs and Government officials may guide such committees to drawing a workable plan. Involvement of NGO volunteers – community leaders – the revenue department staff like Tahsildar - the Block Development Officer (BDO) – the Village Level Worker (VLW) are necessary as they possess the necessary authority and skills to motivate the community.

3.3 Participatory Planning

The village sessions can be conducted once in every six months or during pre monsoon periods during hours that are suitable to the community.

The committee of PRI may prepare a plan for Disaster Preparedness for a village which includes:

- *What,*
- *Where,*
- *When,*
- *How much resources required and*
- *Who will do what before during and after a disaster?*
-

Strategy at micro level includes the following:

- Peoples' awareness
- Peoples' mobilization
- Capacity building
- Preparedness
- Infrastructure building
- Institution building and peoples' action
- Coordination and networking

This manual identifies methods of community preparedness on the basis of the experiences of the Tsunami, floods and the hazards were prioritized for village preparedness plan. It identifies the most vulnerable areas as regards destruction of life, property, infrastructure and economic activities.

The resource mapping is the first step of knowing their villages and these are marked in a separate map and displayed in the village so that the community is aware of such resources for planning. Participatory Vulnerability Mapping at the Village Level may identify several vulnerability which includes:

- Groups - Human
- Places/ Areas -Geo Physical
- Assets - Properties and livelihood activities

- Time Period – Seasonality

Box 3.1. In the event of a disaster. Human vulnerability is the degree to which people are susceptible to loss, damage suffering and death.

- Areas that get inundated with different water levels
- Houses and weak structures
- Livelihood assets such as boats, nets, stores of dry fish
- Livelihood assets such as crops, agricultural assets like livestock
- Village Water Sources
- Drinking Water Facilities
- Health centers

3.4 Participatory Planning

Participatory Planning provides opportunity to the community:

- preventing risks,
- rescue,
- relief and
- rehabilitation activities.
-

It also gives opportunity to the community to know

- their strengths, weaknesses, situation and
- where they stand in terms of what capacity they have,
- What they can do and what they should do in preparedness, preventing risk, rescue, relief and rehabilitation programs.

Participatory Planning is essential for preparedness because the community must be aware of the nature, risk and vulnerability of the disaster. Unless they participate in all stages of disaster preparedness, it is very difficult to provide rescue, relief and rehabilitation in time by external agencies alone.

Table 4 Exercise 5 Resource Mobilization Matrix for Water and Sanitation Sector							
Inputs	Resources Required				Sources		
	Human	Physical	Natural	Finance	Inside	Out side	
					Community	Government	NGOs
Technical							
What Kind of Expertise is needed?							
How much is required?							
When is it required?							
Where is it required?							
How long is it required?							
Materials							
What Materials							
How much							
When is it required							
Where to procure from							
Where to store							
Where to apply							
What skill is required							



Lay out chosen by the Community for Relief camp

4. PARTICIPATORY TOOLS

4.1 Introduction

Using Participatory techniques, the community can be facilitated to discuss what happened during the last cyclone/flood/Tsunami in their village. This can be obtained from the elders of the locality. Participatory techniques provide opportunity to the community in response to the perceived problems of a disaster.

The technique facilitates local community

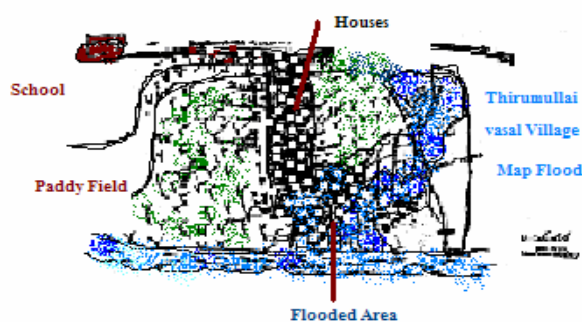
- to make their own appraisal, analysis and plans in disaster management
- to animate and exercise to facilitate information sharing, analysis and sharing among stakeholders in the event of a disaster

Participatory Learning and Action (PLA) technique often uses mapping exercise. Basic resources of the village, process of preparedness, risk and vulnerability analysis, experience of the previous disaster, severity, rescue experience, etc. can be discussed and recorded using this technique.

Community is motivated to understand their past experience after disaster in relation to health and environment. The mapping can be done collectively by the Community, Volunteers, Youth, Women, Ward Member, Sarpanch village panchayat president, other Government and non-governmental officials can keep the same for planning activities. The following characteristics can be gathered in mapping exercise.

Maps drawn by the community (see the maps) shows the hazardous areas for flood and Community buildings for evacuation experienced by the community during earlier floods 2005.

Figure 3 Map shows the flooded area (Blue Color). Community Building like school



4.2 Illustrations of exercises :

The community can identify the resources, infrastructure for managing a disaster and use it for planning and action.

- The geography and topography of the village,
 - E.g. what is the village surrounded by in the North, South, East, and Western directions.

4.2.1 Infrastructure

- e.g. Road, electricity, etc. in Resource mapping in a village
- Safe shelters – cyclone shelters, school, Community Centers, Pucca Houses
- Drinking water sources – overhead tanks, pipeline, source
- Water Bodies
- Dispensary and Primary Health Care Units
- Roads – lanes – streets
- Power Installations
- Telephone, Post Office and other structures

- Go downs (both Government and Private)
- Dealers of Dry food, kerosene etc
- Anganwadi Centers
- Fire Station
- Police Station
- Boats
- VHF/HAM Stations
- Industries and factories

4.2.2 Safe opportunity in a village

- Approach Road, alternate route for safe evacuation
- Cyclonic shelters if any
- Safe Shelter like community centers, school buildings
- Elevated lands, example traditional sand dunes
- Location of Primary Health Centers, hospitals
- Fire stations, Police stations
- Go downs – drugs, food items, other essential items
- Location of trained volunteers, boatmen,

4.3 Listing what causes damage (Hazard mapping)

The community identifies the different hazards it faced, e.g., winds, heavy rains, floods, and so on. It also identifies where these hazards are most likely to affect life, property, and infrastructure in the village. The list may include:

- **Flood hazards** – areas facing the river/ sea side of the village, i.e., near sea, riverbanks, canal banks, village drinking water sources, irrigation tanks or places more prone to flooding
- **Wind hazards** – weak structures vulnerable to high-speed winds, huts, thatched houses and tiled houses, trees and plantations, electricity and telephone towers, and so on
- **Rain Hazards** – lands on an incline that do not have green cover and are most likely to get eroded, tanks and ponds, which may flood fields and submerge houses, and so on.

This list helps the villagers to know where the geographical weakness of the village lies and who and what gets affected because of it. Planning will depend a great deal on knowing about these weaknesses.

4.4 Risk and vulnerability mapping in a village

In the map, the PRI is to identify the following things by asking two questions – What is at Risk and who are at Risk as per the hazards.

4.4.1 Who are at, risk what are at risk –

- Elderly people, children and pregnant women,
- Family valuable documents,
- Sick and ailing people, Houses & weak structures,
- Livelihood assets such as boats, nets, stores of dry fish,
- Pump sets & other installations,
- Families living in vulnerable thatched houses,
- Fishermen at sea, standing crops, horticulture trees and plantation,
- Shrimp seed farmers,
- Village water sources.

After identifying the risk and vulnerability, the community has to decide how those at risk can be safeguarded and what should be done as precautionary measures.

Uses of such exercises are:

- Such information can be put up on a map and displayed.
- Villagers *study it* and *suggest any errors or oversights* that may have crept in.
- *The mapping session is important for situational analysis because the following stages to contingency planning depend on the information listed there.*
- The mapping exercise provides opportunity to the community to know their resources in their village which could be used for disaster management by the community themselves.
- Gives everyone in the community an opportunity to know how each one experienced in a disaster like cyclone/flood and how the village emerged as a whole after it.

It also gives an idea of how prepared the community is to face the cyclone/flood. Based on the findings of this exercise, the community will decide on the different ways through which the village can be better prepared to respond to the future disasters and need based contingency plan can be drawn with their priorities listed.

After mapping, the community identifies those resources available in the village which will help them to reduce risk to life and property. The community can also map such those resource available in the village.

- Safe houses and buildings where families may take shelter in case of a cyclone/flood, elevated land, hillocks and similar natural barriers for livestock protection.
- Safe evacuation routes that will not be disrupted in case of subsequent cyclone / flood. The community decides which family goes where and by which route to avoid crowding.
- Existing health, medical and sanitation facilities that can be used and strengthened in the event of cyclone/ flood
- Can purchase relief stocks of grains, fuel, disinfectants and basic medicines in advance, during the cyclone/flood season.
- Trained members of the village youth clubs, women members of the village teachers may take responsibilities of disaster management and take precautions to safeguard people and property.

4.5 Assessment

The community/ Panchayati Raj Institution must be able to assess the situation and assist the external agencies and government in identifying needs for disaster relief, and to facilitate a timely, appropriate response by the community. An on-site assessment of the following needs to be done:

- The nature of the disaster;
- Damage, including secondary threats;
- Effects on the population;
- Ongoing relief activities and local response capacity;
- Needs for national & international if required assistance;
- Means of delivering international assistance;
- Expected developments may be useful in planning the activities

4.6 Scope of Assessment on Environmental Health

In order to delineate the scope of an assessment, it is useful to distinguish between the following different types of assessments:

4.6.1 Initial or Rapid Assessment

Initial assessment comprises both situation and needs assessment in the early, critical stage of a disaster to determine the type of relief needed for immediate response. Initial assessments aim to:

- Identify the impact a disaster has had on a society and its infrastructure, and the ability of that society to cope;
- Identify the most vulnerable segments of the population that need to be targeted for assistance;
- Identify the level of response by the affected community and its internal capacity to cope with the situation;
- Identify the most urgent relief needs and potential methods of providing them most effectively;
- Highlight special concerns regarding the development of the situation;

- Draw attention to geographical areas / substantive sectors needing in-depth assessment.

Needs assessment aims to define the level and type of assistance required for the affected population. The initial needs assessment identifies resources and services for immediate emergency measures to save and sustain the lives of the affected population. It is conducted at the site of a disaster or at the location of a displaced population. It may also identify the need for continued monitoring and reassessment of the unfolding disaster.

<p align="center">Box 4.1 2. Sanitation – Situation of Population Displaced</p> <ul style="list-style-type: none"> • Placement, number, and cleanliness of latrines. • design and placement of latrines are affecting their use • A sanitation plan if the population increases. • Safe access to latrines for women and girls. • Evidence of water-related diseases. • Proximity of latrines to water sources, storage and distribution points. • Placement and plan for the disposal of corpses. • Plan for the collection and disposal of garbage. • Insect- and rodent-control plan. • Specialist to assist with evaluating requirements. 		
		very good maps of their community
Seasonality calendar	The seasonal calendar contains a lot of information about seasonal changes and related hazards and diseases etc. Events and other information related to specific months of the year.	Using ten stones/ seeds / shells (ten being the highest score) indicates degree, severity or extent of the change.
Ranking	One very useful tool is to use different sizes of stones to order the problems, needs or solutions. Ranking is usually a long exercise because community members discuss the reasons why problems or needs must be put in order in such a way. The value of this exercise is that it facilitates discussion.	To know the severity of the problems and order of prioritization to solve the issues
Transect	Transect is a highly enjoyable activity since this involves walking in the community following a certain path or direction. When someone dominates the group discussion, it is advisable to involve that person in transect walks. Historical transect is the graphic presentation of the history of disasters and development in the community.	Community members can review their history based on a ten-year or a five year period. Decide that the last five years may be the most important period to trace the impact of disasters on their lives.

<p align="center">Box 4.2 Water and Sanitation- Rapid Assessment</p> <p>1. Displaced Population Situation</p>	
<p>Determine the</p> <ul style="list-style-type: none"> • Amount of water available per person per day. • Source and quality of the water. • Evidence of water-related diseases. • Length of time a user waits for water. • Whether there is safe access to water for vulnerable groups. • Types of wells, transportation, and/or storage systems used. • If there are problems with well repair/ rehabilitation. • Availability of additional sources of safe water if required. • Need for water engineers to assist with evaluating requirements 	

Exercise 6. Timeline

Timeline is a very simple tool that narrates the disaster history and significant events that happened in the community. One column gives the year and the other column lists down the events that took place.

Objective

To learn what are the significant disaster events that occur in the community

Sample Key Questions

1. What are the disaster events that happened or are happening in the community?
2. When did they happen?
3. What significant events affected the community?
4. When did they happen?

How to Facilitate

This is a very effective tool to use while waiting for the community members to arrive.

A facilitator can begin by asking a few community members about :

1. What disasters happened in their community and which year they occurred.
2. The facilitator can initiate writing the answers on a flip chart.
3. As community members discuss, writing on flip chart can be passed on to a member who is able to write.

Box 4.3

Outcome of Time line Exercise at Akkaraipettai, Nagai district, India

Some of the major natural disasters in recent past in Tamil Nadu, as told by the community are :

- 1954- Vedaranyam Cyclone
- 1964- Rameswaram Cyclone
- 1967- Cauvery flood
- 1976- Cyclone & flood
- 1977- Cyclone & flood
- 2004- Tsunami
- 2005- Flood including 5 spells of cyclone threat

Timeline exercise can facilitate the community to think what to do ahead of seasonal disasters.

Exercise 7 Hazards and Resource Map

Description

Community members know the hazards that confront their communities.

But hazard and resource mapping is a tool that allows community members to identify graphically the vulnerable members of the community especially the sick, elderly and disabled who are put at risk by hazards like floods.

It also identifies the hazard-prone areas and enables community members to look at their resource base and make an inventory of their capacities. Children can then make very good maps of their community.

Objectives

1. To identify areas at risk from specific hazards and the vulnerable members of the community
2. To identify available resources that could be used by community members in disaster risk management

Sample Key Questions

1. What are the hazards that put the community at risk?
2. Which places/areas in the community are at risk?
3. Which community infrastructures or critical facilities are in danger?
4. Who are the people that are most exposed to risk and will likely need assistance?
5. What resources can be found in the community?
6. Who have the least resources in the community (family or community members)?
7. Who have access and control over the available resources?
8. What resources are at risk?
9. Why are they at risk?

How to Facilitate

If the map is made on a flip chart, this can be hung on a wall where all the community members can add additional data to the map any time they feel. Often, community members will just draw the map using sticks or their fingers on the ground. Do not interrupt the process. The note taker will then have to copy those points in the map on his/her notes.

1. The facilitator has to ask the community members to identify a landmark in the community.
2. Initially, the facilitator puts a mark or a stone to stand for the landmark.
3. The facilitator asks the community members to draw the boundaries of the community.
4. Draw the location of houses, critical facilities and resources in the community.
5. The facilitator asks questions like who have access and control over the resources
6. Community members will then be asked to mark the areas at risk from hazards like flood.
7. After this, community members will identify who are the members of the community who are most at risk and have little resources to prepare for or recover from a disaster.

5. PLAN IMPLEMENTATION

5.1 Introduction

The overall goal of the disaster preparedness is to achieve “Sustainable Reduction in Natural Disaster Risk in hazard prone districts in Tamil Nadu state”. Therefore, the manual aims at:

- strengthening the communities,
- local self-governments,
- district administrations’ response/responsibilities
- Preparedness and mitigation measures in the most vulnerable villages.

A wide representation of community is envisaged in the planning process. The program components would include the following:

- Development of disaster risk management and response plans at Village/ Ward, Gram Panchayat, Block levels.
- Constitutions of Committees at all levels with adequate representation of women in all committees and teams.
- Capacity building at all levels. Special training for women in first aid, shelter management, water and sanitation, rescue and evacuation, etc.
- Capacity building in cyclone and floods resistant features for houses in disaster-prone districts, plans, training in retrofitting, and construction of technology demonstration units.
- Integration of disaster management plans with development plans of local self-governments.

5.2 Implementation Process

The disaster management plan would start from the village/ward level. A cadre of village volunteers would be created to carry out the village based natural disaster risk management programs.

The Village Volunteers will be drawn from:

- Community with the help of civil society organizations
- National Cadet Corps (NCC),
- Volunteers of National Service Scheme,
- Nehru Yuvak Kendras (NYKS),
- Scouts and Guides and ex-service men, etc.

The plans would focus on the disaster risk prevention and early recovery through community-based preparedness and response plans, skill development for construction of hazard-resistant housing and enhanced access to information as per the need of the community.

The Vulnerable districts will be covered under the massive village based disaster preparedness program including development of village contingency plan, Gram Panchayat, Block and district disaster management plans and formation of Disaster Management Committees at the village and block level.

The committees may be useful in carrying out activities that will reduce vulnerability during disaster in their locality in partnership with state nodal agencies and civil society response groups.

After situation analysis on the basis of the participatory mapping, the community may list out the responsibilities of who will do what. The block level officials may facilitate the men, women and youth volunteers who can implement and supervise the activities of the contingency plan. Members of the village would include:

- youth clubs,
- women members of the village
- self help groups,
- literate youths of the village,
- school teachers,
- health workers, Panchayat Members

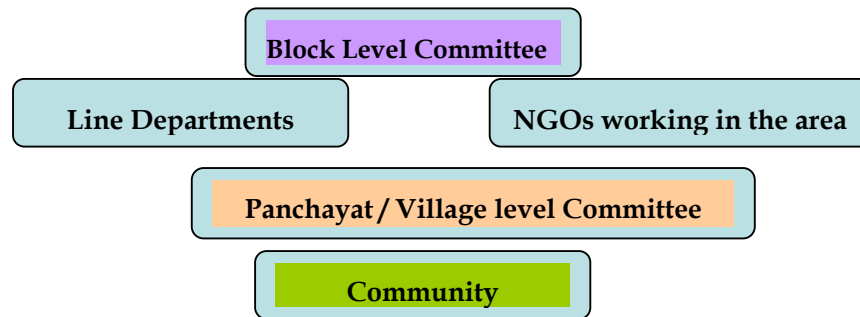
5.3 Who will do what?

These individuals then form small action groups of 5 to 7 members each, depending on the convenience of the community. Each group is given a particular responsibility like, warning dissemination, rescue, relief and health related activities and so on.

The leaders of these action groups would decide what responsibilities they would carry. But each group will have distinct activities to carry out before and after the cyclone/flood.

Figure 7 Organizational structures and flow for sustained action





**Remember that Government assistance may reach very late to the disaster area.
Let us manage quickly and methodically to minimize the hazards**

The community based committees can plan

5.3.1 Before Cyclone/flood:

- Preparations to be made during the cyclone/ flood season, i.e., July to December and all the groups should be ready to face the cyclone/flood through plan of preparedness activities.

5.3.2 During Cyclone/ flood:

- Actions to be taken in the event of a cyclone/ flood i.e., when a cyclone/ flood warning is received, and during the strike itself, evacuate people and their belongings to safer places through safe route as they mapped.

5.3.4 After Cyclone/ flood:

- Activities to cope with and alleviate the effects of the cyclone/ flood and co-ordinate with relief officials agencies for identifying the victims, carrying out the rehabilitation work etc. Some examples of possible action groups are as follows:

5.5 Cyclone/Flood Warning Group –

Dissemination of warning system and information

5.5.1 Rescue Group – Minimizing damage to life and properties

The members of this group need to be physically & mentally strong [both men and women] and in the age group of 18 to 35 years. Include civil defense personnel if available in the village. They have to be trained in evacuation and rescue methods.

The members of this group should co-ordinate with the appropriate government/ NGOs in the flood/ cyclone season to get the facilities for rescue & evacuation, both in terms of rescue-training, rescue infrastructure & equipment and ensuring the alertness of the rescue teams of the government.

5.5.2 Shelter Management Group – Can do:

Check cyclone/flood shelters and safe houses that have been identified to house people.

- Consult engineers and make necessary repairs to make them safe and livable.
- Stock food, water, utensils, medicines, milk powder, candles, matchboxes, kerosene, sufficient for at least one week to be used in the shelters for evacuees.
- Look after the evacuees' food, water and medication, sanitation.
- Keep always a water tank in the shelter, which can be filled with safe water in cyclone/ flood season.
- Ensure that health and sanitation facilities are usable and in place.

5.5.3 First Aid and Medical Group

There should be equal number of men and women in this group. Those with some knowledge of nursing (such as trained dais and AWW / ANMs) will be preferable. The members will have to go through

intensive training and drills for first aid and medical responsibilities.

5.5.4 Sanitation Group

Both men and women members may look after the sanitation responsibilities at the shelters as well as outdoors. Illustrations are based on Tsunami and flood experience:

- Stock bleaching powder in large quantities from nearest PHC / other source.
- Procure water-testing kits from the Drinking water department/TWAD Board.
- Stock kerosene, effective microbial solutions and fuel wood to dispose off carcasses (humans and animals).
- Ensure that water sources in the village are protected from floodwaters.
- Stock sufficient lime bleaching powder bags for disinfection of bigger water bodies.
- Collect temporary latrine platforms and other sanitation requirements from the District Rural Development Agency and put up temporary latrines near the shelters.
- Ensure cleaning of drains and their maintenance without stagnation.
- Ensure that evacuees' follow/ maintain sanitary habits in the shelters.
- Ensure vector control measures when need arises.
- The groups should be indoors at the shelters when the cyclone/flood strikes.
- Spray bleaching powder and other disinfectants in the village wherever necessary to prevent the spread of infectious disease.
- Ensure trenches of latrines are cleaned and disinfected.
- Educate the evacuees how to use the sanitation facilities properly.
- Monitor water contamination with the water testing kit.
- Inform and educate people about purifying water before drinking, to prevent water borne diseases.
- Disinfect water using bleaching powder/ chlorine tablets to make it safe & drinkable.
- Carry out "caring of water in wells" by disinfecting them.
- Carry out clearing of water stagnation in all places and drains.

5.5.5. Relief Group

These activities are normally done by the revenue department and non governmental organizations (NGOs). However, the community can themselves form relief groups and assist the government and NGOs in identifying the real members of the community who need relief. The formation of groups depends upon the activities to be carried out by the community at the village level. This is not exhaustive. The community may decide the number and formation of groups. For the community to respond to a cyclone/flood strike in an organized manner, individuals and their families should take up some responsibilities themselves. Each family and their members should know what they should do in reducing the risk and vulnerability. (Example is safe water handling. Good hygiene behavior)

Once a contingency plan is prepared by a village, it has to be written down and members of the action groups have to be responsible to spread the information to the community about decisions that have been taken. A contingency drill should be enacted during the cyclone/ flood season so that everyone knows what he/ she should do. In this drill, the group members should move from different localities taking the people and some mock material to safe houses

5.6 Roles and Responsibilities of Individuals and Families

Table 6 Who will do what and how? (Nagapattinam Experience)				
Activity	By whom	Method	Supervisor	Purpose
Environmental assessment	Sanitarians	Transect Mapping	Local Health authority	Planning & Monitoring Evaluation
Ensuring Safe drinking water supply, disinfection (BP), Testing end point chlorination Education about collection, transporting, storing and handling Water sampling and testing	Student volunteers Students and Youth in the Relief centers Experts –Public Health Engineers	Using AV aids and FGD Chloroscope H ₂ S method	Hygiene experts Sanitarians Project staff	Preventing water borne diseases
Construction of soak pits	Sanitarians, student volunteers, local community	Using local materials	do	Prevent stagnation of water and mosquitoes breeding
Maintenance of drains Oiling/ leveling	Do	Spray/land filling desilting	do	do
Solid waste disposal, Construction of manure pits	Student, volunteers, local workers, community volunteers	Collection, segregation, transport by vehicles	do	Prevent fly breeding

5.7 Training/ Capacity Building

Training is to be a continuous process on disaster risk management program. The trained cadre of the village will facilitate the process of Disaster Preparedness and Response Plan development at different levels. Selected village volunteers will be provided with three modular training programs to develop the village disaster management plans.

One or two volunteers may be selected by the PRIs/ CBOs/ NGOs from their own locality, based on their past experiences on relief and rehabilitation activities for facilitating the process at village and GP levels. More emphasis should be given to women volunteers in development of village disaster management activities.

Specialized training should be organized at different levels for the disaster management team members for enhancement of skills to effectively carry out their responsibilities such as warning dissemination, search and rescue operation, shelter management, first aid, trauma care, water and sanitation, damage assessment, etc.

The training can be given every year and drills can be done twice a year before monsoon season and cyclone season. To get a brief idea about the types of disaster and its management, the following points will encompass our core objectives:

- Definition of disaster and its types, causes and damages
- What is disaster preparedness
- Brief idea about the Disaster Risk Management Program
- Roles and responsibilities of the PRIs and Disaster Management groups
- Roles and responsibilities of the Groups
- Preparedness of disaster management Plans
- Disaster preparedness for Rescue, relief, rehabilitation, and need assessment
- Alternative relief shelters and housing technology
- Protection of the environment

6. DRINKING WATER

6.1 Introduction

People can survive much longer without food but not without water. Thus, the provision of water demands immediate attention from the start of an emergency.

The aim is to ensure the availability and distribution of enough safe drinking water. *Minimum Standards in Water Supply, Sanitation and Hygiene Promotion* practices are essential so that the *community is free from further risk* of disinfection from disease.

Water is essential for life, health and human dignity. In extreme situations, there may not be sufficient water available to meet basic needs, and in these cases, supplying a survival level of safe drinking water is of critical importance.

In most cases, the main health problems are caused by poor hygiene due to insufficient water and by the consumption of polluted/ contaminated water and may be the source of “*point source epidemic*”. All affected people must have safe and equitable access to a sufficient quantity of water for drinking, cooking and personal and domestic hygiene. The minimum standards for drinking water are given below:

6.2. Quantity

Minimum water needs vary with each situation but increase markedly with raised air temperatures and physical activity. In general, the following quantities of water are desirable:

6.2.1 Individuals:

Drinking	3-4 L/person/day
Food preparation, cleanup.....	2- 3 L/person/day
Personal hygiene.....	6- 7 L/person/day
Laundry	4-6 L/person/day
<i>Total individual needs</i>	<i>15 to 20 L/person/day</i>

6.2.2 Feeding Centers:20 to 30 L/person/day

6.2.3 Health Centers:40 to 60 L/person/day

Additional water may be needed for livestock, sanitation facilities, other community services, and irrigation. Cattle need approximately 30 L of water daily, and small stock requires 5 L. Water will be one of the key factors in deciding a sanitation system.

Box 6.1

Average water use for any household is at least 15 liters per person per day. The maximum distance from any household to the nearest water point is 500 meters. Queuing time at a water source should be no more than 15 minutes. Water sources and systems are maintained such that appropriate quantities of water are available consistently or on a regular basis.

Adequate storage capacity and backup systems for all water supplies must be ensured, because interruptions in the water supply may be disastrous. To avoid contamination, all sources of water used by displaced populations must be separated from sanitation facilities and other sources of contamination.

- Priority for the affected community is restoring drinking water in sufficient quantities of safe water.
- Make special arrangements for water extraction, storage, and distribution.
- M

Box 6.2

Reduction in the quantity of water available to individuals has many health consequences. Proper supplementary and therapeutic feeding programs will be impossible unless sufficient water is available for preparation of food and basic hygiene. As supplies are reduced, personal hygiene suffers; cooking utensils cannot be properly cleaned; food cannot be adequately prepared; clothes cannot be washed; and, most importantly, the direct intake becomes insufficient to replace moisture lost from the body.

will be required to protect the water from contamination.

- In some

- The safety of the water must be ensured right through to consumption in the home.
- Improvements in the existing water supply may take time, particularly if it is necessary to drill or dig wells.

In many emergencies, only contaminated surface water (standing water, streams, or rivers) is initially available. Immediate action must be taken to stop further pollution and reduce contamination of such water. Whatever may be the immediate response, the drinking water **must be safe from its source to mouth**.

Available water sources must be protected from pollution and contamination at once.

Initially, rationing of scarce water may be needed. An influx of displaced people may overburden water resources used by the local population. Rationing will ensure survival of the weak and equity in distribution to the rest of the displaced population.

The design, establishment, and function of a water supply and distribution system must be closely coordinated with health and environmental measures particularly sanitation.

6.3. Assessment

Although estimating the immediate need for water does not require special expertise, assessing different sources of supply does. Depending on the situation, sources of water may be identified by:

- The local self government workers.
- The local population.
- The NGOs

Maps and surveys of water resources like testing facilities may be drawn by the people themselves and kept ready for the planning in their Community building/ Panchayat Building with periodical updating. The assessment of these water sources is the basis for selecting an appropriate source, supply and distribution system and requires expertise in water engineering, sanitation (testing, purification), and, in some cases, logistics. Seasonal factors must be carefully considered. Supplies that are adequate in the rainy season may dry up at other times. Local knowledge will be essential.

Formula: 15 liters × No. of people × Days = liters/day.

6.4.1 Organization

The water system must be developed and organized with and operated by the displaced people from the start, to the extent possible. For example, some Individuals from rural communities may be experts at digging and maintaining wells. Others may be familiar with simple pumps or common pump motors. Such skills can and should be fully used in planning, developing, operating, sustaining, and repairing the water system. Basic public health education on such topics as the importance of avoiding polluting the water with excreta and the use of clean containers at homes is essential.

6.5 Sphere Water Supply Standard

6.5.1. Access and water quantity

- All people have access to a sufficient quantity of water for drinking, cooking and personal and domestic hygiene. Public water points are sufficiently close to shelters to allow use of the minimum water requirement.

6.5.2 Key indicators

- At least 15 liters of water per person per day is collected.
- Flow at each water collection point is at least 0.125 liters per second.
- There is at least 1 water point per 250 people.
- The maximum distance from any shelter to the nearest water point is 500 meters.

6.5.3 Water quality

- Water at the point of collection is palatable, and of adequate quality to be drunk and used for personal and domestic hygiene without causing significant risk to health due to water-borne diseases, or to chemical or radiological contamination from short term use.

6.5.4 Key indicators

- There are no more than 10 faecal coliforms per 100 ml at the point of delivery for disinfected supplies.

- Sanitary survey indicates low risk of faecal contamination.
- For piped water supplies to populations over 10,000 people, or for all water supplies at times of risk or presence of diarrhea epidemic, water is treated with a residual disinfectant to an acceptable standard (e.g. residual free chlorine at the tap is 0.2-0.5 mg per liter and turbidity is below 5 NTU).
- Conductivity is no more than 2,000 MS/cm and water is palatable to users.



Figures A Shallow hand pump – an emergency measure! Quality monitoring is a regular one!!!
(Platform with lead to a drain for spilled water are missing).

No significant negative health effect due to chemical or radiological contamination from short term use, or from the planned duration of use of the water source, is detected (including carry-over of treatment chemicals), and assessment shows no significant probability of such an effect.

Table 7 A Checklist for Action at Field level	
Water safety – Priority	
At the source	<ul style="list-style-type: none"> • Water for drinking is collected from the cleanest possible source. • If necessary, a distinction is made between water for drinking and water for other uses, such as bathing, laundry, watering animals. • Water sources are protected from faecal contamination by fencing (also to keep animals away), and by sitting latrines at least 10m away & defecation fields far away depending on ground conditions.
Collection, storage and use of water at household level	<ul style="list-style-type: none"> • Water is collected and stored in clean, covered containers. • Water is taken from the storage container through a tap placed slightly above the bottom container with a clean, long-handled dipper. • Efforts should be made not to waste water.
Use of water	<ul style="list-style-type: none"> • If there is a risk that water is not safe, it is filtered and/or chlorinated or boiled¹ • Water for making food or drinks for young children is boiled.
Liquid waste	<ul style="list-style-type: none"> • Standing pools of polluted wastewater (from washing, food preparation, wasted tap water) are not allowed to form. (They encourage mosquito breeding, which is a health hazard). • Children are prevented from playing in or near hazardous pools of water. • Arrangements for disposing of liquid waste, such as using soakage pits, are understood and followed.
Personal hygiene	
Water for washing	<ul style="list-style-type: none"> • If possible, plenty of water is used for washing. • Clothing is laundered regularly. • The most readily-available water is used for personal and domestic hygiene.
Hand-washing	<ul style="list-style-type: none"> • All family members wash their hands regularly: after defecating; after cleaning a child who has defecated and disposing off the stool; before preparing food; before eating; before feeding a child. • Adults or older children wash the hands of young children.

7. WATER SOURCE

7.1. Introduction

There are three main sources of water and they include:

- Rain water,
- surface water (streams, rivers, lakes),
- ground water (underground or emerging from springs), and
- sea water.

The water from the sources is distributed through pipes or through bore wells. Some times people may take directly from the sources.

7.2. Surface Water

Surface water is collected directly from

- streams,
- rivers,
- ponds,
- lakes,
- dams, and
- Reservoirs.

It is rarely pure and is likely to require treatment for direct use. Direct access may also cause difficulties with the population. It is preferable to use ground water that has passed through the natural filtration of the soil than to collect water from the surface. However, if the ground is not sufficiently porous to allow extraction of enough water from wells, surface water may be the only option. In such circumstances, emergency treatment measures such as storage, sand filtration, or even disinfection with BP Chlorination are advised.

Control of access to surface water is essential.

7.3. Ground Water

Springs are the ideal source of ground water. Spring water is usually pure at the source and can be piped to storage and distribution points. Water should be collected above the camp. Care should be taken to check the true source of spring water and for supply to the camp.

Care must also be taken to prevent contamination above the takeoff point. The supply of water from a spring may vary widely with the seasons.

If water requirements cannot be met by springs, the next best option is to raise ground water by means of tube wells, dug wells, or boreholes. Ground water, being naturally filtered as it flows underground, is usually microbiologically pure. The choice of method to raise ground water will depend on the depth of the water table, yield, soil conditions, and availability of expertise and equipment.

Wells, boreholes, and pumps must be disinfected immediately after construction, repair, or installation, as they may have been polluted during work. Wells must also be protected from pollution. They should be located where surface water, seasonal rain, or flood water will drain away from the well location. Drinking water well should be located in up land i.e., above and at least 15 meters away from any sanitation facilities and their discharge.

7.54. Rainwater

Rainwater may be the major source of water in areas with adequate and reliable year-round rainfall.

Reasonably pure rain water can be collected from the roofs of buildings or tents if they are clean and suitable. Collecting rainwater, however, is unreliable and requires suitable shelter as well as individual household storage facilities, making it generally impractical for some emergencies. However, every effort should be made to collect rainwater. Allow the first rain after a long dry spell to run off, thus cleaning the accumulations of dust and sediments on the roof top. Small collection systems, such as using local earthenware pots under individual roofs and gutters, should be encouraged.

7.6. Sea water

Seawater can be used for almost everything but not for drinking, and thus reduces freshwater requirements. If no other source is available, desalination has to be adopted for getting water for domestic.

7.7. Water Source Considerations

Consider the following when selecting an appropriate water source:

- Speed with which the source can be made operational.
- Demand and supply.
- Reliability of supply -seasonal variations and, if necessary, logistics.
- Water purity, risk of contamination, and ease of treatment if necessary.
- Rights and welfare of local population.
- Appropriate technology and ease of maintenance.
- Cost.

Take careful account of systems and methods already in use locally. Adopting well-proven and familiar techniques, combined with efforts to improve protection against pollution, is often a sound solution. In addition to organizational measures to protect the water supply, some form of treatment may be necessary. However, water sources that would require treatment should be avoided if at all possible. The purification of unsafe water for supply to the community, particularly in remote areas, can be difficult and requires trained supervision.



Figure 8 Tanks Ready for temporary shelters!!!

7.8 Storage

All temporary shelters / camps must be provided with facilities to store an adequate reserve of water as soon as possible. It will be necessary to store water in covered tanks between the source and distribution points.

Stored water provides an essential reserve and can greatly facilitate distribution, particularly when water is pumped up to elevated tanks. Sedimentation tanks should have the capacity to store an amount of water equal to a day's consumption, thus allowing sedimentation to take place overnight. The quantity of the reserve will depend on the number of people, the nature of the water supply system, and certain logistical aspects. Using internal dimensions and overflow pipe heights above the delivery pipe (depth of storage) capacities are calculated as follows:

Rectangular tanks:

$$\text{Length} \times \text{breadth} \times \text{depth of storage (in m)} \times 1,000 = \text{capacity in L}$$

Cylindrical tanks:

$$\text{Depth} \times \text{radius squared (in m)} \times 3,140 = \text{capacity in L}$$

**Water is essential for life. Always keep options open.
The preparedness gives us alternative options.**



Figure: 9 Distribution by Lorry Tanker



Figure: 10 Fixed Syntex tanks

Distribution

Water distribution will be an important consideration in the layout of the camp because displaced persons must have easy and safe but controlled access to water. Experience shows that persons forced to get water from considerable distances tend to not collect enough and are prone to water washed diseases. The chances of getting water from contaminated sources is high.

Ideally, no dwelling should be located further than 100 m or a few minutes walk from a water distribution point.

Points to be kept in mind are:

- Distribution points should not be located in low-lying areas.
- The area around the distribution point should be paved with stones or gravel or protected by boards, with a runoff to allow proper drainage without stagnation of spilled water.
- Water can be distributed to individual houses in a number of ways depending on local conditions.
- Uncontrolled direct access by individual consumers to primary water sources must be avoided.
- A distribution system should have sufficient number of taps or outlets relative to the size of the population to ensure that people do not wait for long periods.
- Equity in the distribution of water is an extremely important consideration. Water for domestic use should flow between source/ storage and distribution point in pipes to protect its quality.

7.8.1 Qualities of distribution pipes must be

- Pipes must be watertight;
- Leaking pipes suck in polluted stagnant water when the pressure drops or when the system is turned off.
- Pipes may be made up of metal, cement, plastic,
- Plastic pipes are often the cheapest and easiest to lay. They are available in both lengths & coiled, flexible pipe and in rigid lengths.
- Pipes should be buried 1m below ground level for protection from damage and sections of the system should have isolated valves.

7.8.2 Points for Distribution

- Standpipes and push taps are recommended wherever possible as outlets for water.
- Taps, however, are very vulnerable and often require spares, which must be available.
- Where water supplies are limited and the camp is crowded, valve distribution points that can be chained shut may be the only effective solution.
- There should be **one tap per 200 to 250** displaced persons. The more people using a single outlet of water, the greater the risk of pollution or damage.

A certain quantity of wastewater will be generated in the community, both at the individual and communal service level. It must be prevented from becoming a danger to public health, wastewater may be reused for livestock or vegetable gardens, or to flush latrines or must be disposed of safely. (See Waste water

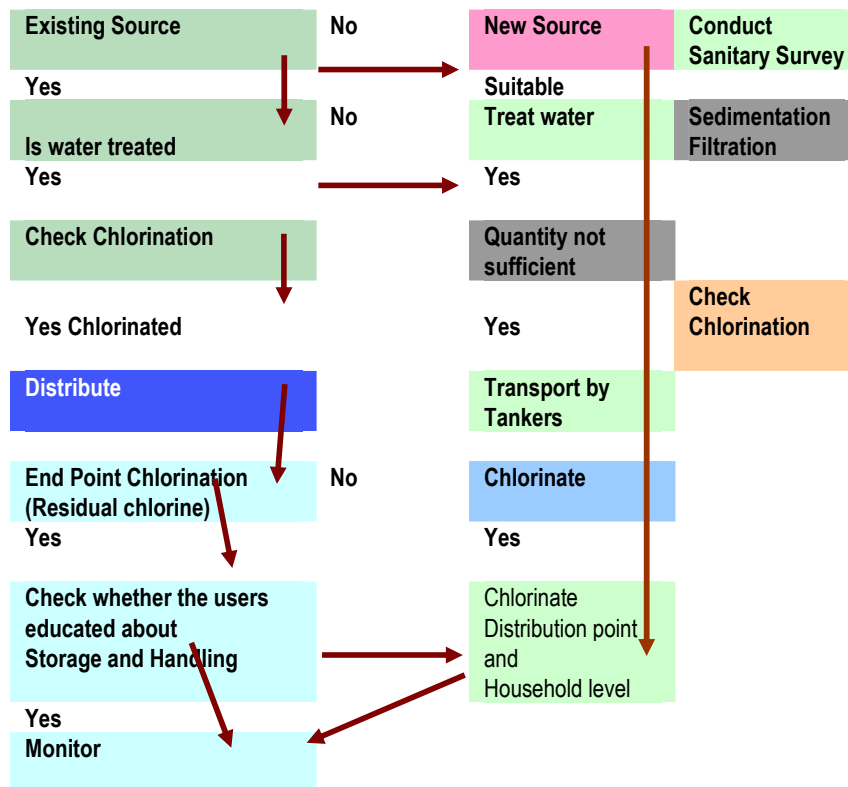
disposal).

7.9 Treatment

Water may contain pathogens, particularly certain viruses, bacteria, protozoa cysts, and worm eggs, that are transmitted from faeces to mouth. Although water contamination by human faeces is the major concern, animal faeces in water may also transmit disease. The greatest risk associated with polluted drinking water is the spread of diarrhoea, dysentery, cholera, and infectious hepatitis (hepatitis A).

Diarrhoea and dysentery are caused by a variety of viruses, bacteria, and protozoa. Their numbers in water will always decrease with time and most rapidly at warm temperatures. Bacteria behave similarly, but in exceptional circumstances, they may multiply in polluted water. The infectious dose of viruses and protozoa is typically very low, whereas the dose of bacteria needed to establish an infection in the intestine may be high, or as in the case of cholera, very low. All methods require regular attention and maintenance.

Figure 11 Step by step approaches for drinking water supply



In addition to protecting water at its source and initially disinfecting wells and boreholes (usually by BP solution), there are four basic methods of treatment:

- storage,
- filtration,
- chemical disinfection, and
- Boiling.

These can be used singly or in combination.

Community level treatment is taken care of by the community themselves at village level with the help of PRI/NGOs.

7.10. Storage at household level

Leaving water undisturbed in containers, tanks, or reservoirs improves its quality. Storage kills some pathogens and settles any heavy matter in suspension (sedimentation). If water supplies cannot be assumed to be safe, immediate action must be taken to provide maximum water storage capacity. Storage of untreated

surface water for 12 to 24 hours will considerably improve its quality. The longer the period of storage and higher the temperature, the greater the improvement. Each house must have 25 liter capacity drinking water container exclusively for drinking purpose.

8. DRINKING WATER QUALITY

8.1 Introduction

Although water may look safe, it may be impure and contain microbiological organisms that cause diseases. The most serious threat to the safety of a water supply is contamination by faeces. Once contaminated, it is hard to purify water quickly under emergency conditions. Where drinking water is scarce, brackish, or even salt water, if available, may be used for domestic hygiene.



Figure 12
Not For Drinking Purpose!
Coastal area after Tsunami

8.2 Water quality monitoring and surveillance

It is always better that

- All new water supplies should be tested for its potability before use.
- Existing supplies should be tested periodically, and
- Immediately after outbreak of any waterborne disease.

The most useful and widely used tests detect and enumerate common faecal bacteria, such as faecal coliforms. Indicators of water quality are:

- *Escherichia coli* (*E. coli*) or faecal *streptococci* contamination will be indicated by the presence of faecal coliforms.
- *E. coli* and faecal *streptococci* are subsets of faecal coliforms, which are a subset of the total coliforms.
- Both the faecal coliform numbers given and the residual chlorine concentration mentioned are two primary water-quality indicators.

The actual test used will depend on the availability of local water testing laboratories and the experience of local sanitarians. Simple sensitive tests like **H₂S** vials are available in the market and can easily be used at the field level by the user themselves. The water to be tested must be added to the level marked in the vials which contain medium. The vials are screwed and kept in the room temperature for 24 hours. Any dark colour change or turbid water with bubbles indicates that water is contaminated and requires treatment or not to be used for drinking.

The presence of faecal coliform bacteria indicates that the water has been contaminated by faeces of humans or other warm blooded animals. Concentrations of faecal coliforms are usually expressed as the faecal coliform count per 100 milliliters (ml) of water. The testing can be done at the district laboratories or institutions having such testing facilities.

Use the following as a rough guide.

Faecal Coliforms per 100 ml Risk
0 to 10 Reasonable quality 11 to 100 Polluted
101 to 1,000 Very polluted
Over 1,000 grossly polluted

The H₂S vials will reveal whether water is contaminated with coliform organisms and we need not wait for the results from the laboratories. We can go for remedial measures. One such remedial measure is to have test for residual chlorination in the drinking water to avoid any contamination.

Figure 13 End Point Residual Chlorination- Monitoring



In cases where water is disinfected by chlorination, it is easier and more appropriate to test for the presence of available chlorine than for bacteria. The presence of available chlorine at approximately 0.2 milligrams per litre (mg/L) at the distribution point indicates that almost all bacteria and viruses have been killed, and that the water is no longer heavily contaminated with faecal or other organic matter.

Ready made reagents are available in the market which can be periodically stocked at the village level.

Figure: 14 at Home Level –Chlorination Checking!!

Water stored in tanks and tanker trucks should also be tested periodically. Environmental health measures should be taken to protect the water between collection and use. It is better to have trained workers to monitor water quality regularly and periodically to provide safe water and to prevent any water borne diseases. A simple monitoring mechanism could be established in the affected area with remedial actions at the community level.



The information collected may be shared with the community or the user groups periodically and awareness on water quality can be undertaken while sharing information with the community.

Residual chlorine test kits are available in the market. Kits with tablet, test tubes and color comparator are very easy to use in the field by any body. Reagent solutions are also available which is economical to use. Simple training is sufficient to know whether the drinking water is safe or not and to take remedial action.

Box 8.1
Water Quality Monitoring
Water Quality Monitoring System in Affected Area

General Profile (to be read with spot map):

- Name of the Source
- Village/Ward/Shelter
- Storage points Location –
- OHT, Street Tap Syntex
- Stand post Public Street Location
- Supply Timings

Monitoring

- Location -Testing
- Who tested
- Method of Testing - For Physical, Chemical and Bacteriological test
- Periodicity of testing -Results – Chlorine level - Remedial measures
- Remarks by Local Health Supervisor

Catchment's Area – Collection method

- Distribution area
- Mode of Distribution – OHT, OHT& Pipes, Lorries RO -
- Quality - Date of Testing
- TDS
- Bacteriological

Remedial action – Chlorination

- Whether end point chlorination tested?
- Others – Storage, handling at household level
- Others - Specify

Figure 15 Water Resource Map Drawn by the community! Water Quality monitoring!!



8.3 Immediate Response

Figure 16 Training Volunteers



If the locally available water supply is not sufficient to meet the minimum needs of the displaced, arrangements must be made to bring in water by truck. While the **quantity** of water available may meet initial minimum needs, the **quality** of the water may be the problem: It is likely to be contaminated. Efforts to control and manage the use of contaminated water should be arranged with the displaced community leaders.

Steps to be taken for Safe drinking water are:

- Immediate steps should be taken to prevent pollution by excreta.
- Where the source is a well or a spring, it must be fenced off, covered, and controlled.
- Community must be educated not to draw water with individual containers that may contaminate the source.
- If possible, make immediate arrangements to store water and to distribute it at collection points away from the source.
- Avoid direct contamination; storage may also make water safer.
- From the start, families will need to carry and store their own water at the household level.
- Suitable containers (10 to 20 litres) are essential. If empty cooking oil containers or the like are unavailable, buckets or other containers must be supplied. They must be kept clean.



Figure 18:

Everybody draws water from the top



Figure 17: No lids!!!

Hygiene Education prevents further contamination during storage, transportation, handling and distribution within the house.

Caution

- If immediately available supplies of water are insufficient, priority will be given to rationing supplies and ensuring equitable distribution.
- Rationing is difficult to organize.
- Uncontrolled distributions are open to abuse.
- Distribution at fixed times for different sections of the camp on rotation basis should be organized.
- Vulnerable groups may need special arrangements.
- Every effort must be made to increase the quantity of water available so that strict rationing is avoided.



1. A shallow hand pump at relief center. Water sample is taken from the hand pump

2. 10 ml of sample water is added to H₂S media. Keep it for 24 hours at room temperature



3. Any colour change in the medium - dark green, foamy water means water is contaminated !!!



**Drinking water Source
Abandoned well after Tsunami
Syntax tanks for storing water
Is water safe?**

**Water - Chlorine Test kit
Tablets, Test tube
Colour chart - a field level Kit**



**Take 5 ml of water from the drinking
water source in the test tube
Add one tablet. Mix well.
Compare the colour with the colour chart
If water turns pink, the water is chlorinated
we need 0.5 ppm chlorine in drinking water**

9. METHODS OF MAKING DRINKING WATER SAFE

9.1 Straining

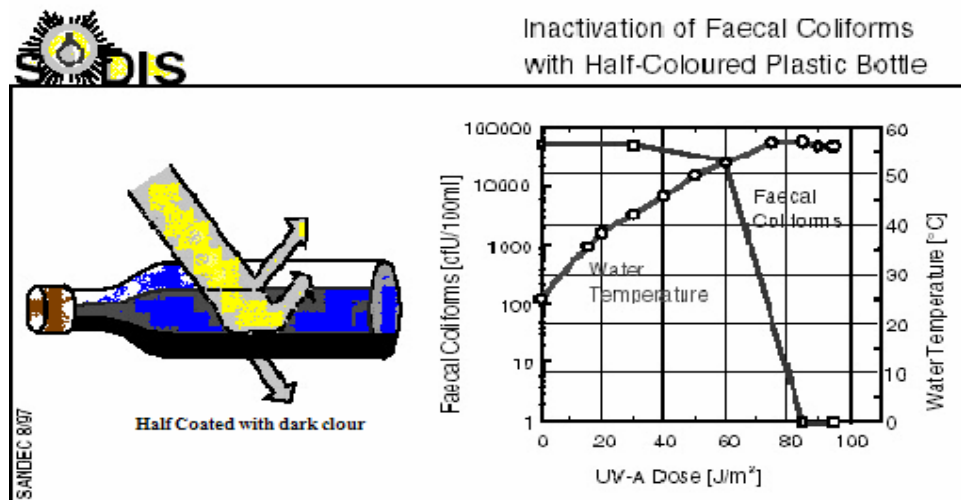
Safe and potable water is very important to prevent water borne diseases. Some methods of making drinking water safe are given below. If heavy sediment or floating matters are present, the water must be strained through several layers of *clean cloth* into a clean container *before boiling, chlorinating or filtering*. This may be a situation during flood and where there is no other source available.

9.2 Solar water disinfection

Sunlight can be used to kill or inactivate many, if not all, of the pathogens found in water. Solar water disinfection is a method of treating relatively small amounts of water at the point of use like schools, shelters and relief camps. It acts through *heating*, the second through the effect of the *natural UV radiation* and the third through a *mixture of both thermal and UV effects*. Solar disinfection is included in the technologies reviewed by WHO for household water treatment and storage.

Turbid water more than <30 NTU is not suitable for solar disinfection. The promoters of **SODIS** suggest the use of thin PET plastic bottles. The half of the bottle furthest from the sun should be painted with black paint to improve the heat gain from the absorption of thermal radiation, and the bottle can be laid on a dark roof to further increase the potential temperature rise in the water

Figure: 19 Solar Disinfection



9.3 Boiling Method

Boiling water vigorously for minimum 10 minutes makes water safe from harmful bacterial contamination. It is very difficult to search materials for boiling immediately after a disaster.

9.4 Disinfection

WHO endorses disinfection of drinking-water and in emergency situations drinking-water should be disinfected in all cases where population size and concentration, lack of sanitary facilities, or health information

Disinfection should not be used as a substitute for protecting water sources from contamination.

There is a number of different water disinfection methods used in stable situations, but the most common method in emergencies is chlorination.

Important advantages of chlorine disinfection are:

- Simple and cheap to dose and to measure, and
- Leaves a residual disinfection capacity in the treated water, safeguarding against contamination in transmission and in the homes,
- Chlorine compounds in solid (BP) or liquid form,
-

Box 9.2

Procedure for using bleaching powder:

1/8 of teaspoonful is sufficient to disinfect 10 liters of water. Bleaching powder should be dry, white, powdery, smell strongly of the chlorine. Take 1 teaspoonful of Bleaching powder and divide it into 8 parts. Take one part and mix with 10 liters of water and allow it for 30 minutes. After 30 minutes water is ready for use.

to store and handle,

- Can be dosed using simple equipment, such as a spoon or bucket,
- Fresh BP contains about 35% of available chlorine and this slowly gets reduced. BP should be stored in air-tight container.

Free residual chlorine levels of more than 0.3mg/l for more than 30 minutes are required to kill bacteria and most viruses. Chlorination of stored water for direct consumption is best achieved using a 1% stock solution of chlorine.

Chlorination is less effective in turbid water. Ideally the turbidity should be less than 5 NTUs. Designated individuals should be responsible for monitoring the free residual chlorine level daily in all distributed and stored supplies, including water in household containers. They can be recruited from the affected population and trained. Bleaching Powder and Chlorine-based tablets (containing trichloroisocyanuric acid) may be used for short-term emergency chlorination.

9.4.1 Disinfecting contaminated wells and tanks

A free residual chlorine level of 1.5mg/l in a well or tank for 24 hours is sufficient to kill most pathogens once the well or tank has been cleaned of any debris and protected. The well or tank should be pumped out, or flushed after disinfection, until the free residual chlorine concentration is below 0.5mg/l. If there is an ongoing risk of contamination, then the source of contamination should be removed and/or the water should be disinfected continuously.

9.4.2 Disinfecting water using a 1% stock solution

Table 10 Preparation of 1% Chlorine stock Solution				
To make 1 liter of the stock solution, mix the quantity shown of one of the following chemical sources with water and make up to 1 liter in a glass, plastic or wooden container:				
Chemical source	Percentage available chlorine	Quantity required	Approximate measures	
Bleaching powder	35	30g	2 heaped tablespoons	
High-test hypochlorite	70	14ml	1 tablespoon solution	
Liquid laundry bleach	5	200ml	1 teacup or 6-oz milk tin	
A 1% solution contains 10g of chlorine per liter = 10000mg/l or 10000ppm (parts per million). 1 tablespoon = 4 teaspoons. It is suggested to use mg/l unit for easy understanding. This stock solution should be fresh, i.e. made every day, and protected from heat and light.				

Source: United Nations Children's Fund (1986).

9.5 Contact time with microorganisms

The contact (retention) time in chlorination is that period between introduction of the disinfectant and when the water is used. A long interaction between chlorine and the micro organisms results in an effective disinfection process complete mixing of chlorine solution and water is necessary. Chlorine solutions lose strength while standing or when exposed to air or sunlight.

Caution

- Make fresh solutions frequently to maintain necessary residual.
- Maintain a free chlorine residual of 0.3-0.5 mg/l after a 30 minute contact time.
- Measure the residual chlorine frequently.
- Locate and eliminate the source of contamination.
- Keep records of pertinent information concerning the chlorination system

Bleaching powder and chlorine tablets are readily available in the market. These products can easily be stored in air tight jars (porcelain or plastic).

9.5.1 A special note about chlorine

Because of publicity, people may be concerned about potentially harmful effects of chlorine in drinking water. However, until other effective, economically feasible treatment options are available; many water-quality professionals agree that the benefits of chlorine in eliminating life-threatening water borne diseases through drinking water problems far outweigh the shortcomings, in emergency as well as no emergency situations.

9.5.2 Post-delivery contamination

Water that is safe at the point of delivery can nevertheless present a significant health risk due to re-contamination during collection, transportation, storage and handling may become an issue when the immediate source becomes non potable/unusable.

Steps that can be taken to minimize such risk include improved collection and storage practices, distributions of clean and appropriate collection and storage containers, treatment with a residual chlorination, or treatment at the point of use. Water should be routinely sampled at the point of use to monitor the extent of any post-delivery contamination.

10. EXCRETA DISPOSAL

10.1 Introduction

Safe disposal of human excreta creates the first barrier to excreta related disease, helping to reduce transmission through direct and indirect routes during and after a disaster and in relief camps. Safe excreta disposal is therefore a major priority, and in most disaster situations should be addressed with as much speed and effort as similar to the provision of safe water supply.

10.2 Excreta disposal, health and survival

Inadequate and unsafe disposal of human faeces can lead to the transmission of faeco-oral disease, can result in the contamination of the ground and water sources and can provide breeding sites for flies which may carry infection.

The importance of excreta disposal cannot be overestimated. Diseases transmitted via the faeco-oral route, such as diarrhoea, have been shown to account for 40% of all childhood deaths in an emergency (Davis and Lambert, 2002) and this figure may be significantly higher in some cases.

Studies conducted in Tsunami affected villages in Tamil Nadu have shown that improvements in water quality alone contributed reductions in diarrhoeal diseases, though safer excreta disposal, and hand washing were not upto the standards.

The introduction of safe excreta disposal can reduce the incidence of intestinal infections and helminth infestations, Excreta-related communicable diseases include cholera, typhoid, dysentery, diarrhoea, hookworm. The likelihood of all these diseases, and especially epidemics such as cholera, increases significantly when a population is already displaced or affected by a disaster.

The provision of appropriate facilities for defecation is one of emergency responses essential for people's *dignity, safety, health and well-being*. Inadequate and unsanitary disposal of infected human excreta leads to the contamination of the ground water and sources of drinking water supplies.

Faeces provide shelter to bread flies to lay their eggs and to carry infection from faeces to other human beings. This is a serious problem in coastal areas where the shelters are congested and a risk to the affected people.

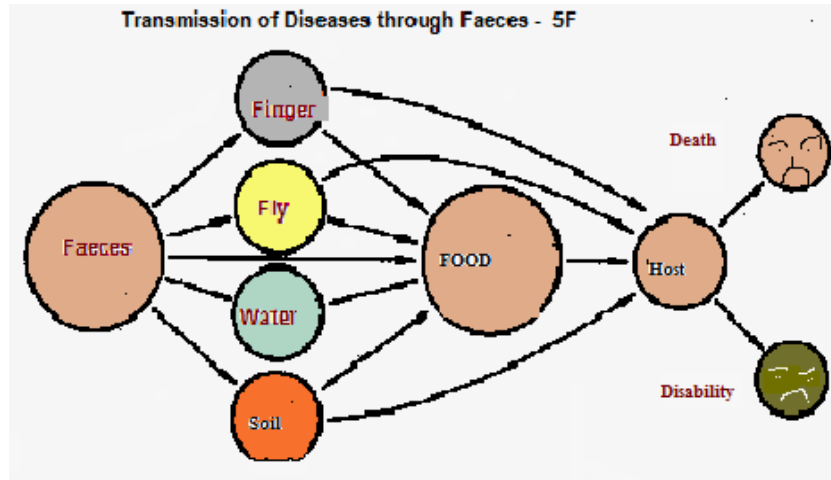


Figure: 20
5 F
Diagram

As may be seen in the figure 20, there are many ways by which disease-producing pathogen spreads or reaches the new host – the human being. The technical objective of sanitary disposal of human excreta is therefore *to isolate or segregate human faeces* so that the diseases-producing organisms in faeces cannot possibly get into a new host through the common modes of transmission.

10.3 Situation

Overcrowding, a harsh environment and disruption of normal sanitation habits can threaten the lives and well-being of the displaced community in emergencies. Proper sanitation is a key aspect of the hygiene cycle involving water & health and is fundamental to a multi-pronged approach in emergency response.

10.4 Objective of the Preparedness in Environmental Sanitation

To prevent the spread of disease and promote a safe environment for the affected community.

10.4.1 Community Response

The community plays a vital role as sanitation is more related to hygiene behaviour than technology alone.

- The co-operation of the community is essential for success.
- Programs must be developed with them, and to the extent possible, adopted and run by them.
- Swift provision of a basic system for human waste disposal is better than delayed provision of improved systems.
- Take full account of sanitation needs in site selection and layout.
- Make full use of locally available human, material and technological resources.
- This includes using both skilled and unskilled refugee labour, using public health or sanitary engineering expertise available in the national institutions and relying on the traditional practices of the refugees and the local people.
- The materials and technology chosen should be simple
- The best guarantee that latrines will be used and kept clean is to allocate them on an individual or family basis. Refuse disposal should be arranged on a community basis;
- Wherever possible, restrict the use of chemicals (for the control of rats, flies and other pests particularly) to specific places and for a limited period of time.

10.4.2 Assessment

In situations where the population has not traditionally used toilets, it may be necessary to conduct a concerted education/promotion campaign to encourage their use and to create a demand for more toilets to be constructed.

The initial assessment should include the following questions before finalizing the intervention:

- What is the estimated population and what is the population density?
- What are the current beliefs and traditions concerning excreta disposal especially regarding

women and children's excreta?

- Do men and women or all family members share latrines, can women be seen walking to a latrine, do children use potties, is children's excreta thought to be safe?
- What material/water is used for anal cleansing? Is it available?
- Are there any existing facilities? If so are they used, are they sufficient and are they operating successfully? Can they be extended or adapted? Do all groups have equal access to these facilities?
- Are the current defecation practices a threat to health? If so, how?
- What is the current level of awareness of public health risks?
- Are there any public health promotion activities taking place? Who is involved in these activities? (Health workers, voluntary groups, home visitors). State government started implementing Total Sanitation Campaign even before the Tsunami struck coastal Tamil Nadu.
- What health promotion media are available/ accessible to the affected population?
- Are men, women and children prepared to use defecation fields, community latrines or family latrines?
- Is there sufficient space for defecation fields, pit latrines etc?
- What are the *topography and drainage patterns of the area*?
- What is the depth and permeability of the soil and can it be dug easily by hand by using simple tools like crowbar pick axe, spade, etc.?
- What is the level of the groundwater table?
- What local materials are available for constructing latrines?
- Are there any people familiar with the construction of latrines?
- How do women deal with menstruation? Are there materials or facilities they need for this?
- When does the seasonal rainfall occur?
- Whose role is it normally to construct, pay for, maintain and clean a latrine (men, women or both)?
-

10.5 A Mapping Exercise for Excreta Disposal

Mapping is a useful exercise which can be used to gain an overview of the situation and to identify excreta disposal problems which are causing a risk to people's health.

- It also helps to formulate strategy for software.
- Mapping exercise should also allow people themselves to appreciate possible risks and it can often be a catalyst for community planned action.
- It can be initiated simply by approaching a small group of people or by organizing groups of people in advance.
- It is useful to conduct separate mapping exercises with women and men to ascertain their different views.

Facilitator can act as a partner in the community and facilitate to

- Explain who you are and that you would like their help in conducting the exercise.
- Have a clear idea in your mind of the possible things that might be identified on a map such as areas of open defecation, houses or shelters with and without latrines, areas of fly breeding, etc.
- Identify defecation habits among children and women groups
- Identify possible resources that might be used and allow people to make their suggestions to prevent open air defecation.
- Allow plenty of time for discussion of the idea of making a map
- If necessary begin the process yourself with a central landmark using a stick to draw on the ground.
- Listen carefully to what people say and allow free discussion and debate amongst participants.
- Keep a record of who took part and when and where.
- When the map is finished, offer to transcribe it or get one of the participants to transcribe it onto paper. Ask the participants to decide where they would like the map to be kept, or who will keep it.

The exercise would be very useful for hygiene education in later stages. The success of any latrine program will again depend on how much the affected population, especially women, are involved and how good the liaison is with the public health promoters, health workers, camp planners. It is not enough to simply build

latrines, they must also be used and kept clean by all users.

10.6 Action

- Localize defecation and prevent contamination of the water supply;
- Collect baseline data on the site and draw a sketch of the area to locate potential zones for sanitary facilities;
- Develop appropriate systems for disposal of excreta, garbage, and wastewater.
- Control vectors of public health importance such as mosquitoes, flies, fleas, lice, bugs, rodents and other vermin;
- Plan the amount of facilities and services to be provided.
- Optimum standards are: for excreta solid waste disposal: one latrine per family; for refuse: one bin of 100 liters capacity for 10 families or 50 persons; one sanitation assistant for every 500 persons; and one sanitarian for every 5,000 persons,
- Establish sanitation teams for the construction and maintenance of infrastructure;
- Set up services for vector control and burial of the dead human & animals;
- Establish a monitoring and reporting system for all environmental health services in co-ordination with the general health surveillance system;
- Include environmental sanitation as an integral part of health education.

Box 10.1 Such exercises conducted in Temporary shelters of Tsunami affected community in Nagapattinam and Cuddalore districts brought out issues for solutions.

- Water stagnation in the camp sites
- Lack of sufficient hand-pumps in a few camp sites
- A few hand pumps under repair
- Few Syntex tanks not used
- No regular filling up of the syntex tanks
- Ventilation is poor in almost all shelters
- Bathing facilities absent or insufficient
- No Separate Urinals
- Available sanitary facilities are not adequate in the shelters
- No Water supply in the toilets
- Improper maintenance of the toilet seats
- Soak pits are not available in some camp sites
- Some soak pits are not leaching
- Soak pits deposited with refuse
- Some camp sites with water stagnating ponds and mosquito breeding is observed
- Over crowding in some shelters
- Improper refuse disposal at the shelters and fly breeding is observed
- Fly and mosquito nuisance
- Blockages in some of the drainage with water stagnation in the camp sites
- Throwing the fish waste/ fish cleaning water before shelters attracting flies
- Dry fish selling in some places attracts flies

11. SAFE EXCRETA DISPOSAL

11.1 Introduction

Measures to collect human excreta and to dispose of refuse should be taken immediately after a disaster and rehabilitation phase itself. It is almost impossible to estimate how long affected community will stay at a given site; more durable facilities should also be established simultaneously. Therefore,

- Identify the site for a defecation field
- Start latrine construction at once
- The greater the time lag between those two actions, the more difficult to shift people from their previous habits
- It is always more efficient to have only one agency responsible for both sensitizing people to environmental sanitation and supervising related activities.

Figure 21, 22 Information, Education and Communication

Activities that may require are

- education for environmental sanitation should focus on the **“how and why”** of hygienic containment of human excreta,
- Simple methods for waste disposal and hygiene at household level (water storage in the home, habitat and personal hygiene, etc.)
- Women, teachers, leaders, and school children should be the first target for such a program. Community participation is a very effective key to the success of sanitation projects.
- Health education and sensitization are a prerequisite to that participation. It should nevertheless be recognized that it takes time to convince the communities.
- Form community based committees to monitor and maintenance.
- Individual families will be responsible for their own units, but where communal latrines are unavoidable, special arrangements to keep them clean will be essential.
- Particular attention must be given to the maintenance and cleanliness of the latrines serving community facilities such as health centers.
- Workers with proper supervision will be required. It may be necessary to pay or otherwise compensate with incentives to those who are responsible for keeping communal latrines clean and operational.



Figure 22 Information, Education

Two main factors will affect the choice of an excreta disposal system in displaced community are:

- Traditional sanitation practices of the refugees and the physical characteristics of the area, including the geology,
- Availability of water, rainfall and drainage.

Box 11.1 Human Excreta Disposal

Take immediate action to localize excreta disposal and prevent contamination of the water supply; Carefully consider cultural and physical factors and ensure that appropriate anal cleaning materials and hand-washing facilities are available at the toilets.

Communal trench latrines may be needed initially, but in most circumstances pit latrines are much better; ensure that latrines can be used at nights also and are safe for women and children for which good lighting is essential.

Failure to take proper account of these can easily result in the system itself rapidly becoming a health hazard.

For a displaced population – relief camps, shelters, where there are no existing toilets, it is not always possible to provide one toilet per 20 people immediately.

It should be remembered that the primary aim is to provide and maintain an environment free from human faeces. Where one toilet is shared by four or five families it is generally better kept, cleaner and therefore regularly used when the families have been consulted about its seating and design. During rescue and in relief camps and in affected areas, people must have access to have adequate numbers of toilets, sufficiently close to their dwellings, to allow them rapid, safe and acceptable access at all times of the day and night.

Table 11 Minimum Numbers of Toilets at Public Places and Institutions in Disaster Situations	
Short Term	Long Term
1 toilet to 50 stalls 1 toilet to 20 beds or 50 out-patients 1 toilet to 50 adults 1 toilet to 20 Staff children -1 toilet per 50 3:1 female to male 1 toilet to 30 girls, 1 toilet to 60 boys	1 toilet to 20 stalls 1 toilet to 10 beds or 20 out-patients 1 toilet to 20 adults 1 toilet to 10 children 1 toilet to 30 girls, 1 toilet to 60 boys 1 toilet to 20 staff

12 DESIGNS AND USE OF TOILETS

12.1 Qualities of Human Excreta

Toilets are sited, designed, constructed and maintained in such a way as to be comfortable, hygienic and safe to use. Factors that may affect the toilets are:

- the number of users
- Ground conditions
- Hygiene behaviour of the user
An average Indian passes 250-300 grams faeces daily.
- The amount of urine is greatly dependent on temperature and humidity, commonly ranging from 0.6 to 1.1 liters per person per day.
- Human excreta of a sick man may contain millions of pathogens.
- As soon as excreta are deposited they start to decompose, eventually becoming a stable material with no unpleasant smell, and containing valuable plant nutrients.
- Gases such as ammonia, methane, carbon dioxide and nitrogen are produced and released and dissolved in the water in a pit.
- Soluble material is produced which may leach into the underlying or surrounding soil or be washed away by flushing water or groundwater.
- Pathogens are destroyed because they are unable to survive in the environment of the decomposing material.

The decomposition, mainly carried out by bacteria, may be either aerobic, i.e., taking place in the presence of air or free air/oxygen (for example, following defecation and urination on to the ground), or anaerobic, i.e., in an environment containing no air or free oxygen (for example, in a leach pit or at the bottom of the septic tank). When all available oxygen has been used by aerobic bacteria, facultative bacteria capable of either aerobic or anaerobic activity take over and finally anaerobic organisms commence activity.

Pathogens may be destroyed because the temperature and moisture content of the decomposing material create hostile conditions. For example, during composting of a mixture of faeces and vegetable waste under fully aerobic conditions, the temperature may rise to 70°C, which is too hot for the survival of intestinal organisms. As excreta is decomposed it is reduced in volume and mass owing to:

- evaporation of moisture;
- production of gases which usually escape to the atmosphere or into the soil;
- leaching of soluble substances;
- transport of insoluble material by the surrounding liquids;

- **Decomposition under water produces a much greater reduction in volume than decomposition in air or in a dry latrine.**
- **Dry pit needs a larger volume than a wet pit**

Where excreta are stored for short periods only, such as in double pit latrines or composting toilets, the reduction process may not be complete before the sludge is removed. In such cases it will be necessary to use higher sludge accumulation rates than indicated above. A 50% increase is tentatively suggested.

12.2 Ground conditions

Ground conditions affect the selection and design of sanitation systems, and the following five factors should be taken into consideration:

- bearing capacity of the soil;
- self-supporting properties of the pits against collapse;
- infiltration rate, porosity of the soil
- Ground water pollution risk.

12.2.1 Bearing capacity of the soil

Some soils are suitable only for lightweight materials - poor loadcarrying capacity - marshy and peaty soils are obvious examples. In general, it is safe to assume that if the ground is suitable for building a house it will be strong enough to support the weight of a latrine superstructure made of similar materials, providing the pit is appropriately lined.

It is recommended that ***all pits should be lined to their full depth.***

Many pits collapsed in Tsunami affected areas and washed away with recent floods in coastal districts of Tamil Nadu because the pits were not lined properly. Many soils may appear to be self-supporting when first excavated, particularly cohesive soils, such as clays and silts, and naturally bonded soils, such as soft rock. It is therefore safer to line the pit. The lining should permit liquid to percolate into the surrounding soil.

Lining may be done by:

- Bricks
- Concrete /Ferro cement rings
- Wooden /bamboo materials
- Empty tar or fuel drums (barrels)

12.2.2 Infiltration rate

The soil type affects the rate at which liquid infiltrates from pits and drainage trenches. Clays in delta regions that expand when wet may become impermeable. Other soils such as silts and fine sands may be permeable to clean water but become blocked when transmitting effluent containing suspended and dissolved solids.

It is recommended that the design of pits and trenches should be based on infiltration through the side walls up to the maximum liquid level. For trenches, the area of all side walls should be used. The rate of infiltration also depends on the level of the groundwater table relative to the liquid in the pit or trench. In the unsaturated zone, the flow of liquid is induced by gravity and cohesive and adhesive forces set up in the soil.

Seasonal variation may produce a change in the amount of air and water in the soil pores and this will affect the flow rate. In the saturated zone all pores are filled with water and drainage depends on the size of the pores and the difference in level between the liquid in the pit or trench and the surrounding groundwater.

12.3 Soil Porosity

Soil porosity also affects infiltration. Soils with large pores, such as sand, gravel, disintegrated rocks and some sand stones containing fissures, drain easily. Silt and clay soils, however, have very small pores and tend to retain water. Soils containing organic materials also tend to retain water but the roots of plants and trees break up the soil, producing

holes through which liquids can drain quickly in addition to their sucking the water for their own growth.

The rate of groundwater flow in unsaturated soils is a complex function of the size, shape and distribution of the pores and fissures, the soil chemistry and the presence of air.

When liquid first infiltrates into unsaturated soil, aerobic bacteria decompose much of the organic matter filtered from the liquid, keeping the pores clear for the passage of air as well as effluent. However, once organic matter builds up so that air cannot pass through the pores, the rate of decomposition (now by anaerobic bacteria) is slower, and heavy black deposits of insoluble sulfides are built up.

Clogging of the pores can be minimized by ensuring that infiltration occurs uniformly over the whole system. Clogging can sometimes be reduced by a regime of alternate "resting" and "dosing" of the soil. The infiltration area is allowed to rest, i.e., to become fully drained of liquid for a period before infiltration recommences. During the resting period, air reaches the soil surface and the anaerobic bacteria causing the clogging die off, allowing the surface to become unclogged. Alternate dispersion trenches are used for such problems.

Gravel is capable of much higher infiltration rates, which may be a problem in areas where shallow groundwater is used for human consumption. This pollution problem can be reduced by the provision of a sand envelope.

12.4 Groundwater pollution risk

The effluent from pits and drainage trenches may contain pathogens and chemical substances that could contaminate drinking-water supplies. Because of their comparatively large size, protozoa and helminthes are rapidly removed by the straining action of the soil, but bacteria and viruses are more persistent. Of the chemical substances generally present in domestic wastes, only nitrates present serious health dangers. Young babies bottle-fed with milk made from water with a high nitrate concentration may develop "blue baby disease", methaemoglobinaemia, which can be fatal if untreated.

The usual means by which effluents affect drinking-water supplies is through pollution of groundwater that feeds wells and bore wells. A further danger is when effluent infiltrates the ground at shallow depth near to water pipes in which there is intermittent flow or in which the pressure is at times very low.

Just as poor joints, cracks and holes in the pipe walls allow water to leak out when the pipes are full, so effluent leaks into the pipes when they are empty or under reduced pressure.

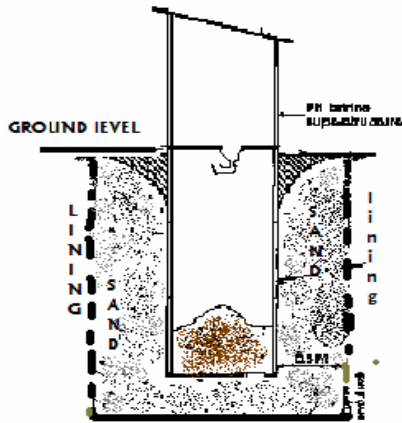
12.5 Purification in unsaturated soil

In sandy soils, a dramatic reduction in coliforms occurs in the first 50 mm. Hence a sand buffer is prepared for effluent disposal in a water logged area. Viruses, because of their small size, are little affected by filtration and their removal is almost entirely by adsorption on to the surface of soil particles. Adsorption of both viruses and bacteria is greatest in soils with high clay content, Viruses, live longer at lower temperatures. Both viruses and bacteria live longer in moist conditions than in dry conditions. Bacteria live longer in alkaline than in acidic soils.

Generally there is little risk of groundwater pollution where there is at least 2 meter of relatively fine soil between a pit or drainage trench and the water table, providing the rate of application is not greater than 50 mm/day (equivalent to 50 liters per m² per day). This distance may have to be increased in areas subject to intense rainfall, as the increased infiltration rate produced by the percolating rainwater may carry pollution further. Holes in soil caused by tree roots or burrowing animals can act in the same way as fissures.

If it is not possible to provide sufficient space between the latrine and the water point, consideration should be given to extracting water from a lower level in the aquifer. Provided the extraction rate is not too great, and the well is properly sealed where it passes through the pollution zone, there should be little or no risk of pollution.

Any water point nearer to the latrine pits and low land area is not at all suitable for drinking purpose.



A depth of two meters of unsaturated sandy or loamy soil below a pit or drainage trench is likely to provide an effective barrier to groundwater pollution and there may be little lateral spread of pollution. Where the groundwater is shallow, artificial barriers of sand around pits can control pollution (see figure)

Figure: 23 reducing the pollution from a pit latrine with a barrier of sand

- In pit latrines and soak away (for most soils), the bottom of any latrine is at least 1 meter above the water table.
- Drainage or spillage from defecation systems must not run towards any surface water source or shallow groundwater source

In disasters, groundwater pollution may not be an immediate concern if the groundwater is not consumed. This happened in coastal Tamil Nadu due to timely help from Tamil Nadu Water and Drainage Board supplying water from distant source through pipes.

12.6 On-site sanitation Technology for Relief camps and Shelters

- Pit latrines
 - Simple pit latrines
- Pour-flush latrines
 - Offset pour-flush latrines
 - Double-pit offset pour flush latrines
- Raised pit latrines
- Septic tanks
- Aqua-privies
 - Disposal of effluent from septic tanks and aqua-privies
- Composting latrines/Eco sanitation
- Multiple latrines

Any review of on-site sanitation shows that there are a large number of options to choose from. Many of the alternatives are variations on, or combinations of, other designs and it is not possible to describe them all. Those planning on-site sanitation should adopt and combine the major options described, to get the most appropriate solution.

12.6.1 Trench Latrines

12.6.1.1 Defecation fields

In an emergency when large number of population is displaced, we can not wait for the technical people to come and construct toilets. The local community must able to face situation with simple technology to prevent the contamination of the ground water and soil by segregating the faeces.

One such method is called trench latrines. The area set aside should be of sufficient size to accommodate 0.25m² per person per day excluding access paths. Separate areas for men and women are usually desirable.

The field should be

- in a convenient place,
- not more than 30 metres
- it would be on land that slopes away from the camp and any surface water sources.
- The soil should be soft enough to dig easily in order to cover excreta.

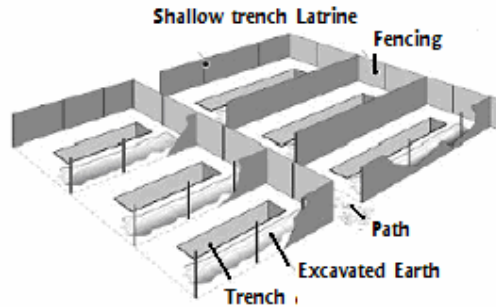
12.6.1.2 Health Education

Health education is required to facilitate the community to use toilets. People must be made aware of

how to use toilets, cleaning and maintenance. Users should be directed to use one by one the trenches / strip until it is filled. When a strip is filled, excreta are then covered by the attendant with at least 10 centimetres of soil and another strip is opened some metres away. The active part of the field should be illuminated at night and demarcated with poles and pegs.

12.6.3 Types

There are two types. 1. Shallow and the second one is called deep trench latrine. A simple shallow trench need only be 20-30cm wide and 15cm deep, and shovels may be provided to allow each user to cover their excreta with soil.

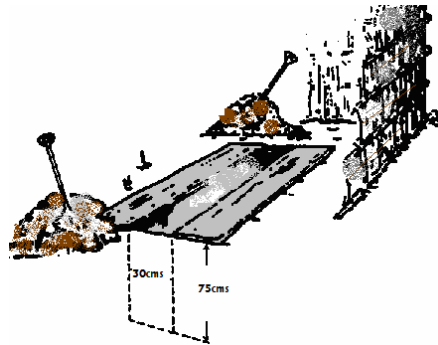


Divide the field into strips 1.5m wide with access paths. Use strips furthest from the entrance first. When a section of trench has its bottom layer fully covered with excreta it is filled in.

Only short lengths of trench should be opened for use at any one time to encourage the full utilization of the trench in a short time. A rule of thumb is to allow 0.25 m² of land per person per day. This means 250 m² per 10,000

people per day, or nearly 2 hectares per week. Men and women's areas should always be separated.

Advantages: Easy and quick to construct, faeces can easily be covered with soil.

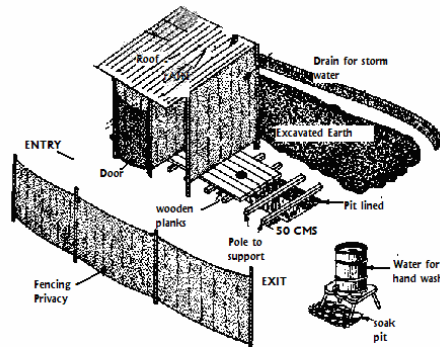


Disadvantages. Short life period, needs more space, privacy is a problem, Water and soil pollution, fly breeding may be there, smell nuisance are additional problems.

12.6.4 Deep trench latrines

A further improvement is the deep trench latrine, which is deeper, longer and wider than the shallow trench latrine. Deep trench latrines are often constructed in the immediate stage of an emergency and will be appropriate if there are sufficient tools, materials and human resources available. These involve the sitting of several cubicles above a

single trench which is used to collect the excreta.



The recommended maximum length of trench is 6m, providing six cubicles. Trenches should be 0.8 - 0.9m wide and at least the top 0.5m of the pit should be lined. After the trench has been dug the quickest option is to put self-supporting plastic slabs straight over the trench. If slabs are not available then wooden planks can be secured across the trench until proper wooden or concrete slabs can be made. The trench should be covered with planks leaving out every third or fourth plank, which is where people defecate. Ideally, all designs should be previously discussed with the community and should take into account the safety of

women and children and elderly or disabled people.

Advantages: Cheap; quick to construct; no water needed for operation; easily understood.

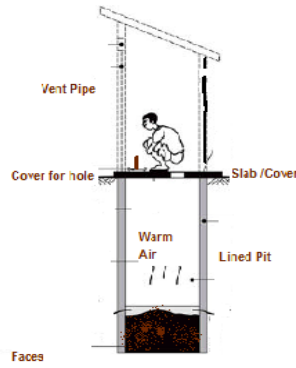
Disadvantages: Unsuitable where water table is high; soil is too unstable to dig or ground is very rocky; often odour problems; fly breeding,

12.7.1. Pit latrines

The principle of all types of pit latrine is that wastes such as excrete, anal cleaning materials are

deposited in a hole in the ground. The liquids percolate into the surrounding soil and the organic material decomposes producing:

- gases such as carbon dioxide and methane, which are liberated to the atmosphere or disperse into the surrounding soil;
- liquids, which percolate into the surrounding soil;
- A decomposed and consolidated residue.



In one form or another, pit latrines are widely used in most developing countries during disaster relief camps. *The health benefits and convenience depend upon the quality of the **design, construction and maintenance.***

Figure 24 Seats over the Pit

Objections to the use of pit latrines are that

- poorly designed and poorly constructed latrines produce unpleasant smells,
- that they are associated with the breeding of flies, mosquitoes in effluent and
- pits are liable to collapse, and
- that they may produce chemical and biological contamination of groundwater.

Pit latrines that are well designed, sited and constructed, and are properly used need not have any of these faults.

Box 11. 2At worst, pit latrines that are badly designed, constructed and maintained provide foci for the transmission of disease and may be no better than indiscriminate defecation. Simplicity of sound construction, low construction costs, the fact that they can be built by householders with a minimum of external assistance, and effectiveness in breaking the mode of transmission of diseases are among the advantages that make pit latrines the most practical form of sanitation available to many people

12.7.2 Pit shape

The depth of the pit to some extent affects the excreta disposal system. As the pit gets deeper the load applied to the pit lining by the ground increases. At shallow depths, normal pit linings (concrete, brick masonry, etc.) are usually strong enough to support the soil without a detailed design.

Commonly, pits are 1.0-1.5 m wide or in diameter, since this is a convenient size for a person to work inside during excavation (A pit with 1.5 meter depth with 1 meter dia has a life span for 5 members for 4 years in a porous soil). The cover slab required such pit is simple to design and construct, and cheap to build. For groups, the pit size and number of pits can be modified.

12.8 Simple Pit latrines

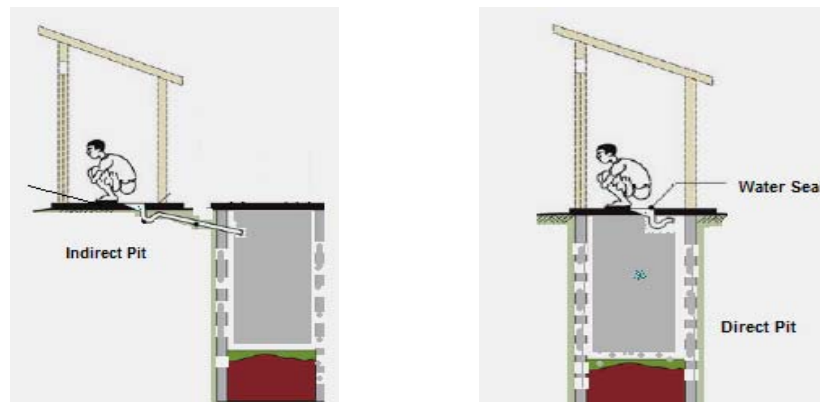
The simple pit latrine (Fig.24) consists of a hole in the ground (which may be wholly or partially lined) covered by a squatting slab or seat where the user defecates. In simple pit latrines, hole may be provided with a cover or plug to prevent the entrance of flies or egress of odour while the pit is not being used. The cover slab is commonly surrounded by some form of superstructure that provides shelter and privacy for the user. The superstructure design is irrelevant to the operation of the latrine but crucial to the acceptability of the latrine to the user. Superstructures range from a simple shelter of sacks, or tin sheets or sticks to a building of bricks or blocks costing more than the rest of the latrine. Such latrines may be constructed in one corner of the site taking the water source and water table into consideration.

12.9 Lining materials and squatting or cover slabs

- Bamboo, bricks, blocks can be used with honeycomb style to allow good percolation.
- Alternately, concrete rings - with holes for drainage, empty barrels with holes for drainage.
- Use the liquid effluent to escape
- Old tyres of trucks may be used.
- The cover slab should be raised at least 150 mm above the surrounding ground to divert surface water away from the pit.
- Commonly, the cover slab sits directly on the lining, - a concrete foundation beam may be necessary to distribute the load of the slab to the lining and surrounding ground.
- A water seal instead of simple hole will make the latrine more scientific.

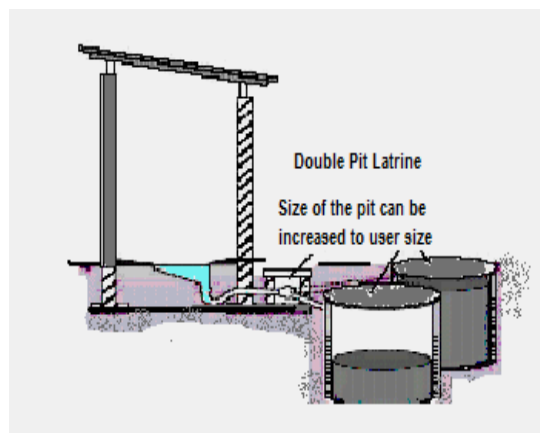
12.10 Pour flush on site latrine

Figure 25, 26 Water seal over the Pit, off side the pit



Pour-flush leaching pit latrines overcome the problems of flies, mosquitoes and odour by having a pan with a water seal. After using the latrine, it is flushed by pouring water in the pan. The latrine pits are usually lined to strengthen the walls, and the soil should be adequately permeable for infiltration.

The concrete floor slab with the pan is either on top of the leaching pit (direct system), or a short distance from one pit (single offset) or two pits (double offset). In offset systems, a short length of stoneware pipes/thick density PVC tubing sloping down from the U-trap to the pit, or in case of a double-pit system, to a diversion box which diverts the flush into one of the two pits at a particular time.



The double offset system enables the two pits to be used alternately. When the first pit is full, it should be left for at least 10-12 months, to allow time for the pathogens to be destroyed. After this time, the contents of the first pit can be safely removed even by hand and used as organic fertilizer.

Figure.27 Double Pit Pour-flush on site latrine – cross section view of a seat over the pit.

The first pit is then ready to be used when the second pit fills up. Pour-flush latrines are most suitable where people use water for anal cleansing and squat to defecate, but they are also popular in countries where other cleansing

materials are common.

Pour-flush latrines may be upgraded to a septic tank with a drainage field or soak away, or may be connected to a small-bore sewerage system. The size of the pit and number pits can be increased according to the number of users.

12.11 Main O&M activities

Hygiene behavior of the community is very important in maintaining the system. Simple ways to keep toilets clean are:

- Before use, the pan is wetted with a little water to prevent faeces sticking to the pan.
- Wastewater from bathing or washing clothes should not be drained into the pit, but disposed of elsewhere.
- No material that could obstruct the U-trap should be thrown into the pan.
- The floor, squatting pan or seat, door handles and other parts of the superstructure should be cleaned daily with brush and water.
- After use, the pan is flushed with water. If water is scarce, water already used for laundry, bathing, etc. may be used.
- Regularly, the pan and U-trap should be checked for cracks or for blockages. If the excreta do not flush quickly, the PVC pipes or diversion box may become choked and they must be removed immediately using scoops and long thin flexible bamboo sticks.

When full, single pits should be abandoned and covered with at least 0.5 m of soil after the cover slab and a new pit dug. The pit can only be emptied manually if the excreta have been left to decompose for at least 10-12 months. In this time, the excreta will have decomposed into harmless humus, which makes a good fertilizer. In a double-pit system, users should regularly monitor the level of the pit contents. If one pit is almost full, diversion of the flushes to the second pit should be done.

If several households use the latrine, arrangements should be made to rotate cleaning tasks among the households. The users need to understand the concept of the system fully to be able to operate and maintain it properly. User education must include the reasons for using one pit at a time, the need to leave a full pit for about two years before emptying, and the use of the decomposed material (humans) excreta as manure. The users also need to know how to switch from one pit to another, and how to empty a pit, even if they do not perform these tasks themselves.

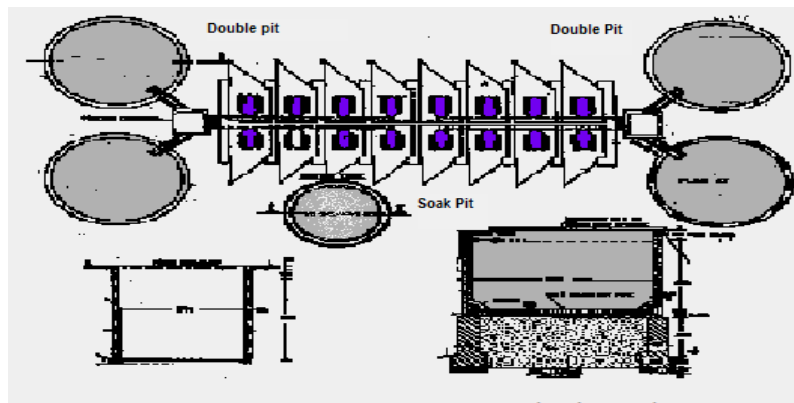
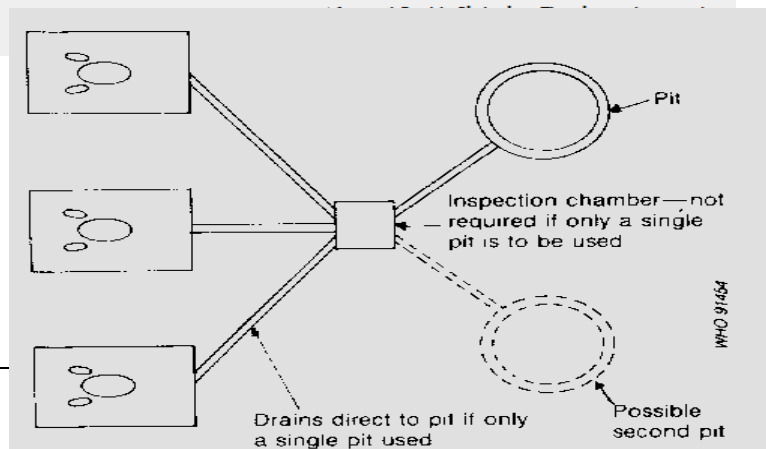


Figure 28. offset pour-latrines for users.



Double-pit flush multiple

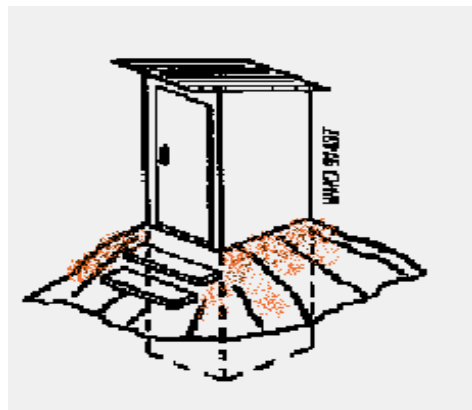
Double pits with pour-flush pans and water seals have been successfully used in our country. The pit design can be calculated based on the number of users. The two toilets are replaced by a single water seal pan connected to both pits by pipes. An inspection chamber containing a Y junction channel is normally built between the pits and the pan so that flushed excreta can be channeled into either pit (Fig28) the positioning or shape of the pits is determined to a large extent by the space available.

If possible, the distance between the pits should not be less than the depth of the pits. This is to reduce the possibility of liquid from the pit in use entering the pit not in use. If the pits have to be built adjacent to each other, the dividing wall should be non-porous. It can also be extended beyond the side-walls of the pit, to prevent cross-contamination. The pit lining can be constructed without holes for a distance of 300 mm either side of the dividing walls.

12.12 Special Occasions - Raised pit latrines

The technical solutions for latrines are limited in areas where there is a shallow water table, areas which are flood prone or are very rocky. If conditions are obviously unsuitable a strong case may need to be made to support the movement of people to a more suitable site. If there is no other option to these sites, alternative solutions will need to be found.

Classically the solution is to build raised latrines or to build pits sealed at bottom. To prevent contamination of the ground water, the bottom of the pit should be at least 1 m above the water level a large number of small capacity latrines, wide rather than deep, are preferable to a few large capacity latrines. Trenches can be dug to take off the liquid effluent in pipes as in soak away and dispersion trenches. Using the same concept mounds or platforms could be built whereby people can defecate over a pan with water seal.



constructed with earthen bund

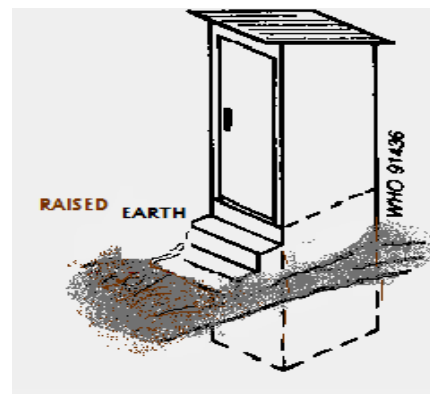


Figure 29, 30 Raised Pit latrines

12.11.1 Raised pit latrine design and Construction

The pit is excavated as deep as possible, but above the ground water table. The lining is extended above ground level until the desired pit volume is achieved. We can use pre fabricated concrete rings. The minimum below-ground depth depends on the amount of water used in the pit and the permeability of the soil.

Where insufficient infiltration area can be obtained below ground level, the raised portion of the pit can be surrounded by a mound of soil.



Figure 31 Raised Pit at Tharangampadi, Tsunami affected village, Tamil Nadu

The section of the lining above ground (excluding the top 0.5 m) can be used for infiltration provided the mound is made of permeable soil, well compacted with a stable side slope, and is thick enough to prevent filtrate seeping out of the sides (Fig. 30, 31). Earth mounds are not recommended on clay soils as the filtrate is likely to seep out at the base of the mound rather than infiltrate the ground.

Raised latrines, Built normally 1 –1.5m above ground level.

Raised pits can be used in combination with any other type of pit latrine (pour-flush, and double-pit). A common application is where the groundwater level is close to the surface. A slight raising of the pit may prevent splashing of the user or blockage of the pit inlet pipe by floating scum.

Instead of using raised pits, the pits can be built above the ground level and the portion below the ground level can be used for leaching by disallowing the leaching downwards. This can be achieved by sealing the bottom of the pit above the ground water level. Alternatively the sand cushion can be provided to prevent the pollution into the ground water.

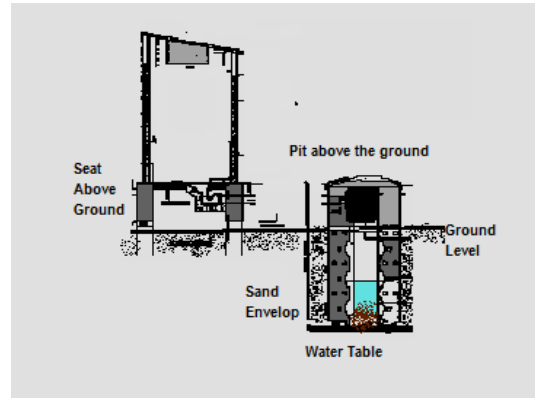
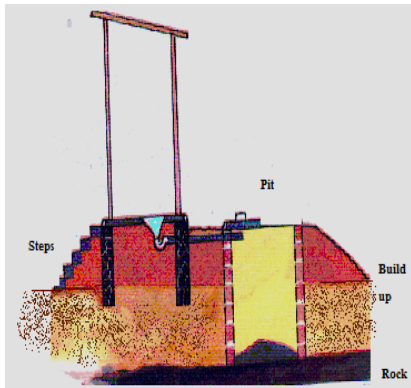


Figure 32, 33 A water Seal latrine Raised over the ground in a water logged area

12.12 Summary of possible solutions in high water table / flood prone areas

- Sealed pits / sealed pits with soak away /septic tanks – the pits may need dewatering before construction can go ahead. 1 m³ pre cast Ferro cement tanks could be manufactured fairly easily with the appropriate fittings for desludging.
- High raised and wide squatting platform and pit above the ground level with soak away pits with sand envelop.
- Low cost sewage system – if there is sufficient water available, pipes from 8" diameter to 3m diameter drainage type pipes, then people can defecate directly into dispersion trench
- Eco sanitation

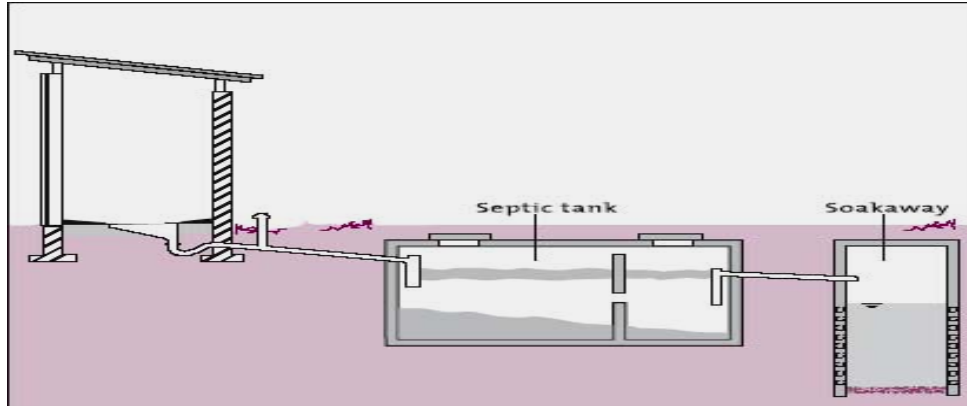
12.13 Special designs for special groups

Latrines built in feeding centers will be used not only by the children but also by their parents and care takers. It will therefore be necessary to build more latrines to accommodate the heavier demand. Ensure that there is enough space available to dig further latrines once the initial ones are full. Latrines will also need to be suitable for children.



Children friendly toilets, Girl friendly urinals

A septic tank is designed to collect and treat wastewater from toilet and other grey water if we allow. Its use is likely to be appropriate where the volume of wastewater produced is too large for disposal in pit latrines, and small water borne sewerage is uneconomic or unaffordable. This is usually some form of underground disposal system, sewer or secondary treatment facility. The treatment process in a septic tank occurs in four stages:



12.14 Septic Tanks

Septic tanks are commonly used in houses with more people and for institutions such as schools hospitals and for small communities. The septic tank, in conjunction with its effluent disposal system, offers many of the advantages of conventional sewerage. However, septic tank systems are more expensive than most other on-site sanitation systems and are unlikely to be affordable by the poorer people. Hence, it may be ideal for institutions, hostels and community halls.

Many problems with septic tank systems arise because inadequate consideration is given to the disposal of the effluent from the septic tank.

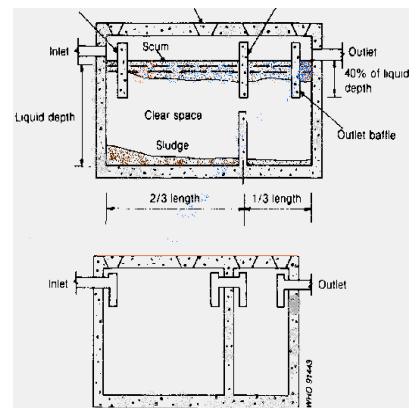
12.15 Operation and maintenance

The settled material forms a layer of sludge at the bottom of the tank which must be removed by desludging periodically. This mostly depends upon the retention time, the inlet and outlet arrangements and the frequency of desludging. Organic matter in the sludge and scum layers is broken down by anaerobic bacteria with a considerable amount of organic matter being converted into water and gases. Sludge at the bottom of the tank is consolidated owing to the weight of liquid and solids above.

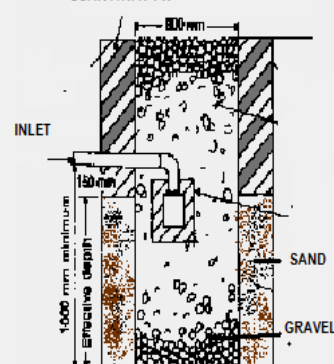
12.15.1 Stabilization of liquids

Figure 37, 38, 39 Septic tanks and a soak away pit without sand envelop

As per a study the liquid in the septic tank undergoes biochemical changes. It was found that although 80-90% of Hookworm and Ascaris eggs were removed by the septic tanks, in absolute terms very large numbers of viable eggs were still in the effluent, with 90% of effluent samples containing viable eggs. Since the effluent from septic tanks is anaerobic and likely to contain large numbers of pathogens which can be a potential source of infection,



SOAK AWAY PIT



it should not be used for crop irrigation nor should it be discharged into canals or surface-water drains and should be disposed through dispersion trenches or soak away pits.

12.16 Design principles

The guiding principles in designing a septic tank are:

- to provide sufficient retention time for the sewage in the tank to allow separation of solids and stabilization of liquid;
- to provide stable quiescent hydraulic conditions for efficient settlement and flotation of solids;
- to ensure that the tank is large enough to store accumulated sludge and scum;
- to ensure that no blockages are likely to occur and that there is adequate ventilation of gases.
- Provision for effluent disposal

A sewage retention time of 48 hours is assumed to be sufficient. In theory, improved settlement results from a longer retention time, although the maximum rate of settlement is usually achieved within the first few hours.

The minimum capacity required for 48 hours' liquid retention is:

- $A = P \times q$ liters, where
- A = required volume for 48 hours' liquid retention;
 P = number of people served by the tank;
 q = sewage flow per person (liters per person per day $\times 2$ for two days).
- Volume for sludge and scum storage
- $B = P \times N \times F \times S$

Where

- B = the required sludge and scum storage capacity in liters;
- N = the number of years between desludging (often 2-5 years; more frequent desludging may be assumed where there is a cheap and reliable emptying service);
- F = a factor which relates the sludge digestion rate to temperature and the desludging interval, as shown in Table 12;
- S = the rate of sludge and scum accumulation which may be taken as 25 liters per person per year for tanks receiving water closet waste only,

The total capacity of the tank (C) is:

- $C = A + B$ liters tank may be divided into two or more compartments by baffle walls.
- Most settlement and digestion may occur in the first compartment with some suspended materials carried forward to the second. The following guidelines can be used to determine the internal dimensions of a rectangular tank.
- The depth of liquid above the tank floor to the outlet pipe invert should not be less than 1.2 m; a depth of at least 1.5 m is preferable. In addition a clear space of at least 300 mm should be left between the water level and the under-surface of the cover slab.
- The width should be at least 600 mm as this is the minimum space in which a person can work when building or cleaning the tank. Some codes of practice recommend that the length should be 2 or 3 times the width.
- These guidelines give the minimum size of tank. There is no disadvantage in making a tank bigger than the minimum capacity. It may be cheaper to build larger tanks.

The tank can be raised above the ground level depending upon the water table. Accordingly, the squatting platform can be raised proportionately.

12.16.1 The tank floor

Some codes of practice recommend that the floor of a septic tank should slope downwards towards the inlet. There are two reasons: firstly, more sludge accumulates near the inlet, so a greater depth is desirable; secondly, the slope assists movement of sludge towards the inlet during desludging.

For a two-compartment tank, the second compartment should have a horizontal floor and the first compartment may slope at a gradient of 1 in 4 towards the inlet. When calculating the tank volume, it should be

assumed that the floor is horizontal at the higher level. The effect of sloping the floor provides extra volume.

12.17. Disposal of effluent from septic tanks and aqua-privies

A septic tank or aqua-privy is simply a combined retention tank and digester. Apart from losses through seepage and evaporation, the outflow from the tank equals the inflow. The effluent is anaerobic and may contain a large number of pathogenic organisms. Although the removal of suspended solids can be high in percentage terms, the effluent is still concentrated and it needs safe disposal.

Effluent from septic tanks and aqua-privies serving individual houses is normally discharged to soak pits or dispersion trenches for infiltration into the ground. Alternately, root zone filters (subsoil surface) may be provided to treat excess of faecal sludge and grey water coming from the households. This is good for long term measures and permanent houses.

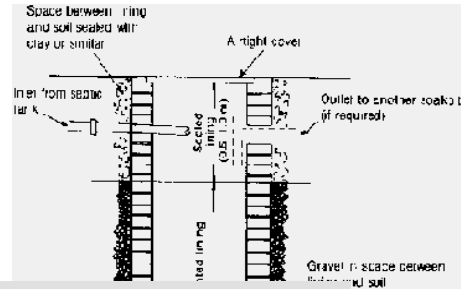
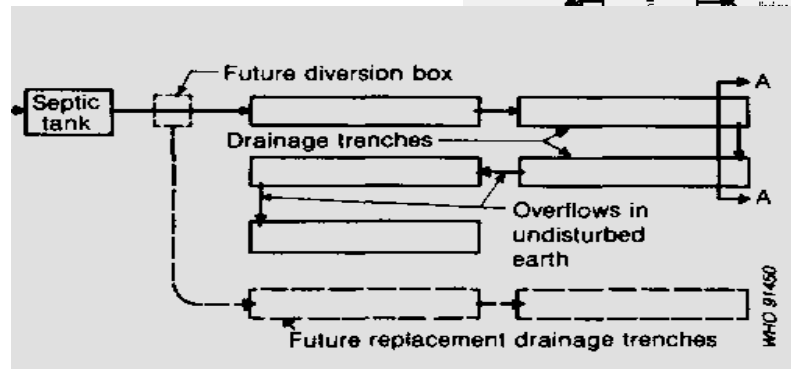


Figure 40, 41, 42 Soak away pits for the disposal of effluent



Pits used to dispose the effluent from septic tanks are commonly 1-2 m deep with a diameter of 1.0-2.5 m. **A rectangular or horizontal may be suitable in high water table areas. This can build in relation to the septic tank height and squatting platform height.** The capacity should be not less than that of the septic tank. Depending on the nature of the soil and the local cost of stone and other building material, soak pits may be lined. Linings are generally made of bricks, blocks or masonry with honeycomb construction or vertical open joints.

The infiltration capacity of the soil may be increased by filling any space behind the lining with sand or gravel. Whether the main part of the pit is lined or filled, the top 500 mm should have a ring of blocks, bricks or masonry with full mortar joints to provide a firm support for the cover. Covers are usually made of reinforced concrete and may be buried by 200-300 mm of soil.

Drainage fields consist of gravel-filled under ground trenches, called leach lines or dispersion/drainage trenches that allow the liquid effluent from a septic tank to infiltrate the ground. Open-jointed (stone ware) or perforated (PVC) pipes lead the liquid effluent into the drainage field. Initially, infiltration may be fast, but after several years the soil clogs and equilibrium saturation of infiltration rate is reached. If the sewage flow exceeds the equilibrium rate of the soil, sewage will eventually flow over the drainage field.

The drainage trenches are usually 0.3-0.5 m wide and 0.6-1.0 m deep (from top of the pipes). The trenches are laid with a 0.2-0.3% gradient of gravel (20-50 mm size), and a 0.3-0.5 m layer of soil on top. A barrier of straw or building paper prevents the soil from washing down due to rains.

The trenches should be laid in series so that as each trench fills, it overflows to the next one. This ensures that each trench is used either fully, or not at all. The trenches should be 1-2 m apart, or twice the trench depth if this is greater than 1 m. The bottom of a trench should be at least 0.5-1 m above groundwater, bedrock or impermeable soil, and the slope of the land should not exceed 10%. Drainage fields are often used

instead of soak away, where larger quantities of liquid effluent are produced.

12.18 Potential problems

- Overflowing leach lines, unpleasant odors, groundwater contamination and social conflict in drainage fields, odors, etc.);
- there is not enough water to use or maintain the system;
- there is not enough space or financial resources for construction;
- the permeability of the soil is poor;
- the bedrock or groundwater are close to the surface;

12.19 Eco sanitation

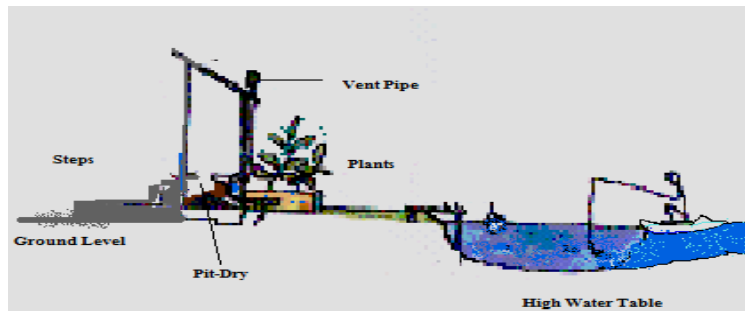
Figures 42, Eco sanitation in a water logged area (Paul Calvert)

The double-vault compost latrine consists of two vaults (watertight chambers) to collect the faeces. Urine is collected separately, because the contents of the chamber should be kept relatively dry. Initially, a layer of absorbent organic material is put in the chamber, and after each use the faeces are covered with ash (or sawdust, shredded leaves or vegetable matter) to reduce smells and soak up excessive moisture. The organic material also ensures that sufficient nitrogen is retained in the compost to make it good fertilizer. When the first chamber is three-quarters full, it is completely filled with dry, powdered earth and sealed, and the contents allowed decompose to anaerobically.



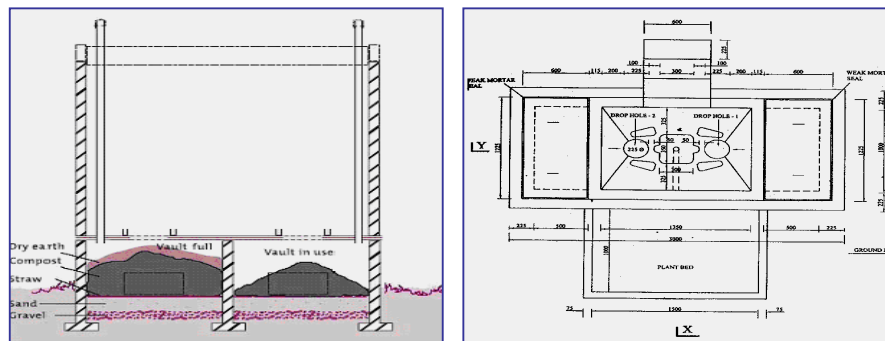
The second vault is then used and when it is three-quarters full, the first chamber can be emptied (even by hand) and the contents used as fertilizer. The chamber should be large enough to keep the faeces long enough for them to become pathogen-free (at least one year). A superstructure is built over both chambers, and each has a squat hole that can be sealed off. The latrine can be built anywhere, since the vaults are watertight and there is no risk of polluting the surroundings. Where there is rock or a high water-table, the chamber can be placed above ground. A ventilation pipe keeps the aerobic system active, which is essential for composting.

Paul Calvert- Eco Sanitation (Back Water Areas)



Figure

45.46 Plan for Double-vault compost latrine



12.20 Operation and Maintenance – Eco sanitation

Initially, some absorbent organic material is put into the empty vault (layer of ashes or lime) to ensure that liquids are absorbed and to prevent the faeces from sticking to the floor. After each use, or whenever available, wood ash and organic material are added. When urine is collected separately and used as a fertilizer. Water used for cleaning should not be allowed to go into the latrine as it will make the contents too wet.

When the chamber is three-quarters full, the chamber is filled to the top with dry loose soil, and the squat hole is sealed. The second chamber is then emptied with a spade and bucket, after which the chamber is ready for next use. The contents dug out of the second chamber can be safely used as fertilizer.

Potential users of an eco sanitation latrine technology should be consulted extensively, to find out if the system is *culturally acceptable*, and if they are motivated and capable of operating and maintaining the system properly. The project agency will need to provide sustained support to ensure that users understand the system and operate it properly.

Adequate Seats for any Toilets may be calculated by the number of Users and the standard

Table 12 Comparison of technological options of sanitary latrines in water logged areas				
Technological Options	Area of application	Cost	Ease of construction	Required soil conditions
Earth Stabilized Raised Pit Latrine	Flood-prone areas	Low to medium	Easy	Permeable soil
Step Latrine	Flood-prone areas	Low to medium	Requires Supervision	Do
Mound Latrine	Flood-prone areas	Low to medium	Easy	Do
Raised Squatting Sand Enveloped Latrine	High-water table areas	Low to medium	Easy	Do
Sand Enveloped Raised Latrine	Flood-prone and High-water table areas	Medium	Requires Supervision	do
Aqua privy	High water table areas	Medium -High	Requires supervision	Do
Septic Tank	do	High	do	Do & need dispersion trench
Eco Sanitation	Water logged Rocky areas	Moderate	Needs little supervision	No special requirement

11.21 Potential problems

- users do not understand how to operate the system properly and leave the latrine contents too wet, which makes the vault odorous and difficult to empty;
- users are too eager to use the latrine contents as fertilizer and do not allow sufficient time for the compost to become pathogen-free;
- the double-vault compost latrine can only be used where people are motivated to use human excreta as a fertilizer;

► Acceptable facilities:

- Successful excreta disposal programs are based on an understanding of peoples' varied needs as well as on the participation of the users.
- It may not be possible to make all toilets acceptable to all groups and special toilets may need to be constructed for children, older people and disabled people e.g. potties, or toilets with lower seats or hand rails.
- The type of toilet constructed should depend on the preferences and cultural habits of the

intended users, the existing infrastructure, the ready availability of water (for flushing and water seals), ground conditions and the availability of construction materials.

► **Safe facilities:**

- Inappropriate seating of toilets may make women and girls more vulnerable to attack, especially during the night, and ways must be found to ensure that women feel, and are, safe using the toilets provided.
- Where possible, communal toilets should be provided with lighting or families provided with torches.
- The input of the community should be sought with regard to ways of enhancing the use of toilets and the safety of users.

► **Anal cleaning:**

- Water should be provided for people who use it.
- Users should be consulted on the most culturally appropriate cleaning materials other than water and on their safe disposal.

► **Menstruation:**

- Women and girls who menstruate should have access to suitable materials for the absorption and disposal of menstrual blood.
- Women should be consulted on what is culturally appropriate.

► **Distance of defecation systems from water sources:**

- The distances given above may be increased for fissured rocks and limestone, or decreased for fine soils. In disasters, groundwater pollution may not be an immediate concern if the groundwater is not consumed.
- In flooded or high water table environments, it may be necessary to build elevated toilets or septic tanks to contain excreta and prevent it contaminating the environment.

► **Hand washing:**

- The importance of hand washing after defecation and before eating and preparing food, to prevent the spread of disease, cannot be over-estimated.
- Users should have the means to wash their hands after defecation with soap or an alternative (such as ash), and should be encouraged to do so.
- There should be a source of water near the toilet for this purpose.

► **Hygienic toilets:**

- If toilets are not kept clean they may become a focus for odour and also for disease transmission and people will prefer not to use them.
- This is encouraged by promotional activities, having toilets close to where people sleep and involving users in decisions about their design and construction, rules on proper operation, maintenance, monitoring and use.
- Flies and mosquitoes are discouraged by keeping the toilet clean, having a water seal, Eco san latrine design or simply by the correct use of a lid on a squat hole.



Figure 47, 48 Toilets –
Rural Pan which requires flushing water

13. DRAINAGE

13.1 Introduction

Wherever people are displaced and put in camps, their waste also accumulates. One such waste is waste water. Disposing of their waste is a growing nuisance for heavily populated areas. The discharge of untreated wastewater and excreta into the environment affects human health by several routes:

- by polluting drinking water;
- entry into the food chain, for example via fruits, vegetables or fish
- bathing, recreational and other contact with contaminated waters
- by providing breeding sites for flies and insects that spread diseases

People must have an environment in which the health and other risks posed by waste water and stagnant water, including storm water, floodwater, domestic wastewater and wastewater from medical facilities, are minimized.

- Areas around dwellings and water points are kept free of stagnant wastewater,
- Storm water drains are kept clear without obstruction,
- Shelters, paths and water and sanitation facilities are not flooded or eroded by water,
- Water point drainage is well planned, built and maintained
- Drainage from washing and bathing areas as well as water collection points are properly disposed off,
- Drainage waters do not pollute existing surface or groundwater sources or cause erosion,
- Sufficient number of appropriate tools are provided for small drainage works and maintenance.

The most effective way to control drainage problems is in the choice of site and the layout of the settlement – always in a raised area and by avoiding low lying areas

13.1.1. Wastewater:

- Domestic wastewater should not be allowed to mix with human waste.
- Sewage is difficult and more expensive to treat than domestic wastewater.
- At water points and washing and bathing areas, the creation of small gardens with flower plants, trees etc./soakage pits to utilize wastewater should be encouraged.
- Special attention needs to be paid to prevent wastewater from washing and bathing areas contaminating water sources.

13.1.2. Drainage and excreta disposal:

Special care is needed to protect toilets and sewers from flooding in order to avoid structural damage and leakage.

13.1.3. Promotion:

It is essential to involve the affected population in providing small-scale drainage works as they often have good knowledge of the natural flow of drainage water and of where channels should be.

13.2 On-site disposal

1. Wherever possible and if (as found in points 2) favorable soil conditions exist, drainage from water points and washing areas should be on-site rather than via open channels,
2. Simple and cheap techniques such as soak pits can be used for on-site disposal of wastewater.
3. Where off-site disposal is the only possibility, channels are preferable to pipes.
4. Channels should be designed both to provide flow velocity for dry-weather sillage and to carry

storm water.

5. Where the slope is more than 5%, engineering techniques must be applied to prevent excessive erosion.
6. Drainage of residuals and washings from any water treatment processes should be carefully controlled so that people cannot use such water and it does not contaminate surface or groundwater sources.

Figure 49 Stagnant water – Mosquitoes breeding – Simple soakage pit can prevent it.



Figure 50 Desilting, oiling, prevents mosquitoes breeding in the disaster affected areas



51 A Soak pit

1 meter depth and

1 meter square

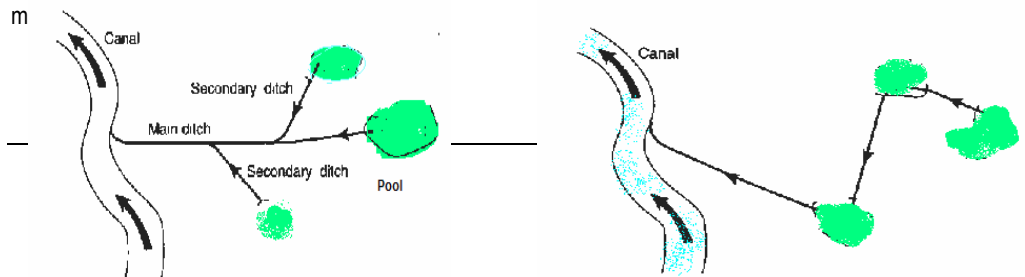
Pit – fill with bottom 1/3rd Tender coconut size stones, middle 1/3rd with coconut size stones or bricks and top 1/3rd with lime size pebbles/burned bricks. A silt trap (of size 1'x1'x1') may prevent clogging of soak pit. Periodically the silt can be removed from the silt trap. If the soakpit clogs, the pebbles may taken out and dried and put again as described above. This simple technology prevents mosquitoes breeding and stagnation of water near water points and houses.



13.3 Simple Drainages for camps

Open earth drains are the simplest to construct. They are used to prevent the accumulation of excess rainwater in depressions in the ground and to dry out marshy areas, borrow-pits, ground pools and other accumulations of surface water. *Layout* : The ditches carry the water away to an appropriate, lower-lying outlet, such as a river, creek, pond, soak away pit or main drainage ditch. They should follow the natural flow of water along the surface. To prevent erosion of the lining of the ditch they should be as straight and short as possible. Sharp bends should be avoided wherever possible and in case of its necessity, the turning is to be smooth curve.

A main ditch may have several lateral or secondary ditches to collect water that does not readily drain into the main ditch. However, the number of such lateral ditches should be kept to a minimum to reduce m



A drain may be roughly lined with flat stones and the spaces filled in with small stones and sealed with cement. Alternatively, a layer of concrete, 4 - 5 cm thick and reinforced with wire mesh may be used. Connecting pre-cast slabs are also commonly used. They are usually made of concrete in sections of 60 - 70 cm with a rounded bottom and a joint to facilitate laying them in a prepared ditch.

Figure 54 Lined with concrete and turf

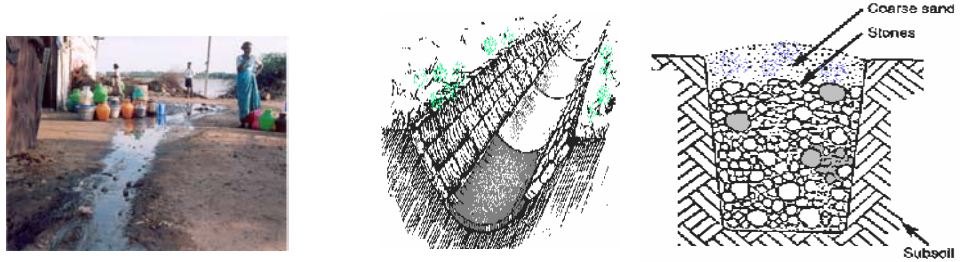


Figure 55 Cross-section of a simple subsoil drain:

Filled with a layer of stones covered with coarse sand Subsoil drainage is more expensive than open drainage and therefore of limited value in the control of mosquitoes.

14. VECTOR CONTROL

14.1 Introduction

A vector is a disease-carrying arthropods/insects/agent. Vector-borne diseases are a major cause of sickness and death in many disaster situations in tropical countries like India. Some of the vectors are:

- Mosquitoes are the vector responsible for malaria, dengue, filarial.
- Non-biting flies, such as the house fly, play an important role in the transmission of diarrhea disease.

14.1.1 Vector-borne diseases can be controlled by:

- appropriate site selection for temporary shelters
- appropriate water supply, i.e., no water stagnation in water points
- proper disposal of excreta – no mixing with open drains
- solid waste management and drainage
- use of chemical controls

14.2 Individual and family protection

- All disaster-affected people must have the knowledge and the means to protect themselves from disease and nuisance vectors that are likely to represent a significant risk to health.
- All populations at risk from vector-borne disease facilitated to understand the modes of transmission and possible methods of prevention
- All populations have access to shelters that do not harbour or encourage the growth of vector populations and are protected by appropriate vector control measures.

14.3 Environmental and chemical vector control includes:

- Minor engineering measures like soakage pits, kitchen garden
- Land filling of water stagnation points with soil, building debris
- Desilting and removal of obstructions in drains for free flow
- Proper disposal of excreta
- Chemical methods – larvicides

The term “source reduction” refers to any measure that prevents the breeding of mosquitoes or eliminates their breeding sites.

14.4 Environmental modification

- Removal or destruction of breeding sites
- Small containers, such as used cans, bottles, tyres and coconut husks that become breeding sites can be removed or destroyed. This method is commonly used to control the breeding of *Aedes aegypti* and prevent dengue.

14.4.1 Leveling and Filling

The filling of mosquito breeding sites with soil, stones, rubble, ash or rubbish is the most permanent control measure available. It is most suitable for reducing breeding in small depressions, water holes, borrow-pits, abandoned ditches or pools, which do not require much filling material. For larger landfills, tractors or other motorized equipment may be preferable. The filling material should be obtained without creating new breeding sites. Waste materials like building debris can be used for most filling.

14.5 Larvicides

Larvicides are applied to mosquito breeding sites to kill larvae. Larvicides may act as stomach poisons, which must be ingested by the larvae while feeding, or as contact poisons, which penetrate the body wall or the respiratory tract. Larvicides are used on breeding sites that cannot be drained or filled.

14.5.1 Petroleum oils

The application of oil to water surfaces in order to kill larvae was one of the earliest mosquito control methods. The larvae are killed in two ways when they rise to the surface to breathe: by suffocation and by poisoning with toxic vapour. Larvicidal oils are not effective against *Mansonia* mosquitoes because their larvae and pupae do not come to the surface but attached to water plants. Removal of plants is the solution.

The oil should be applied in a thin film completely covering the surface. Many different grades of oil may be suitable for mosquito control, depending on local conditions. At higher temperatures thicker oil is required, e.g. crude or fuel oil, while in the presence of vegetation lighter oil with greater spreading power, e.g. kerosene or diesel oil, is necessary. The oils kill larvae very quickly but last only between a few hours and some days.

14.5.2 Commercial oils

Specially prepared commercial oils have been developed which contain surface-active agents that increase spreading power and toxic action. These oils may be effective at 9 - 27 liters/ha. The addition of temephos may increase effectiveness. Properly used, the lighter oils are non-toxic to fish, birds and mammals.

14.5.3 Application

The oils can be applied simply by dripping from a can or bucket or pouring from a watering-can. For large-scale applications it is better to use hand-compression sprayers. Very large areas may be sprayed from the air. In situations where mosquitoes have developed resistance to all the conventional larvicides, consideration may be given to using larvicidal oils, the more expensive insect growth regulators, or bacterial larvicides as alternatives.

14.6 Habitats in and around houses

Mosquito breeding places in and around houses can be divided into two main types:

- Breeding sites with clean water: mainly rain-filled receptacles in humid tropical areas which are suitable breeding sites for some *Aedes* species.
- Breeding sites with polluted water: mainly in on-site sanitation systems and bodies of stagnant and polluted water favoured by *Culex* species.

Measures to prevent breeding in and around houses are usually simple and based on source reduction. They can be implemented by householders on their own premises without help from experts their advice.

14.6.1 Breeding sites with clean water

Most accumulations of clean water are only temporary. Rain fed containers around habitats favor *Aedes aegypti*, which can act as a vector of dengue. These species also breed in containers that are used to store water for drinking or washing. *Anopheles stephensi*, a vector of malaria in some urban areas in south Asia, often breeds in wells, ponds, cisterns and containers used for the storage of drinking-water.

14.6.2 Temporary breeding sites outdoors

- Breeding sites can be found outdoors in
 - rubbish,
 - discarded tyres,
 - discarded household and garden utensils,
 - construction materials,
 - roof gutters,
 - water storage containers,
 - Drinking-water tanks, plants and various other objects.

If villages are located near a beach or river bank, breeding also occurs in water in the bottom of boats.

14.7 Control measures

- Small pools should be filled up with soil, stones or sand and leveled.
- Deeper rain-filled pools can be filled with rubble and covered with a layer of soil
- Rubbish should be cleared and disposed of
- Communities may use refuse to fill borrow-pits, pools and other low-lying areas.
- Refuse should be covered regularly with a layer of soil to prevent flies, mosquitoes and rodents from breeding. The final cover of compacted earth should be at least 50 cm thick and should have a slope of 1 - 5 cm per 10 m for drainage of rain water.
- Such sanitary landfills eliminate mosquito breeding, permit refuse disposal and improve land values. Landfill areas have been used for house construction, children's playgrounds and so on, e.g., Valluarkottare in Chennai.
- Old tyres can be stored under a roof or cover to prevent the collection of rain water piercing a hole will also prevent the collection of water in the tyres.
- Tyres can also be filled with soil and used as plant pots. The application of larvicides or oil to accumulations of rainwater in tyres kills larvae.
- Buckets, bowls and watering cans should be stored in a dry place, or turned upside down.
- Gutters should be inspected periodically and dustrase cleared for easy flow of rain water.
- If necessary they should be cleaned or repaired with a suitable gradient (an inclination of about 1 cm over 10 m length) to avoid standing water.

15. HOUSE FLY

The common housefly lives in close association with people all over the world. The insects feed on human foodstuffs and wastes where they can pick up and transport various disease agents. The house flies act as vector and transmit several diseases by feeding freely on human food and filthy matter alike.

The fly picks up disease-causing organisms while crawling and feeding. Transmission takes place when the fly makes contact with other people or their food. Most of the diseases can also be contracted more directly through contaminated food, water, air, hands and person-to-person contact. This reduces the relative importance of flies as carriers of disease.

In coastal areas, Fish, Fly and Faecal combinations are the most dangerous conditions for the spread of diseases!

15.1 How to control Flies

14.1.1. Improvement of environmental sanitation and hygiene

Four strategies can be employed:

1. reduction or elimination of fly breeding sites;
2. reduction of sources that attract flies from other areas;
3. Prevention of contact between flies and disease-causing germs;
4. Protection of food, eating utensils and people from contact with flies.

15.1.2. Reduction or elimination of fly breeding sites

15.1.2.1 Dung heaps

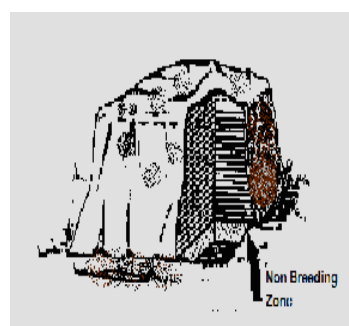
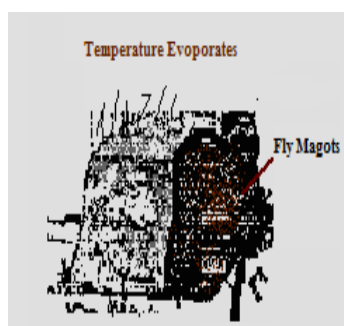
Dung should be stacked to reduce the surface area and the zone in which the temperature is suitable for fly breeding. It should be covered with plastic sheets. The sheet reduces heat loss and the surface layers become too hot for breeding other fly-proof material.

This prevents egg-laying and kills larvae and pupae as the heat produced in the composting process can no longer escape (Fig. 56-57). In hot climates, dung may be spread on the ground and dried before the flies have time to develop. Introduction of earth worms can make the organic waste into wealth. It can be put in pits along with other organic wastes and covered with soil to become good compost for using as manure.

15.1.2.2 Human excreta

Breeding in open pit latrines can be prevented by installation of slabs with a water seal and a fly screen over the vent pipe. If a water seal is not feasible, a tightly fitting wooden lid with long handle may be placed over the drop hole. Installing a ventilated pit latrine can also reduce fly breeding. Defecation in the field, other than in latrines and toilets, may provide breeding places for filth flies (*Musca sorbens*). This is a common problem where large groups of people, e.g., refugees, stay together in temporary camps. Installation of proper latrines should be given priority. Covering the faeces with a thin layer of soil may increase breeding since the faeces are then likely to dry out more slowly.

Figures 56,57 Covering garbage with thick polythene sheet waste prevents fly breeding,



15.2 Garbage and

other organic refuse

This breeding medium can be eliminated by

- proper collection,
- Proper storage,
- transportation and
- proper disposal

In the absence of a system for collection and transportation, garbage can be burnt or disposed of in a specially dug pit. At least once a week the garbage in the pit has to be covered with a fresh layer of soil to stop breeding by flies.

Flies are likely to breed in garbage containers even if they are tightly closed. In warm climates the larvae may leave the containers for pupation after only 3-4 days. In such places, garbage has to be collected at least twice a week. In temperate climates once a week is sufficient. When emptying a container it is important to remove any residue left at the bottom.

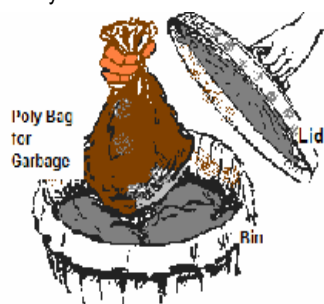


Figure. 58 Good garbage containers with tightly fitting lids may help to reduce fly breeding in towns.

In most places, garbage is transported to refuse dumps, where, to reduce breeding, it is necessary to compact the refuse and cover it daily with a thick layer of soil (15-30 cm). Such dumps should be away from residential areas.

14.2.1 Special attention

- Accumulations of sludge and solid organic waste in open drains, cesspools and seepage pits have to be removed.
- Special precautions should be taken in abattoirs and places where fish is handled and sold. If

- possible, concrete floors should be installed with drains to facilitate cleaning.
- Flies are attracted by the odour emanating from breeding sites. In addition they are attracted by products such as fish-meal and bone-meal, molasses and malt from breweries, milk, and sweet-smelling fruit, like jack & mangoes.

Box 14.1

Prevention of contact between flies and disease-causing germs

The sources of germs include human and animal excrement, garbage, sewage, infected eyes, and open sores and wounds. Measures to eliminate fly breeding also reduce contact between flies and germs. The most important are:

- the installation and use of proper latrines where flies cannot make contact with faeces;
- the prevention of contact between flies and sick people, their excreta, soiled baby nappies, open sores, and infected eyes;
- the prevention of access of flies to slaughter sites and dead animals.

15.3 Methods of killing flies directly

The methods that can be used to kill flies directly can be classified as physical or chemical.

15.3.1 Chemical methods

Control with insecticides should be undertaken only for a short period when absolutely necessary because flies develop resistance very rapidly. The application of effective insecticides can temporarily lead to very quick control, which is essential during outbreaks of cholera, dysentery or trachoma.

15.3.2 Introduction of toxic materials to resting sites

The idea of providing toxic resting sites for flies is based on the observation that houseflies prefer to rest at night on edges, strings, wires, ceilings and so on. Materials that can be impregnated with insecticide include bed nets, curtains, cotton cords, cloth or gauze bands and strong paper strips. The strips can be effective for many weeks in both tropical and temperate areas. This method is cheap, has a long residual effect and is less likely to provoke insecticide resistance than are residual sprays.

15.3.3 Attraction of flies with toxic baits

Traditional toxic baits made use of sugar and water or other fly-attracting liquids containing strong poisons such as sodium arsenite. Milk or sweet liquids with 1-2% formaldehyde can still be recommended for killing flies. Improvements became possible with the development of organophosphorus and carbamate compounds that are highly toxic to flies but relatively safe to humans and other mammals.

16. SOLID WASTE MANAGEMENT

16.1. Introduction

People have an environment that is acceptably uncontaminated by solid waste, including medical waste, and have the means to dispose of their domestic waste conveniently and effectively.

Box 15.1

People from the affected population are involved in the design and implementation of the solid waste program. Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit. All households have access to a refuse container and/or are no more than 100 meters from a communal refuse pit. At least one 100-litre refuse container with proper cover to prevent flies is available per 10 families, where domestic refuse is not buried on-site.

If organic solid waste is not disposed of, major risks are incurred of fly and rat breeding and surface water pollution. Uncollected and accumulating solid waste and the debris left after a natural disaster also create a depressing and ugly environment, discouraging efforts to improve other aspects of environmental health. Solid waste often blocks drainage channels and leads to environmental health problems associated with stagnant and polluted surface water.

Local volunteers must see that

- Refuse is removed from the settlement before it becomes a nuisance or a health risk
- Medical wastes are separated and disposed of separately
- There are no contaminated or dangerous medical wastes (needles, glass, dressings, drugs, etc. at any time in living areas or public places
- There are clearly marked and appropriately fenced refuse pits, bins or specified areas at public places,

- such as markets and slaughtering areas, with a regular collection system in place
- Final disposal of solid waste is carried out in such a place and in such a way as to avoid creating health and environmental problems for the local and affected populations

16.2 Collection

16.2.1. At Household level

The number and size of refuse containers needed varies greatly from situation to situation, and can only be determined in practice through an assessment. As a rule of thumb, one container of capacity 100 - 200 liters, preferably plastic or metal and with a tight-fitting lid, should be provided for every 10 - 20 families, placed not more than 15 meters from the shelter.

16.2.2. At Market/shopping area/vendors

In markets and commercial areas, large containers or collection bays may be needed. To control flies and rats, a committee should be established to manage cleaning of the market area and management of the refuse collection site. Certain wastes, such as waste from fish and animal slaughtering, may need special containers to deal with the large quantities of liquids produced. Before starting the collection service, it is necessary to determine:

- quantity of solid waste to be collected;
- how much waste will be generated;
- frequency of the collection service;
- quantity and size of collector trucks the number of workers required;
- Final disposal method and the disposal site.

For every 1000 residents, 2 workers may be needed. Their tasks include:

- cleaning streets and open spaces;
- collecting waste containers; cleaning facilities, markets, and the like;
- Transferring waste to the treatment or final disposal site.

Handcarts can also be used in large, densely-populated settlements.

16.3 Disposal

16.3.1 Burial of waste

- If waste is to be buried on-site in either household or communal pits, it should be covered at least weekly with a thin layer of soil 20-30 cm thick to prevent it attracting vectors such as flies.
- Disposal sites should be fenced off to prevent accidents and access by rag pickers children and animals.
- Recycling of solid waste within the community should be encouraged, provided it presents no significant health risk.
- Distribution of commodities that produce a large amount of solid waste from packaging or processing on-site should be avoided, for example – plastic bags.
- In low-density settlements where relatively small quantities of refuse are produced, small refuse pits may be dug by each family.

A trench 1.5 meters wide and 2 meters deep can be excavated for the refuse. Each day, refuse should be covered with about 20 cm of earth. When the level in the trench is 40 centimeters below ground level, the trench should be filled with earth and compacted and a new trench dug.

A 1-metre long trench for every 200 camp residents will be filled in about a week. If time and available labour permit, refuse should be separated into material that is biodegradable (vegetable matter), which should be dumped in one trench, and other material (bottles, can, plastic, etc.), which should be dumped in another.

Bottles and cans may be cleaned and recycled, but care should be taken to segregate all containers used for dangerous chemicals, such as pesticides. Containers that have contained pesticides should be crushed so that they cannot be reused. They should be buried far from any water source. The trench for biodegradable refuse can be dug out after 6 months and used as compost.

16.3.2 Sanitary land fill

In most cases, the use of sanitary landfills will be the best option for final disposal. When existing landfills are inoperative or inaccessible, the construction of new landfills will be necessary. The landfill site should be:

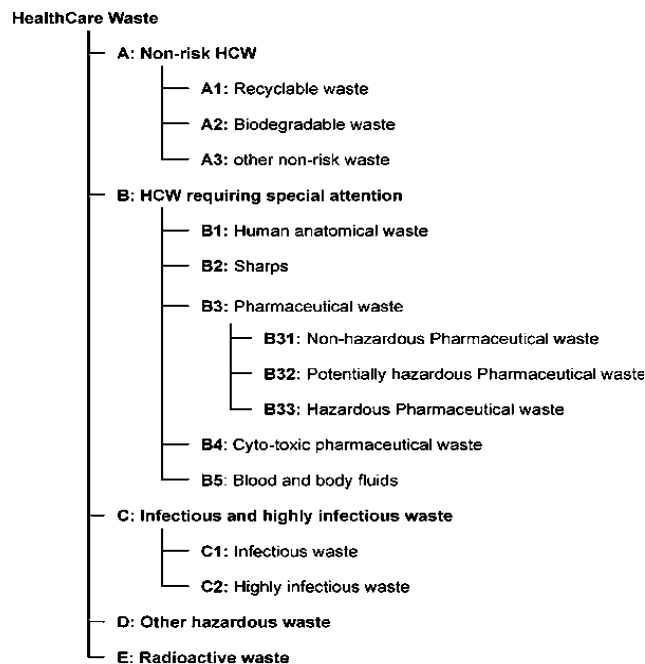
- located away from the settlement;
- accessible;
- on vacant/uncultivated land;
- located in natural depressions with slight slopes;
- downwind from the settlement;
- sited and organized to avoid surface water and groundwater pollution

16.3.3. Incineration

Incineration is a third possibility, but it is not usually suitable for the clothes used by ladies for menstruation sanitary napkins. Incinerators should be located away from the settlement, on the opposite side from the direction of the prevailing wind. They should be built on an impervious base of concrete or hardened earth. Ash and any unburned refuse should be buried and covered with 40 centimeters of soil.

16.4 Health Care Waste

During the post-disaster phase, a lot of health care waste is generated while providing rescue, relief and rehabilitation. In addition, medical relief activities also generate health care waste. Hence it is required to manage the health care waste properly to prevent further untoward incidences. The main categories of waste of concern are:



Each type of waste requires specific measures for

- handling
- storage
- collection
- Transportation
- disposal

Wastes should be segregated at the point of generation according to their type:

- bio contaminated wastes (including sharp materials);
- chemical wastes (drugs, chemical solutions, etc.);
- common wastes (paper, cardboard, glass, or the like; chemical product containers should be treated as chemical wastes).

Examples:

Step	Action
Segregation	Highly infectious waste should be: <ul style="list-style-type: none"> • kept in the medical area until it is pre-treated; • segregated from other general and medical waste; • placed immediately into leak-proof bags or containers.
Pre-treatment	Highly infectious waste should be immediately pre-treated (i.e. autoclaved or chemically treated) before joining the other medical waste.
Packaging	Yellow bags should be labelled with the biohazard symbol and clearly marked with the words "highly infectious waste" with a comment on whether it has been pre-treated or not.
Labelling	Yellow bags should be labelled with the name of the institution and department, type of waste, date, name and signature of person sealing the bag/container.
Storage, transport and treatment	Disinfected highly infectious waste packaged in yellow bags is no longer regarded as highly infectious and can therefore leave the medical area with other yellow-bagged waste, stored, transported and disposed of

- Medical waste includes needles, scalpels, laboratory samples, disposal materials stained with body fluids, and body tissue. This waste requires special care in handling, since needles and scalpels can cut handlers and transmit diseases such as HIV/AIDS, hepatitis B and C and viral haemorrhagic fevers.
- Medical waste should be burnt in an incinerator, preferably as close as possible to the source, e.g., within the clinic or hospital grounds, but also towards downwind of the hospital buildings and dwellings.
- Prior to final disposal, all wastes must be stored safely and transported to respective disposal sites. It is important that different types of waste are stored separately in order to prevent contamination of clean waste by infectious or pathological wastes, and allow easy transportation.
- No untreated bio-medical waste shall be kept stored beyond a period of 48 hours. If for some reason it becomes necessary to store the waste beyond such period, the authorized person must take permission of the prescribed authority and take measures to ensure that the waste does not adversely affect health and environment

16.4.1 Collection and segregation

For each hospital/health centers in the post disaster situation, washable and easily disinfected PVC containers with a capacity of 40 - 50 litres should be used. Waste should be disposed of in coloured bags according to the following codification:

- red bags for bio contaminated wastes
- yellow bags for chemical wastes
- black bags for common wastes.
- Hermetic plastic containers of 2 - 5 litre capacity or opaque glass bottles may be used to store sharp objects.

These wastes should then be collected separately every 12 - 24 hours. Small carts, preferably with lids, should be adapted to this end and the personnel assigned should be protected with aprons, masks, boots and gloves.

16.4.2 Steps in HCW disposal

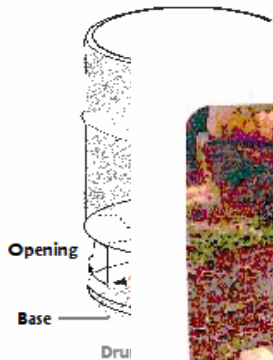
Treatment should be done according to the type of waste. Sharp materials should be disinfected with a 0.5% total chlorine solution before incineration or burial in a sharps pit. Bio contaminated wastes should be incinerated.

Burned bio contaminated wastes, disinfected sharp materials, and chemical wastes should be

disposed of by burial on-site if possible. The burial area should be isolated and protected to avoid illegal recycling. Common wastes may be managed by the municipal waste-collection service, as long as they do not contain hazardous material.

A temporary incinerator for medical waste can be made from an old 200-litre oil drum. However, this is unlikely to perform adequately, and although it may help reduce the volume of waste to be buried, it will produce a lot of black smoke and may only partially reduce the risk posed by the waste.

In temporary situations, a 200-litre drum can be used as an incinerator, divided in half by a metal grate and with an access hole at the bottom to provide air for combustion and easy way of removing ash.



_____ ↑

An empty drum with 0.5mtx0.5mt height opened at both at top and bottom with a front door

We can put iron rods as grill as shown in the figure



Another drum of same size opening both top and bottom is placed over the bottom drum Same procedure can be adopted in masonry work also



Place a conical shaped drum having opening at the top for vent pipe & a opening of same size as other drums is placed over the second drum
Same way we can construct a masonry one

Put a AC Vent pipe over the upper hole in the conical drum a cowl at the top of the AC pipe



Incinerator is ready
Place used sanitary napkins in the middle chamber &
Sprinkle few drops of kerosine and light it with match
close the door and open the door of the bottom chamber



**Smoke from the Vent pipe
Which is 4 meter above
the ground level**

**Harmless ash
It can be removed
& buried**



**masonry Incenerator
disposal of Sanitary Napkins
constructed at Nagapattinam
Temporary shelters
near the women toilets**

Incinerators for the disposal of Sanitary Napkins - closer to the community

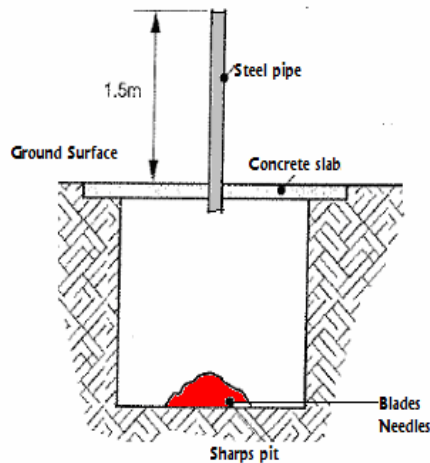


If incineration is not an option, an alternative is to put bandages or other waste into a strong disinfectant. If health care wastes are buried, they should be disposed of in a pit that restricts the access of people and animals. The pit should be built in the medical facility compound and should be surrounded by a fence; each layer of waste should be immediately covered with a layer of dirt. The pit should also be properly lined to prevent contamination of groundwater.

16.4.3 Management of syringes and needles

Great care should be taken with sharp materials such as broken glass, scalpel and old syringes. They should be placed within old metal container so that they are sealed before burial.

A sharp pit can be lined or unlined pit in the ground with a sealed cover. The cover is normally constructed from reinforced concrete and has a small hole left in the middle. A tube or pipe rises vertically from the hole. This can be made from steel, asbestos or PVC pipe and should be approximately 200mm in diameter. This is designed to prevent anyone from reaching inside the pit. Sharp containers can be dropped down the tube into the pit below



Sharps represent one of the most problematic and hazardous types of waste generated within health center. Syringes and needles are of particular concern because they constitute an important part of the sharps and are very often contaminated with blood. The occupational risks are linked to:

- The great quantities that are manipulated daily by health-workers
- The cuts and punctures they may cause followed by a potential infection of the wounds.
- Exposing the populations (and most particularly

children) to risks of cross contamination.

All biomedical waste with sharps or pointed parts has a high potential to injure and inoculate potentially dangerous pathogens.

- All disposable syringes and needles should be discarded immediately following use. The needle should never be recapped since most of the accidents occur when the nurses attempt to recap the needles;
- Under no circumstances are syringes or needles (or the full containers) to be disposed of with normal garbage or dumped randomly without prior treatment;
- Sharps should be placed in specific cardboard, plastic, high-density polyethylene or metallic containers resistant to punctures and leak-proof, designed so that items can be dropped in using one hand, and no item can be removed.

The container should be:

- o labeled with the international biohazard symbol;
- o be of a yellow colour (the international colour coding system for infectious waste strongly recommended by the UN Agencies), and
- o marked «**Danger! contaminated sharps, do not open**»;

16.4.4 Chemical disinfection, used routinely to kill microorganisms on medical equipment has been extended to the treatment of HCW. Chemicals (mostly strong oxidants like chlorine compounds, ammonium salts, aldehydes, and phenolic compounds) are added to the waste to kill or deactivate pathogens.

The treatment is most suitable for liquid wastes, such as blood, urine, stools or hospital sewage. Thermal sterilization should nevertheless be given preference over chemical disinfection for efficiency and environmental considerations.

16.4.5 Land disposal of untreated HCW isn't recommended and should only be used as a last resort.

Alternatively, a specially constructed *burial pit* can be used. Ideally it should be lined with a material of low permeability such as clay to prevent pollution of shallow groundwater and have a fence around it to prevent scavengers accessing the waste. HCW should be covered immediately with a layer of soil after each load. Once the pit is filled, it should be sealed off.

16.4.6 Table showing the Waste disposal methods

Colour Coding	Type of Container –I Waste Category	Treatment options as per Schedule I
Yellow	Plastic bag Cat. 1, Cat. 2, and Cat. 3, Cat. 6.	Incineration/deep burial
Red	Disinfected container/plastic bag Cat. 3, Cat. 6, Cat.7.	Autoclaving/Microwaving/ Chemical Treatment
Blue/White translucent	Plastic bag/puncture proof Cat. 4, Cat. 7. Container	Autoclaving/Microwaving/ Chemical Treatment and destruction/shredding
Black	Plastic bag Cat. 5 and Cat. 9 and Cat. 10. (solid)	Disposal in secured landfill

Schedule I: Categories of bio-medical waste (see rule 5)

Waste Category No.	Waste Category Type	Treatment and Disposal Option +
Category No. 1	Human Anatomical Waste(human tissues, organs, body parts)	incineration@/deep burial*
Category No. 2	Animal Waste (animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals/colleges, discharge from hospitals, animal houses)	incineration@/deep burial*
Category No. 3	Microbiology & Biotechnology Waste (waste from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	local autoclaving/micro-waving/incineration@
Category No. 4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	disinfection (chemical treatment@/autoclaving/microwaving and mutilation/shredding
Category No. 5	Discarded Medicines and Cytotoxic drugs (waste comprising of outdated, contaminated and discarded medicines)	incineration@/destruction and drug disposal in secured landfill
Category No. 6	Soiled Waste (Items contaminated with blood, and body fluids including cotton, dressings, solid plaster casts, linen, beddings, other materials contaminated with blood)	incineration/ autoclaving / microwaving
Category No. 7	Solid Waste (waste generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets etc).	disinfection by chemical treatment@@@ autoclaving/microwaving and mutilation/shredding
Category No. 8	Liquid Waste (waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities)	disinfection by chemical treatment@@@ and discharge into drains.
Category No. 9	Incineration Ash (ash from incineration of any Bio-medical	disposal in municipal landfill

17 FOOD SAFETIES

17.1 Introduction

Next to water, food is an essential item to be given to the displaced population. Food may become difficult to obtain or to keep food safe following a disaster for reasons mentioned below:

- Crops may be destroyed in the fields
- Animals may be drowned
- Food supply lines may become disrupted due to flood, (example, during floods and hurricanes, food may become contaminated by surface water that has itself been contaminated by sewage and wastewaters. Flood waters often pick up large quantities of wastes and pathogenic bacteria from farms, sewer systems, latrines and septic tanks)
- Breakdown in power supply affects cold storage
- People may be forced to flee to areas where they have no access to food.
- Lack of safe drinking-water and sanitation hampers the hygienic preparation of food and increases the risk of food contamination.
- Populations of pests and stray animals, such as dogs and cats, may also increase in the aftermath of disasters.
- Flies and other rapidly-breeding insects may increase dramatically in numbers.
- Faced with severe shortages, people may consume food that is unfit or not intended for human consumption.
- Food is especially susceptible to contamination when it is stored and prepared out of doors or in damaged homes where windows and possibly even walls are no longer intact.
- The crowding of survivors after disasters may aggravate the situation, particularly if sanitary conditions are poor.
- Explosions may result in foodstuffs becoming contaminated with dangerous chemicals or microorganisms
- Accidental release or improper use of insecticides, aerosols, rodenticides and other toxic substances.

Moreover, the safety of whatever food there is may be affected, resulting in a greater risk of epidemics of food borne disease. Food safety problems vary in nature, severity and extent, and depend on the situation during the emergency or disaster.

Disaster-affected people eating food from centralized kitchens that are not properly equipped or run are extremely vulnerable to outbreaks of foodborne disease. The combination of environmental contamination and improper handling of food increases the risk of epidemics.

In emergencies and disasters, food safety includes the safety of food starting from

- food supply
- production
- processing and manufacturing
- transport
- storage
- distribution and sale
- food service and catering establishments and households.

It is essential to assess in what way the food supply may have been adversely affected, and to identify the priority measures needed to protect consumers. For example, suitable locations for mass feeding, such as school kitchens, as well as equipment, supplies and training facilities, should be identified as part of emergency preparedness.

17.2 Food control measures

Following a disaster, an assessment should be made of its effects on the quality and safety of food. For example, in warehouses that have been flooded, high humidity favours the growth of moulds and bacteria in foodstuffs. Intact foods should be moved to a dry place, away from the walls and off the floor. Public health and

food safety authorities may be asked to examine food and its fitness for human and/or animal consumption and, whether food can be salvaged or not.

Salvageable foods are those that have been damaged, but that can be rendered safe through reprocessing.

Unsalvageable foods are those that are irretrievably damaged by microbiological, chemical or physical contaminants, or that have been exposed to conditions making such contamination likely; they should be destroyed.

Tons and tons of dry fishes were removed and buried in Nagapattinam after Tsunami to prevent fly breeding and growth of moulds. The extent and type of damage to food should be assessed, and a decision made regarding the separation and reconditioning of salvageable food.

Markets usually recover or develop quickly in emergencies and provide a valuable means of access to food for the disaster-affected population. However, markets should be regularly inspected and the cooperation of stallholders should be sought to ensure that safe food preparation and handling is carried out.

17.3 Golden rules for safe food preparation

1. **Cook raw foods thoroughly.** Thorough cooking will kill the pathogens, which means the temperature of all parts of the food must reach at least 70°C. Uncooked fruits or vegetables should not be eaten, unless they can be peeled. If milk has not been pasteurized, it should be boiled before use.
2. **Eat cooked food immediately.** When cooked foods cool to safe room temperature, bacteria begin to grow. The longer the wait, the greater the risk.
3. **Prepare food for only one meal.** Foods should be prepared freshly and for one meal only, as far as possible. Thorough reheating of foods is essential if refrigerators have ceased to operate due to power cuts.
4. **Avoid contact between raw foods and cooked foods.** Safely cooked food can become contaminated through even the slightest contact with raw food. This cross-contamination can be direct, e.g., when raw fish comes into contact with cooked foods. It can also be indirect.
5. **Choose foods processed for safety.** Many foods, such as fruits and vegetables, are best in their natural state. However, in disasters and emergencies, they may not be safe and should be peeled before consumption if eaten raw. Dry rations may be easier to keep safe, as they do not need cold-storage, but they do need to be kept dry.
6. **Wash hands repeatedly.** Hands should be washed thoroughly before preparing, serving or eating food and after every interruption, especially after use of the toilet or latrine, changing napkins of a baby or touching animals.
7. **Keep all food preparation premises meticulously clean.** Since foods are so easily contaminated, any surface used for food preparation must be kept absolutely clean. Scraps of food and crumbs are potential reservoirs of germs and can attract insects and animals. The immediate surrounding of the temporary shelter, especially the kitchen and food storage areas should be cleaned and sullage and solid kitchen waste should be disposed of properly. Food should be stored in closed containers to protect it from insects, rodents and other animals. Fly and rat traps should be used if necessary.
8. **Use safe water.** Safe water is just as important for food preparation as for drinking. If the supply of safe/potable water has been disrupted, the water intended for drinking or food preparation should be boiled.
9. **Be cautious with foods purchased outside.** Sometimes food served in restaurants and by street food-vendors is not prepared under hygienic conditions. In times of disasters or emergencies, the chances that such foods are contaminated is greater.
10. **Breast-feed infants and young children.** Breast milk is the ideal source of nourishment for infants during their first months of life. It protects infants against diarrhoea through its anti-infective properties, and minimizes their exposure to foodborne pathogens. In times of epidemics and disaster situations, when foods may be contaminated or scarce, breast milk will ensure a safe and nutritionally adequate food for infants from birth up to the age of 4 - 6 months.

17.4. Mass-feeding centers

Mass feeding centers are very common in Indian situations. A general feeding program, based on the distribution of cooked food, may be necessary for a short initial period in situations where people do not have the necessary resources to prepare their own meals hygienically, or in some conflict situations where they risk having dry rations taken away from them. However, mass preparation of cooked food has a number of disadvantages, including the risk of food-borne disease.

As soon as conditions allow, general feeding programs should be based on the distribution of dry rations. In some cases, as an alternative to mass feeding, it may be possible to help households by providing dry rations that do not need cooking or by setting up temporary shared neighbourhood kitchens where people can prepare food for their own families or in groups.

17.5 Checklist for mass feeding centers

It is of the utmost importance that employees and volunteers who are preparing foods should not be suffering from an illness with any of the following symptoms: jaundice, diarrhoea, vomiting, fever, sore throat (with fever), visibly infected skin lesions (boils, cuts, etc.), or discharge from the ears, eyes or nose.

- All personnel should therefore be made aware of their responsibilities and of the importance of observing the rules for safe food handling. Posters aimed at reminding staff about the rules of safe food handling may be helpful, and should be placed at strategic places in the food preparation area. Illustrations will be particularly useful if food-handlers are illiterate. The local health committee has an important role in facilitating safe community feeding activities.

Where centralized catering is required, one kitchen should be set up for every 200 - 300 families (1000 - 1500 people), with a supervisor appointed to ensure food safety in all centers. Kitchens and eating areas should be sturdy, well-roofed and well-ventilated structures, in areas of the settlement with good access and space for users to wait for meals.

17.6 Public education and information

While education of the public in food safety is important at all times, in disasters and emergencies it becomes vital. In such circumstances, the possible contamination of raw foodstuffs, the pollution of the environment, and the disruption of basic health services increase both the risks of epidemics of foodborne diseases and the severity of their health consequences. It is then necessary to intensify health education activities and extend the channels for communication with the public. The WHO golden rules for safe food preparation, adapted to emergencies and disasters can provide a basis for public education on food safety.

17.7 Safe and hygienic warehouse management

- Storage structures should have good roofs and ventilation.
- Bags must not lie directly on the floor - pallets, boards, heavy branches, bricks, or clean, dry plastic bags or sheets should be placed underneath them.
- Products should be kept at least 40 centimetres from walls and 10 centimetres from the floor.
- Damaged bags should be rebagged and stored apart from undamaged ones.
- A reserve of good-quality empty bags should be kept for this purpose.
- Spilled food should be swept up and disposed of promptly to discourage rats.
- Bags should be piled two-by-two cross-wise to permit ventilation. Spills of cooking oil in the warehouse should be immediately cleaned up to prevent workers slipping and injuring themselves.
- Fuel, pesticides, chlorine and other chemical stocks should never be stored in the same place as food.

18. MONITORING & EVALUATION

18.1 Introduction

The process of monitoring and evaluation should be started as soon as implementation of the environmental sanitation program begins. Monitoring and evaluation are processes used to assess whether interventions are going as per plan, and are useful in:

- assisting in the planning process;
- identify whether any readjustment to a program is required;
- determine the progress of a program; and
- Provide a measure of overall success or failure.

Monitoring and evaluation are two tools to support and improve program performance. They can also provide useful information for reports and allow staff and organizations to learn from mistakes. Monitoring provides action and solutions to the following questions:

- Have the various activities been undertaken as specified in the program design?
- Are inputs reaching the affected population in good time?
- Are the facilities being used and maintained?
- Are hygiene promotion activities encouraging the affected?
- Has the population to participate in program activities and to use the facilities been provided with the requisite material and information ?
- Are there any unexpected problems occurring?

18.2 Monitoring methods

Concurrent Monitoring should be an on -going process which starts in the immediate phase of an emergency and continues indefinitely. It facilitates to change the program as per changing situations.

The public health promotion team along with the sanitation team may use Participatory Appraisal tools to collect this information by observing behaviour and talking to members of affected community individually or in informal groups.

Participatory map drawn by the community showing

- **water source, distribution,**
- **areas of open defecation,**
- **latrines for women, men and children**
- **maintenance problems**
- **waster water disposal system**
- **solid waste disposal system**

A model format

	Areas of Concern	Key Information		Areas of Concern	Key Information
1	Location		2	Name of the block	
3	Name of the Sanitary Worker (Govt)		4	Name of the Sanitary Worker NGO	
5	Population		6	Houses	
7	Number of Latrines		7.1	Condition of the toilets	
8	Additional toilets required		8.1	Problems faced Design, O&M	
9	Water supply		9.1	Source	
10	Chlorination		10.1	End-Point Chlorination	

Items can be added as per the occasion and situation.

In this way, community members are also able to observe the past, present and if any improvements have to be made. Maps should be developed by both men and women and children may also have fun producing maps or placing signs. The responses from such surveys should be discussed between the sanitation team and the community to ensure there is a joint approach for using this monitoring data to improve the effectiveness of the facilities.

18.2.1 Monitoring framework

18.2.2 Force Field analysis (SWOT) analysis

Force Field

Favorable factors - facilitates to achieve the goal – positive factors

Forces - pulls back to original status or that pulls down –negative factors

Focus of what we want to achieve – the goal, the objective

Present condition/status

SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis is a simple monitoring exercise that can be conducted through brainstorming by all key stakeholders and visiting the facilities under the following headings:

Strengths:

Those things that have worked – volunteers from the community

Weaknesses:

Those things that have not worked so well or could be improved – for example, lack of skills to do chlorination or minor repair and plumbing

Opportunities:

Conditions which are favorable and can be taken advantage of by the program – ex service men, NGOs

Threats:

Threats which reduce the range of opportunities for improvement

Hygiene behaviour, stress

This community may be facilitated to analyse the situation at monthly intervals and with different focus groups such as men, women, children, disabled people, the elderly and the government agencies including NGOs. At village level, it is possible to collect, and have monitoring on:

a. Human Resource

- Availability of trained staff
- Does this include skilled staff from within the affected community?
- How are staff selected and trained? Is training on-going?
- Are staff supervised and appraised?
- Are staffs working effectively and efficiently?
- Are there any personnel problems or conflicts?

b. Materials

- Are appropriate resources procured and used as planned?
- Are logistical procedures clear and efficient?
- Is there regular feedback from the field about the materials?
- Is there a need for any additional resources?
- Are local materials used where possible?
- Are there any detrimental environmental effects?

c. Money-Finance

- Has the budget been kept to so far, and if not why not?
- How does expenditure compare with each budget line forecast?
- Is there regular feedback from the finance department?
- Are there any significant unforeseen costs or savings?

d. Time bound Activities

- Are activities being implemented according to schedule, if not, why?
- Is time managed efficiently?
- Are there any unforeseen time constraints?
- Are the targets for facilities and hygiene promotion being met, if not, why not?

e. Impact

- Has the overall health of the population improved?
- Are benefits spread equally among the affected population, is anyone excluded?
- Are the outputs sustainable?
- Are there any relevant needs which have not been addressed?
- Are there any unforeseen effects caused by the programme?
- Are all facilities being used and if not why not?
- Have hygiene practices improved?

f. Community Participation

- Is the community actively involved in design, construction, O&M?

g. Capacity building

- Are there any capacity building activities for the community?
- Are there any conflicts between different stakeholders? Are activities co-coordinated between teams?
- Are activities co-coordinated between implementing agencies?
- Is technical support and information available if required?

h. Reporting

- Are regular reports and plans produced and disseminated?
- Is information from reports fed back into the implementation process?
- Are meetings held regularly with key stakeholders?

Annexure I

Capacity Building at Panchayat /Village level – model module

The Village community/ volunteers can be trained at the Gram Panchayat Level. Four to Five volunteers may be selected from each village preferably one male and one female to carry out Village Disaster Preparedness and Mitigation Plans (VDPMP) at the village level with reference to water supply and sanitation. The village volunteers may be members of the local NGO/CBO, SHG team, PRI members (Ward councillors members), youth clubs or any other active motivated person of the village.

Name of the Training

Preparedness for water supply and sanitation facilities – Disaster management

Venue

Gram panchayat Office/ School or any place

Number of Days:

2 days

Trainees

Two volunteers from each Village (one male and one female)

Training content

Day 1:

- Overview of the Disaster Risk Management Program
 - What is Community Based Disaster Preparedness
 - Types of Disasters
 - What is at risk and who is at risk
 - History of Disasters in that Panchayat – last 20 years
 - Role of volunteers in disaster preparedness
 - (Role of PRIs/ NGOs/Government functionaries too can be discussed)
 - Participatory Rural Appraisal tools and techniques to be discussed
 - Detailed discussion on Social, Resource, Vulnerability and Risk, and Opportunity or Safe mapping
 - Steps for Village Disaster Preparedness Plan preparation.

Day 2:

- Refreshing Day 1 discussion
 - Role of Village disaster Management Committee [VDMC] in water supply (pre, during and post disasters)
 - Detailed discussion of the Village Disaster Preparedness and Mitigation Plan
- Skill development in
 - Assessing Situation – water supply and sanitation
 - Resource mapping – water supply
 - Water quality monitoring
 - Sample testing for water quality
 - Chlorination
 - Sanitary survey
 - Simple repair
 - Sanitation and technology
 - Hygiene
 - Maintenance of facilities
 - Waste water disposal – soak pit,
 - Vector control – oiling- application of larvicide
 - Refuse disposal – composting

Annexure II

FORMAT FOR PREPARING THE GRAM PANCHAYAT DISASTER MANAGEMENT PLAN

Name of the GP.....Name of the Block.....

Name of the District. Date of preparation of Plan:

1. GP Profile

1.1 GP Disaster Management Committee

Sl. No.	Name	Designation	Address	Phone numbers	
				Office	Res. Mobile

1.2 Demographic Details

Sl. No.	Name of the village	Total No. of Households (HH)	Population			Category			
			Adults	Children (<5 yrs)	Total	SC	ST	OBC	GEN

1.3 Household Details

Sl. No.	Name of the village	No. of APL HH				No. BPL			
		ST	SC	OBC	GEN	ST	SC	OBC	GEN

1.4 Population

Sl. No.	SC		ST		OBC		GEN		TOTAL	
	M	F	M	F	M	F	M	F	M	F

2. Topographical Details

2.1. Total Geographical Area in Hectares.

Sl. No.	Agricultural land (ha)			Grazing land	Forest Land	Others Ex Fishing area	Total area
	High	Medium	Low				

2.2. Livelihood Details

Sl. No.	Total house holds	Agriculture	Agricultural labour	Other labour	Fishing	Petty business	Others (specify)

2.3. Irrigation Facilities and Sources

Sl. No.	Ponds	Dug wells	River	Creeks	Lakes	Canal	Others

2.4. Non-Irrigation Rain fed Land; (in Hect)

Type of land	Land in Hect
High Land	
Medium Land	
Low Land	

2.5 Infrastructure (Nos. and/or distance in Kms)

Sl. No.	Name of the Village	PDS Outlets	Post Offices	Police Station/Outpost	Pucca building	CHC	PHC	Dispensary	Cyclone Shelters	Educational Institutions				Livestock centers	Cottage industries	Industries	Godown/storing	Temple(pucca)
										P r i m a r y	M i d d l e	H i g h	C o l l e g e					

2.6. Communication Facilities

Tele communication	No. of boats	No. of buses	No. of trekker	No. of tractors	No. of jeeps	No. of two wheelers

2.7. Financial Institutions

Sl. No.	Name of Institution	Address	Telephone

2.8. Availability of Earthen Mounds/Mountain

Sl. No.	Name of the village	Type of High land	Distance from the Village	Remarks

3. Resources,

3.1 Resource Inventory

Resource Type	Details	Nos	Contacts/Owner's name with telephone number
Transportation/communication	Tractor Trekker Trolley, rickshaw, Boat Telephone Any other		
Containers	Tankers Overhead tankers Jerry cane		
Cleaning/cutting equipments			
Other resources	Gen set Pump set Petromax Tent house		
Shelter temporary	Tents, Tarpaulins/polythene Bamboo		

3.2 Identified safe shelter places

Sl. No.	Type of shelter	Rooms & Plinth area	Capacity & Name of the villages	Facilities available	Ownership/contact details

3.3. Go down/ storing facilities

Sl. No.	Type of go down	Location	Capacity	Owner/authority	Address	Telephone

--	--	--	--	--	--	--

3.4. Industries:

Sl. No.	Name of industry	Type of industry	Manpower	Machinery/equipment	Investment	Output

3.5 Drinking water Sources

Sl. No.	Name of the village	Tubewell	Well	PHD stand Post	River	Canal

3.6. NGOs Profile

Sl. No.	Name of the NGO/CBOs	Contact person	Tele. No.	Area of operation	Specialization	Manpower	Resource available

3.7 Volunteers' Profile

Sl. No.	Name of the village	Name of the NGO/CBO	Name of the volunteer	No. of volunteers trained				
				Rescue	First aid	Ham radio	Relief & Co-ordination	Damage assessment

3.8 Private Professionals:

Expertise	Name	Specialty	Address	Phone Nos.	Service facilities
Doctor					
Ex service man					
Mechanical/civil/electrical engineer					
VAS					
Volunteers trained in rescue operations					
Volunteers trained in operating special equipments					
Volunteers trained in first aid					
Skilled Mechanics					
Drivers (Road and Waterways)					

3.9 Alternative and Safe Route (in kms) See map to location for

Sl. No.	Name of the Route	Alternate route	Remarks

4. VULNERABILITY ANALYSIS

4.1. History of Disasters:

Sl. No.	Disaster	Year of occurrence	Type losses						Infra structure Drinking water, Road, communication
			Human	Crop	Animal	Livelihood	House damage		

4.2. Seasonality of Hazards (Yearwise)

Type of hazards	January to March				April to June				July to September				October to December			
	H	C	A	I	B	C	A	I	H	C	A	I	B	C	A	I

H=Human, C=Crop, A=Animal I=Infrastructure

4.3. Distance of the village from the Risk points (in kms)

Sl. No.	Danger and risk points	Name of the village/hamlets	Distance from the village	Remarks Distance to Shelter
1	Seas			
2	River			
3	Weak embankments			

5. RISK ANALYSIS

5.1 Risk and Vulnerable Groups

Sl. No.	Name of the village	Locate in the social map	Name of the member along with the HH No.
1	Pregnant women/lactating mother		
2	Children below 5		
3	Uncared aged/destitute		
4	Single woman headed household		
5	Fishermen		
6	Disabled Deaf/Dumb		
7	Sick and ailing		
8	Inhabitants of thatched houses		
9	Houses living near sea/river		
10	Any other		

5.2. Risk Prone Infrastructure and Assets:

Sl. No.	Type of assets/infrastructures	Village 1	Village 2	Village 3	Village 4	Total
1	Infrastructure	Thatched houses				
		LI Point				
		TW/Well				
		Pump sets				
		Embankments				
		Telecommunication				
		Roads				
		Others				
2	Livelihood Assets	Boats				
		Nets				
		Looms				
		Potter's wheel				
		Prawn Gheries				
		Agricultural implements				
		Animals' farms				
		Blacksmith's instruments				
		Others				
3	Water sources	Tube wells				
		Wells				
		PHD stand points				
		Rivers				
		Ponds				
		Tanks				
		Canals				
4	Livest	Cattle				
		Poultry				

	Goats/sheep/pigs					
	Others					

6. Mitigation Strategy

6.1. Short term

Sl. No.	Name of village	Required intervention	Agency responsible	Funds required	Time frame

6.2. Long Term

Sl. No.	Name of the village	Required intervention	Agency responsible	Funds required	Time frame

7. Gram Panchayat Plan

7.1. Flood/Cyclone

Activities	Preparedness	Pre (after warning)	During	Post
Early warning and dissemination				
Rescue & Evacuation				
Shelter management				
Health and First AID				
Water, Relief management				
Damage assessment and counselling				
Patrolling/vigilance coordination/rehab/linkage				
Sanitation				
Carcass disposal				

7.2 Activities Plan – Disaster based

7.3 Recording of activities

Type of crisis	Pre /after receiving warning/information	During Disaster Phase	Post Phase
Earthquake			
Flood			
Drought			
Chemical and industrial accident			
Any other			

7.4 CBO/NGO

Type of crisis	Pre /after receiving warning/information	During	Post
Flood/cyclone			
Earthquake			
Fire			
Drought			
Chemical and industrial accident			
Any other			

Activities can be extended to other staff working in various sectors.

8. Capacity Development Activities

8.1. Training

Needs	Resources available	Requirement
First aid		

Sanitation Rescue Conservation of ecosystem		
---	--	--

8.2. Mock Drill Plans

Time	Process (utilization, maintenance, record keeping etc.)	Responsible person

9. Other details

1. Important Names and Phone Numbers useful in disaster management

Name of personnel	Designation & department	Address	Office phone no.	Residence phone no.	Fax No.	Contact person

2. Offices in the Gram Panchayat

Name of the office	Address	Contact person	Telephone		Alternative communication
			Office	Res.	

3. Capability Assessment of the G.P. level offices

Name of the department	Number of staff sanctioned	In position with designation	Vacancy

4. Transportation – list of owners

Examples

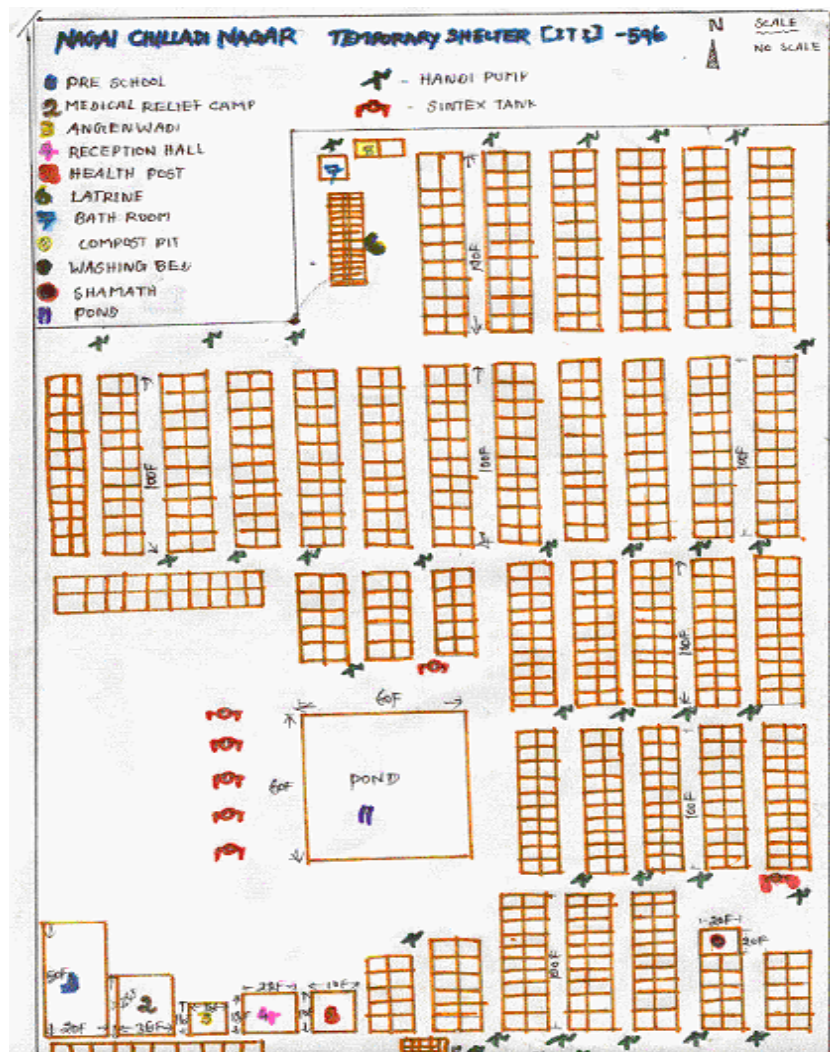
Name of the Bus Owner	Name of the village	Address and Phone No.

Annexure III

Maps

1. Location Map with Village boundary
2. Social/resource Map
3. Hazards Specific Map
4. Risk & vulnerable Map
5. Opportunity/Safe Map
6. Seasonality Hazard calendar

Map Drawn by the Community recently affected Tsunami



Annexure IV

4.1 How to build a Garbage pit?

A suitable site (low lying area must be avoided) at a distance away from the houses, mostly at the corner of the backyard may be selected. L x B x D: 1m x 1m 0.8m pit is dug. An earth bank about 10 cm high is made to prevent rainwater entering the pit.

The Garbage refuse, vegetable leaves, paper, fish, mutton wastes, cattle dung are put into the pit daily as and when they are accumulated in the house. This is covered with 5cm thick layer of earth to prevent flies from breeding in the pit. When the pit is full, the entire pit is covered with layer of firm soil and left undisturbed for 45 days. We can also add earth worms to this pit. The contents after two months will become good fertilizer. Likewise, one can have several pits depending upon the quantity of garbage in the house.

4.2 Composting using Earth worms

By making use of easily available farm wastes like agricultural and cattleshed waste, etc., we can prepare rich compost. It will also pave the way for a subsidiary occupation. Awareness is created among the farmers of the rural areas about the usage of compost and the following facts are to be exposed to the community:

4.3 How to prepare Compost?

4.3.1 Construction of Aerated Tank

First a rectangular tank has to be constructed with bricks and it should be aerated with holes at frequent intervals. The tank must be constructed with bricks and mud. The top portion of the tank should be plastered with cement for longer life.

4.3.2 Size of the tank

- 1.5 meter - Length, 1 meter - Breadth, 1 Meter - Height , Thickness of the wall: one brick size.

The walls should be plastered with cow dung and red soil.

4.3.3 Materials needed

Any organic waste generated from house and farm
Cow dung, Dry soil, Water

4.3.4 Filling

Fill up the tank with agro wastes up to 15 cm height. For every 90 cft you may need 75 to 100 kgs of agro wastes. It may require 120 to 130 lit. of water. 3 to 4% cow dung solution should be sprinkled over the soil.

Thirty to sixty kilograms of dry soil should be spread over the wastes as third layer. First layer wastes then cow dung mixed with water and then dry soil should be filled in the tank. Here we can introduce Earthworms. Thus it may require 10 to 11 layers to fill up the tank. The filling should be continued to a height of half a meter above the tank level and plastered with red soil and cow dung to a thickness of one meter. It will present a dome shape. Every day water should be sprinkled through the holes on the sides of the tank. It will be ideal if the tanks are constructed under the shade of a tree. Otherwise, an improvised shade may be constructed over the tank to save the pit from direct heat from the sun and from heavy rain.

After 15 to 20 days, there will be shrinkage in the pit due to the decomposition of organic matter. The tank

should be refilled to cover up the shrinkage gap and it may require three to four layers additionally.

4.3. 5 Retention Period

After 50 days the compost will be ready.

4.4 Precaution

- Any crack in the dome should be closed as and when it appears.
- In order to hasten the process of decomposition, water has to be sprinkled through the side holes and on the top periodically.
- Any new weeds should be removed then and there.

This can be observed as the dark and highly nutritive compost in the tank after ninety days of extension period. Each tank will supply about three tones of compost, which can be applied to a farm area of 6 to 8 acres.

WHO water quality guidelines?

Only the most basic parameters of common concern have been indicated here. For a comprehensive understanding of water quality parameters, refer to the WHO guidelines for drinking water quality. The Following tests can be conducted at field level and at the district level and institutions established for water testing.

- NTU max. Recommended value is 5, but preferably <1 for disinfection efficiency.
- Taste and odour should be acceptable
- Faecal coliforms should always be 0.
- pH should be between 6.5 - 8.5
- TDS (total dissolved solids): 1000mg/l.
- The relationship between Conductivity and TDS is: Conductivity (microsiemens/cm) x factor (0.55 to 0.9) = TDS (mg/l)
- Ammonia <1.5mg/l. Causes tastes and odour
- Chloride <250mg/l
- Chromium <0.05mg/l has health significance.
- Fluoride <1.5mg/l has health significance.
- High hardness, no limits but can give rise to consumer complaints through no lather formation with soap.
- Lead <0.01mg/l has health significance.
- Mercury <0.001mg/l has health significance.
- Nickel <0.02. Has health significance.
- Nitrate (as NO₃⁻) <50mg/l has health significance.

Annexure VI

Rapid Assessment for Environmental and technical issues

The range of technical options that can be applied in any particular situation will depend both on the human environment and the physical environment in which the emergency occurs. Environmental and technical issues to consider in assessments include:

- Water source
 - Existing source –distant source
 - Treatment facility available
 - Chlorination at source
 - Piped water supply
 - OHT
 - Tanker supply
 - Broken pipes
 - New source – treatment facilities – small scale/large scale
 - Desalination plants – mobile/fixed
 - Committees for water monitoring and distribution

- Ground conditions – soil types and infiltration rates
 - groundwater levels, bearing capacity of soil, ease of excavation;
 - Location and risk of contamination of water sources;
 - Topography and drainage patterns;
 - Climate and rainfall patterns; and
 - Natural, physical and human resources available locally or that can be procured rapidly;
 - Possible environmental constraints or impacts.
 - What local materials are available for constructing latrines?
 - Are there any people familiar with the construction of latrines?
 - Seasonality of rain fall

Annexure VII

Equipment for emergency water supply, particularly for displaced populations:

storage/water-treatment kit:

- pumps and piping;
- fuel storage for pumps;
- treatment chemicals;
- water-quality testing kits;
- tapstands and self-closing taps;
- basic pipe-fitting tools;
- water collection and storage containers.

Equipment for emergency sanitation:

- picks, shovels, rakes, hoes;
- plastic sheeting, poles and nails;
- tractors with trailers and spreaders;
- tractors with loaders and excavator attachments;
- cement mixers;
- moulds and vibrators for making squatting plates;
- cement, calcium chloride, steel reinforcing bars, sand, aggregate.
- Materials, tools and supplies needed for repairing and operating damaged urban water and sanitation networks:
 - accurate maps of networks, location of facilities;
 - equipment for locating pipes;
 - equipment for detecting leaks;
 - equipment for quick coupling and patching of pipes;
 - assorted sizes and types of water pipe;
 - pipe-laying tools;
 - pipe-fitting tools;
 - jointing materials;
 - excavation equipment;
 - valves;
 - hose pipes;
 - welding equipment;
 - protective clothing;
 - boots;
 - heavy-duty gloves;
 - well-head fittings and pumps;
 - fuel tanks;
 - generators;
 - tanks for water distribution;
 - pipes with valves and fittings;
 - sludge pumps;
 - sewage pipes with jointing material;
 - chemicals for water treatment.
- Equipment for vector control:
 - This should follow local practice. See Chapter 10 for details.
- Items used in monitoring and surveillance:
 - Baseline statistical data;

Annexure VIII

Where tubewells, fitted with hand pumps are available and still functioning, these are the most appropriate method of supplying water. However, though it may be desirable to provide a chlorine residual in the water, this is difficult to achieve prior to the water being pumped into water containers. Wide diameter dug wells can be chlorinated either by pouring in a very strong solution to super chlorinate the well, before pumping out, or to use pot chlorinators, in which chlorine powder is mixed with sand for slow dispersion into the water.

Tube well cleaning by chlorination can be achieved by removal of the hand pump and pouring a dose of chlorine solution, which may be based upon bleaching powder if local procurement is undertaken, down the well. In the case of bleaching powder; this should be dry and powdery, not caked or showing any sign of clumping and smelling strongly of chlorine.

Steps to chlorinate a well

- Pump water out of the well for at least half an hour, longer if possible.
- The water should be clear before pumping is stopped. If it is not still clear, keep pumping.
- Clean the surrounding area, so that one can work in a clean environment.
- Remove pump head and in case of Tara pump, the pump rod as well.
- The pump rods should be stored carefully (not allowed to lie on the ground).
- Make up a 1% chlorine solution in a container from which pouring can be done easily, without spilling.
-

Annexure IX

Water surveillance sanitary technicians may be responsible for:

- carrying out routine (e.g. weekly) monitoring of water-distribution systems, including fixed-point and random sampling;
- checking and recording chlorine residuals on the spot, and sampling from sites showing low levels (e.g. <0.1 mg/liter free chlorine) for bacteriological analysis;
- transporting samples to the appropriate laboratory;
- entering analytical results in surveillance reports and making weekly reports to the surveillance coordinator;
- intensifying the monitoring of high-risk water-supply zones, such as those where pressure is low, leakage high, the results of bacteriological tests bad, or standpipes are used;
- carrying out special sampling programs in semi urban and urban areas that are not served by piped systems and preparing reports on them;
- informing the surveillance coordinator, and indicating by appropriate means any advice to be given to the community in an emergency;
- periodically providing samples to the provincial laboratory for chemical analysis and obtaining the results for inclusion in the district archive;
- liaising with local treatment-plant operators and making spot-checks to ensure that they are keeping adequate daily records;
- noting deficiencies and entering them on surveillance reports;
- maintaining a register of all major sources of pollution of water resources, and carrying out periodic surveys of these water resources
- undertaking water source surveys;
- carrying out sanitary surveys of community water supplies;
- providing summary advisory reports to community representatives, pointing out essential remedial action and, wherever possible, providing technical support for improvement;
- keeping and extending an inventory of all water sources and their location, together with a sanitation inventory
- preparing a monthly summary of all sanitary surveys, including the advice provided on remedial action, and sending this summary to the district surveillance coordinator;
- developing and implementing a training program for community-level surveillance of water resources and source protection
- Liaising with community surveillance volunteers, receiving their reports, and providing advice and training.

Annexure X

Water Quality Monitoring Format to be maintained by the Community volunteer/health worker/local health authority in an Emergency situation

Major source

S.No	Name of the Catchment/ main source	Distribution Area	Quality			Chlorination Details	
			TDS	Bacteriological	Others specify	Date and Time of chlorination	Distribution method

At the field level

S.No	Village level Ward level	Distribution				Supply Timings	end point chlorine Result	H2S test Result	Remedial measures	Remarks By supervisor
		OHT	Street tap	Syntax	others					

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Education And Awards	1965: District topper in SSLC 1966: Pre University –St.Johns College, Palayamkottai 1974: MBBS - Madurai Medical College 1982: PG Diploma in Public Health- Madras Medical College - University First 1985: IDRC (Canada) Fellowship -Master's degree in Public Health – National University of Singapore – Rank Holder 1988: Indo – Finnish Fellowship - Post Doctoral Fellow – Primary Health Care – University of Helsinki. 2001: Trained on Water and Sanitation at Delft, Netherlands by UNICEF & GOI
Services to the Nation	1989-92: Member, Academic Council, Anna University 1992-94: Member, Research Advisory Council, NIHFV, GOI 1994-95: Member, National Expert Committee on Rural Sanitation At Present Member, Apex Committee for Southern four states on HRD in Watsan Sector Member, National Core Team for Reform Process in Watsan Sector Member, National Sanctioning Committee, Watsan Sector, GOI Member, State level committees for Water and Sanitation Council, Govt Of TN Member, Fluoride Mitigation cell, Government of Tamilnadu Member, National Resource Team in evaluating GOI schemes Member Core Team on Water and Sanitation, Tsunami affected areas National Facilitator for Total Sanitation Scheme Constructed 25,000 latrines for Rural Community Trained 15,000 people including engineers, doctors and community leaders of various states
Services to Rural Community	★ Trained more than 5,000 professionals for rural water supply & sanitation ★ Built more than 20,000 latrines for Rural Community ★ Sensitized more than 25,000 leaders in various districts in Watsan sector ★ Tsunami affected people – Nagapattinam, Karaikal
Field of Innovations	★ Low Cost Sanitation Technologies, Baby Friendly, Toilet for Physically Challenged ★ Sanitary Science Parks and Rural Sanitary Marts ★ Rainwater Harvesting Models ★ Booklets and Resource Books on Sanitation ★ Manuals and guides for <i>Participatory planning, learning and actions</i> ★ Introduced Safai Darshan scheme for observing success stories in Tamil Nadu and bringing National Integration