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APELL
Awareness and Preparedness
for Emergencies at Local Level

Apell Multi-Hazard Training Kit For Local Authorities

For Community Vulnerability Reduction, Prevention, and Preparedness

United Nations Environment Programme

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APELL MULTI-HAZARD TRAINING KIT FOR LOCAL AUTHORITIES

For Community Vulnerability Reduction, Prevention, and Preparedness

Left to Right: An earthquake training drill in Palawan, Philippines; a village hazard map in Palawan, Phillippines; earthquake survivors in Beichuan, China (source: IFRC)

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TABLE OF CONTENTS

Introduction

BACKGROUND ON THE APELL PROGRAMME

The Awareness and Preparedness for Emergencies at Local Level (APELL) programme was initiated in the late 1980's in response to a number of chemical accidents that resulted in deaths and injuries, environmental damage, and extensive economic consequences in the surrounding communities. These accidents demonstrated the need for improved systems for preventing and responding to chemical emergencies. To address this need, the APELL process was developed to assist communities with chemical hazards in preventing and preparing for industrial accidents. The APELL process is a methodological tool focusing on the local level for identifying possible industrial hazards, raising awareness, and establishing or building local capacity for immediate, multi-party responses in the event that an emergency occurs. The goal of APELL is to promote a community-oriented framework to identify and create awareness of risks in industrialized communities, to initiate measures for risk reduction and mitigation, and to develop coordinated preparedness between industries, local authorities, and communities by building local partnerships between stakeholders. Because the risks, capabilities, stakeholders and regulatory situation of a community will vary from place to place, the process was designed to be adaptable to local conditions.

PURPOSE OF THIS DOCUMENT

Since its inception, the APELL programme has successfully improved community preparedness for chemical accidents from industrial facilities in a number of communities and was promoted in over 40 countries. However, the hazards that threaten communities around the world are not limited to industrial facilities. Although chemical accidents are usually associated with large factories or plants, smaller enterprises and even transportation routes can also present the risk of a hazardous chemical accident. Furthermore, many communities face the threats of natural disasters as well. Every year, there are tragic events where earthquakes, tsunamis, cyclones, floods, landslides, or other disasters cause the death and displacement of many people, as well as substantial economic and environmental damage.

Many communities may feel powerless when faced with these hazards. However, improved preparedness for emergencies can greatly improve a community's ability to respond to and survive both natural and manmade disasters. Because many of the main components of the APELL process are applicable to emergency preparedness regardless of the specific hazards present, the process can provide a valuable resource for multi-hazard emergency preparedness efforts. Recognizing this, UNEP and INERIS have prepared the APELL Multi-Hazard Training Kit (Training Kit) to assist local authorities in preventing and improving preparedness for emergencies from the multiple hazards that may be present in their community. Development of the Training Kit was initiated with funding from the French Ministry of Ecology, Energy, Sustainable Development and the Sea following the 2004 Indian Ocean tsunami. Beginning in 2006, pilot projects were implemented in communities in Sri Lanka and Morocco, and the results and lessons learnt from these pilot projects have been incorporated into the Training Kit to make it as valuable as possible for users.

The objective of the Training Kit is to facilitate local authorities in increasing public awareness of the hazards present in their community, fostering communication between various stakeholders in the community (including the government officials, industry representatives, and the public), and developing co-operative emergency plans for their local area.

This Training Kit is a compilation of information gathered from existing materials and resources. Although extensive information on emergency preparedness for natural and industrial hazards exists, these materials tend to focus on a specific hazard type, such as industrial installations that handle hazardous chemicals, flooding, earthquakes, etc. Few existing resources addressed comprehensive emergency planning from a multi-hazard viewpoint. Recognizing this need, the Training Kit was developed so that local authorities responsible for emergency preparedness could easily access information on comprehensive emergency planning that addresses multiple hazards. The Training Kit is not meant to be a complete list of all the hazards and issues that a community may face; instead, it is meant to provide a summary of the most important principles and steps in improving emergency preparedness, as well as some of the most common hazards found worldwide. Similarly, the modules do not provide detailed guidance on technical issues such as industrial risk analysis, hydrological or meteorological assessments, or building plans for

reducing structural vulnerability. Instead, it provides a brief summary of the main issues present for each hazard source or aspect of emergency planning, with additional resources for further guidance where appropriate and available.

INTENDED AUDIENCE

The primary users of this Training Kit are expected to be local authorities responsible for emergency preparedness or response in countries or areas with identified natural or industrial hazards. This may include government agencies responsible for industrial safety, emergency response, environmental protection, or public health and safety. However, effective emergency planning is generally a multi-stakeholder exercise that should involve community members, local industries and businesses, expert organisations, and any other stakeholders with the potential to be affected by or provide assistance during an emergency. For this reason, any group that is interested in implementing emergency preparedness activities may find the Training Kit useful in identifying the steps they should take to do so.

ORGANISATION AND CONTENT

The Training Kit consists of 15 modules, each of which contains information regarding a specific aspect of community preparedness for emergencies or a common industrial or natural hazard. This document contains a printed summary of each module. The full-length written modules were developed in English and French[1] and are included on the attached CD-ROM, as are slides in English and in French that can be used for group training activities and, where applicable, interactive training exercises. It should be noted that the English modules have undergone minor revisions since the finalization of the French modules. For this reason, the English and French modules are not exact translations of each other, but do contain the same primary components and material.

The first module of the Training Kit is a summary of the APELL Process from a multi-hazard perspective. Modules 2 and 3 provide information on obtaining a better understanding of hazards through the process of hazard and risk analysis. In addition to the guidance provided within these modules, the Community Risk Profile (CRP) tool developed by INERIS and UNEP for qualitative risk characterization, as well as the associated guidance document for use of the tool, is provided on the included CD-ROM. Modules 4 and 5 summarize important considerations that should be made when preparing emergency plans or conducting risk awareness activities with the local population.

The remaining 10 modules provide specific information on common hazards that many communities face. These modules provide hazard characteristics, potential risks and consequences, possible risk reduction activities, and additional resources for assistance in planning or responding to these risks. The additional resources may include major national or international legislation, agreements or programmes related to emergency preparedness, guidance documents that provide more specific information on a given hazard, scientific organisations that can provide technical monitoring and assistance to countries, and other information that may be useful to users of the Training Kit.

How the Training Kit should be used is dependent upon the needs of the users. The printed summary document presents an overview of each training module so that authorities can get a sense of what a comprehensive multi-hazard community preparedness strategy entails. After reviewing the summary document, authorities may decide to review the individual full-length training modules included in the attached CD-ROM for more detailed information on specific aspects of emergency preparedness planning or specific hazards. Depending on the needs of the user, these modules can be reviewed individually or incorporated into an integrated training programme that includes all the training modules relevant for a given community. Users may notice that some information is repeated from module to module; this was done so that each module could be used as a stand-alone document in case the user did not review the entire Training Kit.

Users of the training kit do not necessarily need to review all of the modules to gain a better understanding of risk reduction and emergency preparedness, nor should they assume that because they have reviewed all of the modules they have addressed all of the risks in their community. It is valuable for emergency planners to conduct a thorough assessment of the community and tailor any emergency preparedness activities to their specific context. Additionally, PowerPoint slides have been provided to assist users in sharing the information in the Training Kit with colleagues or others involved in emergency planning and preparedness. Because the needs and objectives of emergency planning and preparedness activities will be different in every community, users should feel free to amend the slides as necessary to make the training as relevant as possible to their situation.

[1] ***Module 1 is only available in English***

1 APELL Handbook from a Multi-Hazard Perspective

The Awareness and Preparedness for Emergencies at Local Level (APELL) programme was developed in 1986 following various industrial accidents that harmed surrounding communities and the environment. The APELL Handbook was written to assist decision-makers and technical personnel in improving community awareness of industrial hazards and in preparing response plans for chemical accidents. APELL is a unique, modular, methodological tool for identifying possible hazards, raising safety awareness, and establishing local capacity for immediate, multi-party responses in the instance of emergencies. Although the initial focus of the APELL programme was on chemical hazards, the methods and concepts used are also applicable to natural hazards. The programme's emphasis on integrated hazard and risk assessment and emergency planning is suitable for the development of comprehensive emergency plans that consider both industrial and natural risks, as well as some aspects of the interaction between the two.

Module 1 of the Training Kit presents an overview of the major aspects of the APELL process as they relate to integrated hazard management and emergency preparedness. This module will familiarize the reader with the main concepts of APELL, including creation of a Co-ordinating Group, assessment of the community's existing capability for emergency prevention and response, and steps to improve this capability.

HOW DOES APELL WORK?

The main goal of the APELL process is to save lives and minimize damage caused by disasters through reducing the vulnerability of communities to natural and industrial hazards. To fully protect themselves, communities must consider various industrial and natural hazards that may pose a threat, as well as the potential interactions between these hazards. Potential interactions include

- Interconnected natural disasters (such as tropical cyclones that create flooding)
- Industrial domino effects, where an accident in one facility damages an adjacent facility, causing a loss of containment and additional accidents
- NATECH events, where a natural hazard triggers or worsens an industrial accident

Additionally, there are typically many stakeholders in the community that will be affected by emergencies, expected to respond, or that can provide valuable information on hazards and risk mitigation measures. To effectively address the various hazards facing a community and increase preparedness, there must be close and direct coordination between all stakeholders. The formation of a Co-ordinating Group is a central element of APELL that aims to involve all applicable groups and representatives. A final important aspect of APELL is the preparation of an integrated community emergency plan that builds upon existing plans and allows for the most thorough understanding of hazards and the most efficient use of resources in an emergency.

SETTING UP THE CO-ORDINATING GROUP

As mentioned above, establishing a multi-stakeholder Co-ordinating Group is the core of the APELL process and crucial to increasing community preparedness. Relevant stakeholders may include industry representatives; government agencies

responsible for emergency services, public health, and environmental protection; local residents and businesses; and technical specialists such as engineers, geologists, and scientists. All potentially affected parties have a legitimate interest in the choices made regarding emergency planning, and strong efforts should be made in ensuring that representatives of all relevant groups are included. However, it is also important that members of the Co-ordinating Group be able to commit to the group and have the authority and legitimacy to represent their constituency. The Co-ordinating Group should also choose an individual (or small group of individuals) to lead the Co-ordinating Group by managing the group activities, conducting meetings and workshops, and resolving disputes.

The role of the Co-ordinating Group is to act as a bridge between the various stakeholders with an interest or responsibility for emergency preparedness and drive the hazard assessment and emergency planning process forward. The Co-ordinating Group does not play a direct role in emergency response activities when an accident or natural disaster occurs, but instead is responsible for assessing the current hazards and levels of preparedness, co-ordinating existing emergency plans, developing an integrated emergency plan, and conducting education and training on aspects of the emergency plan. Co-ordinating Group members must establish procedures for moving the APELL process forward, appoint task assignments, and agree to work together after the plan has been finalized for regular evaluation and improvement of plans.

ASSESSMENT OF THE CURRENT SITUATION

Among the first steps in the APELL process is the collection of information and data regarding current hazards and the level of community preparedness for emergencies. This information can be used to identify strengths, abilities, and aspects of emergency preparedness that can be improved. Potentially valuable information includes:

- **IDENTIFICATION**
of agencies with a potential role to play in emergency planning and response

- **IDENTIFICATION**
of hazards that could produce an emergency situation

- **THE CURRENT STATE**
of community planning and coordination for emergency preparedness

- **IDENTIFICATION**
of existing points of contact and responsibilities of stakeholders in case of an emergency

- **LIST**
of available equipment and materials to be used in an emergency

- **THE EXISTING ORGANIZATIONAL STRUCTURE**
for handling emergencies

- **THE PRESENCE OR ABSENCE**
of specialized emergency response teams for hazardous materials releases

- **THE CURRENT STATE**
of the emergency transportation network, including evacuation routes and access roads

- **PROCEDURES**
for protecting citizens in emergencies (i.e., asking them to remain indoors, respond to emergency sirens in a specific fashion, take shelter is designated buildings, etc.)

- **ESTABLISHMENT**
of a mechanism to enable responders to exchange information during emergencies

It should be noted that the list above is for indicative purposes only, and not all of this information will be available or applicable for a given community. The objective of this step is only to develop a good idea of what resources do or do not exist within the community, and does not imply that all the information above is required to begin creation of a plan

10 STEP PROCESS FOR IMPROVING EMERGENCY PREPAREDNESS

After the existing information has been gathered and reviewed, local authorities and the Co-ordinating Group should have a qualitative understanding of the community's ability to deal with an emergency. At this point, the following 10-step process can be used to increase emergency preparedness.

1. Identify emergency response participants and establish roles, resources and concerns

2. Evaluate risks and hazards that may result in an emergency situation

3. Have participants review existing emergency plans, identify weaknesses

4. Identify response tasks not covered by existing plans

5. Match tasks to resources available from identified participants

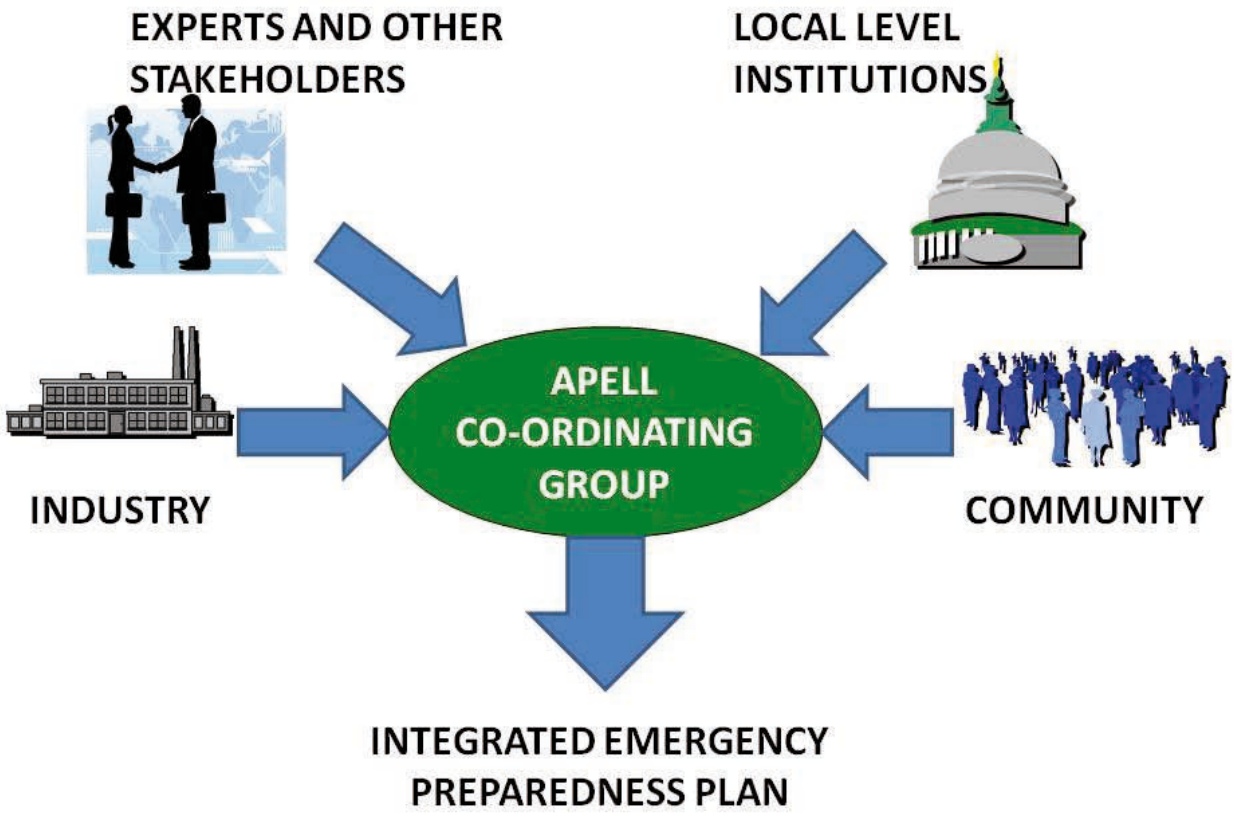
6. Make changes necessary to improve existing plans and integrate into overall emergency plan and gain agreement

7. Commit integrated plan to writing, obtain local government approvals

8. Educate participating groups about the integrated plan and ensure all emergency responders are trained

9. Establish procedures for periodic testing, review and updating of plan

10. Educate general community about the integrated plan



The Co-ordinating Group

2 Multi-Hazard Matrix for Self Assessment

The potential effects of natural disasters are well-known, and numerous examples show the devastating effects they can have on a community. Similarly, an industrial accident can result in extensive consequences both to the facility involved and the surrounding community, depending on the nature of the accident and characteristics of the neighbouring area. Industrial operations naturally aim to avoid any accidents, but nevertheless accidents can and do occur.

One of the first steps in reducing community vulnerability to accidents and disasters is to assess the different hazards present in a community. It is important that risks from both human origins (such as industrial facilities or transportation routes that handle hazardous chemicals) and natural origins (such as earthquakes, volcanoes, and extreme weather events) are considered. Although risk assessment is an important procedure that any community can benefit from, it sometimes requires in-depth studies that require extensive resources and might not be justified unless the risk level is considered especially high. The Multi-Hazard Risk Matrix system described in Module 2 of the Training Kit is a simple tool that can be used for initial community self-assessment of existing risks. The approach proposed in the Multi-Hazard Matrix is a simplified version of the methodology used in the Community Risk Profile (CRP) Tool[1] developed by INERIS for UNEP and visually presents information on various risks within the community. Users of the abbreviated Multi-Hazard Matrix could conduct a more detailed self assessment using the CRP Tool (included on the attached CD-ROM) or other risk assessment methods if initial results indicate that a more thorough self assessment would be useful. Additional information on more in-depth analysis procedures is presented in Module 3 of the Training Kit.

PRELIMINARY STEPS FOR HAZARD EVALUATION

When beginning hazard evaluation activities, the first step is defining the decision context of the hazard assessment. The goal of hazard assessment is to provide information to various stakeholders, such as local authorities, industries, or NGOs, so that they can make decisions regarding community safety and preparedness. Information from hazard evaluations can be used in a variety of ways; for example, it can aid local authorities in determining which areas or groups could be best served by investment in risk mitigation measures and emergency response resources, whether additional regulations are needed to improve public safety, or what land-use planning strategies are necessary to reduce vulnerability. To maximize the usefulness of information obtained during hazard assessment activities, it is important to clearly define how the information will be used.

HAZARD SOURCES CONSIDERED

Any hazard sources with the potential to affect the chosen community should be identified. Hazard sources can include both natural conditions (such as waterways, volcanoes, oceans, extreme meteorological events, etc.) and human infrastructure (including large industrial plants, small and medium sized enterprises, roads, railways, pipelines, etc.).

When considering the various hazard sources, it is important to assess the possibility for interactions between the various hazards identified. For example, industrial estates that contain more than one facility handling hazardous materials are more prone to "domino effects", which occur when an accident at one facility affects a second facility and causes additional accidents. Natural disasters can often have secondary effects that are not always accounted for in emergency planning; for example, an earthquake that occurs during the rainy season can result in landslides.

[1] ***The Community Risk Profile Tool is included on the attached CD-ROM.***

Natural hazards can also lead to industrial accidents by damaging the infrastructure and equipment used to handle hazardous chemicals.

THE MULTI-HAZARD MATRIX

The Multi-Hazard Matrix provides a systematic way to assess the level of risk and vulnerability associated with the various hazards identified. Each hazard source identified is assessed using ten different risk criteria, and assigned a number between 1 and 5 for each risk criterion. A 1 is assigned for a favourable situation (such as a low hazard, low level of vulnerability, or a sufficient level of risk control), and a 5 is assigned for an unfavourable situation (such as a frequently occurring hazard, or lack of protective measures). The risk criteria are:

• PRESENCE:
The first question to be asked is whether the hazard source is present in the area studied. If the risk is not present, then the other risk criteria do not need be assessed.

• KNOWLEDGE:
How well is the hazard understood? Is more information needed to fully understand the hazard source?

• INTENSITY:
What is the possible extent of damage and area impacted?

• FREQUENCY/PROBABILITY:
How often is this event likely to happen?

• EXPOSED ASSETS:
What human, economic, or environmental assets could be affected by this hazard? Potential assets that should be considered include people, industries, businesses, infrastructure, agricultural resources, water supply, and sensitive habitats.

• VULNERABILITY:
The vulnerability of a group of assets describes their capacity to resist the damages of an accident or disaster. For example, certain segments of the population (such as the elderly or those in a hospital) are more vulnerable to disasters requiring rapid evacuation.

• PREVENTIVE MEASURES:
Are measures in place to reduce the probability of hazards as possible? For example, legislation controlling the transport of hazardous goods and safety management systems in industrial facilities can prevent accidents.

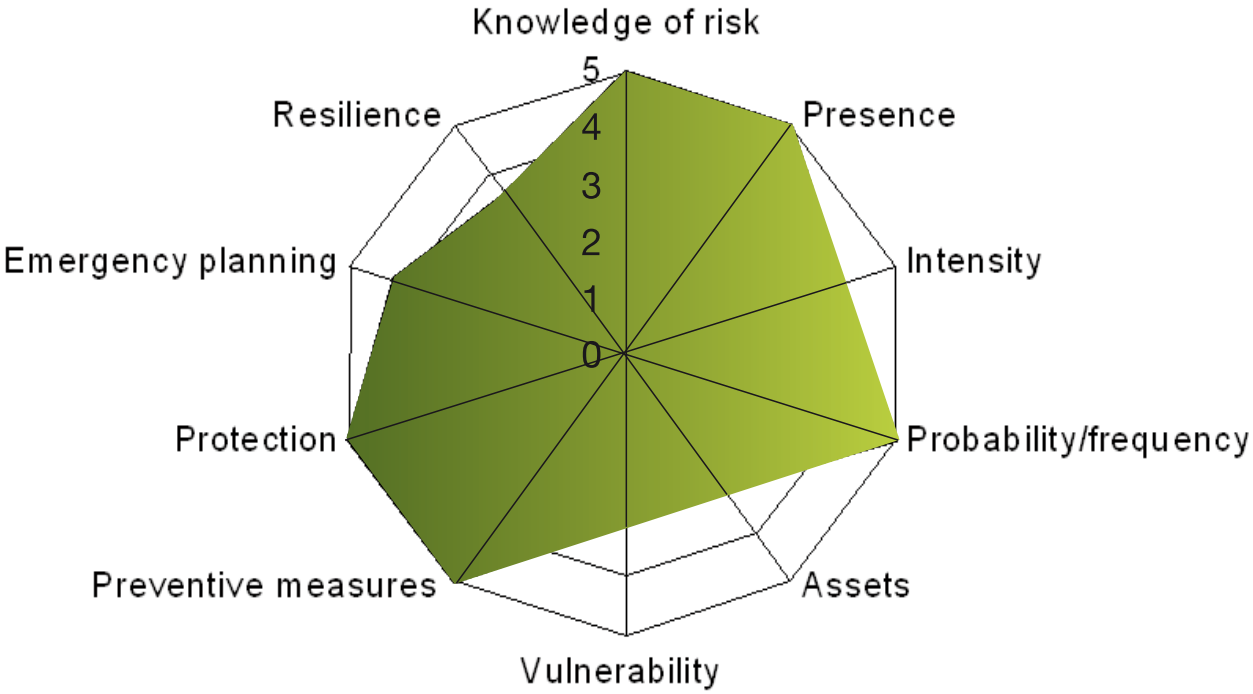
• PROTECTION:
Are measures in place to attenuate the effects of a hazard? Protective measures may include dikes to prevent flooding, reinforcement walls able to withstand an explosion, or land use restrictions that prevent certain types of development in the most vulnerable locations.

	Industry	Transport of dangerous goods	Tornadoes and Cyclones	Flooding	Fast Flooding	Forest fires	Volcano	Earthquake	Ground movement	Tsunami	SMEs
Knowledge of risk 1-5	5	3	5	5	5	5	2	1	5	1	1
Presence 0-5	5	3	3	5	5	5	5	1	4	5	5
Intensity 1-5	4	3	1	2	4	1	1	3	4	3	3
Probability / Frequency 1-5	5	5	4	1	5	2,9	4	3	5	4	5
Assets 1-5	4	4	3	3	3	4	3	3	3	4	3
Vunerability 1-5	5	5	3	4	3	4	3	3	3	3	5
Preventive measures 1-5	5	5	5	2	5	1	5	5	1	5	5
Protection 1-5	5	2	2,5	3,5	5	5	1	4	4	3	5
Emergency planning 1-5	1	1	1	1	1	1	1	1	1	1	1
Resilience 1-5	2	2	2	2	3	2	2	2	2	2	2

Example of completed Multi-Hazard Matrix

• EMERGENCY PLANNING:
Are procedures in place to respond to an emergency should one occur? Are these plans regularly updated and based on hazard assessments and a realistic evaluation of available resources?

• RESILIENCE:
Resilience characterizes the capacity of a community to recover after an accident. Several aspects of a community contribute to its resilience, such as the existence of disaster recovery planning, the economic capacity, health system, and access to knowledge.



Multi-Hazard Matrix Graph for fast flooding

THE MULTI-HAZARD GRAPH

After completing the multi-hazard matrix, a graph can be prepared for each hazard source that visualy represents the level of risk criteria. The graph is prepared using the numbers assigned during completion of the multi-hazard matrix, and the larger the surface area of the graph, the higher the risk and necessity to take prevention and mitigation measures. The graph is divided into three areas. The upper right part of the graph corresponds to the characteristics of the hazard (the presence, intensity, and probability/frequency). The lower part of the graph corresponds to the vulnerability of the community, including the assets exposed to the risk and the community's ability to resist or survive the hazard. The left hand side of the graph represents the risk reduction and control measures that a community can undertake.

Assessment of the graphs for various hazards can help decision makers identify and prioritize risk prevention or mitigation measures. For example, if the left hand side of the graph is large for many of the hazards, the community would most likely benefit from an increased emphasis on risk reduction measures. Similarly, if the lower part of the graph is large, then measures to reduce the vulnerability of the community (such as land-use planning measures) could be the most effective.

3 Risk Analysis

To increase preparedness for emergencies, communities must have a clear understanding of the hazard sources and the threats they pose. This understanding can be obtained through systematic risk analysis, which is a complex but well structured process to measure the risks facing a community. Module 3 of the Training Kit includes a summary of the key elements of risk analysis and methodologies applicable to both industrial and natural hazards.

Module 3 of the Training Kit focuses on methods for in-depth risk assessment that can be implemented on the facility or community level, depending on the risks involved. For communities that wish to conduct a preliminary assessment of hazard sources, a simplified tool is presented in Module 2 of the Training Kit. In many instances, an initial assessment using the methods in Module 2 will indicate the need for further assessment and evaluation of risks. In these cases, the methods presented in this module may be appropriate.

RISK ANALYSIS WITHIN THE CONTEXT OF RISK MANAGEMENT

Risk management is a set of co-ordinated activities or measures expected to reduce risk to a level considered acceptable by stakeholders involved. The basis of risk management is the acknowledgement that a zero-risk situation cannot be reached, as people and organisations, as well as physical systems and processes, can all fail if pushed past their limitations. Therefore, the goal of risk management is to identify the risks present and enact measures that reduce the likelihood and potential consequences of these risks to levels considered acceptable by local authorities, industries, and the public.

Together, risk analysis and evaluation make up the process of risk assessment. Module 3 of the Training Kit does not address the determination of what levels of risk are acceptable, but rather explains the key elements in the risk analysis process and the main approaches to risk analysis.

A village hazard map on Palawan island, the Philippines (source: IFRC)

STEPS FOR RISK ANALYSIS

Regardless of the methodology used, three preliminary steps must be conducted prior to initiating a risk analysis. First, the system to be studied and the objectives of the risk analysis should be clearly defined. An analysis can be used for many purposes, such as identifying new hazards, assessing the efficiency of risk control measures, or identifying additional measures for risk control. To maximize the usefulness of information obtained during analysis activities and prevent the unnecessary expenditure of resources, it is important to have a clear understanding of how the information will be used and what areas or hazards are included or excluded from the scope of the analysis. The second step is collection of the data necessary to perform a technically sound analysis. The amount and type of data required will be largely dependent on the objectives of the analysis, but will typically include information on the technical, natural or social environment being studied, identification of potential hazards, and an analysis of past accidents or events.

Finally, the methodology for analysis must be chosen, based on the objectives of the risk analysis as well as the amount of data available. As a thorough analysis requires the integration of technical and organizational components, a multi-stakeholder working group should be established to conduct the risk analysis. This group can contain representatives from the industrial facility, local authorities, emergency services, natural hazard experts, or community groups.

After the preliminary steps have been completed, the risk analysis can begin. This consists of four main activities:

• DEFINITION OF HAZARDS AND THREAT SOURCES:
Hazard sources can include both natural conditions and human infrastructure.

• IDENTIFICATION OF MULTI-HAZARD INTERACTIONS:
Possible interactions include domino effects at industrial estates; natural disasters with secondary effects that can cause additional emergencies; or NATECH events where a natural disaster triggers an industrial chemical accident.

• ASSESSMENT OF HAZARDS AND RISK-PRONE AREAS:
Identify the areas likely to be affected by each hazard, as well as the assets exposed to the potential impacts. This step can involve modelling of events such as fires, explosions or floods, as well as a review of the risk mitigation measures in place (such as reinforced buildings, evacuation routes, or emergency warning systems).

• RANK THE SOURCES OF THREAT:
This step is necessary to identify priorities for hazard mitigation activities and can be useful for allocation of available resources for risk reduction, control or management.

GENERAL RISK ANALYSIS PROCEDURE

Despite the different characteristics of the various hazards a community might face, a general risk analysis method can be used to gain a better understanding of a wide range of industrial or natural hazards. The main steps of general risk analysis are:

• HAZARD IDENTIFICATION:
Identify the hazards that the community is exposed to, as well as hazard characteristics such as the frequency, intensity, and geographic extent. This information could come from sources such as state and local services, private sector companies, research institutions, and civil society members.

• HAZARD MAPPING:
Maps should be developed that show the location and potentially impacted area of the hazards. Depending on the skills and resources available, this mapping process can be based on technical tools such as geographic information systems (GIS) or traditional methods.

• MAPPING OF ASSETS:
Following the preparation of the hazard map, community assets (such as people, infrastructure, buildings and natural resources) should be mapped. Particular interest should be paid to critical assets that provide functions necessary to the everyday life of the community or that could provide valuable services during an emergency.

• RISK MAPPING:
Risk maps are produced by comparing and/or layering the hazard and asset maps in order to connect the hazard characteristics with the vulnerability of the assets exposed. This should allow authorities to identify areas with the highest risk and prioritize risk reduction measures.

EXISTING TOOLS FOR INDUSTRIAL RISK ANALYSIS

In addition to the steps described above, a number of tools have been developed for risk analysis of industrial systems. These tools are typically either inductive (in which they identify causes and list possible consequences) or deductive (in which they list possible effects and identify the causes that lead to each effect). These tools differ in the amount of information and expertise required to implement the analysis as well as the level of detail that results, and each method has advantages and disadvantages. For this reason, local communities will have to review the decision context for their analysis, as well as their level of understanding of the system being analyzed, to determine the most appropriate method. Certain methodologies are better suited for assessment of individual pieces of equipment or relatively simple systems, whereas other methodologies are better suited for analysis of complicated systems but are also more time consuming and require greater in-depth understanding and expertise.

Risk as a function of probability and intensity

4 Emergency Planning

One of the most important aspects of increasing preparedness for emergencies is the creation of an integrated emergency plan. An effective emergency plan addresses the various hazards a community can face, including both natural and industrial risks, and outlines response activities so that emergency services can operate efficiently during emergencies. A well conceived plan is concise, structured and includes sufficient details to allow rapid access to the crucial required information.

Module 4 of the Training Kit presents a summary of the key issues related to effective emergency planning, including establishment of a Co-ordinating Group, the emergency planning process, and important elements to include in an emergency plan.

THE EMERGENCY PLANNING PROCESS

If the community desires to use the APELL Process for emergency planning, they should create a Co-ordinating Group as described in Module 1 of the Training Kit. The Co-ordinating Group includes participants from different stakeholders in the community and leads the emergency planning process. If the entire Co-ordinating Group is not available for each emergency planning activity, subgroups can be created to address certain tasks. At this stage in the process, the Co-ordinating Group should have already been involved in hazard and risk analysis activities as described in Modules 2 and 3, so members should be familiar with the risks facing the community.

The first step of the emergency planning process is defining an objective for the emergency plan. Additionally, an organisational structure that defines roles and responsibilities during the planning process should be developed, based on the capacities and available resources of the stakeholders. If additional organisations are identified that are not yet involved in the Co-ordinating Group and have an ability or responsibility to provide assistance during emergency response activities, they should be encouraged to participate.

After establishing the objective and organization of the group, the risk and hazards with the potential to result in an emergency situation should be assessed using an appropriate method. Additional information on risk analysis is provided in Modules 2 and 3 of the Training Kit. When the risks are sufficiently understood, the community's existing capacity to manage and respond to these risks should be assessed. This should include a review of existing emergency plans and emergency service networks, resources and equipment available in the event of an emergency, infrastructure and transportation networks that could be used in an emergency, and the existence of any specialized emergency response teams (such as those trained to respond to accidents involving hazardous materials). This information should be used to identify aspects of the emergency response network that need additional development, as well as identifying potential overlaps in responsibilities to allow more efficient use of resources.

As mentioned in Module 1, the APELL process includes a structured ten-step approach for creation and implementation of an emergency plan, which is discussed in more detail in Module 1 of the Training Kit.

COMPONENTS OF AN EMERGENCY PLAN

The components of an integrated emergency plan will vary based upon the hazards a community is faced with and the amount and type of resources available to respond to emergencies. Because an emergency situation will require that information be quickly available and understandable, the plan should briefly and clearly present the essential information. Diagrams, tables and lists are generally preferable to long blocks of text. Some elements that should be included in most emergency plans are:

• ROLES AND RESPONSIBILITIES:

It is crucial to clearly outline the roles and responsibilities of the individuals and organisations who will be involved in emergency response activities. These responsibilities should be based on a realistic assessment of the capabilities of each organisation, and clearly define lines of communication

as well as who is responsible for making decisions and conducting plan mechanisms.

• TRIGGER MECHANISMS:
The conditions that will initiate the plan, as well as notification measures to alert emergency services and the public, should be clearly defined.

• EMERGENCY ASSESSMENT:
A rapid analysis of the emergency situation can aid in ensuring the most appropriate response measures are taken. Necessary information to be obtained, as well as responsibilities for emergency assessment and reporting lines, should be outlined.

• EMERGENCY COMMUNICATION:
The methods for communication during an emergency (which can often damage communication infrastructure) should be outlined, as well as lines for reporting and dissemination of information.

• ACTION MECHANISMS:
The strategies and procedures for managing the emergency and protecting people and the environment should be presented, as well as the agencies responsible for each action.

• POST EMERGENCY RECOVERY:
After the hazard source has been controlled and no longer poses a risk, the recovery phase can begin. The emergency plan should describe what conditions must be in place to begin recovery activities, as well as the responsibilities of various stakeholders in the recovery process.

Mutual Aid Agreements between neighbouring communities or organisations can also be used to increase the resources available during an emergency, increasing local capacity for disaster response and management. If a mutual aid agreement is established, the mechanisms of the agreement should be clearly outlined in the emergency plan to avoid confusion over responsibilities.

RISK COMMUNICATION

Communication to the public in the event of an emergency (whether through sirens, media notices, loudspeakers, or some other method) is a crucial aspect of emergency response and the methods for emergency communication with the public should be clearly described in the emergency plan. However, it is important to communicate with the public prior to an emergency as well. The public has a right to know the risks that they are exposed to, and increasing public knowledge of the measures they should take in an emergency can greatly reduce deaths and injuries. Additional information on risk communication is provided in Module 5 of the Training Kit.

REVIEW, EXERCISES, TRAINING AND EDUCATION

An emergency plan should be an evolving document that is regularly reviewed, updated, and tested. Regular review and updating of the plan can identify deficiencies that were not initially accounted for and provide an opportunity to address additional hazards that may not have been present or recognized during the initial draft. Review of the emergency plan should be scheduled for regular intervals (such as annually) and should also be conducted after any exercise, drill, or actual emergency.

Emergency exercises and drills provide a mechanism for testing the value of the plan and making improvements without waiting until an emergency actually occurs. Emergency exercises can range from table-top meetings that assess the lines of communication and decision making that will occur in an emergency to full-blown drills that simulate mobilisation of emergency resources, evacuation, or other emergency actions.

Training activities build the capacity of emergency services to cope with a disaster and are essential for the effective implementation of the plan. It is important that emergency services personnel participate in interactive training on the emergency plan so they are able to respond effectively when an emergency occurs. The general public should also be informed of the objectives and main features of the plan, as well as the actions they should take in case of an emergency. This can be done through numerous varieties of awareness raising materials and events.

APELL participants in Colombia conduct a tabletop exercise

Risk Communication

5 Risk Communication

The involvement of relevant stakeholders in emergency planning and risk reduction activities is an integral part of the process of developing an integrated emergency plan and increasing community preparedness. Exchange of risk related information is necessary throughout the planning process, from the initial creation of a Co-ordinating Group to review and testing of the emergency plan. However, risk communication to the public also presents specific challenges that must be addressed to encourage adequate participation. Authorities may fear that providing the public with risk-related information will trigger suspicion or panic, and industry representatives can struggle with making technical information understandable to lay persons and avoiding publication of production secrets. However, improved public understanding of hazard sources and emergency preparedness efforts not only increases the community's ability to respond when an emergency occurs, but also enhances the quality and efficiency of emergency planning and risk reduction measures.

Module 5 of the Training Kit presents a summary of the key objectives and issues related to risk communication. The goal of the training module is to demonstrate methods for successfully providing community members with information on hazards and risk mitigation measures, as well as encouraging community involvement in emergency planning and preparedness activities.

GOALS OF RISK COMMUNICATION

The basic purpose of risk communication is to improve public knowledge of various issues relating to risk reduction and emergency preparedness. The community should be made aware of information such as the existing hazards and exposed assets, existing levels of vulnerability, features of emergency planning, and safe behaviour during emergencies. Ensuring that a community is well informed can greatly reduce the degree to which a community is harmed during an emergency.

Additionally, risk communication is an important catalyst for stakeholder discussion. The communication of risks can be a vehicle for exchange of ideas, information, and perceptions that can be useful when developing risk reduction and emergency preparedness strategies. Involving all stakeholders (including the public) in disaster mitigation processes enhances the quality and efficiency of risk reduction measures. Some specific advantages of including the public in planning activities are:

- Improved empirical knowledge of hazards based on previous events can supplement the scientific understanding of hazards

- Improved understanding of the social perception of hazards and the agencies involved in reducing hazards, which can help identify gaps in knowledge and appropriate mitigation actions

- Improved public opinion and ownership of risk reduction measures

- Enhanced community interest and involvement in emergency preparedness activities can lead to increased commitment from political and industrial representatives

KEY ASPECTS OF SUCCESSFUL COMMUNICATION

To enhance the efficiency and relevance of risk communication systems, it is very important to involve the end-users of the communication system in its development. Therefore, for a system to effectively communicate information on hazards, risks, and emergency preparedness measures to the public, representatives from the public must be involved in the system's design and creation. Involving the public in risk communication development can assist authorities in identifying community subgroups that should receive messages, tailoring the messages and method of delivery to the subgroups they

are intended for, and developing a strategy for improving the communication approach over time.

There is no universal method for encouraging public participation in the emergency planning and risk communication process. However, some key elements that can encourage participation in either process are:

• GOVERNMENT LEAD:
Authorities should be proactive in involving members of the public in decision making processes and create conditions that encourage dialogue and interaction.

• EARLY INVOLVEMENT:
Communities should be involved in the early stages of the planning process, and participate in activities throughout the development of emergency and risk communication plans.

• INFORMED CONSENSUS:
Stakeholders should be provided with enough information to sufficiently understand the risks at hand and the decisions being made.

• ALLOW SUFFICIENT TIME:
Consensus-building activities can be time-consuming, so authorities should plan for public involvement and provide background information early in the planning process.

• SHARING THE PROCESS:
A participatory process often involves representatives of stakeholder groups, rather than the entire group. Because many people may not be directly involved during decision-making meetings, the outcome of these meetings should be made available to the community at large.

• PROVIDING FEEDBACK:
Authorities should provide feedback on the contribution of stakeholders and community groups to acknowledge their contribution and increase participatory motivation.

DESIGN OF RISK COMMUNICATION SYSTEMS

Risk communication should inform the community on various issues, such as the existing hazards and assets exposed to them; the community's level of vulnerability and factors affecting the vulnerability of community subgroups; features of emergency planning and risk reduction activities; and safe behaviour for individuals and groups during an emergency. Depending on the risks a community is faced with, additional information should be provided for industrial and natural hazards. For example, communities should be made aware of the potential areas that could be affected by a natural

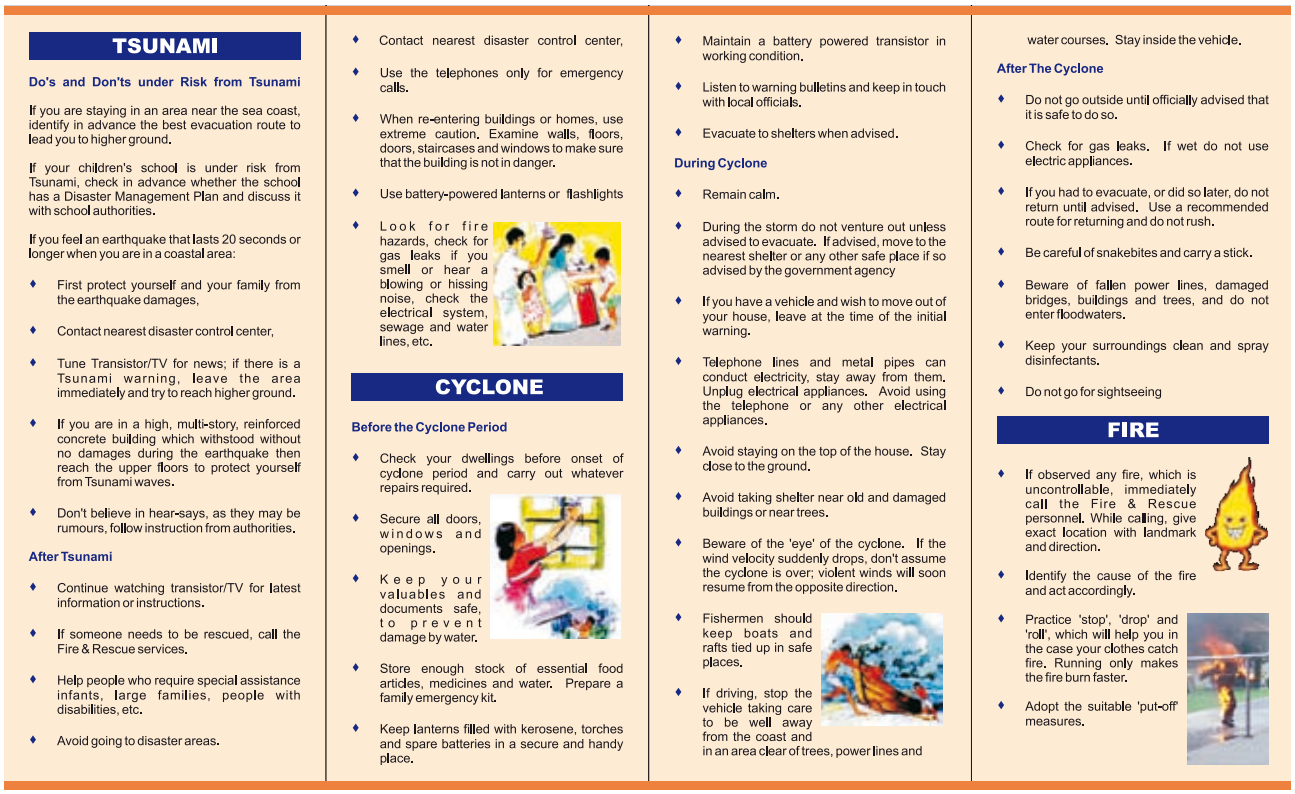
An educational noticeboard for tsunamis in Tanzania (source: IFRC)

disaster, as well as the expected intensity of the event. For industrial hazards, the public should be aware of the types of chemical products used at nearby installations, as well as the potential accident scenarios identified, the probable extent of affected areas, and possible interactions with natural hazards. Additional discussion of information that should be provided to the public for various hazard sources is provided in Modules 6 though 15 of the Training Kit.

Methods for risk communication should be tailored to the intended audience. It is important to consider a number of issues that can influence the degree to which recipients receive, understand, and develop a sense of ownership of risk communication messages, such as gender, literacy, and minority groups or languages. The message must not only reach and be understood by its intended recipient, but it must include information that will be deemed relevant by the recipient (such as information on actually reducing vulnerability) and come from a source that the recipient trusts. Some methods for risk communication include public information campaigns (through mass media, posters, flyers, etc.); youth education campaigns conducted in schools; on-site information strategies to special groups within the community; and web-based information.

WARNING SYSTEMS

Warning systems are a special aspect of risk communication designed to rapidly inform a community of an impending emergency. When well designed and implemented, warning systems can save many lives by notifying the public that they should evacuate or take shelter. Effective warning systems rely on accurate scientific information that forecasts an impending emergency from natural or chemical hazards. However, the success of warning systems is often limited not by the scientific ability to forecast an emergency, but by inadequate notification systems that do not effectively reach the public or persuade it to take necessary measures. For this reason, the intended recipients of an emergency warning system should be considered well in advance when a notification system is being designed, and the message and delivery system should be tailored to the intended audience.



TSUNAMI

Do's and Don'ts under Risk from Tsunami

If you are staying in an area near the sea coast, identify in advance the best evacuation route to lead you to higher ground.

If your children's school is under risk from Tsunami, check in advance whether the school has a Disaster Management Plan and discuss it with school authorities.

If you feel an earthquake that lasts 20 seconds or longer when you are in a coastal area:

- First protect yourself and your family from the earthquake damages,
- Contact nearest disaster control center,
- Tune Transistor/TV for news; if there is a Tsunami warning, leave the area immediately and try to reach higher ground.
- If you are in a high, multi-story, reinforced concrete building which withstood without no damages during the earthquake then reach the upper floors to protect yourself from Tsunami waves.
- Don't believe in hear-says, as they may be rumours, follow instruction from authorities.

After Tsunami

- Continue watching transistor/TV for latest information or instructions.
- If someone needs to be rescued, call the Fire & Rescue services.
- Help people who require special assistance infants, large families, people with disabilities, etc.
- Avoid going to disaster areas.
- Contact nearest disaster control center,
- Use the telephones only for emergency calls.
- When re-entering buildings or homes, use extreme caution. Examine walls, floors, doors, staircases and windows to make sure that the building is not in danger.
- Use battery-powered lanterns or flashlights
- Look for fire hazards, check for gas leaks if you smell or hear a blowing or hissing noise, check the electrical system, sewage and water lines, etc.

CYCLONE

Before the Cyclone Period

- Check your dwellings before onset of cyclone period and carry out whatever repairs required.
- Secure all doors, windows and openings.
- Keep your valuables and documents safe, to prevent damage by water.
- Store enough stock of essential food articles, medicines and water. Prepare a family emergency kit.
- Keep lanterns filled with kerosene, torches and spare batteries in a secure and handy place.
- Maintain a battery powered transistor in working condition.
- Listen to warning bulletins and keep in touch with local officials.
- Evacuate to shelters when advised.

During Cyclone

- Remain calm.
- During the storm do not venture out unless advised to evacuate. If advised, move to the nearest shelter or any other safe place if so advised by the government agency
- If you have a vehicle and wish to move out of your house, leave at the time of the initial warning.
- Telephone lines and metal pipes can conduct electricity, stay away from them. Unplug electrical appliances. Avoid using the telephone or any other electrical appliances.
- Avoid staying on the top of the house. Stay close to the ground.
- Avoid taking shelter near old and damaged buildings or near trees.
- Beware of the 'eye' of the cyclone. If the wind velocity suddenly drops, don't assume the cyclone is over; violent winds will soon resume from the opposite direction.
- Fishermen should keep boats and rafts tied up in safe places.
- If driving, stop the vehicle taking care to be well away from the coast and in an area clear of trees, power lines and water courses. Stay inside the vehicle.

After The Cyclone

- Do not go outside until officially advised that it is safe to do so.
- Check for gas leaks. If wet do not use electric appliances.
- If you had to evacuate, or did so later, do not return until advised. Use a recommended route for returning and do not rush.
- Be careful of snakebites and carry a stick.
- Beware of fallen power lines, damaged bridges, buildings and trees, and do not enter floodwaters.
- Keep your surroundings clean and spray disinfectants.
- Do not go for sightseeing

FIRE

- If observed any fire, which is uncontrollable, immediately call the Fire & Rescue personnel. While calling, give exact location with landmark and direction.
- Identify the cause of the fire and act accordingly.
- Practice 'stop', 'drop' and 'roll', which will help you in the case your clothes catch fire. Running only makes the fire burn faster.
- Adopt the suitable 'put-off' measures.

Community awareness materials from Kanniyakumari, India

Fixed Industrial Installations

6 Fixed Industrial Installations

The presence of an industrial facility in a community can have positive benefits, such as the creation of jobs and increased economic activity. However, many industrial operations use hazardous chemicals which carry the risk of toxic releases, fires, explosions, and other potential accidents that can affect human health, property and the environment. The consequences of an industrial accident can result in harm to the industrial installation, neighbouring facilities, surrounding communities and the environment. Therefore, it is crucial that industries, government authorities and the public understand the risks posed by installations in their communities, take steps to reduce these risks as feasible, and develop integrated emergency plans to respond to an accident should one occur.

Module 6 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to chemical accidents and increase their level of preparedness in case of an emergency. This module will focus on fixed chemical facilities, while other modules of the Training Kit will cover transportation risks (Module 7) and Small and Medium Enterprises (Module 8).

THE MAIN CAUSES OF CHEMICAL ACCIDENTS

The main risks posed by fixed industrial installations are due to the hazardous substances which are stored or handled on site. Hazardous substances may also be produced as the result of loss of control of a chemical reaction or as products of a fire. Hazardous chemicals are typically classified based on the types of hazards they present. Common classifications include materials that are toxic, explosive, flammable, corrosive, hazardous to the environment, and reactive with water. It is important to remember that many chemicals have more than one hazardous characteristic. There are three primary chemical packaging and identification systems used to quickly identify the hazardous characteristics of a given chemical: the European classification system, the UN Globally Harmonised System (GHS), and the United States National Fire Protection Association system. It is crucial that chemicals in an industrial facility be accurately labelled so that workers and emergency services can identify chemicals and hazards efficiently.

The primary causes of industrial accidents can be classified as organizational problems, external factors, or malicious acts. Organizational problems stem from inadequate safety management systems and include technical failures such as equipment rupture or leaks, as well as human errors such as a lack of knowledge or mishandling of materials. External factors include natural hazards such as floods or earthquakes, as well as offsite events that impact the facility (such as an explosion at a neighbouring plant). Malicious acts such as terrorism or sabotage can also result in chemical accidents.

WHAT ARE THE RISKS?

The primary accident scenarios associated with fixed industrial installations all generally stem from a loss of containment, where a hazardous substance is no longer within its normal controlled environment. However, this loss of containment can result in different consequences, such as a hazardous or toxic release, a fire, an explosion, or some combination of the three. A toxic release can contaminate the air, water, and/or soil, resulting in negative health effects on nearby communities and damage to the environment and wildlife. Different types of flammable chemicals and containment systems will result in different types of fires, and it is important for emergency services to understand the type of fire to effectively control it. Explosions can cause massive damage through the release of mechanical and chemical energy. It is important to recognize potential "domino effects", or accidents that can trigger additional accidents. For example, a fire located near a storage vessel containing pressurized gas and liquid can cause a boiling liquid expanding vapour explosion (BLEVE), and the use of water to put out a fire can result in a hazardous release if the water is not contained within the facility.

The immediate consequences of a major accident may be death or injury, heavy damage to installations and buildings, and pollution and damage to the environment. Workers and the installation are most likely to be affected, but serious accidents can also endanger the nearby population and environment. A serious accident has long-term effects at three levels: the industry, the people living in the vicinity, and the environment.

The industry where the accident occurs will be faced with financial consequences, such as costs for equipment repair and replacement, a loss of production, and a potential loss of customers. Additionally, a chemical accident can result in bad publicity for the company involved, lawsuits resulting in heavy fines, and judiciary investigations that can lead to further negative publicity, additional fines, and even prison terms. People living in the vicinity of an accident can suffer severe health consequences as a result of chemical exposure, including sicknesses that don't manifest themselves until long after the actual exposure. Some people might be affected by psychological impacts as well, such as post-traumatic acute stress. Local populations can also suffer economic consequences, such as job losses if the installation is shut down and reduced property values if the area is considered unsafe. Environmental effects include damage to sensitive habitats, the death of plants and animals, reduced productivity in agriculture and fishing, as well as public health issues such as contaminated drinking water.

UNDERSTANDING AND REDUCING THE RISKS

Chemical accident risk reduction measures can include preventive approaches such as industrial safety management systems, protective approaches that increase preparedness in case of an accident, and intervention approaches that are used to respond to an accident. Risk reduction measures must involve not only industrial workers and managers, but also local authorities and community members.

Industrial operators can reduce chemical hazard risks by lowering the hazard potential (for example, by reducing the quantity of hazardous substances stored at a facility and using inherently safer production methods), preventing accidents through measures such as employee training and equipment inspections and maintenance, and limiting the consequences of accidents. Local authorities should raise public awareness of chemical hazards and emergency plans and implement chemical storage and transport laws. Community members should familiarize themselves with hazards and emergency plans and communicate concerns to authorities and industry leaders. To increase community preparedness for an industrial accident, it is crucial for all stakeholders to be involved.

An important aspect of risk reduction is the creation and coordination of emergency plans. Often times, industrial facilities will have an emergency plan addressing onsite response to a chemical accident, but this plan will not be sufficient if a release has offsite impacts. Similarly, an offsite emergency plan can be ineffective if it doesn't take into account the risk posed by chemical installations. Therefore, it is important for communities to create an integrated emergency plan that addresses the various hazards facing a community and also allows for the most efficient uses of community and industrial emergency service resources. An emergency plan can vary largely according to the hazards and risks the community is exposed to; however, a well conceived plan should be concise, well-structured and allow rapid access to required information. Additional information on Emergency Planning can be found in Module 4 of the Training Kit.

Offsite damage from refinery explosion (source: U.S. Cheminal Safety and Hazard Investigation Board)

7 Transportation of Hazardous Materials

Increased industrialization the world over has also brought an increase in the transportation of hazardous materials. According to Organization for Economic Co-ordination and Development (OECD) about 10 per cent of all tonnage transported consists of hazardous substances[2]. In both developing and industrialized countries, the risk of a chemical accident during transportation is generally higher than the risk of an accident in a fixed facility, and can cause harm to people or the environment. Furthermore, communities and emergency services along a transportation corridor are less likely to have measures in place to respond efficiently to a chemical accident, increasing the risks posed to people and the environment.

Module 7 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to accidents during the transportation of hazardous chemicals and increase their level of preparedness in case of an event. This module focuses on transportation by road, railway, pipeline, and waterway, while other modules of the Training Kit cover fixed installations (Module 6) and Small and Medium Enterprises (Module 8).

THE MAIN CAUSES OF CHEMICAL TRANSPORTATION ACCIDENTS

The risks posed by transporting hazardous substances are similar to the risks present at fixed installations due to storage, handling or repackaging of chemicals. Hazardous chemicals are typically classified based on the types of hazards they present. Common classifications include materials that are toxic, explosive, flammable, corrosive, hazardous to the environment, and reactive with water. It is important to remember that many chemicals have more than one hazardous characteristic.

While the risks posed by the transportation of hazardous chemicals are caused by the same chemical properties present at fixed industrial facilities, the risks of transporting these materials are more complex for a number of reasons. Transport routes typically cover a large geographical area and accidents can occur anywhere along the route. Furthermore, many routes pass through densely populated areas that may not have the knowledge or capability to respond to emergencies involving hazardous chemicals. Hazard identification can be more difficult and can sometimes result in a delay in ascertaining what substances are involved, and the population near a transportation accident (including residents, other drivers or rail passengers) is less likely to know how to respond than workers at a fixed chemical installation. Finally, the number of stakeholders involved is generally greater than with fixed installations, and includes transport industries that might not have representation in the potentially affected communities.

The specific causes of transportation accidents depend largely on the method of transport. Transport by road is generally considered the most dangerous method of transport because driver mistakes, such as excessive speed, poorly negotiated turns, or driving while fatigued, can easily result in an accident. Additionally, damage to the vehicle or the road itself and environmental conditions such as fog or ice also increase the risks. Trucks transporting hazardous chemicals often drive in areas with high levels of traffic and can easily be affected by external factors such as the mistakes or recklessness of other drivers. Travel by rail is generally considered safer than by road since it is a fixed network, but accidents can still occur as a result of collisions with another train, car or bus; unsuitably maintained tracks or train equipment; conductor negligence; and sabotage or terrorism. Pipelines are also fixed, protected installations, but technical failures, rupture from heavy equipment or natural events (such as an earthquake), corrosion or malice could all produce a leak, explosion or fire. Waterway accidents are typically the result of technical failures amplified by weather conditions or damage caused by third parties.

[2] ***UNEP, 1992. Technical Report #12 «Hazard Identification and Evaluation in a Local Community».***

WHAT ARE THE RISKS?

The accident scenarios associated with chemical transportation all generally stem from a loss of containment, where a hazardous substance is no longer within its normal controlled environment. However, this loss of containment can have various consequences, such as a hazardous or toxic release, a fire, an explosion, or a combination of the three. Domino effects are more likely if more than one chemical is being transported, but can also result from inherent features of the transportation method (such as the fuel tank or engine).

UNDERSTANDING AND REDUCING THE RISKS

Risk reduction measures should involve all stakeholders, including transportation operators, governmental authorities, and community members. Carriers can reduce the hazard potential by transporting smaller quantities of materials, using safer methods of transport (such as rail instead of trucks), and ensuring that all equipment and vehicles are maintained in good condition. Technical measures, such as the use of more protective packaging or tank materials, can also reduce the chances of an accident. Carriers should also use established methods for documenting and labelling the chemicals contained in each shipment so that authorities can respond appropriately in case of an accident.

Local authorities should work with transporters and community members to raise public awareness of chemical hazards and emergency plans. Authorities can also take preventive measures such as diverting transporters with hazardous chemicals to routes away from densely populated or environmentally sensitive areas, as well as restricting the transportation of dangerous chemicals when additional hazards are present (such as during rush hour or unsafe weather conditions). Construction of roadside features designed to reduce the consequences of a spill, such as a drainage systems or impermeable layers, can also be used to reduce risks. Integrated emergency plans should be developed so that communities and emergency services are well prepared to respond to an accident should one occur. Additional information on Emergency Planning can be found in Module 4 of the APELL Training Kit.

Community members should familiarize themselves with hazards and emergency plans and communicate concerns to authorities and industry leaders. To increase community preparedness for an industrial accident, it is crucial for all stakeholders to be involved. The United Nations Guidance for Dangerous Goods Transport Emergency Planning in a Local Community (TransAPELL) was designed to provide communities with help in planning for accidents arising from the transport of dangerous goods[3]. When communities are fully informed about possible hazards, and when they have been educated about risk management and crisis management plans, the impacts of accidents can be substantially reduced.

São Sebastião port area, Brazil

GUIDANCE AND LEGISLATION

There are a number of national and international initiatives aimed at making the transport of hazardous chemicals safer. Internationally, regulations concerning the transport of dangerous goods are managed by the Economic Commission on Europe of the United Nations and the Intergovernmental Organisation for International Carriage by Rail. These organisations developed international regulations, harmonised for all major means of transport, which were adopted by approximately fifty countries[4]. These regulations control the classification of hazardous substances; the use of documentation and warning labels; and the packaging and loading of hazardous substances.

The North American Emergency Response Guidebook (2008)[5] was prepared jointly by authorities from Mexico, the United States and Canada as guidance for first responders at chemical emergencies. The guide, available in English and Spanish, assists first responders in quickly identifying the specific or generic hazards of the materials involved in the incident and protecting themselves and the general public during the initial response phase of a chemical incident. The guide includes information on safe distances for isolation and protective action during emergencies involving hazardous chemicals.

[3] The TransAPELL Guidance document is available online at http://www.unep.fr/scp/publications/details.asp?id=2679.
[4] For more information on these legal instruments and recommendations, please visit the UNECE website on the transport of dangerous goods at http://www.unece.org/trans/danger/danger.htm.
[5] The Guidebook is available online in English and Spanish at http://www.tc.gc.ca/eng/canutec/guide-menu-227.htm.

8 Small and Medium Sized Enterprises

In many countries SMEs form the backbone of the industrial sectors where hazardous chemicals are manufactured, transported, repackaged and/or used. The agro-chemical, chemical, leather and tanning, metal finishing, mining, paint and coatings, pharmaceutical, and plastics sectors are all industries that use hazardous materials. While these businesses are often very important to the economic livelihood of an area, the chemicals used can pose a risk to human health and the environment if they are not properly managed. However, there are obstacles that often prevent the responsible management of chemicals in SMEs. Legislation that has been developed to address hazardous chemicals is often more applicable to large companies with sophisticated management systems, and can be difficult to SMEs to cope with. Furthermore, many SMEs do not have access to relevant sources of information on chemical hazards or are resistant to invest in sound chemical management due to economic concerns.

Despite this, SMEs must be involved in chemical management and community emergency planning to prevent harm to their installations, surrounding communities, and the environment. Chemical accidents from SMEs can be particularly damaging to the company and community involved, as the economic consequences of an accident could put an SME out of business. This in turn can be devastating for a community where the SME is a significant contributor to the local economy.

Module 8 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to chemical accidents and increase their level of preparedness in case of an event. This module focuses on Small and Medium Enterprises, while other modules of the Training Kit cover fixed industrial installations (Module 6) and transportation risks (Module 7).

HAZARDS AND RISKS AT SMES

The main risks posed by SMEs are due to the hazardous substances which are stored or handled on site. While numerous hazardous chemicals may be used at SMEs, the most common hazardous chemicals are liquefied petroleum gas (LPG), ammonia, and chlorine. LPG is a mixture of hydrocarbons used as a fuel for heating or other industrial purposes. Ammonia is the most widely used refrigerant in the food industry, but is also used for metal treating operations and production of rubber, fertilizers, and synthetic fibres. Chlorine is generally used in water and wastewater treatment plants, as a cleaning or disinfecting agent, and in the production of pesticides, antifreeze, refrigerants, anti-knock compounds, plastics, and resins.

The primary causes of accidents at SMEs can be classified as organizational problems, external factors, or malicious acts. Organizational problems stem from inadequate safety management systems and include technical failures such as equipment rupture or leaks, as well as human errors such as a lack of knowledge or mishandling of materials. External factors include natural hazards such as floods or earthquakes, offsite events (such as an explosion at a neighbouring plant), or even malicious acts such as terrorism or sabotage.

WHAT ARE THE RISKS?

A chemical accident at an SME can result in the same consequences as a release at a larger facility, including hazardous releases, fires, explosions, or some combination of the three. The most common hazardous chemicals found in SMEs are LPG, ammonia and chlorine. LPG is flammable and explosive, and the gas forms a mixture with air that is hazardous to skin, eyes, and the respiratory system

even if un-ignited. Because LPG is heavier than air, it can accumulate in any low-lying area such as depressions in the ground, drains, or pits. Ammonia is often stored as anhydrous ammonia (a gas) or aqueous ammonia (a liquid). Anhydrous ammonia is toxic and can irritate or corrode the skin, eyes, and respiratory tract. Reactions between ammonia and metals can produce explosive hydrogen gas, and in a fire ammonia can react to produce toxic or irritant fumes. Chlorine is highly toxic by inhalation or skin absorption, and can cause damage to the skin, eyes and respiratory tract. Although it is not flammable, chlorine can form flammable or explosive compounds with other chemicals (including ammonia). All three chemicals are often stored in pressurized gas tanks, and overheating of a tank containing any of these chemicals can result in a pressure rise, container failure, and explosion.

Workers and the SME facility are most likely to be affected, and in many cases SMEs are more vulnerable than large installations. The facility where the accident occurs will be faced with financial consequences, such as costs for equipment repair and replacement, a loss of production, poor publicity, and a potential loss of customers. Accidents at SMEs typically have a higher event/impact ratio than large companies, meaning that an SME is typically less able to respond to the financial consequences of an accident and more likely to go out of business. However, it is important to remember that the effects of chemical accidents can also extend beyond the facility involved. People living in the vicinity of an accident can suffer severe health consequences or even death as a result of chemical exposure. LPG, chlorine and ammonia are all highly reactive and likely to travel as a gas or vapour, meaning that they can interact with vegetation, moisture and structure or ground surfaces as they migrate.

UNDERSTANDING AND REDUCING THE RISKS

A number of measures can be implemented to reduce the risks posed by hazardous chemicals manufactured, stored, or used at SMEs. Many of the measures are similar to those used to prevent and prepare for accidents involving large companies, such as implementation of industrial safety management systems and preparation of integrated emergency plans (a more thorough discussion of these measures is included in Module 6). As is the case with larger installations, prevention and preparedness for accidents at SMEs requires the involvement of all stakeholders, including SMEs, larger companies or industry groups, government authorities, and the public. However, it is important to recognize specific issues that can hinder the development of systems designed to manage the risks of chemicals at SMEs. For example, SMEs are often not expected to have significant chemical risks (both by workers and the surrounding community), and thus are not often under pressure to manage their chemical hazards. Furthermore, due to economic limitations and an underestimation of the risks involved in their operations, investing in safety and accident prevention may not be a high priority for SMEs.

To address these issues, government authorities should ensure that information related to chemical safety is accessible and ensure that regulations governing chemical safety are applicable and relevant to SMEs. It can also be useful to elicit the assistance of larger companies or industry organizations in sharing best practices related to chemical management and emphasizing the economic benefits of preventing accidents. Additionally, local authorities should raise public awareness of chemical hazards and emergency plans. The SMEs can reduce chemical risks by lowering the hazard potential, preventing accidents through measures such as employee training and equipment inspections and maintenance, and limiting the consequences of accidents.

Finally, community members should familiarize themselves with hazards and emergency plans and communicate concerns to authorities and industry leaders. To increase community preparedness for an industrial accident, it is crucial for all stakeholders to be involved.

RESPONSIBLE PRODUCTION

UNEP's Responsible Production approach is a framework designed to assist SMEs in managing their chemical hazards. The approach was created to build capacity for management of chemical hazards across the value chain by engaging businesses, supply-chains, distributors, traders and buyers in safer production, accident prevention, and emergency preparedness. The Responsible Production guidance is a systematic, continuous improvement approach aimed at organisations that do not have the resources or capability to establish sophisticated chemical management systems at their facilities[6].

[6] *More information on the Responsible Production approach is available online at: http://www.unep.fr/scp/sp/saferprod/activities.htm*

Tropical Cyclones

9 Tropical Cyclones

A tropical cyclone is defined as a tropical storm with winds that have reached a constant speed of 74 miles per hour (119 kilometers per hour [km/h]) or more. Cyclones are also refered to as hurricanes in the Atlantic and Eastern Pacific Ocean and as typoons in the western Pacific. In addition to the strong winds associated with cyclones, the storms typically involve torrential rains and storm surges which result in flooding. In the past 40 years, it is estimated that over 500,000 people have lost their lives as a result of cyclones, and millions more have been affected by damage to homes, buildings, and economic systems[7].

An increase in extreme weather events, including cyclones, is anticipated in many areas of the world as a result of climate change[8]. Cyclones can erase the gains of social and economic development that had been won over years and decades of hardship, especially in developing countries where mitigation measures may not be in place.

Module 9 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to cyclones and increase their level of preparedness in case of a cyclone. This module outlines the environments and communities likely to be at a risk for cyclones, as well as methods for increasing public awareness of the hazards and protective measures, conducting forecasting and establishing a notification system, and reducing the risks posed by cyclones.

HAZARD DESCRIPTION

Cyclones are formed when low-pressure weather systems form over warm water in the open ocean. Cyclones require moisture and heat from warm ocean water to maintain their strong winds; therefore, when a storm passes over land it will begin to weaken rapidly. However, high winds and rainfall from a cyclone can reach several hundred miles inland. Cyclones typically result in strong winds, torrential rainfall, storm surges, and even tornadoes. Gusts and squalls can cause temporary wind speeds of up to 400 km/h. Cyclone winds can rip the roofs off of buildings and send large amounts of debris airborne, which then crash into other structures at high speeds, causing further damage. Cyclones can also form tornadoes which add to the storms' destructive power.

It is estimated that the majority of deaths associated with tropical cyclones are related to flooding[9]. Storm surges are an abnormal increase in the ocean level resulting from the cyclone's strong winds, and can increase the average water level by 4.5 meters or more. Furthermore, the strong winds from a cyclone can produce large waves, further increasing the potential for flooding and creating very dangerous conditions. The amount of damage from a storm surge in a particular area is partly determined by the slope of the shoreline. A shallow slope off the coast will allow the storm surge to inundate larger areas of coastal communities, whereas a steeper coastline will not result in as much surge flooding. Flooding can also occur inland of the storm's landfall because of torrential rains that can last for several days after the high winds have diminished and occur even when the cyclone itself was not very strong.

FORECASTING AND EARLY WARNING

Tropical cyclones occur seasonally, so certain times of the year present the greatest risk in different regions. In some countries, national or regional weather services have several tools to monitor tropical cyclones. The World Meteorological

[7] World Health Organisation Collaborating Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EMDAT).
[8] UNEP, University of Oxford, United Nations World Tourism Organization, WMO, 2008. «Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practice».
[9] United States Federal Emergency Management Agency (FEMA). Hurricane Hazards Summary. http://www.fema.gov/hazard/hurricane/hu_flood.shtm.

Organization's (WMO's) Tropical Cyclone Programme is also responsible for establishing coordinated forecasting systems worldwide. Scientists can use meteorological data to run computer models forecasting storm intensity and movement; however, storms can change direction or strength quickly and models do not always accurately depict the location and conditions of a storm's landfall. For this reason, emergency services and residents in the potential path of a cyclone are often advised to plan and prepare for a storm one category higher than the current forecast.

While scientific advances can improve the reliability and accuracy of storm forecasts, these advancements will only save lives and reduce destruction if they are paired with effective methods of communicating with local populations and an integrated emergency plan that outlines responsibilities and procedures to be followed should a cyclone occur. It is also important to identify and address the social conditions that can impede implementation of early warning systems at the community level, such as a distrust in the agencies administering the warnings (sometimes as a result of previous false alarms), a misunderstanding of the risks posed by cyclones, or the fear that personal property won't be protected during an evacuation. To address these challenges, early warning systems must be combined with public awareness campaigns and community representatives should be involved in emergency planning. To increase the potential that early warning messages reach their intended audience, the end-users of forecasting systems should be involved in their design, implementation and assessment.

UNDERSTANDING AND REDUCING THE RISKS

Following the identification of areas vulnerable to cyclone impacts, certain measures can be implemented to reduce the risks posed by cyclones. Land-use planning can be used to limit development in coastal areas that are especially susceptible to cyclones; however, it is important to recognize the limitations of land-use planning as coastal areas are usually highly desirable for residential, tourist, and economic uses. Building codes can be used to require structures in vulnerable areas to have certain features that improve their physical resistance to high-winds and flooding. Safe building practices should be encouraged by government agencies and communicated to developers and the general public, especially in communities where many of the homes are self-built. It is particularly important to encourage the reinforcement of important community infrastructure such as hospitals and schools. Even having just a few buildings in the community that are built to withstand cyclones can provide a valuable source of shelter in case of emergency.

Finally, community members must be aware of the risks posed by cyclones and the appropriate measures to take should one occur. Communities should develop integrated emergency plans to be implemented before, during and after a cyclone. It is important to remember that reducing the risks posed by cyclones requires involvement of stakeholders on all levels, including government authorities at the national and local level, rescue services, scientists, and individuals in the community.

In addition to involving concerned members of the public in the emergency planning process, all members of the community should be made aware of cyclone hazards in the area through risk communication. The basic purpose of risk communication is to improve public knowledge of cyclone hazards, the vulnerability of certain groups or communities, features of emergency plans, and safe practices during a cyclone. For information from cyclone-hazard assessments to be effective, it must be communicated to the appropriate audience. Communication during a cyclone is crucial to coordinate emergency response activities and inform members of the public of emergency shelters, evacuation routes, and other important information.

Cyclone damage in Myanmar (source: IFRC, 2008)

Flooding

10 Flooding

Floods have the greatest damage potential of all natural disasters, and account for two-thirds of people affected by natural hazards world-wide[10]. Some regions of the world are more affected than others. It is estimated that between 2000 and 2007 approximately 42% of all hydrological disasters, which include floods as well as landslides, occurred in Asia. People from Asia accounted for approximately 96% of the people killed, injured, made homeless or otherwise affected by hydrological disasters over this period[11].

On a global basis, there is evidence that both economic damages and affected people are on the rise at an alarming rate[12]. Floods often erase the gains of social and economic development that had been won over years and decades of hardship. This holds particularly true in developing countries, where floods often hit worst and mitigation measures are less likely to be in place.

Module 10 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to flooding and increase their level of preparedness in case of an event. This module outlines the environments and communities likely to be at a risk for flooding, as well as methods for increasing public awareness of the hazards and protective measures, conducting flood forecasting and establishing a notification system, and reducing the risks posed by floods.

HAZARD DESCRIPTION

The primary natural causes of floods include intense or prolonged precipitation, snowmelt, tropical storms or cyclones (which can cause flooding through heavy precipitation and storm surges in coastal areas), tsunami waves, and sea level rise as a result of climate change. Floods can be observed on every kind of river, although some areas are more susceptible than others. Particularly vulnerable environments include floodplains exposed to prolonged precipitation, riverine areas exposed to sudden precipitation, rivers affected by snowmelt, and deltas and coastal areas. Floods can have widely different characteristics; in major rivers, they rise and fall slowly, while in urban areas they can rise and fall within minutes.

Human activities can also magnify the destructive effects of floods. Establishing settlements in floodplains not only puts lives and property at risk, but can also alter water channels increasing the risk and magnitude of flooding. Development of roads, buildings and paved areas during urbanization processes prevents rainwater infiltration, creating artificial runoff streams and sometimes resulting in debris or facilities that block natural drainage. Environmental degradation often reduces the water holding capacity of natural features such as forests and wetlands, as well as depositing eroded materials in river channels, decreasing their capacity and increasing the potential for flooding. Failure to maintain or properly manage drainage systems, dams and levees can also influence flooding patterns.

FORECASTING AND EARLY WARNING

Establishing a flood forecasting and warning programme enhances all other flood mitigation measures. There are a number of options available to organizations that wish to understand the potential for flooding in their area and predict future events. Many technical programmes are available that forecast the occurrence of a flood event and anticipate its characteristics in terms of volume, time and space. State agencies responsible for hydrological and meteorological monitoring typically conduct flood forecasting activities. However, it is important to remember that local inhabitants can directly observe river and flow patterns, and this knowledge can be very useful in assessing the risk of flooding, supporting community-based preparedness activities, and predicting the onset of a flood.

[10] International Strategy for Disaster Reduction (ISDR), 2004. «Living with Risk. A Global Review of Disaster Reduction Initiatives».
[11] World Health Organisation Collaborating Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EMDAT).
[12] ISDR, UN Department of Economic and Social Affairs, 2004 «Guidelines for Reducing Flood Losses».

The goal of flood forecasting is to increase the lead time communities and emergency services have to prepare for a flood when one becomes imminent. An increased lead time allows relief staff and communities more time to implement disaster plans and conduct emergency management activities, which can save lives and reduce the damage inflicted on property. However, for the benefits of a flood forecasting system to be realized, it must be combined with an effective system of communication to promptly notify emergency services as well as vulnerable members of the community. To increase the likelihood that emergency messages meet their intended audience, it is necessary for end-users of forecast and warning systems to be involved in their design, implementation and assessment.

UNDERSTANDING AND REDUCING THE RISKS

Various measures can be taken to better understand and reduce the risks posed by floods. The most effective risk mitigation plans incorporate different strategies and organisations. It is important to remember that reducing the risks posed by floods requires involvement of stakeholders on all levels, including government authorities at the national and local level, emergency services, technical experts such as hydrologists, and individuals in the community.

Flood risk assessment and mapping consists of identifying areas with the potential to flood in an event of a given intensity. Vulnerability assessment incorporates the results of flood mapping with an analysis of the population and structures present in threatened areas, as well as the capacity for threatened communities to cope with flooding. This can identify which communities are the most at risk and help decision makers prioritize mitigation and emergency relief procedures.

Improving community preparedness for floods can be done in a number of ways. Community awareness campaigns can be conducted to improve public knowledge of the risks they face and what measures they should take to stay safe during a flood, such as responding to warning signals, following evacuation routes, staying out of floodwaters, and listening to designated news services for information and updates. The development of a comprehensive, realistic and relevant integrated emergency plan can greatly improve community preparedness in the face of flood risks. Rescue services should have sufficient equipment, training, and information on flood characteristics, as well as integrated emergency plans that clearly outline the responsibilities and measures to be taken during a flood and mechanisms for communicating with each other and the public.

Villagers by flooded homes and fields in Jiangsu province, China (source: IFRC)

Wildfires

11 Wildfires

Wildfires are typically defined as an uncontrolled fire burning in forested, vegetated or developed areas. Uncontrolled fires continue to cause widespread social, economic and environmental damage in all regions of the world. Based on a review of satellite imagery data, an estimated 350 million hectares of land were affected by fire in 2000[13]. The immediate effects of wildfires can include death or displacement of people living in fire-prone areas, illness as a result of air pollution, and property damage. Fires can also result in widespread destruction of agricultural resources and decreased food security, as well as environmental damage such as forest degradation, soil erosion, habitat loss, and reduced biodiversity. Uncontrolled fires, particularly in areas with human development, can present a significant hazard to local communities, economies, and the environment and can erase the gains of social and economic development that had been won over years and decades of hardship. This is especially true in developing countries where fire prevention and suppression resources may be less established. Furthermore, increasingly frequent drought events brought on by climate change are likely to increase the risk of wildfires in many areas of the world[14].

Module 11 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to wildfires and increase their level of preparedness in case of an event. This module outlines the environments and communities likely to be at a risk for wildfires, as well as methods for increasing public awareness of hazards and protective measures, conducting forecasting and establishing a notification system, and reducing the risks posed by fires.

HAZARD DESCRIPTION

Wildfires can be caused by humans as well as natural phenomena, although it is estimated that 80 to 90% of fires are started by human activity. Research indicates that the leading cause of forest fires globally is agricultural burning for land management that gets out of control[15]. Additional human activities that can result in wildfires include maintenance of grassland for livestock management, extraction of forest products, industrial development, hunting, negligence, and arson.

A wildfire can start in any environment with sufficiently dry vegetation; however, certain plants are more resistant to burning than others. Plants that have a high volume of vegetation (for example, forests or shrubs as opposed to grasses), accumulate large amounts of dead vegetation, contain a low level of moisture, or contain resin are all more likely to burn than plants without these characteristics. An area with a large amount of small vegetation (such as grass, leaves and twigs) building up on the ground is especially hazardous.

Certain climatic conditions can also increase the risk of fires. A hot, dry weather pattern for prolonged periods can dry out grasses and leaves, making the area more susceptible to burning. Strong winds can push a fire out of control and beyond the capabilities of fire-fighters. In some countries, El-Niño years have been found to induce weather patterns making forest fires more likely. The topography and landscape in an area also affects the potential for wildfires; fires on sloped ground can spread more quickly than on flat ground, whereas the presence of barriers such as rocks, bare soil, lakes, streams or roads can slow or prevent the spread of a fire.

FORECASTING AND EARLY WARNING

Establishing a fire forecasting and warning system enhances fire mitigation measures. Forecasting measures typically include monitoring meteorological and vegetation conditions using technical tools, such as satellite observation and GIS instruments, or more traditional methods such as watch patrols and observation towers. Some countries

[13] Joint Research Centre of the European Commission, 2005. SAFARI 2000 Global Burned Area Map. Available online from Oak Ridge National Laboratory Distributed Active Center, Oak Ridge, Tennesee (http://daac.ornl.gov/S2K/guides/spot_veg_burned.html).
[14] UNEP, University of Oxford, United Nations World Tourism Organization, WMO, 2008. «Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practice».
[15] Food and Agriculture Organization, 2007. «Fire Management - Global Assessment 2006».

have implemented advanced observation and modelling systems that can not only identify conditions that present a fire hazard, but can also estimate the potential intensity and speed of a fire. Collaborative regional meteorological organizations exist in some areas and often have resources and technical capabilities that member states would not have on their own. It is also important to recognize that local communities often have empirical knowledge of the historical conditions resulting in wildfires in the past; this knowledge can be utilized by authorities in development of a forecasting and early-warning system.

The goal of forecasting is to identify conditions that warrant additional prevention measures (such as prohibiting campfires) and to increase the lead time communities and emergency services have to react to a fire when it begins. An increased lead time improves fire fighters' ability to control the fire and allows local communities more time to implement emergency plans and evacuate if necessary. It is crucial that all forecasting and early identification measures are combined with an effective system of communication to promptly notify emergency services as well as vulnerable members of the community. To increase the likelihood that emergency messages meet their intended audience, it is necessary that end-users of forecast and warning systems are involved in their design, implementation and assessment.

UNDERSTANDING AND REDUCING THE RISKS

Various measures can be taken to better understand and reduce the risks posed by wildfires. The presence of a wild-urban interface (WUI), where homes or other structures are in the immediate vicinity of naturally occurring flammable vegetation, should be of distinct concern to emergency services. A review of land-use practices, vegetation characteristics, topography and landscape can identify areas that are particularly susceptible to wildfires. By comparing this information to the locations of population centres, structures and important resources, local authorities can identify which communities are the most at risk and help decision makers prioritize mitigation and emergency relief procedures. In some instances prescribed, controlled burning can reduce the potential for wildfires.

Land management, such as plant selection in landscaped areas, placement of roads or trails within forests, and restriction of development in WUIs can all reduce the risk of wildfires as well. Homeowners should be notified of measures they can take to protect their houses or dwellings, as well as the potential risks and procedures for emergency response or evacuation. It is also important to recognize the social conditions that increase the potential for wildfires, such as sustenance agricultural communities that rely on field burning for their livelihood.

When designing and implementing mitigation strategies against wildfires it is crucial to involve all stakeholders, including government authorities at the national and local level, emergency services, technical experts, and individuals in the community. Just as with other hazards, increased community preparedness for wildfires (through risk communication and development of an emergency plan) can greatly reduce risks.

Emergency services respond to wildfires in the United States (source: IFRC, 2008)

Volcanoes

12 Volcanoes

A volcano is a vent or chimney to the earth's surface from a reservoir of molten rock (magma) that resides deep in the crust of the earth. Volcanic eruptions occur when the molten rock moves upward and breaks through zones of weakness in the Earth's crust, and can release lava flows, debris avalanches, and explosive blasts of noxious gases and volcanic ash. Past volcanic eruptions have caused widespread death (such as the 1985 eruption of the Nevado del Ruiz volcano in Colombia which killed approximately 22,000 people), as well as lung problems from exposure to volcanic gas and ash, destruction of towns and villages, widespread damage to infrastructure, and harm to local agricultural production and food security. Volcanic eruptions can erase the gains of social and economic development that had been won over years and decades of hardship, especially in developing countries where volcanic monitoring and emergency services may be less established.

Module 12 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability to volcanoes and increase their level of preparedness in case of an eruption. This module outlines the areas likely to be at a risk, as well as methods for increasing public awareness of hazards and protective measures, conducting forecasting, establishing a notification system, and reducing the risks posed by volcanoes.

HAZARD DESCRIPTION

Most of the 550 active volcanoes on earth are located along the margins of adjacent tectonic plates. However, volcanoes can be located away from the plate boundaries as well. The Pacific area is the most active volcanic zone, in particular the so called "Ring of Fire", which encircles the Pacific Ocean and affects Southeast Asia, China, Japan, and the western coast of North, Central and South America. The regions of the world that have been the most affected by volcanic eruptions in the past 35 years are Central and South America, Southeast Asia, and Central Africa.

Depending on the type of eruption, volcanoes can emit gases, molten rock, and solid particles. Volcanic gases include hydrogen chloride, hydrogen sulphide, carbon monoxide and carbon dioxide, all of which can result in health problems or even death. The molten rock emitted from a volcano can sweep away or incinerate structures in its path, as well as melt snow caps and glaciers which can result in massive flooding. The solid particles emitted from a volcano can range from fragments that are several metres in diameter (called volcanic bombs) to ash that can be dispersed over hundreds of kilometres. Volcanic ash can cause respiratory illness, damage to electrical equipment, and even structural damage when large quantities of wet ash accumulate on rooftops.

Volcanic eruptions can vary widely in their strength and impacts. Some eruptions may only release minor amounts of steam, gas, rocks or lava and have no effect on nearby communities, whereas large eruptions may result in lava and mudflows that destroy entire towns, as well as clouds of ash and volcanic gas that can reach miles into the air and affect areas hundreds of miles downwind. In addition to the direct results of an eruption, it is important that secondary effects such as earthquakes, lahars, landslides and forest fires be considered and prepared for.

FORECASTING AND EARLY WARNING

Earthquake activity beneath a volcano almost always increases before an eruption because magma and volcanic gas must first force their way up through shallow underground fractures. This makes the fractures vibrate and can break rocks underground, triggering earthquakes. However, the earthquakes triggered by volcanoes are typically low-magnitude and cannot always be detected without specially placed scientific instruments. In addition to earthquakes, large eruptions are often preceded by smaller, less-disruptive eruptions. A thorough understanding of the history and characteristics of a volcano can also lead to a better idea of the type and strength of eruptions that are likely to occur.

Permanent lava lake in the Nyirangongo volcano crater, Rwanda (source: IFRC, 2009)

The task of volcano monitoring typically falls on national or international organizations, and dramatic improvements in this field have resulted in an increased ability to forecast and characterize eruptions. However, despite our abilities in forecasting volcanic activity, many eruptions still result in disaster. Researchers who investigated the 1985 Nevado del Ruiz eruption in Colombia concluded that although there was sufficient scientific information indicating the likelihood of an eruption, this information was not conveyed to at-risk communities, and emergency plans did not sufficiently address the possibility of an eruption[16]. Therefore, it is crucial that an effective means of communication is established to ensure that the identification of volcanic activity and signs of an impending eruption are communicated to emergency services and the public in at-risk areas. To increase the likelihood that emergency messages meet their intended audience, it is necessary that end-users of warning systems are involved in their design, implementation and assessment.

UNDERSTANDING AND REDUCING THE RISKS

There are various measures that can be taken to better understand and reduce the risks posed by volcanoes. Volcano monitoring can not only detect volcanic unrest as it occurs, but can also forecast eruptions and predict the likely impacts of an eruption. By reviewing data on past eruptions, scientists can also prepare hazard-zonation maps that identify the areas most likely to be affected by volcanoes. Additional assessment of the landscape and climatic characteristics of the volcano can determine the potential for debris flows, lahars, flooding and forest-fires. By comparing this information to the locations of population centres, structures and important resources, local authorities can identify which communities are the most at risk and help decision makers prioritize mitigation and emergency relief procedures.

If the risks posed by a volcano are understood, certain measures can be implemented to reduce the hazards. Land-use planning can discourage the development of areas known to be at a high risk and identify crucial infrastructure such as roads or communication equipment that could potentially be damaged in an eruption. Increased public awareness of measures that should be taken before, during and after an eruption can make a community more able to respond and survive. It is also important to recognize and address the social conditions that can impede implementation of risk reduction strategies, such as distrust in evacuation orders, sustenance agriculture conducted on volcano slopes, and fear that personal property won't be protected during evacuation. To ensure that emergency plans are effective, it is crucial to involve all stakeholders, including government authorities at the national and local level, emergency services, scientific experts, and individuals in the community, during their design and implementation. Just as with other hazards, increased community preparedness for volcanic eruptions (through risk communication and development of an emergency plan) can greatly reduce risks.

[16] United States Geological Survey (USGS). «Nevado del Ruiz Eruption and Lahar, 1985». Website: http://vulcan.wr.usgs.gov/Volcanoes/Colombia/Ruiz/description_eruption_lahar_1985.html.

Earthquakes

13 Earthquakes

An earthquake is a sudden motion or tremor of the ground produced when tectonic plates move against each other and release waves of energy. Every year, hundreds of thousands of earthquakes affect some part of the earth, but the majority are so small that they can only be detected by scientific equipment. Earthquakes that can be felt by people are estimated to occur approximately twice a week, and mega-earthquakes occur once or twice a year. Large earthquakes can not only cause the death of thousands of people, but can also severely damage buildings and infrastructure, resulting in large numbers of homeless people and economic devastation. Earthquakes have the potential to erase the gains of social and economic development that have been won over years and decades of hardship. This holds particularly true in developing countries, where risk mitigation measures and emergency response resources may be less established.

Module 13 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability and increase their level of preparedness in case of an earthquake. This module outlines the areas likely to be at a risk, as well as methods for increasing public awareness of hazards and protective measures, establishing a notification system, and reducing the risks posed by earthquakes.

HAZARD DESCRIPTION

Earthquakes occur along the margins of adjacent tectonic plates. The Pacific area is the most active zone, in particular the so called "Ring of Fire", which encircles the Pacific Ocean and affects Southeast Asia, China, Japan, and the western coast of North, Central and South America. The regions of the world that have been the most affected by earthquakes in the past 40 years are Southern and Eastern Asia, South America, and Central America. The extent of damage produced by an earthquake is dependent on the energy released (measured using the Richter scale), the distance between a community and the earthquake location, as well as the depth of the earthquake, with deeper earthquakes producing less damage.

The most obvious consequence of earthquakes is structural damage and resulting casualties and injuries. The amount of damage done to buildings depends on their construction as well as the nature of the soil in the vicinity; certain types of soil can amplify the destructive surface waves and are more prone to ground failure. In addition to structural damages, there are numerous other consequences that can result from earthquakes. Damage to pipelines and other infrastructure can release hazardous chemicals which can in turn cause fires or public health hazards. Public health emergencies can also occur when an earthquake damages drinking-water infrastructure or creates unsanitary conditions, as can be the case when sewer lines are broken. Earthquakes can also result in landslides, tsunamis, and flooding. In emergency planning, it is very important that these secondary effects be considered and prepared for.

FORECASTING AND EARLY WARNING

Despite efforts made by scientists, reliable prediction of individual earthquakes still eludes us. However, the world's largest earthquakes do have a clear spatial pattern, and estimates of the locations and magnitudes of some future large earthquakes can be made. Where faults and plate motions are well known, the fault segments most likely to break can be identified. If a fault segment is known to have broken in a past large earthquake, recurrence time and probable magnitude can be estimated based on fault segment size, rupture history, and strain accumulation. While these activities cannot be used to precisely pinpoint the location or time of an earthquake, they can be used to assess the general level of risk for an area.

Additionally, there are events that will sometimes preclude an earthquake, such as foreshocks, which are small tremors that can precede a larger earthquake by anywhere from a few seconds to a few weeks. Additionally, there have been recorded instances of animals acting strangely prior to earthquakes. It is hypothesized that this is because the animals can feel the non-destructive primary waves

from the earthquake, which travel more quickly than the destructive secondary and Rayleigh waves. Scientists in some areas have developed early warning systems that can predict an earthquake through detection of primary waves, but these systems only allow a few seconds of warning time. Despite the occasional presence of warning signs prior to earthquakes, many earthquakes occur with no recognizable signs and we do not currently possess the ability to accurately predict earthquakes with any degree of certainty. Therefore, it is crucial that at-risk communities practice risk mitigation measures and develop integrated emergency plans.

UNDERSTANDING AND REDUCING THE RISKS

While earthquakes cannot be prevented, several strategies can be used to reduce the number of casualties and degree of damage. Identification of vulnerable geographic zones, which include land along fault lines as well as areas where soil is the most susceptible to liquefaction or subsidence, should be used to distinguish high-risk areas. Scientific investigations can be combined with the local communities' empirical knowledge of the locations most impacted by previous earthquakes that have occurred.

The identification of the most vulnerable geographic zones should be compared with the locations of high-density residential areas, industrial facilities, and important infrastructure (such as hospitals, telecommunication equipment, and transportation terminals). The identification of high-risk or high-priority structures in vulnerable zones can help determine which communities are the most at risk and help decision makers develop emergency procedures. It can also identify structures that could benefit the most from seismic retrofitting, which consists of building upgrades that improve the capability for the structure to survive shaking from an earthquake. Safe building practices should be encouraged by government agencies and communicated to developers and the general public, especially in communities where many of the homes are self-built.

Land-use planning can be conducted to prevent certain kinds of development (such as industrial facilities or high-density apartments) in susceptible locations and vulnerable geographic zones. Land-use planning requirements can be done by enacting enforced legislation or by providing incentives to build in safer zones.

In addition to conducting measures to reduce the risks posed by an earthquake, it is crucial that communities create integrated emergency plans that outline the procedures, roles and responsibilities to be in place when an earthquake occurs. When designing and implementing emergency plans, all stakeholders (including government authorities at the national and local level, emergency response services, scientific experts, and individuals in the community) should be involved. Just as with all other hazards, authorities can also increase preparedness by conducting community awareness campaigns to inform the public of earthquake hazards, emergency plan procedures, and steps they can take to improve their safety during an earthquake.

Man walking in front earthquake rubble, Haiti (source: IFRC, 2010)

Landslides

14 Landslides

Landslides are gravitational mass movements of earth that are often triggered by other natural disasters, such as earthquakes, volcanic eruptions, or tropical storms. It is estimated that approximately 500 major landslides have occurred in the past century, as well as numerous smaller landslides that caused extensive damage on a local level. Approximately 54,000 deaths have been attributed to landslides worldwide over the past 100 years, as well as extensive property damage and numerous people made homeless[17]. Landslides can result in devastating economic consequences as they threaten infrastructure and resources that numerous industries rely on. They also have the potential to erase the gains of social and economic development that have been won over years and decades of hardship. This holds particularly true in developing countries, where risk mitigation measures and emergency response resources may be less established.

Module 14 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability and increase their level of preparedness in case of a landslide. This module outlines the areas likely to be at a risk, as well as methods for increasing public awareness of hazards and protective measures, establishing a notification system, and reducing the risks posed by landslides.

HAZARD DESCRIPTION

Landslides can be triggered by rainfall, earthquakes, wildfires or volcanic activities, as well as by human activities such as deforestation, farming, or construction and development activities. Landslides can occur anywhere on Earth as long as there is sloped ground. However, because many landslides are started by earthquakes or volcanoes, areas with increased geologic activity are typically more susceptible to landslides. Over the past 100 years, major landslides have occurred most frequently in Asia, while those in North, South and Central America have resulted in the most deaths and injuries and those in Europe cause the most expensive damage. The size and speed of a landslide can vary greatly and is dependent on numerous factors, such as the geology, soil lithology, moisture content and level of vegetation or development on the slope. Debris flows occur when water rapidly accumulates in the ground, turning the soil to mud which can rapidly flow downhill and pick up debris such as boulders, trees or cars.

Landslides may result in catastrophic disasters by destroying settlements in urban and urbanizing areas and causing not only death and injury, but also large numbers of homeless people. They cause great economic losses by devastating infrastructure such as roads, railways, bridges, dams, and ports. Landslides also have environmental consequences, such as destruction of forest areas, damming in valleys, and increased sediment transport in rivers. In fact, the 1980 eruption of Mount St. Helens in the United States resulted in a debris flow that traveled 14 miles and formed several new lakes by damming a river. This posed a threat to upstream areas that were flooded when the lakes formed, as well as downstream communities which risked massive flash flooding if the dam ever failed[18].

FORECASTING AND EARLY WARNING

Landslides can present a number of warning signs. Changes in surface water drainage patterns, new cracks or bulges in the ground, or a sudden increase, decrease, or change in turbidity in rivers or creeks can all be signs that a landslide is about to occur. Other warning signals include structural abnormalities, such as misaligned doors or windows, tilting or cracking of concrete floors and foundations, broken utility pipelines, and tilting fences. Heavy rains increase the risk of landslides, and ground-shaking from earthquakes can also cause landslides to occur. For this reason, these events should always be considered a reason to exercise extra caution in hilly or mountainous areas and even trigger implementation of an emergency plan and evacuation. It is important that people in landslide-prone areas be informed of the possible warning signs and advised on the appropriate course of action if they notice them. Ideally, a method of

[17] World Health Organisation Collaborating Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EMDAT).
[18] USGS, 2005. Fact Sheet 2005-3156 «Landslide Hazards - A National Threat»

communication should be developed so that people who identify warning signs can contact authorities to spread the warning to other potentially affected areas.

Although technology intensive, real-time monitoring of landslide prone areas can also be used to predict impending landslides. Monitoring systems typically involve sensors installed in landslide-prone areas, which detect minor movements in the earth's surface and send warning signals back to emergency agencies. However, for these systems to be effective, there must be clear lines of communication between scientists monitoring the sensors, government authorities, and the general population in at-risk areas.

UNDERSTANDING AND REDUCING THE RISKS

Several strategies can be used to reduce the number of casualties and degree of damage inflicted during a landslide. A crucial step in risk mitigation is identifying the areas with the greatest chance of being impacted by a landslide. Scientists can create landslide hazard maps by assessing numerous variables such as rainfall thresholds, slope angle, soil type, and predicted levels of earthquake shaking. These maps can not only show the most instable slopes likely to result in a landslide, but also the chance that the landslide will travel down slope a given distance. However, it is important to note that even without the technical resources required to make the most detailed hazard maps, a general idea of the hazard level can also be obtained by noting the locations of prior landslides. Landslide risk maps combine the information contained in the landslide hazard map with an inventory of the structures and populations located in at-risk areas. The identification of high-risk or high-priority structures in vulnerable zones can help determine which communities are the most at risk and help decision makers develop emergency relief procedures.

In addition to understanding the hazards facing a community, there are a number of strategies for reducing the hazard. While landslides are considered a natural disaster, it is important to recognize the human activities that can increase the chances that a landslide will occur. Deforestation, farming, and construction on sloped areas can all increase the possibility of a landslide and often put additional structures and resources in harm's way. Land-use planning that limits development in hazard-prone areas can reduce the risks posed by landslides. When conducting land-use planning, it is important to remember that it is not only sloped ground that can be at risk, but also the areas at the bottom of hills or canyons, as well as stream channels. To a limited extent, building codes can also be used to increase the capability of structures in hazard-prone areas to withstand landslides.

It is also crucial that communities create integrated emergency plans that outline the procedures, roles and responsibilities to be in place when a landslide occurs. When designing and implementing emergency plans, all stakeholders (including government authorities at the national and local level, emergency services, scientific experts, and individuals in the community) should be involved. Local authorities should ensure that sufficient technical and human resources are available for emergency management following a landslide, and community members should be notified of measures they should take before, during and after a landslide.

Landslide damage, Sumatra, Indonesia (source: IFRC, 2009)

Tsunamis

15 Tsunamis

A tsunami is a series of large waves resulting from a massive displacement of water that occurs when geologic actions, such as earthquakes or volcanic activity, occur underwater. The 2004 Indian Ocean tsunami was one of the most catastrophic natural disasters in recent history, resulting in the death of over 225,000 people, along with widespread flooding, homelessness, loss of infrastructure and economic turmoil[19]. Although tsunamis are a relatively infrequent hazard, the potential consequences can be colossal. Because coastal areas are often densely populated and frequently used for tourism, fishing, shipping, and other economically important activities, the hazards presented by tsunamis are particularly threatening. Tsunamis have the potential to erase the gains of social and economic development that had been won over years and decades of hardship. This holds particularly true in developing countries, where risk mitigation measures and emergency response resources may be less established.

Module 15 of the Training Kit presents a summary of the measures a local community can take to reduce their vulnerability and increase their level of preparedness in case of a tsunami. This module outlines the areas likely to be at a risk, as well as methods for increasing public awareness of hazards and protective measures, establishing a notification system, and reducing the risks posed by tsunamis.

HAZARD DESCRIPTION

Tsunamis can occur in all oceans, but occur most frequently in the Pacific. In particular, areas with high levels of geologic activity are more susceptible to tsunamis, particularly areas near the "Ring of Fire", which encircles the Pacific Ocean and affects Southeast Asia, China, Japan, and the western coast of North, Central and South America. The regions of the world that have been the most affected by tsunamis in the past 40 years are South and Southeast Asia. The extent of damage produced by a tsunami is dependent on the magnitude of the geologic activity causing the tsunami, the distance from the originating point of the tsunami, the topography and the degree of development at the coastline it affects.

When a tsunami reaches land, it releases a tremendous amount of energy. Fast moving water can quickly flood an area and wash away buildings, boats and large rocks or debris, resulting in drowning and destruction of buildings and infrastructure along the coast. While large concrete high-rises can often survive tsunamis, smaller structures can easily wash away. The initial danger from a tsunami can last several hours as a series of waves reach the shoreline. In addition, a tsunami can cause extensive long-term environmental damage, such as a release of hazardous substances, creation of waste material, erosion of coastal areas and destruction of coral reefs. The contamination of groundwater and other drinking water sources can create a public health emergency, and crop damage can result in decreased food security for an area. The economic impacts of a tsunami can also be devestating, as local industries such as tourism and fishing are heavily damaged.

FORECASTING AND EARLY WARNING

Although it is extremely difficult to predict an earthquake or other geologic event occuring offshore, it is possible to detect these events and transmit the information to monitoring staff and emergency personnel onshore. Scientists can detect offshore earthquakes and monitor wave information, using this information to model the likely speed, path, and intensity of the tsunami waves. They can then issue tsunami warnings and tsunami watch adviseries to potentially affected areas. However, for monitoring activities to be effective, it is crucial that this information is quickly passed on to the general public, who also must be informed of the correct measures to take. Tsunami warning alerts should be disseminated using more than one method, and can include the use of radio, tv, sirens and loudspeakers.

The 2004 Indian Ocean Tsunami is a tragic example of the devastation that can occur when no tsunami warning system is in place. Many of the communities affected by the tsunami

[19] World Health Organisation Collaborating Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EMDAT).

would have had enough time to seek high ground or take shelter in sturdy buildings if a warning had occured when the earthquake was detected. However, this system did not exist in most communities, meaning that people had no warning and no time to evacuate at risk areas. Recognizing this, the Pacific Tsunami Warning Center (which had been in operation since the 1940's) expanded its operations and now provides tsunami warnings 24 hours per day to 26 member countries.

Warning signs of impending tsunamis sometimes also manifest themselves at coastal areas. Sometimes tsunami-triggering earthquakes can be felt onshore, although it is important to remember that not all tsunami-triggering earthquakes can be felt and earthquakes that seem minor on land could actually trigger a large tsunami. Another common tsunami warning sign is water at the shoreline rapidly receding as the trough of the wave reaches land. At times rapidly receding water is a cause of confusion and people will walk out to the exposed ocean floor to investigate, putting themselves in great danger. Therefore, it is crucial that these warning signs and appropriate response behaviours be communicated with local communities.

UNDERSTANDING AND REDUCING THE RISKS

While tsunami waves cannot be prevented, community awareness programs combined with hazard assessment and early warning systems can help reduce the number of casualties and degree of damage. Scientists can prepare maps that show areas likely to flood in a tsunami based on geographic and topographic data. These hazard assessment maps, as well as community knowledge of flooded areas in past events, should be compared with the locations of high-density residential or tourist areas, industrial facilities, and important infrastructure (such as hospitals, schools, telecommunication equipment, and transportation terminals) to better understand the tsunami hazard. Evacuation routes, shelters, and emergency plans must take into account this information and consider which locations and communities are the most at risk.

Land-use planning can be used to try and prevent certain kinds of development in tsunami-prone areas, although it can be very difficult to implement and enforce since the locations most at risk are often highly desirable for tourist, residential, and economic uses. Building codes requiring certain structural safety features in hazardous areas can also be used to reduce damages. Encouraging a higher level of structural support for buildings in tsunami-prone areas can reduce the amount of damage and provide a place for people in the area to take shelter until the tsunami passes.

In addition to conducting risk analysis and mitigation activities, increasing community preparedness is crucial in reducing the potential consequences of a tsunami. Communities should create integrated emergency plans that outline the procedures, roles and responsibilities to be in place when a tsunami warning or watch is issued or when warning signs (such as an earthquake or receding water) occur. Risk-prone areas, evacuation routes, and shelters should be clearly marked with signs, and community members should be informed of the correct actions to take before, during and after a tsunami. Local authorities should ensure that sufficient technical and human resources are available for emergency management following a tsunami. Additionally, risk communication activities should be conducted so that community members are aware of the tsunami risk, the emergency plan, and measures they can take to improve their safety.

Damage from the 2004 Indian Ocean Tsunami (source: IFRC, 2004)

Previous place for CD-Rom

About the UNEP Division of Technology, Industry and Economics

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:

> sustainable consumption and production,
> the efficient use of renewable energy,
> adequate management of chemicals,
> the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

> **The International Environmental Technology Centre** - IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
> **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
> **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
> **Energy** (Paris and Naibori), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
> **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
> **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

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Many communities may feel powerless when confronted with the possibility of a natural disaster or an accident involving hazardous chemicals. However, improved preparedness for these emergencies can greatly enhance a community's ability to respond to and survive both natural and industrial disasters. This Training Kit has been developed to assist local authorities in increasing their preparedness and reducing their vulnerability in the face of natural and industrial disasters. It is based on UNEP's APELL process, which has been promoted in many communities around the world to increase preparedness for industrial accidents.

This document contains a summary of the 15 modules which comprise the Training Kit. The full Training Kit is included on the attached CD-Rom, and for each module includes a guidance document and slides in French and in English. Each module provides information on different aspects of accident prevention and emergency preparedness (such as risk analysis, emergency planning, risk communication, etc.) and specific hazards that communities may face (fixed industrial installations, floods, earthquakes, etc.).

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