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Myanmar Consortium for Capacity Development on Disaster Management

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Early Warning System for Myanmar Training Manual

Ministry of Social Welfare, Relief and Resettlement

Relief and Resettlement Department

Early Warning System for Myanmar

Training Manual

USAID FROM THE AMERICAN PEOPLE UN-HABITAT UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME RIMES MCCDDM different lead times, for guiding planning and decision-making. Enhancing DRR capacities, redounds to resilience.

The EWS for Myanmar Training is composed of the following components, which will comprehensively build participants' capacity for a more effective disaster risk reduction:

Module 1. Contextualization of the EWS for Myanmar Training. This Module is intended to set the training environment, for facilitating friendly and meaningful interaction among participants. For the training to be fully beneficial, this module will also facilitate clarity and oneness, among facilitators and participants of what to expect in, and subsequent to, the training.

Module 2. Introduction to EWS. This Module targets to make participants understand and appreciate the EWS and its components, actors therein, functions, and role in disaster risk reduction, at the outset of the training. Understanding the EWS at the beginning of the training is expected to facilitate deeper assimilation of subsequent modules and how each module feeds into the end-to-end process.

Module 3. Risk Knowledge. The understanding of historical hazards; hazards not yet experienced but may be potentially experienced in the future; and the vulnerabilities and capacities in communities, is essential for anticipating potential risks from impending and future hazard events. This module specifically focuses on a) historical risk information and b) tools and methodologies for participatory risk assessment.

Module 4. Monitoring and Warning Service. EWS is anchored on multi-hazard, multi-timescales information generated by National Meteorological and Hydrological Services (NMHSs) and National Tsunami Warning Centers (NTWCs). In Myanmar, the official and mandated source of multi-hazard, multi-timescales information is the Department of Meteorology and Hydrology (DMH). Understanding the role of DMH, the various information products and services it generates, and the intended utilization of these products, is an important requirement for an enhanced EWS in Myanmar. Further, capacities for converting information into potential impacts outlook and management strategies will be built herein.

Module 5. Dissemination and Communication. Information products generated by DMH should be communicated to stakeholder institutions and communities. Communication of multi-hazard, multi-timescales information, however, involves a series of processes to customize the same for target recipients/audiences, and the intended purpose of the message/information. This session brings forward these processes, for ensuring warning/information effectiveness.

Module 6. Response Capability. The ultimate gauge of an effective EWS is how it can mobilize institutions and communities into action for saving lives, assets and properties, ensure effective resources management, and even catalyze productivity. It has to be understood that in EWS, multi-hazard, multi-timescales information is only among the inputs – there are other capacities required for completing the puzzle. Having strong response capacities, both in sectoral institutions and communities, will contribute to an effective and functional EWS.

Module 7. EWS Sustainability for Enhanced DRR. For the EWS to remain functional, it has to evolve. Gaps have to be addressed and capacities have to be improved. Regular assessment of the EWS is required, for guiding development/capacity building initiatives. Capacity building has to be continuous, driven by past and current learnings, current and residual gaps, and technological developments.

MODULE 2 INTRODUCTION TO EWS

Rationale: EWS is an often-misunderstood concept. In many cases, the responsibility for EWS is erroneously accorded to only one (1) or a limited number of institutions/stakeholders. The appreciation of the elements and functions of the end-to-end, people-centered EWS, the actors therein and their roles, and the coordination mechanisms required, is foundation in strengthening DRR.

This Module targets the common understanding, among participants, of the EWS in Myanmar.

SESSION 2.1. WHAT IS EWS?

Description: The importance of EWS, as an indispensable component of DRR, is the key message in this session. This session elucidates the elements and other requirements for an effective EWS.

Objectives: At the end of this session, it is expected for the participants to:

- understand and appreciate EWS and identify its elements
- appreciate the end-to-end, people-centered approach and identify actors from the national, sub-national and local levels
- understand the functionality of EWS, for meaningful DRR, and the measure of its effectiveness
- better understand key terminologies and concepts in DRR, and apply such enhanced understanding in their DRR-related undertakings
- understand the guiding principles in DRR, for deepening appreciation of the EWS functionality

Methodologies: This session combines the following methodologies:

- PowerPoint Presentation
- plenary discussion
- group discussion/exercise/game

Key Learning Points. The EWS is a key pillar for reducing risks to lives, livelihoods and assets vis-à-vis natural hazards – both of hydro-meteorological and geological nature. While early warning is the information generated by NMHSs and NTWCs, the EWS is a set of capacities required for generation and dissemination of timely and meaningful warning information for enabling individuals, communities and organizations threatened by a hazard to prepare and act appropriately and in sufficient lead time for reduction of potential for loss.

The end-to-end people-centered EWS, in Figure 1, is composed of the following **equally important** and **inter-connected** elements for **reduction of potential risks:** a) risk knowledge, b) monitoring and warning service, c) dissemination and communication and d) response capability.

Figure 1. Elements of the EWS (UNISDR, 2006)

The elements are elaborated, below:

> ***Risk Knowledge.*** Involves prior knowledge of risks in communities and involves systematic data collection and risk assessments for guiding analysis of preparedness actions, for specific hazards. Part of risk knowledge is the understanding of hazards (past, current and potential), vulnerabilities, and capacities; and availability of risk assessments/analysis information for guiding institutional and community decisions.
>
> ***Monitoring and Warning Service.*** This refers to development of hazard monitoring and early warning services. Key to this element is the monitoring of right/relevant parameters, improving analysis, and generation of reliable and timely information.
>
> ***Dissemination and Communication.*** Warnings have to be clear, understandable and customized for communities to enable appropriate action. Communication pathways have to be in place as well, to ensure that relevant information reaches institutions and communities.
>
> ***Response Capability.*** Capacities in institutions and communities, for facilitating effective action based on early warning information, should be built to ensure functional and effective preparedness. The scope of response capability extends from availability and suitability of response/preparedness plans; integration of local

knowledge and capacities in decision-making processes; and readiness of constituency to respond to warnings, among others.

The EWS, therefore, looks further and broader than just the early warning information. An effective EWS, and DRR, is guided by information of various hazards and timescales, with stakeholders capacitated to apply information, for a **proactive** and **anticipatory** approach.

EWS in DRR. As mentioned in the outset, the EWS is an integral part of meaningful disaster risk reduction, facilitating **preparedness** actions based on approximation of potential hazard impacts.

Multi-Hazard Approach to EWS. For optimum effectiveness of EWS, it has to be linked to all natural hazards. Multi-hazard people-centered EWS contributes to cost-effectiveness of investments, sustainability, efficiency, functionality, and reliability. Multi-hazard EWS gets to be practiced more often, facilitating its functionality vis-à-vis less frequent, but high impact, hazards (e.g. tsunami). Better understanding, by stakeholders, of risks from various hazards guide appropriate preparedness measures.

Stakeholders, Ownership, and Bottom-Up Approach. An effective EWS necessitates involvement of, and ownership by, a wide range of institutions, communities and individuals, from national to local level. Operational warning institutions for meteorological, hydrological, and geological hazards; national and local disaster risk management institutions; government sectors; research institutions; non-government and development organizations; private sector; local governments; communities; and households are all part of the end-to-end EWS.

A bottom-up approach is integrated, for ensuring that requirements of those most at-risk are considered, and continuous efforts for reducing vulnerability and enhancing capacities, are in place.

Inclusiveness. The people-centered EWS considers vulnerabilities of population amidst differential gender, cultural, social, and geo-physical considerations, and other elements that contribute to reducing vulnerabilities and enhancing capacities, for effectively responding to warnings.

Measure of EWS Effectiveness. The effectiveness of EWS can be best gauged by how it contributes to saving lives and reducing impacts to properties and livelihoods.

Key challenges in EWS. In many countries, including Myanmar, the understanding, appreciation and application of a wide range of multi-hazard, multi-timescales information, for disaster risk reduction, remains a potential that is yet to be fully harnessed. The requirement for capacity building is extensive and intensive, and, hence, a sustained process of understanding requirements[1] and responding to such requirements is necessary.

Principles. Analysis, by the World Meteorological Organization (WMO), of good practices in EWS for disaster risk reduction, from various countries, highlighted the principles, as captured below:

- strong political acknowledgement of EWS benefits, as evidenced by integration thereof in disaster risk management policies, plans, legislation, and budget, from national to local levels
- effective EWS is anchored on four (4) components: a) hazard detection, monitoring and forecasting; b) risks analysis and incorporation of risk information in warnings and preparedness actions; c) dissemination of timely and "authoritative" warnings; and d) community planning and preparedness

[1] *Requirements change due to the changing nature of hazards, exposure and vulnerabilities, and capacities.*

- EWS stakeholders are identified, with roles and responsibilities defined for each stakeholder, and coordination protocols among stakeholders clarified. These are embodied in plans, legislation, and other official/legal instruments, from national to local levels
- support to EWS capacities are adequate (e.g. human, financial, equipment, etc.), from national to local levels, and with sustainability mechanisms imbedded into the system
- risks assessment provides inputs into warning formulation and preparedness planning
- warning messages are clear, consistent and includes risk information; considers integration of threat levels to preparedness actions (e.g. color-coded information, etc.); understood by all concerned, from authorities and institutions making decisions to communities; comes from recognized and "authoritative" source
- reliable warnings are received by relevant authorities, stakeholders, and communities- and population-at-risk, with sufficient lead time
- preparedness/response plans ingest hazard severity and levels of potential exposure and vulnerability of communities
- preparedness trainings and awareness activities are integrated into formal and informal capacity building programs, and regular drills are conducted
- feedback mechanisms in various levels are in place, for facilitating EWS improvements

Further, the Sendai Framework for DRR, 2015-2030, adopted the following principles, quoted as published by UNISDR (2015), highlighting the importance of the different components of EWS:

- Each State has the primary responsibility to prevent and reduce disaster risk, including through international, regional, subregional, transboundary and bilateral cooperation. The reduction of disaster risk is a common concern for all States and the extent to which developing countries are able to effectively enhance and implement national disaster risk reduction policies and measures in the context of their respective circumstances and capabilities can be further enhanced through the provision of sustainable international cooperation;
- Disaster risk reduction requires that responsibilities be shared by central governments and relevant national authorities, sectors and stakeholders, as appropriate to their national circumstances and systems of governance;
- Managing the risk of disasters is aimed at protecting persons and their property, health, livelihoods and productive assets, as well as cultural and environmental assets, while promoting and protecting all human rights, including the right to development;
- Disaster risk reduction requires an all-of-society engagement and partnership. It also requires empowerment and inclusive, accessible and non-discriminatory participation, paying special attention to people disproportionately affected by disasters, especially the poorest. A gender, age, disability and cultural perspective should be integrated in all policies and practices, and women and youth leadership should be promoted. In this context, special attention should be paid to the improvement of organized voluntary work of citizens;
- Disaster risk reduction and management depends on coordination mechanisms within and across sectors and with relevant stakeholders at all levels, and it requires the full engagement of all State institutions of an executive and legislative nature at national and local levels and a clear articulation of responsibilities across public and private stakeholders, including business and academia, to ensure mutual outreach, partnership, complementarity in roles and accountability and follow-up;
- While the enabling, guiding and coordinating role of national and federal State Governments remain essential, it is necessary to empower local authorities and local communities to reduce disaster risk, including through resources, incentives and decision-making responsibilities, as appropriate;

- Disaster risk reduction requires a multi-hazard approach and inclusive risk-informed decision-making based on the open exchange and dissemination of disaggregated data, including by sex, age and disability, as well as on easily accessible, up-to-date, comprehensible, science-based, non-sensitive risk information, complemented by traditional knowledge;
- The development, strengthening and implementation of relevant policies, plans, practices and mechanisms need to aim at coherence, as appropriate, across sustainable development and growth, food security, health and safety, climate change and variability, environmental management and disaster risk reduction agendas. Disaster risk reduction is essential to achieve sustainable development;
- While the drivers of disaster risk may be local, national, regional or global in scope, disaster risks have local and specific characteristics that must be understood for the determination of measures to reduce disaster risk;
- Addressing underlying disaster risk factors through disaster risk-informed public and private investments is more cost-effective than primary reliance on post-disaster response and recovery, and contributes to sustainable development;
- In the post-disaster recovery, rehabilitation and reconstruction phase, it is critical to prevent the creation of and to reduce disaster risk by "Building Back Better" and increasing public education and awareness of disaster risk;
- An effective and meaningful global partnership and the further strengthening of international cooperation, including the fulfillment of respective commitments of official development assistance by developed countries, are essential for effective disaster risk management;
- Developing countries, in particular the least developed countries, small island developing States, landlocked developing countries and African countries, as well as middle-income and other countries facing specific disaster risk challenges, need adequate, sustainable and timely provision of support, including through finance, technology transfer and capacity-building from developed countries and partners tailored to their needs and priorities, as identified by them.

Basic Terminologies and Concepts. Annex 1 provides the definition of terminologies and concepts, in DRR, as adopted by RRD.

SESSION 2.2. EWS IN MYANMAR

Description: In Myanmar, experiences from various devastating hazard events, i.e. Indian Ocean Tsunami in 2004, Cyclone Nargis in 2008, and severe flood in 2015, among others, have underscored the importance of capacities built in all EWS elements. This session focuses on the enabling policies, institutional arrangements, and current capacities and gaps in the EWS.

Objectives: At the end of this session, participants are expected to:

- strengthen their understanding of the EWS, in Myanmar context, through legislations and policies that govern DRR in the country
- understand and be able to undertake effective coordination mechanisms with various institutions and entities, for an enhanced EWS
- understand strengths and gaps in end-to-end EWS, for guiding future plans and decisions

Methodologies: The following methodologies are employed to make this session enriching:

- PowerPoint Presentation
- plenary discussion

- group discussion/exercise/game

Key Learning Points. Hazards are part of Myanmar's geo-physical features. Learning from devastations caused by Cyclone Nargis in 2008, the Standing Order on Disaster Management was put in place in 2009, underscoring the role of EWS and instilled the utilization of risk/forecast/warning information for informed decision-making. Experiences from Cyclone Giri (2010) and other hazard events facilitated the enactment of the Natural Disaster Management Law in 2013 and the Disaster Management Rules in 2015, all highlighting the importance of EWS.

Supporting the requirement for anticipatory actions (i.e. ahead of hazards), the Natural Disaster Management Law of 2013 provides, under Chapter VI, that mandated institutions undertake functions, for reduction of potential damages and losses from hazards, viz.:

- preparatory and preventive measures for disaster risk reduction, prior to hazard events, which include improvements in EWS, application of knowledge and innovation as part of a culture of safety and resilience, from national to community levels; integration of disaster risk reduction in development plans; and putting in place sound preparations from national to community levels
- preparatory measures, in areas, where hazards are likely to strike should include the following: identification of potentially exposed areas and assessment of risks, and planning of necessary actions; undertaking public awareness and practicing EWS; enhancement of capacities for reduction of potential damages and losses; encouragement of active participation of community members; issuance of early warning information to the public, for guiding preparedness actions including, but not limited to, evacuation and moving of assets/properties to safe areas; stockpiling of food, relief items, and rehabilitation materials, for efficient response to requirements; establishment of coordination mechanisms with other authorities, for obtaining assistance as necessary; and building back better
- mitigation measures, in areas where hazards could potentially strike, include, among others: building of cyclone shelters and other relevant evacuation shelters in appropriate areas; establishment of embankments along the coast and flood-prone areas; preservation of mangroves along the coast and re-forestation

For facilitating better understanding of stakeholder roles in EWS, such roles should be evaluated against the expanded end-to-end EWS, in Figure 2.

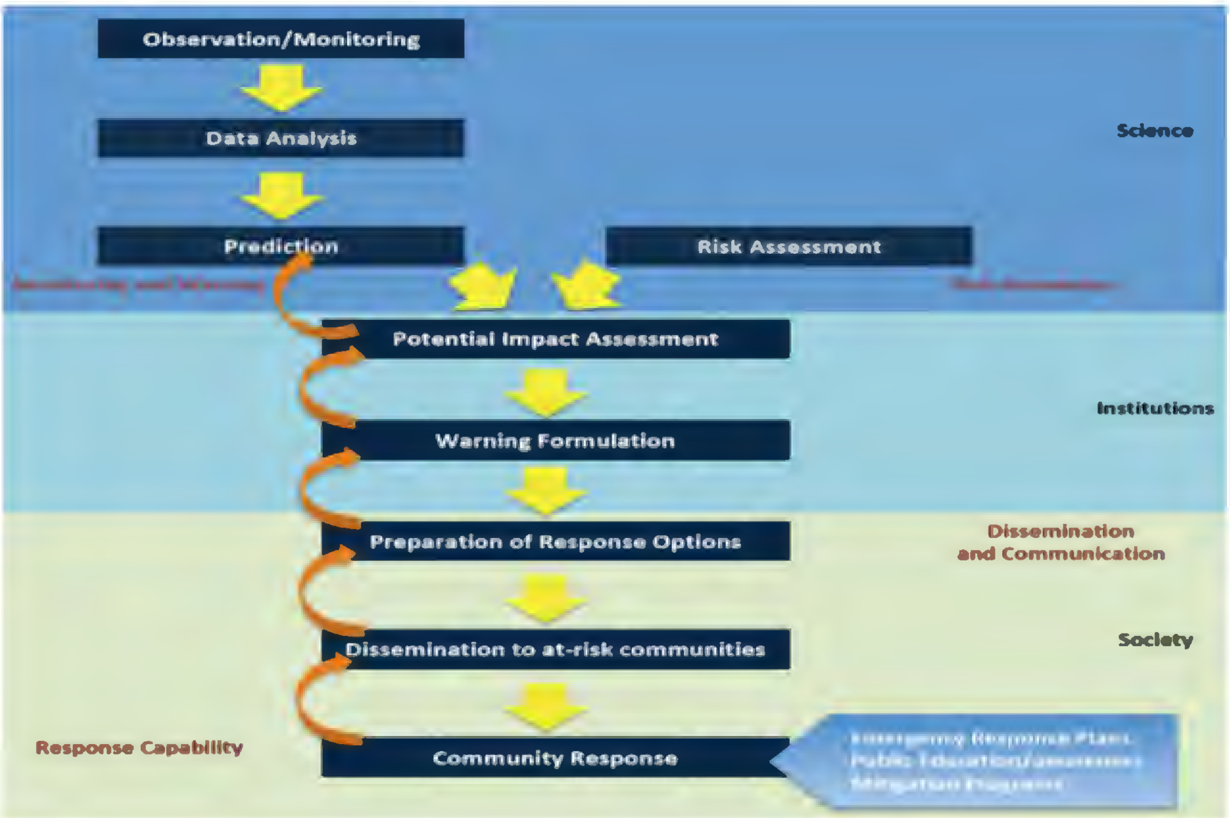

Figure 2. Expanded end-to-end EWS processes (RIMES)

While the practice of DRR, in Myanmar, has improved over years of learning lessons from natural hazards, gaps pervading the end-to-end process have to be sustainably addressed.

For strengthening DRR in the country, the Myanmar Action Plan on Disaster Risk Reduction (MAPDRR), the first phase of which was completed in 2009 and granted government endorsement in 2012, is being renewed (MAPDRR2016), in an effort to ingest requirements vis-à-vis the changing DRR landscape. A component of MAPDRR2016 is the assessment of disaster and extreme events risks in Myanmar, feeding into the EWS elements.

Various development institutions, of international and regional scope, are providing assistance to national and local stakeholders in improving EWS in Myanmar. The efforts by and large, however, needs to be better coordinated and customized to institutional and community requirements in order to contribute significantly to meaningful capacity building.


Hazard Calendar

These Training Modules, on Early Warning System (EWS) for Myanmar, have been completed through the collaboration of the Relief and Resettlement Department (RRD), Department of Meteorology and Hydrology (DMH), United Nations Human Settlements Program (UN-Habitat) and the Regional Integrated Multi-Hazard Early Warning System (RIMES) with support from the Myanmar Consortium for Capacity Development in Disaster Management (MCCDDM) Project.

MODULE 3 RISK KNOWLEDGE

Rationale. Risk knowledge refers to the understanding of hazards, both historical and potential; and the range of risks that have been experienced, and could be possibly experienced, in communities. This Module's focus is on capacitating participants on the analysis of risks from various hazard events, and how such analysis contributes to more effective DRR.

Module 3 includes sessions for analyzing significance of historical hazard and risk information, and tools for participatory risk assessment in communities.

SESSION 3.1. LOCAL HISTORICAL RISK INFORMATION: SIGNIFICANCE AND IMPLICATIONS

Description: A resource for better management of current and future risks is the understanding of historical risks. This session brings forward the significance of historical risk knowledge and how such knowledge can aid better disaster risk reduction, in the future.

Objectives: At the end of this session, participants are expected to:

- understand the importance of local knowledge of historical risks
- appreciate the necessity of documenting historical hazards, community exposure and vulnerability to natural hazards, and local capacities
- utilize historical risk information for current and future DRR

Methodologies: This session is delivered through the following methodologies:

- PowerPoint presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points: ***Importance of Local Risk Knowledge.*** Local risk knowledge has tremendous contribution to capacities in managing/overcoming recurrent hazards, through enhanced understanding of such hazards and their range of differential impacts in various areas and various stakeholders in communities; relationship of the state of environment to hazard impacts; and application of coping mechanisms.

As key to understanding this session, it is imperative to recall that in the context of DRR, risk is the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNISDR, 2009). In brief, risk can be expressed in the following equation, where R is risk, H is hazard, V is vulnerability and C is capacity:

$$R = \frac{H \times V}{C}$$

Over centuries, communities have experienced hazards of varying degrees and magnitudes, and have developed mechanisms to overcome the impacts of such hazards. While ideally handed over and evolved through generations, many are not documented and arguably, those which are more frequent, but having low impacts, are better remembered compared to those which occur less frequently, but having severe impacts.

In many communities, the younger generation and new community members are devoid of local risk knowledge, making them as among the vulnerable groups. This community population is often "surprised" by hazard events and how they suffered devastating impacts, due to non-preparedness or non-understanding of the severity of the potential hazard impacts, before the event.

As often the case, local risk knowledge is overlooked as new community members settle in and development is pursued, resulting to higher rates of vulnerability. When local risk knowledge is low, activities or priorities – including development plans – are unlikely to be informed, thereby exposing essential elements hazards.

Some relevant questions in having a deeper understanding of local risks, are the following:

- what have been the hazards experienced in the community?
- what have been the range of impacts experienced, for each hazard?
- per hazard, what have been the most extreme experienced? When was this and what were the impacts?
- what is the pattern of recurrence of these hazards?
- who have been most vulnerable per hazard?
- are these the same vulnerable groups every time a particular hazard occurs?
- why is the vulnerability recurrent for these particular groups?
- what are the local coping capacities practiced by the population?
- what are local resources available that aids DRR, when faced with various hazard events?

Documentation of community experiences. Documentation of community experiences are essential for educating generations of local risks. In many communities, however, the systematic documentation of hazards, and risks, are not undertaken. In some areas, pragmatic documentation of extreme hazard events have been done; below cites a few examples:

> ***Japan.*** Stone marker, in Aneyoshi, advising local residents not to build houses below the marker location, in Figure 3. The stone marker has been in place for hundreds of years, documenting the extent of tsunami event that was once experienced in the area.

*Figure 3. An ancient stone marker reminding residents in Aneyoshi, Japan that houses are **not** to be built lower than the location of the stone (Sasaki, K./Fackler, M., New York Times, 2011).*

Canada. In Kamloops, British Columbia, Canada, a flood marker stands in the High Water Plaza, Riverside Park identifying significant flood events, in Figure 4. The highest flood event recorded was in 1894; others were in 1972, 1948, and 1984.

Figure 4. Flood marker in Kamloops, British Columbia, Canada, marking significant events. The most severe flood event recorded was in 1894 (Waymarking.com, 2011)

Integration of local risk knowledge into short-, medium- and long-term plans and decisions. Integration of local risk knowledge into decisions and plans, together with other EWS elements, is essential for anticipatory and proactive risks reduction. Examples, below, provide perspectives on the application of risk knowledge.

Philippines. Located in northernmost part of the country, Batanes Province is a group of islands situated between Philippines and Taiwan. Wind, rain, and typhoons[2] are part of the province's normal climate. Of its 10 islands, only three (3) are inhabited. About ¾ of its population (total population is 16,604 as of December 2014) are engaged in farming and fishing.

Anchored on the province's long experience of typhoons and its various impacts[3], the Ivantans[4] evolved mechanisms for improving how they cope with local hazards:

- Houses are characterized by thick stone walls (around 2-4 feet), with thick roof made of long-bladed grass called *cogon* (sn: imperata cylindrica), and small doors and windows for resisting typhoon winds, in Figure 5.
- Local boats (called paluwa), commonly used in interisland transportation, were made with round-shaped hull, for better navigation in rough seas, in Figure 6.
- Agriculture lands are usually lined with trees, as wind breakers, to prevent damage to crops.

Figure 5. Houses in the province of Batanes, Philippines are made up of thick stone walls, and thick thatched roof for withstanding typhoons (Photo: Babiera, M; Source: Uy & Shaw; adapted from Hornedo, F., 2000; in UNISDR, 2008)

[2] *Typhoons are the same as cyclones; the name varies based on the area of origin. It should be noted that on an average, the Philippines is crossed by about 20 typhoons per year; approximately eight (8) pass through Batanes.*
[3] *Historical impacts include animal death, unroofing of local structures and houses, destruction and damage to buildings, drifting off-course of fishing boats, among others.*
[4] *Inhabitants of Batanes Province*

Figure 6. Local boats in Batanes province have rounded hulls, for better navigation in rough seas (Photo: Babiera, M; Source: Uy & Shaw; adapted from Hornedo, F., 2000; in UNISDR, 2008)

Japan. In the earlier provided example of tsunami stone marker in Aneyoshi, residents integrated the warning into their decision on building their houses; this, despite the fact that they were not able to personally witness the tsunami that the stone marker was referring to – the marker has been in its spot before their generation. All of the 11 houses in the village were safe from the 11 March 2011 Japan tsunami – the wave reached 300 feet below the marker.

Risk knowledge in risk prioritization and development investments. Resilient development has to integrate risk knowledge. In a country that is facing fast-paced development, priorities of national and local governments, development organizations, and communities have to be guided by risk knowledge, along with other EWS elements.

SESSION 3.2. TOOLS AND METHODOLOGIES FOR PARTICIPATORY RISK ASSESSMENT

Description: This session targets building of capacity of participants to undertake participatory risk assessment, for improving understanding of local hazards, vulnerabilities and patterns thereof, and capacities for guiding better plans and decisions.

Objectives: This session aids participants in:

- identifying tools for participatory hazard, vulnerability and capacity assessment
- undertaking and leading participatory risk assessment in communities
- integrating risk assessment outputs into plans and decisions

Methodologies: The following training methodologies are employed in delivering this session:

- PowerPoint presentation
- plenary discussion
- group discussion/exercise/game

- on-site exercise (to pre-determined village)

Key Learning Points. Undertaking Risk Assessment. The importance of risk knowledge, as underscored in the earlier session, builds the case for the necessity of undertaking risk assessment, in every community, and making available the outputs for integration into multi-sectoral plans and decisions.

While various methodologies are available for risk assessment, this Module employs methodologies for participatory risk assessment, to optimize the inclusion of community perspectives/local risk knowledge in the same. The capacity building in undertaking participatory risk assessment is expected to enable local governments to be able to undertake, and update, risk assessments regularly.

Focus group discussion (FGD) is the key driver of participatory risk assessment, enabling facilitators to discuss with local stakeholders about hazards in their communities, the impacts they experienced, the vulnerabilities and factors contributing to impacts, and local capacities. A moderator/facilitator guides the discussion and ensures participation of stakeholders in the deliberation of topics at hand. The FGD also facilitates discussion, among stakeholders, for clarifying and validating facts, as well as obtaining differential perspectives on the same topic. FDG is illustrated in Figure 7.

Figure 7. Focus group of farmers in Myanmar's Central Dry Zone (Photo credit: Policarpio/RIMES, 2013)

In a participatory risk assessment, it is important that community participants cut across sectors, sub-communal zones, gender and age groups, to ensure that all relevant information are obtained.

Preparations. Before doing the risk assessment, necessary preparations have to be undertaken, as follows:

- capacity building of team members:
    - what they are going to do
    - why they are doing it
    - how they are going to do it

- identification of facilitators, note takers, and team members who will undertake necessary arrangements
- identification, in advance, of potential sensitive issues and threshing out a range of strategies in addressing the same
- visits to communities, and identification of stakeholders, have to be pre-arranged
- FGDs should be brief (within 3 hours or less), in order not to bore participants
- Tools, and their utilization, have to be understood and determined, prior to the FGD

Principles. The primary aim of undertaking participatory risk assessment is for people in communities to have deeper understanding of their hazards, vulnerabilities, and capacities, for guiding plans and decisions, for improving disaster risk reduction. Both the process and outputs of participatory risk assessment have to be owned by, and integrated into, communities. This is essential if the risk assessment outputs are to drive initiatives for reducing community vulnerabilities and improving capacities.

To facilitate ownership by, and integration into, communities, the following are to be remembered when undertaking participatory risk assessment:

- common understanding, clarity and agreement have to be established, between facilitators and community members, on the purpose of the participatory risk assessment
- courtesy and respect is paramount, with consideration for sensitivities in relevant issues and concerns
- utmost participation from stakeholders is the key to having meaningful process and outcome; a non-formal environment has to be established at the beginning of discussions/activities, to develop rapport with community members
- enjoin discussion with participants; be conscious to constantly steer the discussion to align with the purpose of the activity
- information collated should analyzed with community members; priority risks have to be identified with them
- as part of action planning, empowerment of communities is utmost – the process for identification of low-cost but effective mechanisms or processes for reducing vulnerability and increasing capacity would be a recommended approach

Hazard Assessment. The first component in disaster risk assessment, hazard assessment facilitates determination/establishment/confirmation of climate and geological hazards relevant to the locality, their location, range of intensities, frequency and probability (UNISDR, 2009).

As part of this training, key tools that will be utilized for undertaking hazard assessment are a) key informant interview, b) mapping and c) seasonal calendar.

> ***Key informant interview,*** in Figure 8, is employed for gathering hazard-related data from DMH, RRD and other related institutions. Ideally, significant observation and other data, for relevant hazards, are already obtained before conducting community-level activities, to guide discussions as well as to serve as validation for information provided by community stakeholders. It is best to have a checklist of data required/guide questions for conducting expert interviews.

Figure 8. Key informant interviews are useful for obtaining relevant data from authorities or experts (http://www.umanitoba.ca/institutes/natural_resources/dengue/pphotos.htm)

Mapping is targeted to identify the different hazards that have been experienced in various parts of the community, in visual form (refer to Figure 9). Community stakeholders draws the community map, and identify the hazards that have been experienced, in which part of the community, as far as they can remember. Various indicators can be used (e.g. colors, flags, stones, sticks, etc.) In this training, mapping will also be used for assessing key capacities / resources in communities.

Seasonal Calendar gleans information on the seasonality (or lack thereof) of hazards experienced in communities (in Figure 10). Better understanding of the seasonal behavior (or lack thereof) of hazards contributes to better preparedness.

Figure 9. Mapping, in participatory risk assessment, is an effective tool for visual presentation of hazards affecting communities. Mapping is also an affective tool assessing and understanding vulnerabilities and capacities (Photo: UN-Habitat, 2017)

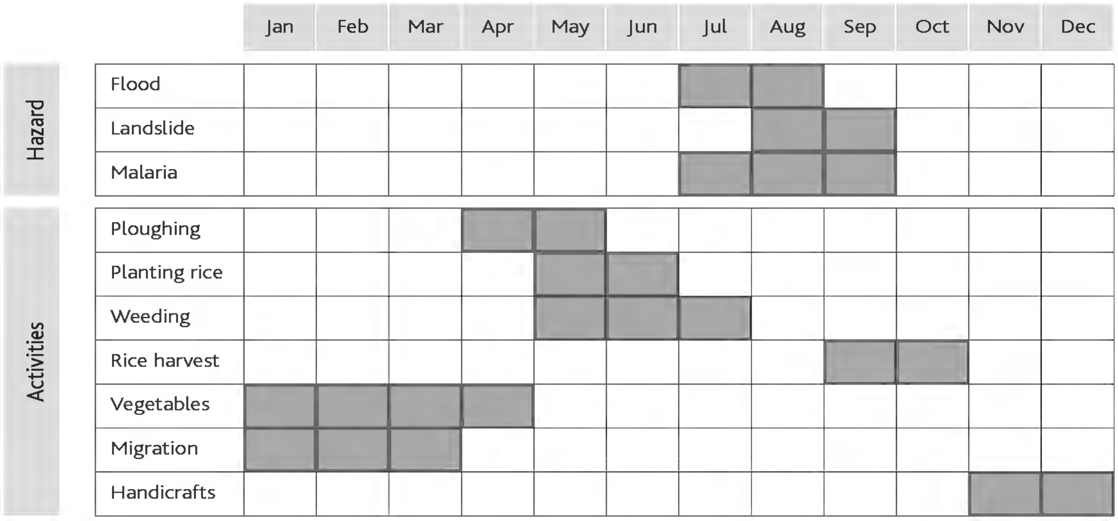

Figure 10. Seasonal calendar assists in identifying the seasonality, or non-seasonality, of hazards. As part of this training, the seasonal calendar will also be used for identification of key activities, in different sectors, for facilitating better understanding of livelihood-related and other activities which are most at risk, in particular seasons. The seasonal calendar can further facilitate better understanding of non-seasonality of some hazards, like earthquake and tsunami. (Figure: Tearfund, 2011)

Vulnerability Assessment focuses on exposure of population, assets and livelihoods to hazards; and their susceptibility to, or the capacity to overcome, hazard impacts. Vulnerability is determined by various factors including physical, social, health, environment and economic perspectives. The following tools are effective for undertaking vulnerability assessment:

> ***Seasonal Calendar*** (refer to Figure 10), for identifying key activities/decisions, in the community, across seasons. Used together with the seasonal hazard calendar, this provides better comprehension of activities that could potentially be vulnerable, given particular hazards, as well as activities that could be optimum given the right conditions.
>
> ***Transect Walk*** to confirm exposure, vulnerability, and capacity data from secondary sources, as well as to obtain other relevant information, presented in Figure 11.

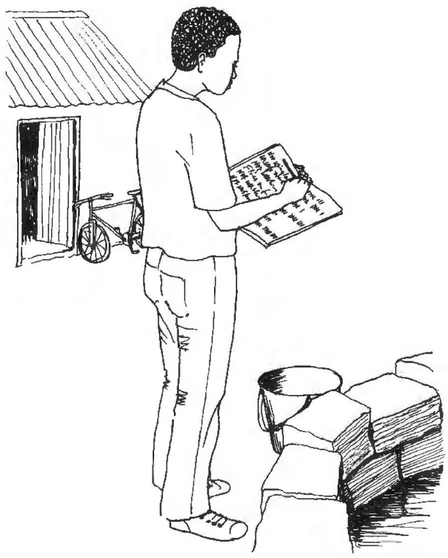

Figure 11. Transect walk is used for confirmation of data obtained from secondary sources, as well as to gather other relevant information (Figure: Tearfund, 2011)

Vulnerability and Resource Mapping (refer to Figure 10), for identification of population at risk, critical infrastructures that are at risk, as well as those which may be used as capacities during hazard events (e.g. evacuation centers, etc.).

Risk Analysis facilitates prioritization of hazards, impacts and vulnerabilities. The process is key for guiding plans, policies, decisions and interventions. Tools that could be utilized for risk analysis are provided below:

Ranking, in Figure 12, facilitates identification of hazards, impacts, and activities which are utmost for communities. Ranking can be done through voting, or any similar mechanisms. This process is useful in understanding which hazard(s) has severest impacts to community members.

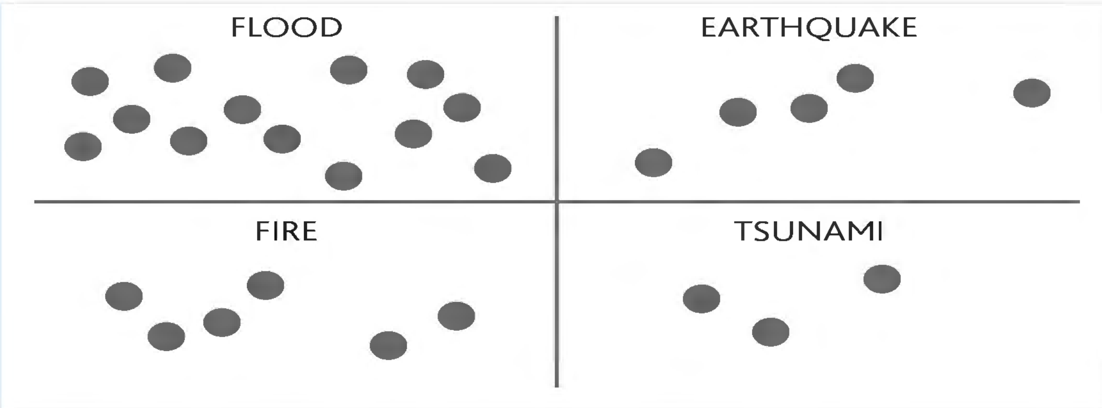

Figure 12. Ranking allows community members to priotitize hazards of most significant impacts to them (Figure: Tearfund, 2011)

Historical timeline is utilized to visualize trends in hazard occurrence, over long periods of time, and their varying impacts. The trends can be used to draw inferences vis-à-vis potential impacts of similar hazards in the future (in Figure 13).

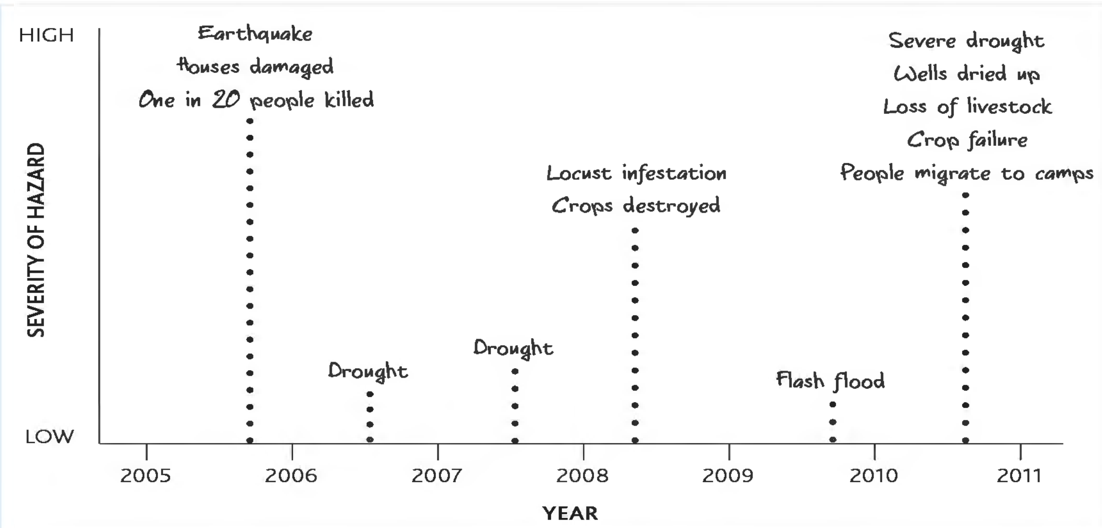

Figure 13. Historical timeline assists in understanding the trends in hazard occurrence and their impacts. Indicators of severity of hazard impacts are usually through the size or height of indicators (Figure: Tearfund, 2011)

Contents

MODULE 4 MONITORING AND WARNING SERVICE

Rationale. Key to EWS is monitoring and warning service, for guiding informed decisions. In Myanmar, DMH provides monitoring and warning services for both hydro-meteorological and geological hazards. In order to facilitate informed decisions, stakeholders in various levels should be able to understand, contextualize into their sectors and activities, and utilize information of various timescales from DMH. The understanding of inherent uncertainties in forecast is also important to meaningful application of the same, for risks reduction.

SESSION 4.1. DMH: MANDATES AND SERVICES

Description: This session encapsulates the key mandates and services of DMH, for disaster risk reduction. As an integral element of the EWS, it is a necessity for participants/stakeholders to understand DMH's role, as the provider of multi-hazard, multi-timescales information.

Objectives: At the end of this session, participants are expected to:

- understand the mandate of DMH and connect this to EWS
- identify key areas of society where DMH-generated information contributes to

Methodologies: This session employs the following:

- PowerPoint presentation
- Plenary discussion
- Group discussion/exercise/game

Key Learning Points. DMH, today under the Ministry of Transport and Communications, has a long history of providing multi-hazard, multi-timescales information, for preparedness, for various stakeholders in Myanmar.

Established on 1 April 1937 as Burma Meteorological Department (BMD), it became a member of the International Meteorological Organization (IMO) in 1938. After 35 years, BMD was reorganized on 23 October 1972; and renamed Department of Meteorology and Hydrology in 1974.

DMH was under the aegis of then Ministry of Transport and Communication, in 1947; it was moved to the Ministry of Communications, Posts and Telegraphs in 1992. Subsequently, in 1999, DMH was moved to the Ministry of Transport. Driven by the recent changes in government landscape in Myanmar, the Ministry of Transport has been reorganized and renamed as Ministry of Transport and Communications in 2016, where DMH remains as a line department.

The first Myanmar Daily Weather Report was issued on 1 June 1947. 70 years after, DMH services has evolved and currently, multi-timescales information – from daily, 10 days, monthly, seasonal, and climate change projections – are generated and issued to stakeholders.

DMH has also established the National Earthquake Data Center (NEDC), as its dedicated division for the provision of earthquake monitoring and tsunami early warning services.

DMH has the key mandate for generation and provision of forecast/warning/ information, for:

- taking precautionary measures by society against, and minimize the impacts of, natural hazards
- promotion of safety, comfort, efficiency and regularity of air, land, sea and inland water transportation
- bringing sustainable development and utilization of natural resources, to include hydro-power generation, production from forests, and utilization of water, energy, and other available resources
- promotion of agricultural and food production
- ensuring efficient operation, planning and development of activities in defense, industry, health, social welfare and other relevant sectors in Myanmar

In addition, DMH is mandated for undertaking international collaboration for capacity development in multi-hazard observation, monitoring, analysis, warning development and communication of information.

Currently, DMH includes 8 divisions: meteorology, hydrology, agro-meteorology, aviation meteorology, seismology, upper Myanmar, lower Myanmar, and engineering.

SESSION 4.2. HYDRO-METEOROLOGICAL HAZARDS: DRIVERS, MONITORING AND PREDICTION SYSTEM AND INFORMATION SERVICES

Description: This session introduces climate drivers, for better understanding of local climate and hydro-meteorological hazards, overview of DMH forecasting/prediction processes, and multi-timescales information products and services available, as well as mechanisms of translating forecasts into relevant information for various sectors, for disaster risk reduction.

Objectives: At the end of the session, participants would be able to:

- understand various climate drivers relevant to Myanmar
- understand various hydro-meteorological hazards in Myanmar and identify their triggers
- have a basic understanding of DMH's mechanisms for hazards monitoring and forecast/warning generation
- understand available forecast/warning information of various timescales generated by DMH, and identify their intended uses

Methodologies: Key methodologies employed in this session are:

- PowerPoint presentation
- video presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points. ***The Climate System:*** The climate of a location is affected by its latitude, terrain, and altitude, as well as nearby water bodies and their currents in Figure 14. Climate and hazards vary, based such interactions.

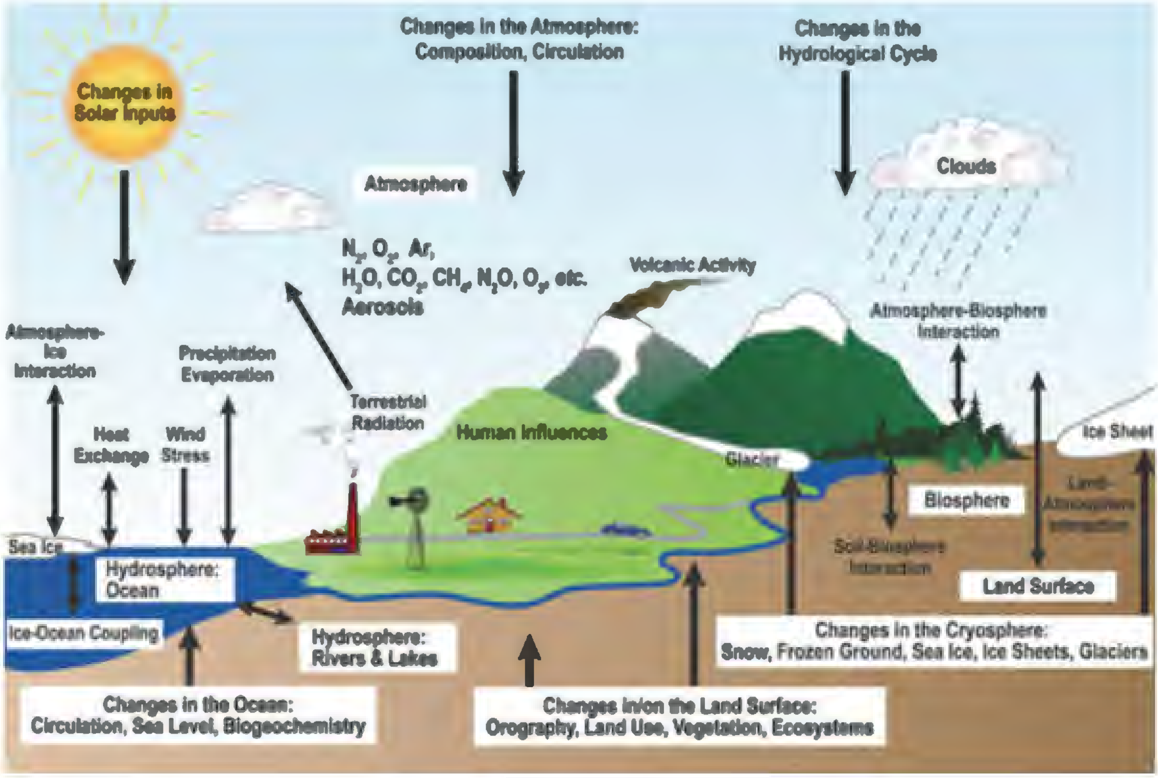

Figure 14. Climate is the result of the interaction of various elements (Figure: Baede, A., et al. in IPCC, 2001)

Referenced to definition of terminologies by UNISDR (2009), hydro-meteorological hazards include processes and/or phenomena, of atmospheric, hydrological or oceanographic origin, that have potential for causing loss of life, injury and other related impacts, damage to property, disruption to social and economic sectors, or degradation of the environment.

Hazards in Myanmar, due to hydro-meteorological causes, are driven by dynamic process in the atmosphere. Myanmar's seasonal climate is primarily due to the reversal large-scale wind patterns, called the monsoon. The wet season in the country (May-October), which on a national average contributes around 95% of the annual rainfall, is due to the abundant moisture carried inland by the Southwest Monsoon. On the other hand, the dry season is dominated by cool dry winds of the Northeast Monsoon. Figure 15 explains this.

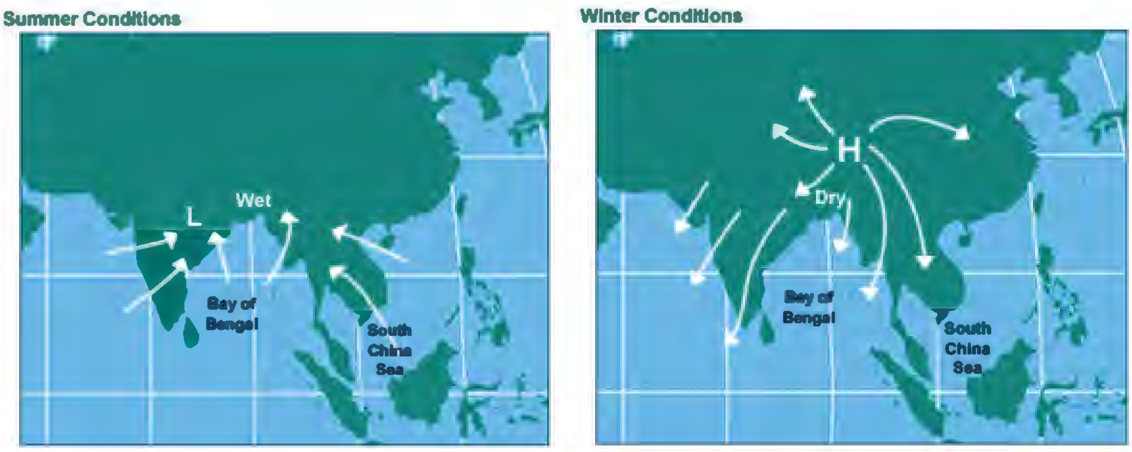

Figure 15. Large-scale reversal of winds, called monsoon, drives Myanmar's seasonal climate. (Figure: The Comet Program, 2008)

Spatial and temporal variations in rainfall is manifest in Myanmar. While many parts of the country observe only one (1) rainfall peak (July/August) within its rainy season, the Central Dry Zone observes 2 rainfall peak (May/June and August/September).

Due to proximity to the source of moisture and strategic location vis-à-vis the Southwest Monsoon, Myanmar's coastal areas are the wettest parts of the country, receiving up to 5,000mm annually. In comparison, the driest area in the country - the Central Dry Zone - receives only around 500-1000mm of rainfall yearly. The modulator of the Central Dry Zone's semi-arid climate are the mountains that surround the area, preventing most of the Southwest Monsoon rainfall (rain shadow effect, in Figure 16.

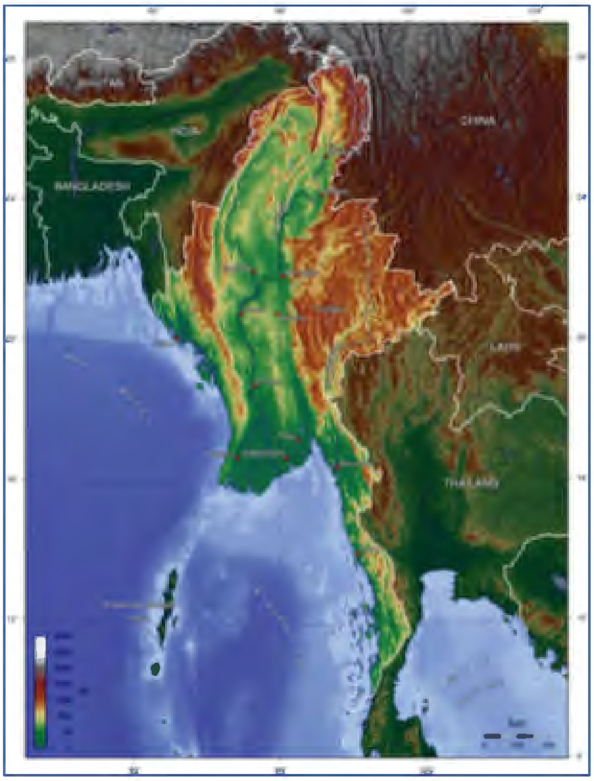

Figure 16. Mountains enveloping Myanmar's Dry Zone, preventing much of the Southwest Monsoon rainfall from entering the country's central area. Figure: http://www.lahistoriaconmapas.com

Based on regional and local conditions dominant in the area, year-on-year, variations in rainfall and temperature are experienced – this is referred to as temporal variability. The variabilities, in both space and time, often result to hazards. Recurrent hazards, of hydro-meteorological origin in Myanmar, include:

Heavy Rainfall. While the Southwest Monsoon is highly essential for livelihoods productivity and general well-being of Myanmar constituency, it also brings various hazards to the country. Heavy rainfall, during the season, can usually lead to secondary hazards like floods and landslides. Heavy, short-duration rainfall, may also be observed when there are severe weather disturbances of regional and local scales (e.g. storms in the Bay of Bengal, remnants of typhoons from South China Sea, thunderstorms, etc.)

As mentioned in the outset, **flood** can occur from excessive rainfall. Rainfall-induced floods can be **riverine** (flood usually covers a wide area, due to swelling of rivers); **flash** (typically very rapid, driven by short-duration extreme rainfall upstream or on-site); or **localized** (isolated or in small locations, triggered by heavy rainfall and other factors like inefficient drainage system, etc.).

Another secondary hazard to heavy rainfall is **landslide**, which is a downward movement of rock, debris, or soil. Based on age and quality of rocks/soil, and other environmental conditions, elevated areas can have different rainfall thresholds, beyond which a landslide can occur.

Cyclone. Tropical cyclones form over warm waters (i.e. warmer than 26°C in the vicinity of the equator). Warm water catalyzes evaporation, which is necessary for conveying energy into the atmosphere, from the ocean. A cyclone is characterized by rotating high-speed winds, with a defined eye (low pressure area) in the core. It should be noted that since cyclones obtain their energy from the ocean, they weaken as they make landfall, move inland, or into higher altitudes. Myanmar's proximity to the Bay of Bangal make it susceptible to cyclones. Cyclones are most frequent in Myanmar in April and May, and in October and November.

Cyclones are associated with **strong winds**. Strong winds can propel **storm surge** as secondary hazard to cyclones, thereby resulting to coastal flooding. Coastal flooding can also occur from high tide and in some cases, the combined effect of heavy rainfall and high tide.

On the other hand, **thunderstorms** are localized events that are swift-forming. A thunderstorm is characterized by short-duration intense rainfall occurring with lightning and thunder. In some cases, localized flooding can be triggered by heavy rainfall from thunderstorms. In severe thunderstorms, hail and tornadoes may occur.

In Myanmar, the most water-stressed regions are those in the Central Dry Zone. **Drought**, however, is not confined to this zone – drought can also occur in other places in the country in cases where there is significant deficit in rainfall from the Southwest Monsoon, as well as from severe weather disturbances.

DMH identifies broad areas in Myanmar where hazards can occur, in Figure 17. These are, however, broad categorizations and have to be refined, in specific areas, through experiences gleaned from local constituents.

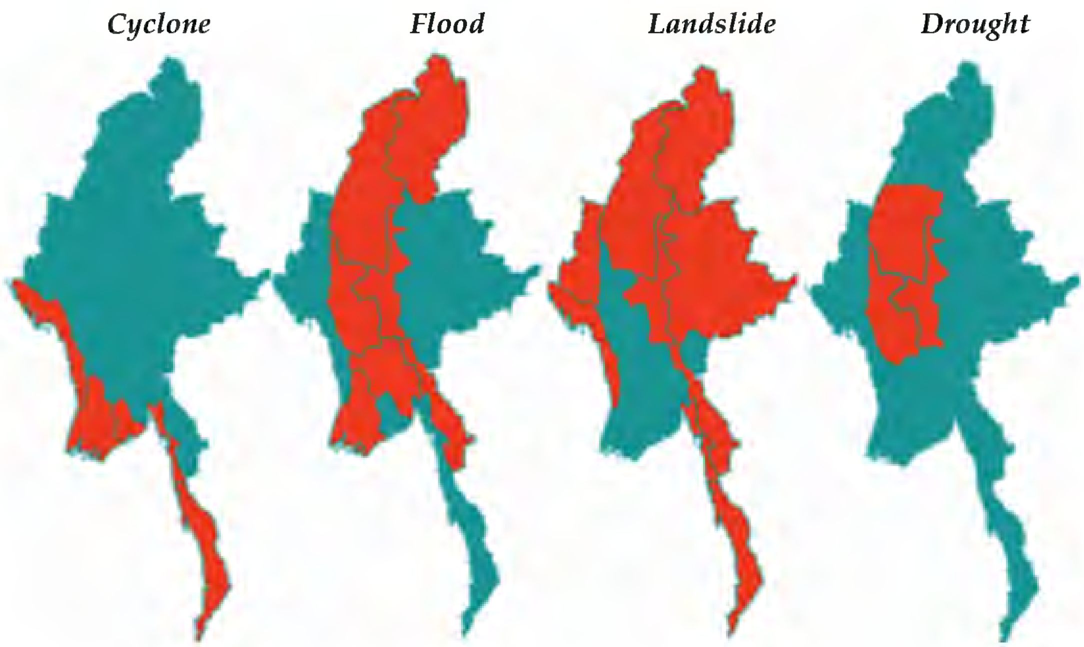

Figure 17. Areas prone to hydro-meteorological hazards in Myanmar (Figure: DMH)

Monitoring and Prediction. DMH has a network of observation stations, to facilitate real-time monitoring of weather conditions in many parts of the country. DMH, as a member of WMO, is also connected to regional and global centers for weather/climate prediction, for provision of guidance to forecasters for generation of forecasts/warnings for the country. Further, through assistance from various international and regional partners, DMH forecasters run weather/climate models which further provide basis for analysis of most likely weather conditions that can occur in various parts of the country.

In finalizing forecasts/warnings for Myanmar, the skill of the forecaster is very important, noting varying model outputs from various centers and DMH-run models, and many other factors that play significant influence to local weather/climate.

In the previous Module, the importance of historical data have been highlighted for understanding local risks. In DMH, historical data provides much needed evidence in understanding patterns, variabilities, extremes and trends in climate; feeds into various climate models for customization of forecasts/predictions; and provides reference for anticipating future climate.

DMH-Generated Forecast of Various Timescales. DMH has evolved multi-timescales information for various stakeholders in Myanmar. These are provided below:

Climate Change Projections. Drawing from latest models and datasets, DMH has generated projections for potential rainfall and temperature conditions in 2021-2040; 2041-2060; 2061-2080; and 2081-2100 time slices, for various regions and states.

Seasonal Climate and Water Levels Outlook. The seasonal climate and water levels outlook are issued specifically for the Southwest and Northeast Monsoon season. Per DMH protocol, the seasonal outlook is provided to the public annually, on 28 April. Providing information on the potential climate / flood for the wet season, the seasonal climate outlook includes monsoon intensity, monsoon onset and withdrawal periods, bay conditions, cyclone frequency, potential rainfall conditions for regions and states, and number of rainy and foggy days and flood outlook for respective hydrological monitoring sites. The seasonal climate / water levels outlook is divided into early monsoon (May to June); peak monsoon (July to August) and late monsoon (September until monsoon withdrawal). Updates are provided every 28 June for the peak monsoon; and 28 August for the late monsoon.

Monthly Climate and Water Levels Outlook. Provided to stakeholders every 28th of each month, the monthly climate outlook provides information on the potential rainfall and number of rainy days, and development of severe weather disturbances over the Bay of Bengal, among others. The water levels outlook provides information vis-à-vis potential water conditions in various rivers in the country.

10 Days Forecast. DMH-generated 10 days forecast provides a summary of the likely water levels, rainfall and number of rainy days, and Bay of Bengal conditions. The 10 days forecast is updated every 8th, 18th and 28th of each month.

Daily Weather and Water Levels Forecast. Updated on 24-hour basis, this indicates potential rainfall and temperature for Myanmar's states and regions; and Bay of Bengal and sea conditions. The daily weather forecast further provides an outlook/potential conditions for the next 2 days. The daily water levels forecast provides 24-hour advance for (42) hydrological forecasting stations along 12 major rivers.

Severe weather warnings. These are issued when storms form over the Bay of Bengal. Specifically, DMH issues:

- ***Storm News,*** in cases where storms/cyclones: are not expected to cross Myanmar; have the potential to cross Myanmar but not yet within the country's area of responsibility; or threat is over

- ***Storm Warning,*** in events where storms/cyclones: are expected, within 12 hours, to cross the coast of Myanmar; or are already in the country.

When storms/cyclones form during the dry months, DMH issues **untimely rainfall warning**. Further, relevant to heavy rainfall, DMH also generates flood information, as follows:

- ***Flood warning,*** when observed water level is one (1) meter below the pre-determined danger level in particular stations

- *Flood bulletin*, when observed water level has breached the pre-determined station-wise danger level. Updates are regularly provided until the water has receded.

Further, DMH issues **significant water level bulletin** and **minimum alert water level bulletin** depending on water level in upstream stations:

- **Significant water level bulletin**, in April and May (pre- monsoon), is issued for guiding people in low-lying areas, fishermen and farmers near the river bank to be cautious of rising of water level, due to sharp rise in water level in upstream stations. The significant water level bulletin is issued 3 to 7 days in advance for downstream stations along Ayeyarwaddy and Chindwin Rivers.

- **Minimum alert water level bulletin** is issued to relevant local communities and authorities for guiding navigation and river pumping, etc. This is issued during the low-flow period (March, April and May), when the water level reach or fall below respective minimum alert water level at least (10) days in advance, in identified six (6) stations of Ayeyarwaddy River and one (1) station of Chindwin River in Central Myanmar areas.

Interpreting Forecasts/Warnings. In order to facilitate effective utilization of forecast of various timescales, terminologies to describe weather/climate condition have to be understood by stakeholders. Tables 1 to 5 provides guidance for better understanding of multi-timescales products, through interpretation of the terminologies used in forecasting.

Table 1. Interpretation of Terminologies in Long/Extended Range Forecasts

Parameter	Terminologies	Interpretation
Rainfall and Temperature	Average	In climatology, average is computed from historical observation data of at least 30 years.
Rainfall	Normal	Anticipated/observed rainfall is close to average, at within the range of ± 20%
	Below Normal	Anticipated/observed rainfall is less than the normal rainfall range (i.e. below - 20%)
	Above Normal	Anticipated/observed rainfall is higher than the normal rainfall range (i.e. above + 20%)
Temperature	Normal	Anticipated/observed temperature is within ±1.5°C of the average temperature
	Below Normal	Anticipated/observed temperature is less than the normal temperature range (i.e. lower than average temperature – 1.5°C)
	Above Normal	Anticipated/observed temperature is greater than normal temperature range (i.e. higher than average temperature +1.5°C)

Table 2. Interpretation of Terminologies for Monsoon Intensity

Parameters	Terminologies	Conditions
Monsoon intensity	Vigorous	Anticipated/observed monsoon conditions include robust rainfall, strong wind, and rough seas
	Strong	Anticipated/observed monsoon conditions include significant rainfall, strong wind, moderate to rough seas
	Moderate	Anticipated/observed monsoon conditions include less rainfall and moderate winds in many parts of the country; this is characterized by increased rainfall in the Central Dry Zone.
	Weak	Anticipated/observed monsoon conditions include slight wind, light to smooth sea, and less rain in most

		of the country; convection/thunderstorm rain, however, is manifest in Central and Northern Myanmar.
	Feeble	Anticipated/observed conditions is overall characterized by fine weather and smooth seas with light wind

Table 3. Interpretation of Terminologies in Short-Range Forecasts

Parameters	Conditions	Interpretation
Rainfall	Isolated	Anticipated/observed rainfall is in about 30% of the area of respective region or state
	Scattered	Anticipated/observed rainfall is in about 50% of the area of respective region or state
	Fairly widespread	Anticipated/observed rainfall is in about 75% of the area of respective region or state
	Widespread	Anticipated/observed rainfall is in >75% of the area of respective region or state
	Cloudy	No rain is expected/observed; overcast conditions
	Light	*Central Myanmar*: Less than .5 inch of rain is likely/observed within 24 hours *Rest of the country*: Less than 1 inch of rain is expected/observed in 24 hours
	Heavy	*Central Myanmar*: more than 1.5 inches of rain is expected/observed in 24 hours *Coastal areas/rest of the country*: above 3 inches of rain in 24 hours
	Regionally Heavy	*Central Myanmar*: more than 30% of the area anticipates/has observed over 1.5 inches of rainfall within 24 hours *Rest of the country*: over 30% of the region or state anticipates/experiences over 3 inches of rainfall in 24 hours;
	Isolated Heavy	*Central Myanmar:* about 30% of the area anticipates/experiences over 1.5 inches of rain in 24 hours *Rest of the country:* around 30% of the region or state expects/experiences over 3 inches of rain within 24 hours
Squalls	Occasional	Squalls is likely/experienced 4 to 6 times within 24 hours
	At time	Squalls is likely/experienced 1 to 2 times within 24 hours
Sea	Light	Wave height is about 2-4 feet
	Rough	Wave height is about 4-8 feet
	Very rough sea	Wave height is about 8-12feet

Table 4. Storm and Wind Categories

Classification	Wind Speed (in mph)
Low Pressure Area	≤ 32
Depression	32-38
Deep Depression	39-54
Cyclonic Storm	55-72
Severe Cyclonic Storm	> 73
Severe Cyclonic Storm with Hurricane Wind Force	> 120

Table 5. DMH Color Coding System for Storms/ Cyclones

Color Code	Interpretation
Yellow	The storm or cyclone is not anticipated to cross the coast of Myanmar

Orange	The storm or cyclone is heading to the coast of Myanmar, but not anticipated to be in the country in 12 hours
Red	The storm or cyclone is likely to cross the coast of Myanmar within 12 hours
Brown	The storm or cyclone is crossing the coast of Myanmar or is within the country's area of responsibility
Green	The storm or cyclone has passed and the threat is over

SESSION 4.3. GEOLOGICAL HAZARDS: DRIVERS, MONITORING AND PREDICTION SYSTEM, AND INFORMATION SERVICES

Description: Multi-hazard EWS is essential for holistic, cost-effective, and optimum system. This session is dedicated to understanding prevailing geological hazards in Myanmar, their drivers, as well as their recurrence and range of impacts thus far experienced in the country, and impacts that could be potentially experienced in the future. This session also integrates DMH capacity in monitoring and provision of relevant information vis-à-vis such hazards.

Objectives: This session assists participants to:

- understand various geological hazards in Myanmar, and their drivers
- understand and appreciate DMH's capacity for monitoring, analysis and prediction systems for geological hazards
- identify and understand monitoring/early warning products and services for geological hazards
- identify and appreciate preparedness for various geological hazards

Methodologies: This session is undertaken with the following methodologies:

- PowerPoint presentation
- video presentations
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points. ***Geological Hazards.*** Geological hazards originate from internal earth processes (UNISDR, 2009). Key examples of geological hazards in Myanmar are earthquakes – tsunami, liquefaction and earthquake-induced landsides are among earthquake's secondary hazards experienced in the country.

Earthquake Drivers. An earthquake is what occurs when two blocks of earth suddenly slip past one another (USGS). The most relevant earthquake in Myanmar is tectonic, which results from swift movements along faults.

Tectonic earthquake occur because the earth's crust and top mantle are comprised of many moving parts called tectonic plates. Along the edges of the tectonic plates are faults and when the plates move, the faults can get stuck. The continued movement of the plates can lead to the faults suddenly unsticking, thereby generating earthquakes.

Acronyms

BMD	Burma Meteorological Department
DMH	Department of Meteorology and Hydrology
DRR	Disaster Risk Reduction
EWS	Early Warning System
FGD	Focus Group Discussion
GAD	General Administration Department
IMO	International Meteorological Organization
IPCC	Intergovernmental Panel on Climate Change
MAPDRR	Myanmar Action Plan on Disaster Risk Reduction
MCCDDM	Myanmar Consortium for Capacity Development in Disaster Management
NDPCC	National Disaster Preparedness Central Committee
NEDC	National Earthquake Data Center
NMHS	National Meteorological and Hydrological Service
NTWC	National Tsunami Warning Center
RIMES	Regional Integrated Multi-Hazard Early Warning System
RRD	Relief and Resettlement Department
UNDP	United Nations Development Programme
UNISDR	United Nations Office for Disaster Risk Reduction
UN-Habitat	United Nations Human Settlements Program
USGS	United States Geological Survey
WMO	World Meteorological Organization

Earthquakes in Myanmar. Myanmar's seismicity is highly influenced by a) Eaurasian plate, b) Indian plate, c) Burma plate and d) Sunda plate, in Figure 18.

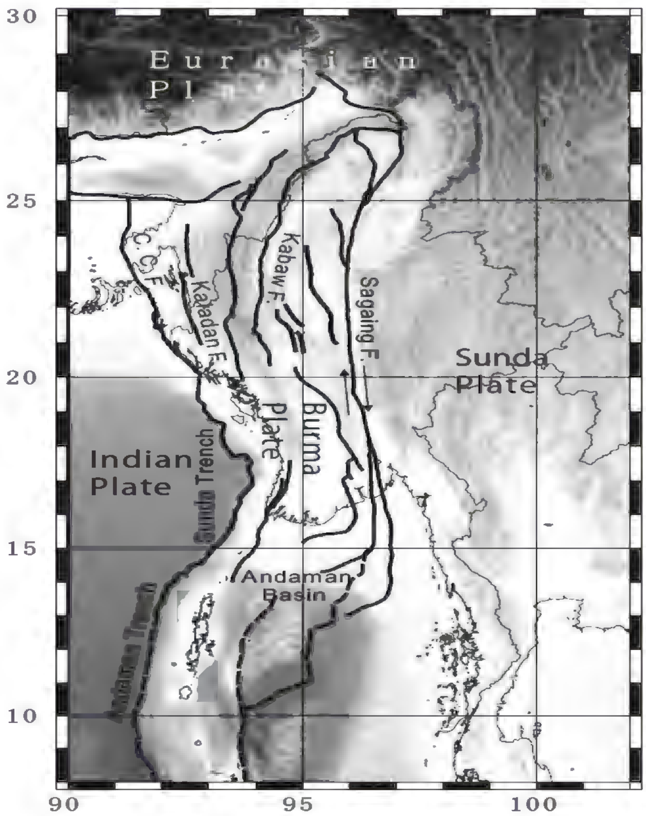

Figure 18. Relevant tectonic plates for Myanmar (Hurukawa, et al., 2010; in DMH, 2013)

Earthquakes in Myanmar can be attributed to:

- Subduction of the Indian plate under the Burma plate, at a rate of around 3.5cm/year. The movement of the Indian plate towards north vis-à-vis Southeast Asia is the main driver of the Sagaing fault, extending to about 1000 kilometers from north to south of Myanmar.
- The movement of Burma plate, towards north, from Andaman Sea at an average of 2.5-3.0 cm/year (Bertrand et al., 1998; Curray, 2005 as cited by DMH et al, 2009).

Sagaing fault cuts across the length of Myanmar, and the trigger of many historical earthquakes in the country; other faults also contribute to earthquake events. Historical earthquake events recorded in Myanmar are provided in Figure 19.

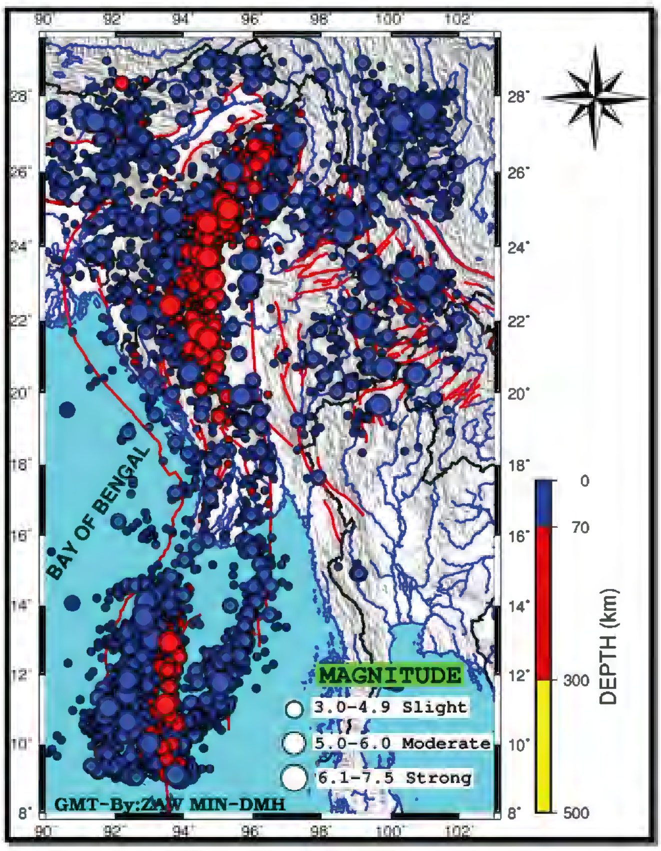

Figure 19. Historical earthquake events recorded in Myanmar's Area of Responsibility. The colors indicate the depth of the events; the dot size is indicative of the earthquake magnitude (DMH)

It is important to remember the range of earthquake impacts experienced in Myanmar – these will provide a reference to potential damages in future earthquake events, given prevailing structures of building and critical facilities.

The damages from significant earthquake events in Myanmar are provided in Table 6.

Table 6. Impacts of Significant Earthquake Events in Myanmar		
Earthquake Event	**Magnitude**	**Impacts**
Maymyo 1912	8.0	o Damages were severe o Aftershocks were felt 6 months after the event o North of Taunggyi experienced serious landslide
Bago May 1930	7.3	o Damages were extensive o 500 casualties in Bago and 50 casualties in Yangon
Kamaing January 1931	7.3	o Affected the Northern part of Myanmar o Epicenter was at Indawgi Lake o Landslide occurred
Tagaung September 1946	7.5	o One of the strongest earthquakes recorded o Occurred in the western part of Thabeikyin District
Sagaing July 1956		o Hit Central Myanmar with a depth of between 8 and 10 km o Destructive in Upper Myanmar, causing property damage at Mandalay and Sagaing o 40 people were recorded dead
Bagan 1975		o One of the most remembered earthquake events in Myanmar's history o Aftershocks were of moderate intensity and felt in Bagan and in surrounding areas o Many historical pagodas were damaged o 2 people were recorded dead
Taungdwingyi September 2003	6.8	o 3 monks and 4 village leaders were dead due to poorly engineered buildings o collapse of a school (earthquake happened at night, hence did not cause any fatality) o Landslide, liquefaction and sand eruption occurred o Pagodas, some bridges, houses and schools damaged
Tarlay March 2011	6.8	o About 986 buildings were damaged o Death toll was recorded at 76 o Over 18,000 people were affected o 125 people were injured o More than 3000 people were left homeless o 1 bridge collapsed o Epicenter was about 35 miles Southeast of Kengtung, near Loimwe village o Earthquake was also felt in Thailand, Laos PDR, Vietnam and China (Yunnan)
Thabeikkyin November 2012	6.8	o 26 dead; 231 injured o 251 houses, 4 schools, 22 hospitals, 48 government buildings, and around 137 religious buildings were damaged o Shwegugyi and Shwezigon Pagodas were damaged in Singu Township o Magnitude 5.0 aftershocks were felt within the first hours of the earthquake and about 100 more aftershocks were recorded
Chauk August 2016	6.8	o Many historical pagodas were damaged in Bagan

Secondary Hazards to Earthquakes. It is important to recognize the secondary hazards to earthquakes, which could immediately follow big earthquake events. Among these secondary hazards are earthquake-induced landslides, liquefaction and tsunami.

Earthquake-induced landslides refer to mass of rocks and/or soil sliding or slipping down mountain or hill slopes triggered by earthquake.

In many instances, **liquefaction** - where the ground or soil can turn to liquid or semi-liquid state – happens after a strong earthquake. Liquefaction occurs as the soil loses its strength from shaking and mixes with water. This usually happens in water-saturated areas like flood plains and river banks. In some cases, buildings sink or tilt in areas affected by liquefaction.

Where earthquake impacts on electrical, gas, or chemical lines or storage tanks, **fire** may occur. Fire can be exacerbated by lack of water, in cases where water lines are also damaged by earthquakes.

By far, the most destructive secondary hazard to earthquake is **tsunami**. Tsunami occurs from swift displacement of water from the ocean, typically caused by shallow (i.e. depth of less than 100 km) off-shore earthquakes. In Myanmar, tsunamis can either be regional (i.e. originating from areas outside Myanmar) or local (i.e. generated offshore, within Myanmar's Area of Responsibility). The process of tsunami generation is provided in Figure 20. Local tsunamis, because their proximity, can reach Myanmar coast much faster than regional events.

Tsunami height is dictated by the strength of the earthquake and water depth. In deep waters, the tsunami wave is short; as the wave approaches the shore and water becomes shallow, the tsunami wave becomes higher; tsunamis have tremendous energy and can destroy buildings and other infrastructures along its path (in Figure 21).

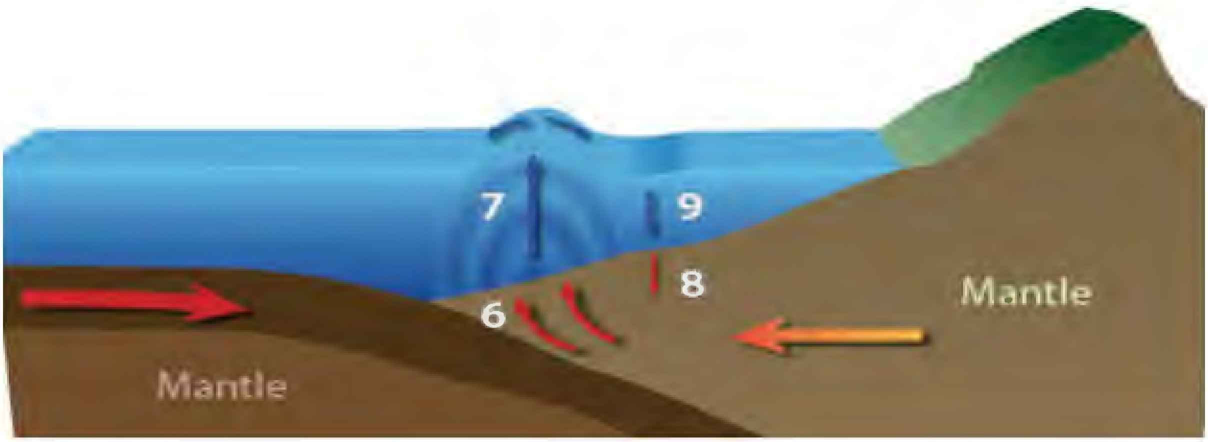

Figure 20. A tsunami is generated as energy from underwater earthquake pushes the water upwards with tremendous force (Figure: NOAA)

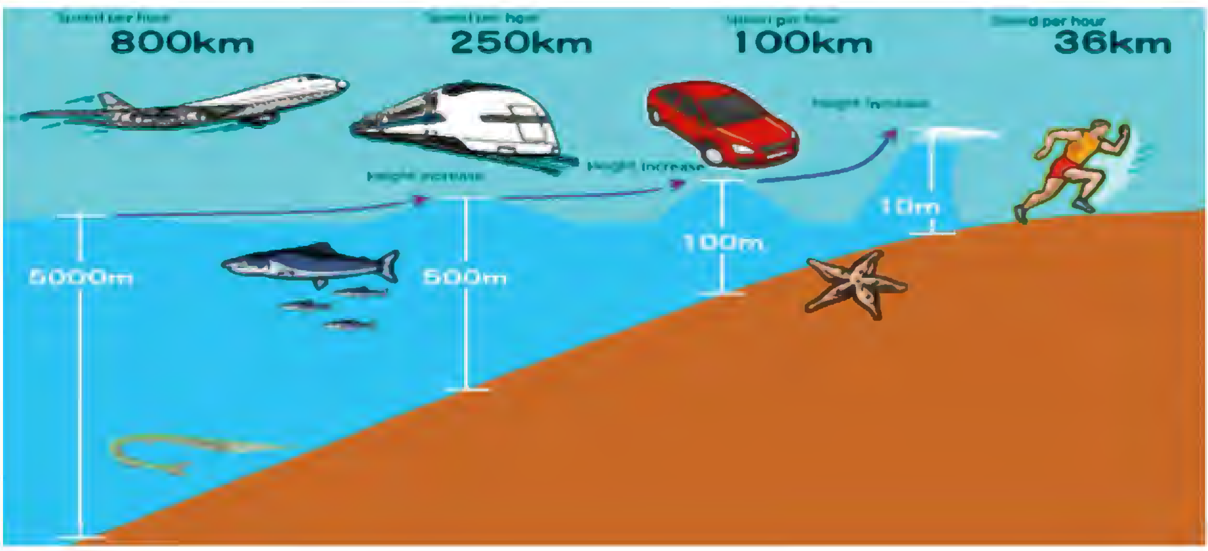

Figure 21. As tsunamis approach the shore, they become slower but the waves become higher. Tsunamis pack tremendous energy which can destroy buildings and other infrastructures (Figure: JMA)

Tsunami Events in Myanmar. Although there have been no concrete records of tsunami events which impacted Myanmar prior to 2004, its long historical record of earthquake events (over 170 years) suggests possibility of tsunami events in the past, due numerous to earthquake events of magnitude ≥ 7.0.

The Indian Ocean tsunami, in December 2004, which originated from Sumatra, Indonesia reached the coastal areas of Myanmar 3-4 hours after earthquake generation in Sumatra; the absence of early warning for tsunami in the Indian Ocean region, during that time, resulted to various damages and deaths in Myanmar (Table 7), despite availability of lead time for evacuation.

Table 7. 2004 Indian Ocean Tsunami Impacts in Myanmar

State/Division, Township	Villages Affected	Households Affected	Population Affected	Injured	Deaths	Properties Damaged
Ayeyarwady Region						
Labutta	7	337	1,138	41	25	99 boats, 8 schools, 4 rice mills, 1 pagoda
Ngaputaw	9	108	1,007		5	19 boats, 1 bridge, 2 pagodas
Bogale (urban areas)					1	Wall collapsed
Rakhine State					22	
Tanintharyi Division	7	92	447		8	44 boats, 3 warehouse, 1 bridge

Earthquake Monitoring and Tsunami Early Warning. DMH has a dedicated division for Earthquake Monitoring and Tsunami Early Warning – the NEDC. NEDC has a network seismographs/seismometers, accelographs, and sea level gauges over the country. DMH is also connected to regional and global earthquake monitoring and tsunami early warning systems, for reference and guidance.

Real-time data from local observation stations and from global and regional earthquake monitoring and tsunami early warning systems are analyzed by NEDC experts/scientists, for generation of news/reports/alerts/warnings for Myanmar. Table 8 provides details of the earthquake and tsunami information generated by DMH.

Table 8. Earthquake and Tsunami Information Generated and Issued by DMH

Issuance	Criteria for Issuance
Earthquake Information	
Issuance	**Criteria for Issuance**
Earthquake News	o Earthquake is within Myanmar; magnitude ≥ 3.0 and deciphered shaking (intensity)
	o Earthquake is in Andaman Sea and Bay of Bengal; magnitude ≥ 4.5
	o Earthquake is in the Indian Ocean; magnitude ≥ 6.0
	o Inland earthquakes in neighboring countries; magnitude ≥ 5.0 o Earthquake is in countries within the distance of ≤ 2000 miles (e.g. China, Indonesia and Philippines); magnitude ≥ 6.0 o Earthquake is within the Asian Region; magnitude ≥ 7.5
Tsunami Early Warning	
Issuance	**Criteria for Issuance**
Localized Tsunami	
Tsunami Alert, with Earthquake News	o Magnitude ≥ 6.5 o Depth < 50 km o Expected run-up of 0.5 to 2 meters
Tsunami Warning	o Magnitude ≥ 6.5 o Depth < 50 km

	o Expected run-up of > 2 meters (less than 60 minutes travel time, to the coast, from the source
Tsunami Cancellation	o Cancellation is issued after confirmation that there is no tsunami threat; or when tsunami threat is over
Distant/Regional Tsunami (in the Indian Ocean)	
Tsunami Alert, with Earthquake News	o Magnitude ≥ 7.5 o Depth < 50 km o Expected run up of 0.5 to 2 meters o Greater than 3 hours travel time, to Myanmar coast, from the source
Tsunami Warning	o Magnitude ≥ 7.5 o Depth < 50 km o Expected Run up of > 2 meters
Tsunami Cancellation	o Cancellation of tsunami warning can be undertaken after confirmation that there is no tsunami threat or when tsunami threat is over

Tsunamis are low lead-time events. Hence, NTWCs – including NEDC in Myanmar – have established protocols for issuing tsunami information, in Figure 22.

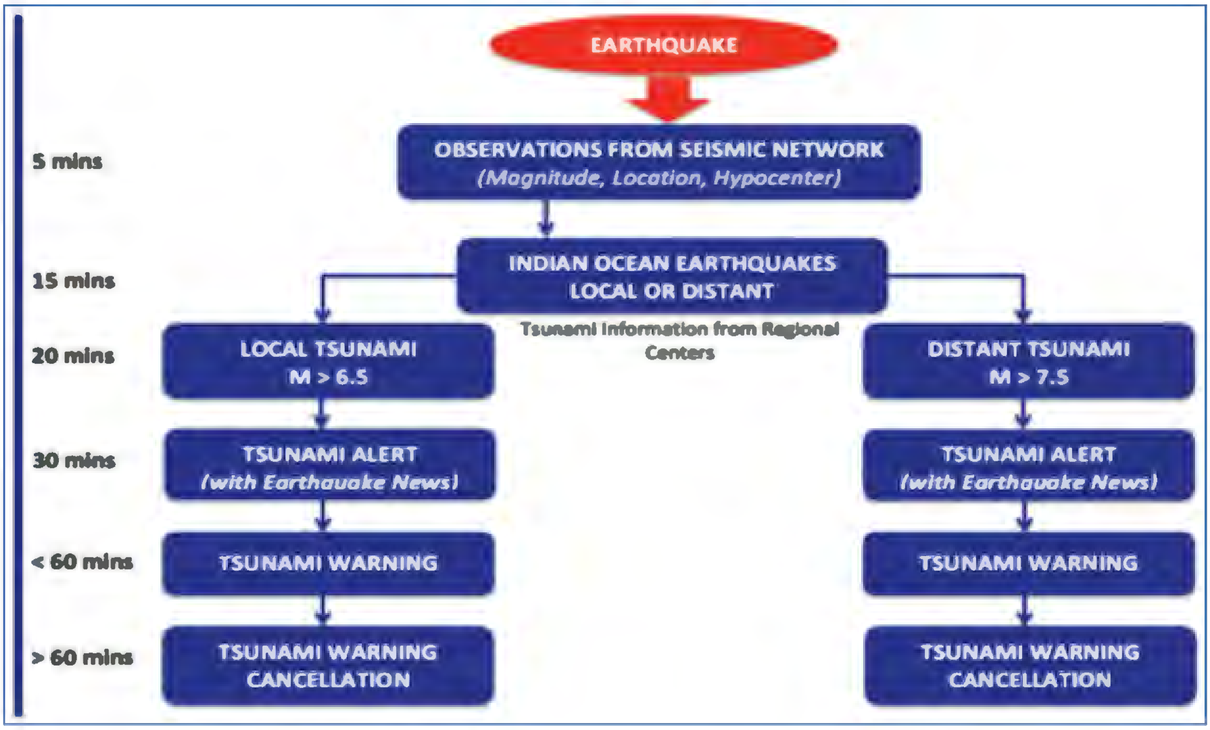

Figure 22. NEDC SOP in issuing tsunami information and the estimated time for information generation and issuance

It should be noted that based on historical events and currently available knowledge, tsunamis are not expected when earthquakes occur inland; when the magnitude is < 6.5; and depth is > 50 km in offshore earthquakes.

Earthquake and Tsunami Preparedness. Due to current limitations in science, in detecting earthquakes ahead of time, and therefore in providing more lead-time for tsunami warnings, it is necessary for stakeholders to understand that earthquake preparedness is a must.

Table 9. To Be Done Before, During and After Earthquakes

BEFORE	DURING	AFTER
o Check if your home, place of work or any other relevant	o If you are inside a structurally sound building,	o If inside an old, weak structure, take the fastest way

site is along an active fault, or potential areas for liquefaction and/or landslides. • Structural soundness of buildings and important infrastructures should be determined. • Strengthening/ retrofitting houses and other relevant infrastructures should be done, as necessary. • Proper structural design and engineering practice is required when constructing a house or building. o In your workplace and residence, identify relatively strong parts of the building where you can take refuge during an earthquake (e.g. sturdy tables, etc.) o Learn to use fire extinguishers, first aid kits, alarms and emergency exits. These should be accessible, handy and properly marked. o Prepare your work place and residence for potential earthquake events. • Strap heavy furniture to walls to prevent sliding or toppling • Store breakable items, harmful chemicals, flammable materials in lowermost shelves/safe areas and secure them • When not in use, turn off gas tanks • Keep heavy materials in lower shelves • Check stability of hanging objects • Ensure that you have, at all times, an earthquake survival kit	stay there • Protect your body from possible falling debris by getting under a sturdy desk or table o If you are outside, move to an open area: • Get away from power lines, posts, walls and other structures that may fall or collapse • Stay away from buildings with glass panes • Stay away from other structures that may collapse or may be damaged o When driving a vehicle, pull to the roadside and stop • Do not attempt to cross bridges or overpasses which may have been damaged o If you are along the shore and you feel an earthquake strong enough to make standing difficult, it is always safest to assume that a tsunami has been triggered • Move away immediately from the shore toward higher ground • Seek confirmation of tsunami generation by listening to radio or through other communication mechanism that could connect you to warning institutions/relevant local authorities o If on a mountain or near steep hill slope, move away from the edges where landslides may occur	out • Get out calmly and orderly. Do not rush to the exit • Use the stairs; do not use elevators • Check yourself and others for injuries o Check your surroundings • Clean up chemical spills, toxic, flammable and other dangerous materials to avoid any chain of unwanted events • Check for fires and if any, have it controlled • Check water and electrical lines for defects. If any damage is suspected, turn the system off o In case you are evacuating from your residence, leave a message indicating where you are going and how you can be contacted • Your earthquake survival kit should be with you, for ensuring your protection and safety o Help reduce he number of casualties from earthquakes: • Don't enter partially damaged buildings; strong aftershocks may cause further damage/collapse • Gather information, including disaster prevention instructions, from authorities through battery-operated radios and other mechanisms • Obey safety precautions o Unless you need emergency help: • Do not use your telephone to call relatives and friends. Disaster risk management authorities may need the lines for emergency communications • Do not use your car and drive around areas of damage. Rescue and

		relief operations need the road for mobility

Adopted from Philippine Institute of Volcanology and Seismology (PHIVOLCS)

SESSION 4.4. DEVELOPMENT OF IMPACT-BASED WARNING SERVICES

Description: Forecasts are often technical and challenging for end-users – especially for community members – to understand, and apply. While DMH, and partner capacity building institutions, invest in efforts to simplify forecast information, users have to be capacitated on understanding forecasts/warnings, and in forecast/warning-based generation of potential impacts outlook, and management strategies. This is especially essential for stakeholders in institutional level, whose guidance and assistance are required by end-users (i.e. community members, farmers, fishermen, etc.). While forecasts have certain levels of reliability, uncertainties are to be recognized as inherent to forecasts and should be taken into consideration in making plans and decisions

Objectives: At the end of the session, participants would be able to:

- appreciate uncertainties inherent in forecasts and be able to take these into consideration in analyzing and drawing potential impacts, based on specific events
- develop a set of potential impacts outlook, in relevant sectors, based on multi-timescales information
- draw a range of response/management strategy options, based on potential impacts

Methodologies: This session employs the following:

- PowerPoint presentation
- plenary discussion
- group discussion/exercise/game

Key Learning Points. ***Understanding Forecast Uncertainties.*** In assessing forecast-based potential impacts and recommended preparedness actions, it is essential to recognize first the uncertainties associated with forecasts – it should be noted that uncertainties increase as lead time increases. It is best, thus, to use longer lead time forecasts for planning, and shorter-range forecasts for making decisions.

Cyclone warnings, for example, provide a range of uncertainties in terms of track, time of landfall, and strength. The cone of uncertainty, in Figure 23, provides information on the potential movement of the cyclone from its predicted tract. Preparedness, therefore, has to be considered vis-à-vis such potential movements.

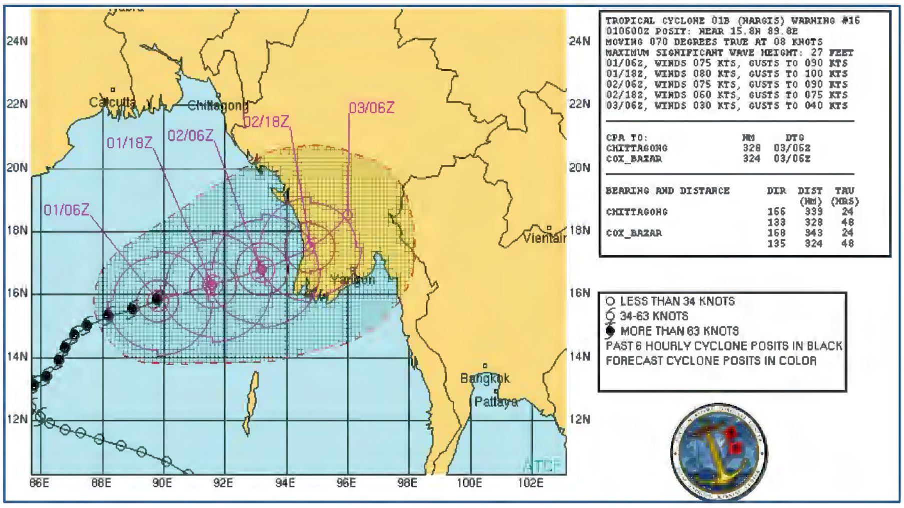

Figure 23. The uncertainty in the track of Cyclone Nargis is indicated in the cone of uncertainty (in dotted line and shaded area); the cone of uncertainty suggests the probability that the cyclone may stray from its anticipated track, to areas within the cone of uncertainty (Figure: JTWC)

Assessing Forecast-Based Potential Impacts. To be better understood by decision-makers and end-users, forecasts have to be analyzed and converted into a) a set of information on potential impacts for various parts or communities in Myanmar and b) a set of actions that could be undertaken by institutions and communities, for reducing potential impacts/risks. The analysis of potential impacts would require understanding of:

- hazards and range of potential impacts, given uncertainties associated with the warnings
- vulnerabilities and capacities in communities

Table 10 provides a matrix for detailed analysis.

Table 10. Matrix for Analyzing Forecast-Based Potential Impacts

Hazard	Forecast and Uncertainties	Secondary Hazards that may Potentially Occur	Vulnerable Elements/Population	Potential Impacts Considering Uncertainties and Vulnerabilities
Cyclone	o could make a landfall in Rakhine in the next 12 hours o could move away from its projected tract o currently having gusts of up to 60 miles per hour o rainfall is expected to be heavy and widespread in Rakhine and in surrounding regions o could intensify due to another low pressure area near its track	o storm surge o flood	*If cyclone keeps its track and intensity:* o who and what are vulnerable? o reasons for vulnerability *If cyclone moves away from projected track:* o who and what are vulnerable? o reasons for vulnerability	o What would be the potential impacts to vulnerable population and other elements given wind and rainfall information?

In completing Table 10, it would be useful to understand potential impacts of wind on structures, in Figure 24. It should be noted, however, that Figure 24 has to be customized to Myanmar. In cases where houses of light materials are in the path of cyclones, then the impacts would be more than what is depicted in Figure 24.

The matrix (Table 10) will evolve accordingly as other vulnerable elements are identified.

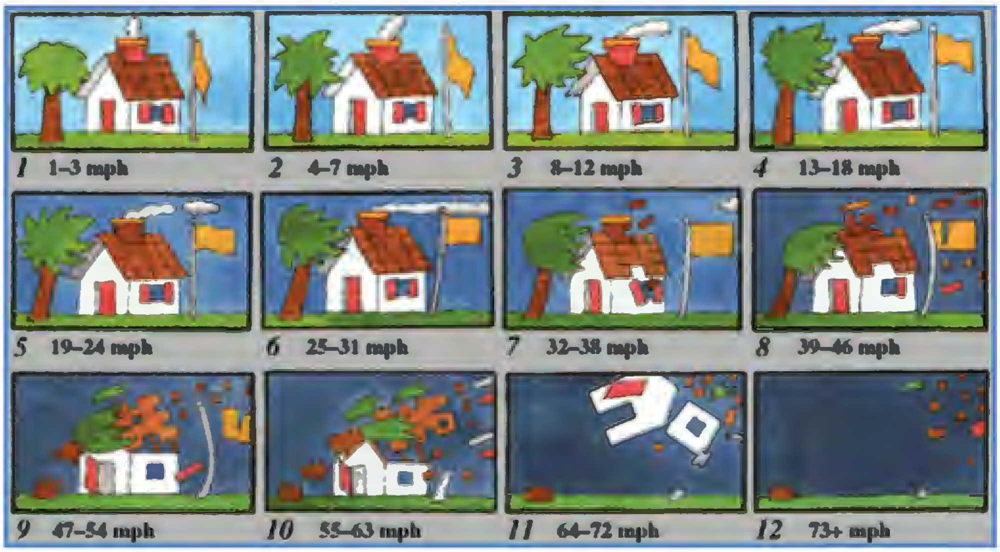

Figure 24. The Beaufort scale can be used for estimating wind impacts on structures

Developing Response/Risk Management Options. Based on the analysis of potential impacts, a set of response/risk management options have to be evolved to address vulnerabilities and risks. Response/risk management options are a set of actions that could be undertaken **based on forecast/warning information**, and **before** the hazard.

Taking the outputs from Table 10, stakeholders can complete Table 11, for identifying the range of response/risk management options than can be undertaken by institutions and communities, triggered by potential impacts.

Table 11. Potential Impacts-Based Response/Risk Management Options	
Potential Impacts Drawn from Table 10	**Response/Risk Management Options**
Worst Case Scenario o	
Average Case Scenario o	
Best Case Scenario o	

Response/risk management options are not limited for responding to immediate warnings, as in the case of severe weather events. Like forecast, response options can also be multi-timescales, looking into the future. It should also be noted that managing impacts of hazards should not be limited to risk management, but should also take into consideration resources management. Examples are provided in Table 12.

Table 12. Range of Response/Risk Management Options		
Short-Term (Immediate)	Medium-Term (Month to Season)	Long-Term Years/Decades
o Evacuation o Storing of food items, medicines, etc. o Water harvesting o Harvesting of standing crops o Moving of harvested crops to safe areas	o Stockpiling of medicines o Water harvesting o Switching to alternative crops o Relevant drills	o National and local legislations o Structural mitigation facilities o Zoning codes o Land use plans o Building codes/regulations o Risk assessments and prioritization of interventions o Research for identification of suitable/viable adaptation strategies

Figures, Tables, and Annexes

Figures

MODULE 5 DISSEMINATION AND COMMUNICATION

Rationale. Dissemination of forecasts/warnings and obtaining feedback from stakeholders are among the pillars for effective EWS. This process requires capacity building for ensuring that a) information are received by key stakeholders in both institutional and community levels, b) the forecast, range of potential impacts, and the preparedness actions are well understood by stakeholders, for facilitating action, and c) feedback could be easily provided, for validating local manifestations of events as well as for receiving recommendations for improving information availability.

SESSION 5.1. INSTITUTIONAL MECHANISMS FOR END-TO-END COMMUNICATION OF INFORMATION

Description: Session 5.1 intends to catalyze the understanding of participants of the mechanisms, protocols and importance of the end-to-end communication of warnings in Myanmar.

Objectives: This session shall enable participants to:
- refresh themselves with the existing institutional arrangements for end-to-end communication/dissemination of information in Myanmar
- Identify, understand and appreciate their roles in end-to-end communication of forecast/warning information
- Identify key areas for improvements in end-to-end communication mechanism and be able to provide recommendations

Methodologies: This session employs:
- PowerPoint presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points. ***Official Dissemination/Communication Protocol.*** Information generated by DMH, is provided to stakeholders via website, fax, sms, email and Facebook. This process is provided in Figure 25.

Roles of Institutional Stakeholders. Institutional stakeholders (i.e. officials in government and other institutions relevant to EWS) have the responsibility to link information to stakeholders in a manner that could facilitate actions. Essentially, everyone is a part of the EWS and has contributions to make.

Institutional stakeholders can take the role decision support providers, for supporting end-users/decision-makers (Figure 26). Decision-support providers, having the experience to leverage forecasts for facilitating decisions in the sub-national and community levels.

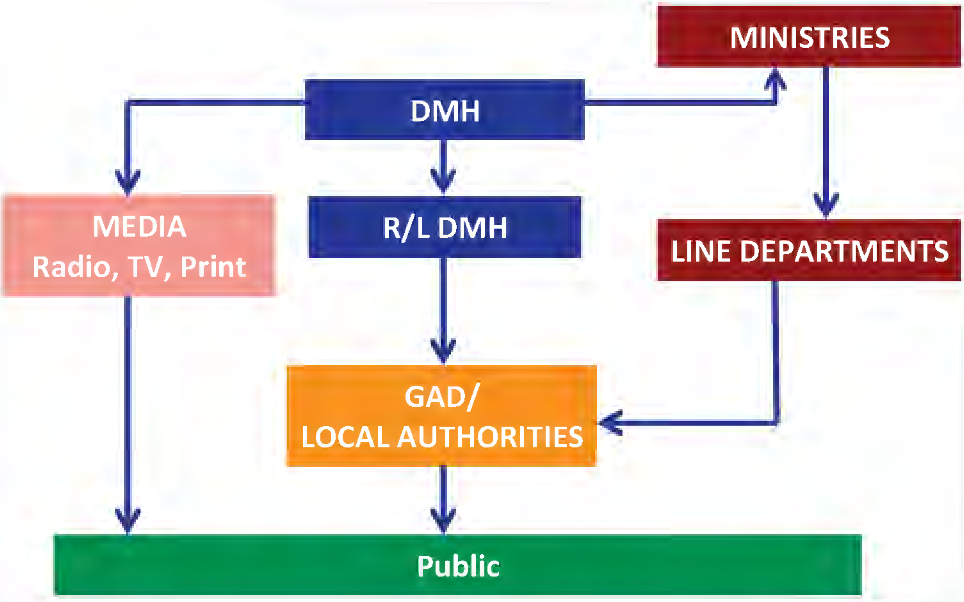

Figure 25. DMH's dissemination process for information of various timescales.

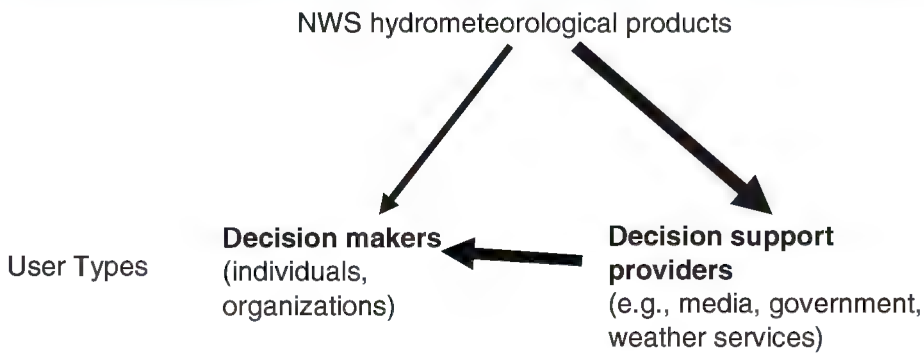

Figure 26. Institutional stakeholders can have the role of decision support providers for assisting end-users ingest forecasts of various timescales (Figure: National Academy of Sciences, 2006)

Feedback from Stakeholders. Engagements with various stakeholders indicate key gaps in receiving and understanding information:

- Information is not received on time
- Information is not understood

Improvements can be undertaken, in response to identified gaps, in Table 13.

Table 13. Identifying Key Areas for Improvements in Dissemination/Communication of Forecast/Warnings

Gaps	Recommendations	Potential Integration of Recommendations into Institutional Priorities

SESSION 5.2. COMMUNICATING SECTORAL RISKS AND OPPORTUNITIES

Description: Building on gaps identified in the previous session, this session targets to build capacity of participants in customizing risks (and opportunities) information, for specific communities/audiences.

Objectives: At the end of this session, participants would be able to:
- have a deeper understanding of the methodologies/steps for customizing risk (and opportunities) information
- identify suitable communication mechanisms for various communities depending on lead time of the anticipated hazard, levels of risks, accessibility, language, characteristic of at-risk population, etc.

Methodologies: This session employs:
- PowerPoint presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points. ***Impacts of Communicating Risks and Opportunities.*** Essential to communicating risks and opportunities is the understanding that the target of the process is to have impacts in institutions and communities – be it taking action to save property, asset, or life; enhancing awareness; encouraging improved legislations and funding support; or changing perceptions in how decisions are made.

The scope of communicating risks and opportunities include a) provision of alerts to communities for taking actions to save lives, properties and assets, in anticipation of an imminent hazard and b) enhancing awareness and facilitating sustained and long-term preparedness actions, for reducing vulnerabilities and enhancing capacities.

Elements to be Considered in Communicating Opportunities and Risks. The following are to be evaluated and considered in communicating opportunities and risks, for ensuring that the message is effective and warrants the action targeted.

Source. In the EWS, the source of the information is DMH, being the mandated generator of multi-hazard, multi-timescales information. It is important to validate that the information received by RRD and other relevant institutions, are from DMH, to avoid confusion, especially when hazards are fast forming, or if vulnerabilities are high.

Message. As intermediary institutions, institutional stakeholders' roles are important in a) customizing the message for relevant communities and sectors and b) ensuring that the message is received, timely, by end-users. In customizing the information, the following guide questions are primary:
- what are the key information imbedded in the message?
- what are the risks to be communicated to stakeholders?
- what are the recommended actions for preparedness?
- how soon should these recommended actions be undertaken?

It should be noted that messages in EWS have to be:
- correct, concise and complete
- clear, simple, and can easily be understood

- concrete and coherent
- courteous

Channels. The decision on which channels to use depends on the impact(s) targeted to be achieved. If the situation calls for **urgency** and **immediate action**, channels to be used in inter-institutional communication are: telephone, mobile phone, VHF radio, and other mechanisms that can facilitate immediate information to stakeholders. It should be taken into consideration that communication mechanisms have to be **redundant**, such that in the event of failure of one (1) communication mechanism, others can still function. In EWS, failure of receipt of information can mean failure of the entire system.

In reaching broader audiences, fastest communication mechanisms are radio and television. The time of delivery of the message should also be analyzed, as radio and television may not be very effective if an urgent message is delivered at night or very early in the morning, and requires immediate action – as in the case of tsunami.

For community level dissemination, urgent messages are best communicated via public address system, loudspeakers, sirens, etc. For focal persons, communication could be done through two(2)-way VHF radio, telephone, and mobile phone.

For enhancing awareness and facilitating sustained capacity building, face-to-face interactions through meetings, seminars, workshops, conferences, marches, and exhibitions could be undertaken. Multi-media, audio and video presentations can also be used. Television, radio, internet, billboards and posters are also powerful tools for encouraging/enjoining preparedness; in communities, folk media can be utilized.

Receiver. It is equally important to tailor the message based on stakeholders/end-users who will receive the same. Considerations to be taken in customizing the message to audiences are age, profession, income, ethnicity, language, geographical location, and sometimes, religion.

Note that in communicating risks and opportunities, uncertainties should also be communicated, as discussed in Module 4.

For facilitating better understanding of the session, Table 14, below, is to be completed, based on a specific forecasts from DMH:

Table 14. Communicating Risks and Opportunities to Various Audiences

Forecast	Potential Risk and Opportunities	Recipients of the Message	Customized Message	Channel to be Used

SESSION 5.3. FEEDBACK ARRANGEMENTS

Description: As discussed previously, feedback facilitates validation of the manifestation of the anticipated/forecasted events on-ground and provision of recommendations for improvements. An EWS that constantly improves has a robust feedback mechanism.

Objectives: At the end of this session, participants would be able to:
- appreciate the importance of feedback in every level in EWS
- be equipped with skills in developing partnerships and coordinating with various relevant institutions and stakeholders, for ensuring robust feedback mechanisms
- develop receptivity to feedback, as an entry point for improvements

Methodologies: For delivering the session effectively, the following are utilized:
- PowerPoint presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points: ***Functions of Feedback Mechanism.*** In EWS, feedback mechanism serves the following important functions:
- emphasize the importance of user views
- ensuring a people-centered EWS
- measure how information has been understood and applied; ascertain the value of information to users, for offering insights into the usefulness of information to stakeholders and/or need for improvements
- receive recommendations for improvements in the end-to-end EWS
- validation/reporting of event impacts in communities
- support the development/tailoring of information and services; ensuring that the same are relevant for specific constituency by addressing their requirements
- provide an opportunity for motivating and enhancing partnerships
- guides decisions of stakeholders (generators, intermediaries and users themselves)
- mechanism for facilitating continued learning and continued research, for products development – to remain aligned to goals, develop new strategies, and develop products and services for improvements

Requirements for a Robust Feedback Mechanism. A robust feedback mechanism should be regular rather than ad hoc, end-to-end, sustained, involves multi-sectoral stakeholders, and be connected to a mechanism that enables dynamic response to recommendations for ensuring EWS evolution, as required.

A robust feedback mechanism, in EWS, can provide guidance to DMH, RRD, GAD, and other institutions involved, into the usability of products, their performance and further improvements. Given a strong feedback mechanism, and receptivity of key decision-makers to evolve decisions based on feedback, EWS can always be refined to suit user needs. A robust feedback mechanism is provided in Figure 27.

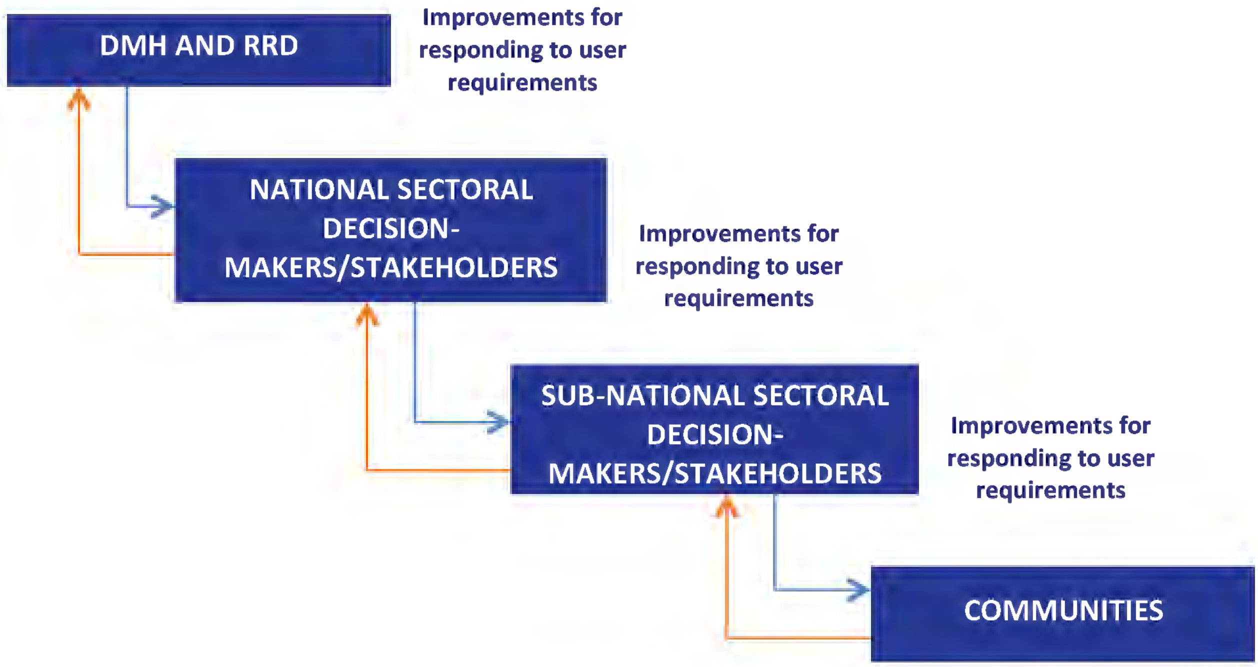

Figure 27. A robust feedback mechanism connects stakeholders at various levels and facilitates constant adjustment of information and relevant mechanisms, for catering to user sectors/end-users.

Considering that EWS requires multi-stakeholder, multi-level partnerships, stakeholders are to identify key institutions/actors that they have to collaborate with, for robust end-to-end feedback mechanism. Current gaps, and recommendations to address gaps should be identified. In the plenary, stakeholders can identify their ideal perspective of an effective and efficient feedback mechanism.

MODULE 6 RESPONSE CAPABILITY

Rationale. EWS is best gauged or assessed on how it is able to mobilize institutions and communities into action for saving lives, assets and properties; ensure effective resources management; and even catalyze productivity. It has to be understood that in EWS, multi-hazard, multi-timescales information is only among the inputs – there are other capacities required for completing the puzzle. Having strong response capacities, both in sectoral institutions and communities, will contribute to an effective and functional EWS.

SESSION 6.1. RESPONSE CAPACITY ELEMENTS IN INSTITUTIONS AND COMMUNITIES

Description: Local response capacities have to be in place in order for preparedness actions, based on forecast/warning information, to be effective. Efforts at continually identifying vulnerabilities and capacities, and collective action for reducing the former and developing the latter should be a priority in institutions and communities.

Objectives: This session shall enable participants to:

- evaluate response capacities in institutions and communities
- have enhanced insights for developing/ strengthening local capacities

Methodologies: This session utilizes:

- PowerPoint presentation
- plenary discussion
- brainstorming
- group discussion/exercise/game

Key Learning Points. ***Holistic Approach to Preparedness.*** Communities are first responders to hazards. Communities, hence, should have utmost capacity for preparedness. While timely and reliable information can facilitate preparedness, this has to be complemented by local capacities that will catalyze appropriate action. In cases where there are no evacuation areas, for example, people have limited options vis-à-vis safe areas when anticipating cyclone impacts. It is, thus, essential that local capacities are continually built if communities are to be resilient.

Challenges in capacity building. As in many communities in Asia, there are challenges to capacity building in communities in Myanmar. Some challenges are provided hereunder:

> **Development exacerbating vulnerability.** Development is often equated to urbanization. Urbanization, however, requires meticulous planning in terms of putting in place facilities that could withstand hazard impacts and facilities that can accommodate future climate conditions and stresses from increased population. Development in most areas in Myanmar remains unplanned. With more population moving towards built-up areas, and facilities not properly designed, more population becomes vulnerable.
>
> **EWS and DRR are often not prioritized.** As often the case, EWS and DRR do not become priorities until a significant hazard/disaster event is experienced.

EWS and DRR are often viewed as segmented, rather than being considered from a holistic point of view.

Enabling environment. While numerous legislations are available, the full implementation is not yet realized. Further, the context of preparedness still remains an evolving issue. In many countries, including Myanmar, preparedness is still interpreted as disaster response, rather than response to early warning.

Organizational/institutional support needs to compliment local/community initiatives/decisions. For optimizing effective preparedness, local/community decisions need to be complemented by organizational/institutional support. This is especially required, when communities need resources beyond what local constituents can make available.

Addressing Challenges. National and sub-national institutions, and local communities, should be able to take into consideration the prevailing EWS/DRR/preparedness gaps in prioritizing interventions.

SESSION 6.2. INFORMATION INTO ACTION

Description: Converting information into action requires cross-cutting capacities. Functional capacities for formulation and implementation of actions shall be the focus of this session.

Objectives: At the end of this session, participants would be able to:

- analyze functional capacities in communities
- be able to apply such capacities in communities, for facilitating action

Methodologies: This session will employ:

- PowerPoint presentation
- plenary discussion
- group discussion/exercise/game

Key Learning Points. Functional Capacity. Functional capacities are needed to formulate and implement actions which focus on getting things done (UNDP, 2009). These capacities, adopted from UNDP (2009), include:

Capacity for engaging local stakeholders. Motivating and mobilizing stakeholders encourages agreement and fosters partnerships, ownership, and better management of processes in large groups or communities, amid diversity in population, opinion, perspectives, and other factors.

Capacity for assessment. Assessing capacities and gaps, for defining goals and for gauging progress against baseline and desired capacity.

Capacity for formulation of development response. Development response should take stock of capacities and address gaps. Due to various requirements, development response should be molded to such differing requirements, integrating very short, short, medium and long-term strategies.

Capacity for implementation of development response. Policies and strategies remain on paper until they are properly implemented. The role of national and local actors in ensuring proper implementation, and sustainability of interventions, is paramount.

Capacity for evaluation. Identification of lessons learnt, for promoting better practices, and obtaining feedback for guiding improvements in policies and strategies are must. Monitoring of progress, milestones, and achievements are also important.

MODULE 7 EWS SUSTAINABILITY FOR ENHANCED DRR

Rationale: Capacities and vulnerabilities in EWS evolve due to changes in nature of hazards and impacts, population, technology, etc. EWS, thus, has to evolve with such changes for suiting to local requirements, and has to be guided by objective assessment of capacities and gaps, for guiding interventions.

SESSION 7.1. EWS ASSESSMENT TOOLS: SUSTAINED END-TO-END EWS CAPACITY BUILDING

Description: Enabling capacities for end-to-end EWS includes focus on capacity building for undertaking regular assessments of EWS strengths and gaps in communities, for guiding development interventions. Sub-national and local stakeholders should be able to undertake such assessments and integrate the outputs into short-, medium-, and long-term plans.

Objectives: At the end of this session, participants would be able to:

- assess, on a regular basis, capacities and gaps in EWS
- integrate assessment outputs into local development plans, and advocate for national government support, where necessary

Methodologies: This session takes advantage of:

- PowerPoint presentation
- plenary discussion
- group discussion/exercise/game

Key Learning Points. Strengthening every component of the EWS is the foundation of resilience. Every development intervention should feed into enhancing local (and national) EWS. The capacity to regularly evaluate local capacities and gaps should be an intrinsic function of national, sub-national and local officials.

RIMES has developed an EWS Audit/Assessment tool that has been tested in Myanmar, as a tool for community EWS assessments for guiding capacity development (in Figure 28). The detailed assessment tool is provided as Annex 2.

Figure 28. Outputs from the EWS Audit could guide priority EWS interventions (Figure: Adapted from UNISDR, 2006)

SESSION 7.2. SIMULATION DRILLS

Description: This session intends to assess the assimilation of participants of knowledge from the preceding sessions, and guide them in undertaking end-to-end simulation drills, for different hazard magnitudes.

Objectives: At the end of this session, participants would be able to:

- demonstrate knowledge and skills gained from the training
- customize exercises for various communities within their areas of responsibility

Methodologies: This session utilizes:

- PowerPoint presentation
- Simulation drills

Sample scenarios, to be utilized in the simulation exercises, are provided in Annex 3. It has to be noted that the scenarios may be further customized/revised, based on the context of the training and in cases where there are more recent significant events observed.

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Annexes

Annex 1. Definition of DRR Terminologies and Concepts Adopted by RRD

A

Acceptable Risk: The level of potential losses that a society or community considers acceptable given existing social, economic, political, cultural, technical, and environmental conditions

Adaptation: The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities

Absorbing Capacity: The buffering ability that enables a society to dissipate the effects of an event. It is a function of the level of preparedness of the society to respond to the event and the resilience of the population and environment

Active Fault: A fault is active if it exhibits physical characteristics such as historic earthquake activity, surface fault rupture, geologically recent displacement of stratigraphy or topography, or physical association with another fault system judged to be active. When these characteristics are suspected or proven, it is classed as active and judged to be able to undergo movement.

Adverse Effect: The first visually perceptible change; a specific chemical or physical characteristic of the material/object usually considered abnormal or undesirable. This term is commonly used for risk analysis in the fields of health, safety, and environmental policy.

Aftershocks: The long, exponentially decaying sequence of smaller earthquakes that follow a large-magnitude earthquake for months to years, exacerbating the damage; A type of ground failure

Awareness: The continual process of collecting, analyzing, and disseminating intelligence, information, and knowledge to allow organizations and individuals to anticipate and react effectively.

B

Biohazard: Biological agents and materials which are potentially hazardous to humans, animals, or plants, which include infectious or disease-causing agents, potentially infectious materials, certain toxins, ad other hazardous biological materials

Building Codes: Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to ensure human safety and welfare. Building Codes include both technical and functional standards.

C

Capacity: A combination of all strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of disaster. It may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

Capacity Building: Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.
In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Capacity, adaptive (Capacity adaptive): Defines adaptive capacity as a combination of society's ex-ante vulnerability to damages from natural hazards and its ex-post resilience or ability to cope with damages that result.

Capacity, coping and adaptive (Coping and Adaptive Capacity): While the concept of coping capacity is more directly related to an extreme event (e.g. flood or a winter storm), the concept of adaptive capacity refers to a longer time frame and implies that some learning either before or after an extreme event is happening. The higher the coping capacity and adaptive capacity, the lower the vulnerability of a system, region, community or household. Enhancement of adaptive capacity is a necessary condition for reducing vulnerability, particularly for the most vulnerable regions and socioeconomic groups.

Capacity Development: The process by which people, organizations, and society systematically stimulate and develop their capacities over time to achieve social and economic goals including through improvement of knowledge, skills, system, and institutions.

Climate Change: The climate of a place or region is changed if over an extended period (typically decades or longer), there is a statistically significant change in measurements of either the main state or variability of the climate for that place ore region.
Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use. Note that the definition of climate change used in the United Nations Framework Convention on Climate Change (UNFCC) is more restricted, as it includes only those changes, which are attributed directly or indirectly to human activity.

Community: In the context of disaster risk management, a community can be defined as people living in one geographical area, who are exposed to common hazards due to their location. They may have common experience in responding to hazards and disasters. However, they may have different perceptions of and exposure to risk. Groups within the locality will have a stake in risk reduction measures (either in favor or against them).

Community-Based Disaster Risk Management (CBDRM): A process of disaster risk management in which at-risk communities are actively engaged in the identification, analysis, treatment, monitoring, and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. This means that the people are at the heart of decision-making and implementation of disaster risk management activities. The involvement of the most vulnerable is paramount and the support of the least vulnerable is necessary. IN CBDRM, local and national governments are involved and supportive (ADPC-CBDRM-11, 2003).

Corrective Disaster Risk Management: Management activities that address and seek to correct or reduce disaster risks, which are already present.

Contingency Plan/Emergency Plan: An anticipatory emergency plan to be followed in an expected or eventual disaster, based on risk assessment, availability of human and material resources, community preparedness, local and international response capability, etc.

Coping Capacity: The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effect of natural and human induced hazards.

Critical Facility: The primary physical structures, technical facilities and systems, which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency.

Cyclone: A weather system consisting of an area of low pressure, in which winds circulate at speeds exceeding 61 km/hr, also known as 'Cyclone' or Tropical Storm. These are non-frontal synoptic scale weather systems originating over tropical waters with organized convention and definite cyclonic surface wind circulation.
Winds rotate around the low pressure centre in an anti-clockwise direction in the Northern hemisphere and in a clockwise direction in the southern hemisphere.

D

Disaster: It is a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses, which exceed the ability of the affected community or society to cope, using its own resources (UNISDR, 2004). A disaster happens when a hazard impacts upon a vulnerable population and causes damage, casualties and disruption. An earthquake in an uninhabited desert cannot be considered a disaster no matter how strong the intensities produced. An earthquake is only disastrous when it affects people, their property and activities.

Disaster Risk: This is the chance or likelihood of suffering harm and loss as a result of hazardous event. It closely depends upon the exposure of something to a hazard. It can be expressed as:
Risk = Chance (c) x Loss (L)
The output of risk analysis is usually an estimation of the risk scenarios.

Disaster Risk Management: The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies, and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.
Comprehensive approach and activities to reduce the adverse impacts of disasters. It encompasses all actions taken before, during, immediately after, and some time after a disaster. It is holistic and includes activities on mitigation, preparedness, emergency response, recovery rehabilitation, and reconstruction.

Disaster Risk Reduction: (disaster reduction): All actions take decrease the consequences including measures of prevention, mitigation, preparedness, response, and research.
The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risk throughout a society to avoid (prevention) or limit (mitigation and preparedness) the adverse impacts, within the broad context of sustainable development.

Disaster Mitigation: Separate and aggregate measures taken prior to or following a disaster to reduce the severity of the human and material damage caused by it.
Mitigation refers to measures, which can be taken to minimize the destructive and disruptive of hazards and thus lessen the magnitude of a disaster. Mitigation measures can be of different kinds, ranging from physical measures such as flood defences or safe building design, to legislation, training, and public awareness. Mitigation is an activity that can take place at any time: before a disaster occurs, during an emergency, or after disaster, during recovery or rehabilitation.

Disaster Prevention: The aggregate of approaches and measures to ensure that human action or natural phenomena do not cause or result in disaster or similar emergency. It implies the formulation and implementation of long-range policies and programmes to eliminate or prevent the occurrence of disasters. Based on vulnerability analysis of risks, it also includes legislation and regulatory measures in the field of town planning, public works and environmental development.
The aggregate of approaches and measures taken to ensure that a hazard does not cause a disaster, either by preventing the event or by mitigating activities, or by activities and structures that are able to absorb the event.

Damage Assessment: The process of determining the magnitude to and the unmet needs of the private sector and the public sector caused by a crisis.

Human-Made Disasters: Disaster or emergency situation of which the principal, direct causes are identifiable human actions, deliberate, or otherwise. Apart from "technological disasters" this mainly involves situations in which civilian populations suffer casualties, losses of property, basic services and means of livelihood as a result of war, civil strife, and other conflict or policy implementation. In many cases, people are forced to leave their homes, giving rise to congregations of refugees or externally or internally displaced persons.

Slow-Onset Disasters (also called Creeping Disaster or Slow-onset emergencies): Situations in which the ability of people to sustain their livelihoods slowly decline to a point where survival is ultimately jeopardized. Such situations are typically brought on or precipitated by ecological, social, economic, or political conditions.

Sudden-Onset Natural Disasters: Sudden calamities caused by natural phenomena such as earthquakes, floods, tropical storms, volcanic eruptions. They strike with little or no warning and have an immediate adverse effect on human populations, activities, and economic systems.

Post Disaster Assessment (sometimes called **Damage and Needs Assessment**): The process of determining the impact of a disaster or events on a society, the needs for immediate, emergency measures to save and sustain the lives of survivors, and the possibility for expediting recovery and development.

Assessment is an interdisciplinary process undertaken in phases and involving on-the spot surveys and the collation, evaluation and interpretation of information from various sources concerning both direct and indirect losses, short and long-term effects. It involves determining not only what has happened and what assistance might be needed, but also defining the objectives and how relevant assistance can actually be provided to the victims. It requires attention to both short-term needs and long-term implications.

Prospective Disaster Risk Management: Management activities that address and seek to avoid the development of new or increased disaster risks.

Disaster Cycle: An explicit typology for disaster planning comprised of four phases: mitigation, preparedness, response, and recovery

Disaster Drill: A simulation of a disaster to assess and improve the effectiveness of a healthcare organization or system's emergency management plan.

Disaster Management: A collective term encompassing all aspects of planning for and responding to disasters, including both pre- and post disaster activities. It may refer to the management of both the risks and consequences of disasters.
It is also defined as the aggregate of all measures taken to reduce the likelihood of damage that will occur related to a hazard or hazards, all measures taken to minimize the damage once an event is occurring or has occurred, and all measures taken to direct recovery from the damage. Furthermore, it can be the body of policy and administrative decisions and operational activities that pertain to the various stages of a disaster at all levels.

Disaster Plan: A formal written plan of action for coordinating the response of an organization in the event of a disaster within the organization or the community.

Disaster Risk Assessment: It refers to a participatory process to assess the hazards, vulnerabilities, and capacities of a community. Through hazard assessment, the likelihood of the occurrence, the severity and duration of various hazards are determined.
The vulnerability assessment identifies what elements are at risk and the causes of their vulnerable conditions. The households and groups that are most exposed to a hazard are identified. The assessment takes into account the physical, geographical, economic, social and political factors that make some people vulnerable to the dangers of a particular hazard.
In the capacity assessment, the community's resources and coping strategies are identified. The result of the disaster risk assessment is a ranking of the disaster risks of the community as basis of planning for risk reduction.

Disaster Vulnerability: A measure of the ability of a community to absorb the effects of a severe disaster and to recover. Vulnerabilities vary with each disaster, depending on the disaster's impact on the affected population or group.

E

Early Warning: The provision of timely and effective information through identified institutions, that allows individuals exposed to a hazards to take action to avoid or reduce their risk and prepare for effective response.
Early Warning Systems include a chain of concerns, namely: understanding and mapping the hazard; monitoring and forecasting impending events; processing and disseminating understandable warnings to political authorities and the population.

Earthquake: The violent shaking of the ground produced by deep seismic waves, beneath the epicenter, generated by a sudden decrease or release in a volume of rock of elastic strain accumulated over a long time in regions of seismic activity (tectonic earthquake). The magnitude of an earthquake is represented by the Richter Scale; the intensity by Mercalli Scale.

Earthquake Cycle: The concept holds that two comparable sized earthquakes rupturing the same segment of a fault will be separated by a period of time long enough to re-accumulate strain in the amount equal to the elastic strain drop in the first earthquake. The stages in the cycle are: (1) a long period of seismic quiescence, except for the aftershocks, following a major earthquake, (2) a shorter period of increased seismicity as elastic strain accumulation approaches the critical strain level, and (3) the next major earthquake as the critical strain level is suddenly exceeded.

Earthquake Hazards: The physical effects generated in an earthquake (e.g. ground shaking, ground failure, surface fault rupture, regional tectonic deformation, tsunami run up, seiches, and aftershocks)

Earthquake Resistant Buildings: Buildings that are sited designed and constructed in such a way that they are able to resist the ground shaking from large-magnitude earthquakes without collapsing and from moderate-magnitude earthquakes without loss of function and with damage that is repairable.

Elements at Risk: The population, properties, economic activities, including public services, etc. at risk in a given area.

El Niño-Southern Oscillation Phenomenon: A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts over many months, such as altered marine habitats, rainfall changes, floods, droughts and changes in storm patterns.

Emergency: A sudden and usually unforeseen event that must be countered immediately to minimize the consequences. The term is often used for disaster. With rational planning, emergencies can be tackled more effectively.

Emergency Management: The organization and management of resources and responsibilities for dealing with all aspects of emergencies, particularly preparedness, response, and rehabilitation.
It involves plans, structures, and arrangements to engage the normal endeavors of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.
The efforts of state and political subdivisions to develop plan, analyze, conduct, provide, implement and maintain programs for disaster mitigation, preparedness, response, and recovery. The function of the organizations concerned, ensuring that their organization can continue to function during and after a crisis.

Emergency Preparedness: Measures taken in advance of an emergency to reduce the loss of life and property and to protect a nation's people and institutions from all types of hazards through a comprehensive emergency management program of preparedness, mitigation, response and recovery.

Emergency Response: Actions taken during and immediately after a disaster to ensure that its adverse effects are minimized and that people affected are given immediate relief and support. It includes search and rescue, relief services, as well as restoration of power, water, and telephone services.

Emergency Services: The set of specialized agencies that has specific responsibilities and objectives in serving and protecting people and property in emergency situations.

Environmental Impact Assessment (EIA): Studies undertaken in order to assess the effect on a specified environment of any new factor, which may upset the current ecological balance.
EIA is a policy making tool that serves to provide evidence and analysis of environmental impacts of activities from conception to decision-making. It is utilized extensively in national programming and for international development assistance projects. An EIA must include a detailed risk assessment and provide alternative solutions or options.

Epicenter: The point on the earth's surface vertically above the subsurface point where the fault rupture originated.

Evacuation: Organized, phased and supervised dispersal of people from dangerous or potentially dangerous areas.

Extensive Risk: The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts.

Eye of the Cyclone: A term used for the centre of a cyclone. It is the point where the wind rotates in a counter-clockwise direction. In the centre of the eye, the wind is calm or slight and cloudiness is nil or light.

F

Fault: A fracture or a zone of fractures in the earth along which displacement of the two sides relative to one another has occurred as a consequence of compression, tension, or shearing stresses. A fault may rupture the ground surface during an earthquake, especially if the magnitude is greater than 5.5. The length of the fault is related to the maximum magnitude with long faults able to generate larger-magnitude earthquakes than short faults.

Forecast: Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area

G

Geological Hazard: Natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
Geological Hazards include internal earth processes or tectonic origin, such as earthquakes, geologic fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surface collapses, expansive soils and debris or mudflows.
Geologic Hazards can be single, sequential or combined in their origin and effects.

Geographic Information Systems (GIS): Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analyzing, and displaying data about the earth that is spatially referenced.
GIS are increasingly being utilized for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.

H

Hazard: It is an event or occurrence that has the potential to cause injuries to life and damage property and the environment. Examples of natural hazards are typhoons, tsunamis, earthquake and volcanic eruption exclusively.
Landslides, floods, drought, fires can be described as socio-natural hazards since their causes are both natural and man-made. The distinction between natural and man-made hazards is becoming harder to define. For example, flooding may be increased through landfill, drainage, or groundwater extraction; storm surge hazard may be worsened by the destruction of mangroves.
Human-made hazards are associated with industries or energy generation facilities and include explosions, leakage of toxic waste, pollution, dam failures. War or civil strife is also included in this category. Some hazards can cause secondary hazards e.g. an earthquake causing landslides, which dams a river and then causes flooding. A community may be exposed to multiple hazards as a result of secondary hazards.

Hydro-meteorological Hazard: Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Human-Made Hazard: A condition, which may have disastrous consequences for a society. It derives from technological processes, human interactions with the environments, or relationships within and between communities.

The disasters or emergency situation in which the major direct cause or causes are intentional or unintentional human actions that result in civilian populations suffering casualties, loss of property, basic services, and means of livelihood as a result of war or civil strife. Human-made disasters or emergencies can be rapid or slow onset and, in case of internal conflict, lead to complex disasters.

Human-made disaster acknowledges that all disasters are caused by human because they have chosen, for whatever reason, to be where natural phenomena occurs that result in adverse impacts of people.

Natural Hazard: Natural phenomena which occur in proximity and pose a threat to people, structures or economic assets and may cause disaster. They are caused by biological, geological, seismic, hydrologic, or meteorologic conditions or processes in the natural environment.

Hazard Analysis: Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics, and behavior.
It is the process of quantifying the probability that something will injure or harm something in a given geographic area during a specified time interval. Hazard Analysis is comprised of three sequential components: Hazard Identification, Vulnerability Assessment, and Risk Analysis

Hazard Assessment (also called Hazard Analysis or Evaluation): An estimate of the range of the threat from natural and technological hazards to humans and their welfare. The physical parameters used to characterize the earthquake threat include: magnitude, frequency, duration, two-dimensional areal extent, speed of onset, three-dimensional spatial dispersion and temporal spacing (e.g. the tendency of large-magnitude earthquakes to cluster in time).
It is the process of estimating, for defined areas, the probabilities of the occurrence of potentially damaging phenomena of given magnitude within a specified period of time. Hazard assessment involves analysis of formal and informal historical records, and skilled interpretation of existing topographical, geological, geomorphologic, hydrological and land-use maps, as well as analysis of social and economic and political conditions.

Hazard Environment: The geological, geophysical, and geotechnical setting of the community that controls where, why, and how frequently earthquakes occur, how big they are, and their severity.

Hazard Mapping: The process of establishing geographically where and to what extent particular phenomena are likely to pose a threat, property, infrastructure, and economic activities. Hazard mapping represents the results of hazard assessment on a map, showing the frequency/probability of occurrences of various magnitudes or durations.

Hazard Mitigation: Sustained actions taken to reduce or eliminate the long-term risk to human life and property from hazards and their effects. The term is sometimes used in a stricter sense to mean cost effective measures to reduce the potential for damage to a facility or facilities from a disaster event.

Hazard Resistant Standards: Guidelines for building construction that ensure a minimum level of safety for the occupants, given the forces that natural hazards impose on the area governed by the guidelines.

Hazard Risk: The probability that a hazard event will occur within a specified time interval; the third and highest level of hazard analysis sophistication.

Hazard Vulnerability Analysis: An analysis that estimates the potential impact of the hazards on an area. The goal of the analysis is to prioritize potential disasters that could affect an area based on likelihood of occurrence and impact. The analysis can then be used as a starting point for emergency plans, enabling communities to use their resources most effectively.

L

Landfall: A point on the land where a cyclone crosses the coast.

Landslide: A massive and more or less rapid sliding down of soil and rock, causing damage in its path. The most common and widespread type of ground failure; consists of falls, topples, slides, spreads, and flows of soil and/or rocks on unstable slopes.

Lead Time: Period between the announcement and arrival of a particular hazard.

Liquefaction: occurs mainly in young, shallow, loosely compacted, water saturated sand and gravel deposits when subjected to ground shaking; results in temporary loss of bearing strength.

Land-use planning: Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions.

Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.

Land-use planning can help mitigate disasters and reduce risks by discouraging high density settlements and construction of key installations in hazard-prone areas, control of population density and expansion, and in the site of service routes for transport, power, water, sewage, and other critical facilities.

M

Magnitude: A numerical quantity, denoted by Arabic integers with one decimal place accuracy (for example 7.8) to characterize earthquake in terms of the total energy released after adjusting for difference epicentral distance and focal depth. Magnitude differs from intensity in that, magnitude is determined on the basis of instrumental records; whereas, intensity is determined on the basis of subjective observations of damage. Measured on a logarithmic scale, magnitude is open ended theoretically, with the two largest magnitude earthquakes to date being M 9.5 Chile earthquake of 1960 and the M 9.2 Alaska earthquake of 1964. Moderate-magnitude earthquakes have magnitudes of 5.5 to 6.9; large-magnitude earthquakes have magnitudes 7.0 to 7.9; and great-magnitude earthquakes have magnitudes of 8.0 and greater. The energy increases exponentially with magnitude. For example, a magnitude 6.0 earthquake releases 31.5 times more energy than a magnitude 5.0 earthquake, but (31.5)(31.5) or approximately 1,000 times more energy than a magnitude 4.0 earthquake.

Magnitude of an earthquake: The "size" of an earthquake, expressing the amount of energy released in the form of elastic waves as measured by a seismograph, on a scale such as Richter's.

Man-made Disaster: A disaster not caused by natural phenomena, but by man's or society's action, involuntary or voluntary, sudden or slow, directly or indirectly, with grave consequences to the population and the environment. Examples: technological disaster, toxicological disaster, desertification, environmental pollution, conflict, epidemics, fires.

A disaster that humans clearly cause, such as wars, armed conflicts, or civil strike. All other disasters with the exception of technological disasters (e.g. industrial accidents, railway crashes) are labeled natural. Avalanches, floods, landslides, droughts, and crop failures are thus given the same quality of naturalness as earthquakes, tropical cyclones, and volcanic eruptions.

Mass Casualty: The definition of disaster implies a discrepancy between number of victims and its treatment capacity. This does not necessarily means a mass casualty situation, in which case the number of victims is overwhelming.

Mass Casualty Event: Pertaining to any large number of casualties produced in a relatively short period of time, usually as the result of a single incident such as a severe tropical cyclone, flood, earthquake, or armed attack that exceeds local logistical support capabilities, as in a mass casualty incident.

It may have the same magnitude in terms of human life and suffering, but does not destroy the infrastructure of the society. Examples of mass casualty events include epidemics, complex emergencies, etc. The impact of such events is close to or may even exceed that of disaster, but the infrastructure remains intact and mechanisms can be developed within the infrastructure to cope with circumstances.

Mitigation: Structural (e.g. reinforcing buildings) or non-structural (e.g. training building contractors or educating the public) measures taken in advance of a disaster, which are aimed at decreasing or eliminating its impact on society and environment.

Multi-Sectoral Disaster Risk Reduction Platform: A nationally-owned and led mechanism - adopting the form of a forum or committee – that serves as advocate for disaster risk reduction at different levels and contributes with both analysis and advice on action through a coordinated and participatory process. A forum to facilitate the interaction of key development players from line ministries, disaster management authorities, academia, civil society and other sectors around the disaster reduction agenda.

Mandatory Evacuation: An evacuation that takes place when appropriate authorities determine that there is an absolute need to evacuate an area, usually on a large-scale possibly for a long period of time (for greater than 24 hours)

Mass Casualty Incident (MCI): A situation in which large number of casualties or patients results from a disaster such as a natural event or an act of terrorism. Mass casualty incidents potentially create a massive influx of patients to hospitals and other health care facilities.

Medical and health incident management system: An overarching system for organizing and managing the medical and public health entities involved in a mass casualty incident response. The model provides an approach for a community to use in developing its own medical response capability.

Mitigation Evaluation: The identification of mitigation alternatives to assess the effectiveness of the alternatives. The alternatives are evaluated for their likely effect on risk and their cost.

Multi-agency coordination entity: An entity that functions within a broader multi-agency coordination system. It may establish priorities among incidents and associated resource allocations, untangle conflicting agency policies, and provide strategic guidance and direction to support incident management activities.

N

National Platform for Disaster Risk Reduction: A generic term for national mechanisms for coordination and policy guidance on disaster risk reduction that is multi-sectoral and inter-disciplinary in nature, with public, private and civil society participation involving all concerned entities within a country.

National Warning System: The government agency/department/unit mandated to generate and disseminate warning and other emergency information from the warning centers or regions to warning points in each state/region.

Natural Hazard: A naturally occurring phenomenon that puts life or property at risk. Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural hazards can be classified by origin, namely: geological, hydro-meteorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.

Natural Disaster: A potential threat to humans and their welfare caused by rapid and slow onset events having atmospheric, geologic, and hydrologic origins on solar, global, regional, national, and local scales (e.g. floods, severe storms, earthquakes, landslides, volcanic eruptions, wild fires, tsunamis, droughts, coastal erosion, etc.)
It is also defined as a sudden major upheaval of nature, causing extensive destruction, death and suffering among the stricken community, and which is not due to man's action. However, (a) some natural disasters can be of slow origin, e.g. drought, and (b) a seemingly natural disaster can be caused of aggravated by man's actions, e.g. desertification through excessive land use and deforestation.

P

Preparedness: Activities and measures taken in advance to ensure effective response to the impacts of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations. It is a continuous process involving efforts at all levels of government and private-sector and nongovernmental organizations to identify threats, determine vulnerabilities, and identify required resources.
The term "readiness" is used interchangeably with preparedness. Preparedness includes designing warning systems, planning for evacuation and relocation, storing food and water, building temporary shelter, devising management strategies, and holding disaster drills and exercises.

Prevention: Encompasses activities designed to provide permanent protection from disasters, including engineering and other physical protective measures, but also legislation on land use and urban planning.

Public Awareness: The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important to public officials in fulfilling their responsibilities to save lives and property in the event of a disaster.

Public Awareness activities foster changes in behavior leading towards a culture of risk reduction. This involves public information, dissemination, education, radio, television broadcasts, use of printed media, as well as, the establishment of information centers and networks and community and participation actions.

R

Recovery: Recovery is the process to fully restore the community to pre-disaster level of functioning or better than that. This refers to rehabilitation of livelihoods, restoration of social and economic activities and reconstruction of shelter and infrastructure.

Relief/Response: The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Rehabilitation: The operations and decisions taken after a disaster with a view to restoring a stricken community to its former living conditions, whilst encouraging and facilitating the necessary adjustments to the changes caused by the disaster.

Reconstruction: Actions taken to re-establish a community after a period of rehabilitation following a disaster. Actions include construction of permanent housing, full restoration of all services, and complete resumption of the pre-disaster state.

A long-term development project that follows a disaster or emergency that reconstructs a community's infrastructure to pre-existing levels. Reconstruction is often associated with an opportunity to improve a community rather than to simply "reconstruct" a pre-existing system.

Rescue: To access, stabilize, and evacuate distressed or injured individuals by whatever means necessary to ensure their timely transfer to appropriate care or to a place of safety.

Resilience/Resilient: The capacity of a system, society, or a community potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Residual Risk: The risk that remains in unmanaged form, even when effective risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained.

Response: The totality of measures taken during and immediately after disaster impact. Such measures are directed towards saving life and protecting property and to dealing with the immediate damage caused by the disaster (e.g. damage assessment, debris removal, search and rescue efforts, and emergency medical services. It also refers to those activities that address the short-term, direct effects on an incident. Response includes immediate actions to save lives, protect property, and meet basic human needs. It also includes the execution of emergency operations plans, as well as mitigation activities designed to limit the loss of life, personal injury, property damage, and other unfavorable outcomes. As indicated by the situation, response activities include: applying intelligence and other information to lessen the effects or consequences of an incident; increased security operations; continuing investigations into the nature and source of the threat; ongoing public health and agricultural surveillance and testing processes; immunizations, isolation, or quarantine, and specific law enforcement operations aimed at preempting, interdicting, or disrupting illegal activity, and apprehending actual perpetrators and bringing them to justice.

Response time: The time lapse between the dispatch and arrival of the emergency response unit at the scene of the emergency.

Retrofitting: Reinforcement of structures to become more resistant and resilient to the forces of natural hazards. It involves consideration of changes in the mass, stiffness, damping, load path and ductility of materials, as well as radical changes such as the introduction of energy absorbing dampers and base isolation systems. Examples of retrofitting includes the consideration of wind loading to strengthen ans minimize the wind force, or in earthquake prone areas, the strengthening of structures.

Risk: The probability that negative consequences may arise when hazards interact with vulnerable areas, people, property and environment.

Risk, Acceptable: The concept of acceptable risk is not particularly easy to define. It is essentially a measure of the risk of harm, injury or disease arising from a chemical or process that will be tolerated by a person or group.

Whether a risk is "acceptable" will depend upon the advantages that the person or group perceives to be obtainable in return for taking the risk, whether they accept whatever scientific and other advice is offered about the magnitude of the risk, and numerous other factors, both political and social.
Degree of human and material loss that is perceived by the community or relevant authorities as tolerable in actions to minimize disaster risk.

Risk Assessment/Analysis: A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods, and the environment on which they depend.

Risk Characterization: The synthesis and summary of information about a potentially hazardous situation that addresses the needs and interests of decision makers and of all interested and affected parties. It also refers to the designation of risk on a categorical scale (e.g. low, medium, and high). Risk characterization provides input for deciding which areas are most suited to mitigate risk.
Risk is measured in terms of a combination of the consequences of an event and their likelihood.

Risk Communication: The understanding of risks, the transfer of risk information to the public, and the transfer of information from the public to decision makers. Risk communication involves a dialogue among interested parties including risk experts, policy makers, and affected citizens.

Risk Factor: A characteristic that has been statitiscally demonstrated to be associated with (although not necessarily the direct cause of) a particular injury. Risk factors can be used for targeting preventative efforts at groups who may be particularly in danger of injury.

Risk Management: The public process of deciding what to do when risk assessments indicate that risk, or the chance of loss, exists. Risk management encompasses choices and actions for communities and individuals (i.e. prevention, mitigation, preparedness, recovery), which are designed to:

a. stop increasing the risk to future elements that will be placed at risk to natural and technological disaster;
b. start decreasing the risk to existing elements already at risk; and
c. continue planning ways to respond to and recover from the inevitable natural and technological hazard, including the imponderable extreme situation or catastrophic event.

The process whereby decisions are made and actions implemented to eliminate or reduce the effects of identified hazards. A framework for the systematic application of management policies, procedures, and practices to the tasks of identifying, analyzing, evaluating, treating, and monitoring risks

Risk Transfer: The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.

Risk Mitigation: The implementation of mitigating actions, depending on an organization's chosen action posture (i.e. the decision on what to do about overall risk). Specifically, risk mitigation may involve **risk acceptance** (taking no action), **risk avoidance** (taking actions to avoid activities that involve risks), **risk reduction** (taking actions to reduce the likelihood and/or impact of risk), and **risk sharing** (taking actions to reduce risks by sharing risks with other entities). Risk mitigation is best framed within an integrated systems approach that encompasses action in all organizational areas; including personnel, processes, technology, infrastructure, and governance. An integrated systems approach helps to ensure that taking action in one or more areas will not create unintended consequences in another area

Risk Map: Cartographic representation of the types and degrees of hazards and of natural phenomena that may cause or contribute to a disaster.

Risk Mapping: The presentation of the results of risk assessment on a map, showing the levels of expected losses, which can be anticipated in specific areas, during a particular time period, as a result of particular disaster hazards.

Risk Marker: It is an attribute of a hazard that is associated with an increased probability that an event may occur and can be used as an indicator of an increased or increasing risk that the event will occur.

Risk Reduction: Long-term measures to reduce the scale and/or duration of adverse effects of unavoidable or unpreventable disaster hazards on a society that is at risk, by reducing the vulnerability of its people, structures, services, and economic activities to the impact of known disaster hazards. Typical risk reduction measures include improved building standards, floodplain zoning, land-use planning crop diversification, and planting windbreaks. The measures are frequently subdivided into structural, nonstructural, active, and passive measures.

Runoff: Rainwater that flows over land and into the streams and lakes; it often picks up soil particles along the way and transport it to streams and lakes.

S

Seismic Zonation: A public policy tool sued to link earthquake risk assessment and earthquake risk management, with the objective being to identify, delineate, and highlight those geographic areas of a community where investments in expanded risk assessment and specific mitigation measures and regulations are needed to mitigate, prevent, or reduce the community's perceived unacceptable risk.

Seismicity: Earthquake activity, as measured in terms of number of events, their magnitude, distribution, and frequency.

Slow Disaster: A disaster, usually natural, the beginnings of which are slow, sometimes imperceptible until the full effect is felt, as in poor crops leading to drought and famine. Synonym: creeping disaster.

Socio-natural hazard: The phenomenon of increased occurrence of certain geophysical and hydrometeorological hazard events, such as landslides, flooding, and land subsidence and drought, that arise from the interaction of natural hazards with overexploited or degraded land and environmental resources.

Storm Surge: It is an abnormal rise in the level of water along a shore, primarily as a result of high winds and low pressures generated with tropical cyclones; generally affects only coastal areas but may intrude some distance inland.

Strategic Planning: Consists of preparing the organization to respond to disaster threats in locations that are not specified and not immediately threatened.
A plan that addresses long-term issues such as impacts of weather forecasts, time-phased resource requirements, and problems such as permanent housing for disaster displaced victims, environmental pollution, and infrastructure restoration.

Structural/non-structural measures: Structural measures refer to any physical construction, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure to reduce or avoid possible impacts of hazards.

Susceptibility: This is the degree to which a person or population is affected by a phenomenon. This term may be used interchangeably with vulnerability.

Sustainable Development: Development that meets the needs of the present without compromising the ability of the future generation to meet their own needs. It is based on socio-cultural development, political stability and decorum, economic growth, and ecosystem protection, which all relate to disaster risk reduction.

T

Technological Hazards: Danger originating from technological or industrial accidents, dangerous operations, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation:

Some examples: industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial, or technological accidents (explosions, fires, and spills).

Tabletop Exercise: An exercise that places senior staff, elected or appointed officials, or other key personnel in an informal setting to discuss simulated situations. This type of exercise is intended to stimulate discussion of various issues regarding a hypothetical situation. It can be used to assess plans, policies, procedures, or to assess types of systems needed to guide the prevention, response to, and recovery from the defined event. Tabletop exercises typically aimed at facilitating the understanding of concepts, identifying strengths and shortfalls, and/or achieving a change in attitude. Participants are encouraged to discuss issues in depth and develop decisions through slow-paced problem solving rather than rapid, spontaneous decision-making as would occur under actual or simulated emergency conditions.

Toxicological Disaster: Serious environmental pollution and illness caused by the massive accidental escape of toxic substances into the air, soil or water, and to man, animals or plants

Tsunami: A series of large waves generated by sudden displacement of seawater (caused by earthquake, volcanic eruption or submarine landslide); capable of propagation over large distances and causing a destructive surge on reaching land. The Japanese term for this phenomenon, which is observed mainly in the Pacific, has been adopted for general usage.

V

Vulnerability: This refers to a set of prevailing or consequential conditions, which adversely affect people's ability to prevent, mitigate, prepare for and respond to hazardous events. These long-term factors affect a household or community's ability to absorb losses after disaster after disaster and to recover from the damage. Vulnerabilities precede disasters; contribute to their severity; impede disaster response; and may continue to exist long after a disaster has struck.
Anderson and Woodrow (1980) categorize vulnerabilities into three areas:

- **Physical/Material Vulnerability**: For example, poor people who have few physical and material resources usually suffer more from disasters than rich people. The poor often live on marginal lands; they don't have any savings or insurance; they are in poor health. These factors make them more vulnerable to disasters and mean that they have harder time surviving and recovering from a calamity than people who are better off economically.
- **Social/organizational Vulnerability**: People who have been marginalized in social, economic or political terms are vulnerable to suffering from disasters whereas groups, which are well organized and have a high commitment to their members, suffer less during disasters. Weakness in social and organization areas may also cause disasters. For example deep divisions can lead to conflict and war. Conflict over resources due to poverty can also lead to violence. A second area of vulnerability then, is the social and organizational aspect of a community.
- **Attitudinal/Motivational Vulnerability**: People who have low confidence in their ability to affect change or who have "lost heart" and feel defeated by events they cannot control, are harder hit by disasters than those who have a sense of their ability to bring changes they desire. Thus, the third area of vulnerability is the attitudinal and motivational aspect.

Vulnerability also refers to the extent to which an individual, community, sub-group, structure, service, or geographical area is likely to be damaged or disrupted by the impact of a particular disaster hazard.

Vulnerability Study: Study and investigation of all the risks and hazards likely to cause a disaster.

MODULE 1 CONTEXTUALIZING THE EWS FOR MYANMAR TRAINING

Rationale: The end-to-end EWS is integral for effective DRR. The EWS, however, remains to be fully understood and appreciated by various stakeholders in the end-to-end process. The EWS requires multi-institutional collaboration, for effective DRR. An effective EWS, and therefore effective DRR, relies on the connectivity, collaboration and integration of various elements and stakeholders, from national to levels, across sectors and disciplines.

Module 1 intends to establish that every participant, in the training, is part of the EWS. It underscores the interactive nature of the training, the cooperation required from each participant to maximize learning, and the sharing of information and experiences for collective enhancement of knowledge and understanding of the different sessions; and sets clarity, between the facilitators and the participants, of what are to be expected during, and after, the training. Module 1, further, introduces the training components to the participants, for appreciation of the latter of the contents of the training and the connectivity of every module and session to the holistic capacity building process.

SESSION 1.1. SETTING THE TRAINING ENVIRONMENT AND LEVELING OF EXPECTATIONS

Description: This session targets to establish a sociable and interactive environment in the training. For optimized learning, meaningful interaction among participants and facilitators is required. Through group activities that are introduced, key concerns in EWS are expected to be highlighted which will be connected to later parts of the training. Moreover, this session is expected to level off what would be expected from the training, as well as from participants.

Objectives: This session is expected to aid participants to:

- be acquainted with each other and develop friendly relationships to facilitate healthy interactions throughout the training
- understand the importance of each person's (and institution's) contribution to an effective EWS
- understand the value of cooperation, coordination and team work, in a functional, multi-stakeholder, multi-level system
- establish clarity, between facilitators and participants, on what are to be expected during, and after, the training

Methodologies: Highly interactive, this session employs the following methodologies:

- plenary discussion
- group discussion/exercise/game
- brainstorming
- PowerPoint presentation

Key Learning Points. The EWS is a comprehensive system of different elements, that should be put together like a puzzle, in order to function effectively and generate desired results. Take as an example, the human body. In order for us to function effectively, each part – having different functions - have to contribute meaningfully. Saving lives, properties and assets is the desired result of EWS.

Vulnerability Analysis: The process of estimating the vulnerability to potential disaster hazards of specified elements at risk. For engineering purposes, vulnerability analysis involves the analysis of theoretical and empirical data concerning the effects of particular phenomena on particular types of structures. For more general socio-economic purposes, it involves consideration of all significant elements in society, including physical, social and economic considerations (both short- and long-term), and the extent to which essential services and traditional and local coping mechanisms are able to continue functioning.
The assessments of an exposed population's susceptibility to the adverse health effects of a particular hazard

W

Warning: A message informing of danger. The alerting of emergency response personnel and the public to the threat of extraordinary danger and the related effects that specific hazards may cause. A warning issued by the National Weather or Meteorological and Hydrological Service (e.g. severe storm warning, tropical cyclone warning, flood warning) for a defined area indicates that the particular type of severe weather is imminent in that area.

Wetland: A vegetated ecosystem where water is a dominant factor in its development and existence.

Zonation: In general, it is the subdivision of a geographical entity (country, region, etc.) into homogenous sectors with respect to certain criteria (for example, intensity of the hazard, degree of risk, some overall protection against a given hazard, etc.)

Annex 3. Sample Scenarios for Simulation Exercises

3.1 EARTHQUAKE

You are in a meeting with colleagues from RRD and other government institutions. While in the middle of the meeting, you felt the shaking. The shaking is quite strong at around intensity VI.
You are going to:

3.1.a. Demonstrate what you are going to do, noting that you are in a meeting room, on the 3rd floor of a building. There is an elevator in the building, just outside your meeting hall. There are 3 meeting rooms, between your meeting room and the stairs. There are study tables around the meeting room.

3.1.b. The following day, you are to call a meeting with colleagues for earthquake preparedness, based on your experience. Demonstrate this meeting and the details of your discussions, for enhancing earthquake preparedness in your area of jurisdiction.

3.2 TSUNAMI

A magnitude 9.2 earthquake occurred in Sumatra, Indonesia at around 3:30 on (identify date). Based on historical data and model estimations, DMH issued the following:

- *Tsunami Warning*
  - There is a potential for tsunami wave of about 0.5 to 3 meters to be generated and reach the coast of Rakhine, Ayeyarwady and Thanintharyi at around 6:00 – 7:00 (identify date). Those in the coastal areas are advised for immediate evacuation.

- *Tsunami Update*
  - Tsunami wave of about 1.5-2.5 meters has been generated and expected to reach the coast of Rakhine, Ayeyarwady and Thanintahryi Regions at around 6:00 – 7:00 (identify date). Those in the coastal areas are advised to remain in safe shelters/areas and continue to monitor updates from DMH.

- *Tsunami Warning Cancellation*
  - Tsunami wave of about 1.5-2.5 meters was generated and passed Rakhine State, and Ayeyarwady and Thanintharyi Regions (identify time and date). The tsunami threat is over. Coordinate with your local authorities for safe return to houses/shelters.

You are going to:

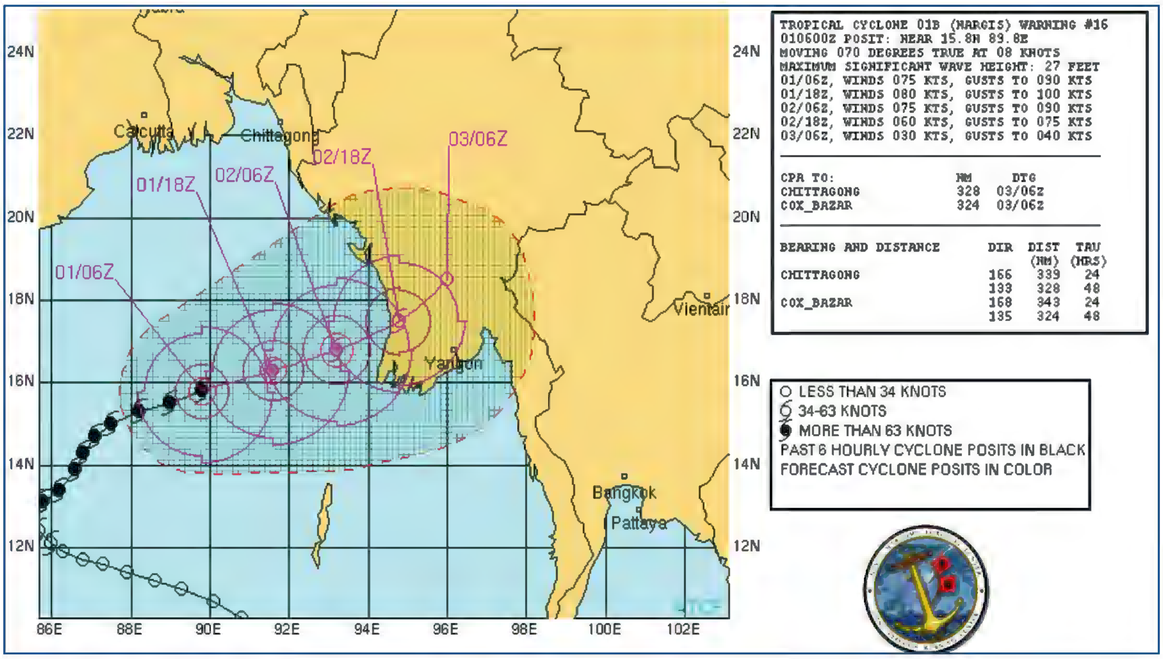
3.2.a. Demonstrate the actions that you will undertake in each level of information provided.

3.3 CYCLONE

A cyclone warning has been issued by DMH, with the following details, among others:
- wind gusts of up to 80 miles per hour
- with potential landfall in between Rakhine and Ayeyarwady in 2 days (track is provided in the following figure)

You are going to:

3.3.a. Simulate the preparedness measures that you are going to undertake based on forecast updates



Track of cyclone approaching the coast of Myanmar

3.4 3 DAYS, 10 DAYS, MONTHLY AND SEASONAL OUTLOOK

You are to:

3.4.1 Simulate the scenario provided for in the table, below:

Integrating Information of Various Timescales into Plans and Decisions		
SCRENARIO: Involving different stakeholders, there is an on-going meeting for planning for resilience/disaster preparedness vis-à-vis 10 days forecast, monthly outlook and seasonal outlook. The different sectors are to identify their preparedness actions, integrating weather/climate information into their activities/plans for the period. Based on the information provided below, please provide details on the activity/plans for the period and preparedness actions.		
Forecast	**Activity/Plans for the Period**	**Preparedness Actions**
10 Days ***Bay of Bengal Condition*** *A low pressure Area may form over the South Bay of Bengal. Weather will be generally fair in the North Bay and partly cloudy in the Andaman Sea and elsewhere in the Bay of Bengal* ***Rain Condition and Rainy Days*** *About normal rainfall is likely in the (identify) State.* ***Day Temperature*** *Day temperature will be about normal in (identify) State*		
Seasonal (May to October) ***Onset and withdrawal of Southwest Monsoon***		

Southwest monsoon is likely to set into the whole country on first (10) days of June 2017. Southwest monsoon is likely to retreat from the whole country third (10) days of September 2017. ***Early Monsoon Period Forecast*** The early monsoon is likely to establishment over Myanmar by end of June. 2 Low Pressure Areas may form over the Bay of Bengal and one may further intensify into the depression. During the early monsoon period, monsoon will be moderate. Below normal rainfall is expected in (identify) Region/State. ***Mid Monsoon Period Forecast*** Mid Monsoon period is from July to August. 3 Low Pressure Areas may form over the North Bay of Bengal and 2 may further intensify into the depression. During the mid-monsoon period, monsoon will be moderate to strong. About normal rainfall is likely in (identify) Region/State ***Late Monsoon Period Forecast*** Late Monsoon period is from until monsoon withdrawal. 2 Low Pressure Areas may form over the Bay of Bengal and may further intensify into the depression. During the late monsoon period, monsoon will be weak to moderate. (Identify) Region/State is likely to have about normal rainfall. Overall rainfall condition for the Southwest Monsoon Season in (identify) Region/State will be below normal Temperature is likely to be above normal in (identify) Region/State.		

3.5 CLIMATE CHANGE PROJECTIONS

Using updated data sets and models, DMH generated the following projections:

- Potential increase in temperature, in (identify) Region/State, by 2021-2040; 2041-2060; 2061-2080; 2081-2100
- Potential increase in rainfall 2021-2040; 2041-2060; 2061-2080; 2081-2100
- Increased variability in the behavior Southwest Monsoon

- Potential for more frequent extreme (short-duration, intense) rainfall events
- Shorter Southwest Monsoon Season

You are to:

3.5.1 Draw a set of climate change adaptation measures for specific regions and present them to the national government for prioritization and funding support.

The EWS is misunderstood by many as merely referring to warning information. The scope, however, of EWS extends beyond warning information. It includes other essential elements in the long chain of capacities that should be present to facilitate informed planning and decision-making.

The EWS encompasses technical monitoring and warning institutions, national sectoral institutions, disaster risk managers, research institutions, media, local government leaders, non-government organizations, and community members. While the functions of each one are different, all contribute to how the end-to-end system performs.

SESSION 1.2. TRAINING OVERVIEW

Description: At the beginning of the training, participants are to be provided a full perspective of the purpose of the training, the inclusive modules and sessions, the approaches for facilitating learning, and what are expected from the participants after they have been trained.

Objectives: Participants are able to, at the end of this session:

- understand the purpose of the training, its components, training methodologies involved, and what are expected from them at the end of the training
- understand the connectivity of each module to other modules in the training

Methodologies: This session shall be carried out through the use of:

- PowerPoint presentation
- plenary discussion
- brainstorming

Key Learning Points. The EWS for Myanmar Training encapsulates the essence of an effective, efficient, and functional EWS for meaningful DRR. While EWS has long been recognized as a necessary tool for reducing loss to lives, assets and properties, its full potential is still to be realized in societies due to capacities that have to be built in the end-to-end chain.

As defined by the United Nations Office for Disaster Risk Reduction (UNISDR, 2009), the EWS is an **integrated system** of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems, and processes that enable individuals, communities, governments, businesses and others to take **timely action** to **reduce** disaster risks in **advance** of hazardous events.

In the EWS for Myanmar, the most significant questions are: a) how stakeholders undertake preparedness activities after receipt of warning information, and b) are warning information translated into actions that enables institutions and communities to benefit from it, through reduction of hazard risks.

Given the integrated process, stakeholders in the EWS are cross-cutting and encompassing various sectors from the national to community levels. An effective disaster risk reduction is guided by multi-hazard information of various timescales, with stakeholders capacitated – with full appreciation of uncertainties associated with information/warnings – to apply information, for a **proactive** and **anticipatory** approach.

The EWS for Myanmar Training is broadly aimed at building the capacity of participants, and their respective organizations, in utilizing information for different hazards and of