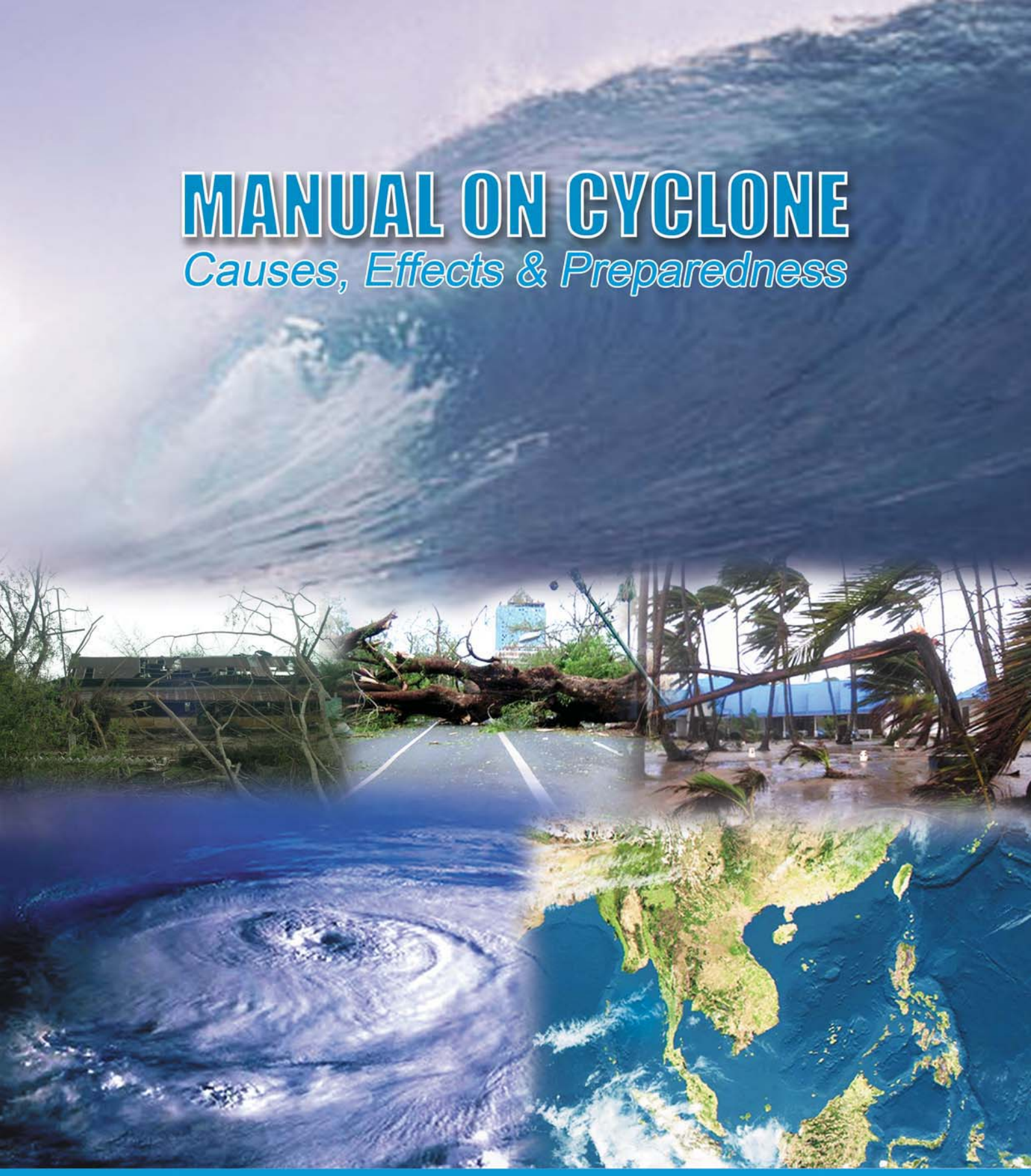
MANUAL ON CYCLONE

Causes, Effects & Preparedness



UN HABITAT
UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME

Scope of the Manual

This manual is developed with wider consultations and inputs from various relevant departments/ministries, UN Agencies, INGOs, Local NGOs, Professional organizations including some independent experts in specific hazards. This is intended to give basic information on WHY, HOW, WHAT of a disaster. It also has information on necessary measures to be taken in case of a particular disaster in pre, during and post disaster scenario, along with suggested mitigation measures. It is expected that this will be used for the school teachers, students, parents, NGOs, Civil Society Organizations, and practitioners in the field of Disaster Risk Reduction.

Excerpts from the speech of Ban Ki-moon, Secretary-General of the United Nations

Don't Wait for Disaster

No country can afford to ignore the lessons of the earthquakes in Chile and Haiti. We cannot stop such disasters from happening. But we can dramatically reduce their impact, if the right disaster risk reduction measures are taken in advance.

A week ago I visited Chile's earthquake zone and saw how countless lives were saved because Chile's leaders had learned the lessons of the past and heeded the warnings of crises to come. Because stringent earthquake building codes were enforced, much worse casualties were prevented. Training and equipping first responders ahead of time meant help was there within minutes of the tremor. Embracing the spirit that governments have a responsibility for future challenges as well as current ones did more to prevent human casualties than any relief effort could.

Deaths were in the hundreds in Chile, despite the magnitude of the earthquake, at 8.8 on the Richter Scale, the fifth largest since records began. In Haiti, a less intense earthquake caused hundreds of thousands of deaths. Haiti had non-existent or un-enforced building codes, and very poor preparedness.

The lessons are universally applicable. No country is immune from disaster, be it earthquakes or floods, storms or heatwaves. More and more intense natural disasters are affecting all five continents, we believe as a result of climate change. Many of the world's poorest people live in high-risk densely populated cities in flood or earthquake zones, or both.

The culture of disaster risk reduction must spread. I am encouraged that we already have a head start in this regard. The Hyogo Framework for Action, a 10-year plan to make the world safer from disasters triggered by natural hazards, was adopted by 168 governments in 2005.Hyogo gives national authorities a blueprint to assess and reduce risks through planning, training, and better public education. For example, making sure that schools, hospitals, and other key public infrastructure meet certain safety standards.

There has been progress. Bangladesh lost more than 500,000 people during Cyclone Bhola in 1970. It subsequently built 2,500 cyclone shelters on elevated concrete platforms and trained more than 32,000 volunteers to help in evacuations. When Cyclone Sidr struck in 2007 with an enormous sea surge, the death toll was less than 4,000. Cyclone Nargis, a similar event in unprepared Myanmar in May 2008, cost 140,000 lives. Cuba weathered four hurricanes in 2008. It sustained $9 billion of physical damage but very few lives were lost.

The evidence is overwhelming. Yet the lessons of these disasters are forgotten with depressing speed. We know prevention actually saves governments money in the long run. When China spent $3.15 billion on reducing the impact of floods between 1960 and 2000, it averted losses estimated at about $12 billion. Similar savings have been recorded in Brazil, India, Vietnam and elsewhere.

Everyone has a role to play.

Governments, central and local, have to do what it takes to make communities able to cope with both continuing challenges and sudden shocks.

The Chile and Haiti earthquakes showed us once again why action *before* disasters makes all the difference. To prevent natural hazards turning into disasters, we must all act sooner and act smarter.

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Chapter 1

Introduction to Cyclone

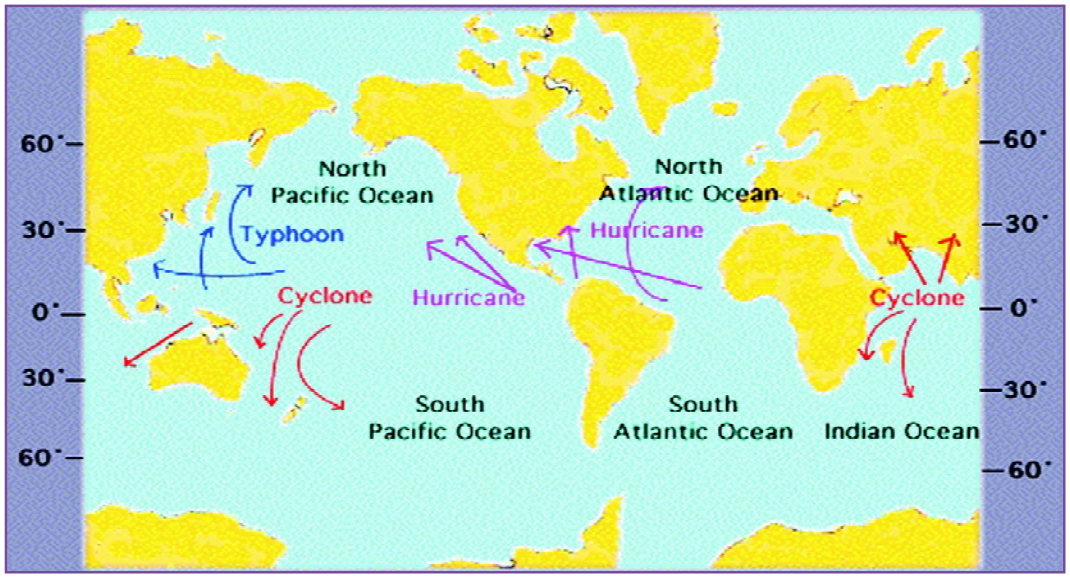
1.1 What are cyclones?

A cyclone is a huge strong wind system which blows around the centre of intense low pressure area. Cyclones are the local name of the Indian Ocean and the South Pacific Ocean, but in the Northwest Pacific Ocean they are known as typhoons, and in the Northeast Pacific Ocean and North Atlantic, they are known as hurricanes. Since the cyclones form in the tropical region, they are also known as tropical storms, tropical revolving storms or tropical cyclones. In the northern hemisphere, cyclone winds blow anticlockwise and they reverse in the southern hemisphere.

1.2 When and where do cyclones occur?

Cyclones begin in tropical sea regions during the summer and tend to move initially westward, then eastward towards higher latitude (Map 1.1).

Map 1.1: Formation areas and typical tracks of tropical cyclones worldwide



Source: http://www.ntlib.nt.gov.au

The regions of the world where tropical cyclones usually originate can be summarized as follows:[1]

- *Tropical North Atlantic Ocean*
  - East of the Lesser Antilles and the Caribbean, east of 70°W during the months of July to October
  - North of the West Indies in June to October
  - Western Caribbean during the months of June and late September to early November
  - Gulf of Mexico during the months of June to November
- *Western North Pacific Ocean, including the Philippines,* during the months of May to November, but storms sometimes occur in all months.
- *North Pacific off the West Coast of Central America,* during the months of June to October.
- *Bay of Bengal and Arabian Sea,* from May to June and October to November.
- *South Pacific Ocean, West of 140°W,* from December to April.
- *South Indian Ocean,* from December to April.
  - Northwestern Coast of Australia during the months of November to April
  - West of 90°W from November to May

Tropical cyclones form over oceans of the world except in the South Atlantic Ocean and in the South Eastern Pacific.

1.3 How do cyclones occur?

Cyclones develop over warm seas near the equator. Air heated by the sun rises very swiftly, which creates areas of very low pressure. As the warm air rises, it becomes loaded with moisture which

[1]http://www.pagasa.dost.gov.ph/genmet/tropicalcyclone areas_of_formation.html

condenses into massive thunder clouds. Surrounding air rushes in to fill the void that is left. But because of the constant turning of the earth on its axis, the air is bent inwards and then spiral upwards. The swirling winds rotate faster and faster, forming a huge circle which can be up to 500-1000 km across. At the centre of the storm is a calm, cloudless area called the eye - where there is no rain, and the winds are fairly light (Figure 1.1).

Figure 1.1: Formation of a tropical cyclone

The development of cycle of tropical cyclones can be divided into three stages:

- Formation and initial development
- Full maturity
- Decay

Formation and initial development

Four atmospheric and oceanic conditions are necessary for the development of a cyclonic storm: -

- A warm sea temperature in excess of 26 degrees centigrade to a depth 60 metre which provides abundant water vapors in the air by evaporation.
- High relative humidity of the atmosphere to a height of above 7000 m facilitates condensation of water vapors into water droplets and clouds; releases heat energy thereby inducing a drop in pressure.
- Atmospheric instability encourages formation of massive vertical cumulus cloud convection with condensation of rising air over ocean.

- A location of at least 4-5 latitude degrees from the equator allows the influence of the forces due to the earth's rotation to take effect wind circulation around low-pressure centers.

Full Maturity

If the ocean and atmosphere environment continues to be favourable the cyclone may continue to intensify as it moves pole-ward. The cloud system becomes more circular in shape and develops a distinct eye. This is the shape which signifies the cyclone is at its most severe and dangerous stage. Approximately half of the cyclones of this form progress to full maturity.

Decay

A tropical cyclone begins to dissipate when the central pressure becomes filled up. The storm eye becomes distorted. High wind becomes weak. Severe weather becomes moderate. When the cyclone hits land, storm wind and storm surge may occur near the coastline, and heavy rain and flood may occur along the storm track in land. Intense rain may last for weeks.

1.4 Classification of cyclones

Cyclones are classified according to their wind speed, however, the classification, varies from region to region. In the United States, they are classified into 5 different categories on the basis of their wind speed as measured on the Saffir-Simpson scale (SS scale). This classification is given in Table 1.1.

Table 1.1: Saffir-Simpson Hurricane Scale

Scale Number (Category)	Sustained Winds in m/h	Damage	Storm Surge (ft.)
1	74-95	Minimal	4-5
2	96-110	Moderate	6-8
3	111-130	Extensive	9-12
4	131-155	Extreme	13-18
5	156 or above	Catastrophic	>18

Source: NWS, NOAA

1.5 Hazards associated with cyclones

There are three hazards associated with a cyclone, which cause destruction.

a) Storm surge: A storm surge is an abnormal rise of sea level near the coast caused by a severe tropical cyclone; as a result, sea water inundates low lying areas of coastal regions drowning human beings and livestock, eroding agricultural land, beaches and embankments, destroying vegetation and reducing soil fertility.

b) Strong wind: The most destructive force of a cyclone comes from fierce winds. These winds are strong enough to easily topple fences, sheds, trees, power poles and communication systems, while hurling helpless people through the air. Many people are killed when the cyclone winds cause buildings and houses to collapse and completely blow away resulting in loss of life and property.

c) Flood: Heavy and prolonged rains due to cyclones may cause floods and submergence of low lying areas causing loss of life and property. Floods and coastal inundation due to storm surges pollute drinking water sources causing outbreak of epidemics. Long after a cyclone has passed, road and rail transport can still be blocked by floodwaters. Water often becomes contaminated from dead animals or rotten food, and people are threatened with diseases like diarrhoea and other infections.

1.6 Destructive cyclones in the past

The destructive cyclones in the Northern Indian Ocean during the period 1940 to 2008 are listed below. (Cyclones which caused fatalities over 3000 people are included here)

- 1942 Bengal Cyclone: hit near the India/Bangladesh border, resulting in around 40,000 fatalities.
- 1960 East Pakistan I Cyclone: 6,000 deaths can be attributed to this cyclone that hit the eastern portion of Pakistan on October 10 what was known then as East Bengal State.

- 1963 East Pakistan II Cyclone: on May 23, the cyclone hit present-day Bangladesh (then known as East Pakistan province), causing 22,000 fatalities due to storm surge and flooding.
- 1965 Pakistani Bengali Cyclones: two cyclones that hit on May 11 and June 1 killed a total of 47,000 people.
- 1965 Pakistani Cyclone: hit near Karachi, Pakistan on December 15, causing about 10,000 casualties.
- 1970 Bhola Cyclone: killed between 300,000 to 500,000 people in East Pakistan (now Bangladesh).
- 1971 Orissa Cyclone: killed around 10,000 people in Cuttack, Orissa, India.
- 1977 Andhra Pradesh Cyclone: killed 10,000 people in Andhra Pradesh, India.
- 1985 Cyclone 01B: on May 25 in Bangladesh, Meghna River Delta a cyclone created a surge 15-20 feet high killing around 6,000 - 10,000 people.
- 1988 Cyclone 04B: on November 26 the cyclone hit the Sundarbans part of Bangladesh. Heavy storm surge killed 2000 people (with 6000 missing). In addition, the storm caused 1000 fatalities in Malaysia, Thailand, and western Indonesia.
- 1991 Bangladesh Cyclone: killed 138,000 people in the Chittagong region of Bangladesh.
- 1999 Orissa Cyclone: killed around 10,000 people in the Orissa state of India.
- 2007 Cyclone Sidr: struck Bangladesh on 15 November, and killed at least 3,500 people.
- 2008 Cyclone Nargis: struck the Ayeyarwady Delta in Myanmar killing over 130,000 people and devastating the country's largest city, Yangon, making it Myanmar's deadliest natural disaster in history, the costliest North Indian cyclone on record, and the second deadliest North Indian cyclone in recorded history.

Chapter 2

Cyclones in Myanmar

2.1 Geo-physical location of Myanmar

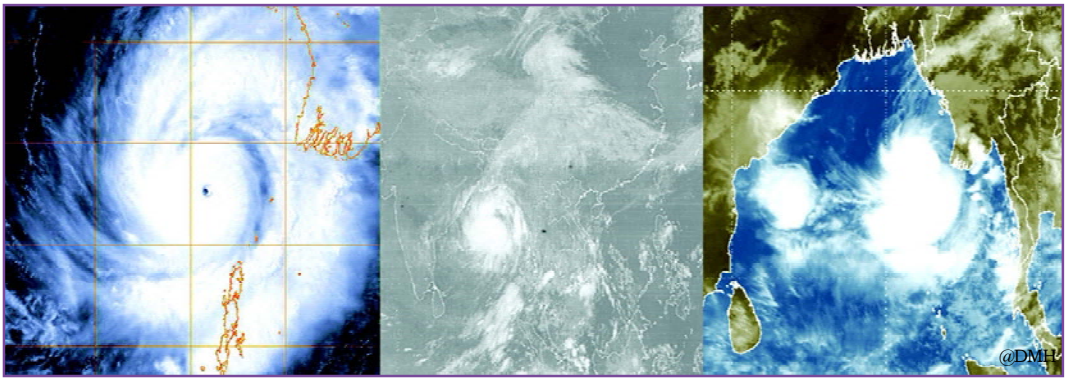
Myanmar is the western-most country of Southeast Asia, situated between latitudes 09 ° 32' N and 28 ° 31' N and longitudes 92 ° 10' E and 101 ° 11' E. The country is surrounded by the Bay of Bengal and the Andaman Sea along its 2400 km long coast line. Therefore the country is potentially threatened by waves, cyclones and other associated hazards. The Bay of Bengal of the North Indian Ocean stretches northwards from the equator to the river mouths of Bramaputra, Ganges and Magna and eastward from Chennai coast of India to Myanmar coast, in the tropical region. A cyclone once generated, moves generally westward initially. If there is slight recurvature of cyclone path, the cyclone heads towards Bangladesh. If the recurvature is sudden then the cyclone moves towards Myanmar coast. With increasing degree of recurvature, the tendency to cross Myanmar coast at lower latitudes is also increased.

2.2 Cyclone seasons in Myanmar

Annually there are about ten tropical storms in the Bay of Bengal from April to December. Severe cyclones occur during the pre-monsoon period of April – May and post monsoon period of October - December. The tropical storms that form during the monsoon period June – September are weak and of short lifespan before making landfall on the Indian coast. In the post monsoon period, remnants of typhoons from the South China Sea regenerate into storms in the Bay of Bengal. Therefore the Bay of Bengal has two cyclone seasons annually about a month before the southwest monsoon and three months after the southwest monsoon.

Among the cyclones that made landfall in Myanmar coast during the period 1887 to 2005, 30% of the storms are in May, 19% in April and18% in the months of October and November. The Department of Meteorology and Hydrology (DMH) assumes the

Figure 2.1: Satellite view over the Cyclones in the Bay of Bengal



Mala, 24-30 April, 2006 | Akash.C.S., 14-15 May, 2007 | Nargis, 24 April-2/3 May, 2008

month of May as the highest possible period for cyclones to take landfall on Myanmar coast.

2.3 Categories of storms in Myanmar

Storms that affect Myanmar are categorized according to strength as follows:

Table 2.1: Categories of storms in Myanmar

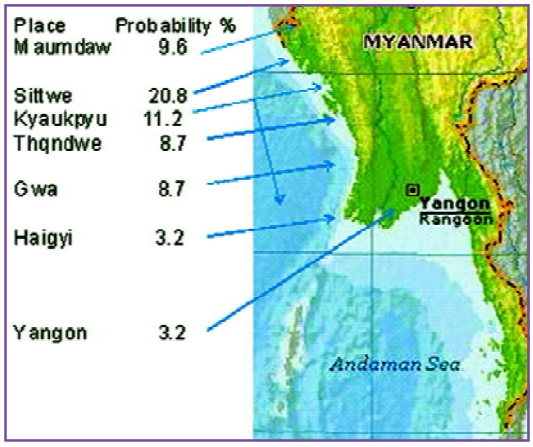
No.	Terminology	Wind Speed	
		Knots per hour	Miles per hour
a	Low pressure area	18-27	21-31
b	Gale	28-33	32-38
c	Tropical storm	34-47	39-54
d	Cyclone	48-63	55-74
e	Severe cyclone	64-85	75-102
f	Super cyclone	86 and above	103 and above

Source: Standing Order on Disaster Management, NDPCC

2.4 Areas prone to cyclone in Myanmar

Myanmar coastline consists of three main segments; namely, the Rakhine Coast in the northwest, the Ayeyarwady Delta in the middle, and the Tanintharyi Coast in the southeast. According to the 1947-2008 data of cyclone landfall on Myanmar coast, the highest probability is at Sittwe, Kyauk Phyu and followed by Maundaw and decreasing south towards the Ayeyarwady delta (Map 2.1). Cyclones generated in the bay have never crossed the southern coast in Mon State and Tanintharyi Division till 2008. However, due to southward shifting of the cyclone track (eg. the Cyclone Nargis), there is uncertainty that cyclones will not cross the southern coastal zone of Myanmar in the near future.

Map 2.1: Cyclone landfall probability along Myanmar Coast (1947-2008)



Source: DMH

The following regions of Myanmar are considered as vulnerable areas to cyclones:

- Rakhine State
- Ayeyarwady Division
- Yangon Division
- Mon State
- Tanintharyi Division

2.5 Destructive cyclones in Myanmar

In the cyclone history of Myanmar, there are 36 cyclones that crossed Myanmar coast during 1947 to 2008. Maximum death toll was 130,000 during Cyclone Nargis in 2008.

Table 2.2: Major Cyclones in Myanmar (1947 - 2008)

No	Dates of TRS in the Bay of Bengal	Place of Landfall	Loss of human lives and property
1	6-8 October 1948	Sittwe	A few people dead, 10 million kyats damaged .
2	22-24 October 1952	Sittwe	4 dead in Yangon, damage in Sittwe and Pathein estimated 10.0 million kyats.
3	15-18 May 1967	Kyaukpyu	Damage in Pathein District 10 million kyats and in Kyaukpyu District 20.0 millions Kyats
4	20-24 October 1967	Sittwe	2 dead with 90% houses destroyed, more than 10.0 millions kyats lost in Sittwe, 90% houses destroyed in Rathey Taung and Kyauktaw, more than 100 people dead and more than 1000 heads of cattle lost with damage estimated at 5.0 millions in Monywa District, Water level of Upper Chindwin River rose 10 feet over night.
5	7-10 May 1968	Sittwe	1037 dead, 17537 cattle lost, 57663 Houses destroyed, estimated damage 10.0 million kyats.
6	5-7 May 1975	Pathein	303 dead, 10191 cattles lost, 246700 homes destroyed, estimated loss 446.5 million kyats.
7	12-17 May 1978	Kyaukpyu	90% destroyed, estimated damage 200.0 million kyats.

8	1-4 May 1982	Gwa	90% destroyed in Gwa, 27 dead in States and Divisions, damage estimated 82.4 million kyats.
9	16-19 May 1992	Thandwe (Sandoway)	27 dead in Man-Aung, Rambre, Kyaukpyu, Thandwe, Taungote and damage cost more than 150.0 million kyats
10	2 May 1994	Maundaw	Estimated damage 59.0 million kyats
11	25-29 Apr 2006 (Cyclone Mala)	Near Gwa	37 people dead and damage cost 428.56 million kyats
12	28 Apr- 3 May 2008 (Cyclone Nargis)	Ayeyawady/Yangon Delta	138,373 people missing or dead, 300,000 heads of cattle killed, houses and over 4000 schools in more than 6000 villages destroyed, damage cost 13 trillion kyats

Source:DMH, PONJA

Chapter 3

Mitigation and Preparedness Measures for Cyclones

3.1 Mitigation Measures

Mitigation means measures taken prior to the impact of a disaster to minimize its effects. Mitigation measures for cyclone include both structural and non-structural measures. These measures need government intervention as well as community participation. Some of the measures, especially legislation and policy matters, cannot be initiated by the community itself but need the government's initiative and intervention. Since the local people are the persons best aware of the strengths and weaknesses of their area, location, culture and customs of the community, some activities should be initiated, and developed by the community themselves. These community mitigation activities can be achieved with the support from government and other civil society organizations.

a) Hazard mappping

Hazard mapping for cyclones represents the results of cyclone hazard assessment on a map, showing the frequency/probability of occurrences of various intensities or durations. Cyclones cannot be predicted several days in advance. Past records and paths can give the pattern of occurrence for particular wind speeds. A hazard map will illustrate the areas vulnerable to the cyclone, and associated storm surge and flood in any given time. It will be useful to estimate the severity of the cyclone and potential damage intensities in the region. The map is prepared with data inputs of past climatological records, history of wind speed, frequency of flooding etc.

b) Land use planning

Land use planning should be systematically considered for cyclones so that least critical activities are placed in vulnerable

areas. Location of settlements in the flood plains is of utmost risk. Siting of key facilities must be marked in the land use. Policies should be in place to regulate land use and enforcement of building codes.Vulnerable areas should be kept for parks, grazing grounds or flood diversion instead of human settlements.

c) Engineered structures

Structures need to be built to withstand wind forces. Good site selection is also important. The public infrastructures including buildings for electricity services, communication facilities, hospitals, schools, rural healthcare centres and community centres should be engineered structures. The people should also be encouraged to construct engineered structures for their dwellings. These measures need government's intervention in providing building codes and other regulatory framework.

Some examples of general good construction practice include:

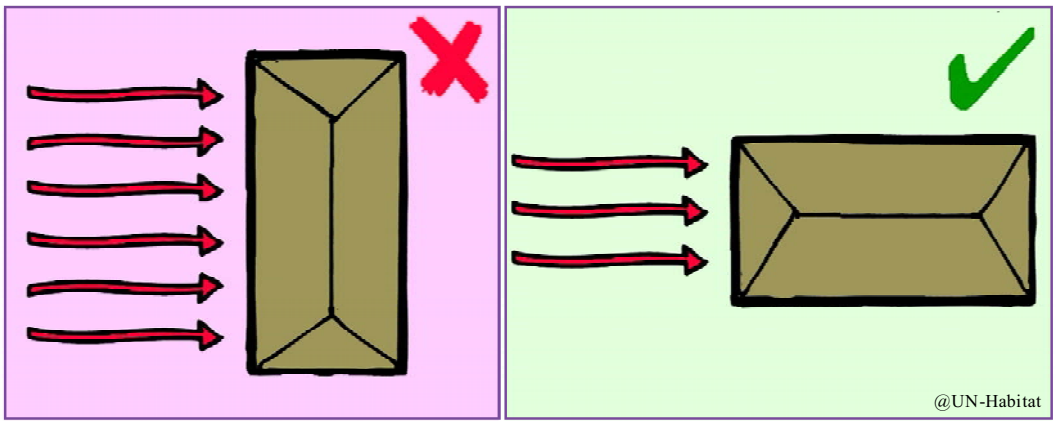
- Cyclonic storms inundate coastal areas. It is advised to construct buildings on stilts or on earthen mounds.
- Houses can be strengthened to resist wind and flood damage. All elements holding the structures need to be properly anchored to resist the displacement or flying off of the objects. For example, large overhangs on roofs should be avoided, and the projections should be tied down.
- Buildings should be wind and water resistant.
- Buildings storing food supplies should be protected against the winds and water.

d) Retrofitting Non-engineered Structures

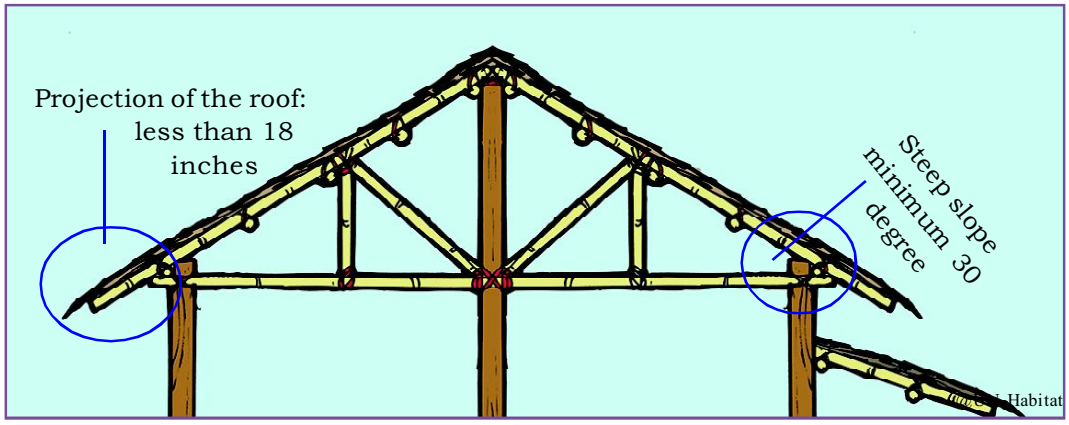
A large portion of Myanmar people lives in self-designed non-engineered buildings. The knowledge on how to strengthen non-engineered buildings should be shared with the community. Local engineers and artisans can take part in the construction and retrofitting of the buildings in their locality and demonstrate disaster resistant construction methods to the people.

The following are few suggested points for the community people to ensure that the houses are resistant to severe weather conditions and provide higher level of safety.

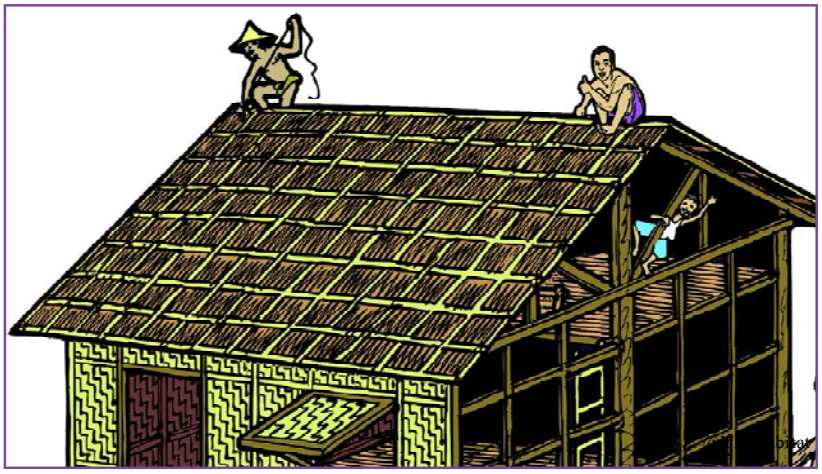
- Face the shorter side of a 'rectangular type' shelter towards where the strong winds normally blow from.



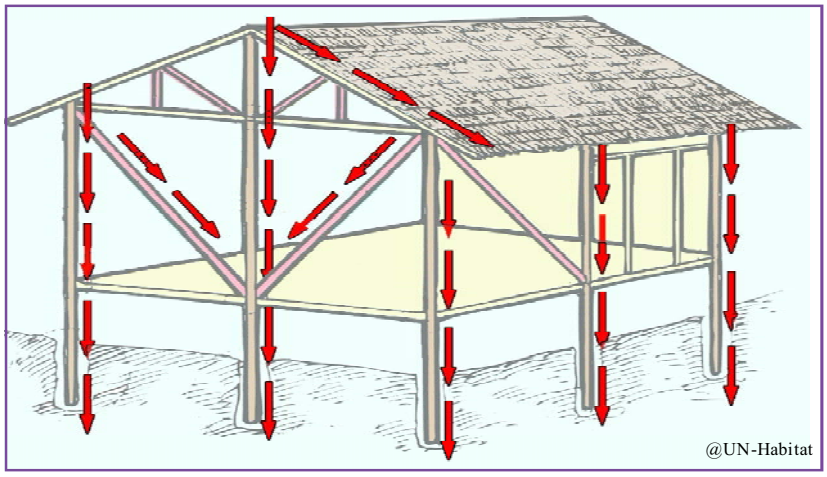
- Construct a roof with a steep slope (minimum 30 degrees), to reduce risk of being blown off.
- Limit the projection of the roof on all sides to maximum 18 inches.



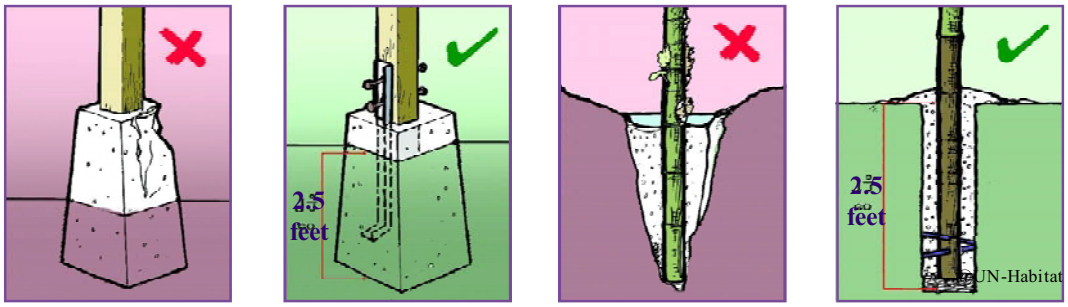
- Fix the cover of the roof firmly to the frame of the roof. Place a lattice on top of the thatch or dani roofing.



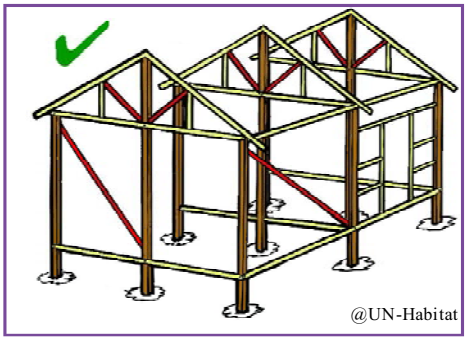
- Fix rafters, purlins, tie beams and post plates firmly to the posts.



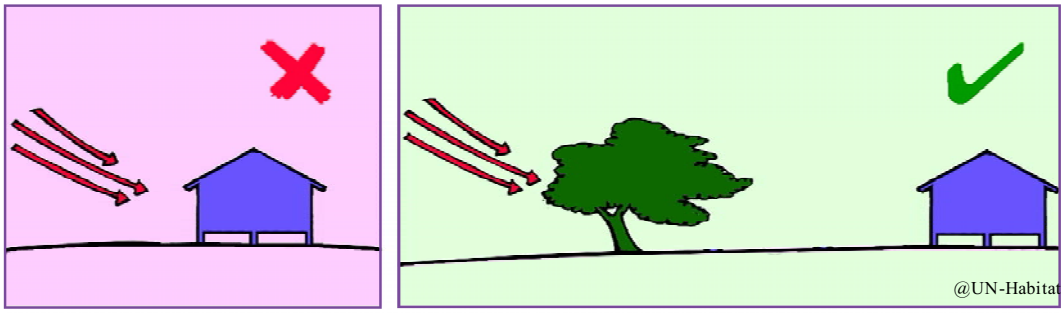
- Anchor the strong posts with solid footings to the ground.



- Strengthen the shelters against the winds with braces on each side.



- Plant trees at a safe distant from the house to break the wind forces.



- Build the house on stilts or on the highest location of the plot.
- Maintain the important parts of the shelter regularly.
- Re-tighten and repair the shelter before the monsoon starts.

e) Cyclone Shelters

Cyclone Shelters are necessary for areas vulnerable to recurrent cyclones. The construction of cyclone shelters require substantial funding, therefore, generally linked to support from government or external donors. Besides, it also involves technical and engineering components which are usually beyond the capacity of community.

For construction of cyclone shelters, the most appropriate sites should be selected, using the Geographical Information System

A Cyclone shelter constructed for local community in Tha Gyar Hin Ooe, Kan seik village tract, Dedaye Township

(GIS) method, after a detailed consideration of the density of population, transportation and communication conditions, distance from areas where the cyclones took landfall in the past and the topography of the area. The location of the cyclone shelter should have road links to main routes and to surrounding rural communities so that people can reach the shelters during emergencies without delay. Consideration also needs to be given not only to shelter provision during disasters but to water supply, food storage, shelter for livestock and cattle and basic sanitation facilities. Special emphasis should be placed on the construction of cost-effective buildings. During normal time these buildings can be used as schools or as community centres. In case of cyclones or floods, community can take shelter in these designed buildings.

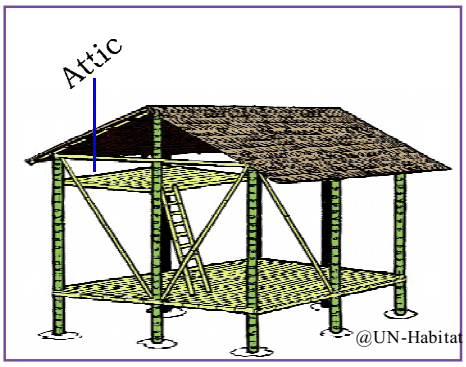
The local community needs to ensure maintenance of cyclone shelters in normal times so that the buildings are ready for use during storms. The condition and strength of these shelters should be checked regularly and especially before and during the cyclone. All necessary reinforcement and repairs should be made before the cyclone season.

f) Flood management

Flooding will result from a cyclonic storm. Storm surges will flood the coastal areas. Heavy rains will bring in flash floods. Embankments along the rivers, sea walls along the coasts may keep water away from the flood plains. Water flow can be regulated through construction of reservoirs, check dams and alternate drainage channels/routes.

Community people should also take up the following flood mitigation activities:

- Improving drainage system in the area by clearing gutters, drains, creeks and streams of any debris so that they can carry rainwater away quickly and reduce the risk of flooding.
- Raising platforms for flood shelter for human beings and cattle and/or raising the public utility installations above flood levels.
- Elevate shelter on stilts. The shelter floor should be at least 3 feet above the ground.
- Create sufficient drainage under and around the shelter.
- Avoid storing materials under the shelter which may obstruct water drainage.
- Compact solid earth around the footings to avoid standing water.
- An attic should be constructed in the house so that it can act as a safe refuge when flood water rises above the house's floor level. An escape hatch should be included in the attic.



g) Improving vegetation cover

Improvement of the vegetation will increase water infiltration capacity of the soil. The roots of the plants and trees will keep the soil intact and prevent erosion and slow runoff to prevent or reduce flooding. The trees planted in rows will act as a wind breaker. Coastal shelterbelt plantations can be developed to break severe wind speeds as it minimizes devastating effects. There is need for urgent measures like mangrove shelterbelt plantations along cyclone-prone coastal areas. Species chosen for this purpose should not only be able to withstand the impact of strong cyclonic winds, but also keep in check soil erosion.

Moreover, a fence of trees thick enough around the village can supply fruits, timber and fuel wood for the community in good weather and reduce the severity of wind and floods during the stormy weather.

h) Mangrove plantation

Mangroves protect the coastal area from storm surge and wind which accompanied with cyclones. The tangle of branches slows the flow of water. Community should also participate in the mangrove plantation which could be organized by the local authorities, NGOs or the community itself. Mangroves also help in erosion-control and coastal conservation.

i) Saline embankments

Another activity that can be taken up as part of the community based mitigation are construction of saline embankments to protect habitation, agriculture crop and important installations along the coast from sea water inundation due to storm surge.

j) Raised embankment or levees

Raised embankments above high flood or storm surge level need to be identified or constructed within an easily accessible place which can serve as an assembly point for various activities in normal weather and as good shelter in stormy weather and high violent floods.

A raised embankment in Bogalay

k) Artificial hills (mounds)

Construction of artificial hills act as a strong community shelter for immediate evacuation after receiving a warning. These earthen hills can be used for safe shelters for the livestock populations. This can be undertaken through various government schemes and through employment genertations schemes by various humanitarian agencies through Cash For Work (CFW) activities.

l) Public awareness generation

Public awareness through education is the key to saving many lives. It has been proved that most of the damage to lives and livelihoods are due to lack of public education and awareness. These can be done through various public awareness generation strategies. Emphasis should be given on using the existing awareness generation mechanisms in order to make it more acceptable and easily understood. Public awareness can be generated through banners/posters, display boards, skill-based competition programmes in school/public gatherings/group discussions, documentary film/video show, mock drills and simulation exercises, pamphlets, brochures and handouts, song and drama in street plays, poster competition, photos exhibitions, street play and shows on cyclone and other related disasters. At

A poster competition on disaster management theme, at a school in Kyauktan Township, Yangon Division

the community level, public awareness programmes should also include interpretation of early warning and proper utilization of early warnings, identified safe shelters and identified safe routes for evacuation and signals to be used for every stage of early warning.

m) Cyclone preparedness and response plan

There is an important need for comprehensive cyclone preparedness and response plans at all levels in order to enhance preparedness to save lives and livelihoods. Standard Operating Procedures (SoPs) needs to be developed for immediate actions upon receiving a warning. It needs to be followed up through mock drill/simulation exercises at all levels in order to test the efficacy of the planning with necessary updating at regular intervals. As the community is the first responder to any disaster, special focus needs to be given on community-based disaster preparedness and effective response through active community participation. Community plans need to be prepared using various PRA/PVA tools with identification of vulnerable groups/populations, hazard profiling of the community, resource mapping and identification of specialized teams for quick response through using the quick response teams (QRTs). Trainings on search and rescue, first aid,

early warning dissemination need to be provided so as to show how to act in pre, during and post disaster situations. The community should also identify its mitigation activities in order to mitigate future disasters through using the existing coping mechanisms.

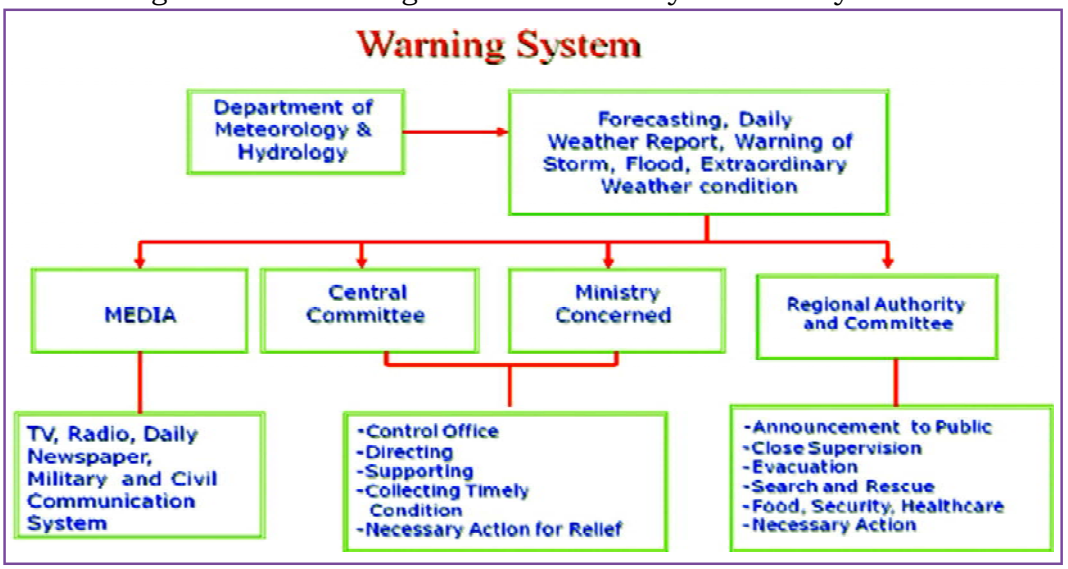
n) Policy regulations, acts and technolegal regimes

There is a strong need for technolegal regimes which will enable strong policy support for longer term disaster mitigation. This will inform all stakeholders on their roles and responsibilities, the building codes, human settlements and enforce legal bindings on mitigating disaster risks in the cyclone prone areas. This initiative involves decision making at higher level for creating an enabling environment to reduce cyclone risk.

o) End to end warning system

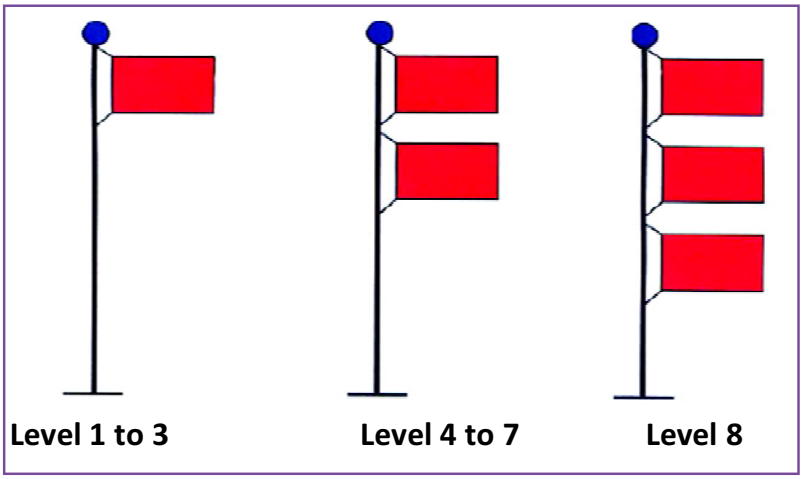
There is a need for an end to end early warning which will enable people at all levels to respond quickly and effectively. The Department of Meteorology and Hydrology is the nodal department for issuing cyclone warning and special weather news for the public. The community should be well aware of the warning system, the warning signals and the source where they can get the early warning of cyclones.

Figure 3.1: Warning Dissemination System in Myanmar



Source: DMH

Figure 3.2: Designation of Flag Signals Indicating Storm Hazards for Display in Wards/Villages



(Red flags are used.)

Source: Standing Order, NDPCC

Flag Signals

National Disaster Preparedness Central Committee provides "Designation of Flag Signals which indicates Storm Hazards for Display in Wards/Villages".[2]

Alert Level 1: There is a possibility of a storm in the area and the public should pay particular attention to weather news updates and comply with instructions.

Alert Level 2: A storm has begun forming and the public should pay particular attention to weather news updates and comply with instructions.

Alert Level 3: There is a likelihood of severe weather conditions caused by a storm and the public is advised to pay particular attention to alerts/warnings, news updates and comply with instructions.

Alert Level 4: A storm of modest strength is imminent and the public is advised to pay particular attention to alerts/ warnings and comply with instructions.

[2]NDPCC, Standing Order on Natural Disaster Management,2009

Alert Level 5: A weak storm has become one of moderate strength and the public is advised to stay alert.

Alert Level 6: Weather conditions are likely to worsen due to the storm and the public is advised to comply with alert/warnings.

Alert Level 7: Weather conditions are likely to worsen due to a storm of moderate wind speeds in the area and the public is advised to follow the weather updates and comply with alert/warnings in a timely manner.

Alert Level 8: The storm is gaining strength and the public is advised to begin evacuations.

Alert Level 9: A severe storm will strike the area and evacuations are advised.

Alert Level 10: A severe storm is imminent and everyone should evacuate to safe locations.

Alert Level 11: The storm has struck and communications have been disrupted.

Weather Alerts and Forecasts

The Department of Meteorology and Hydrology issues the following forecasts, special weather news and alerts.

(a) Regular Daily Weather News

The Myanmar Language Programme of the Nay Pyi Taw Voice of Myanmar makes daily weather news broadcasts four times a day: in the morning at 07:00 hours, in the afternoon at 13:00 hours, in the evening at 18:00 hours and at night at 20:00 hours.

The English Language Programme of the Nay Pyi Taw Voice of Myanmar makes daily weather news broadcasts in the morning at 0:00 hours, in the afternoon at 14:00 hours and at night at 21:30 hours.

The above programmes in Myanmar and in English can be tuned in at the following frequencies.

Table 3.1: The Frequency for daily weather news broadcasting

Time	Short Wave (meter)	Medium Wave (meter)
Morning	41.75	520
Afternoon	50.13	520 and 505
Evening	30.85	520, 505 and 594

Yangon City FM makes weather news broadcasts twice a day at 89 MHz. The schedule of the weather news broadcasts is not fixed.

Yangon Radio makes weather news broadcasts for sea-going vessels at 15:45 hours at 156.6 MHz.

Myanmar Radio and Television (MRTV) and Myawady Television (MWD) make weather news broadcasts after the 8:00 p.m. News. MRTV-4 makes weather news broadcasts 4 times a day on a flexible schedule.

(b) Special Weather News

The Special Weather News is released as required beginning with the formation of a storm in the Andaman Sea and/or the Bay of Bengal. The Special Weather News is carried by Myanmar Radio and City FM two or three times every hour and by the MRTV and MWD in regular weather reports.

(c) Storm Warnings

Storm warnings are issued depending on the severity of the storm and the likelihood of making landfall on the Myanmar coast and are carried by the Voice of Myanmar 3 to 6 times every hour and by the MRTV and MWD in real time as a news bar.

Designating an emergency situation

Yellow Stage: The formation of a tropical storm in the Bay of Bengal and the Andaman Sea is designated as the Yellow Stage. At this Stage, Myanmar Radio and City FM broadcast updates two or three times an hour while the MRTV and the MWD include updates in the daily weather news. At the Yellow Stage, the part of the Bay of Bengal and the Andaman Sea where the storm is forming is indicated. The maritime weather forecasts and storm warnings are to be obtained by a Myanmar Five-Star Shipping Line vessel at Ports.

Orange Stage: When a tropical storm has formed in the Bay of Bengal and the Andaman Sea and begins moving toward the Myanmar coast, the Orange Stage is designated. At this stage, Myanmar Radio and City FM broadcast updates three or four times an hour while the MRTV and the MWD carries frequent updates as a news bar.

Red Stage: When a storm moving towards Myanmar coast is expected to make landfall in 12 hours, the Red Stage is designated. At this stage, storm warnings containing the following details such as time, location, maximum, wind speed, next movement, area of land fall, storm surge and sea condition are broadcast 3 to 6 times an hour by Myanmar Radio, while the MRTV, the MRTV-4 and the MWD carries real-time updates as a news bar and as breaking news.

Brown Stage: When a storm makes landfall on the Myanmar coast, the Brown Stage Emergency is designated. At this stage, storm warnings are broadcast 3 to 6 times an hour by Myanmar Radio, while the MRTV, the MRTV-4 and the MWD carries real-time updates as a news bar and as breaking news.

Green Stage: When a storm has weakened and the storm hazard has passed, the Green Stage is designated. After the storm has passed, updates are broadcast 2 to 3 times an hour by Myanmar Radio, while the MRTV, the MRTV-4 and the MWD carries real-time updates as a news bar and as breaking news.

24-Hour News Updates: A 24-hour broadcasting station or broadcasting channel dedicated to special weather updates should be set up. This channel should broadcast weather updates and special news round the clock as required.

Notice that cyclone movement can change any moment. The public can also have updated weather news from 24-hour automatic answering system of the Department of Meteorology and Hydrology at phone number **01-667766**.

3.2. Cyclone Preparedness at Community Level

Disaster Preparedness covers activities to enhance the ability to predict, respond to and cope with the effect of a disaster. It includes pre-cautionary measures by households, communities and organizations to react appropriately during and following the event.

Community-based preparedness activities at community level include designing warning dissemination system, planning for evacuation and relocation, storing food and water, building temporary shelter, devising management strategies, and holding disaster drills and exercises.

a) Community-based Organization on Disaster Risk Reduction

It is ideal if the community has already formed a Community-based Organization (CBO) on Disaster Risk Reduction (DRR). If not, the community should organize a community-based organization comprising of the stakeholders in the community.Under the CBO on Disaster Risk Reduction, a number of sub-groups or teams should also be organized on different disaster management activities such as early warning dissemination, evacuation, search and rescue, first aid, relief operation etc.

b) Community-based Disaster Management Plan

The CBO should prepare the Community-based Disaster Management Plan (CBDM) with the help of government personnel, NGOs and the community leaders and with the participation of the community members. In the plan, the list of activities which

A community discussion on the Community Disaster Management Plan

the community members have to perform for cyclone preparedness should be included. It should also identify the duties and responsibilities to be carried out by individuals in the community so that they are aware of their specific responsibilities when an emergency warning is received. Once the plan is prepared, it should be shared to the community through different means, such as informing in the community assembly, posting on the notice board of village/ward Peace and Development Council, monasteries/ churches, market, etc. and the community people should fully understand all the contents of the plan. The plan should also be evaluated on its effectiveness through drills and actual experience when the disaster strikes the community. It should be updated periodically or regularly at pre-determined intervals.

c) Safe community shelter

The community should identify safe community shelter. If not, the community should select some resistant buildings among the existing buildings in the area to be used as cyclone shelters for

the community members in case of a cyclone. These buildings could be government offices or public buildings, like schools, community halls, or privately owned buildings. The consent of the owner of the building should also be sought in advance. The safe routes to the shelters should also be identified.

d) Early Warning

Early warning system for cyclone should also be established. Some community members should be assigned for monitoring, receiving and dissemination of early warning to the community. The assigned persons should have a clear understanding on where and how to get the early warning, the message contents of the early warning and how to disseminate the early warning. The community should identify the signals to be used at every stage of cyclone, for example, giving alarm by knocking the iron rod, or by using loud-speakers for evacuation. Early warning dissemination system for isolated remote households and those who are in the sea should also be identified.

e) Evacuation mapping

The community should also prepare the evacuation map which identifies safe places and the routes to be used for evacuation. This should be informed to the community in advance of the cyclone season.

f) Shelter for livestock

Livestock owners should identify a safe fenced enclosure, above flood level, to which their animals could be moved during a cyclone. If none exists, neighborhood farmers might work together to prepare an appropriate enclosure. Hills for livestocks can be constructed and they should be separated from hills for evacuees.

g) Mock drill

Drills or simulation exercise should be arranged before the cyclone season. It can be organized for the Community-based Organization on Disaster Risk Reduction as well as for the community as a whole. Mock drills should ensure a well-prepared community with well

defined roles and responsibilities of various stakeholders. The strength and weakness of the community preparedness for a cyclone can be found in a drill then the necessary activities and changes should be updated from time to time. Mock drills can also serve as an effective tool for public awareness on cyclone and community preparedness on it.

h) Training

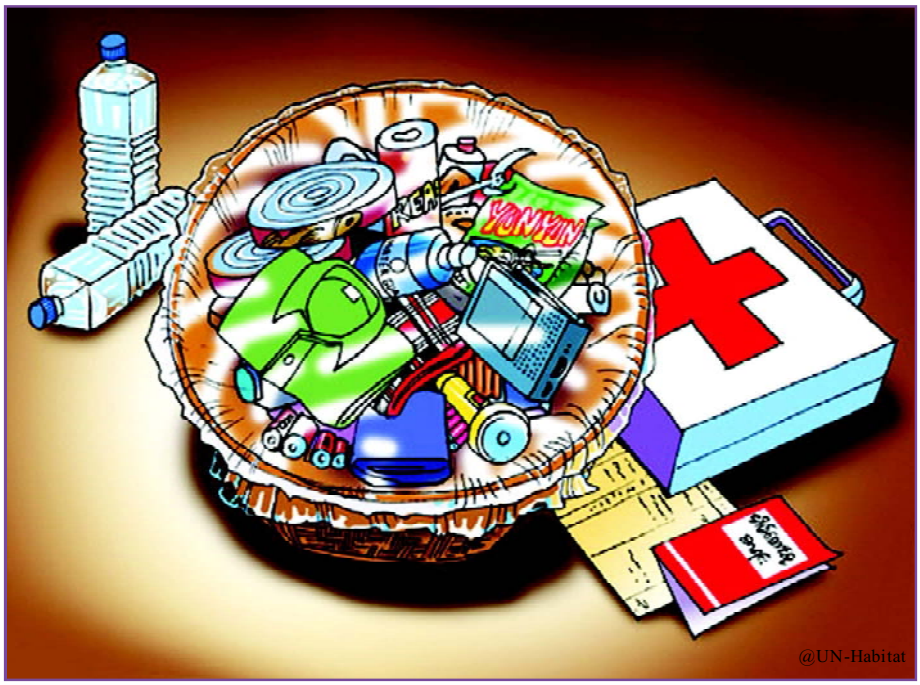
Training on preparedness, relief and recovery activities should be provided for the community with the assistance of relevant government departments and NGOs in the community. The trainings can be for first aid, search and rescue, evacuation, understanding of early warning dissemination, etc.

3.3 Cyclone Preparedness at Household Level

Every household living in the cyclone prone area should be well prepared for the cyclone season. The following points are suggested for cyclone prepareness at household level:

- Listen to radio or TV weather reports throughout the cyclone season.
- Check the house for weak points – loose or damaged wooden frame or wall cladding, loose or missing nails, termite or moisture damage to wooden structure. Make any necessary repairs.
- Check the roof for loose sheeting or loose nails etc. Use spiral thread nails for repairs.
- Ensure that windows can be protected either by shutters (make some if necessary) or by taping.
- Clear trees and branches that overhang the house and any dead trees from around the house.
- Prepare a home emergency kit and make someone responsible for maintaining it. It should include:

- Water containers with covers.
- Dry or tinned food and a can opener
- Plastic sheeting, bags and sacks
- Battery powered or wind-up radio
- Lighting (torch or candles or a lamp with fuel and spare wick, a lighter, matches)
- Spare batteries for the radio and torches.
- First aid kit (bandages or clean cloths, band aids, Oral Rehydration Solution (ORS), antiseptic, antibiotic, pain reliever, etc)
- Any medicines that family members must take
- Change of clothing for everyone
- Rope/string, hammer and nails to tie things down.



A sample of cyclone emergency kit

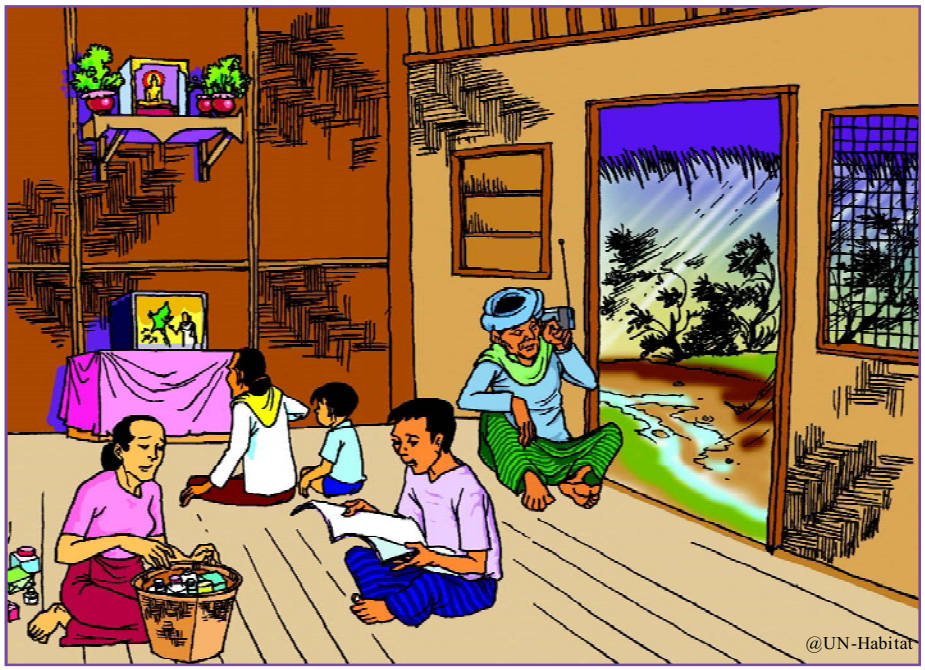
- Keep important papers in one place, preferably in a plastic bag so that they are protected and can be collected quickly if evacuation is necessary.
- Have a family conference and plan for cyclone, keeping everybody informed on:
    - what is in the emergency kit and where it is kept
    - The nearest safe shelter if the house is threatened or damaged
    - How to get safely to that shelter.
    - The most important items to be looked after, and where they are kept
    - Where to meet if the family cannot get home in time (children may be at school or parents away working or visiting).
    - How and where to get help if needed.
- Find out about the cyclone warning system, particularly where warnings can be obtained.
- List the emergency phone numbers.

Chapter 4

Safety Tips on Cyclones

4-1 When a cyclone approaches

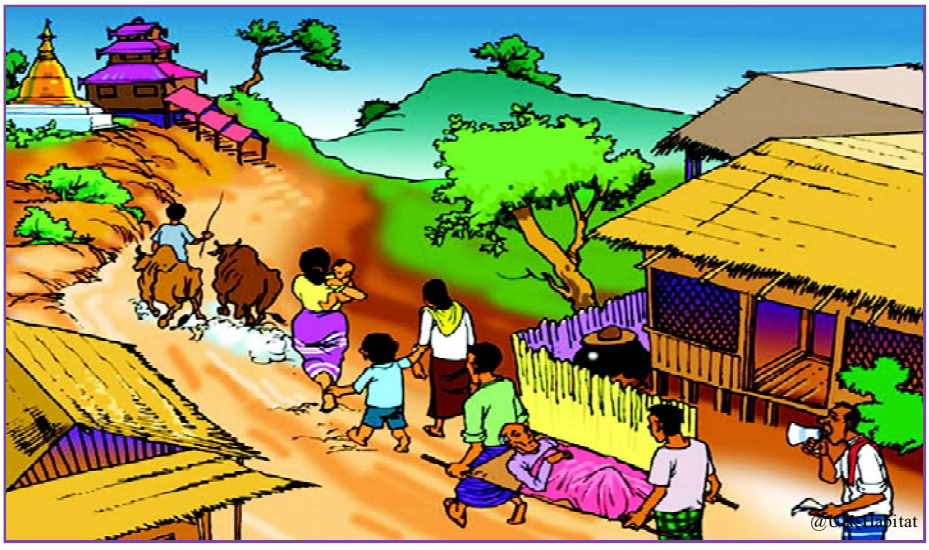
- Listen to radio and watch TV for storm advices and warning. A cyclone may change direction, speed or intensity within a few hours, so stay tuned to the radio for updated information.
- Secure all doors and windows and draw curtains.
- Store or secure loose boards, corrugated iron, rubbish tins or anything else that could become dangerous flying objects.
- Tape up large windows to prevent them from shattering.
- Put valuables, medicines and spare warm clothing in plastic bags with the emergency kit and keep handy.



A family preparing for an approaching cyclone

4.2 Evacuation before the cyclone

- In area subject to river flooding, or close to the beach at a low level, move to a safe shelter above flood level before the cyclone arrives. Don't wait until the last minute in the hope of saving all your possessions. You could disappear with them.
- Wear strong clothing and shoes to protect against glass cuts.
- When evacuating, make sure everyone knows where you are going.
- If time is limited, take the emergency kit only. If there is time to gather supplies, follow priorities. Suggested priorities are:
    - Emergency kit
    - Extra food and water
    - Important documents and paper
    - Blankets and clothes
    - Plastic sheeting
    - Other valuables



Community people evacuating to a safe shelter before a cyclone hits

- Switch off electricity and gas and lock the house before you leave.
- While evacuating, be careful of –
    - Washed out bridges
    - Broken power lines
    - Floating debris in streams
    - Falling trees and branches
    - Flowing building debris, particularly glass and corrugated iron
    - Flying objects in the strong winds

4.3 When the cyclone hits

- Stay indoors and take shelter in the strongest part of your house.
- Stay well away from glass windows and doors, particularly glass louver windows
- Listen to the radio and follow instructions from local authorities.
- If a window or a door opens due to storm wind, open a window make a hole on the opposite.
- Beware of the calm 'eye' of the storm. This can last for an hour or so. If the wind drops suddenly, stay inside unless you have to make emergency repairs. Strong wind will blow suddenly from opposite direction.
- If it needs to go outside, take shelter again as soon as you hear the sound of wind rising. It will probably rise very quickly, be very strong and come from a new direction.
- If the house starts to break up, protect everyone with mattresses or blankets; hold on to strong fixtures or shelter under beds or strong tables.
- Listen to the radio whenever possible, for forecasts and messages.

- Ensure all live pets/animals/livestock are not tied or kept in locked compounds.
- Do not go outside or onto a beach during a lull in the storm, storm surge may follow.

Do not go to the sea or near the beach, a storm surge can follow after a storm

4.4 After the cyclone passes

- Don't go outside until officially advised it is safe to do so. Check for gas leakages and don't use electrical appliances if wet.
- Continue to listen to your local radio for official warnings and advice.
- If you did evacuate your home, don't return until advised it is safe to do so.
- On return, use a recommended route and don't rush.
- Beware of fallen powerlines, damaged bridges, buildings and trees, and don't enter floodwaters.

- Heed all warnings and don't go sight-seeing.
- If the house has become uninhabitable due to cyclone damage, contact your Community-based Organization on Disaster Risk Reduction or to local authority to identify for further assistance.
- Cyclones are often accompanied by large storm surges from the ocean and water bodies. The precautions listed for floods should be taken for people living near the coast or river bank.
- Avoid listening to rumours.

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The List of Organizations Contributed to the Development of this Manual

- Action Aid
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- Care Myanmar
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- Department of Meteorology and Hydrology
- Fire Services Department
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- Maltesa International
- Metta Foundation
- Myanmar Engineering Society
- Myanmar Geosciences Society
- Myanmar Information Management Unit
- Myanmar Red Cross Society
- Pact Myanmar
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- United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)
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- World Vision

MANUAL ON CYCLONE

Causes, Effects & Preparedness

Developed by UN-HABITAT, Myanmar

For further information:
UN-HABITAT, Myanmar
No. 6, Natmauk Road
Tamwe Township, Yangon
Myanmar
desk@unhabitat-mya.org