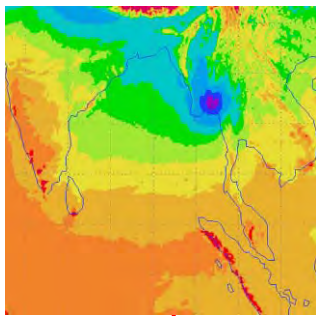


Joint Rapid Situation Assessment Report:

Status and context of four Coastal Townships of
Yangon and Ayeyarwady Divisions in Myanmar

May 2008

Bangkok, Thailand



Jointly prepared by

Department of Meteorology and Hydrology (DMH), Myanmar
and

Asian Disaster Preparedness Center (ADPC), Thailand

Table of Contents

Table of Contents	2
Team composition	2
1. Introduction	3
1.1 Background	3
1.2 Cyclone NARGIS.....	3
1.3 Tracts and predictions.....	4
2. Methodology of Assessment.....	6
2.1 Approach and methodology	6
2.2 Assessment sites.....	7
3. Observed situation of three systems	8
3.1 Early Warning System.....	8
3.1.1 Cyclone detection and forecasting	8
3.1.2 Warning and Dissemination.....	9
3.1.3 Community level dissemination and public awareness	11
3.2 Natural and Built System	13
3.2.1 Natural resources	13
3.2.2 Performance of the physical structures.....	14
3.2.3 Heavy machinery use in recovery operations.....	15
3.2.4 Energy and electricity	15
3.2.5 Water supply and sanitation	16
3.3 Societal and Economic System	17
3.3.1 Livelihoods and economic situation	17
3.3.2 People’s responses.....	17
4. Conclusions and recommendations	19

Team composition

Department of Meteorology and Hydrology (DMH)

Tun Lwin
Tin Ngwe

Yangon division:

Sein Maw Oo
Khin Maung Lwin
Ba Thet Oo
Kyaw Oo

Ayeyarwady division:

Maung Maung Soe
Sein Lin
Aung Myint Kyi

Asian Disaster Preparedness Center (ADPC)

AR Subbiah
Atiq Kainan Ahmed

For any further query or comments, please contact:

Mr. Tun Lwin

Director General, Department of Meteorology and Hydrology, Yangon, Myanmar.

Mr. Atiq Kainan Ahmed

Social Scientist (CCR Focal point), ADPC, Thailand.

Email: atiqka@adpc.net

1. Introduction

1.1 Background

For the past few years, Asian Disaster Preparedness Center (ADPC) as a regional entity is encouraging the Myanmar Government agencies to develop an “institutional process” for improved early warning and disaster preparedness in the country. Various initiative including introducing risk communication concepts, monsoon forums, UNESCAP Regional Trust Fund initiatives, sharing of experimental severe weather forecasting are among others.

Since 2006, with the Department of Meteorology and Hydrology (DMH) of Myanmar ADPC was jointly encouraging Myanmar agencies to develop a platform called “Monsoon Forum” where national institutions engaged in early warning and disaster preparedness can meet twice in a year and discuss various issues of forecasting, early warning, and disaster preparedness measures and so forth. This initiative has started to grow and gradually becoming a platform to share national disaster preparedness issues under the auspices of the Ministry of Transport.

With these commitments, under the present situation of cyclone NARGIS, ADPC remained engaged in encouraging and supporting DMH as a long-term partner and friend of Myanmar government.

The experimental forecasting of ADPC Early Warning System that was provided with a good lead time ahead of the Cyclone NARGIS was well appreciated by the DMH. DMH also welcomed to join ADPC professionals for a rapid situation assessment at community level jointly with the respective DMH members in the some townships of the affected region of Myanmar.

The present document is a brief output of this “Joint Rapid Situation Assessment” carried out in the four townships of the NAGRIS affect areas of Myanmar immediately after the cyclone affect. The rapid assessment was carried out jointly by the Department of Meteorology and Hydrology (DMH) of Ministry of Transport of Myanmar and Asian Disaster Preparedness Center (ADPC) Thailand from in the second week of May, 2008.

The objective of the present document is to provide with prompt and useful information (i.e. facts, findings and recommendations) to establish and improve an effective community level early warning systems as part of the overall community resilience in the coastal areas of Myanmar. This document is produced to assist DMH and other associated agencies participating in the Monson forum to take into their accounts in future planning and coordinated actions in the coming days.

1.2 Cyclone NARGIS

The first cyclone of the 2008 season in the Northern Indian Ocean and in the Bay of Bengal was a devastating one for Myanmar. The Severe Cyclonic Storm (SCS) NARGIS made landfall with sustained winds of approximately 130 mph and gusts of 150-160 mph, which is the equivalent of a strong Category 3 or minimal Category 4 hurricane as per the World Meteorological Organization (WMO) standards. Some of the salient features of the cyclone NARGIS are shown in the box below.

Popular news sources are identifying this as the deadliest named cyclone in the North Indian Ocean Basin, as well as the second deadliest named cyclone of all time, behind Typhoon Nina. Including unnamed storms, NARGIS is the 8th deadliest cyclone of all time. NARGIS was the first tropical cyclone to strike the country since Cyclone Mala made landfall in 2006.

Life span	: 26 April, 2008 to 3 May, 2008	
Landfall area	: Ayeyarwady, Yangon, Mon and Kayin state	
Category	: Severe Cyclonic Storm (SCS)	
Radius of storm	: approximately 250 miles	
Maximum wind speed	: approximately 130 mph	
Maximum peal surge	: approximately 22 feet	Source: DMH

1.3 Tracts and predictions

NARGIS developed on April 27 in the central Bay of Bengal. Initially it tracked slowly northwestward and, encountering favorable conditions, it quickly strengthened. Dry air weakened the cyclone on April 29, though after beginning a steady eastward motion NARGIS rapidly intensified to attain peak winds of at least 165 km/h (105 mph) on May 2. The Joint Typhoon Warning Center assessed peak winds of 215 km/h (135 mph).

The cyclone moved ashore in the Ayeyarwady division of Myanmar near peak intensity and, after passing near the major city of Yangon, the storm gradually weakened until dissipating near the border of Myanmar and Thailand. Cyclone NARGIS came ashore across the mouths of the Irrawaddy and followed the coastline northeast. The shallow waters allowed the counter-clockwise circulation or winds around NARGIS to pile up a large storm surge to the right of the storm's track.

The graphical tracks of the cyclone NARGIS is shown in the following maps produced by various agencies including the national Department of Meteorology and Hydrology (DMH), Joint Typhoon Warning Center (JTWC), UNOSAT and Asian Disaster Preparedness Center (ADPC). Analyzing various sources and based on a synoptic analysis DMH has produced their own cyclone prediction and issued forecasts and warning to various layers in Myanmar.

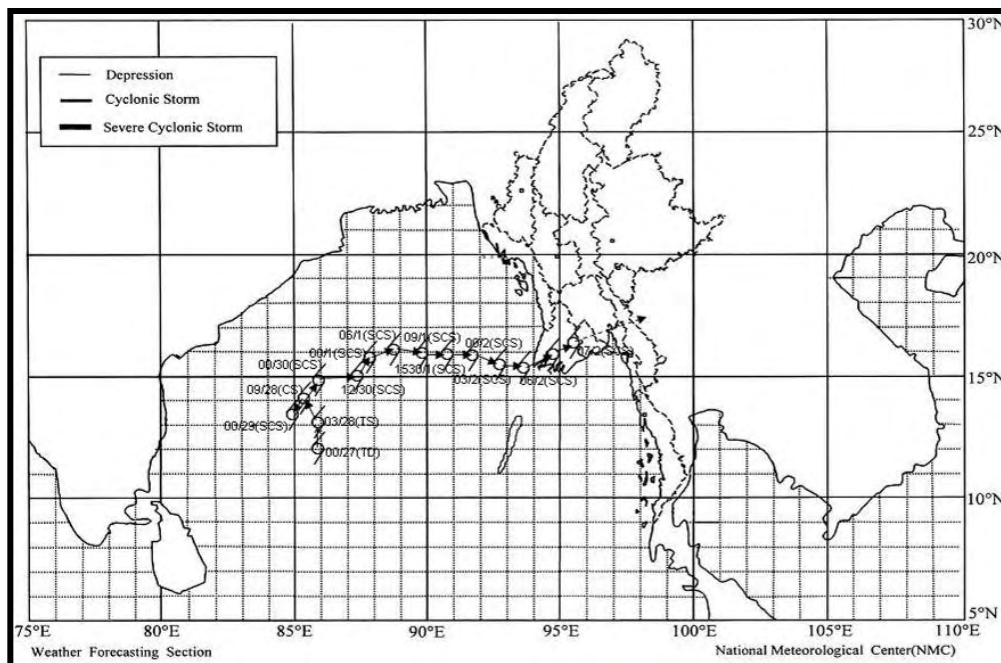


Figure 1: Observed tracts of NARGIS (Source: NMC, DMH, May 2008).

Forecasting and predictions by external sources to DMH:

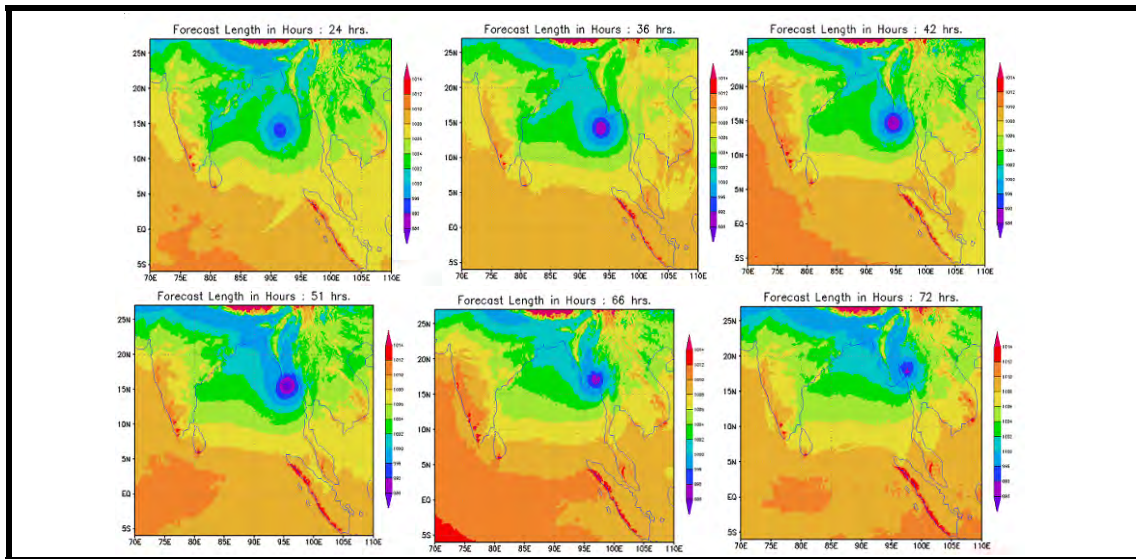


Figure 2. ADPC’s numerical modeling outputs. The Mean Sea Level Pressure (hPa) forecast with initial condition of 30-04-2008 12 UTC. The initial forecasting started from a week before the storm made landfall. (Source: ADPC).

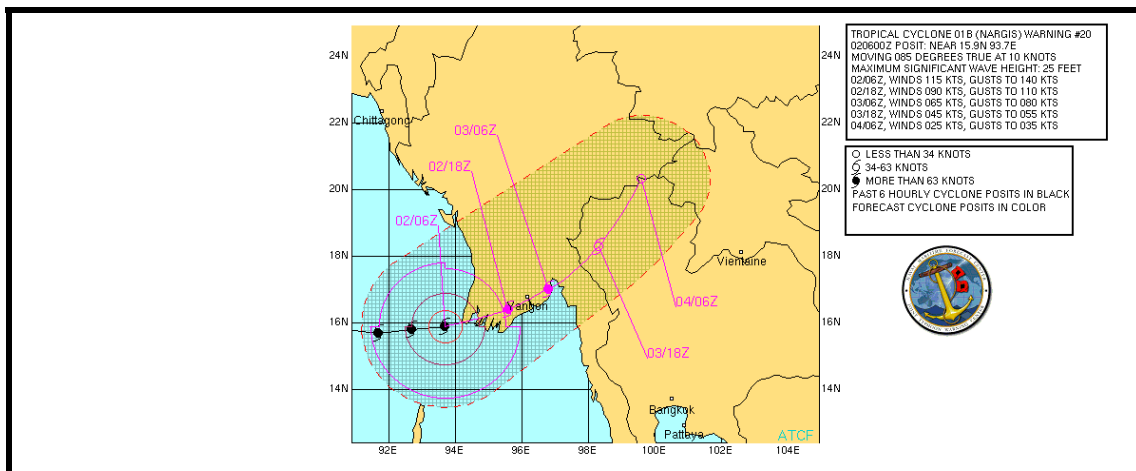


Figure 3: Predicted tract of NARGIS by JTWC (Source: JTWC May, 2008).



Figure 4. Tract as plotted by UNOSAT with intensity (Source: UNOSAT, May, 2008).

2. Methodology of Assessment

2.1 Approach and methodology

The “Joint Rapid Community Resilience Situation Assessment” was devised to carry out quick information that can help take immediate actions reflecting the immediate findings and outcomes of the situation at community levels. Collection of the timely information was considered as a major methodological derivative.

Considering the timeliness and scope of the assessment, the present situation assessment was built on following features:

- a) Timely collection of the immediate findings;
- b) Joint operation by the DMH national professionals and ADPC professionals;
- c) Making use of the already collected information by the DMH field team visiting in the Ayeyarwady division (at the time of field work);
- d) Making use of the Coastal Community Resilience (CCR) framework with necessary and adequate adaptation;
- e) Produce quick report on the basis of this “rapid and qualitative data” to inform timely actions of DMH and others to share in the upcoming Monsoon Forum;
- f) Develop an objective account of the reality on the early warning system at community level; and
- g) Compile lessons learned and develop synergic recommendations.

In this respect some of the major steps considered in the assessment as follows:

1. Review of secondary documents
2. Joint team formation and discussion for the field assessment (formed by the DMH authority)
3. Rapid assessment formulation
 - a. Identification of key issues and checklist
 - b. Contextualization, translation of the elements and sub-elements
 - c. Site selection field assessment
4. Field trip to selected sites for rapid assessment in Yangon division
 - a. Assessing current situation and profile of the area
 - b. Eliciting on the elements of resilience (group discussions and interviews)
 - c. Scoring exercise with cross evaluation
 - d. Visual documentation
5. Discussion, Analysis and making synergy of data with the Ayeyarwady division team
6. Post field work brainstorming, briefing and validation
7. Final report writing and documentation.



2.2 Assessment sites

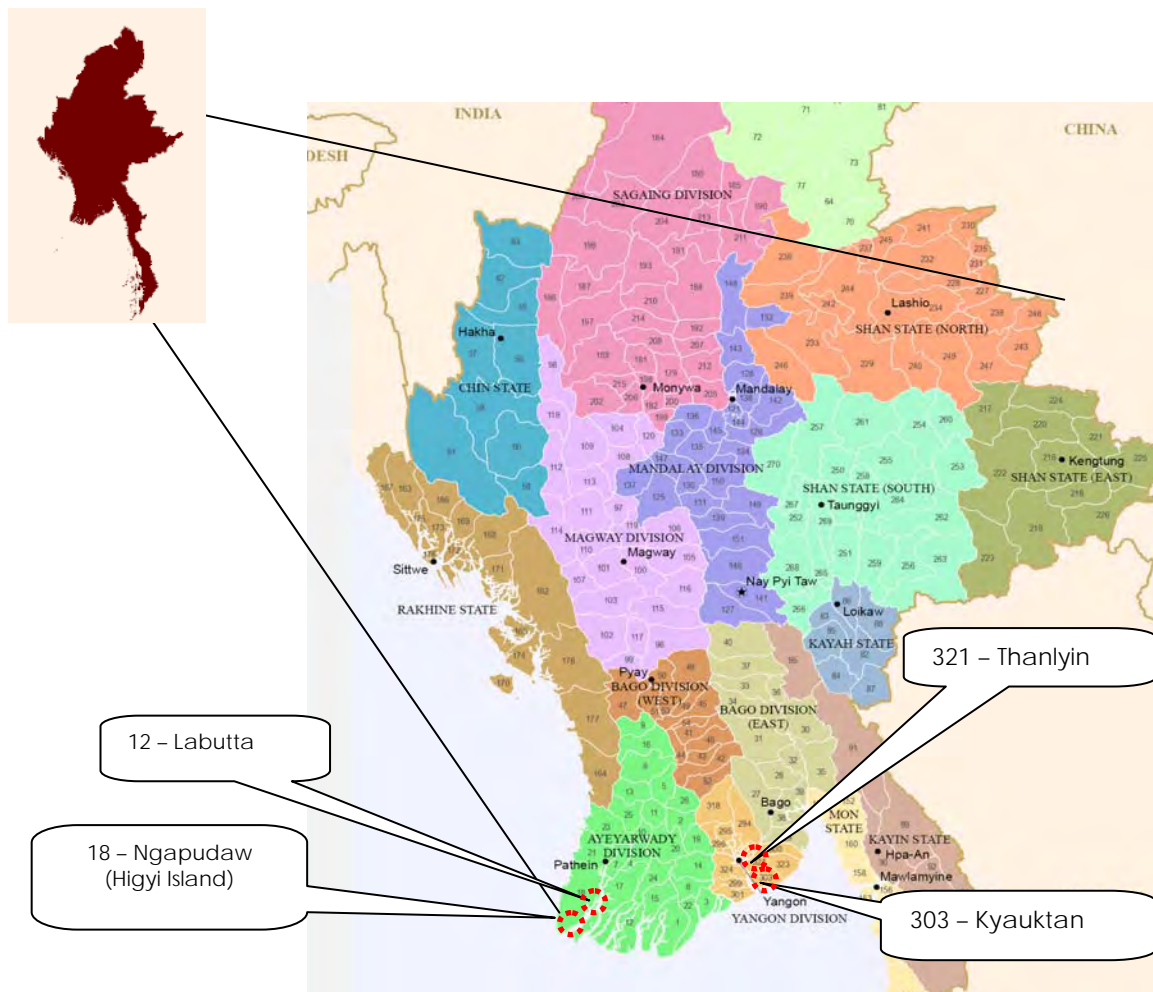
In order to come up with a context based and relatively quick situation assessment, four different sites are selected. Two sites are taken from Yangon division and two sites from Ayeyarwady division.

Yangon division	Ayeyarwady division
Thanlyin township (code: 321) Kyauktan (code: 303)	Labutta township (code: 12) Ngapudaw township (code: 18)

Ayeyarwady division townships are the first hit townships of NARGIS and both are largely affected by tidal surge and severe wind blow. These are the low lying areas, mostly large paddy cultivating areas and extremely exposed townships. Labutta township which is probably one of the most affected townships and Higyi Island (a sub-township) of Ngapudaw township was considered for this assessment. Higyi Island was reported as the first sub-township where the cyclone made first landfall.

On the other hand, Thanlyin and Kyautan townships under the Yangon division are largely populated and mostly affected by the intense wind and relatively lower height storm surge. These two communities are also near to the Yangon city, perry urban in nature and very close to the estuaries of the lower Yangon.

In selecting assessment sites both type of areas (“cyclone wind affected” areas in Yangon division and “surge and wind affected” areas in Ayeyarwady division) were considered.



3. Observed situation of three systems

On the basis of the field assessment and close interaction with DMH, the present chapter provides an account of the situation and context of three major systems of post NARGIS coastal Myanmar. The chapter provides a generic account of the following three observed systems:

- Early Warning System
- Natural and Built System
- Societal and Economic System

From this analysis, synergic conclusions and recommendations are made and placed in the concluding chapter.

3.1 *Early Warning System*

Early warning system remained as a widely discussed question in all phases of the NARGIS. A specific focus was, thereby, given to find out the facts about the early warning provisions at dual levels: at national level as well as at community level. Rapid assessment was carried out to collect useful and objective information on the various facets of the early warning systems. Some of the emerged findings are outlined below:

3.1.1 Cyclone detection and forecasting

- It was found that DMH has a long-standing established system and procedures for cyclone detection, prediction and forecasting at their Yangon office. WMO guidelines and procedures are primarily followed by the agency. They are also found connected with the other NHMS in the region including Indian Metrological Department (IMD), Thai Meteorological Department (TMD) and others;
- It was found that in January 2008 DMH's GTS system was updated with the support of WMO. DMH now has a well operational system giving them access to the GTS daily information and data;
- From the discussion and reviewing of the documents from DMH it was found that DMH has actually detected the cyclone from a very early stage of its formation and have made formal notice of it on 25th (almost a week before the cyclone has made landfall). The low pressure has been identified and the formation on low pressure Low Pressure Formation over South West Bay of Myanmar was well documented on 25 May;
- In detection and forecasting DMH collects information from various sources (listed below) but in deciding for tropical cyclone track prediction they rely on a "synoptic method". The other sources below they use for reference and validation purposes time to time through accessing respective source websites in a periodic manner:
 - Joint Typhoon Warning Center (JTWC)
 - India Meteorological Department (IMD)
 - Thai Meteorological Department (TMD)
 - Asian Disaster Preparedness Center (ADPC)

- National Centers for Environmental Prediction (NCEP)
 - Japan Meteorological Agency (JMA)
 - Tropical Storm Risk (TSR)
- In terms of predicting the cyclone surge height DMH has it's own cyclone storm surge prediction model based on "empirical method" where using this method they predicted the surge height of NARGIS. The forecasted peak surge height according to DMH is shown in the table below:

Table 1. Chronologically forecasted peak surge height by DMH

Date	Observed Time (MST)	Issued Time (MST)	Forecast Peak Surge height (Feet)	Places
May 1, 2008	15:30 hrs	17:30 hrs	8-10	Southern Rakhine State and northern Ayeyarwady coastal areas.
	18:00 hrs	19:00 hrs	8-10	Southern Rakhine State and northern Ayeyarwady coastal areas.
May 2, 2008	19:30 hrs	21:00 hrs	10-12	Along Ayeyarwady coast
	03:00 hrs	06:00 hrs	10-12	Along Ayeyarwady coast
	12:30 hrs	13:00 hrs	10-12	Along Ayeyarwady coast
	13:30 hrs	14:00 hrs	12	Along Ayeyarwady coast
	14:30 hrs	15:00 hrs	12	Along Deltaic coast
	15:30 hrs	16:00 hrs	12	Along Deltaic coast
	17:00 hrs	18:00 hrs	12	Along Deltaic coast
May 3, 2008	05:30 hrs	06:00 hrs	12	Gulf of Mottama

Source: (DMH May, 2008)

3.1.2 Warning and Dissemination

- It was found that the warning and dissemination of the cyclone NARGIS was performed routinely using multiple modalities from the national level. DMH's central weather forecasting center was the primary source and information was transmitted to pre-identified agencies and channels through multiple mode of dissemination.
- The warning message was disseminated in three different formal mode:
 - special "storm news",
 - bulletin, and
 - daily weather report.

Storm Warning
Issued at (18:00) hours MST evening on 2.5.2008

The Severe Cyclonic Storm (NARGIS) over the East Central Bay has crossed the (HYGI) Island with the wind speed (50-60) mph at about (10:00) MST, about (70) mph at about afternoon, 120 mph at about (14:00) MST today.

According to the observation at (17:00) hours MST today, It is centered at about over the (THAMEHLA) Island and moved Eastwards with (15) mph and forecast to cross the YANGON and downgraded into a Land Depression and reach the Northern part of THAILAND after (36) hours.

Under the influence of this Cyclonic storm, frequent squall with rough seas will be experienced off and along Delatic, Mottama, Mon, Tanintharyi Coasts and surface wind speed in squall may reach (60) mph and (120) mph near the storm centre. The storm surge may reach (12) feet along the Deltaic Coasts due to the influence of this Severe Cyclonic storm.

Figure 5. Storm warning was disseminated on May 2, 2008 at 18:00 hours (Source: DMH).

These cyclone information and warning was disseminated to following recipient destinations:

- 34 ministries in Myanmar Government
- Relevant State(s)/ Division(s) Peace and Development Council (PDC) then further transmit to the district level authorities)
- Responsible Army commander(s)
- Responsible Naval commander(s)
- Responsible Air Force base-commander(s)
- Myanmar Radio and Television
- All relevant Port authorities
- Myanmar Red Cross
- United Nations Development Programme (UNDP) Country Office
- Others (as found relevant at times)

Table 2. Chronological record of information (i.e. special news, warning) disseminated by DMH

Date	Base Observation Time	Issue time (MST)	Major information shared by DMH
25 April, 2008	[15:30 MST, 0900 UTC]	4:00 pm	Special News: Low Pressure Formation over South West Bay
26 April, 2008	[06:30 MST, 0000 UTC]	2:00 pm	Bulletin: Low Pressure Area (LPA) still persists
27 April, 2008	[06:30 MST, 0000 UTC]	7:00 am	Special News: Yesterday's LPA over South East Bay intensify further into a Depression. It is forecast to move North Westwards.
28 April, 2008	[09:30 MST, 0300 UTC]	7:30 am	Special News: Yesterday's Depression over South East Bay and adjoining South West Bay has intensified further into a Tropical Storm. It is forecast to move North Eastwards.
29 April, 2008	[06:30 MST, 0000 UTC]	7:00 am	Special News: Yesterday's Tropical Storm over South East Bay and adjoining South West Bay has intensified further into Severe Tropical Storm "NARGIS". Initially it is forecast to move Northwards.
30 April, 2008	[15:30 MST, 0900 UTC]	5:00 pm	Special News: The Severe Cyclonic Storm NARGIS has not appreciable further intensified and move eastwards slowly. It is forecast to move North-Northeastwards slowly next 24 hours commencing evening today
1 May, 2008	[12:30 MST, 0600 UTC]	1:00 pm	Special News: The Severe Cyclonic Storm is intensified and move East-Northeastward and it is forecast to cross the coast between Southern Rakhine State and Northern Ayeyarwady division during the next 36 hours commencing noon today.
2 May, 2008	[09:30 MST, 0300 UTC]	10:30 am	Special News: The Severe Cyclonic Storm NARGIS has crossed southern Ayeyarwaddy coast near Higyi Island in last few hours.
2 May, 2008	[14:30 MST, 0800 UTC]	3:00 pm	Special News: The Severe Cyclonic Storm further intensified and moved Eastwards. It's centered were continue to cross Ayeyarwady, Yangon and South Bago Divisions and it is forecast to cross the coast between the South Rakhine state and Northern Ayeyarwady divisions during the next 24 hours commencing 2 May evening.
3 May, 2008		6:00 am	Special News: The Sever Cyclonic Strom NARGIS has crossed the Southern Ayeyarwady and Southern Yangon during this morning (3 May) and the center of the storm crossed over the Pathein on morning 1 am of 3 May, over the Pyapon between 2-3 am morning, and over Yangon at 5 am. The wind speed was 100-120 mph. This SCS will continue to move as a land depression in next 24 hours to reach the northern part of Thailand.

Source: DMH reports and forecasting published from 25 April to 3 May, 2008.

The overall analysis of the forecasting and warning information of the DMH information shows that the cyclone was tracked from its very early stage and chronologically its status and track with predictions were disseminated with lead time.

The table above on the chorological account suggests that cyclone was tracked in time, forecasted in time and even on the day of landfall it was circulated to the designated recipient authorities well on time.

DMH source has also tried to communicate the respective authorities and state/division Peace and Development Councils on a repeated manner.

3.1.3 Community level dissemination and public awareness

Beyond the central level dissemination of warning of forecasting and warning of the cyclone community level reception was reported in the rapid assessment. Discussions held with local authorities at township peace and development offices as well as with the community level public places with members of the communities in four sites.

Situation in Yangon townships: In the Yangon townships, it was found that the cyclone warning was well received by the local authorities and quite ahead of time through Myanmar TV and Radio as well as their administrative channels. Among the community members, the warning was reached more through Myanmar TV and Radio messages.

Situation in Labutta townships: In Labutta township there has been communication from DMH and the local authorities were also warned over the telephone and VHF radio communication. At community level it was reported that local people also received the message through national TV and radio.

Situation in Higy Island: In the Higy island which is a very remote island and very most southwester corner of the Ayeyarwady division was communicated several times from DMH with warning messages. The presence of a Neval base in Higy island made possible to make a timely dissemination among the command areas. Neval camp population was also able to evacuate to a higher ground was saved people from the storm surge.

In general the national warning issued from DMH was found duly transmitted to the respective departments authorities and departments. On May 1, 2008 DMH authorities and Director General has also called for an interview with the national news paper and warned the communities with interpretations of this potential strike of cyclone NARGIS on the coastal areas of Myanmar. This information was widely published on the Daily News Light of Myanmar on May 2, 2008 morning publication – the morning of the day of landfall (see figure).

However, in spite of the warning from DMH was transmitted to most of the township authorities and public with a good lead time through various redundant information modes, the community response to these information in most of the areas remained quite slow and in many cases almost none.



Figure 6: “Cyclone NARGIS is approaching towards Myanmar coast and People should be aware of the storm surge along the coastal areas” (an article published on 2nd May morning publication of the Daily News Light of Myanmar).

Discussions with local authorities and community people in the Yangon division indicated that most of the people have never anticipated such an intensity of the cyclone. Mostly people thought that staying inside of their houses would be enough for sheltering. However, these proved largely wrong as the intensity of the cyclone wind along with the duration remained fatal for the communities in the coastal and inlands of the Yangon division.

On the other hand, it was reported that in the townships the warning reached people and local authorities have also circulated the warning through the local CDMA mobile and public notification systems. People also tried to stay in their houses but the intensity of the wind and mostly the tidal surge actually made the major damage in the division. Particularly in the Labutta township it as a major damage and primarily caused by the storm surge and the share strength of the tidal surge. It was reported that in those low lying areas even the storm surge came upto 20+ feet.



Figure 7. A young man from Higyi Island showed that how far he had climb up on his house-roof to save his life from the surge water.

In general, from the experiences from both types of field sites it was experienced that the warning this time has reached from central level upto the local township level. The lead time was there as well for making evacuations. However, particularly in the Yangon division findings suggest that that people had lack of experiences of any major cyclone in this area for quite a long time and the locals have also wrong estimation of the strengths and magnitude of the cyclone. Thereby large number of damages of property and natural resources (i.e. trees) have bee a consequence. The duration of the storm remained as another added factor. On the other hand, in the Ayeyarwady division people never anticipated the strength of the surge its height and the duration which made them structurally vulnerable as well. At the same time in the Ayeyarwady division sites lack of protective shelters are one of the major causes of this severe fatality.

By and large, people's lack of knowledge on the actions for preparedness, planning and what people would do with the warning was not quite deafened at community level. Although much of the communities have received some sort of warning at their communal levels but the lack of knowledge, public awareness towards the warning and limited shelters made them vulnerable in a large way. And these vulnerabilities coupled with the intensity and duration of the wind and surge water made the ultimate damage to life and property.

3.2 *Natural and Built System*

3.2.1 Natural resources

The most visible impact of the cyclone NARGIS is seen on the natural resources. In both the divisions the vegetation (e.g. trees, plants, homestead gardens), land, roads, water bodies remained largely affected by the cyclone.



In the Yangon division, particularly in the field sites, there has been a major loss of natural vegetation. Old trees were found uprooted, branches broken miles after miles along any major roads. Regeneration of these trees may take a long time and may have environmental consequences. This may have a further impact on the ecosystems and animal habitations.

These falling of trees often caused a major damage to the properties and houses of the area. Trees fallen over houses, walls and establishments subsequently made a large number of damage of properties alongside. Human injuries were reported due to these fallings.

Beside these wind driven damages in the exposed areas of the Ayeyarwady divisions where the major land is used for paddy cultivation was found largely affected by the saline water intrusion. Due to surge and the volume of water intruded in the rice cultivating farmlands and also entered through the number of tributaries and estuaries may have a large-scale crop loss in coming crop season. Immediate water stagnation is a major problem, at the same time the ongoing southerly monsoon creating more rainfall that might also delay the drainage and discharge



At the same time in the Ayeyarwady division it was reported that large number of salt pans were affected due to the surge and wind. Salt pans are affected due to sand other object depositions as well.

In next few weeks, if the drainage clearances do not perform well then it may cause water stagnation in the coming weeks and may aggravate due to the monsoon impacts into this area. A heavy monsoon is already been forecasted in these low lying areas which may cause a delay in drainage. This may lead towards a prolonged station of these saline water into the fertile lands of Ayeyarwady delta.

3.2.2 Performance of the physical structures

The heavy intensity of the wind, the duration of the gust and the height of the surge made the physical structures in the community extremely vulnerable. In the context of NARGIS all three came together and most of the physical structures performed quite poorly.

Small thatched houses in many cases did not survive at all and completely damaged. A big number of households remain partly damaged but not in a livable condition. Many big structures did not survive as well. Structural designs were not prepared to tolerate such intensity for these large structures even. The intensity as well as the direction of the cyclone NARGIS remained as two crucial things for this area and also a significant damaging factor for the housing pattern and structural pattern.

It was observed that as temples are usually based in the higher ground of the communities, many of these temple domes and tops are also seen damaged due to the strong wind. However, many temples are also survived well as these are well constructed with well planned designs. It also proved that farm based structures may survive well even with cyclones of this intensity.



Small thatched houses performed very poorly

Large structures did not perform well due to poor design



In most of the houses and buildings, the roof were found made of corrugated tin sheets and those are proved to be prone to damage of wind speed that NARGIS generated.



Roof-top remained concern for most of the houses

Beside the housing structure and pattern the community infrastructure were also found vulnerable such as walls and fences etc. But in some cases the better protected public structures such as shoreline protection or river bank protection measures were found some places performed not that bad.

In the Yangon division sites, it was observed that some protected areas performed relatively better while the unprotected and exposed areas suffered the most. Many areas are situated in a very vulnerable part of the river bank. Estuarine positioning of the area made these settlements vulnerable to the strong wind.



3.2.3 Heavy machinery use in recovery operations

In structural recovery and response operations use of heavy machinery was observed in use in Yangon division. Blockage of roads and networks due to the fall of trees and other objects needs use of heavy machineries such as trucks, cranes, trucks, sawing machine, and so forth. Mostly these are requested through the local authorities and government agencies. In the Thanlyin township heavy machineries are found hired from the international port authorities to remove larger objects from the main entrance and roads of the communities. However, where there heavy machineries were not found available, various types of wood sawing and log cutting instruments are observed to be in use.



3.2.4 Energy and electricity

Right before the cyclone approached in Yangon division the electricity supply was cut off. As a consequence no major death due to electric shock or such reported in the Yangon division. But after the storm crossed over the division the densely populated Yangon division has remained the heaviest affected in terms of the damage of electricity infrastructure. Miles and miles of area were found out of electricity in the division. Poles and electricity infrastructure in some areas seem to be completely damaged and require long-term rehabilitation.

In the field sites in the Yangon division as of the assessment time no electricity was found restored. It seems a number of weeks and even month may be required to see the electricity in full operation in those two townships.

The energy requirements at this point for the major infrastructural operation machinery and operation of emergency communication and transportation was found provided through the government sources with rationing. However, both in energy and electricity a long-term recovery plans would be needed.



3.2.5 Water supply and sanitation

Drinking water remained as a major shortage in many of the areas in the Ayeyarwady townships. Water sources remained broken in many cases and also got contaminated in most of the exposed affected areas. However, it was observed that many households are collecting rainwater effectively for preserving their drinking water in households. With the monsoon rains rainwater collection was observed in mass scale at community level. Government relief and rehabilitation operations are reported distributing bottled waters in many most needed areas.



3.3 Societal and Economic System

3.3.1 Livelihoods and economic situation

In all the selected townships, (except the Thanlyin township where major proportion of people's livelihoods are dependent on the international port activities), the livelihoods of the sea facing communities either depended heavily on the fisheries activities, agriculture, shrimp cultivation, salt panning and other related activities. In the Ayeyarwady division, all these peoples' livelihoods were reported largely affected by the cyclone.

For the farmers the land got affected and saline water intruded in their farmlands. If this water drainage takes time and water stagnation remains for new more day-weeks then the land can get salinated and may have long-term natural impact. Farmers standing crops (at remained affected Fishing gears, households based livelihoods means, livestock were affected).

In general, the poverty in the low lying part of the Ayeyarwady is relatively higher than the other parts or the Myanmar leaving a small household accumulation assets and wealth. During the NARGIS most of the households in these area have lost their household based assets and equipments. This may have a long term repercussions over their livelihoods recovery in future.

Lose of lives in many households in Labutta and other remote areas of Ayeyarwady division also have psycho-social impacts. Particularly among the fishers, this may have a long term effect where more day to day offshore fishing is required and family members are the critical support to that.

Among the wage labors, there has been already an ongoing impact. Lack of asset and wealth transfer in the post disaster situation made a clear scarcity of work within the communities and around. Wage labors dependent on the day to day income are anticipated to fall into follow up economic consequences and traps leaving no household assets to support their critical days.

Within the community, no cash for work or financial relief may also consequence the livelihoods recovery of small livelihoods groups and vulnerable groups (women, elderly, disable) in a critical situation in coming days.

3.3.2 People's responses

In spite of the devastation of cyclone NARGIS, during the assessment a great deal of people's initiatives are observed within the assessed townships. These are indeed social capitals of the Myanmar society and found in operation as "bounce back characteristics" of the community.

In societies it was observed that people are mobilizing themselves to help each other with what ever means and support they have. It was found that people are clearing their roads and networks. Removing large logs collectively and using these uprooted trees branches and woods for their firewood, woods and other measures. People have started to use these for their housing rehabilitation and setting back their dwellings.

It was observed that people are trying to come up with innovative ideas and practices to harness their energy. Such as collecting rainwater for their drinking water and so forth.

In terms of psycho-social rehabilitations people are helping each other to re-adjust themselves within the communities.



4. Conclusions and recommendations

Cyclone NARGIS was the most devastating cyclone in the recent history of Myanmar. This is due to various the **characteristics of the hazard** itself including its:

- strength as a *“Severe Cyclonic Storm”* of Category 3 (as per WMO classification) with maximum wind speed of about 120-130 mph;
- *“slow moving nature”* and of *“long duration”* without downgrading of its strength on the tract;
- tract over the *“low-lying areas”* of the Myanmar coast;
- *“inter-exchange with shallow waters”* where it was allowed a counter-clockwise circulation or winds and regaining to pile up a large storm surge to the right of the storm's track; and

Besides its volatility as a hazard cyclone NARGIS turned into a major disaster due to a number of **vulnerabilities**. Some of the reasons can be singled out as below:

- Vulnerabilities of the *densely populated* Ayeyarwady River deltaic region;
- Presence of *big number of estuaries and a complex topography* of the Ayeyarwady River delta;
- *Absence of any adequate shelter facilities* for people (such as cyclone shelters) and livelihoods (such as livelihoods shelter or high grounds);
- *Poor mobility opportunities* (such as unavailability of road networks and inland traffics);
- *Existing gaps of early warning dissemination systems* beyond township level and risk communication (e.g. unavailability of sufficient community level dissemination support instruments such as VHF, alerting and notification instruments and so forth);
- *Poor public knowledge and awareness* on the unknown risks at community levels.
- *Poverty* and lack of assets to recover promptly.

Some of the **conclusions** and respective **recommendations** derived from the assessment can be outlined thematically below:

A. Hazard identification and forecasting:

- Nationally there is an established system of cyclone detection and forecasting is available through DMH establishments. DMH takes the lead on this and consult national, regional and international centers analytically prior reaching decisions;
- Multiple-validation was performed from central level taking the outputs of various other national, regional and international early warning centers and services;
- Taking a reference of the various sources DMH made a quite accurate prediction based on their own “synoptic method”;

- DMH using an “empirical method” predicted the peak surge level for various areas and subsequently transmitted for dissemination.

Recommendation on Hazard identification forecasting:

- ✚ Establish strong formal ***operational linkages with the WMO establishment and regional multi-hazard early warning center of ADPC*** for regular validation and use of high-computational numerical modeling based on WRF system.
- ✚ Scientists from DMH can be ***seconded to ADPC and WMO systems*** for receiving advanced training and develop custom products for Myanmar.

B. Dissemination of forecasts and warning:

- National dissemination of warning was initiated from DMH and timely bulletin, special storm news and warning was provided by DMH.
- A good “lead time” was demonstrated in dissemination of the warning to the responsible authorities.
- Multiple redundant modes including regular DMH bulletins, news, warning, telephone and VHF communications and so forth.
- Local authorities and authorities in charge on the first hit and relevant areas were warned ahead of time.
- News media including national dailies, Myanmar radio, MRTV and all possible sources are communicated
- Local authorities and local administration of major forecasted townships were. Local authorities are then responsible for alerting the communities further with their downstream networks and last mile communication in their respective areas.
- National and central administration, departments, NAVY and others were been regularly informed from the DMH central.

Recommendation on dissemination of forecasting and warning:

- ✚ It is essential that the existing system early warning is assessed through an ***“early warning system auditing assessment”***.
- ✚ This would provide the clear understanding of the gaps in early warning from one end to another. On the basis of this an ***“end-to-end” multi-hazard early warning and dissemination systems*** can be designed for the country where role of each of the agencies at various levels will clearly outlined and agreed upon.
- ✚ On the basis of these agreed understanding through an ***“institutional process”*** (i.e. Monsoon forum) and multi-agency cooperation ***“Standing Operating Systems (SOP)”*** can be established to set adequate accountability at various level with clear mandate of operations of each agencies, professionals and entities.

C. Public Education and Awareness:

- It was evident from the field discussions that a great deal of “un-clarity” is existing among the local households and even among the local authorities in what next to do with the warning and forecasting information from the national level.
- In many cases it was expressed that people received the forecasting and warning messages in the communities through multiple modes with good a lead-time but as people “never perceived the intensity” of the cyclone” and “never experienced a cyclone of such magnitude” in this region in recent years, they have failed to take any effective form of systematic preparedness measure at community level other than sheltering at their own dwellings.

Recommendation on “Public Education and Awareness Raising”:

- ✚ It is important that contents of the warning messages remain more clearly articulated in a form that people can easily understand and take immediate action. In this respect, clearly studied and context based custom **“warning message contents, products and procedures”** need to be developed. This needs interaction both with DMH, other national level agencies, local level stakeholders/authorities and communities.
- ✚ A well devised public education and awareness campaign including educational curricula development based on **understanding of science, institution and societies needs to be developed**. A **“social mobilization campaign” to institutionalize risk communication** needs to be established at national to local levels.
- ✚ **“Awarding system”** on the basis of successful achievements of communities needs to be established for encouraging public awareness at communities and local institutional level on a periodic basis.

D. Disaster Preparedness Capacity:

- Disaster preparedness is introduced in the national level but effective mechanisms are not fully developed and internalized/ mainstreamed within sub-national and local authority levels (i.e. at township levels) that can penetrate a local level integrate disaster management planning and practices.

Recommendation on “Disaster Preparedness Capacity Enhancement”:

- ✚ A comprehensive program needs to be evolved to build a Comprehensive Disaster Management Structure in Myanmar. This can be essentially linked with the **“early warning and disaster management at all levels”**. Comprehensive Disaster Management Programme (CDMP) of Bangladesh is one such example that might be looked at for devising such a national comprehensive programme in Myanmar.
- ✚ Local level (township and division level), end-to-end disaster management and early warning systems needs to be introduced through a regular **capacity building training program** under the umbrella of national disaster management council and other relevant national platforms(s). This should be effectively linked with the DMH warning systems and overall capacity building for all phases of the disaster risk reduction.