# Report to UN- Asia Pacific Adaptation Network
## Early Warning Systems for Disasters in Sri Lanka

Sri Lanka is prone to natural disasters such as Tsunami, Landslide, Floods, Cyclones, High winds, Drought, Coastal erosion, Thunder storms etc. The country is also prone to manmade hazards due to unplanned human settlement development and climate change trends. Floods in December 2012 alone affected 17 districts and approximately more than half of million people were affected. Landslide and cutting failure frequently cause disasters in hilly area in Sri Lanka. In the year 2003, 252 deaths were recorded due to cutting failure and landslide.

Since the Tsunami in 2004 the Government of Sri Lanka has taken significant steps forwarded strengthening legislative and institutional arrangements for disaster risk management in 2005.Sri Lanka Disaster Management Act no 13 0f 2005 was enacted which provide the legal basis for instrument a disaster risk reduction in the country. The National Council for Disaster Management (NCDM) is a high level inter-ministerial body. The chairman of the NCDM is HE the president and vice chair the by Hon Prime Minister, other member are leader of the opposition, ministers in charge of 20 selected subject areas , provincial council, chief ministry's and five members of the opposition provides direction to disaster risk management in the country. The act also provides for establishing the Disaster Management Centre (DMC) under the council to be the apex body for the purpose of planning, co—coordinating and implementing of certain natural and other forms of disasters.

Disaster Management Centre (DMC) is the leading agency for disaster management in Sri Lanka. It is mandated with the responsibilities of implementing and coordinating national and sub national level programmes for reducing disaster risk with the participating of the stakeholders.

### A) Disaster Management Plans

Main tasks of the DMC is to developed disaster management plans for responding to disaster across all levels. Development of such plans is required by the Sri Lanka Disaster Management Act and National Disaster Management policy.
District disaster management coordinating units (DDMCU) are the focal point for coordinating of district level, divisional level, local authority level and Grama Niladari level for coordinating response and managing and disseminating in emergency situations.

### B) Weather Information for Decision Making.

The Meteorological Department responsible for weather forecasting is one of the oldest government departments in Sri Lanka. Since establishment it has rainfall records for some stations of more than 150 years. At present the department maintains 37 Automatic Weather Station (AWS) network with updating every 10 minutes. Rainfall records provide facilities for trend analysis and thus has a major role especially in predicting floods and possibly understanding droughts. Linked to international networks weather data is shared among key Sri Lankan organizations as required, eg Irrigation Department, MASL,

Agricultural Department, National Building Research Organization, Fisheries Department, Coast Conservation Department and Ceylon Electricity Board.

Focal points are available in these institutions and regular interaction takes place including when there is a rainfall event of more than 100mm.

A Climate Studies and Research Division of the Department also analyses data and informs likely scenarios and projections to these agencies.

In addition weather stations are maintained by the Irrigation Department, MASL, Electricity Board and some plantations. The Irrigation Department which has wide network is presently updating its weather stations to 122 automatic weather stations to be completed by 2015 to ensure fast information flow as it is responsible for flood forecasting. Daily updating of reservoir levels is being done by the Irrigation Department with increased frequency input during times where reservoirs are at or near full supply level. Same occurs with MASL where the Water Management Unit constantly appraises water levels in the reservoirs managed by MASL and the CEB. NBRO too maintains a system of automatic rain gauges for use in landslide vulnerable areas.

### C) Early Warning Systems for Floods and Droughts.

Being an island, Sri Lanka unlike countries that share basins and rivers, do not have to be preoccupied to respond to events such as floods resulting as a consequence of extreme weather events in neighboring countries. Floods mostly seen as hazard and causing economic loss and loss of life in most instances do have beneficial impacts such as ground water recharge, help maintain wetland eco systems whilst keeping flood plains fertile by depositing rich silt on riparian lands.

Floods are generally critical in May to July in Wet Zone of the country and November to January in Dry zone of the country. There are three types of floods mainly affects in country.

1. Riverine floods; this is another way to say river floods and river reaches its flood stage water can rise and spill over the banks of river.
2. Urban floods; these types of floods that happening in a relatively short period of time and can inundate an area several feet of water.
3. Reservoir induced floods; these types of floods that occur at the downstream of a reservoir due to spillage of reservoir at high rains are classified as reservoir induced floods

### a) Flood forecasting

The Irrigation Department is responsible for flood forecasting and issuing early warnings to the general public to safeguard and evacuate from riverine floods and reservoir induced floods.

Irrigation Department currently maintains 32 permanent river gauging stations at critical locations of rivers of the country.

It is planned to increase 122 permanent weather stations at critical river basins and reservoirs by end 2015. Water levels, rainfall data of these locations are presently being transmitted online. Close interaction with the Metrological Department enables a reliable forecasting regime to be in place.

The river gauges have been so calibrated in reference the flood situation of the relevant flood plain as follows.

1. Flood alert level
2. Minor flood level
3. Dangerous flood level
4. Critical flood level

**b) <u>Flood Forecasting Process</u>**

Kelani , Kalu, Gin & Niwala are the main river basins in the wet zone of Sri Lanka which are viable for frequent flooding. The river stages and the rainfall of key stations of these rivers are monitored continuously (3 times per day even during non-working days) from Colombo ID Head Office. When excessive rainfall occurs and if the river stages are closer to the Minor flood level special Flood Monitoring Unit is organized in Colombo office to monitor water levels in every hour, day & night continuously until the excessive climatic condition is cleared. Prior flood warnings are issued from this office to the relevant agencies including DMC for proper mitigation or adoptive actions.

Special attention is being given to Kelani, Kalu, Gin, Nilwala ( 4 river basins) to establish river gauge stations at all key points. CDMA telephones are provided to all these stations to be connected to Colombo office to enable on time data communication. These data are processed in Colombo and conveyed to the required agencies with minimum time lag.

Gauge stations are manned by ID permanent employees HSL day & night and all the 365 days of the year. At Head Office of ID a Special Operations Unit is organized to work for 24 hours continuously until critical weather conditions are cleared.

Department of Meteorology is consulted for the next 24 hour forecast of rainfall and to get necessary rainfall data from their stations. The data of these gauging stations are transferred presently over the phone to Hydrology Branch of the Department as follows including dissemination.

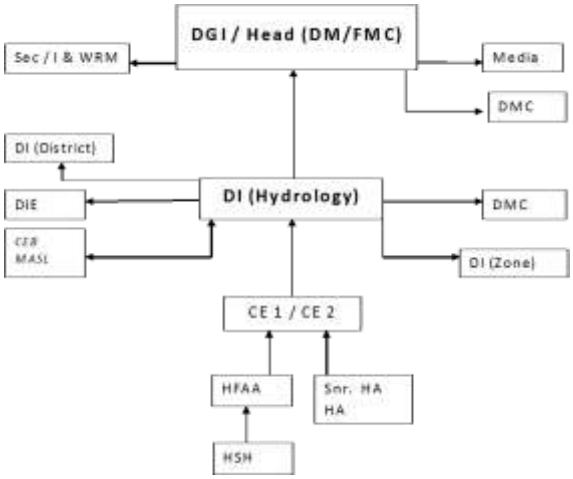
The water levels of all the major reservoirs managed by ID are daily monitored by staff of respective DIE division and reported to respective District Director and Water Management Division in Head office daily. If water level of any reservoir is closing to spill level then steps are taken to closely monitor such reservoir. The data transfer and dissemination system of reservoirs as follows.

**c) <u>Flood Forecasting Decision Support System of Irrigation Department</u>**

**DM/FM Committee**
**DI (AM), DI (Hydro), DI (WM), DI (DM & FS), CE(DS)**

Sec – Secretary /I&WRM
DGI – Director General of Irrigation
H/DM FMC – Head/ Disaster Management and Flood Monitoring Committee
DMC – Disaster Management Centre
DI (Dis) – Director of Irrigation (District)
DI (Zone) - – Director of Irrigation (Zone)
DIE – Divisional Irrigation Engineer

CE – Chief Engineer
CEB – Ceylon Electricity Board
MASL – Mahaweli Authority of Sri Lanka
HFAA – Hydrological Field Assistant
HA- Hydrological Assistant
HSH - - Hydrological Survey Helper



### d) Flood Monitoring Committee

Irrigation Department Flood Monitoring Committee is directly under Director General of Irrigation and Additional Director General (System Management). It is consists of Directors of Irrigation -Assets Management, Hydrology, Water Management and Flood Studies, Drainage and Disaster Management. Emergency Operation Room functions round the clock with participation of officers from Flood Monitoring Committee and their representatives.

### e) Flood Management Programme

Out of the 103 river basins, 16 have been identified as critical, due to being longer than 100km with a basin area of 1,000 Km2 or more, for flood mitigation and prevention.

The river basins that were identified as critical are located in areas where there is rapid development resulting in the reduction of the surrounding forest and permeable areas. As a result, surface runoff has increased where excess water flows to the sea without being utilized productively. This event has the potential to create floods, deluging a large area, causing server damages to crops and properties.

Name of the identified critical river basins:

1. Mahaweli Ganga
2. Malwathu Oya (Aruvi Aru)
3. Kala Oya
4. Kelani Ganga
5. Yan Oya
6. Deduru Oya
7. Walawe Ganga
8. Maduru Oya
9. Maha Oya (Mundeni Aru)
10. Kalu Ganga
11. Kirindi OYa
12. Kumbukkkan Oya
13. Menik Ganga
14. Gin Ganga
15. Mi Oya
16. Gal Oya

### D) Early Warning Systems for Droughts

There is at present no specific method for drought prediction but both the Meteorological Department and irrigation/agriculture authorities are trying to establish a drought monitoring system. In recent times the increasing frequency and unpredictability in drought occurrences makes it imperative that the issue of drought prediction be taken as priority process.

The onset of drought is an insidious process and difficult to predict till it is upon us and effects noticed. Coping with droughts are related to increasing water storage and river diversions and regulating systems, adjusting crops, cultivars, adopting crop diversification and cultural practice's for crop production under drought conditions.

Climate smart agriculture is being perceived as being increasingly important in this endeavor pending reliable forecasting systems that will enable prior preparation for drought situations. Drought monitoring systems when in place will enable addressing and coping with drought and is increasingly significant in the context of climate change.

**E) <u>Early warning system for Landslides</u>**

National Building Research Organization (NBRO) under the Ministry of Disaster Management in Sri Lanka has been conducting a Landslide Hazard Zonation Mapping in the ten districts of hill country areas since1989 covering entire districts of Badulla, Nuwaraeliya, Matale, Kandy, Kalutara, Ratnapura, Kegalle,Matara, Hambantota& Galle districts in 1:50000 & 1 : 10000 scale.

Established Auto meter rain gauging for important locations. This gives more accurate rainfall data for early warning. This can update every hours. NBRO issues landslide warning landslide watch level using colure core yellow mention that message "If the rain continue within next 24 hours be watchful on the possibility of landslide and cut slope failure. Level 02 using colour code amber mention that "since a prevailing bad weather condition is expected to continue within next 24 hours be alert on the possibility of landslide rock falls and cut slope failures.1$^{st}$& 2$^{nd}$ warning issued to the Disaster Management Centre and DMC issues warning to the public.

Enhanced real time landslide forecasting and early warning capacity is by establishing automates rain gauges network in 50 communities/ catchment in Badulla, Kandy, Kegalle, Kurunegala, Matale, Nuwaraeliya districts where Doppler Rader coverage is not available.

Main objectives is to issue timely and effective early warning on landslides to vulnerable communities to reduce the lives and property damage. The early warning can be used by inputting real time rainfall data obtained through automated rain gauges with the established of the proposed system, vulnerable communities receive the early landslide early warning message during heavy rain to timely evacuate as pre planned and practiced from risk areas.

At preset over 3000 landslide prone sites have been identified and mapped by NBRO in 9 districts prone to frequent landslides.


**F) <u>Multi Stakeholder engagement for last mile Early Warning system</u>**

The 2004 Indian Ocean tsunami that claimed the lives of 35000 of Sri Lankan people and displaced one in twenty has highlighted the critical importance of an effective National Early Warning System for Sri Lanka (NEWS:SL). Meeting this need, which has been discussed after each of our too frequent disasters such as the cyclones of 1978 and the floods of 2003, can no longer be postponed.

Recognizing that effective warning is just one of the critical parts of a comprehensive risk management system that includes mitigation, preparedness, response and recovery. Warning is a crucial component of the overall risk management system that failed in the 2004 Indian Ocean tsunami.

**G) <u>Current Early warning Systems and Responsibilities</u>**

DMC is the main focal point responsible for coordinating early warning, along with the relevant technical agencies and Technical Committees, its dissemination and for ensuring last mile dissemination of same. The Emergency Operations Centre of the DMC will be in constant coordination with all technical agencies responsible for natural and man-made hazards and in instances of any imminent disaster it will take action to inform the responsible officers for onward communication to the sub-national levels and communities. Early warning messages are based on different stages which include **"Alert, Warning, Evacuation order, Withdrawals and Stand down."**

DMC has established an effective early warning system for disasters – natural, technological and man-made - through the Emergency operation Centre of the DMC. Priority will be given for those disasters, such as riverine floods, landslides, flash floods, tropical cyclones, storm/sea surges etc. At the same time for rarer but very destructive hazards such as tsunami, systems are in place. Methods of obtaining information about impending disaster events and issuing early warnings would vary from one hazard to another due to different characteristics of different hazards. With respect to local hazards such as floods and landslides, local systems already available will be strengthened. For other hazards such as earthquakes, tsunamis, adverse weather conditions and cyclones the relevant agencies will work in constant coordination with the respective regional and international warning centers.

## H) Technical Institutions Responsible for Forecasting and Issuing Warning Alerts for Different Hazards; and their Roles and Responsibilities

At present in Sri Lanka, there are several technical agencies to handle issues related to different hazards / disasters. For most of the disasters, there is a government institution legally mandated to monitor the disasters which fall within their expertise as follows,

### a) Technical Agencies

Technical agencies are responsible to issue the warnings of relevant disasters as per table below

**Technical Agencies responsible for issue of warnings**

| Disaster | Responsible Technical Agencies |
|---|---|
| (*a*) A landslide | National Building Research Organization (NBRO) |
| (*b*) A cyclone | Department of Meteorology |
| (*c*) A flood | Department of Irrigation (DOI) / Mahaweli/Agrarian |
| (*d*) A drought | DOI, Department of Meteorology |
| (*e*) An industrial hazard | Central Environmental Authority (CEA) |
| (*f*) A tsunami (seismic wave) | Department of Meteorology |
| (*g*) An earthquake | Geological Survey & Mines Bureau (GSMB) |
| (*h*) An air hazard | Airport and Aviation Authority |
| (*i*) A maritime hazard | Marine Environment Protection Authority (MEPA) |
| (*j*) A fire | Local Authority (Fire Brigade) |
| (*k*) An epidemic | Ministry of Health |
| (*l*) An explosion | Ministry of Defense |
| (*m*) Air raids | Airport and Aviation Authority |
| (*n*) Civil or internal strife | Ministry of Defense |
| (*o*) Chemical accident | Ministry of Industries |
| (*p*) Radiological emergency | Atomic Energy Authority |
| (*q*) Oil spills including inland & marine oil spills | MEPA |
| (*r*) Nuclear disaster | Atomic Energy Authority |
| (*s*) Forest fire | Forest Department |
| (*t*) Coastal erosion | Coast Conservation & Coastal Resource Management Department (CC&CRMD) |
| (*u*) Tornado, lightning strikes and severe thunder storms | Department of Meteorology |

Technical agencies provide the early warning messages to the DMC. The DMC will analyze these early warning messages and disseminate to the vulnerable communities via various technical and non-technical communication methods.

## I) Communication Systems for Early Warning Dissemination

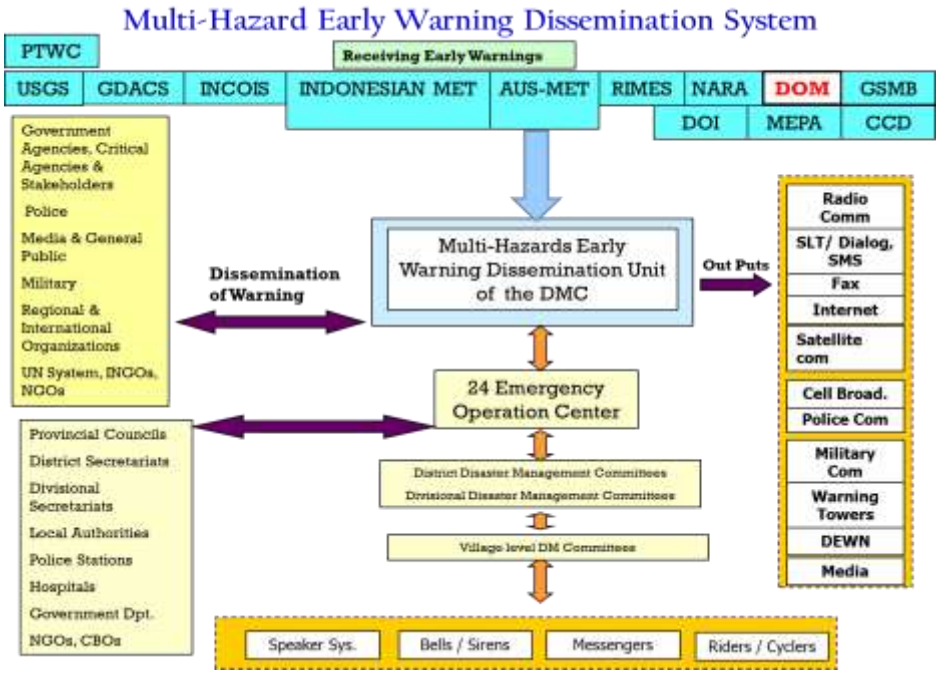
Early Warning (EW) mechanisms and systems have been established for effective issue of EW of an impending disaster at national and sub-national levels down to the last mile where communities are.
Dissemination of warning from National level to the grassroots level are divided into four layers, namely, National, District, Divisional and GN Level. The Emergency Operation Center (EOC) of the DMC receives the EW message from International and Regional Technical Agencies. A national level EW message is disseminated to the emergency response committees and their responsibility is to pass the messages to their own organizations. District level EW is disseminated through District Disaster Management Centre Units (DDMCU) to the District Secretariat and stakeholder agencies and also to the political authority. Divisional level EW messages are disseminated to the divisional secretariat from DDMCUs.
Divisional secretariat will disseminate message to political authority, S & R teams, Police and district stakeholders. At the same time the EW is disseminated to the local authorities they will pass the message to the vulnerable community is mainly through the Police and military communication systems, radio communication, multi-hazard early warning towers, media and the normal telephone systems. GN level EW message is disseminated to the vulnerable community by last mile communication tools.
Alternative countrywide communication systems already been established and with these improvements, DMC ensure that there will be a mechanism to inform the vulnerable communities immediately. These include the Nation-wide Emergency Communication System, which will be used to provide information on:

- Impending cyclones, floods, landslides, epidemics, sea surges, tsunami and storms etc.
- Impending floods due to dam breach, rapid opening of sluice gates; dam & reservoir related floods
- Inundated areas, and closure of roads and bridges that have become impassable
- Evacuation routes and safe areas and etc.

Early warning messages are based on different stages which include **“Alert, Warning, Evacuation order, Withdrawals and Stand down.”**

According to the EW framework, when there is an impending disaster, the technical agency responsible for the given hazard determines the scale of the disaster and the decision is conveyed to the Ministry of Disaster Management and the Emergency Operation Centre of the Disaster Management Centre.

The technical agency may receive hazard alerts from its own in-country monitoring facilities/ mechanisms or from regional and international EW agencies. The vulnerable community itself could also be a source of information to the technical agency regarding an impending disaster. The technical agency or the first respondent is different for different hazards.




Several Methods were integrated with early warning from National level up to grass root

**National Leveland District Level**

- Media.
- Early Warning Towers.
- Police & Military Communication
- Cell Broadcast/ SMS
- Intra Governmental Network
- Satellite & Radio Communication (HF & VHF)
- Telephones / CDMA/ GSM
- Radio Communication
- Telephones/Fax / CDMA/ GSM
- Police & Military Communication
- Media

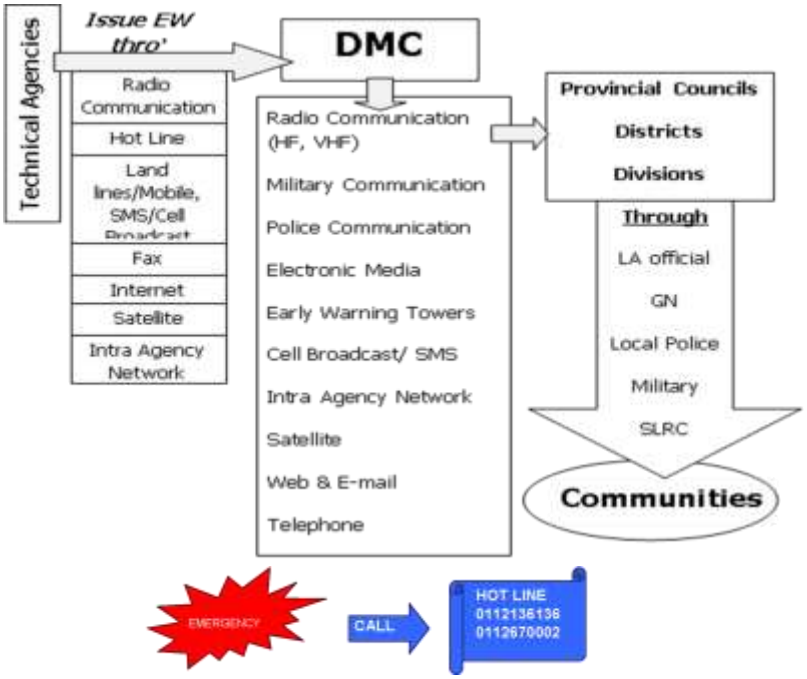
**Village Level**

- Telephones / CDMA/ GSM
- Police Vehicles – Announcements NGOs and CBOs
- PA Systems
- Sirens ( Hand and Electric)
- Temple and church bells
- Riders/ Push Bicycle & Motor Cycles/Messengers
- SMS / Cell Broad cast
- Early Warning Towers
- Media
- Traditional and Religious methods
- Early Warning Committees (Door to Door)

### a) Last Mile Dissemination to the Communities

From the above locations (district / divisional / local authority / Grama Niladhari levels or other identified specific locations) onwards, the dissemination to the communities through following various methods:

Personnel and agencies such as Local authority officials, GNs, Local Police, CBOs, NGOs, Military, Police and Volunteers will be involved in the dissemination activities. The effectiveness of the methods will be different in different locations depending on the location specific characteristics.




### b) Early Warning (EW) Mechanism

Each organization must ensure and confirm the delivery of the early warning messages up to their last mile branches. DMC must confirm the proper working of the early warning system and ensure the reception of the warning up to the grass root level. DMC must confirm the ground level information and clarify with the technical agencies whether the information is valid to address a disaster.

### c) Role of the Media

Media has a vital role to play in the last mile dissemination of the early warning. It is the Media that accesses the last mile community in most of the areas of the country. DMC has the responsibility to ensure authenticity and accuracy of the early warning messages to media via appointed media spokespersons.

DMC must ensure the accuracy of the press release and provision of the particular information to the media within the shortest duration of time.

### d) Role of Military and Police for early warning dissemination

DMC has direct coordination with military and police to disseminate the early warning messages to vulnerable communities. Military and Police posts are located in many areas in the entire country.

DMC must ensure the communication method and the accuracy of the early warning messages. Military and Police possess separate early warning systems which can access more vulnerable communities and they can direct these communities to safe locations at ground level.

### e) Responsibilities of the District Disaster Management Centre Units for early warning

The District Disaster Management Coordinating Unit (DDMCU) is the district level authority which is responsible for ensuring the dissemination of early warning messages to last mile locations.

DDMCU should establish volunteer committees at the ground level and must ensure to equip enough early warning methods and equipment at the village level locations.

DDMCU must clarify EOC messages with DMC before disseminating the early warning messages to the village levels.

### f) Responsibilities of the Grama Niladhari for Early Warning dissemination

Guiding District Disaster Management Coordination Units in coordinating and implementing warning dissemination related activities at the Province, District, Local Authority, Divisional Secretary , GramaNiladhari and Village Disaster Management Committee levels.

**Divisional Secretary is the party with major response at Divisional level** for the early warning dissemination. DS should update with the relevant committees and ensure proper early warning dissemination at the last mile and dissemination priority by vulnerability of particular disaster.

Grama Niladhari (GN) is the government officer at the village level for the early warning dissemination. GN should update the relevant committees and ensure proper early warning dissemination at the ground level.

Evacuation drills/Mock Drills are compulsory to be conducted /practiced in the possible GN Division or DS Division annually under response/guidance of District Secretary ,Divisional Secretary and Grama Niladhari .Early Warning message flow to last mile/Vulnerable group should be very clearly defined and follow practices as legally permissible. Village Disaster Management Committees major responsibility to regular update and disseminate at last mile.

### g) Early Warning Contingency Plan

DMC is required to have a contingency plan if the main system does not support the proper early warning dissemination. It should cover the entire EW system from the national level to the grass root level. DDMCU also must ensure the district level and GN level contingency plans.