

# **CONSULTANCY MISSION REPORT FOR Sri Lanka**

**Dr. Y.E.A. Raj, Mission Expert on Met,  
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As part of the project on Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning System, three expert consultants, one on meteorology, one on hydrology, and one on Disaster Risk Reduction, conducted a highly successful two-day mission to Sri Lanka on 7 –8 August 2014. The purpose of the mission was to collection and compile data, information, examples, and diagrams on standard operating procedures (SOPs) best practices, gaps and needs, and recommendations for inclusion in the Manual on Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazard Early Warning System which will meet the needs of the 13 beneficiary countries involved in the Project.

**PHOTO**



### *Acknowledgments*

These workshops were conducted as Activity 1.3 of Project Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning System. The lead organizations for the project are the ESCAP/WMO Typhoon Committee and the WMO/ESCAP Panel on Tropical Cyclones in association with a wide cross section of partner agencies. Very kind appreciation is expressed to ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and Southeast Asian Countries who have funded this project; to the (Different organizations involved in the two day meetings) for their vital assistance, support, and active participation in these successfully workshop; and Typhoon Committee Secretariat who provided excellent and very time consuming support, coordination, detailed arrangements, and insights for the missions.

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## **1. Introduction**

The Economic and Social Commission of Asia and Pacific (ESCAP) approved a submitted project *Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning System (EWS)* and funded it through the ESCAP Multi-Donor Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and South East Asia. ESCAP/World Meteorological Organization (WMO) Typhoon Committee (TC) and the WMO/ESCAP Panel on Tropical Cyclones (PTC) in cooperation with other agencies had recognized a strong need to create synergies in early warning systems among different types of coastal hazards by reviewing existing Standard Operating Procedures (SOPs).

## **2. Project Overview**

The goal of the project is to promote community resilience to coastal multi-hazards through effective SOPs for multi-hazards EWSs. The project is collaboration with multiple agencies and organizations. It involves thirteen beneficiary countries in TC and PTC regions. The designated target groups include National Meteorological and Hydrological Services, National Tsunami Warning Centres, and National Disaster Management Offices in TC and PTC Members' countries.

Activity 1 is to collect, review, analyze, and synergize existing SOPs in TC and PTC Members' countries and develop a Manual/Handbook of SSOP Procedures. The third item in Activity 1 is to synergize existing SOPs and develop additional SOPs as needed to meet identified gaps and needs and compile a Manual of Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning Systems (EWS), mainly focusing on the hydro-meteorological aspect, to meet the needs of diverse users, like decision makers, early warning issuers, media, researchers, operational, public, including fishermen at community level.

To complete Activity 1.3 and to meet the success indicator, in addition to the three in-country pilot workshops already carried out, consultants visited targeted countries in the Panel of Tropical Cyclone region, Myanmar, Sri Lanka and Maldives and 3 targeted countries in the Typhoon Committee region, Cambodia, Malaysia and Viet Nam. The missions to the PTC region countries were conducted during 4 – 11 Aug 2014 and to the TC region countries during 28 Aug – 5 Sep 2014.

## **3. Purposes of the Mission Visits**

- a. To review existing coastal multi-hazards EWS SOPs of hydro-meteorological services, disaster management, media, roles of elected official, and others from national to district to local levels,
- b. To identify best practices, gaps and needs, and recommendations for internal and cross-cutting SOPs, and
- c. To compile data, information, examples, and diagrams collected on SOPs best practices, gaps and needs, and recommendations for inclusion in the Manual on Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazard Early Warning System which will meet the needs of the 13 beneficiary countries involved in the Project.

#### 4. Missions Dates and Team Members

##### Dates:

##### a. PTC Countries

Myanmar	4 - 5 August 2014
Sri Lanka	7 - 8 August 2014
Maldives	10 -11 August 2014

##### b. TC Countries

Malaysia	28-29 August 2014
Cambodia	1-2 September 2014
Viet Nam	4-5 September 2014

##### Team members:

##### a. For the PTC countries' missions:

- Dr. Y.E.A. Raj (Dr. Yesudhas Eben Aruma Raj), Former Deputy Director General, Regional Meteorological Centre, Chennai, India Meteorological Department
- Mr. Abdul Majid, Former Director of National Flood Forecasting Bureau, Pakistan
- Mr. Ahmed Kamal, Member (Disaster Risk Reduction - DRR), National Disaster Management Authority, Prime Minister's Office, Pakistan

##### b. For TC countries' missions:

- Dr. Tokiyoshi Toya, Former Regional Director for Asia and the South-West Pacific, WMO;
- Mr. Abdul Majid, Former Director of National Flood Forecasting Bureau, Pakistan;
- Mr. Amir Ali Khan, Assistant Professor, National Institute for Disaster Management, New Delhi, India.

#### 5. Workshop Programme and Overview

The programme for the two-day workshop for all the three countries as designed by the project manager and the SSOP committee is given in Appendix 1a. Another program slightly modified as specific to Sri Lanka and was made available to the consultants is given in Appendix 1b.

The actual program as it took place is given below.

Day 17 Aug 2014, Venue: DoM, Colombo

*Session 1:* 0845-0915 Consultants meeting with DGM, Sri Lanka, Dr..Lalith Chandrapala in his chambers.

*Session 2:* 0915-1030 With participants, Brief presentation by the consultants

*Session 3:* 1030-1230 Combined session with participants from DoM, Sri Lanka and also from several other departments

1330-1500 Round table meeting between each consultant and group of

participants

*Session 4:* 1515-1600 Interaction with media persons

Day 2 8 Aug 2014

0930-1230 Consultants seeking clarification from the participants on the questionnaires submitted by DoM.  
Further discussions with the participants

1400-1600 Briefing and summarising by all consultants,  
Briefing on recommendations.

**Brief description of the proceeding during 7-8 August 2014 at Department of Meteorology, Sri Lanka is given below. List of participants is given in Appendix 2.**

On 7 Aug 2014 the consultants had a half an hour meet with Director General of Meteorology, Department of Meteorology, Sri Lanka, Dr. Lalith Chandrapala during which the scope of the visit of the consultants was discussed. At 0915 hours the sessions commenced in the conference hall. More than 25 participants attended which included nearly 8 participants from DoM. Other participants hailed from various departments of Govt. of Sri Lanka such as Coast guard, Air force, Navy, Disaster management centres, Irrigation department, Health ministry etc. During this specific session all the three consultants provided a briefing of the SSOP project, the purpose of their visit to Sri Lanka and also the scope of the meets. At 1030 hours the interactive sessions commenced, there was only a combined session and no parallel sessions were conducted.

In the post lunch session a round table type of discussions with participants from DoM was conducted by the Met consultant Dr. Y.E.A. Raj. 7 senior officers from DoM participated in this meet. The status of EWS and that of the various SOPs were discussed in detail. Similar meetings were held by the consultants Dr. Majid and Dr. Kamal with participants who hailed from Hydro and DRR departments.

At about 1515 hours there was an interactive session with media though only one representative from a media house turned up. The first day proceedings closed at about 1600 hours.

On 8 Aug 2014 the sessions commenced at about 0930 hours. According to the schedule planned there should have been meeting with district and local representatives (i.e., hailing from different areas of Sri Lanka). However there was no participation of district local representatives. More or less the same participants who attended the previous day's session attended the session on 8<sup>th</sup> August as well. During the morning session the questionnaire was critically gone through and clarifications on answers provided by DoM, which needed further clarity was sought from the DoM participants. The final session commenced at 1345 hours during which all the consultants provided a detailed briefing to the participants about the data they collected and the status of EWS and SOP for Coastal Multi Hazards, as existing in Sri Lanka and as gathered by them. The recommendations were also briefly presented. The proceedings closed at about 1600 hours.

## 6. Mission Summary / Early warning system

### 6.1 Meteorology

Sri Lanka is an island country in the North Indian Ocean / Bay of Bengal and is spread over an area of 65,610 sq.km. The Sri Lankan coast line has an estimated length of 1340 km. Appendix 3 presents the geographical location of Sri Lanka. The annual normal rainfall of Sri Lanka is more than 300 cm in the south western parts and reaches up to more than 500 cm in some of the interior hill stations. The northwestern coastal region is the driest, receiving annual rainfall of less than 125 cm with one coastal stretch receiving less than 100 cm. Appendix 4 presents the spatial distribution of annual normal rainfall of Sri Lanka.

The major coastal weather hazards which affect Sri Lanka could be listed as under:

- a. Cyclonic storms (CS) which form and move over BoB. Heavy rainfall, strong squally winds and storm surge are the disastrous features associated with a CS land fall.
- b. Strong winds along the coast both on shore and off shore.
- c. Rough seas, high waves, swells closer to the coast.
- d. Heavy rainfall associated with weather features such as monsoon
- e. Tsunami waves (not strictly a weather event but ocean generated)

The EWS for coastal multi hazard existing in Sri Lanka maintained by the DoM, Sri Lanka is given below:

a. No of Surface meteorological observatories	-	23
No of coastal observatories (out of the 23)	-	11
b. Total No. of rain gauges from which daily rainfall data is received on real time mode	-	80+23
No. of rain gauges from which rainfall data is received in delayed mode	-	170
c. No. of Automatic Weather Stations/Raingauges	-	37
d. No. of Radiosonde / Radio wind Station (At Colombo, 3 observations per week)	-	1
e. No. of Pilot Balloon observatories	-	4
f. No. of S/C/X band weather radars installed over the Coastal region	-	Nil

Appendix 5 presents the spatial distribution of the observatory network maintained by DoM, Sri Lanka.

DoM of Sri Lanka receives International meteorological data through GTS. Satellite weather pictures are received from INSAT, Meteosat and from Korean satellites through internet. Fax, email and telephone communications provide the backup. Dedicated fax lines and SMS system exist to receive Tsunami and cyclone warnings. All coastal hazards warnings are handled by only one warning centre, which is the early warning centre, DoM. The warning centres function round the clock throughout the year. The DoM is also running WRF models and generating forecasts based on Numerical weather prediction models. The website of DoM, Sri Lanka which is [www.meteo.gov.lk](http://www.meteo.gov.lk) is found to be very basic and not detailed. The home page has links for warnings for Cyclone, Heavy rainfall, Squally winds and Tsunami.

For cyclone warning, DoM, apart from their own warning services also depend upon the advisory bulletins issued by Regional Specialised Meteorological Centre (RSMC), functioning from India Meteorological Department (IMD), New Delhi and also the JTWC website. The participants from DoM said that only 16 CS affected Sri Lanka in the last 100 years. During the

50 years period 1964-2013, 8 CS crossed Sri Lankan east coast originating over BoB, out of these 8 only 3 reached Severe CS (CS/SCS, wind speed more than 34/48 knots over the sea) intensity. The most recent SCS that crossed Sri Lankan coast was the 23-28 Dec 2000 SCS and subsequent to this there has not been any CS crossing of Sri Lanka till now. Appendix 6 presents the tracks of the 8 CS+SCS which crossed Sri Lankan coast during 1964-2013. As such cyclone warning has not been a major task for the DoM, Sri Lanka, according to the participants from DoM.

However considering the fact that even an SCS which does not cross Sri Lankan coast can still cause severe weather over Sri Lanka and in the nearby sea areas, cyclone warning services of Sri Lanka assume considerable importance and relevance. Tsunami warnings are received from INCOIS (India), JMA, CLSN and also from Australia and Indonesia.

For dissemination of the severe weather warning messages and to take them up to the end user, the DMC or Disaster management Centre of Sri Lanka takes most of the responsibility. Media briefing on weather events and warnings is also carried out by DoM.

A flow diagram depicting EWS of weather hazards affecting Sri Lanka is presented in Appendix 7.

#### *Best practices*

- Adequate surface observatory network
- 24 hours a day, 7 days a week continuous monitoring of data
- Data analysis, prediction and warning generation are continuously improved by updating knowledge and through participation in international and regional training programs.
- Making full use meteorological products available internationally, including the RSMC products and issuing warning bulletins for all coastal hazards.
- Checking of data quality and evaluation of forecasts.
- Holding inter agency discussions to identify and then rectify the deficiencies.

#### *Gaps, needs and Recommendations*

- No weather radar has been installed so far in Sri Lanka.
- Lack of equipment and technical expertise in disaster monitoring using sensors and also data collection and exchange
- More no. of AWS/ARG should be installed in due course
- Only one Radiosonde / Radio wind observatory exists.
- The website is too basic and should be upgraded to provide more products and information than what is available at present.

## **6.2 Hydrology**

### *6.2.1 General*

a. There are around 103 natural streams (Rivers and Streams) in Sri Lanka out of which twenty are the major rivers. Nine rivers are those major rivers which have high flood frequency and are the major source of flood hazard. Most of the rivers drain into the sea causing floods along the coastal belt. There are a number of small and relatively big reservoirs (locally called tanks) built on the rivers. Such tanks number more than 18 thousand and are an important component of Irrigation system of the Sri Lanka. Map showing river network, reservoirs and

tanks is given as Appendix 13. Table indicating the data of river basins and tanks in Sri Lanka is placed at Appendix 14.

*b. Flood Forecast Authority and the Flood forecast methodology*

Irrigation department of Sri Lanka has the mandate to do the flood forecasting in the country in accordance with the flood protection ordinance 1904. The department has established around 35 river gauging stations and more than three hundred rain measuring stations. Meteorological department of Sri Lanka (MDS) has more than three hundred rain stations. Besides the Met and Irrigation departments, Ceylon Electricity Board and Mohawali river authority also maintain six and ten rain stations respectively. This data is also available for flood forecast.

Flood forecast assessment at present is done on the basis of statistical relations worked out between the upstream and downstream gauge station using the historical data. Attempt is made to use the MIKE (Danish) model also. However most commonly it is the actual gauge station data which is communicated to the user under the flood situation. During the flood season all the 35 river gauges are continuously monitored and whenever any flood level is registered at any river gauge point the flood warning is issued which indicates the actual and future (forecast) trend in general terms. Specimen of flood warning/ flood notice is given as Appendixes 15, 16 and 17.

In assessing the future flood situation verbal discussions are made with the Meteorological department regarding the forecast & future weather situation. On account of large variability of the rainfall in such tropical country as Sri Lanka, it is often difficult for the Met office to forecast the next day's precipitation in a given river basin. Consequently in the absence of a reliable rain forecast the future flood forecast is not given quantitatively and only qualitative assessment of the flood in the form of rising / falling trend is made for the various flood levels in such terms as Minor, Medium, Major and Critical.

*c. Dissemination of the flood forecast/warnings*

Flood forecasts are communicated by the Irrigation departments to the Disaster Management Committee (DMC), Met department and the media. DMC is responsible to convey the flood warnings to all the related private and Government organizations & agencies.

### *6.2.2 Good practices*

- Irrigation department maintains hourly observational watch for 35 rain gauge stations for continuous monitoring of the flood situation.
- Post flood studies are conducted using MIKE-II model. This is a good practice since it helps to calibrate the model for real time flood forecasting for future and also provides some greater insight into the flood problems relating to the rivers in Sri Lanka.
- Rating curves have been prepared for all the 35 river gauge stations. This enables the computation of discharge data over these river locations.
- Dams & reservoirs are inspected regularly for which SOP for the Dams exists and is being practiced.
- Flood plan inundation maps for Colombo region are being created based upon the last major flood that affected Colombo during the year 1989. The risk maps for the four river based upon 89 flood have been completed.
- Reservoir data is regularly collected by water management branch of the Irrigation department for about 330, small, medium and large storages including 80 reservoirs.

- To indicate the intensity of the flood wave, the qualitative flood forecast in the easily understandable terms as minor, medium, major and critical is given.
- In case of impending floods attempt is made to draw down the water level in the major reservoirs as a flood mitigation measure. On the seasonal basis also water level in the reservoir is reduced prior to the onset of the flood season.

### 6.2.3 Gaps and needs

*Gaps:* Flood forecast/ warnings are issued by the Irrigation department which is located in another building away from the Met department. Thus no regular and continuous contact is maintained between the two organizations. Even the dedicated telephone link is not available. Quite often the irrigation department gets the met information from web of met department. This stands the risk of Irrigation department losing vital flood information or receiving the information with delay from the met department in case of a real big flood emergency. Floods being the most common and most disastrous natural hazard in Sri Lanka, close and continuous contact is maintained with the Met department.

*Needs:* There is a need that the Irrigation department remains in close contact with the Met department and in case the Meteorological situation indicates the possibility of floods, the Met department immediately informs the Irrigation department and holds a verbal discussion with them. Since in tropical countries like Sri Lanka, it is hard to forecast the rain much in advance, a strong vigilance in close monitoring of the rain situation is necessary by the Irrigation department to enable the timely issuance of flood forecast.

#### *Recommendation*

Flood forecasting unit of the Irrigation department may be housed within the Met department building and all the real time river and rain data receiving network shifted in the Met department building or else the flood forecasting may be placed under the Met department as is the case in large number of tropical countries (including Pakistan).

- No (advance) forecast of the flood is made for the upper riparians. Only the actual data of the upstream points on the river is obtained on the basis of which some forecast for the lower river reaches is made. There is a need to increase the forecast lead time by making flood forecast for the upper river reaches using the forecast rainfall.
- There is a need to forecast flash floods also. However this calls for the installation of weather (C or S band) radar which is presently not available.
- No floodplain zoning is either practiced or even planned. There is a need to have some legislation to keep the floodplain of at least the major rivers clear from settlements etc to reduce damage to the life & property.
- No pre-flood releases from the smaller dams is done to reduce the downstream during floods as a flood mitigation measure.

## 7. Standard Operating Procedures

### 7.1 Meteorology /SOP

#### 7.1.1 Web site of Dom, Sri Lanka

The website of Sri Lanka [www.meteo.gov.lk](http://www.meteo.gov.lk) is available in the 3 national languages of Sri Lanka viz. Sinhalese, Tamil and English. It contains links for warnings which include severe

weather, cyclone and tsunami. The severe weather forecasts include warning for heavy rain and strong wind.

### *7.1.2 SOP for cyclone warning and dissemination*

The existing SOPs of cyclone warning as provided by DoM are as under

- a. An SOP for cyclone warning running into just under 2 pages
- b. Another SOP for disaster warning but mainly dealing with cyclones, one page in tabular form
- c. Another SOP in pictorial form with colour coding

The above are presented in Appendix 8 (a, b, and c)

SOP given in a. above is very generic and is far from specific, SOP given in b. above is a bit vague, it says SOP for disasters but describes cyclone SOP only but includes colour coding. The 40 knots threshold which is used does not conform to the international practices followed by most of the other panel countries. The warning criteria described in (c) above uses the concept of distance from the island which is again not found in the SOP for TCs as available in WMO publications.

The DoM, Sri Lanka does not follow any port warning procedures, as briefed by the participants from DoM, though port warning procedures are an integral part of SOP on cyclone warning as detailed in the WMO publication TD 84, TCP 21, 2013 edition, which describes the cyclone warning procedures followed by all the panel countries. That DoM, Sri Lanka does not follow the standard port warning procedure is surprising considering that it has a long coast line and several ports. Even if a depression forms over BoB which is a frequent occurrence, port warning DC1, which is distant cautionary Signal No.1, should be issued even if the low pressure system stands little chance of striking the Sri Lankan coast. Appendix 9 presents the port warning procedure and signals currently in use in most of the Asian countries.

Regarding dissemination, the Disaster management centre or DMC, Sri Lanka is the responsible agency for dissemination at all levels. Warnings for fishing community are disseminated through Department of fisheries. However SOP for fisheries warning was not provided to the consultants.

The DMC, Irrigation Department which is responsible for flood warning and the fisheries department all have their internal SOPs as briefed by the participants from these departments.

### *7.1.3 Requirements for a comprehensive cyclone warning SOP*

The SOP for cyclone warning as followed by DoM&H Sri Lanka is not fully documented. A robust SOP for cyclone warning must cover the following aspects.

- a. Stage warning of CSs, Alert, Pre-warning, warning and de-warning. The various categorisation of CS should preferably follow international/ regional practices.
- b. The frequency of warning messages should be clearly defined. It could be of 6 hours duration in the alert stage, 3 hours in the later stages and 1 hr when the CS approaches the coast.
- c. Each bulletin for a specific CS should be serially numbered. The current bulletin should clearly mention the Serial no, date and time of issue, the name of the CS, to whom bulletin is addressed and when the next bulletin would be issued.

- d. Technically the bulletin should contain details such as the intensity of the CS, the wind strength, the likely time of land fall, the likely extent of damage that will be caused at the time of land fall to coastal and interior regions and also the extent of storm surge.
- e. As coastal observations play a crucial part in tracking a CS when it approaches the coast, the frequency of coastal observations should be increased; normally it could be one observation per hour. This should be included in the SOP.
- f. A list of people who receive warnings with all contact details such as telephone, fax no., mobile no., email addresses should be available.
- g. The SOP should also include warnings for fisherman, shipping and also for ports. Detailed Standardised Port Warning procedures which include the type of signals to be hoisted are already available (Appendix 9).
- h. If the warning messages are to be delivered to a Disaster Management Centre of the Government, which would be responsible for further dissemination to end users same should be clearly stated in the SOP.
- i. Once the CS has made land fall, a post landfall survey team of the DoM should immediately proceed to the affected coastal region. The team should take photographs of the damage and also collect data of several features which can provide crucial data on the exact location of land fall and damages caused. The height of storm surge also can be estimated by such a survey. A detailed SOP for the procedures to be followed during post land fall survey should also be included in the cyclone SOP.
- j. A detailed report on the CS should be prepared shortly after its landfall and dissipation. Its genesis, track, intensity during its life, place of land fall, lowest pressure of the TC, maximum wind sustained, satellite pictures, actual track, forecast track, forecast error, pictures of damages suffered, storm surge realised are some of the aspects which must be included in the report.
- k. The SOP for TC warning should also include warning in respect of specialised areas such as agriculture, horticulture and aviation.
- l. In the dissemination of messages Radio, TV and SMS dissemination could play a vital role in ensuring the '*Last Mile Connectivity*'.
- m. It is possible that TV, telephone and SMS might fail in the event of failure of land line communication in the affected area. Battery powered radios can easily work if the transmitter is located in an interior region not likely to be affected by the TC. SOP should describe standby fail safe communication and dissemination systems.

The above are suggestive but not exhaustive aspects which an SOP for cyclone warning must include.

The World Meteorological Organisation (WMO) s Technical Document, i.e. WMO/TD No.84, Report TCP No.21, 2013, entitled "*Tropical Cyclone Operational Plan for the Bay of Bengal and the Arabian sea*" extensively covers the cyclonic warning procedures, which could be adopted by the panel countries, including Sri Lanka. The cyclone manual published by IMD and updated in 2003 is also quite detailed. IMD has recently (in 2013) published a very detailed SOP for Cyclone warning which though India specific also includes several procedures which could be followed by any panel country.

### 7.1.3 *SOP for Heavy rainfall*

Appendix 10 presents a very brief SOP for Heavy rainfall followed by DoM, Sri Lanka. According to the SOP, moderate rainfall is defined as <100 mm, Heavy rainfall as 100-150 mm,

Very heavy rainfall as >150mm. Presumably the rainfall amounts refer to 24 hours cumulated rainfall of a specific rain gauge station. Colour coding is also available in the SOP. However detailed descriptions and instructions are not included.

#### 7.1.4 *Sea area bulletin*

Sea area bulletins which are available in the website include forecasts for winds along the coast and for rough seas. Specific warnings for fishermen are not included. Appendix 11 presents categorization of strong winds and height of waves over sea areas. When wind speed (over sea) is more than 30 km/hr and gusting to 60 km/hr and wave height exceeds 2 m alert/advisory is issued. When wind speed is above 70 km/hr (gust 100 km/hr) and wave height is more than 4.5 m warning is issued. Colour coding is also available. However a comprehensive SOP is not available.

#### 7.1.5 *Tsunami warning*

Appendix 12 presents the Tsunami warning SOP in tabular form with colour coding. The various levels of warning are information, watch, warning and very severe Tsunami warning. Again a comprehensive SOPs lacking.

#### 7.1.6 *Best practices, Gaps & Needs, Recommendations*

As presented in the proceeding subsections, DoM, Sri Lanka has been rendering early warning services for the coastal hazards that affect Sri Lanka. The dissemination part is also well structured with the DMC taking on substantial responsibility. The warnings are generated and disseminated in a variety of formats which include colour-codings for ease of interpretation by different type of users. Further awareness programs are held at regional and local levels to help build credibility. The SOPs are frequently updated. Almost all the SOPs are available in soft copy formats (i.e. Computer accessible).

However detailed, comprehensive and self-contained SOPs are lacking in respect of most of the severe weather events. That there are no detailed SOPs for cyclone warning and that port warning procedures are not included is also a major gap in the SOP setup.

In respect of cyclone warning WMO (2013) which is the recent updated version provides substantial information. IMD (2013) also has come out with an updated comprehensive SOP for cyclone warning. DoM Sri Lanka should try to prepare comprehensive and detailed SOPs for the various multi hazards affecting the coastal region of Sri Lanka. The SSOP manual which will be prepared should also address all these gaps found in the present SOPs in operation by DoM and by including detailed SOPs with easy customisation options for use by a specific country.

## 7.2 **SOP/HYDROLOGY**

There are two flood related SOPs in use at the moment.

- a. The River flood SOP
- b. The Dam Breach SOP

The two SOP'S have each three parts relating to before, during and after the flood hazard occurrence. SOP's are given at Appendix 18-20 and 21-23 respectively. The SOP's provide for the actions to be taken by the Irrigation department before, during and after the flood hazard, SOP's are quite logical, but are very brief and general.

### *Gaps and needs*

- SOP for floods and dam breach are not very specific and need to be more comprehensive in assigning the roles and responsibilities at all levels during all the three phases of flood hazard.

Furthermore there is need to have a consolidated SOP which should enable the coordination of the action and the activities of the various flood related organizations. This should include action to be taken prior to and after the flood season to ensure the safety of the dams and the other river protection works. Presently some regular reports are called for by the Director Irrigation but no laid down schedule is provided in the SOP for the pre flood actions. Similarly the actions to be taken by the river related agencies for the restoration of the river system after the major floods is not clearly laid down in the present SOP's

- Due to the absence of SOP to ensure the coordination between the various river related agencies regarding actions to be taken in case of flood hazards. Presently the small dams are not operated with due consideration to the prevailing flood situation. Consequently the small dams do not play any effective role in the flood mitigation process.

## **7.3 SOP/DRR**

### *7.3.1 General*

As a part of the SSOP Mission meetings both combined as well as separate were held with all relevant stakeholders which mainly included representatives from DMC, NBRO, Department of Irrigation, Department of Fisheries, Sri Lankan Police, Sri Lanka Arm, Sri Lankan Navy, Sri Lankan Air Force, Department of Coast Guards, Health Early Warning Centre, Sri Lanka Red Cross Society and Media. All relevant issues were shared by the participants. Representatives of Sri Lankan Armed Forces showed special interest in discussing the response system put in place by the Disaster Management Centre/Ministry of Disaster Management.

### *7.3.2 Disaster Risk Reduction*

Over the past few decades, disaster losses in Sri Lanka have increased substantially. The country is prone to natural disasters caused by floods, cyclones, landslides, drought and coastal erosion with increasing instances of environmental pollution related hazards. The devastation caused by the Indian Ocean tsunami of 2004 has highlighted that Sri Lanka is also vulnerable to low-frequency, high impact events which cause extensive damage and reverse years of development gains.

The Government of Sri Lanka has taken significant steps towards strengthening legislative and institutional arrangements for disaster risk management. The Sri Lankan Parliament Select Committee on Natural Disaster, a bi-partisan committee, was constituted to deliberate on issues relating to the status of disaster management in Sri Lanka. The Committee's recommendations towards achieving a safer Sri Lanka have subsequently guided legislative and policy efforts in this regard.

In May 2005, the Sri Lankan Disaster Management Act was enacted which provides the legal basis for instituting a Disaster Risk Management (DRM) system in the country. The Act establishes the National Council for Disaster Management Council (NCDM) and the Disaster Management Centre (DMC). The NCDM chaired by the President, vice-chaired by the Prime

Minister with participation of the Leader of Opposition, Ministers, Provincial Council Chief Ministers and five members of the Opposition, provided direction to DRM in the country. In November 2005, Ministry of Disaster Management (MoDM) was established under the Prime Minister. In January 2006, Ministry of Disaster Management and Human Rights (M/DM&HR) was created as a separate Ministry with NCDM and DMC gazette under its purview. It has been accorded the lead role in directing the strategic planning process for disaster prevention, mitigation, response and recovery.

After the tsunami, the need to coordinate efforts of various government agencies and the offers of support by international agencies in the area of DRM both for natural and human-made disasters has been recognized. The DMC has prepared a framework to identify and coordinate multi stakeholder efforts in the next 10 years through a holistic strategy or 'Road Map' towards building a safer Sri Lanka. Consultations with provincial and district administrations of Hambantota, Ampara and Kandy have gone towards enriching the various proposals presented. This Road Map is focused on seven thematic components which are consistent with ongoing and past efforts in the field of disaster risk management and development planning, and as in the Hyogo Framework of Action 2005-2015:

- Policy, Institutional Mandates and Institutional Development;
- Hazard, Vulnerability and Risk Assessment;
- Tsunami & Multi-hazard Early Warning Systems;
- Preparedness and Response Plans;
- Mitigation and Integration of DRR into Development Planning;
- Community Based Disaster Risk Management;
- Public Awareness, Education & Training

The DRR Road Map has seven thematic areas. These include:

- a. Policy, Institutional Mandates, and Institutional Development including components like preparation of a national disaster management plan, national policy for DM, a national emergency response plan, reviewing, formalizing mandates and identifying capacity development needs of agencies to perform their DM functions as well as steps to implement policies already in place.
- b. Hazard, Vulnerability and Risk Assessment comprising activities ranging from flood simulation modeling in key river basins to the development of a vulnerability atlas for Sri Lanka. This will enable development planning which is sensitive to multiple hazards and different kinds of vulnerabilities.
- c. Tsunami and Multi-hazard Early Warning System incorporating elements to generate advance warnings for floods, cyclones, abnormal rainfall, droughts, landslides, thus enabling decision-makers to take necessary measures well before the occurrence of a disaster.
- d. Mitigation and Integration of DRR into Development Planning encompassing activities relating to reducing impacts of droughts, preventing floods and landslides, and providing protection against storm surge, sea and coastal flooding by incorporating disaster risk considerations into development plans, thus ensuring sustainable development.
- e. CBDRM involving activities that recognize the fact that the communities, even when affected, are still the first line of defence against if they are well prepared. Interventions proposed include mobilization of community teams, creation of a local network of trained volunteers and establishment of resource centres and small grants to fund priority projects by community teams.

- f. Preparedness and Response Plans to minimize the adverse impacts of a hazard through effective precautionary actions and timely, adequate responses. Prioritized activities include development of a national emergency preparedness and response plan, and establishment of emergency operation centres at national, provincial, district and local authority levels
- g. Public Awareness, Education, Training focusing on empowering the public with ways and means to reduce disaster losses, and includes a national awareness campaign, promoting disaster awareness among professional through integration in university curricula and training, and among children through integration in school curriculum and school awareness programs.

### *7.3.3 Good Practices*

- 25 district level officers working in the districts directly connected with DMC and represent DMC presence at the district level.
- 55 Search & Rescue Teams (with 25 minimum staff per team).
- 25 districts with maximum 13 and minimum 5 staff per district for disaster management.
- Dialog, VHF/HF, Microwave USGS System, Big Operation Room with LCDs under the control DMC.
- 25 acres land being procured for the construction of NIDM
- Sri Lanka Government is providing funds for DRR and NIDM to show its ownership.
- Dialog-Mass Alert Disaster Emergency Warning Network connected with 5000 community people for activities on ground as first responders and disaster warning disseminators.
- TV & Radio Channel- Derana Multifaceted news channel. Have the largest sms. Media says we get more info from Met Department. Have experience of working in the disaster situations.

### *Gaps*

- Agriculture warning is needed
- Brief SOPs given. No more available
- Gaps in TC warning SOPs (No DRR personal was present, DRR interaction on ground not discussed)
- Brief SOPs shared but not provided.
- Not everything has been put in writing. To whom the warning to be communicated, to whom we need to link up with the last mile on ground
- Port warning is very important. Port warning and SOPs are missing
- There are no SOPs for implementing backup systems, office evacuation, calling in extra personnel etc.

### *Needs*

- Central dissemination of information should be only one
- Format for message are important. Form should include appropriate clause.
- Agriculture warning and related SOPs are needed
- Heavy rainfall warning should be given. SOPs need to be prepared in writing
- SOPs for handling different coastal hazards should be prepared at the national, provincial and district/local level
- SOPs describing how the different centres will coordinate actions in a multi-hazard

situation needs to be prepared

- National and Regional Centres should be networked for effective data collection, utilization and dissemination. For that matter requisite networking equipment should be provided
- SOPs for the process of real time sharing and availability of data collected should be prepared
- There are no established and mandated by law standardized processes, and roles and responsibilities of all organizations generating and issuing warnings. Specific SOPs needed
- SOPs on sharing of risk assessment data need a consideration.
- SOPs are needed to build the credibility and trust in warnings with reference to understanding difference between forecasts and warnings.
- Steps in the form of SOPs are needed to minimize false alarms to improve communication to maintain trust in the warning system
- Media related SOPs should be there

### **Based on discussions with reps of Armed Forces following transpired:**

#### *Lessons Learned*

- Use of military persons in DRM task is more effective and efficient with high return of investments.
- First responder – Army – in any situation
- First responder – Army – All areas due to their military training.
- Controlling of general public in disasters
- Still the general public as well as the down level representative of DRM coordinators in the field have not realized the boundaries and limitations of the military in a disaster situation. Especially this condition becomes worse as the responsibilities of the individual are not properly defined.

#### *Present Situation*

- Training programs can be arranged to impart proper training on DRM, thereby getting maximum outcome from military personnel
- Close supervision and guidance are intensively required.

#### *Gaps*

- Army does not have sophisticated equipment and specified trained live ware for each and every task.
- It thus will slow down the process
- Acquisition of avant-garde equipment and getting specified training professional knowledge from professional instructors for DRM tasks will enhance the adeptness and accuracy.
- With the prevailing development and other dedicated tasks assigned, Army is not able to deploy trained military men at all times. Therefore, training within the resp. Battalions will help to lessen the gap.

#### *Conclusion*

- Army's major role in 2004 tsunami

- Special training on relief tasks
- Short fall of ultra – modern equipment have squandered human resources capacities of the Army.

*Suggestions*

- Suggested to have a centralized and National Training School for disaster relief training
- It is proposed to install permanent divisional equipment centers for each AGA division under the direct supervision of DMC to facilitate the disaster relief teams / DRM teams which operate in the same area.
- The centers must be fortified with the equipment which may be required in disaster relief work specific to the area.  
(Refer to Appendix 24).



Sri Lankan Department of Meteorology – Rain Gauges of different types

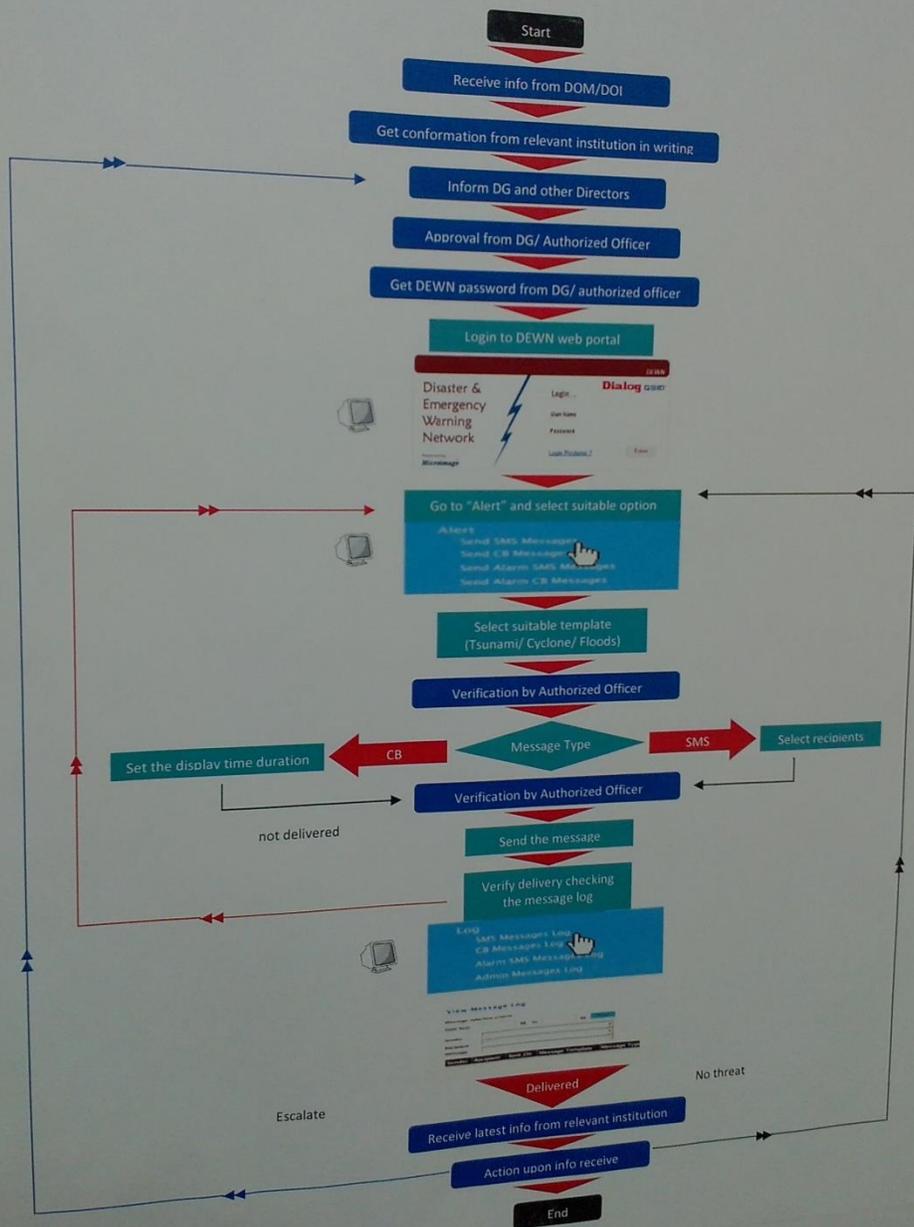


HF/VHF-Radio Communication Network for DMC



**Early Warning Towers and Repeaters For Real Time Warning Dissemination - DMC**

# DEWN OPERATION FLOW CHART



Disaster Early Warning Network (DEWN) Operation Flow Chart – DMC



**Sri Lanka's First Mass Alert Disaster Emergency Warning Network**



**Disaster Operation Cell – DMC**



**Disaster Operation Cell – DMC**



Detailed Interactive Session With Reps from Armed Forces, Coast Guards etc.



Interaction with Media

## **8. Conclusions**

The purpose of the workshop was to review existing coastal multi-hazards EWS SOPs of hydro-meteorological service, disaster management, media, elected official, and others from national to district to local levels; identified best practices, gaps and needs, and recommendations for internal and cross-cutting SOPs; and then to compile data, information, examples, and diagrams collected on SOPs best practices, gaps and needs, and recommendations for inclusion in the Manual on Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazard Early Warning System which will meet the needs of the 13 beneficiary countries involved in the Project. These purposes have been met and were described above.

Now the challenge is to take the information from these six missions and develop a Manual/Handbook of Synergized Standard Operating Procedures for Coastal Multi-hazards Early Warning Systems focusing on the hydro-meteorological aspects to meet the needs of diverse users and to create a Manual that can and will be used. This development will be done in collaboration and coordination with the five consultants, the beneficiary countries, the Task Force, the TC Advisory Working Group, and 7 partner organizations. This Manual/Handbook will then form the foundation for the training and working meeting scheduled under Activity 2 of the project.

## **List of Appendixes**

### **Common**

- 1a. Originally planned schedule of meets for Days 1 & 2
- 1b. Slightly modified schedule as drafted for Sri Lanka
2. List of participants

### **Met**

3. Geographical location of Sri Lanka
4. Spatial distribution of annual normal rainfall of Sri Lanka.
5. Tracks of cyclonic storms that crossed Sri Lankan east coast during the 50 years period 1964-2013 (source: Cyclone eAtlas, IMD)
6. Spatial distribution of the observatory network maintained by DoM, Sri Lanka
7. EWS dissemination in Sri Lanka – Flow chart
- 8a. SOP for cyclone warning
- 8b. SOP for disasters
- 8c. SOP for alert levels and warning criteria of cyclones
9. SOP for port warning
10. SOP for Heavy rainfall – diagram
11. SOP for warnings for wind and waves over sea – diagram
12. SOP for Tsunami warnings

### **Hydro**

13. Surface water - Sri Lanka
14. River basins and tanks in Sri Lanka
15. Flood Warning (1)
16. Flood Warning (2)
17. Notice on Flood dated 2011-05-29
18. SOP – before river flood (1)
19. SOP - river flood (2)
20. SOP – Reversing flood
21. SOP – before dam breach
22. SOP – during dam breach
23. SOP – after dam breach

## **DRR**

24. Military empowered DM model

### **References & Bibliography (Met)**

WMO, TD No.84, TCP 21, Tropical cyclone operational plan for the Bay of Bengal and the Arabian Sea, 2013 edition, 106p.

India Met. Dept., 2003, Cyclone manual, 469p

India Met Dept., 2013, Cyclone warning in India, Standard Operation procedure, 204p

### **List of Appendixes (General)**

Appendix IA Guide to Writing Effective SOPs

Appendix II Checklist for Effective SOPs for EWS

Appendix III Information on Early Warning System Overview

Appendix IV Early Warning System Checklist Items

Appendix V General Basic Information on EWS for NHMS, Warnings, Communications, and Relationships

**Appendix 1a (p28-31)**

**Consultants Visits for the Synergized Standard Operating Procedures (SSOPs)  
Sri Lanka – 7-8 August 2014**

<b>SSOPs Schedule</b>			
<b>Time</b>	<b>Activity</b>	<b>Participants</b>	<b>Venue</b>
<b>Day 1</b>			
08:30 – 09:00	<b>Registration</b>		
09:00 – 09:40	Introduction to the SSOP Project	Consultants and All Participants	DMH
09:40 – 09:50	Questions/Discussion of Overall Project	Consultants and All Participants	DMH
09:50 – 10:00	<b>Coffee Break</b>		
10:00 – 12:00	<b>Parallel Meetings I (2 Groups)</b>		
	<p><b>Group -1</b>            These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify specific existing coastal related MOUs/SOPs which could be synergized.</li> <li>2. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>4. Collect recommendations for SSOP Manual.</li> </ol>	Meteorological and Hydrological Consultants and Warning Services Participants (Met/Hydro/Seismo)	DMH
	<p><b>Group-2</b>            These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify specific existing coastal related MOUs/SOPs which could be synergized.</li> <li>2. Identify existing coastal MOUs/SOPs which need improvement.</li> </ol>	DRR Consultant and DRR Participants	DMH

	<p>3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</p> <p>4. Collect recommendations for the SSOP Manual.</p>		
12:00 – 13:00	<b>Lunch Break</b>		
13:00 – 14:40	<b>Continue Parallel Meeting I</b>		
14:40 – 15:00	<b>Coffee Break</b>		
15:00 – 17:00	<b>Parallel Meetings II (2 Groups)</b>		
	<p><b>Group -1</b>  These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify what the district and local different agencies need and when, for both short notice events like tsunami or longer notice events like a tropical cyclone.</li> <li>2. A focused discussions and identifying especially what is needed to get information/warnings to the “last kilometer” and how to receive information back from this level.</li> <li>3. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized.</li> <li>4. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>5. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>6. Collect recommendations for the SSOP Manual.</li> </ol>	<p>Hydrological and DRR Consultants and Decision Makers participants. (Warning services representatives are encourage to attend but only as observers)</p>	DMH
	<p><b>Group-2</b>  These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify what the media needs and</li> </ol>	<p>Meteorological Consultant and Media participants. (Warning services representatives are encourage to attend but only as observers)</p>	DMH

	<p>when, for both short notice events like tsunami or longer notice events like a tropical cyclone.</p> <ol style="list-style-type: none"> <li>2. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized.</li> <li>3. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>4. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>5. Collect recommendations for the SSOP Manual.</li> </ol>		
<b>Day 2</b>			
09:00 – 10:20	<b>Discussion with District and Local Representatives</b>		
	<p>These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify what the district and local different agencies need and when, for both short notice events like tsunami or longer notice events like a tropical cyclone.</li> <li>2. A focused discussions and identifying especially what is needed to get information/warnings to the “last kilometer” and how to receive information back from this level.</li> <li>3. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized.</li> <li>4. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>5. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>6. Collect recommendations for the SSOP Manual.</li> </ol>	<p>Meteorological, Hydrological and DRR Consultants and District and Local Representatives. (Warning services representatives are encourage to attend but only as observers)</p>	DMH
10:20 – 10:40	<b><i>Coffee Break</i></b>		
10:40 – 12:00	<b>Continued Discussion</b>		
12:00 – 13:00	<b><i>Lunch Break</i></b>		

<b>Combined Meeting Present Results and to Seek Solutions Needed for SSOP Manual</b>			
13:00 – 13:15	Summary of Parallel National Meteorological / Hydrological/ Tsunami Warning Services	Meteorological and Hydrological Consultants lead and all participants	DMH
13:15 – 13:30	Summary of Parallel Disaster Risk Reduction Management Offices	DRR Consultant lead and all participants	DMH
13:30 – 13:45	Summary of Parallel Decision Makers – Government Officials and Others	Hydrological and DRR Consultants lead and all participants	DMH
13:45 – 14:00	Summary of Parallel Media	Meteorological Consultant lead and all participants	DMH
14:00 – 14:15	Summary of District and Local Representatives	Meteorological, Hydrological, and DRR Consultants lead and all participants	DMH
14:15 – 14:35	<b><i>Coffee Break</i></b>		
14:35 – 16:30	Discussion of the integration, collaboration, and coordination needed by the five areas discussed. 1. Focus discussion on what is needed and how the SSOP Manual can help fulfill the needs. 2. What does the SSOP need to contain. 3. Recommendations for SSOP Manual	Meteorological, Hydrological, and DRR Consultants lead and moderate and all participants	DMH
16:30 – 17:00	1. Summary of the meeting and results 2. Final comments by participants	Meteorological, Hydrological, and DRR Consultants and all participants	DMH

## Appendix 1b (p32-33)

### Proposed Meetings Structure:

The meetings will be conducted from 0900 to 1200 and from 1300 to 1700 with an hour for lunch from 1200 to 1300.

Time (min)	Start	End	Meetings	Participants
<b>Day 1</b>				
<b>Combined Kick-off Meeting</b>				
40	09:00	09:40	Introduction to the SSOP Project	Consultants and All Participants
10	09:40	09:50	Questions/Discussion of Overall Project	Consultants and All Participants
10	09:50	10:00	Break – Preparation/Setup for next meetings	Mr. Sam Muchemi
<b>Parallel Meetings 1</b>				
<b>Parallel National Meteorological / Hydrological/ Tsunami Warning Services</b>				
120	10:00	12:00	These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries. 1. Identify specific existing coastal related MOUs/SOPs which could be synergized. 2. Identify existing coastal MOUs/SOPs which need improvement. 3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed 4. Collect recommendations for SSOP Manual.	Meteorological and Hydrological Consultants and Warning Services Participants  1. DOM. 2. DMC 3. Department of Irrigation 4. NBRO
60	12:00	13:00	<b>LUNCH BREAK</b>	
100	13:00	14:40	Continued Discussions-	
20	14:40	15:00	<b>Break to move to next meetings</b>	
<b>Parallel Disaster Risk Reduction Management Offices</b>				
120	10:00	12:00	These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries. 1. Identify specific existing coastal related MOUs/SOPs which could be synergized. 2. Identify existing coastal MOUs/SOPs which need improvement. 3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed 4. Collect recommendations for the SSOP Manual.	DRR Consultant and DRR Participants  1. DMG 2. NBRO 3. Department of Irrigation 4. Department of Fisheries 5. SL Police 6. SL Army 7. SL Navy 8. SL Air force 9. Health Early warning Center 10. SL Red Cross Society
60	12:00	13:00	<b>LUNCH BREAK</b>	
100	13:00	14:40	Continued Discussions	
20	14:40	15:00	<b>Break to move to next meetings</b>	
<b>Parallel Meetings 2</b>				
<b>Parallel Decision Makers – Government Officials and Others</b>				
120	15:00	17:00	These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries. 1. Identify what the decision makers need and when, for both short notice events like tsunami or longer notice events like a tropical cyclone. 2. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized. 2. Identify existing coastal MOUs/SOPs which need improvement. 3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed 4. Collect recommendations for the SSOP Manual.	Hydrological and DRR Consultants and Decision Makers participants. (Warning services representatives are encourage to attend but only as observers)  1. DOM 2. NDRSC 3. District Secretariat/representative
<b>Parallel Media</b>				

120	15:00	17:00	<p>These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify what the media needs and when, for both short notice events like tsunami or longer notice events like a tropical cyclone.</li> <li>2. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized.</li> <li>2. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>4. Collect recommendations for the SSOP Manual.</li> </ol>	<p>Meteorological Consultant and Media participants. (Warning services representatives are encourage to attend but only as observers)</p> <ol style="list-style-type: none"> <li>1. TV</li> <li>2. Radio</li> <li>3. Printed Media</li> <li>4. DOM</li> </ol>
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Time (min)	Start	End	Meetings	Participants
<b>Day 2</b>				
<b>District and Local Representatives</b>				
90	09:00	10:20	<p>These discussions should focus on developing a useful, comprehensive Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning System (SSOP Manual) which will meet the needs of the countries.</p> <ol style="list-style-type: none"> <li>1. Identify what the district and local different agencies need and when, for both short notice events like tsunami or longer notice events like a tropical cyclone.</li> <li>2. A focused discussions and identifying especially what is needed to get information/warnings to the "last kilometer" and how to receive information back from this level.</li> <li>3. Identify any specific coastal related MOUs/SOPs which exist and which could be synergized.</li> <li>2. Identify existing coastal MOUs/SOPs which need improvement.</li> <li>3. Identify specific areas both technical and non-technical where additional coastal related SOPs are needed</li> <li>4. Collect recommendations for the SSOP Manual.</li> </ol>	<p>Meteorological, Hydrological and DRR Consultants and District and Local Representatives. (Warning services representatives are encourage to attend but only as observers)</p> <ol style="list-style-type: none"> <li>1. DMC</li> <li>2. DOM</li> <li>3. District Secretariat/representative</li> </ol>
20	10:20	10:40	<b>Break</b>	
100	10:40	12:00	Continued discussions	
60	12:00	13:00	<b>LUNCH BREAK</b>	
<b>Combined Meeting – Present Results and to Seek Solutions Needed for SSOP Manual</b>				
15	13:00	13:15	Summary of Parallel National Meteorological / Hydrological/ Tsunami Warning Services	Meteorological and Hydrological Consultants lead and all participants
15	13:15	13:30	Summary of Parallel Disaster Risk Reduction Management Offices	DRR Consultant lead and all participants
15	13:30	13:45	Summary of Parallel Decision Makers – Government Officials and Others	Hydrological and DRR-Consultants lead and all participants
15	13:45	14:00	Summary of Parallel Media	Meteorological Consultant lead and all participants
15	14:00	14:15	Summary of District and Local Representatives	Meteorological, Hydrological, and DRR Consultants lead and all participants
20	14:15	14:35	<b>Break</b>	
115	14:35	16:30	<p>Discussion of the integration, collaboration, and coordination needed by the five areas discussed.</p> <ol style="list-style-type: none"> <li>1. Focus discussion on what is needed and how the SSOP Manual can help fulfill the needs.</li> <li>2. What does the SSOP need to contain.</li> <li>3. Recommendations for SSOP Manual</li> </ol>	Meteorological, Hydrological, and DRR Consultants lead and moderate and all participants
30	16:30	17:00	<ol style="list-style-type: none"> <li>1. Summary of the meeting and results</li> <li>2. Final comments by participants</li> </ol>	Meteorological, Hydrological, and DRR Consultants and all participants

Appendix 2 (p34-36)

2014-08-08

Expert Mission to PTC Country of Sri Lanka under the Project of Synergized Standard Operating Procedures (SSOP)  
for Coastal Multi-Hazards Early Warning System, 4<sup>th</sup> August 2014

No.	Region	Name of Participant	Organization/Dept.	Tel. No.	E-mail Address	Signature
1		H.M. H B Herath	DDMCW Colombo	0772297959	ghen@... gmail.com	
2		J. D. Amarasekera	Irr. Dept.	0718676076	jugal@... yahoo.com	
3		D S C Fernando	Sri Lanka Air Force	0719872913	sanathf1125@gmail.com	
4		NSK Dharmasundara	Sri Lanka Air Force	0772229063	sanilakanchana@gmail.com	
5		Dr. Rajapriya Balasuriya	DPRD/ Ministry of Health	0777356305	rajapriya@... yahoo.com	
6		H. Col. Samitha Indrawone	Mil Coord - DM		samitha1@yahoo.com	
7		J. W. S. Pulguttumani	DM	0772130754	tutubika@yahoo.com	
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Expert Mission to PTC Country of Sri Lanka under the Project of Synergized Standard Operating Procedures (SSOP)  
for Coastal Multi-Hazards Early Warning System, 4-5 August 2014

No.	Region	Name of Participant	Organization/Dept.	Tel. No.	E-mail Address	Signature
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12		D.A. Jayasinghe	DOM	0773772780	dayananda.p.hotmail.com	
13		M.D. Dayananda	Dept. of Meteor	0714293358	daya_md7@hotmail.com	
14		A. P. Warnaseery	"	0774368310	rashandhi@yahoo.com	
15		K. Sivabalanam	Imigr DOM	0776854257		
16		Major SDB Dissanayake	Sr Army (Adm)	075583014	dawapriya75@yahoo.com	
17		Shanu Pathirana	DMC	0773952902	shanuk@yahoo.com	
18						

Expert Mission to PTC Country of Sri Lanka under the Project of Synergized Standard Operating Procedures (SSOP)  
for Coastal Multi-Hazards Early Warning System, 7-8 August 2014

No.	Region	Name of Participant	Organization/Dept.	Tel. No.	E-mail Address	Signature
19		S.P.C. Sugeeshan	Irrigation Dept	0718566923	sugeeshwana123@gmail.com	
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21		Dr. Rajapriya Balasuriya	Ministry of Health	0777356305	rajapriya@yahoo.com	
22		Saijith Tharanga	Nethm (radio)	077-6022781	saijitharanga@gmail.com	
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24		M.D. Dayananda	Dept. of Meteorology	0714293358	daya_md7@hotmail.com	
25		KIAMS PREMALAK	"	0714402908	spremalal@yahoo.com	
26		A.C.M. Rodrigo	Dep. of Meteorology	0773846163	acmchanna@gmail.com	
27		Sheela Bannage	Derana (TV)	0773580455		

**Expert Mission to PTC Country of Sri Lanka under the Project of Synergized Standard Operating Procedures (SSOP)  
for Coastal Multi-Hazards Early Warning System, 7-8 August 2014**

No.	Region	Name of Participant	Organization/Dept.	Tel. No.	E-mail Address	Signature
10		V. W. S. Perera	Darc	077 2130954	vakindite@yahoo.com	
11		Shann Pathirana	Darc	077 3437902	shannulka@yahoo.com	
12		SNB Thaldena	DMC GSMB	071 3528751	nilmini.thaldena@gmail.com	
13		H. Col. SMH Sivalingam	FML - EOL	077 2095328	Savitri1@yahoo.com	
14		Eng. K. Sivapalanathan	Irrigation Dept	077 6784251	disirapala@yahoo.com	
15		Disna Mudalige	Daily News (Printed Media)	0719 797652	disnamm@gmail.com	
16		H. D. P. Tisserat	DFAR	0777177794	sdilite20@gmail.com	
17		Haj SOB Dissanayake	SL Army (ARDF)	077 5528014	dewa.priya.75@yahoo.com	
18		NSB/ Bumbala	DMC	077 2 - 320 571	hirza@dmc.gov.lk	

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No.	Region	Name of Participant	Organization/Dept.	Tel. No.	E-mail Address	Signature
19		S. P. C. Sugeeshan	Irrigation Dept	0718566923	sugeeshwara123@gmail.lk	
20		J. D. Amarasekera	Irrig Dept	0718676026	jasethanara@yahoo.com	
21		M. Rajapriya Balasuriya	Ministry of Health	0777 356305	rajapriyab@yahoo.com	
22		Sajith Tharanga	Net FM (radio)	077-6122781	sajiththaranga@gmail.com	
23		A. R. Warnasoori	DCM	0774368220	rashandhira@yahoo.com	
24		M. D. Dayananda	Dept. of Meteorology	0714293358	daya_md7@hotmail.com	
25		K I S P R E M A L A	"	0714402908	spremala@yahoo.com	
26		A. C. M. Rodrigo	Dep. of Meteorology	0773846163	acmchanna@gmail.com	
27		Sheela Bannayya	Derana (TV)	0773520455		

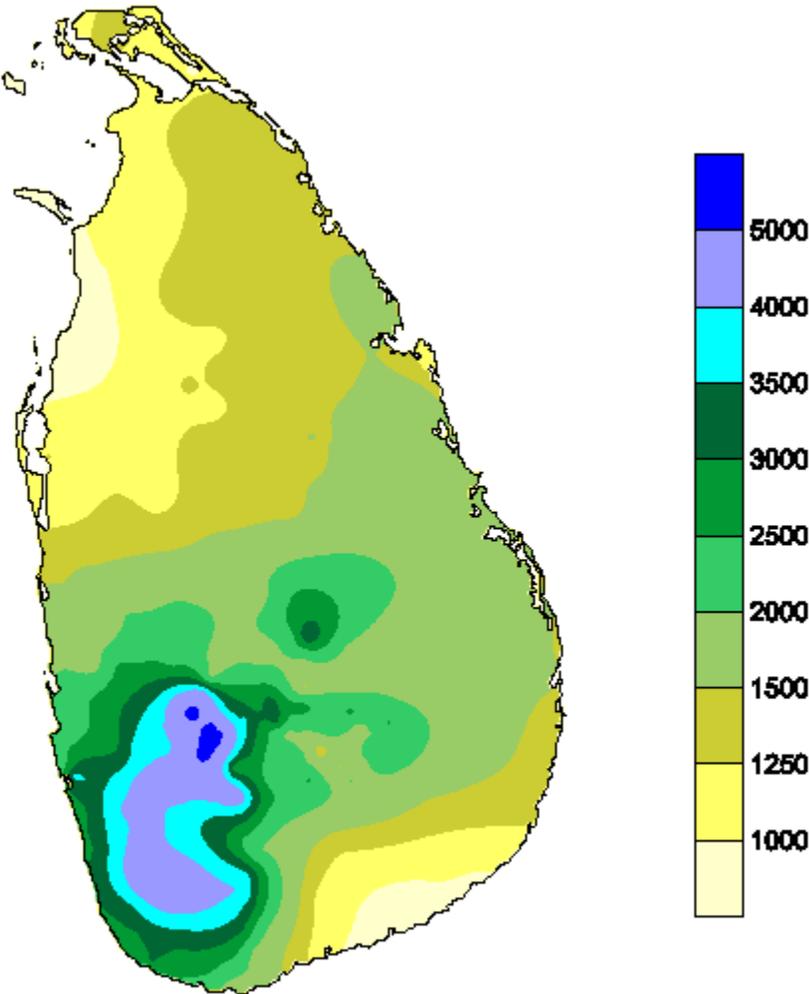
List of participants (Sri Lanka)

### Appendix 3



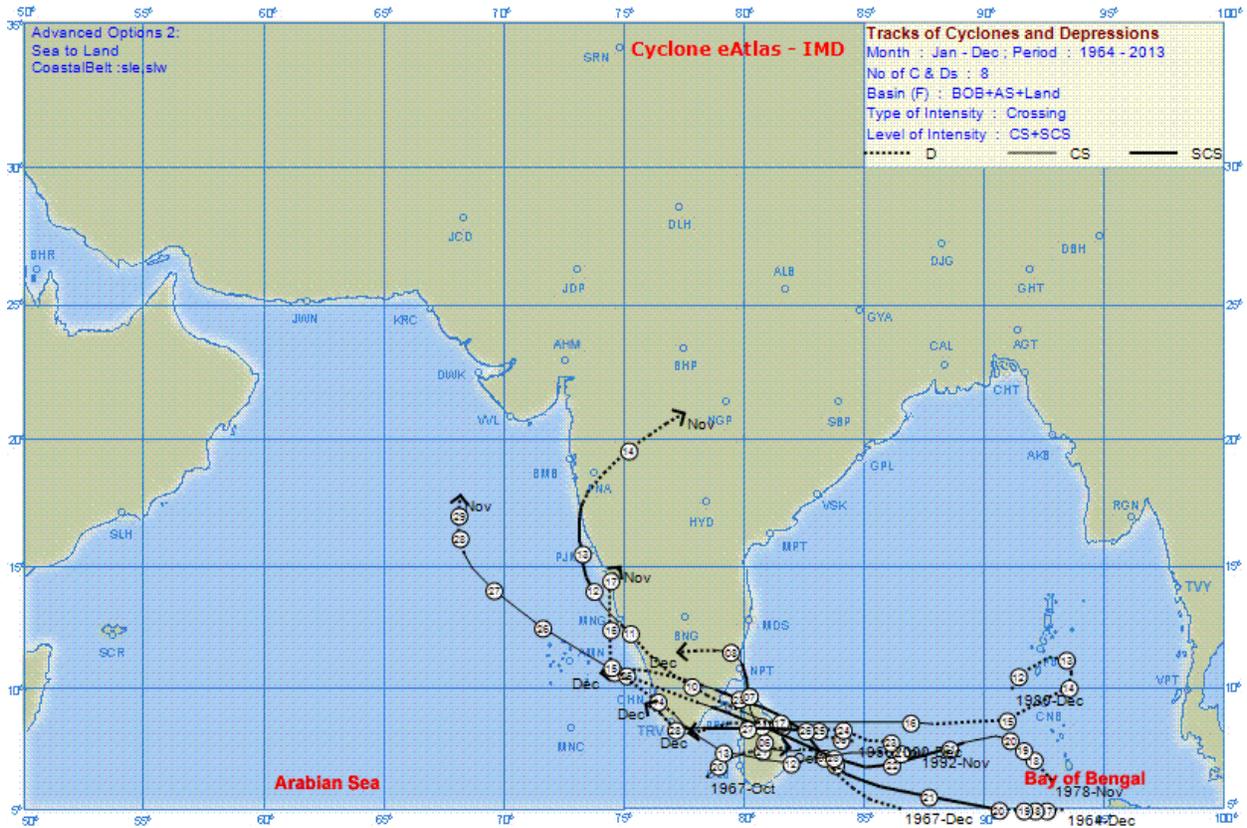
Geographical map of Sri Lanka.

Appendix 4



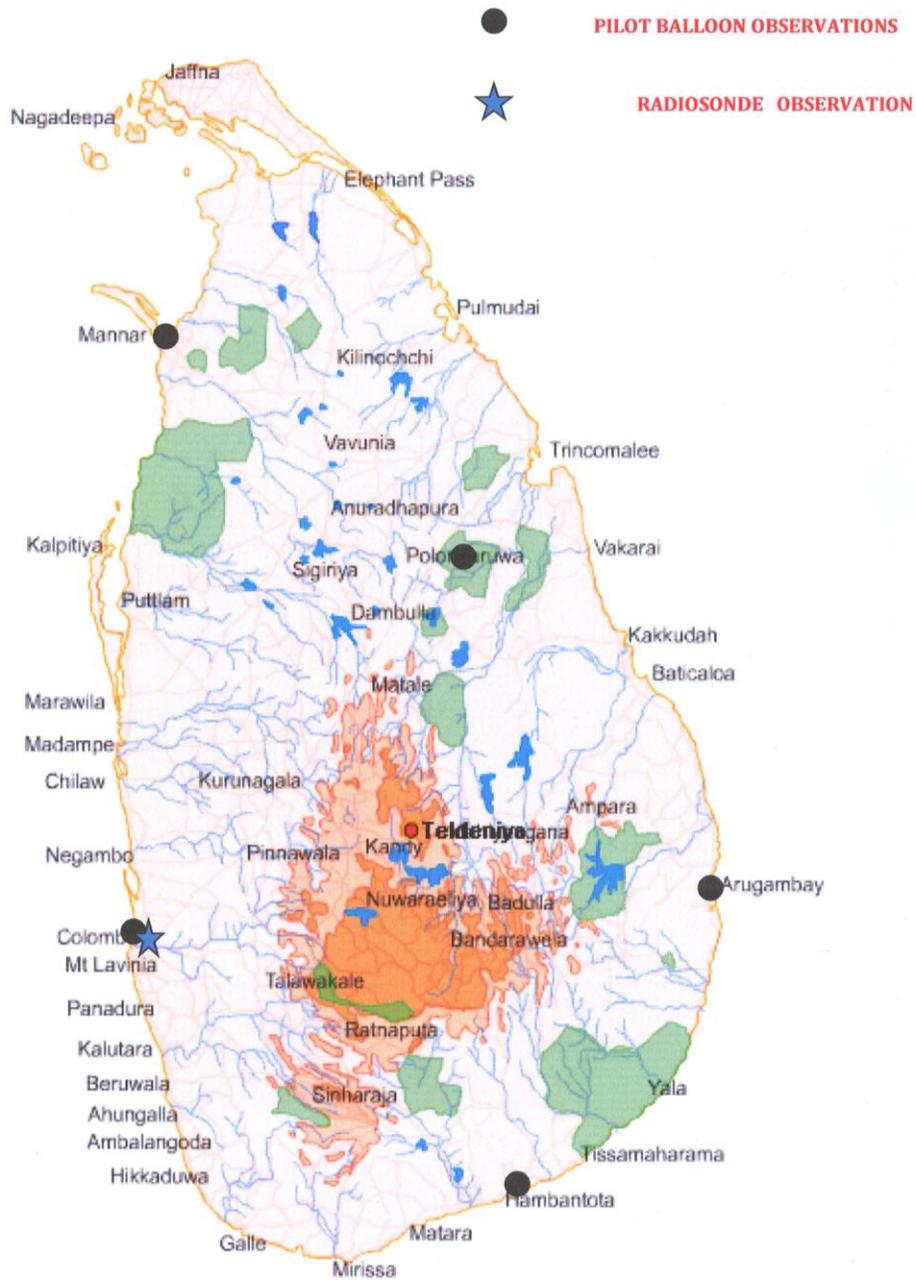
Spatial distribution of normal annual rainfall over Sri Lanka (mm)

## Appendix 5



Tracks of Cyclones / Severe Cyclonic storms that crossed Sri Lankan coasts during the 50 year period 1964-2013 (source: Cyclone eAtlas, IMD)

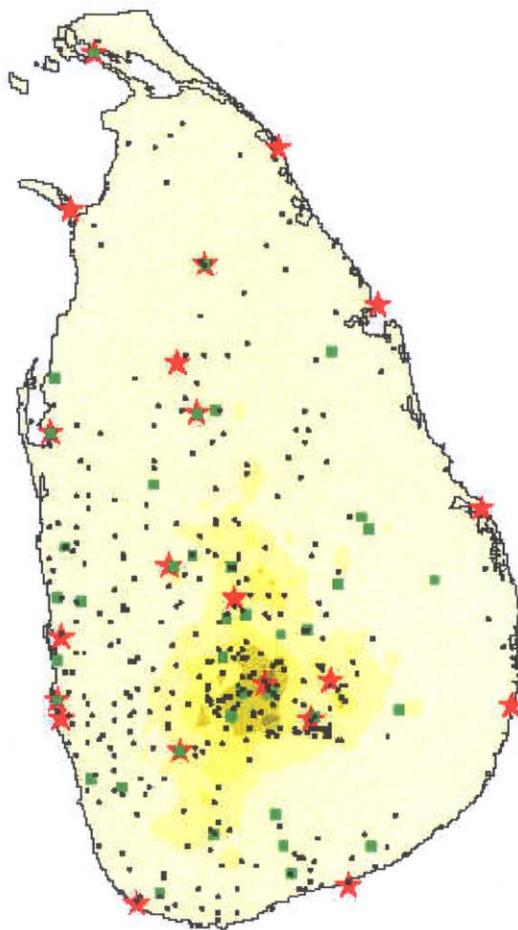
Appendix 6a



Sri Lanka – Meteorological Observational organization.

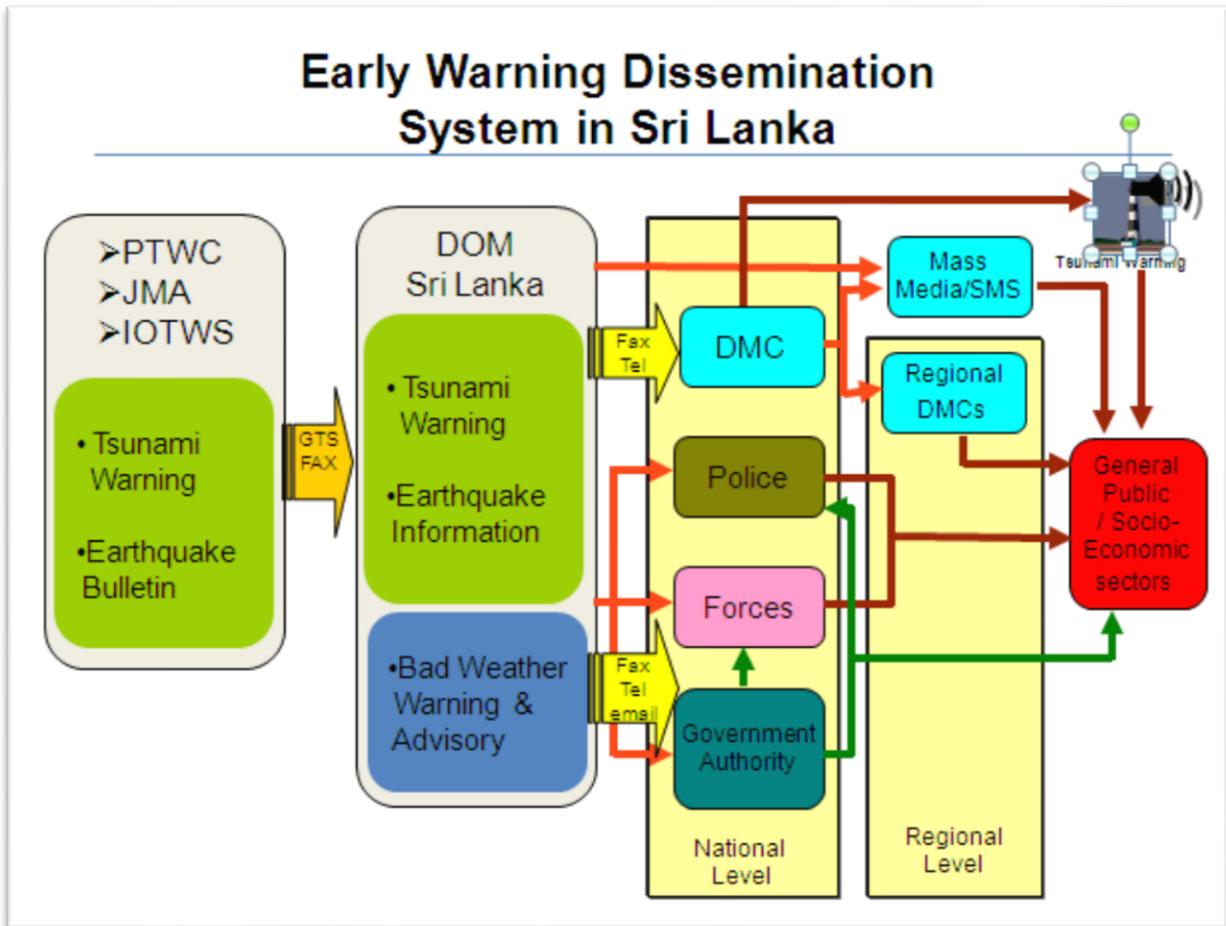
## Appendix 6b

- ★ Principal Meteorological Stations
- Raingauge Stations
- Agrometeorological Stations



Sri Lanka – Meteorological Observational Organisation

Appendix 7



## **Appendix 8a**

### **SOP for Cyclone**

1. Always vigilant about cyclogenesis areas. If found get the available/adequate information about the event and note down. Include in the daily weather summary.
2. If low pressure area is formed include in Shipping Report and Fleet forecast. Note down the Centre and the intensity if possible.
3. Inform DGM and one of MIC, DD ,DM. (He/She should inform the other relevant officers) Get the advice and instruction for immediate action
04. If the system is moving towards the Sri-Lankan area, inform relevant met offices to do hourly METARs-Inform Com to receive the messages and observers to plot.
05. Draw the path of the system. Decide which type of message to be issued after consulting a senior officer (Refer the annex A).
06. Ask somebody to go through the message (Checking).
- 07 Use intra-com to quick transmission of the message to DMC, Irrigation department, NBRO, Police communication, Rupavahini and SLBC.
08. Make three copies of the alert/Warning send two to com, Ask com officers to fax  
To two lists using two fax machine.
09. Give one copy to an observer to inform relevant met offices.
10. Take necessary action to send emails update the Web
11. Continuously check the messages received
12. Refer annex B for further instructions

## **Annex A.**

There are four types of bulletins

1. General information in the forecast –Colour White-If the cyclone is more than 550 kms away from the coast

2. Cyclone alert (Colour- Amber)

Must be used if the Center is 300 kms away and not more than 550 kms-Alert

Should be issued every 12 hours

3. Cyclone Warning (colour-Red)

Must be used

- To upgrade the Watch bulletin

If the Center is 200 kms away and not more than 300 kms-warning should be issued every 6 hours

If the Center is less than 300 kms away -warning should be issued every 3 hours

4. Cancellation-Threat is over (Colour-Green)

- If there is no cyclone threat

## **Annex B**

After the arrival of other officers

Two or three should attend for the quarries – Com officer and observer can be released.

One should check sea level data with Observers, run storm surge model

One should check the IMD bulletins, other web information received

One should attend for web updating

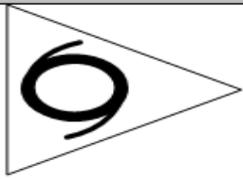
## Appendix 8b

### SOP for Disaster

<b>Signal No.</b>	<b>Colour</b>	<b>Description</b>	<b>Action Required</b>
1	White	Potential area of development of vortex	Information only, vessels at sea to be vigilant
2	White	Cyclone has formed	Information only, vessels t avoid the area, listen to media
3	Orange	Weather experienced in coastal region, sea getting rough	Vessels to avoid area, people to stay away from sea/beach
4	Orange	Raining and windy (~40 knot) sea rough	Stay away from beach, vessels in danger, be inside building
5	Orange	Heavy rain with very strong winds (~>40 knots)	Be ready to leave buildings with weak structures (in relevant areas only) and low line (flood prone) areas, secure your home/valuables
6	Red	Heavy rain with very strong winds >40 knots, cyclone expected to cross land	Evacuate to pre designated safe places
7	Red	Severe weather with very strong winds (> 50 knots), severe cyclone expected to cross land	Evacuate to pre designated safe places.
0	Green	Cyclone Warning Cancellation/Withdrawal Bulletin ALL CLEAR.	

## Appendix 8c

### ALERT LEVELS - CYCLONE

Sl. No	SIGN	ALERT STATUS	DESCRIPTION	ACTION REQUIRED
1		Information	Likely formation of a cyclonic storm <sup>2</sup>	Information only and listen for regular weather updates
2		Alert	Cyclonic storm has formed and approaching <sup>2</sup>	Be vigilant and listen for regular weather updates. Act according to the relevant official instructions  Possible evacuation in high risk areas
3		Warning	Cyclonic storm making land fall	Possible evacuation in high risk areas and listen for regular weather updates. Act according to the relevant official instructions
4		Threat is over	Cyclonic storm threat is over	Cyclonic storm threat is over however, associated threats such as rainfall need to be monitored. Act according to the official instructions

### Warning Criteria for cyclones

LAND		SEA	
Center is 300 kms away from the island	Alert	For the affected sea area	Warning
Center is less than 300 Kms away from the island	Warning		
Possibility of entering the Cyclone in to the island	Warning		
Possibility of entering the Cyclone with T.>4.5 in to the island	Very severe warning		

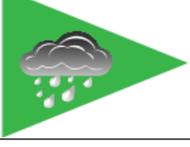
## Appendix 9

**Table 6.4. Port Warning Signals (General System) used in India**

Signal/ Flag No.		NAME	Symbols		Description
			Day	Night	
1	DISTANT BAD WEATHER	DC1			Depression far at sea. Port NOT affected.
2		DW2			Cyclone far at sea. Warning for vessels leaving port.
3	LOCAL BAD WEATHER	LC3			Port Threatened by local bad weather like squally winds.
4		LW4			Cyclone at sea. Likely to affect the port later.
5	DANGER	D5			Cyclone likely to cross coast keeping port to its left.
6		D6			Cyclone likely to cross coast keeping port to its right.
7		D7			Cyclone likely to cross coast over/near to the port.
8	GREAT DANGER	GD8			Severe cyclone to cross coast keeping port to its left.
9		GD9			Severe cyclone to cross coast keeping port to its right.
10		GD10			Severe cyclone to cross coast over or very near to the port.
11		XI			Communication failed with cyclone warning office.

## Appendix 10

### Heavy Rainfall Warning Colour Code

Sl. No	SIGN	ALERT STATUS	DESCRIPTION	ACTION REQUIRED
1		Information	Likelihood of Moderate Rainfall < 100 mm	Effects of rainfall will vary from place to place according to local conditions. Act according to the relevant official instructions
2		Alert	Likelihood of Heavy Rainfall 100- 150 mm	Effects of rainfall will vary from place to place according to local conditions. Act according to the relevant official instructions
3		Warning	Likelihood of Very Heavy Rainfall > 150 mm	Effects of rainfall will vary from place to place according to local conditions. Act according to the relevant official instructions
4		Threat is over	Threat of heavy rainfall is over however light to moderate rainfall can be experienced	Effects of rainfall will vary from place to place according to local conditions. Act according to the relevant official instructions

### Warning Criteria for Heavy Rainfall

Amount	Bulletin
Rainfall > 50 mm in 6 hrs and rainfall > 100 mm in 24 hrs	Alert/Advisory
Rainfall >150 mm in 24 hrs	Warning

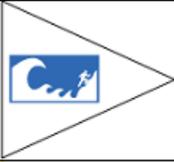
## Appendix 11

Land		Sea			colour
Wind speed	Bulletin	Wind speed	Height of waves	Bulletin	
Average wind is >30kmph and gusting >60 kmph	Alert/Advisory	Average wind is >30 kmph and gusting >60 kmph	>2m	Alert/Advisory	Amber
Average wind is >50kmph and gusting >70 kmph	Warning	Average wind is > 70 kmph and gusting > 100 kmph	>4m	warning	Red
		Squall line Wind speed>70 kmph		Alert/Advisory	Amber

Criteria use in DOM, Sri Lanka for Strong winds

## Appendix 12

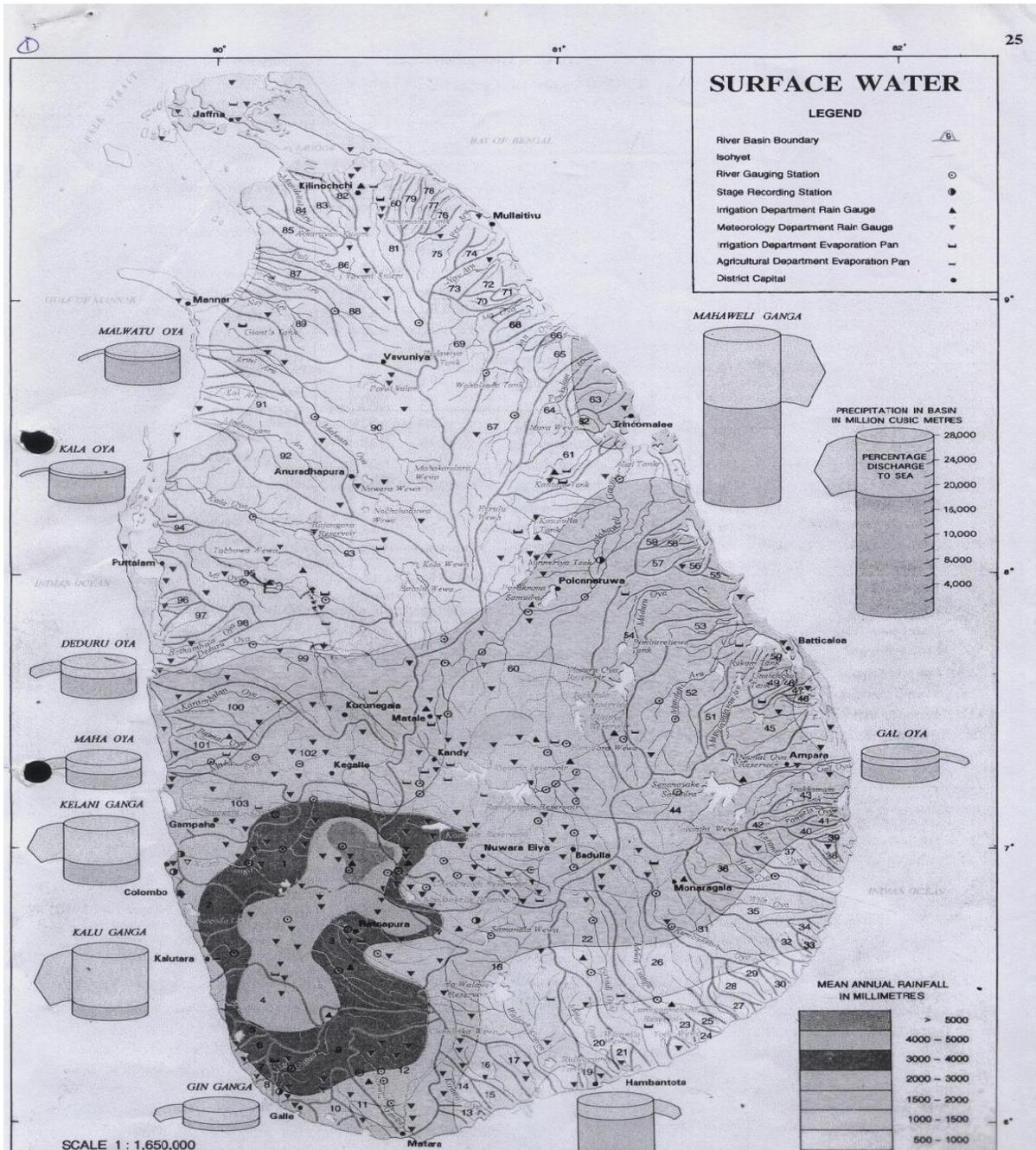
The signal levels colours assign for alert status.

Sl. No	SIGN	ALERT STATUS	DESCRIPTION	ACTION REQUIRED
1		Information	Major earthquake occurred	Information only, stay vigilant, listen to authorities and media updates
2		Watch	Tsunami may be generated.	Be vigilant and get ready for possible evacuation. Act according to the local authorities
3		Warning	Tsunami has been generated, Sri Lanka coast will be affected	Evacuate to safe areas. Act according to the local authorities
4		Threat is over	Tsunami threat is over	Act according to the local authorities.

### Warning Criteria for tsunami

Magnitude of the Earth quake	Potential for Tsunami	Bulletin	Colour
<b>&lt; 6.5</b>	No Tsunami threat	Information	white
<b>6.5&lt;M&lt;7.5</b>	Tsunami possible within 100km of the epicenter	Information	white
<b>7.0&lt;M&lt;7.5</b>	Potential for destructive Tsunami within 100km of the epicenter But Sri-Lanka is not in the area.	Watch	Amber
	Potential for destructive Tsunami within 100km of the epicenter But Sri Lanka is in the area	Warning	Red
<b>7.6&lt;M&lt;7.8</b>	Potential for destructive regional Tsunami. But Sri Lanka is not in the area	Information	White
	Potential for destructive regional Tsunami. But Sri Lanka is in the area.	Warning	Red
<b>7.8&lt;M</b>	Potential for destructive ocean wide Tsunami. But Sri Lanka is in the area	Warning	Red
	Mega tsunami is expected wave height >3m	Very Sever Tsunami warning	Brown

# Appendix 13



Surface water - Sri Lanka

## Appendix 14

(2)

**Table 2**  
**River Basins and Tanks in Sri Lanka**

Name of River Basin	AREA (sq. km)	No. of TANKS
Kelani Ganga	2292	20
Bolgoda Ganga	378	12
Kalu Ganga	2719	6
Bentara Ganga	629	2
Madu Ganga	60	1
Madampe Lake	91	1
Telwatta Ganga	52	42
Ratgama Lake	10	1
Gin Ganga	932	2
Koggala Lake	65	1
Polwatta Ganga	236	2
Nilwala Ganga	971	16
Sinimodera Oya	39	9
Kirama Oya	225	206
Rekawa Oya	76	113
Urubokka Oya	352	182
Kachchigala	223	150
Walawe Ganga	2471	777
Karagan Oya	58	28
Malala Oya	404	378
Embilikala Oya	60	20
Kirindi Oya	1178	334
Bambawe Ara	80	27
Mahasiliwa Oya	13	5
Butawa Oya	39	18
Menik Ganga	1287	294
Katupila Ara	87	45
Kurundu Ara	132	35
Nabadagas Ara	109	9
Karambe Ara	47	2
Kumbukkan Oya	1233	81
Bagura Oya	93	19
Girikula Oya	16	0
Helawa Ara	52	7
Wila Oya	490	65
Heda Oya	611	55

37 Karanda Oya	427	95
38 Semana Aru	52	17
39 Tandiadi Aru	22	15
40 Kangikadichi Aru	57	10
41 Rufus Kulam	35	7
42 Pannel Oya	106	21
43 Ambalam Oya	117	11
44 Gal Oya	1813	191
45 Andella Oya	528	47
46 Tumpun Keni	9	35
47 Namakada Aru	12	25
48 Mandipattu Aru	101	29
49 Pathantoppu Aru	101	46
50 Vett Aru	26	9
51 Unnichchai	350	52
52 Mundeni Aru	1295	138
53 Miyangolla Ela	228	27
54 Maduru Oya	1559	231
55 Puliyanpota Aru	53	11
56 Kirimechchi Odai	78	24
57 Bodigolla Aru	166	45
58 Mandan Aru	13	1
59 Makarachchi Aru	38	8
60 Mahaweli Ganga	10448	1003
61 Kantalai Aru	451	120
62 Palampotta Aru	70	101
63 Panna Oya	145	12
64 Pankulam Aru	381	164
65 Kunchikumban Aru	207	95
66 Palakutta Aru	21	4
67 Yan Oya	1538	832
68 Mee Oya	91	40
69 Ma Oya	1036	366
70 Churiyan Aru	75	15
71 Chavar Aru	31	24
72 Palladi Aru	62	14
73 Manal Aru	189	88

74 Kodalikallu Aru	75	59
75 Per Aru	378	156
76 Pali Aru	85	9
77 Maruthapillay Aru	41	8
78 Theravil Aru	91	15
79 Piramenthal Aru	83	14
80 Methali Aru	122	22
81 Kanakarayan Aru	906	202
82 Kalwalappu Aru	57	4
83 Akkarayan Aru	194	70
84 Mandakal Aru	300	50
85 Pallavarayan Kaddu	161	39
86 Pali Aru	456	142
87 Chappi Aru	67	15
88 Parangi Aru	842	425
89 Nay Aru	567	282
90 Aruvi Aru	3284	1726
91 Kal Aru	212	14
92 Moderagam Aru	943	509
93 Kala Oya	2805	1425
94 Moongil Aru	44	0
95 Mi Oya	1533	1556
96 Madurankuli Aru	73	105
97 Kalagamuna Oya	153	189
98 Rathambala Oya	218	291
99 Deduru Oya	2647	3274
100 Karambala Oya	596	483
101 Ratmal Oya	218	15
102 Maha Oya	1528	33
103 Attanagalla Oya	736	17
Jaffna Peninsula and Islands	1200	293
Talaimannar	126	7
Coastal areas not included in River Basins	5043	0
<b>TOTAL</b>	<b>65525</b>	<b>18387</b>

(Dharmasena, 1995; Ratnatunga 1978)

River basins and tanks in Sri Lanka

## Appendix 15

From: Upali sarath Wijesekara (uswijesekara@yahoo.com)  
To: rupavahini@yahoo.com; mohanslbc@yahoo.com; rhythmfmnews@gmail.com;  
hirufmnews@gmail.com;  
Date: Sat, May 28, 2011 5:41:27 PM  
Cc:  
Subject: Please telecast this message in all the three languages.

### Flood Warning issued by Irrigation Department on 2011.05.28 at 17:00 hr

Water level of **Kelani Ganga** at Colombo is still at 5.10 ft.  
This is a raise of 0.10 ft above the Minor Flood Level.  
Water level at Hanwella is 5.27 m which is 27 cm above Minor  
Flood Level.  
All other up stream River Gauge Stations are flowing bellow flood  
levels.

All the people living in both sides of the river from Colombo to  
Hanwella and related low land areas are warn to be vigilant. It is  
expected that this flood level will prevail during the next 6 hours.

**Kalu Ganga** at Rathnapura Ellagawa and Putupaula(Kalutara)  
also observed a rise of water levels but are flowing bellow flood  
level. Kukule branch of this river at Kalawellawa is still at 6.57 m  
level which is 67 cm above Minor Flood Level but not rising during  
last 6 hours. It is expected this will not cause further flood hazard.

**Gin Ganga & Niwala Ganga** flood threat have been  
relieved

Irrigation department is monitoring these flood levels continuously  
and further notice will be released if the situation get aggravated.

*M*

Appendix 16

From: Upul sarath Wijesekara (uswijesekara@yahoo.com)  
To: dmceoc@dmc.lk;  
Date: Sat, May 28, 2011 11:21:31 AM  
Subject: Please telecast this message in 3 languages

**Flood Warning Issued by Hydrology Division of  
Irrigation Department  
on 2011.05.28 at 10:30 hr**

**Water level of Kelani Ganga at Colombo has been  
raised up to the level of 5.30 ft.**

**This is a raise of 0.30 ft above the Minor Flood Level.**

**All the people living in both sides of the river from  
Colombo to Hanwella are warn to be vigilant. It is  
expected further rise of this level within next 6 hours.  
But this raise will not exceed 5.70 ft.**

**Irrigation department is continuously monitoring the  
River Water Levels.**

**If the situation becomes more aggravate further notice  
will be issued**

  
**Eng. Sarath Wijesekara  
Deputy Director Hydrology  
Irrigation Department.**

Appendix 17

http://us.mgs.mail.yahoo.com/uc/launch?...  
Serin

**From:** Upali sarath Wijesekara (uswijesekara@yahoo.com)  
**To:** rupavahini@yahoo.com; mohanslbc@yahoo.com; rhythmfnews@gmail.com;  
hirufmnews@gmail.com; itnnews@slt.lk; dmceoc@dmc.lk; adaderana@gmail.com;  
**Date:** Sun, May 29, 2011 4:45:18 PM  
**Cc:**  
**Subject:** Pl telecast this message

**Notice on Flood Issued by Hydrology Division of  
Irrigation Department  
on 2011.05.29 at 16:30 hr**

**Water level of Kelani Ganga at Colombo has been decreased to  
4.60 ft.**

**This is 0.40 ft bellow the Minor Flood Level.**

**Since all the up stream River Gauge Stations are flowing bellow  
flood levels and no significant rainfall is observed upper  
catchment area, it is expected further decrease of this level.**

**So we can notice that the effected flood in Kelani Ganga will be  
relieved by next 12 hours.**

**Except Kukule Ganga of Kalu Ganga at Kalawellawa which has  
still create slight flood effect, all other rivers are flowing normal.**

**Irrigation department is continuously monitoring the River  
Water Levels.**

**If the situation becomes more aggravate further notice will be  
issued**

*M*

**Eng. Sarath Wijesekara  
Deputy Director Hydrology  
Irrigation Department.**

**Appendix 18**

SOP -bef-river flood

SOP	
Hazard	Revering flood (Flood due to river rising)
Stage of Hazard	Before (When the river water level reaches the alert level)
Jurisdiction Level	National
Oraganization	Irrigation Department
Responsibal Persons	Overall Responsibility : Director of Irrigation (Hydrology) : Chief Engineer of Hydrology : Irrigation Engineer in-charge of the Division (DIE) : Senior hydrological assistant (Snr HA) : Hydrologycal field Assistant (HFA)
Action	Responsibility
Alert Gauage reader of all the Gauge stations of the basin in for 24 hours vigilance.	HFAA
Officer In-Charg of the basin to be stationed at Hub Station.	CE
Arrenge the Flood Monitoring Unit at Colombo Office Of Hydrology Division	CE
Receive and record Hourly River Water Level and Rain fall of Each Gauge Station of the basin	Snr HA
Coordination within Dept and out side the Agencies	DI (DM, Dr. &FS)

**Appendix 19**

SOP-river flood- during

SOP	
Hazard	Revering flood (Flood due to river rising)
Stage of Hazard	During (When the river water level reaches the alert level)
Jurisdiction Level	National
Oraganization	Irrigation Department
Responsibal Person	Overall Responsibility Director of Irrigation (DI (H)) Chief Engineer of Hydrology (CE) Irrigation Engineer In-Charge of the Division (DIE) Senior hydrological assistant (Snr HA) Hydrological field Assistant (HFA)
Action	Responsibility
Flood Monitoring Unit will be in action on 24 hours basis	DI (H)
Continuously monitor, Record & Analyze the hourly River Water Levels and Upper Catchment Rainfall.	CE
Issue Flood Warnings accoding to the risk level to DMC, Media, DIE of Irrigation Division, Dist. Director of the Irrigation and Zonal DI	DI (H)
Provide consulation to the field engineers who are engaged in flood Mitigation.	DI(H)
Measure flood Discharges.	SnrHFA
Coordination within Dept and out side the Agencies	DI (DM, Dr. &FS)

Appendix 20

SOP	
Hazard	Revering flood (Flood due to river <del>falling</del> )
Stage of Hazard	<b>After</b> (When the river water level reaches the alert level)
Jurisdiction Level	National
Oraganization	Irrigation Department
Responsibal Person	Overall Responsibility Director of Irrigation (DI (H)) Chief Engineer of Hydrology (CE) Irrigation Engineer In-Charge of the Division (DIE) Senior hydrological assistant (Snr HA) Hydrologycal field Assistant (HFA)
Action	Responsibility
Withdrawal of Warning	DI (H)
wind up Flood Monitoring Unit	CE
Change back to normal Operation	HFA
Provide consultation required to Dist. DI for Flood Damage repair works.	DI (H)
Map the Flood Affected area	HA
Record the analysis of the behavior of river water levels with the uper catchment Rainfall for future reference	Snr HA

## Appendix 21

### SOP-bef-dam breach

SOP	
Hazard	Dam Breach – Major / Medium Irrigation schemes
Stage of Hazard	Before
Jurisdiction Level	National
Organization	Irrigation Department
Responsible Person	Overall Responsibility Addl DGI (Irrigation & Water Management)
Action	Responsibility
<ul style="list-style-type: none"> <li>Preparation of Standing order part A and part B Emergency Action Plan (EAP) including maps to identify the risk areas, flood wave travel time, the depth of water and the location of access routes to the risk area.</li> </ul>	DI (District)
<ul style="list-style-type: none"> <li>Strengthening of Head works</li> </ul>	DI (District)
<ul style="list-style-type: none"> <li>Observation of alert on extreme weather conditions and issue warnings</li> </ul>	DIE
<ul style="list-style-type: none"> <li>Co-ordination with MASL and CEB regarding mahaweli and CEB reservoirs.</li> </ul>	DI (WM)
<ul style="list-style-type: none"> <li>Regular Dam safety inspection and submission of reports for Head works by EA, DIE, Dist. DI with Mechanical Engineer.</li> </ul>	DI (District)
<ul style="list-style-type: none"> <li>Coordination within Dept and out side the Agencies</li> </ul>	DI (DM, Dr. &FS)

**Appendix 22**

SOP - dur-dam bre

SOP	
Hazard	Dam Breach – Major / Medium Irrigation schemes
Stage of Hazard	During
Jurisdiction Level	National / District / Divisional
Organization	Irrigation Department
Responsible Person	Overall Responsibility Addl DGI (Irrigation & Water Management)
Action	Responsibility
<ul style="list-style-type: none"> <li>• Issuing Evacuation order to DMC, Media, Public, Relevant agencies including Police and Armed forces as mentioned in EAP.</li> <li>• Continus Information to relevant authorities and Down Stream Agencies.</li> <li>• Providing necessary additional resources</li> <li>• Operating of 24 hrs Monitoring Unit under supervision of Director (Assest Management)</li> <li>• Assuring the safety of the Dept. structures and Alternative Arrangements.</li> <li>• continuous monitoring of rainfall, inflow, outflow of reservoir and weather condition.</li> <li>• Issue withdrawal order.</li> <li>• Coordination within Dept and out side the Agencies</li> </ul>	<p>DIE</p> <p>DI (District)</p> <p>DI (District)</p> <p>Addl. DGI(I &amp;WM)</p> <p>DI (District)</p> <p>DIE</p> <p>DI (District)</p> <p>DI (DM, Dr. &amp;FS)</p>

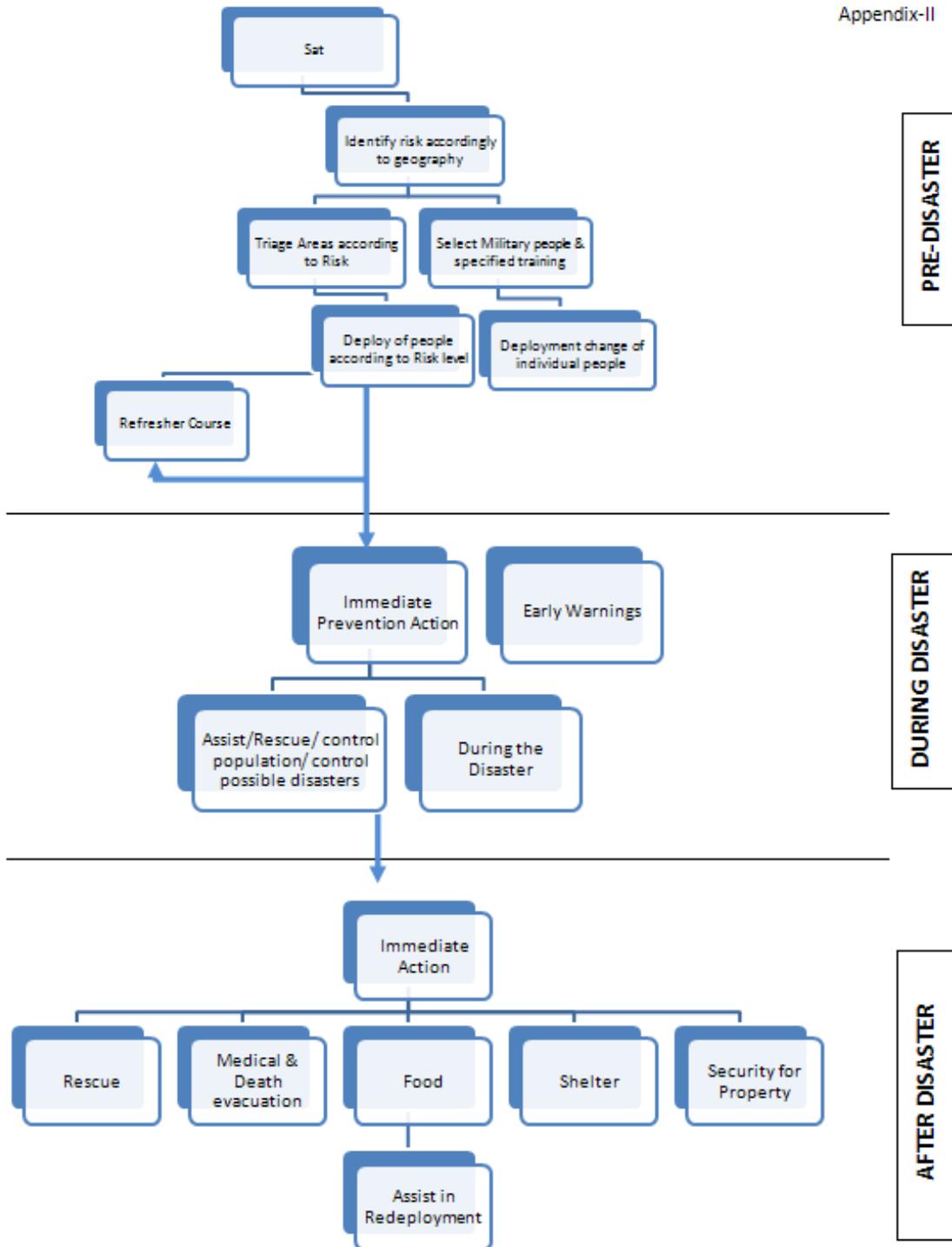
**Appendix 23**

SOP-aft-Dam bre

SOP	
Hazard	Dam Breach – Major / Medium Irrigation schemes
Stage of Hazard	After
Jurisdiction Level	National / District / Divisional
Organization	Irrigation Department
Responsible Person	Overall Responsibility Addl DGI (Irrigation & Water Management)
Action	Responsibility
<ul style="list-style-type: none"> <li>● Find out the reasons for dam breach</li> </ul>	DI (District)
<ul style="list-style-type: none"> <li>● Recontruction works</li> </ul>	DI (District)
<ul style="list-style-type: none"> <li>● Providing necessary resources</li> </ul>	DGI

Appendix 24

Appendix-II



**MILITARY EMPOWERED DM MODEL**