

Preparation of Disaster Management Plans for Electricity, Petroleum and Water Industries

**Final Report: PREPARATION OF DISASTER MANAGEMENT
PLAN FOR CEYLON ELECTRICITY BOARD AND
LANKA ELECTRIC COMPANY**

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Acknowledgment

Development of Institutional Disaster Management Plan was initiated by the Public Utility Commission of Sri Lanka as mandated by the Public Utility Commission Act No 35 of 2002, with the objective of ensuring the provision of continuous supply of electricity to consumers even during emergency situations. The Plan was developed as provided in the Disaster Management Act No 13 of 2005 and as per guidelines issued by the Disaster Management Centre. Director General of PUCSL would like to thank the following agencies for the support given to develop the plan for Ceylon Electricity Board (CEB) and Lanka Electricity Company (Pvt) Ltd (LECO);

General Manager - CEB, Addl. GMs, DGMs, Chief Engineers and Engineers of various Divisions and Branches of CEB, General Manager – LECO, Addl. GMs, DGMs, Chief Engineers, engineers and all other the staff in both organizations for providing data, sharing past experiences and comments at various stages of development of the Plan and supporting throughout the process.

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Finally, to consultants for assisting PUCSL to develop the IDMP for CEB & LECO.

Executive Summery

As an Island nation, Sri Lanka experienced extreme hydro-metrological events more frequently due to climate change. Thus, one of the significant challenges faces by the power sector in Sri Lanka is to provide uninterrupted electricity supply to consumers even during disasters. The Power Sector of Sri Lanka is governed by Ceylon Electricity Board (CEB), a statutory organization formed under Ceylon Electricity Board Act No 17 of 1969 and Lanka Electricity Company (Pvt.) Ltd., registered under Companies Act No 17 of 1983). Both organizations are regulated by Public Utilities Commission of Sri Lanka, established as per the PUCSL Act no 35 of 2002 and has issued licenses for CEB for Power Generation, Transmission and Distribution, while LECO responsible for power distribution in designated area only.

CEB and LECO has the responsibility to achieve SDG Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all by 2030. However, increasing trend in water related disasters disrupting plans of CEB and LECO to active targets by 2030.

CEB is manage by a Board, the Chairman and the General Manager supported by 6 Additional General Manages (Addl.GM) in operation division and 4 Addl. GM providing Support services, DGMs and Chief Engineers in Branches, Units and Sub-Units. LECO is managed by a Team consist of Board of Directors, Chairman, General Manager and 4 Additional General Manages responsible for Operation, Engineering, Finance and Human Resources Management divisions. Deputy General Managers, Assistant General Managers and 7 Chief Engineers support the management team. Both organizations have registered contractors to assist during a disaster to maintain the supply.

Considering that the electricity has become one of the basic needs for the day-today life of the modern-day society, both electricity utility agencies (CEB and LECO) have established a response team at regional and local levels with decentralized authority to take immediate action to safeguard life of people, restore supply and bring the life of general public to normalcy during and after a disaster.

Public Utility Commission Sri Lanka, empowered to promote the interest of consumers support the CEB and LECO to develop an Institutional Disaster Management Plan as provided in the Disaster Management Act No 13 of 2005 to responding to any impending disasters and ensure uninterrupted electricity supply during emergencies.

Conducting a risk assessment of electricity supply schemes is a basic requirement to identify risk levels of infrastructures against four selected hazards and develop mitigation, preparedness and response and recovery plans. Prioritization should be determined based on the likelihood or frequency of a hazard as well as the possible damage or consequence it poses to the industry. Initially 15 hazards were ranked high to low impacts, 6 were identified mostly affecting electricity supply sector. PUCSL, in consultation with CEB and LECO, has informed that the following hazard have been selected for detail hazard exposure, vulnerability and risk analysis. Consultant has agreed to include Coastal hazard and tsunami in addition to four selected by CEB though it is beyond the contractual obligation.

CEB	LECO
Flood	Flood
Drought	High wind/ Cyclone
High wind/ Cyclone	Coastal Hazards (cover Coastal Erosion, Sea Surges and Sea Level Rise)
Landslide	Tsunami

PUCSL in consultation with CEB has selected four hazards, floods, drought, landslides and chemical hazards for further analysis. Profile of four hazards were evaluated based on 8 characteristics and flood ranked highest followed by drought, chemical hazards and Landslide.

CEB and LECO agreed that power generation (Hydro, Thermal and renewable, Grid Sub Station of transmission and distribution are critical infrastructure of electricity supply schemes and considered for exposure, vulnerability and risk assessment. Hazard profiles developed by DMC, Irrigation Department, Meteorological Department and NBRO for Flood, drought, and landslides were collected with the assistance of PUCSL. Coordinates of identified element at risk provided by CEB and LECO were overlaid with the hazard layers respectively and exposure level of the critical infrastructure (element at risk) were identified temporal factor has not been considered in detail under this study due to unavailability of high-resolution data but it was taken in account using the data available in Desinventra database of DMC. Details of exposure levels of identified critical infrastructure are given in table 2.17-2.31.

The vulnerability assessment provides a framework for developing risk reduction options and associated costs. In the absence of vulnerability data of infrastructure, exposure, resistance and resilience of the infrastructure to different hazards, which were used to develop indicators to assess vulnerability, each group of elements at risk was evaluated based on the level of exposure identified and the sensitivity of each group of elements at risk to the respective hazards for the continuous power supply in qualitatively.

Details of vulnerability assessment given in the Table 2.32- 2.34

The electricity sector's disaster response capacities involve a range of actions taken during and after a disaster to ensure continued power supply and safety. As the data is not available as per the table 2.35, risk assessment was conducted without considering the capacity of Ceylon Electricity Board and Lanka Electricity Company.

Compiling hazard, element at risk (Electricity generation, transmission, and distribution), level of exposure and vulnerability of electricity infrastructure risk of flood, drought, landslide and coastal hazards were assessed by districts. Detail risk assessment for floods, landslides, Drought, Cyclone/High Winds, Coastal Hazards and Tsunami provided in tables 2.36-2.40.

Hazards are present in all electricity schemes, in varying degrees. Disaster mitigation is essential even when floods, droughts, landslides, and cyclone/high winds, coastal hazards and tsunami do not directly threaten, as accidents could damage the distribution lines and transformers and significantly impact service. Mitigation plan proposed encompasses risk management related best practices in design, construction and maintenance measures to optimize their utilization. CEB and LECO use different standards for the design of all structures in electricity supply

system. In order to ensure resilience of structure to disasters, CEB and LECO may have to review design standards and incorporate Disaster Risk Reduction concepts into design standards. Hazards, issues and impacts and possible mitigation measures related to critical infrastructure of electricity supply system are given in table 3.1-3.4.

Preparedness in the electricity sector is a critical component of ensuring reliable service delivery and the safety of personnel and the public during emergencies.

For effective operationalization, it is essential to systematically collect, validate, and maintain the relevant data and information to ensure availability for planning, decision-making, and response actions. Hazard type and impact focus, Institutional role and responsibility for preparedness, Command and coordination structure, Early warning, safe response to an emergency, Resources readiness provided in the Table 4.1-4.6

Table 4.7- 4.31 indicate the data required to be collected at scheme level to develop a preparedness plan for response for each scheme.

The Emergency Response Plan (ERP) is primarily composed of procedures and protocols that must be activated to respond to a variety of hazards, including localized to large-scale floods, droughts, landslides, cyclone/ high winds, coastal hazard and tsunami. Officer responsible and Standard Operation Procedure to implement risk reduction activity relate to 6 hazards is given as sample.

Disaster damage and loss assessments estimate, first, the short-term government interventions required to initiate recovery and second, the financial requirements to achieve overall post-disaster recovery, reconstruction and disaster risk management or reduction. Detail damage and loss assessment process and format for collection of data required to as pre- and post-disaster activity given in table 4.33-4.36.

A disaster recovery plan (DRP) is a formalized, structured approach that specifies how an organization can restart operations efficiently following a disaster, caused by natural or human intervention. Several steps for the preparation of recover. Recovery plan will be completed in two stages. Data required to conduct loss and damage assessment could be collected before disaster strikes and disaster loss and damage assessment as post disaster activity. Damage and loss data will be used to complete the need assessment and budgetary requirement for rehabilitation of affected infrastructure.

Five training Modules proposed in the Training Plan for electricity supply sector related to Disaster Risk Management to improve the capacity of officers engaged in DRR activities.

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List of Abbreviation

ADB	Asian Development bank
AGM	Assistant General Manger
BBB	Building Back Better
BCP	Business Continuity Plan
CBO	Community Based Organizations
CBS	Central Bank of Sri Lanka
CE	Chief Engineer
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CERF	Central Emergency Response Fund
DAD	Department of Agrarian Development
DALA	Damage and Loss Assessment
DDMCU	District Disaster Management Unit
DGM	Deputy General Manager
DL	Distribution Lines
DMC	Disaster Management Centre
DoM	Department of Metrology
DPRD	Disaster Preparedness and Response Division
DRF	Disaster Recovery Framework
DRM	Disaster Risk Management
DRP-	Disaster Recovery Plan
DRR	Disaster Risk Reduction
DS	Divisional Secretary
EC	Electric Conductor
EOC	Emergency Operation Centre
ERP	Emergency Response Plan
EU	European Union
EWS	Early Warning System
FGD	Focus Group Discussion
FM	Finance Manager
GCRI	Global Climate Risk Index
GDP	Gross Domestic Product
GFDRR	Global Fund for Disaster Risk Reduction
GIS	Geographic information system
GND	Grama Niladhari division
GoSL	Government of Sri Lanka
GSS	Grid Sub Station
ICS	Incident Command System
ID	Irrigation Department
IDMP	Institutional Disaster Management Plan
IPCC	International Panel of Climate Change
IUCN	International Union on Conservation of Nature
KPI	Key Performance Indicator
KW	Kilo watt
LiDAR	Light Detection and Ranging
LKR	Sri Lanka Rupees
MASL	Mahaweli Authority of Sri Lanka
MDM	Ministry of Disaster Management
MoH	Ministry of Health, Nutrition and Indigenous Medicine

MWh	Mega Watt Hour
NBRO	National Building Research Organization
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NCDM	National Council for Disaster Management
NCP	North Central province
NDMCC	National Disaster Management Coordination Committee
NDRSC	National Disaster Relief Service Centre
NEOP	National Emergency Operation Centre
NGO	Non-Governmental organization
NP	Northern Province
NRMC	National Resource Management Centre
NWP	North Western Province
NWSDB	National water Supply Drainage Board
OIC	Officer in Charge
PDNA	Post-Disaster Needs Assessment
PDRP	Post Disaster Recovery Planning
Po-DRP	Post Disaster Recovery Plan
Pr-DRP	Pre disaster Recovery Plan
PUCSL	Public Utility Commission of Sri Lanka
RE	Regional Engineer
SDGs	Sustainable Development Goals
SOP	Standard Operation Procedure
TL	Transmission Lines
UDA	Urban Development Authority
UNDP	United Nations Development Programme
WB	World Bank

Chapter 01. Introduction

Background

Sri Lanka is increasingly affected by various hazards, including weather-related events such as cyclones, monsoonal rain, and subsequent flooding and landslides¹. In addition, climate change brings forth unpredictable increases in hydro-meteorological hazards, both in their occurrences and intensity further aggravating the situation. During the last decade, the occurrence of disasters has increased by about 20% due to hydro-meteorological events².

Disaster risks, hazards and their impacts in Sri Lanka are on the increase due to a multitude of factors. Population dynamics, increasing demand for natural resources such as water and land, rapid and unplanned urbanization, and development planning devoid of disaster risks and exposure are some of the key contributory factors in this regard. A recent study done by the World Bank team estimated that 87 percent of Sri Lanka's population lives in moderate or severe hotspots for disasters³. The Global Climate Risk Index (GCRI) Report 2019 lists Sri Lanka in second place among the countries most affected by extreme weather events in 2017. However, later GCRI 2020 ranked Sri Lanka in the sixth position and in the year 2021 Sri Lanka ranked 30th place.⁴

Extensive disasters such as floods, landslides, droughts, and cyclonic winds could affect the country's development as much as a rare disaster event of catastrophic proportions such as a tsunami. The Annual Average Loss (AAL) due to disasters in Sri Lanka was estimated at US\$ 380 million⁵. The floods and landslides in 2016 and 2017 have caused damages and losses amounting to US\$723 million and US\$469 million, respectively. The estimated recovery costs were LKR 257.4 billion⁶. Damages and losses due catastrophic tsunami in 2004 were estimated at US\$ 1200⁷million. Cumulative damages and losses in social, productivity and infrastructure sectors due to recurrent floods and landslides, since 2010, have exceeded the damages and losses caused by the Indian Ocean tsunami in 2004⁸.

Sectors representing the lifeline services such as drinking water supply, electricity, and communication are severely damaged due to recurrent disasters.

Post Disaster Need Assessment (PDNA) of 2016 and 2017 floods and landslides showed that cumulative value of damages and losses in the electricity sector were 1313.45 million LKR.

As an Island nation, Sri Lanka experienced extreme hydro-metrological events more frequently due to climate change. Thus, one of the significant challenges faces by the Ceylon Electricity

1 Ministry of Disaster Management Annual Report 2019

2 Sri Lanka DRM Status Report 2019

3 World Bank, South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards. South Asia Development Matters

4 Global Climate Risk Index Reports 2019, 2020 and 2021

5 Fiscal Disaster Risk Assessment and Risk Financing Options, Sri Lanka. World Bank Group (GFDRR). 2016

6 Ministry of Disaster Management & Ministry of National Policies and Economic Affairs. Sri Lanka Post Disaster Needs Assessment Floods and Landslides, 2016, 2017

7 ADB, JIBIC and WB- Preliminary estimate of tsunami 2004 (2007)

8 www. desinventar.lk

Board (CEB) and Lanka Electricity Company (LECO) is the provision of uninterrupted electricity supply to consumers during disasters.

1.2. Profile of Power sector

Institutional and legal framework of CEB and LECO

Public Utility Commission of Sri Lanka (PUCSL), established as per the PUCSL Act no 35 of 2002, closely link with following key agencies to reduce the risk in utility services and facilitate the lifeline service provider as follows;

- **Disaster Management Centre** will be closely linked with PUCSL to develop Disaster management plans for utility industries, disseminate early warning messages on hazard situation and coordinate with other response agencies to manage the disaster impacts.
- **Agencies providing early warning and response.**
PUCSL to establish links with Irrigation Department, National Building Research Organization (NBRO), Meteorological Department etc. to obtain weather forecasts and early warning on probable hazards.
PUCSL also could coordinate with armed forces and police to provide support to utility service delivery agencies to manage disaster impacts and reduce the interruption of services to consumers.
- **Project funding**

Establish links with National Planning Department and Treasury to facilitate the release of funds for implementation of actions identified in the disaster Management Plan.

1.2. Power Sector Structure in Sri Lanka

1.2.1. Ceylon Electricity Board

The Power Sector of Sri Lanka is governed by Ceylon Electricity Board (A statutory organization formed by an Act of Parliament) and Lanka Electricity Company (Pvt.) Ltd. (registered under Companies Act), both are fully owned entities of the Government of Sri Lanka, regulated by Public Utilities Commission of Sri Lanka.

The Power Sector interactions of State Institutions are indicated in the figure 1.1.

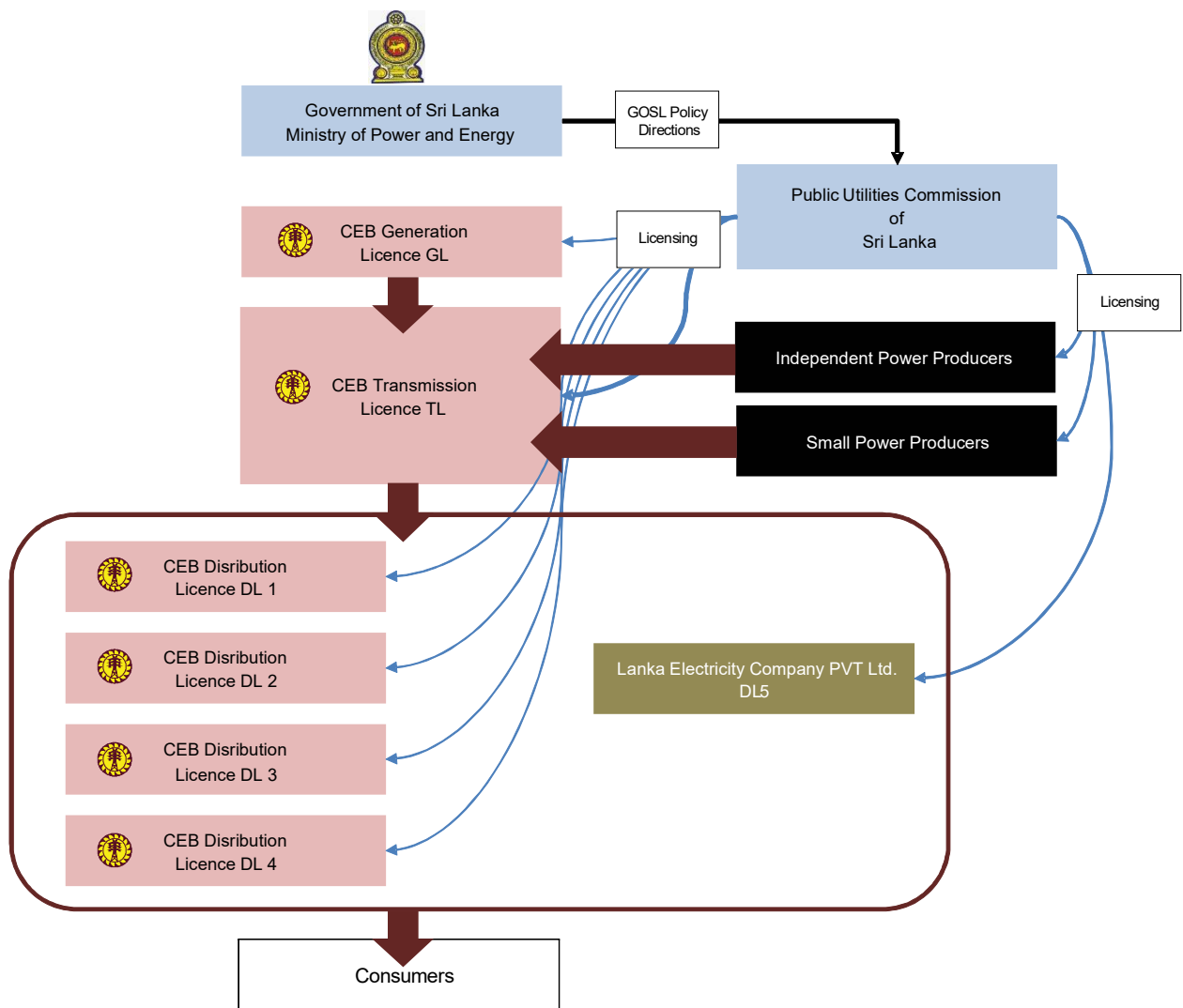


Figure 1.1. Power Sector Organization in Sri Lanka

While Ceylon Electricity Board (CEB) is responsible for Power Generation, Transmission and Distribution, Lanka Electricity Company (Pvt.) Ltd. (LECO) is responsible for power distribution in designated area at 11kV level and below.

The Ceylon Electricity Board (CEB) has been established in 1969 as provided in the Act of Parliament, no. 17 of 1969. As per the Act, CEB is vested with responsibilities of development and co-ordination of the Generation, Supply and Distribution of Electrical Energy.

Country's power Generation is carried out by CEB under Generation License (*CEB's own power plants*) and private independent power producers (IPPs) under generation licenses issued to them by the PUCSL. In addition, there are small scale power producers (eg. Solar PV) generating under license exempted provisions granted by PUCSL. CEB's transmission network figure 1.2 and area of power distribution show in figure 1.4.

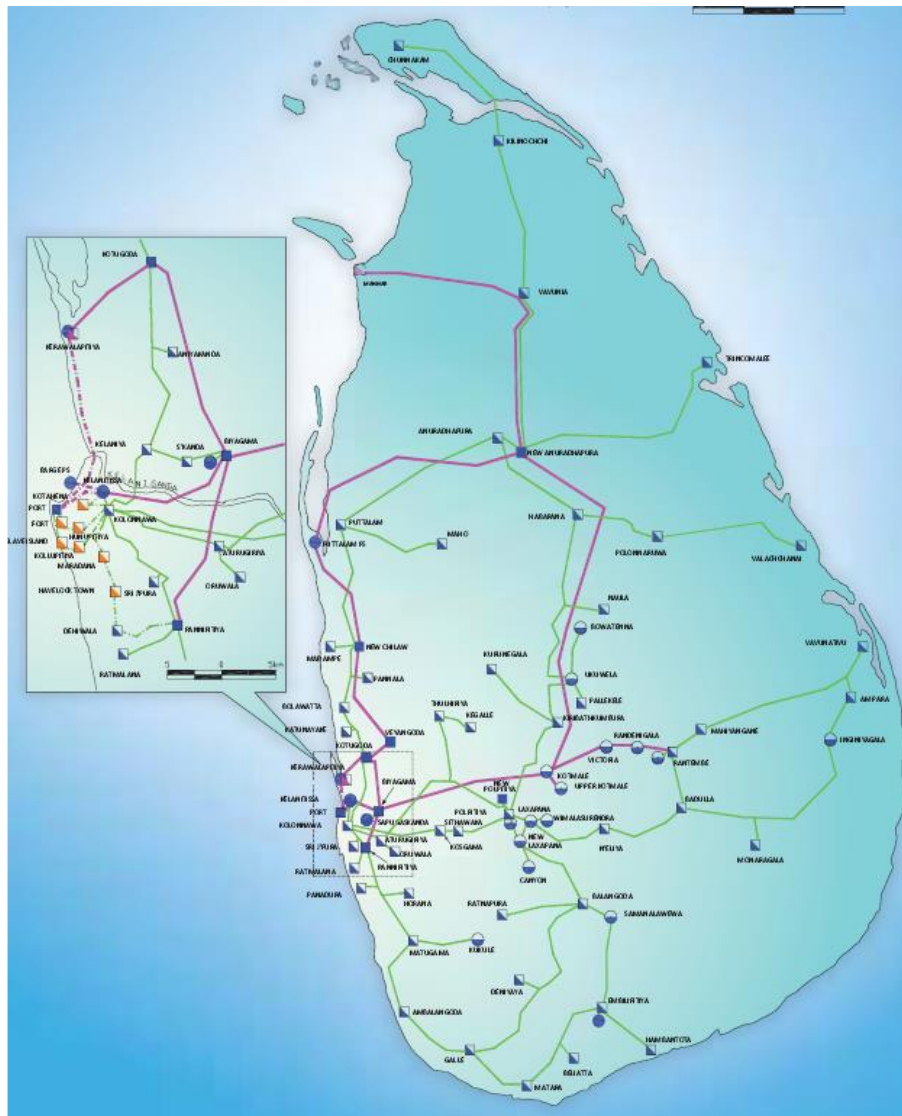


Figure 1.2. Electricity Transmission Network

CEB is managed by a Board, the Chairman and the General Manager supported by 6 Additional General Managers (Addl.GM) in operation division and 4 Addl.GM providing Support services, DGMs and Chief Engineers in Branches, Units and Sub-Units.

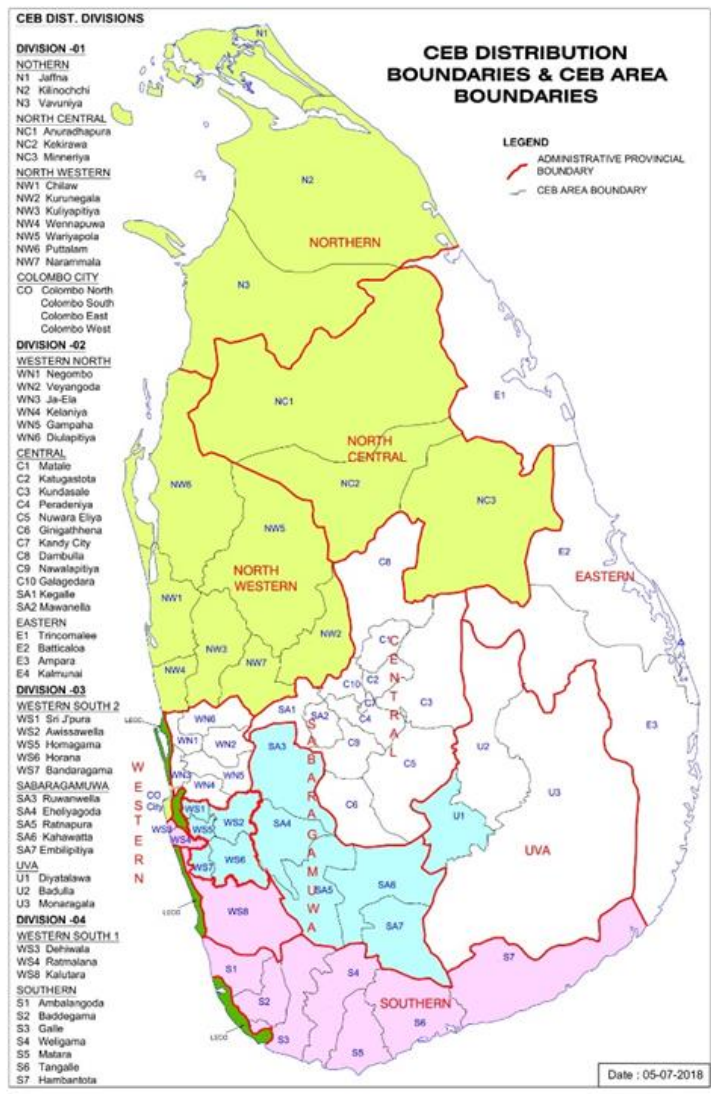


Figure 1.3. Power Distribution Areas of CEB

CEB organization structure up to Divisions level is shown in figure 1.3.

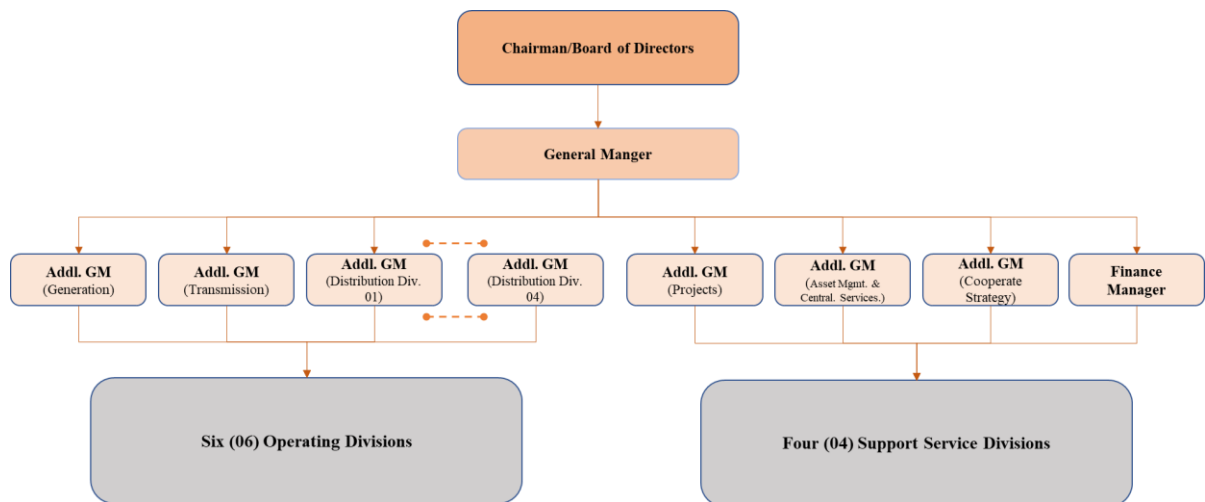


Figure1.4: organization structure of the CEB as at end of 2022

Power sector is regulated by the Public Utilities Commission of Sri Lanka (PUCSL). CEB is vested with a Generation License (GL), a Transmission License (TL) and four (4) Distribution Licenses (DLs) by PUCSL.

Country's power Generation is carried out by CEB under Generation License (CEB's own power plants) and private independent power producers (IPPs) under generation licenses issued to them by the PUCSL.

1.2.2. Lanka Electricity Company (Pvt.) Ltd.

Lanka Electricity Company (LECO) was established as a state owned private limited liability company registered under Company Act no 17 in 1983. LECO was originally assigned the responsibility of operation electricity network once owned and operated by Local Authorities but subsequently some of the CEB distribution areas were vested with LECO for them to have a contiguous operating area for flexibility and economy of operations.

LECO purchase power in bulk from CEB at 11kV voltage through CEB's 33/11kV Primary Substations and distributes in its area through their 11kV and LV networks. Thus, LECO has no generation or transmission activities. Power distribution area of LECO is shown in figure 1.5.

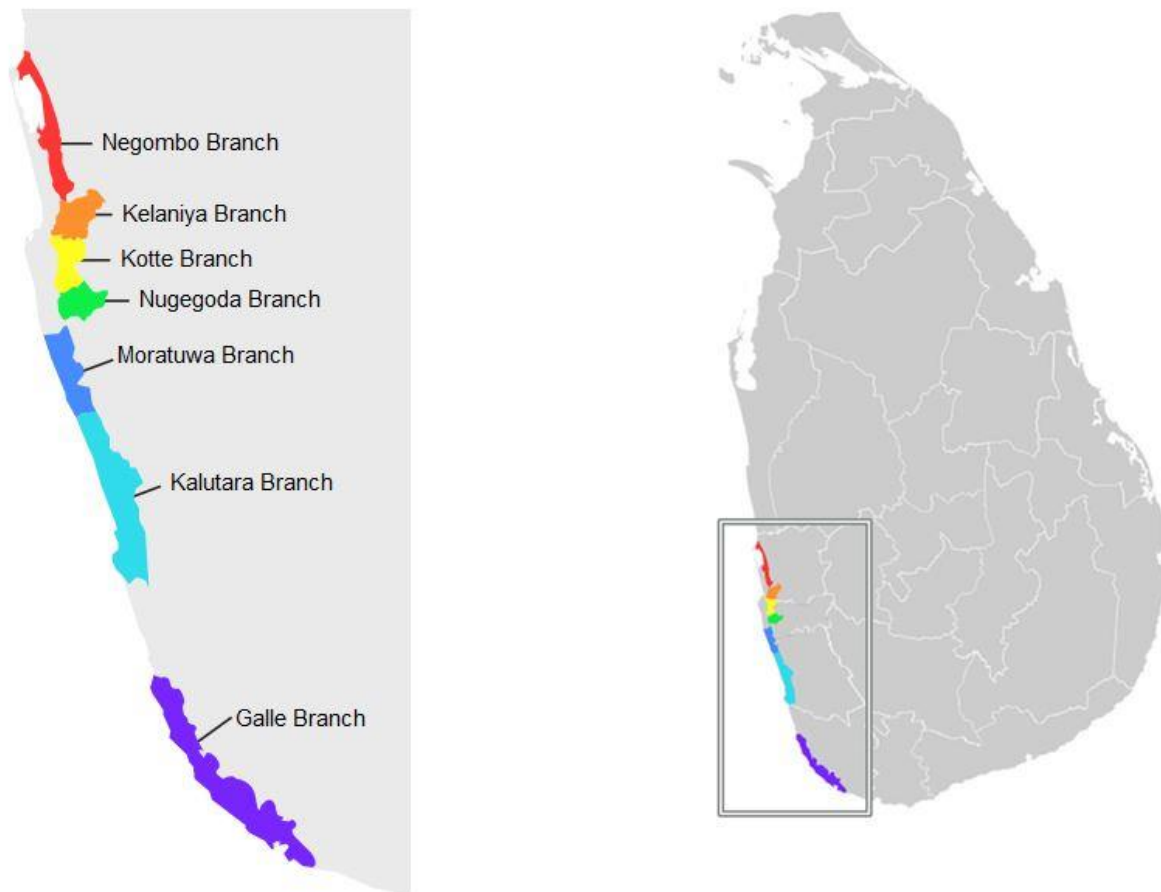


Figure 1.5. Power Distribution Areas of LECO

LECO is managed by a Team consist of Board of Directors, Chairman, General Manager and 4 Additional General Manages responsible for Operation, Engineering, Finance and Human Resources Management divisions. Deputy General Managers, Assistant General Managers and 7 Chief Engineers support the management team. Area of operation of LECO is shown in fig. 1.5.

1.3. Arrangements in place to address an Emergency Situation

As already indicated in Chapter 1, the Electricity Utility Industry has faced numerous disasters, caused by natural events and human induced hazards, throughout the history. As Electricity has become one of the basic needs for the day-today life of the modern-day society, Electricity Utilities (CEB and LECO) have paid immediate attention to disasters & hazards and taken immediate action to safeguard life of people, restore supply and bring the life of general public to normalcy, in the past, successfully.

CEB's response during Cyclone in 1978 in Eastern Region, civil war in North and East 1982 - 2009, Civil unrest / insurrection in 1988-1989, Rathnapura flooding in 2003, Tsunami in 2004 and flooding in Kalutara districts in 2016, Covid-19 in 2020-2021 etc. testify their capacity to handle such situations. LECO too faced major disasters (Floods) in 2006, 2016, 2018 etc. and

Covid-19 in 2020-2021. In the past, senior Technical Managers (ie. Engineers) in the affected area have taken the responsibility of responding to disasters. Other divisions / branches outside the disaster impacted area provided all necessary supports (such as man-power, equipment, machinery, spares etc.) to respond to the situation. Depending on the severity of the disaster, either Provincial Officer (DGM), Divisional Officer (Addl.GM) in CEB and Branch managers in LECO coordinated such activities. As required, in addition to their own (CEB, LECO) employees, registered contractors were also deployed for the supply restoration. In many cases of flooding / Tsunami, Landslides, the immediate response was to isolate the power distribution network in the affected area as soon as possible in order to ensure no electrocution occur due to accidents or inadvertent operations. Thereafter, section by section power supply was restored ensuring the safety of public and users and safety of plant and equipment. If this process was delayed, it was mainly due to inaccessibility of the location (switchgear, line etc.) due to access roads being badly damaged or blocked. In fact, the response to a disaster really depended on type of disaster as utilities attempts were to maintain the supply as much possible as electricity / lighting was one of the basic commodities required by disaster response teams of other organizations.

Further, Corporate Managements in CEB and LECO supported the autonomy assumed by Senior technical offices / Managers since priority to public safety was that of over the administrative procedures. Meanwhile, local technical managers coordinated with local government administrative authorities and other organizations (eg. RDA Engineers, Irrigation Engineer, District Secretariat, Grama Niladari etc.) to assess the situations, to get / render necessary assistances etc. Meanwhile, senior Managers (Senior Engineers) outside the disaster area were coordinating with other governmental agencies and provided necessary supports. In addition, direct personnel level close interactions among senior managerial and middle level technical officers helped carrying out emergency operations on verbal communication while ensuring safety and coordination. Decentralized financial authorities in utilities help further in taking quick actions when necessary. As Disaster Management Center or Government's Disaster Management mechanism was not established until late 2005, and no systematic procedure had been introduced, these disaster responses were initiated by the utility management on their own, and led to success with their experience.

However, as such Responding Procedures are not documented in CEB / LECO, the experience may go un-transferred to the next generation of staff. Also, the ever-increasing complexities of power sector may pose different unexpected issues with different hazards which may not have thought of. Hence, procedures, authority levels, resource allocations etc. need to be properly documented.

Following National Disaster Management Centre directives, CEB developed Operating Procedures for some selected hazards. Later during 2017-2019, CEB initiated a process of developing a comprehensive Functional Manual for 'Corporate Risk Management', developed Risk Management Policy Framework and Risk Assessment Matrix etc., and is now expanding to developing detailed operating procedures operating unit wise. The exercise is ongoing. The

draft version of Functional Manual ‘Corporate Risk Management’ is yet to receive CEB Board approval.

The LECO too developed a comprehensive ‘Disaster Management Plan’ in mid-2020 following DMC directives, in Conformity with Sri Lanka Disaster Management Act of May 2005 and Nation Policy. It outlines SOP for disaster response.

1.4. Economic Risk

Government of Sri Lanka has pledged its commitment to achieve 17 Sustainable Development Goals (SDG) by 2030. Towards this, the government has enacted SDG Act No19 of 2017 to supervise the development of policies and strategies on SDG and facilitate all agencies to follow-up and monitor the implementation of 17 SDG and 169 Targets.

Accordingly, CEB and LECO has the responsibility to achieve Goal 7- Ensure access to affordable, reliable, sustainable and modern energy for all by 2030.

However, increasing trend in water related disasters such as floods, drought, cyclones, landslides and coastal hazards during the last decade caused significant damages to infrastructure and substantial losses to agriculture, industry and commercial establishment. Development funds are frequently transferred to reconstruct damage infrastructure, relief recovery operations. Further the Climate change impacts have intensified the hydro meteorological hazards causing frequent severe cyclonic condition associated with flood, drought and landslides disrupting plans of CEB and LECO to active targets by 2030. Therefore, it is critical to mainstream disaster risk reduction concepts as outlined in Sendai Framework for Disaster Risk Reduction into development planning process of CEB and LECO to ensure the electricity supply sector is resilient to disaster impacts and achieve SDG target by 2030.

National Planning Department, in developing new format for formulation of project proposals, has informed all state sector agencies, expecting funds for sector development to align the project objective/s with the relevant SDGs and mainstream the Disaster Risk Reduction in to the relevant component of the project cycle.

Disaster risk reduction is the core of sustainable development and economic risk could be minimized by mainstreaming DRR in to all sector development projects and programmes.

1.5. Objectives of the proposed IDMP

The efficient performance of the energy sector has a fundamental impact on economic development. Without an adequate power supply, basic services (such as piped water supply), industrial and non-industrial operations, and access to information, communications, and digital connectivity will be adversely affected. Without access to electricity, it is difficult to maximize the income-generating activities that are essential to alleviate poverty in rural areas.

However, with the increasing number of disasters caused by natural hazards and climate change impacts in the country, as mentioned above, it has become a challenge to protect the electricity supply from disasters and to provide continuous services to the public with minimum disruption. The Public Utilities Commission of Sri Lanka (PUCSL), established as per Public Utilities Commission Sri Lanka Act no 35 of 2002, empowered to promote the interest of Consumers

and safety and service delivery of public utility industries. Therefore, PUCSL has decided to improve the capacity of agencies providing utility services to prevent/mitigate hazards, respond and recover from disasters with minimum impact to the industry and consumers. Therefore, PUCSL and initiated action to assist the CEB and LECO to formulate Disaster Management Plan (DMP), which includes emergency response, restoration plans, and mitigation plan to maintain customer-related electricity supply service without any hindrance.

As per the section 4 (h) and section 10 of Disaster Management Act No 13 of 2005, every Ministry, Government Department, Public Cooperation (Here after known as Institutions) required to prepare a Disaster Management Plan in conformity with the National Policy on Disaster Management, National Disaster Management Plan (NDMP) and guidelines laid down by the National Council for Disaster Management (NCDM) and the technical assistant provided by the Disaster Management Centre (DMC).

As per Section 12(2) of the DM Act, it shall be the duty of every Ministry, Government Department or public corporation, to take all measures necessary for the immediate implementation of their Disaster Management Plans prepared under section 10 of the Act within their respective Ministry, Department, or Corporation, as the case may be to counter the effect of the disaster or the impending disaster or to mitigate the effect of such disaster or impending disaster.

Institutional Disaster Management plan cover:

- Plan to respond to disasters at all levels,
- Plan to providing relief and implement post disaster recovery and rehabilitation measures,
- Preparedness plan to minimize/mitigate disaster impacts and to prevent occurrence of future disasters including mainstreaming disaster risk reduction into the development process,
- Planning for physical, financial, and human resource to facilitate the above three components,
- Improved standard operational procedures incorporating Disaster Risk Reduction measures.

Chapter 02

Hazard Identification

2.1. Introduction

Power Sector is one of the most important infrastructures of the country, as growth of this sector is directly correlated with the economic growth of the country as it is the major input for the social and economic welfare of the society. The natural disasters or man-made disasters always involve losses and damage of infrastructure of the life line services of the country. Any disruption in Power Sector due to natural or manmade disaster creates hardship to the human beings, as every aspect of human life is directly or indirectly associated with the electricity.

However, reliability of electricity supply in Sri Lanka face serious challenges from natural and human induced hazards. Due to severe drought 2015, generation of hydropower was stopped as the water level of reservoirs has dropped below 20% capacity. In 2022 drought condition significantly reduced hydro-power generation in the country and power regulator has warned of impending power cuts if the water levels in the hydro power reservoirs do not improve.

As uninterrupted electricity supply service from industry to domestic user is one of the indicators which correctly measure the development of the country, in order to eliminate or if not possible, to minimize damages which cause disruption in generation, transmission and distribution of electricity sector, it becomes extremely important to evolve disaster management plan followed by the disaster risk assessment for the sector.

Hence the main objective of the study is to identify the risk associated with frequently occurring hazards on electricity sector to ensure that risks are eliminated or reduced to tolerable level in order to ensure uninterrupted service leading to achieve sustainable development goals.

The main objective is facilitated by five basic objectives for risk assessment as follows:

- **Identification and quantification of hazards that can affect the power supply system, whether they are natural or derive from human activity;**
- **Estimation of the susceptibility to damage of components that are considered essential (critical Infrastructure) to provide electricity in case of disaster;**
- **Definition of measures to be included in the mitigation plan, such as: retrofitting projects, improvement of watersheds, and evaluation of foundations and structures, improving awareness of consumers to minimize wastage of electricity.**
- **These measures aim to decrease the physical vulnerability of a system's components;**
- **Identification of measures and procedures for developing an emergency response and operation plan. This will assist the CEB and LECO to supplement services in emergencies;**
- **Evaluation of the effectiveness of the mitigation and emergency plans, and implementation of training activities, such as simulations, seminars, and workshops.**

2.2. Hazard Identification

Sri Lanka has experienced many natural hazards such as drought, flood, landslide and cyclones during the past. It has also experienced human induced hazards such as, bomb explosions, strikes, fires, chemical hazards etc. The vulnerability to disasters caused by natural, as well as human-induced hazards are in varying degrees on account of its unique geo-climatic topographic features, environmental degradation, population growth, urbanization, industrialization, non- scientific development practices and socio-economic conditions.

Hazards and disasters are two sides of the same coin neither can be fully understood or explained from the standpoint of either physical science or social science alone nor are inextricably linked to the ongoing environment changes at global, regional and local levels. Environmental hazards exist at the interface between the natural events and human systems. With respect to the frequency and consequence of the frequent hazards, Flood, drought, Landslide, Cyclone and Tsunami have been identified for further study. The impacts of these hazards and their multiplier effects on economy, national development and severity of affected infrastructures are well known but needs to be adequately quantified. Disasters such as flood, drought, landslide cyclones/high wind, tsunamis etc., need to be scientifically and statistically studied with details hazard assessment followed by the exposure, vulnerability and capacity assessment of the electricity sector of the country.

Hazards may occur or be introduced throughout the electricity supply system, from generation to consumers. Effective risk management, therefore, requires identification of all potential hazards, their sources, possible hazardous events and an assessment of the risk presented by each.

Depending on their origin, hazards can be of two types:

- a) Those related to natural events, i.e., physical phenomena arising in nature;
- b) Those caused by human activity.

This classification cannot be employed rigidly, since we often find interactions between natural phenomena and human actions. For instance, a landslide may be caused by erosion as a result of deforestation, by failures in channeling runoff or wastewater, or by settlements in unstable areas.

Another method of classifying hazards is based on their mode of occurrence.

- a) Sudden onset, as in the case of earthquakes;
- b) Gradual (Slow) onset, as in the case of drought.

The various types of hazards manifest themselves as events that can have adverse effects and can potentially lead to an emergency or even reach the level of a disaster. However, it is common for the classifications above to be applied to disasters.

2.2.1 Hazard Prioritization

Hazard prioritization is the process of identifying all hazards that impact the industry and determining which ones are the most severe so that they can be addressed first. Prioritization should be determined based on the likelihood or frequency of a hazard as well as the possible damage or consequence it poses to the industry.

The Hazard prioritization identifies the hazards and examines the risks that pose a threat to the people, property, environment and economy of the country particularly focusing the electricity supply. This assessment is a critical part of the preparation of disaster preparedness plans for the electricity supply of the country. Identified hazards should be used in mitigation strategies, preparedness programs, emergency response plan, and training & awareness programs in the electricity supply to ensure the resilience of the sector.

2.2.2. Objectives of Hazard Prioritization

The prime objective of ‘hazard prioritization is to evaluate hazards, then prevent occurrence of the hazard or minimize the level of its risk by adding control measures, as necessary.

The major objective will be accomplished through the following sub-objectives as follows:

- To identify high impact hazard to the electricity supply of the country.
- To select four hazards, as required by the TOR of the assessment; for in-depth risk assessment and to formulate mitigation strategies, preparedness programs, emergency response plan exercises, and training and awareness programs related to disaster risk management in the electricity supply industry.

2.2.3. Data Used for the Hazard Prioritization

The hazard prioritization utilized data and information from the following sources;

- Desinventra Database of Disaster Management Center,
- The data and information provided by Ceylon Electricity Board and Lanka Electricity Company Ltd. and PUCSL
- Damage and Loss Assessment Report 2010 Flood, Post Disaster Need Assessment Reports of 2016 and 2017 flood and landslides report,
- Damage and Loss Assessment reports of Disaster Management Center,
- Disaster study reports published by UN Agencies such as IUCN, UNDP, WFP, etc.

During the analysis approximation and assumptions were made as the existing data set was associated with numerous limitations;

2.2.4. Limitations

- Following the return periods of the particular hazards, the frequency of hazards has not been documented by responsible agencies.

- Terminologies of the Desinventra database have not been customized based on the country context.
- Data on damages and losses are not recorded in any of the databases

2.2.5. Assumption

- Assume the impacted population is proportionately to the affected Consumers of electricity supply
- Assume a positive correlation between the data on destroyed houses (Fully Damaged) and damaged infrastructure of CEB, and LECO
- Data was grouped assuming the different disaggregation recorded in Desinventra (Eg. Data recorded under; flood, rain, storms were grouped as flood and data on high winds and cyclone in one group, slope failures, movement of earth surface, rock falls as landslides).
- The frequency of hazards was calculated based on the number of data cards recorded during the last 30 years in the Desinventra database.

2.2.6. Hazard Prioritization Methodology

For the ranking of hazards, the following criteria were applied:

- Frequency/ probability of occurrence: based on historical observation, how often the type or level of hazard will occur.
- Impact on the Public: based on historical observation and demographic information and study, how the type or level of hazard would affect the general public and their daily lives (no. of people affected/ no. of Housing damage) Impact on Responder to save lives and minimize property damages, based on historical observation and study, how the type or level of hazard would affect responders 'ability to save lives, protect property.
- Impact on continuity of operations / program operations: based on historical observation and study, how the type or level of hazard would affect the operation of facilities and execution of services in support of disaster and daily operations.
- Impact on property, facilities, and infrastructure: based on historical observation, study, how the type or level of hazard would affect county facilities, critical infrastructure, and other structures.
- Impact on delivery of services: based on historical observation and study, how the type or level of hazard would affect the public or private delivery of essential services to the affected or neighboring population.
- Impact on the environment: based on historical observation, and study, how the type or level of hazard would affect the environment, and associated effects
- Impact on the economic condition: based on historical observation, study, how the type or level of hazard would affect the economic success and viability of local, state, and national enterprises, and longer-term impacts to supply chain or commodity requirements.

This hazard prioritization also looked at current hazards through the lens of climate change. In anticipation of the impact of climate change in the country, this analysis also projected which hazards could occur more frequently or become more extreme in the future.

The hazard prioritization is to determine which criteria to use to rank the hazards. Criteria may include factors such as the probability of an emergency, the level of vulnerability of people or property, or both, the degree of manageability, and whether the hazard may worsen and how quickly. In this study, these indicators were assessed using proxies developed based on the assumptions such as;

- No. of Affected population having a direct relationship with the impact on the electricity sector.
- No. of housing, damage is directly related to the damage to electricity supply infrastructures.

All the hazards mentioned in the Sri Lanka Disaster Management Act were considered for the analysis. However, the availability of data for each hazard varies dramatically. Data was standardized to ensure the accuracy of the analysis.

In order to determine the relative weight assigned to each hazard, two approaches were used.

First approach: Data and information recorded in the DesInventar database of DMC were used to evaluate the frequency of occurrence and severity adopting the assumption explained above to overcome the limitations of the paucity and quality of historical recorded data.

As the data fields recorded in Desinventar database having different definitions, (Eg. landslide, slope failures, slips, soil Collapse etc.), data and information recorded under following terms were grouped as summarized in table 2.1 below:

Table 2.1: Summary of Disaster Groups

Terms	Group Terms
Landslides, Slope Failures, Slips, Soil Collapse, Cutting Failure	Landslide
Floods, Heavy Rains, Flash Floods, Urban Floods	Flood
Storm surge, Coastal Erosion, Sea Level Rise,	Coastal Hazards
Natural Drought, Agricultural Drought	Drought
Cyclone, Strong Winds, Gale, Storm, Tornado	Cyclone

The second option would be to conduct an expert elicitation exercise using techniques such as the Delphi method.

The prioritization process in this assessment comprises the following steps:

- Step 1. Identification of the hazard
- Step 2. Identification and definition of the criteria by which each selected hazard/ will be quantified.
- Step 3. Assignment of criterion-based values to the hazard
- Step 4. Normalization of these values to make them comparable between criteria.
- Step 5. The weighting of the criteria reflects their relative importance.

- Step 6. Combining the weighted normalized values for each hazard to produce a score and ranking of the scores to obtain the order of priority.
- Step 7. Reporting

2.2.7. Analysis and Results of Hazard Prioritization

After identifying the frequency and the consequence of particular hazards all the data was standardized and categorized as illustrated in the following table 2.2

Table 2.2: Frequency and Consequence Ranking

Scale of Severity or the consequence	Category	Scale of Frequency or likelihood	Category
<1	Insignificant	<1	Very unlikely
1-2	Minor	1-2	Unlikely
3-5	Moderate	3-5	Possible
6-8	Major	6-8	Likely
>8	Catastrophic	>8	Very Likely

Using the above matrix risk or the impact of each hazard were identified and categorized qualitatively as given in the table 2.3.

Table 2.3: Hazard Ranking

Scale of Ranking (Frequency X Consequence)	Category
<1	Low
1-4	Low- Medium
9-25	Medium
36-64	Medium- High
>64	High

All the hazards were plotted Probability/livelihood (frequency) against the Impact / severity(consequences) and the results are illustrated in Table 2.4.

Table 2.4: Hazard Probability against impacts

Impact or Severity						
		<i>Insignificant(1)</i> (<1)	<i>Minor(2)</i> (1-2)	<i>Moderate(3)</i> (3-5)	<i>Major (4)</i> (6-8)	<i>Catastrophic(5)</i> (>8)
Probability or Likelihood	<i>Very Likely</i> (>8)	Low-Medium	Medium	Medium-High Drought	High Coastal Hazards	High Flood
	<i>Likely</i> (6-8)	Low-Medium Fire	Low-Medium	Medium	Medium-High	High Landslide
	<i>Possible</i> (3-5)	Low maritime hazard; Lightening	Low-Medium	Medium Pollution Industrial Hazard Chemical Hazards	Medium-High	Medium-High High wind/Cyclone
	<i>Unlikely</i> (1-2)	Low , Air Hazard	Low-Medium nuclear disaster, radiological emergency	Low-Medium	Medium	Medium-High Tsunami
	<i>Very Unlikely</i> (<1)	Low Epidemic / Air raids	Low	Low-Medium	Medium	Medium Earthquake Explosion

The hazard prioritization summary provides a list of the hazards ranked into five categories of risk as given in table 2.5.

Table 2.5: The hazard prioritization summary

Category	Types of Hazards
High	Flood, Landslide, Coastal Hazard
Medium-High	Drought, High wind, /Cyclone, Tsunami
Medium	Pollution, Industrial Hazard, chemical Hazards, Earthquake, Explosion
Low -Medium	Nuclear Disasters, Radiological Emergency
Low	Epidemic, Air Raids

Based on the above analysis following six hazards were selected and submitted to PUCSL with a request to select for hazard for further analysis.

1. Floods
2. Landslide,
3. Coastal Hazard
4. Drought,
5. High wind, /Cyclone,
6. Tsunami

2.2.8. Prioritized Hazards

It is expected that the hazard ranking report will serve as a base document for in depth risk analysis required to be done for this study. Based on the available data, the result of final raking is Flood, Landslide, Coastal Hazard, Drought, High wind, /Cyclone and Tsunami.

PUCSL, in consultation with CEB and LECO, has informed that the following hazard have been selected for detail hazard exposure, vulnerability and risk analysis. Table 2.6;

Table 2.6: Hazards selected for risk analysis

CEB	LECO
Flood	Flood
Drought	High wind/ Cyclone
High wind/ Cyclone	Coastal Hazards (cover Coastal Erosion, Sea Surges and Sea Level Rise)
Landslide	Tsunami

2.3. Hazard Assessment

Sources and the details of data used for the Hazard Assessment are given below table

Table 2.7: Details of Hazard Layers

Hazard	Sources	Scale	Area Covered	Remarks
Flood	Disaster Management Centre, Irrigation Department	1:50,000	All Island	Map compiled with 100 years return period flood map published by CRIP project - Ministry of irrigation and Water Management for 10 river basins with remote sensing Data extracted timely during flood events.

Landslide	National Building Research Organization	1:50,000	All landslide prone areas	Map depicts landslide susceptibility areas
Drought	Disaster Management Centre	1:50,000	Island wide	Maps prepared based on the Agro-Ecological Zones and categorized as high, moderate and low. Hazard profiles published by DMC
High winds Cyclone	Meteorological Department/ Disaster Management Centre			Hazard profiles published by DMC
Coastal hazards		1:50,000		
Sea level Rise	Disaster Management Centre		Covering whole coastal areas	Hazard profiles published by DMC
Sea surges		1:50,000		
Tsunami	Disaster Management Centre	1:50,000	Cover coastal belt 2 km into the land	Hazard profiles published by DMC

2.3.1. Floods

Floods are caused by extreme rainfall, unusually high sea levels, or the failure of dams and dikes. Floods are becoming increasingly common as a result of human activity that causes environmental deterioration, deforestation, and unsuitable land use. However, certain floods are caused by the geomorphology and climatology of water catchment areas. The extent of flood effects is determined by the water's level, pace, and geographical region covered.

The average rainfall in Sri Lanka is approximately 2000 mm with significant variation across the country. The wet zone South western region of the country received 2500 mm of rainfall while the dry zone received 1750 mm rainfall during the northeast monsoon period. Most of the floods occur during these Southwest and North East monsoon period and are usually associated with tropical storms or depressions, active monsoon conditions and break monsoon situations.

The main effects of floods on electricity supply systems are the following:

- Total or partial destruction of water intakes to power house;
- Blockage of components due to excessive sedimentation;
- Inundation of Power transmission grid network
- Floating debris (uprooted trees or floating logs) could damage the distribution network including electricity poles located in low lying areas

- Flood water could damage the household distribution system
- Flooding of Grid Sub stations

Spatial distribution of the maximum experienced flood in the country is given in figure 2.1

Spatial distribution of flood situation of the entire country is given in Figure 2.1 (Irrigations Department has prepared flood maps covering inundation areas and not depth) and 17.37% of the country affected by flood in varying degrees. Severe flooding areas belongs to the South and Western part of the country which represent 14.12 %.

List of major flood events experience during 2010-2024 in the country has been summarized in table 2.8 below;

Table. 2.8: Major flood events experience during 2010-2024) in the country

SN	Name of the event	Period/Year	Area affected	General impact with specific Impact to Electricity Sector
1.	South west monsoon Floods, Kelani, Kalu, Gin Nilwala ganga and Attanagalu Oya	May 2010	Colombo, Kalutara, Gampaha, Galle Matara districts	Damaged to infrastructure mainly household distribution system) Rs 9.3 million and losses Rs 6 million due non-payments of bills.
2.	South west monsoon Floods, Malwathuoya, Kelani, Kalu ganga Attanagalu Oya, Daduruoya,	May 2016	Anuradhapura, Colombo, Gampaha, Kegalle, Puttalam, Rathnapura	Power supply in 19 districts interrupted. Highest number of damages in Kaduwela divisional Secretariat. Bulk supply meters, transformers, MCCB, Distribution lines, MCCB cutouts, Energy meters and few stores. CEB damages- Rs.154.67 mns Losses - Rs 314,48 mns LECO damages- Rs.5297 mns Losses - Rs 109.7 mns
3	South west monsoon flood	2017 May 25 June 6	Galle, Matara, Hambantota, Rathnapura, Kalutara districts. Highest damages recorded in	Matara Grid Substation was completely inundated. The cost of damages to the Matara GSS was estimated to be LKR 48.49 million. Due to interruption of power supply 330,000 people were affected.

Kotapola DS division in Matara district. Power disconnected to 143,371 consumers in Rathnapura town, Elapatha, Kiriella, Ayagama and Kalawana.

Serious damages recorded in Kalawana, Ayagama and Kalutara DS divisions. In Kalutara district 79,000 consumers were affected. Total Damages and losses to power sector was Rs 652.46 mns. CEB damages and losses were Rs 474.32 mns and Rs 178 mns respectively. LEO incurred a damages and losses of Rs 0.31 mns and Rs. 0.15 mns respectively.

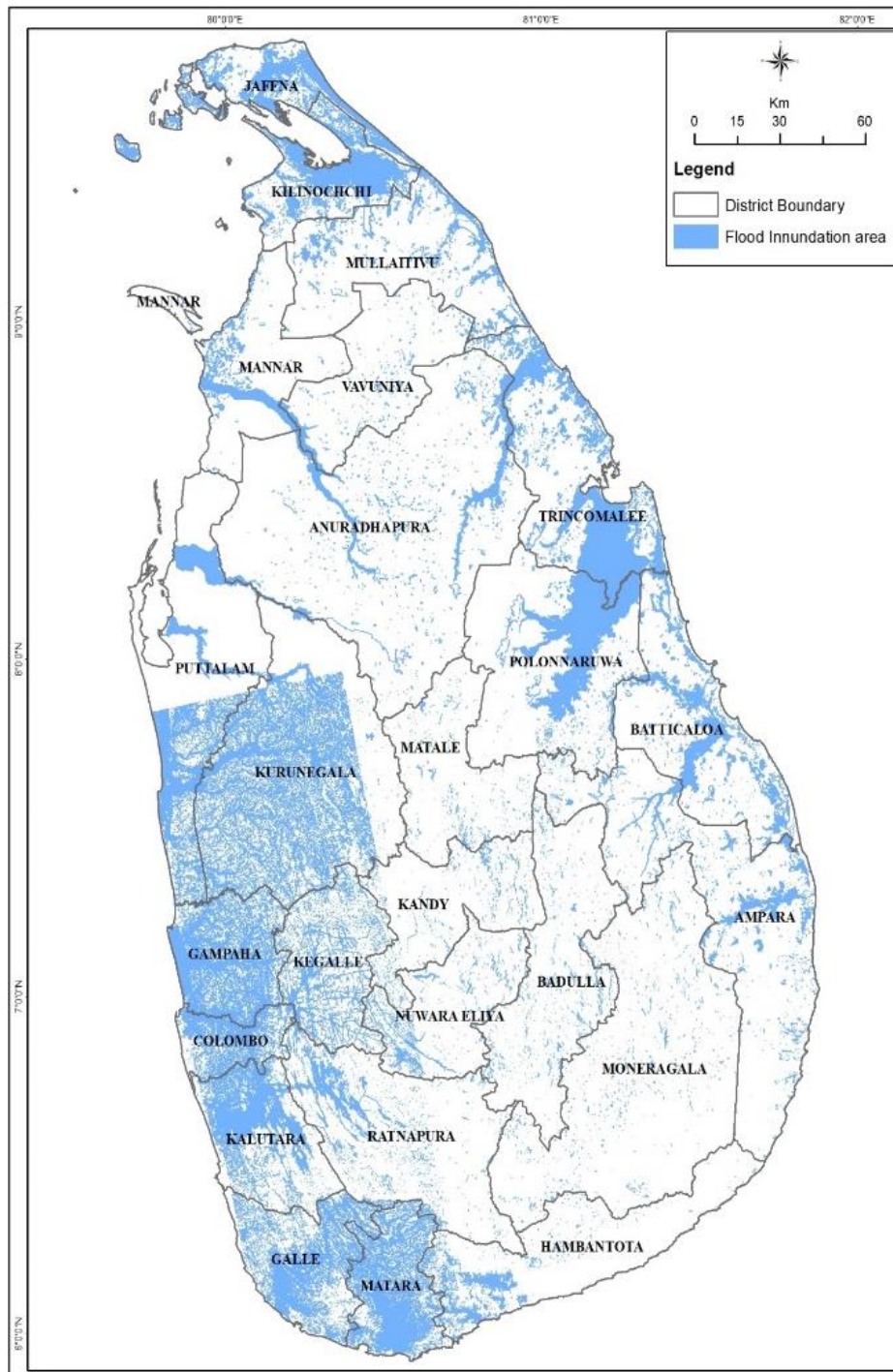


Figure 2.1. Flood Risk at District level (Sources: Data from DMC and Dept. of Irrigation)

2.3.2. Landslides

Landslides occur when the composition, structure, hydrology, or vegetation of a sloping terrain changes abruptly or gradually. They are frequently linked to major dangers such as earthquakes and water saturation induced by storms or heavy rains. Leaks in the irrigation channels located in hilly terrain as well as leaks water supply distribution systems could cause excessive moisture in the soil leading to landslides. When drinking water is supplied without sufficient sewage, the

situation can deteriorate quickly. The magnitude of a landslide's impact is determined by the volume and speed of the mass in motion, as well as the extension of the unstable zone and the mass's fragmentation. Landslides are generally predictable since they are preceded by fissures and undulations in the terrain.

- Total or partial destruction of the works, particularly intake and transmission components in the path of active landslides
- Footing of transmission towers located in hilly slopes could be affected
- Indirect impacts due to the blocking of roads and the disruption of power and communications;

As shown in the Figure 2.2 Kandy, Matale, Kegalle, Rathnapura, Galle, Matara, Hambanthota, Kalutara, Badulla, NuwaraEliya, Badulla, Moneragala, Gampaha and Colombo have been identified as possible district for landslides and slope failures but details of the probability for occurrence of landslide or slope failures not available.

Landslide susceptibility map (Figure 2.2) depicts in the figure and the landslide hazard zonation were categorized as; Not likely, Modest, Expected and Most likely following qualitative assessment by national Building Research Organization (NBRO). Moreover, flow path of the landslides is also not available.

List of major landslide events experience in the country has been summarized in table 2.9 below;

Table 2.9: Major Landslide events experienced 2000-2024

S.N.	Name of the event	Period/Year	Area	General impact with specific Impact to Electricity Sector
1	Devastating Landslides due to heavy precipitation exceeding 250mm /day	2003 January	Rathnapura, Matara, Hambantota	157 people dead due collapse of houses. Distribution lines providing power to the village was damaged. Revenue losses reported.
2	Slope failures and landslides	Jan 2007	Walapane, Nuwaraeliya and Matara district	23 people lost their lives, 350 houses destroyed. No major damages to distribution system
3	Landslides due to heavy rainfall exceeding 250 ml per day	May 2010	Matale, Nuwara Eliya, Badulla, Ratnapura, Kegalle, Kalutara, Matara and Galle districts	Damages to distribution systems and house hold connections
5	Landslides due to torrential rain	Rain May 14 – 16, 2016	Homes of 72 families in the villages of Siripura, Pallebage and	Damages to houses connections, meters, switch gear.

Elagipitya. Kegalle and Rathnapura districts were damaged

- 6 Landslides due to heavy precipitation exceeding @500-300 mm /day 25 may 2017 Kalatuwawa are in Colombo district. Power supply to Water Pumping Stations at Labugama/ Kalatuwawa affected due to earth slip at Thummodara, interrupting water supply in Colombo District.

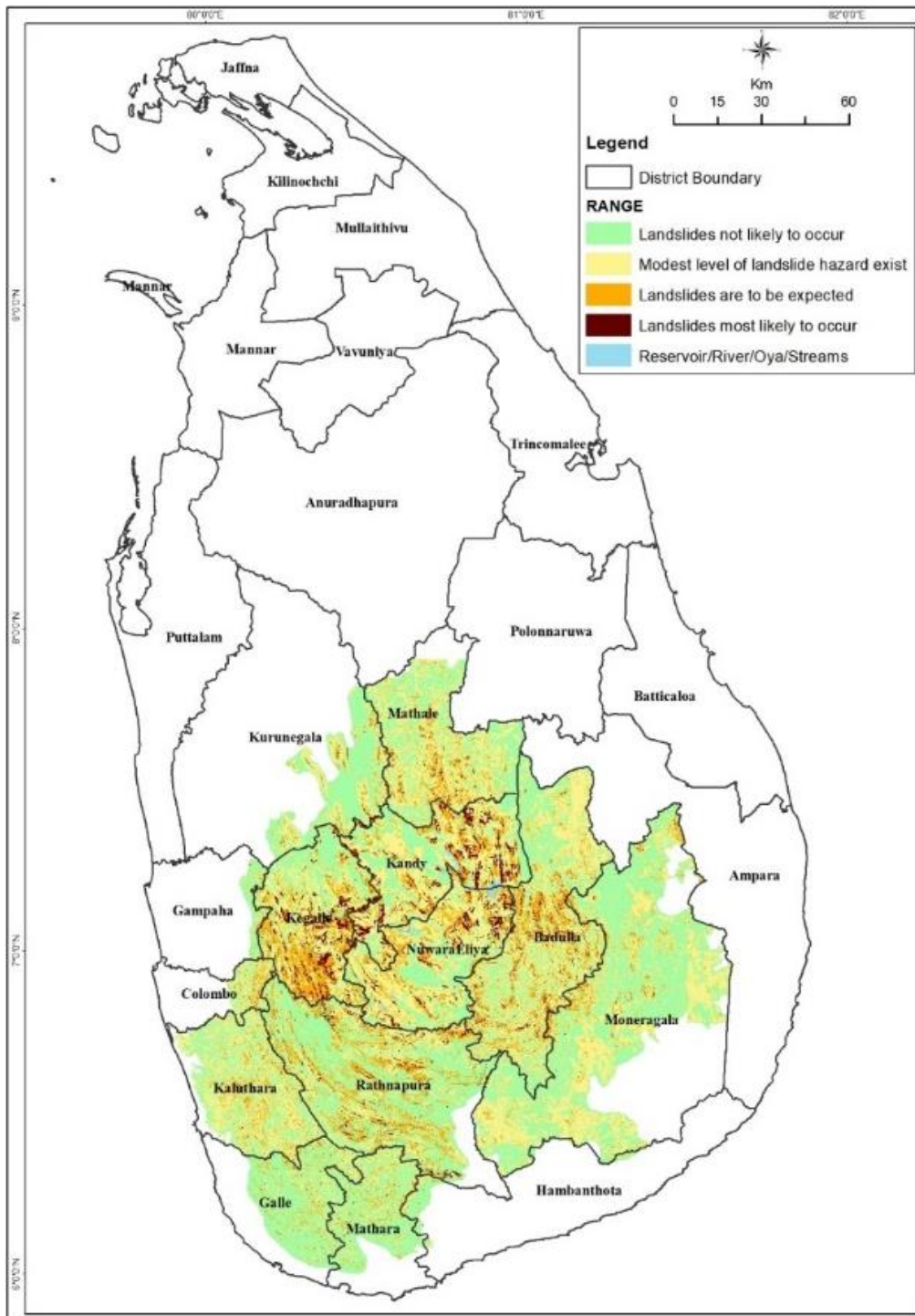


Figure 2.2. Landslide Susceptible Map of Sri Lanka (Data Source: NBRO)

2.3.3. Drought

Droughts are long, dry periods that occur during natural climatic cycles and are caused by a complex set of hydrometeorological variables that affect both the soil and the atmosphere. They do not necessarily start when it stops raining, because enough water may have been stored in reservoirs or in the ground to maintain hydric equilibrium for a while. A deficit of rainfall below the annual average cause's dry spells and a prolonged deficit could trigger slow-onset drought

conditions. Droughts have resulted in significant economic, environmental, and social impacts causing revenue losses increase expenditure in energy sector.

The potential impact of drought on electricity systems includes the following effects:

- Partial or total shutdown of generation of Hydro power
- Increasing power demand due to dry weather condition
- Increasing use of fossil fuel to balance the losses from hydro power

Spatial distribution of drought which has developed by DMC is shown in figure 2.3 with three zones as High, moderate and Low considering dry spells and the drinking water distribution data and information. Hence usage of the map having limitation as it does not reflect the total drought types such as meteorological, hydrological, social etc.

List of major drought events experience in the country has been summarized in table 2.10 below;

Table 2.10: major drought events experience in the country

S.N	Name of the event	Period/Year	Area	General impact with specific Impact to Electricity Sector
1	Metrological, hydrological and agricultural drought	2000	Primarily Kurunegala Hambantota district.	Less precipitation in catchment areas limiting hydropower generation. More than 1.3 million people were affected.
2.	Metrological, hydrological and agricultural drought	2001	Mainly impacted in Ampara, Badulla, Hambantota, Moneragala, Rathnapura and Puttalam districts	Drought continued for nearly six months. Sri Lanka faced, electricity crisis following a severe drought and water levels in hydro reservoirs dropping drastically. Initially one-and-a-half-hour power cuts was introduced extending to even seven hours per day lately. ⁹ More than 2.14 million people were affected. Priority was given to provide drinking water.

⁹ History repeating itself-Sri Lanka electricity crisis, EIU Nov 2022, <http://www.chambers.lk>

3	Metrological, hydrological and agricultural drought	2004	Anuradhapura, Badulla Kurunegala, Puttalam, Hambantota, Monergala, Polonnaruwa, Puttalam Rathnapura	Reduction of hydropower generation led the CEB to purchase power from private operator of thermal power plants.
4	Metrological, hydrological and agricultural drought	2014	Ampara, Anuradhapura, Batticaloa, Hambantota, Polonnaruwa, Jaffna, Trincomalee, Puttalam Rathnapura, Kalutara, Mannar, Kilinochchi	Drought mainly impacted agriculture drinking water supply in NCP and NWP. The drought reduced water levels in reservoirs, forcing a reduction in hydropower generation and leading to power cuts.
5	Metrological, hydrological and agricultural drought	2016	19 Districts were affected. More than 50,000 people were affected in Ampara, Anuradhapura, Batticaloa, Gampaha and Hambantota districts	Generation hydropower reduced as the priority was given to provided drinking water.
6	Metrological, hydrological and agricultural drought	2017	Puttalam, Kurunegala, Trincomalee Hambantota. Impact has been island wide. A total of 21 districts affected.	Low water levels in the reservoir's catchment areas, limited the generation of hydropower.
7	Metrological, hydrological and agricultural drought	2018	Out of 13 districts affected, more than 100,000 people were affected in Batticaloa, Kilinochchi, Kurunegala, Mannar and Puttalam districts	In 2018 Sri Lanka experienced a significant drought, particularly impacting the dry and intermediate zones of the island
8	Metrological, hydrological and agricultural drought	2019	15 Districts were affected. Amapara, Batticaloa, Jaffna, Kilinochchi, Kurunegala, Mannar, Moneragala, Puttalam and Matale districts more than 50000 people affected.	

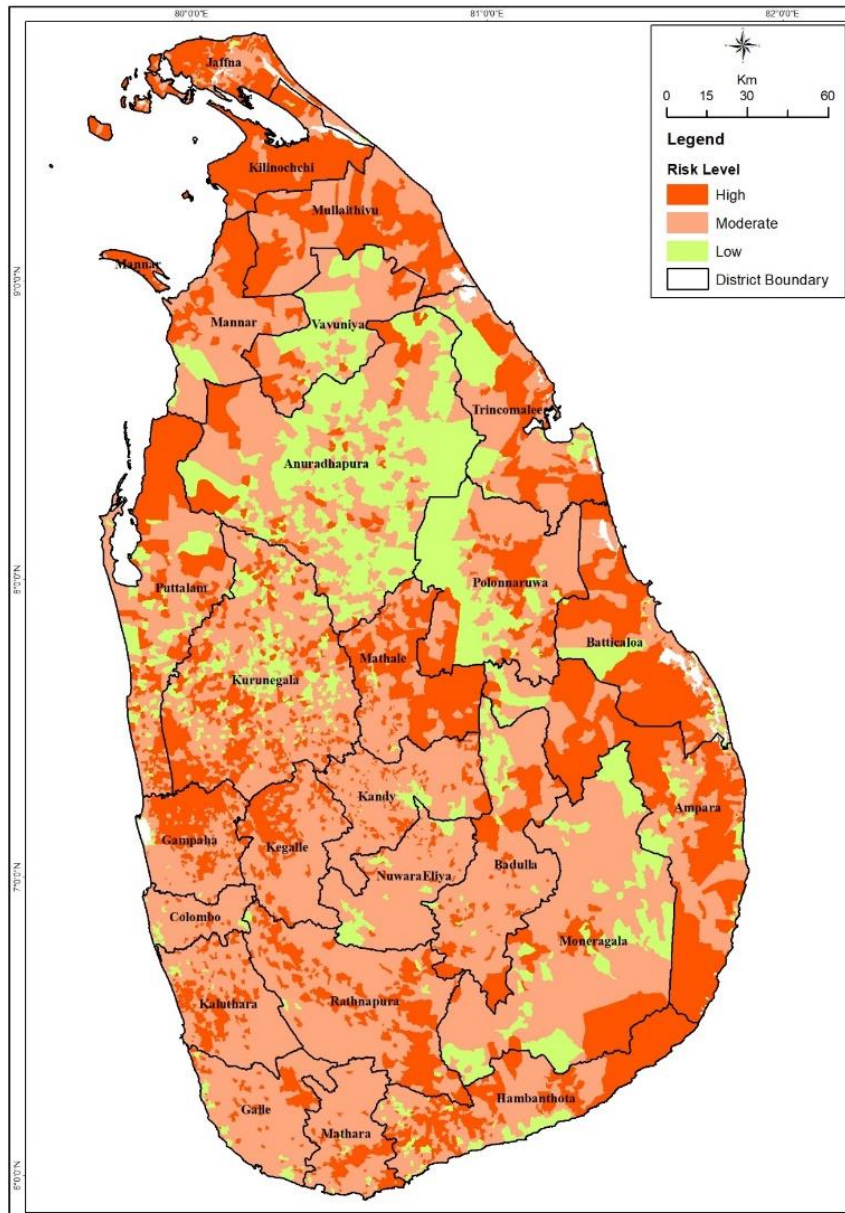


Figure 2.3. Drought Distribution Areas (Data Source: DMC)

2.3.4. High Winds/ Cyclones

A large proportion of cyclones are generated in the Bay of Bengal and the Arabian Sea. Because of the geographical location of the island, tropical cyclone path of the Bay of Bengal lies in the vicinity to the East and Northeast coastal areas. Cyclones that have gone through the island since 1900 are shown in Table 2.11 Most cyclones do not make landfall in Sri Lanka as its relative proximity of Sri Lanka to the equator. Of the 450 cyclones that formed in the Bay of Bengal during the period from 1891 to 2000, only 4% (Sixteen cyclonic or severe cyclonic storms) have made landfall in Sri Lanka. Severe cyclonic storms, in particular, have resulted in

the loss of lives of the order of several hundred as well as considerable damage to housing and other infrastructure due to both the surge and the high winds.

Table 2.11: Cyclones that have pass through Sri Lanka from 1891-2000

No.	Year/Month	Situation	Origin
1	1906 January	Cyclone Storm	07.5N, 84.5E
2	1907 March	Severe Cyclone Storm	08.5N, 86.5E
3	1908 December	Cyclone Storm	07.5N, 83.5E
4	1912 December	Cyclone Storm	05.5N, 82.5E
5	1913 December	Cyclone Storm	06.5N, 85.5E
6	1919 December	Cyclone Storm	08.0N, 86.0E
7	1922 November	Severe Cyclone Storm	08.5N, 88.5E
8	1925 March	Cyclone Storm	05.0N, 78.5E
9	1931 December	Severe Cyclone Storm	07.5N, 82.5E
10	1964 December	Severe Cyclone Storm	04.9N, 93.0E
11	1966 November	Cyclone Storm	08.0N, 84.
12	1967 December	Cyclone Storm	04.0N, 89.0E
13	1978 November	Severe cyclone storm	06.5N, 92.5E
14	1980 December	Cyclone Storm	10.5N, 91.5E
15	1992 December	Severe Cyclone Storm	07.5N, 87.2E
16	2000 December	Severe Cyclone Storm	07.5N, 90.0E

Source: Hazard Profile Sri Lanka

The spatial Distribution of cyclones in eastern and north central provinces are shown in figure 2.4 revealed that **Batticaloa**, Hambantota, Matara, Galle, Gampaha, Kalutara, Rathnapura and Badulla are **most impact districts**. In 1978 cyclone impacted eastern province of Sri Lanka destroyed over 13010 electrical lines resulted in a substantial number of people being left without electricity in the eastern province for some months.

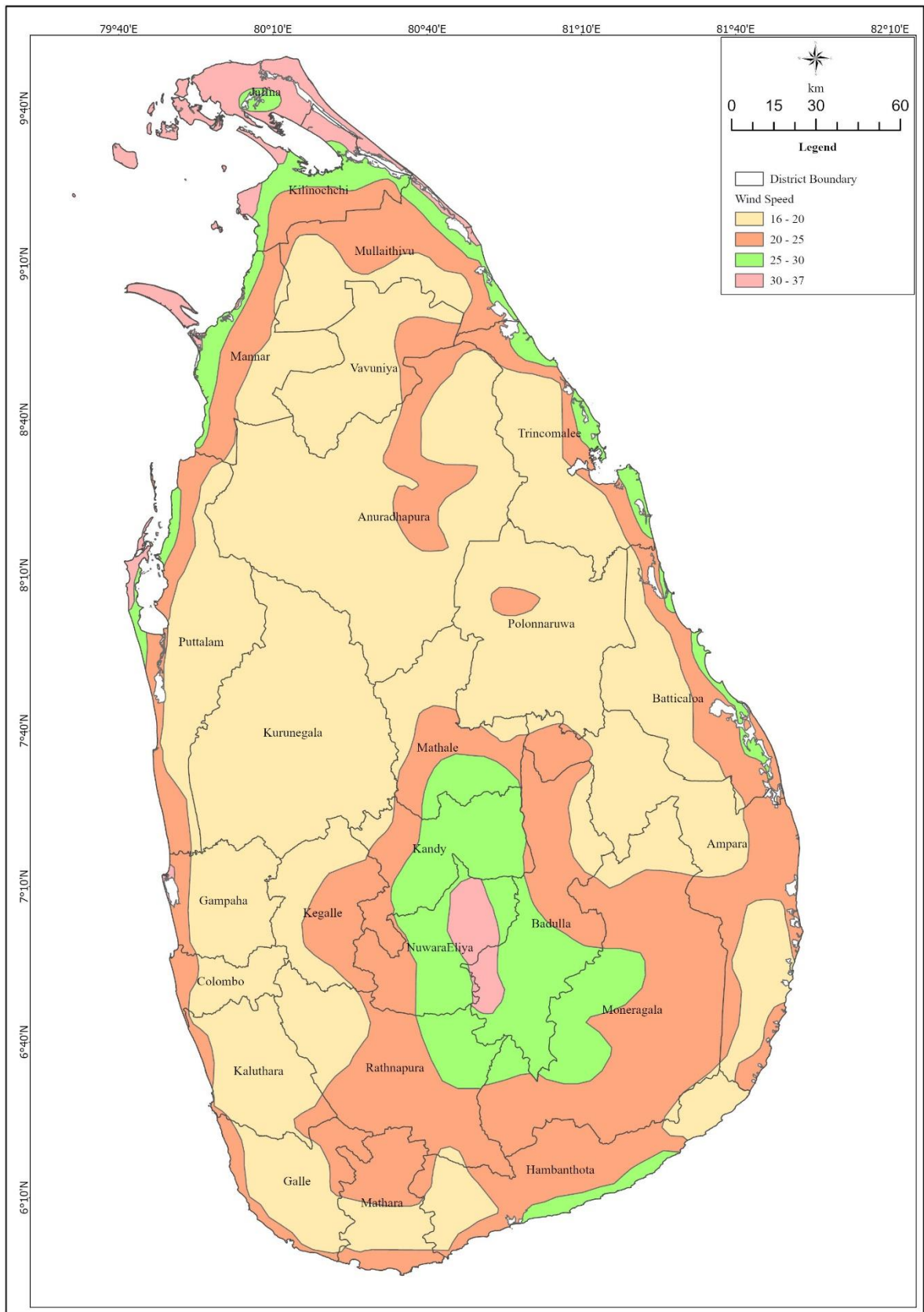


Figure 2.4. Spatial Distribution of Cyclone/High Wind in Sri Lanka

List of major Cyclone/high wind events experience in the country has been summarized in table 2.12 below;

Table 2.12: Major Cyclone/high wind events experience in the country

S.N.	Name of the event	Period/Year	Area	General impact with specific Impact to Electricity Sector
1	Cyclone	Nov 1978	Batticaloa district	130 electrical distribution lines including poles were destroyed.
2	Hihg wind Cyclone	2000 Feb 04 2000 Dec 26	Mostly affected Anuradhapura, Batticaloa and Trincomalee.	The 2000 cyclone had a significant impact on Sri Lanka's electricity distribution system, causing widespread disruptions and damage. Strong winds and heavy rainfall led to power outages and damaged electrical systems in many areas. Several areas were left without power for days. Fallen trees damaged distribution lines.
3	High wind	2012 December 18 th and 19 th	Mostly affected was Batticaloa district	Total number of people affected was 197,437 of which 195,189 were from Batticaloa district. Local distribution system was affected. Some damages caused by fallen trees
4	High winds	2017 December	Matara, Kalutara, Galle and Colombo districts were mostly affected.	Total of 126531 people affected. 34,105 houses damaged. Only the distribution lines in affected districts were damaged due fallen trees.
5	High winds caused by Cyclonic affect	2020 December	Jaffna district mostly impacted. Colombo and Gale are other districts affected.	Out of 173,540 people affected 62,840 from Jaffna district. 14,125 houses were also damaged

2.3.5. Tsunami

In 2004, a massive earthquake registering 9.0 on the Richter scale struck off the coast of Sumatra, Indonesia triggering a tsunami impacted several countries including Sri Lanka. More than 31,000 people in Sri Lanka were dead and approximately 6,300 remained missing. Coastal areas from Chillaw to Jaffna via Galle were affected in varying degrees across thirteen districts as shown in Figure 2.5 The waves penetrated inland areas up to 500 meters in many places, leaving behind few intact structures. Coastal infrastructure, including roads and railways, power, communications, water supply and sanitation facilities, and fishing harbors have all been severely damaged.

Displaced person exceeded 400, 000, and nearly 2 million people were affected. estimates stand at 443,000, while the affected population were estimated between one and two million. More than 130,000 houses were damaged of which nearly 99,000 were completely destroyed.

Despite the unprecedented loss of human life, it appears that the impact of the tsunami disaster on the power sector is rather limited and marginal. The damage is largely confined to the medium and low voltage distribution lines and transformers located in coastal areas, while other infrastructure (such as grid-substations, major transmission lines, and power plants) was not directly damaged by the tsunami. The number of households in the Ceylon Electricity Board (CEB) operating area to which electricity supply was interrupted is approximately 62,500 (about 2 percent of total CEB household customers) and more than 7,800 in Lanka Electricity Company Ltd. (LECO) operating area (more than 2 percent of total LECO household customers). About 48 km of medium voltage distribution lines (11kV and 33kV) and 405 km of low voltage distribution lines (below 400V) are destroyed and need to be replaced. About 70,000 sets of meters and service wires connected to households are also damaged, as the tidal wave washed away houses, distribution poles, and wires. A total of 88 sub-stations located in the distribution networks were also damaged. The total cost of damage to the assets owned by the CEB and LECO, according to the preliminary estimate, is approximately LKR 1.04 billion (\$10.0 million)¹¹.

¹¹ Sri Lanka 2005 Post-Tsunami Recovery Program Preliminary Damage and Needs Assessment- Asian Development Bank Japan Bank for International Cooperation and World Bank Colombo, Sri Lanka January 10 – 28, 2005

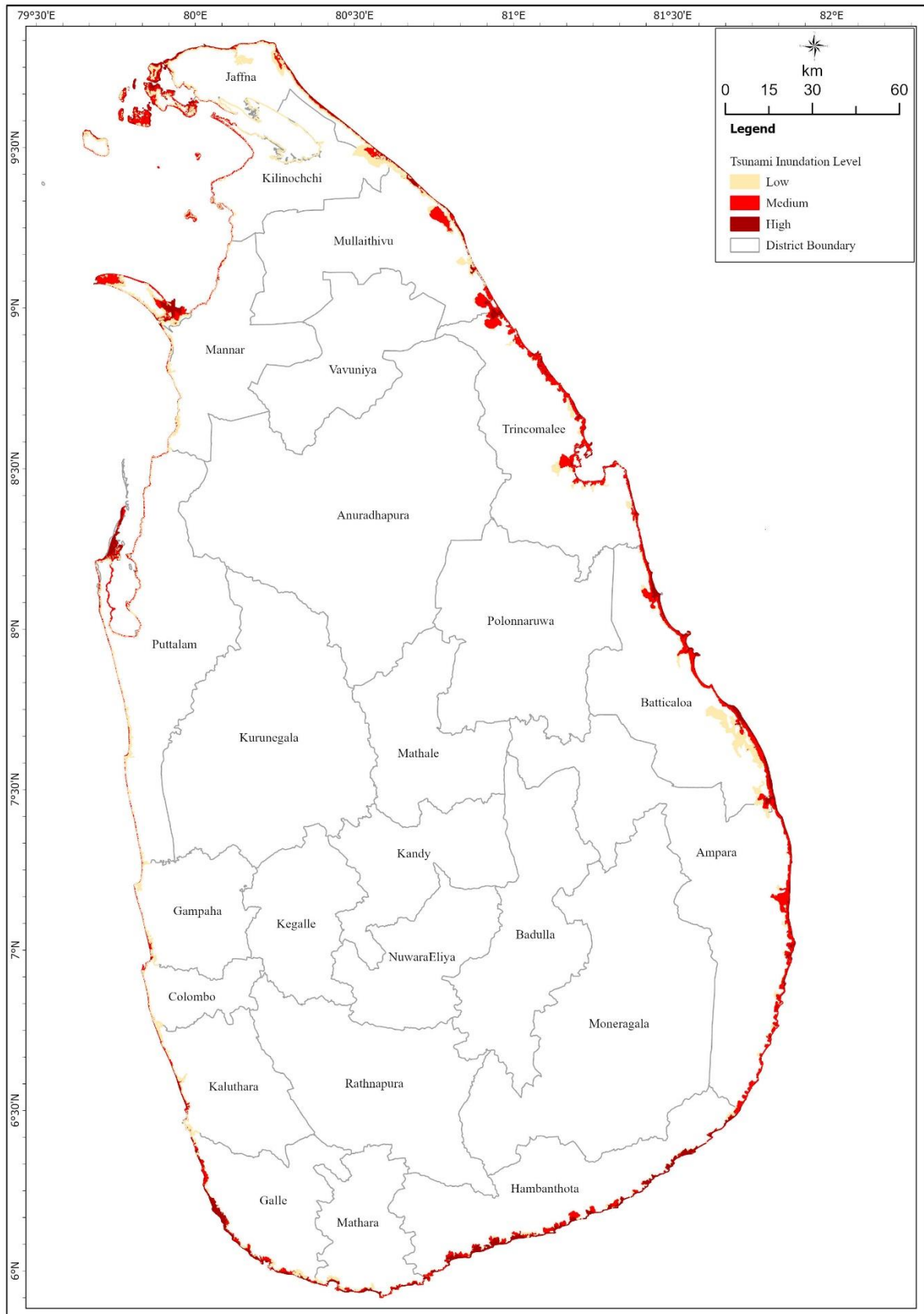


Figure 2.5. Tsunami Inundation map

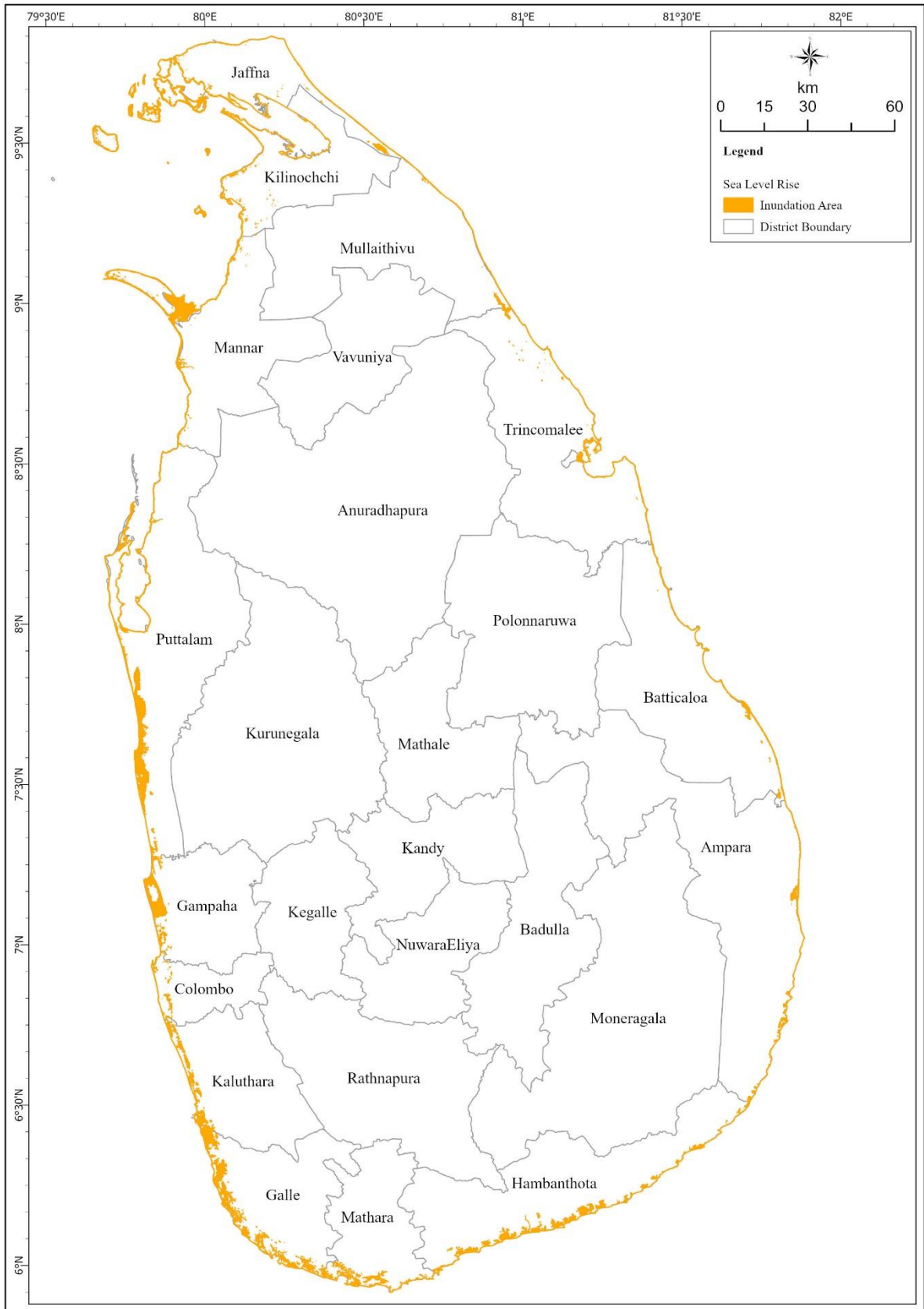


Figure 2.6. Sea Level Rise map

2.3.6. Coastal Hazards (Sea Level Rise & Sea Surge)

2.3.6.1. Sea Level Rise

The Intergovernmental Panel on Climate Change (IPCC) has predicted in 2007 that coastal area is vulnerable to sea level rise and in its 1997 report has stated for the tropical area that “Coastal lands are particularly vulnerable to sea level rise and under the worst condition sea level could rise 59cm in 100 years (Fig. 2.6). Thermal expansion of ocean waters as they warm and Increase in the ocean mass, principally from land-based sources of ice (glaciers and ice caps, and the ice sheets of Greenland and Antarctica) are two main reasons for sea level rise.

Hazard profile provides four scenarios of predicted change of sea level, compared to datum established in 2000. High tide and the sea level rise due to climate change are considered predicting the final level and as given below.

2025-year sea level rise	0.508 m
2050-year sea level rise	0 .658 m
2075-year sea level rise	0.808 m
2100-year sea level rise	0.95

Most affected coastal areas are in Puttalam, Colombo, Gampaha, Kalutara, Galle, Matara, Hambantota, Mannar and Jaffna districts.

2.3.6.2. Sea Surges

Abnormal rise in sea water level due to high wind or cyclones inundating low lying areas in the coastal belt. Depending on the topographical features of the coastal belt, wind speed and other factors sea waves could rise several meters above the present level.

Hazard profile has shown that the north and east coasts are more prone to the cyclone induced storm surge hazard (Fig. 2.7) with the north-western coastline including the coastal areas of Mannar and Jaffna peninsula particularly exposed.

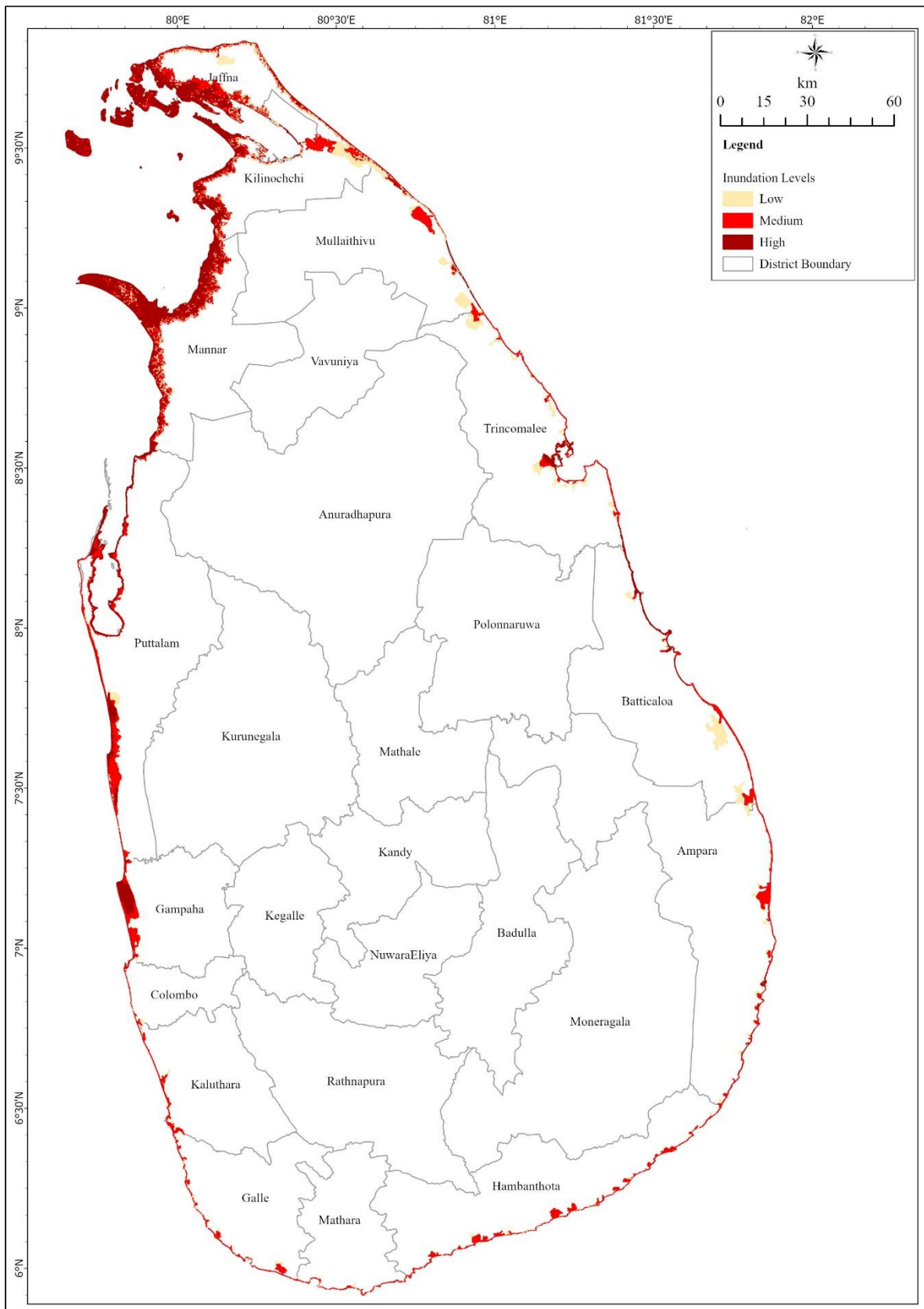


Figure 2.7. Sea surge map

Table 2.13: Multi Hazards at District Level

District	Total Area (km2)	Area Cover under each Hazards (km2)													% Area Cover under each Hazards																
		Flood	Drought			Landslide Susceptibility	Cyclone/High Wind				Tsunami	Sea Level Rise	Sea Surge	Flood	Drought			Landslide Susceptibility	Cyclone/High Wind				Tsunami	Sea Level Rise	Sea Surge						
			Low	Moderate	High		1	2	3	4					16-20	20-25	25-30		30-37	Low	Moderate	High				1	2	3	4	16-20	20-25
Ampara	4485.03	263	372.142	1486.31	2606.54					2731.5	1687.7	0.005		124.5	21.2	59.6	5.86	8.30	33.14	58.12					60.90	37.63	0.00		2.78	0.47	1.33
Anuradhapura	7212.23	385	3553.03	2921.29	736.928					6172.9	1038.3						5.34	49.26	40.50	10.22					85.59	14.40					
Badulla	2871.96	19.9	250.917	2021.52	599.831	947.33	1361.7	466.22	78.571	306.14	1091.6	1275	199.24				0.69	8.74	70.39	20.89	32.99	47.41	16.23	2.74	10.66	38.01	44.40	6.94			
Batticaloa	2489.19	433	260.842	777.458	1444.88					1379.8	924.03	185.3		241.9	23	84.7	17.40	10.48	31.23	58.05					55.43	37.12	7.44		9.72	0.92	3.40
Colombo	679.727	202	37.7468	609.166	33.9411	74.699	114.59	36.337	3.4606	536.9	144.2			9.9	9.6	4.5	29.72	5.55	89.62	4.99	10.99	16.86	5.35	0.51	78.99	21.21			1.46	1.41	0.66
Galle	1615.66	317.9	64.8147	1354.99	195.171	754.06	205.54	92.517	5.1148	1079.3	534.51			61.7	30.9	20	19.68	4.01	83.87	12.08	46.67	12.72	5.73	0.32	66.80	33.08			3.82	1.91	1.24
Gampaha	1385.98	519.8	15.345	766.207	601.662	111.26	31.28	12.86	0.6839	1182.8	186.71		15.83	12.8	50.5	83.6	37.50	1.11	55.28	43.41	8.03	2.26	0.93	0.05	85.34	13.47		1.14	0.92	3.64	6.03
Hambantota	2623.59	122	208.145	1239.11	1173.37	122.19	32.463	9.129	0.5276	890.42	1471.6	254		112.5	65.7	45.5	4.65	7.93	47.23	44.72	4.66	1.24	0.35	0.02	33.94	56.09	9.68	0.00	4.29	2.50	1.73
Jaffna	1012.01	417.8	16.5672	372.941	600.862							83.61	888.28	245.8	77.5	525	41.28	1.64	36.85	59.37					0.00	0.00	8.26	87.77	24.29	7.66	51.88
Kalutara	1646.45	414	19.8753	1271.69	353.934	606.36	739.57	149.33	8.6463	1441.7	203.78			21.3	30.5	16.8	25.15	1.21	77.24	21.50	36.83	44.92	9.07	0.53	87.57	12.38			1.29	1.85	1.02
Kandy	1924.03	16	104.449	1589.63	224.451	546.28	827.81	318.06	183.64	122.25	521.53	1281	0.0084				0.83	5.43	82.62	11.67	28.39	43.02	16.53	9.54	6.35	27.11	66.56	0.00			
Kegalle	1661.26	158	25.4779	1444.69	533.434	461.59	595.74	447.23	153.46	885.68	776.64						9.51	1.53	86.96	32.11	27.79	35.86	26.92	9.24	53.31	46.75					
Kilinochchi	1263.4	456	2.18417	166.805	1085.8						517.81	477	254.57	39.2	24.5	243	36.09	0.17	13.20	85.94					0.00	40.99	37.75	20.15	3.10	1.94	19.19
Kurunegala	4904.48	601	825.523	2860.33	1209.67	627.33	286.67	72.782	9.9039	4904.5	0.4101						12.25	16.83	58.32	24.66	12.79	5.85	1.48	0.20	100.00	0.01					
Mannar	1997.86	213.5	142.909	1208.59	649.713					757.73	774.87	309.2	140.02	61.3	24.6	424	10.69	7.15	60.49	32.52					37.93	38.79	15.48	7.01	3.07	1.23	21.21
Matale	2057.82	14.5	18.1806	853.556	1185.88	754.26	871.89	198.78	23.315	909.12	709.62	438.9					0.70	0.88	41.48	57.63	36.65	42.37	9.66	1.13	44.18	34.48	21.33				
Matara	1309.94	385	19.7927	1058.41	231.39	609.48	219.62	78.369	4.6466	498.28	810.55			23.8	23	2.7	29.39	1.51	80.80	17.66	46.53	16.77	5.98	0.35	38.04	61.88			1.82	1.76	0.21
Monaragala	5752.25	31	1195.88	3833.87	722.323	2348.7	1638.7	226.66	15.351	565.15	4058	1129					0.54	20.79	66.65	12.56	40.83	28.49	3.94	0.27	9.82	70.55	19.63				
Mulaithiu	2682.97	192.5	0.53285	1298.95	1274.36					1087.1	1115.6	245.6	68.294	108	8.2	84.5	7.17	0.02	48.41	47.50					40.52	41.58	9.15	2.55	4.03	0.31	3.15
Nuwara Eliya	1745.35	47	182.024	1500.12	61.0777	472.67	846.91	269.52	104.49		434.88	899	409.33				2.69	10.43	85.95	3.50	27.08	48.52	15.44	5.99	0.00	24.92	51.51	23.45			
Polonnaruwa	3446.32	770.5	1119.04	1629.87	716.944					3319.7	146.11						22.36	32.47	47.29	20.80					96.33	4.24					
Puttalam	3160.84	558	438.292	1456.24	1266.3					2075.7	810.53	156.9	74.794	54	134	203	17.65	13.87	46.07	40.06					65.67	25.64	4.97	2.37	1.71	4.24	6.43
Ratnapura	3288.7	162	39.1196	2316.59	933.073	1534.1	807.37	573.68	91.046	913.42	1824.1	551.3					4.93	1.19	70.44	28.37	46.65	24.55	17.44	2.77	27.77	55.47	16.76				
Trincomalee	2643.62	881.5	533.32	1261.73	847.514					1694.5	605.25	335.4		138.4	20.7	56.8	33.34	20.17	47.73	32.06					64.10	22.89	12.69		5.24	0.78	2.15
Vavuniya	1896.19	72.5	757.299	1010.37	237.638					1680.6	324.72						3.82	39.94	53.28	12.53					88.63	17.12					

2.4. Element at Risk

All objects, people, activities, and processes that may be adversely affected by hazardous phenomena in a specific area, whether directly or indirectly, are considered elements at risk in the disaster risk assessment. This includes structures, facilities, human resources, equipment, economic operations, public services, and the environment. The element at risk can be detailed based on the level of risk assessment. For example, if a project-specific risk assessment is necessary, more data about the element at risk must be considered because they raise the certainty of the risk assessment and allow for more accurate risk-based decisions. Easily it would be accomplished using the asset management registry of particular entity.

There are numerous sorts of elements at risk, as well as numerous classification schemes. The table is an example of such a classification.

Table 2.14: Example of Classification of Element at Risk

Element at risk	Required Details
Building	construction types, building height, building age, total floor space, replacement costs
Human Resources	No of human resources Staff and customers approximately, distribution in space, distribution in time, age distribution, gender distribution, handicapped
Essential Facilities	Transport, Equipment, Stores, generation Sources, etc.
Databases	Technical, Financial, Customer details etc.
Environment of the location	Electricity distribution characteristic's (Highly urbanized, Industrialized etc.)

The electricity sector includes interdependent functions that are potentially competitive, such as

generation and supply, and noncompetitive, such as provision of transmission and distribution networks. Hence, the selection of the list of elements at risk for the study followed by the process of delivering electricity which a chain

- Transformation of the energy source (fossil fuels, renewable natural resources, or nuclear) into electricity (generation);
- Transportation to large load centers and balancing supply with demand, since storage of large quantities of electricity is still unfeasible (transmission);
- Network to reliably connect and supply to end customers (distribution);

The summary of the element at risk considered for the study is given in Table 2.15.

Table 2.15: Summary of Element at Risk Electricity Sector

District	Generation			Transmission		Distribution			
	Power Generation			Grid sub stations		132 KV line Poles		Primary Stations	
	Hydro	Thermal include coal.	Renewable	CEB	LECO	CEB	LECO	CEB	LECO
	No.	No							
Ampara				01		282			
Anuradhapura				04		997			
Badulla				02		442			
Batticaloa				02		221			
Colombo		01		19		642			20
Galle				02		292			10
Gampaha		02		07		695			14
Hambantota				02		175			
Jaffna		01				98			
Kalutara		01		04		345			10
Kandy	04			03		643			
Kegalle	01			03		516			
Kilinochchi				01		134			
Kurunegala				04		527			
Mannar				02		157			
Matale	02			01		601			
Matara				02		241			
Monaragala	03			01		174			
Nuwara Eliya	07			03		87			
Polonnaruwa				01		522			
Puttalam		01		03		292			
Ratnapura	03			04		693			
Trincomalee				02		438			
Vavuniya				01		152			

2.5. Exposure Assessment

Exposure assessment is used to determine the contact of element at risk with a potentially hazardous event and, if so, level of exposure (Spatial Factor) and the duration of exposure (Temporal Factor) (Based on the length of hazard event).

In order to assess the level of exposure of the element at risk in against each hazards map over laying was applied using Arc GIS software. Coordinates of identified element at risk provided by CEB and LECO were overlaid with the hazard layers respectively and exposure level of the critical infrastructure (element at risk) were identified temporal factor has not been considered in detail under this study due to unavailability of high-resolution data but it was taken in account using the data available in Desinventra database of DMC.

2.5.1. Flood Exposure

Flood maps provided by Irrigation Department and DMC were merged with respect to the attribute data of the shape files. Since data on the severity of flood or the return periods are not available flood exposure of the element at risk was assessed following the inundation areas. Hence catchments exposure was based on the spatial extend of inundation and other elements at risk. Exposure was assessed based on the following indicator ***“Element at risk is located in inundation area Yes/No”*** and the exposed elements are summarized in the following tables 2.16.

Table 2.16: Level of Exposure of Power Stations (Generation) to Flood Hazard

District	Name of Element at Risk	Ownership	Type	Energy Source	Exposed to flood (Yes/No)
Colombo	Kelanitissa	CEB	Thermal	Oil	Yes
Gampaha	Sapugaskanda PS		Thermal	Oil	No
	Kerawalapitiya		Thermal	Oil	Yes
Jaffna	Chunnakam		Thermal	Oil	No
Kalutara	Kukule		Hydro	Water	No
Kandy	Kotmale		Hydro	Water	No
	Nilambe		Hydro	Water	No
	Rantembe		Hydro	Water	No
	Randenigala		Hydro	Water	No
Kegalle	Broadlands		Hydro	Water	No
Matale	Ukuwela		Hydro	Water	No
	Bowatenna		Hydro	Water	No
Moneragala	Udawalawa 2		Hydro	Water	No
	Uma Oya		Hydro	Water	No
	Inginiyagala PS		Hydro	Water	No
Nuwara Eliya	Canyon		Hydro	Water	No
	Wimalasurendra		Hydro	Water	No
	New Laxapana		Hydro	Water	No
	Laxapana		Hydro	Water	Yes

	Polpitiya		Hydro	Water	No
	Upper Kotmale		Hydro	Water	No
	Victoria		Hydro	Water	No
Puttalam	Lak Wijaya Coal		Thermal	Coal	No
Ratnapura	Embilipitiya ACE Power		Thermal	Oil	No
	Udawalawa 1		Hydro	Water	No
	Samanalawewa		Hydro	Water	No

Table 2.17: Level of Exposure of Transmission (Grid Sub Stations) to Flood Hazard

District	Name	Category	Ownership	Exposed to flood (Yes/No)
Ampara	Ampara	GSS	CEB	No
Anuradhapura	Habarana	GSS		No
	New Habarana GSS	GSS		No
	New-Anuradhapura	GSS		No
	Anuradhapura	GSS		No
Badulla	Badulla	GSS		No
	Mahiyanganaya GSS	GSS		No
Batticaloa	Vavunativu	GSS		No
	Valachchanai	GSS		No
Colombo	Kesbewa GSS	GSS		Yes
	Ratmalana	GSS		No
	Pannipitiya	GSS		No
	Dehiwala	GSS		No
	Padukka GSS	GSS		No
	Oruwala GSS	GSS		No
	Sri Jayawardanapura	GSS		Yes
	Sub A-Havelock Town	GSS		No
	Athurugiriya	GSS		No
	Sub E-Kollupitiya	GSS		No
	Sub N-Hunupitiya	GSS		No
	Sub M-Slave Island	GSS		No
	Sub I-Maradana	GSS		No
	Sub F-Fort	GSS		No
	Kolonnawa	GSS		Yes
	Sub B- Pettah	GSS		No
	Kosgam	GSS		No
	Sub C-Kotahena	GSS		Yes
Seethawaka	GSS	No		
Galle	Galle	GSS		No
	Ambalangoda GSS	GSS		No
Gampaha	Sapugaskanda GSS	GSS	No	
	Kelaniya GSS	GSS	Yes	
	Biyagama	GSS	No	
	Aniyakanda GSS	GSS	Yes	

	Kotugoda	GSS		No
	Katunayake	GSS		Yes
	Veyangoda	GSS		No
Hambantota	Beliatta	GSS		No
	Hambantota	GSS		No
Kalutara	Matugama	GSS		No
	Kaluthara GSS	GSS		No
	Panadura	GSS		No
	Horana GSS	GSS		Yes
Kandy	Nawalapitiya GSS	GSS		No
	Kiribathkumbura	GSS		No
	Pallekele GSS	GSS		No
Kegalle	Maliboda GSS	GSS		No
	Kegalle GSS	GSS		No
	Thulhiriya	GSS		No
Kilinochchi	kilinochchi	GSS		No
Kurunegala	Pannala	GSS		No
	Kurunegala	GSS		No
	New Chilaw GSS	GSS		No
	Maho Grid Substation	GSS		No
Mannar	Mannar GSS	GSS		No
	Nadukkuda	GSS		No
Matale	Naula GSS	GSS		No
Matara	Matara	GSS		Yes
	Deniyaya	GSS		No
Moneragala	Monaragala GSS	GSS		No
Nuwara Eliya	Nuwara Eliya	GSS		No
	New Polpitiya GSS	GSS		No
	Ragala GSS	GSS		No
Polonnaruwa	Polonnaruwa GSS	GSS		No
Puttalam	Bolawatta	GSS		No
	Madampe	GSS		No
	Puttalam	GSS		No
Ratnapura	Embilipitiya	GSS		No
	Balangoda	GSS		No
	Ratnapura	GSS		No
	Wewalwatta GSS	GSS		No
Trincomalee	Kappalthurai	GSS		No
	Trincomalee	GSS		No
Vavuniya	Vavunia	GSS		No

Table 2.18: Level of Exposure of Distribution System to Flood Hazard

District	Element at Risk			Element at Risk Exposed to flood							
	Total Distribution 132 KV line Poles	No of system Poles	Primary Stations	No of Distribution system 132 KV line Poles			Primary Stations				
				CEB	LECO	Total	CEB	LECO	Total		
Ampara	282	No			60			60			
Anuradhapura	997				44			44			
Badulla	442				0			0			
Batticaloa	221				18			18			
Colombo	642			20	600			600		8	
Galle	292			10	74			74			
Gampaha	695			14	639			639		6	
Hambantota	175				32			32			
Jaffna	98				74			74			
Kalutara	345			10	275			275		1	
Kandy	643				1			1			
Kegalle	516				57			57			
Kilinochchi	134				116			116			
Kurunegala	527				178			178			
Mannar	157				28			28			
Matale	601				0			0			
Matara	241				238			238			
Moneragala	174				0			0			
Mullaitivu	87				4			4			
Nuwara-Eliya	522				5			5			
Polonnaruwa	292				96			96			
Puttalam	693				112			112			
Ratnapura	438				11			11			
Trincomalee	152				70			70			
Vavuniya	331				8			8			

2.5.2. Exposure of Element at Risk to Landslide Hazard

1:50,000 scale landslide susceptible map provided by the National Building Research Organization (NBRO) was used to understand the level of exposure of the element at risk (Power generators, Grid stations, sub stations, pylon transmission lines, distribution system). Landslides maps have categorized level of susceptibility to occur landslide in geographical area as Not Likely, Modest, Expected and Most Likely. But the maps have not been validated based on the actual historical record on landslide and the landslide flow paths have not been identified. Hence the degree of certainty of maps is questionable. Summary of the element at risk exposed to landslide is given in Table 2.19. Thermal Power plants are not located in Landslides prone areas.

Table 2.19: Level of Exposure of Power Stations (Generation) to Landslide Hazard

District	Name of Element at Risk	Ownership	Exposed to Landslide			
			Not likely	Modest	Expected	Most likely
Kalutara	Kukule	CEB	×			
	Kotmale					×
Kandy	Nilambe		×			
	Rantembe		Near water body			
	Randenigala			×		
Kegalle	Broadlands			×		
Matale	Ukuwela			×		
	Bowatenna				×	
	Udawalawa 2		×			
Moneragala	Uma Oya		×			
	Inginiyagala PS		×			
	Canyon				×	
	Wimalasurendra		Near water body			
	New Laxapana				×	
Nuwara Eliya	Laxapana				×	
	Polpitiya				×	
	Upper Kotmale				×	
	Victoria		×			
Ratnapura	Samanalawewa		×			

Table 2.20: Level of Exposure of Grid Sub Stations (Transmission) to Landslide Hazard

District	Element at Risk	Ownership	Exposed to Landslide			
			Not likely	Modest	Expected	Most likely
Badulla	Badulla	CEB	×			
Badulla	Mahiyanganaya GSS		×			
Colombo	Kosgam		×			
Colombo	Seethawaka			×		
Kalutara	Matugama			×		
Kalutara	Kaluthara GSS		×			
Kalutara	Panadura			×		
Kalutara	Horana GSS			×		
Kandy	Nawalapitiya GSS			×		
Kandy	Kiribathkumbura		×			
Kandy	Pallekele GSS		×			
Kegalle	Maliboda GSS			×		
Kegalle	Kegalle GSS		×			
Kegalle	Thulhiriya		×			
Kegalle	Thulhiriya		×			
Kurunegala	Kurunegala		×			
Matale	Naula GSS			×		
Matara	Deniyaya			×		
Moneragala	Monaragala GSS		×			
Nuwara Eliya	Nuwara Eliya			×		
Nuwara Eliya	New Polpitiya GSS			×		
Nuwara Eliya	Ragala GSS					×
Ratnapura	Balangoda		×			
Ratnapura	Ratnapura		×			
Ratnapura	Wewalwatta GSS			×		

Table 2.21: Level of Exposure of Distribution System to Landslide Hazard

District	Total No of Distribution system 132 KV line Poles				Primary Stations				
	Not likely	Modest	Expected	Most likely	Not likely	Modest	Expected	Most likely	Not likely
Badulla	162	220	52	6	No				
Colombo	38	52	10	2					
Galle	66	4	3	1					
Gampaha	10	2							
Hambantota	4	1							
Kalutara	142	138	28	2					
Kandy	242	281	63	41					
Kegalle	147	210	125	39					
Kurunegala	120	28	3						
Matale	252	216	32	2					
Matara	75	37	6						
Moneragala	123	49	2						
Nuwara Eliya	117	299	61	24					
Ratnapura	188	83	57	1					

2.5.3. Exposure to Drought Hazard

Sri Lanka has constructed 16 major hydro power plants, which have capacity to generate 1074 MW. All hydro power plants are located in Central and Sabaragamuwa provinces. As of 2017, just under 30% of Sri Lanka's gross electricity generation came from hydropower¹². In 2019 total hydropower generation was reduced to 15% of the generating capacity due to drought impact. Since the water scarcity is the issue associated with drought, hydro power stations were considered for analysis exposure to drought against the high, moderate and low categories. Hazard map published by the DMC and desinventar data base used. Summary given in Table 2.22. Udawalawe and Umaoya Hydro power plants are highly exposed to drought. Wimalasurendra and Upper Kothmale power plants indicate low exposure. Other 19 PS are located in moderately expose areas. Chunnakam Termal power plant of Jaffna district require has make arrangement to get water for cooling system during drought.

¹² Climate Risk Country Profile Sri Lanka-WB Group- ADB 2021

Table 2.22: Level of Exposure of Power Stations (Generation) to Drought Hazard

District	Name of Element at Risk	Ownership	Exposed to Drought		
			High	Moderate	Low
Colombo	Kelanitissa	CEB		×	
Gampaha	Sapugaskanda PS			×	
	Kerawalapitiya			×	
Jaffna	Chunnakam		×		
Kalutara	Kukule			×	
	Kotmale			×	
Kandy	Nilambe			×	
	Rantembe			×	
	Randenigala			×	
Kegalle	Broadlands			×	
Matale	Ukuwela			×	
	Bowatenna			×	
	Udawalawa 2			×	
Moneragala	Uma Oya		×		
	Inginiyagala PS			×	
	Canyon			×	
	Wimalasurendra				×
	New Laxapana			×	
Nuwara Eliya	Laxapana			×	
	Polpitiya			×	
	Upper Kotmale				×
	Victoria			×	
Puttalam	Lak Wijaya Coal			×	
	Embilipitiya ACE Power			×	
Ratnapura	Udawalawa 1			×	
	Samanalawewa				

Level of exposure of transmission and distribution to drought has not been investigated as it does not show substantial impact to infrastructures in those sectors.

2.5.4. Exposure to Cyclones and High Winds

Trees fallen due to high winds/cyclone could damage the poles in electricity distribution systems disrupting power supply. As example high winds which brought down trees, have cut off power to 467,500 electricity users in May 2024¹³).

Table 2.23: Level of Exposure of Power Stations (Generation) to Cyclones and High Winds Hazard

District	Name of Element at Risk	Ownership	Wind speed			
			16 - 20	20 - 25	25 - 30	30 - 37
Colombo	Kelanitissa	CEB		×		
Gampaha	Sapugaskanda PS		×			
	Kerawalapitiya			×		
Jaffna	Chunnakam					×
Kalutara	Kukule		×			
Kandy	Kotmale				×	
	Nilambe				×	
	Rantembe				×	
	Randenigala				×	
Kegalle	Broadlands		×			
Matale	Ukuwela			×		
	Bowatenna		×			
Moneragala	Udawalawa 2			×		
	Uma Oya				×	
	Inginiyagala PS		×			
Nuwara Eliya	Canyon			×		
	Wimalasurendra			×		
	New Laxapana			×		
	Laxapana			×		
	Polpitiya			×		
	Upper Kotmale				×	
	Victoria				×	
Puttalam	Lak Wijaya Coal				×	
Ratnapura	Embilipitiya ACE Power			×		
	Udawalawa 1			×		
	Samanalawewa				×	

Table 2.24: Level of Exposure of Grid Sub Stations (Transmission) to Cyclones and High Winds Hazard

District	Name	Category	Ownership	Wind speed			
				16 - 20	20 - 25	25 - 30	30 - 37
Ampara	Ampara	GSS	CEB	×			
Anuradhapura	Habarana	GSS		×			
	New Habarana GSS	GSS		×			
	New-Anuradhapura	GSS		×			
	Anuradhapura	GSS		×			
Badulla	Badulla	GSS				×	
	Mahiyanganaya GSS	GSS			×		
Batticaloa	Vavunativu	GSS			×		
	Valachchanai	GSS			×		
Colombo	Kesbewa GSS	GSS		×			
	Ratmalana	GSS			×		
	Pannipitiya	GSS		×			
	Dehiwala	GSS			×		
	Padukka GSS	GSS		×			
	Oruwala GSS	GSS		×			
	Sri Jayawardanapura	GSS			×		
	Sub A-Havelock Town	GSS			×		
	Athurugiriya	GSS		×			
	Sub E-Kollupitiya	GSS			×		
	Sub N-Hunupitiya	GSS			×		
	Sub M-Slave Island	GSS			×		
	Sub I-Maradana	GSS			×		
	Sub F-Fort	GSS			×		
	Kolonnawa	GSS			×		
	Sub B- Pettah	GSS			×		
	Kosgama	GSS		×			
	Sub C-Kotahena	GSS			×		
Seethawaka	GSS	×					
Galle	Galle	GSS	×				
	Ambalangoda GSS	GSS		×			
Gampaha	Sapugaskanda GSS	GSS	×				
	Kelaniya GSS	GSS		×			
	Biyagama	GSS	×				
	Aniyakanda GSS	GSS	×				
	Kotugoda	GSS		×			
	Katunayake	GSS		×			
	Veyangoda	GSS	×				
Hambantota	Beliatta	GSS	×				
	Hambantota	GSS		×			
Kalutara	Matugama	GSS		×			

	Kaluthara GSS	GSS		×			
	Panadura	GSS		×			
	Horana GSS	GSS		×			
Kandy	Nawalapitiya GSS	GSS			×		
	Kiribathkumbura	GSS			×		
	Pallekele GSS	GSS				×	
Kegalle	Maliboda GSS	GSS		×			
	Kegalle GSS	GSS		×			
	Thulhiriya	GSS		×			
Kilinochchi	kilinochchi	GSS			×		
Kurunegala	Pannala	GSS		×			
	Kurunegala	GSS		×			
	New Chilaw GSS	GSS		×			
	Maho Grid Substation	GSS		×			
Mannar	Mannar GSS	GSS				×	
	Nadukkuda	GSS					×
Matale	Naula GSS	GSS			×		
Matara	Matara	GSS		×			
	Deniyaya	GSS		×			
Moneragala	Monaragala GSS	GSS				×	
Nuwara Eliya	Nuwara Eliya	GSS					×
	New Polpitiya GSS	GSS			×		
	Ragala GSS	GSS					×
Polonnaruwa	Polonnaruwa GSS	GSS		×			
Puttalam	Bolawatta	GSS			×		
	Madampe	GSS			×		
	Puttalam	GSS		×			
Ratnapura	Embilipitiya	GSS			×		
	Balangoda	GSS				×	
	Ratnapura	GSS		×			
	Wewalwatta GSS	GSS			×		
Trincomalee	Kappalthurai	GSS			×		
	Trincomalee	GSS				×	
Vavuniya	Vavunia	GSS		×			

Table 2.25: Level of Exposure of Distribution System to Cyclones and High Winds Hazard

District	Total No of Distribution system 132 KV line Poles				Primary Stations			
	16 - 20	20 - 25	25 - 30	30 - 37	16 - 20	20 - 25	25 - 30	30 - 37
Ampara	191	91						
Anuradhapura	950	47						
Badulla	25	116	276	25				
Batticaloa	117	104						
Colombo	492	150			1	19		
Galle	266	26				10		
Gampaha	595	100			3	10		1
Hambantota	73	102						
Jaffna			27	70				
Kalutara	345				3	7		
Kandy	13	387	244					
Kegalle	266	250						
Kilinochchi		27	34	66				
Kurunegala	527							
Mannar	33	35	35	53				
Matale	278	286	37					
Matara	81	160						
Moneragala	4	122	48					
Mullaitivu	10	77						
Nuwara Eliya		284	174	64				
Polonnaruwa	261	31						
Puttalam	595	72	25					
Rathnapura	32	266	140					
Trincomalee	103	35	14					
Vavuniya	331							

2.5.5. Exposure to Tsunami

The Indian Ocean Tsunami in 2004 significantly disrupted Sri Lanka's electricity supply, causing widespread outages and damage to infrastructure. The disaster destroyed coastal power plants and transmission lines, leaving many areas without power for extended periods. The impact also extended to the distribution network, as the tsunami's force damaged substations and power poles.

The tsunami's destructive power directly impacted power infrastructure along the coast, including power plants, substations, and transmission lines. Coastal power plants, crucial to Sri Lanka's electricity grid, were either destroyed or severely damaged, leading to immediate and widespread blackouts. The force of the tsunami also snapped power lines and caused damage to transmission infrastructure, disrupting the flow of electricity to other parts of the country. Substations, which are essential for regulating voltage and distributing power, were also damaged or destroyed, further hindering the restoration of power supply. The tsunami's impact on the electricity grid had long-term consequences, requiring significant efforts to repair and rebuild the damaged infrastructure and restore power supply to affected areas.

Table 2.26: Level of Exposure of Power Stations (Generation) to Tsunami Hazard

District	Name of Element at Risk	Ownership	Exposed to Tsunami Hazard		
			High	Moderate	Low
Colombo	Kelanitissa	CEB	No	No	No
Gampaha	Sapugaskanda PS		No	No	No
	Kerawalapitiya		No	No	No
Jaffna	Chunnakam		No	No	No
Kalutara	Kukule		No	No	No
Puttalam	Lak Wijaya Coal		No	No	No

Table 2.27: Level of Exposure of Grid Sub Stations (Transmission) to Tsunami Hazard

District	Element at Risk	Ownership	Exposed to Tsunami Hazard		
			High	Moderate	Low
Ampara	Ampara	CEB	No	No	No
Batticaloa	Vavunativu		No	No	No
	Valachchanai		No	No	No
Colombo	Kesbewa GSS		No	No	No
	Ratmalana		No	No	No
	Pannipitiya		No	No	No
	Dehiwala		No	No	No
	Padukka GSS		No	No	No
	Oruwala GSS		No	No	No
	Sri Jayawardanapura		No	No	No
	Sub A-Havelock Town	No	No	No	

	Athurugiriya		No	No	No
	Sub E-Kollupitiya		No	No	No
	Sub N-Hunupitiya		No	No	No
	Sub M-Slave Island		No	No	No
	Sub I-Maradana		No	No	No
	Sub F-Fort		No	No	No
	Kolonnawa		No	No	No
	Sub B- Pettah		No	No	No
	Kosgam		No	No	No
	Sub C-Kotahena		No	No	No
	Seethawaka		No	No	No
Galle	Galle	No	No	No	
	Ambalangoda GSS	No	No	No	
Gampaha	Sapugaskanda GSS	No	No	No	
	Kelaniya GSS	No	No	No	
	Biyagama	No	No	No	
	Aniyakanda GSS	No	No	No	
	Kotugoda	No	No	No	
	Katunayake	No	No	No	
	Veyangoda	No	No	No	
Hambantota	Beliatta	No	No	No	
	Hambantota	No	No	No	
Kalutara	Matugama	No	No	No	
	Kaluthara GSS	No	No	No	
	Panadura	No	No	No	
	Horana GSS	No	No	No	
Kilinochchi	kilinochchi	No	No	No	
Mannar	Mannar GSS	No	No	No	
	Nadukkuda	No	No	No	
Matara	Matara	No	No	No	
	Deniyaya	No	No	No	
Puttalam	Bolawatta	No	No	No	
	Madampe	No	No	No	
	Puttalam	No	No	No	
Trincomalee	Kappalthurai	No	No	No	
	Trincomalee		×		

Table 2.28: Level of Exposure of Distribution System to Tsunami Hazard

District	Total No of Distribution system 132 KV line Poles			Primary Stations		
	High	Moderate	Low	High	Moderate	Low
Ampara						
Batticaloa						

Colombo			1
Galle		3	1
Gampaha	2		
Hambantota			
Jaffna			
Kalutara		1	2
Kilinochchi			
Mannar	4	1	
Matara			
Mullaitivu			
Puttalam	11		
Trincomalee	2		

2.5.6. Exposure to Sea Level Rise and Sea Surge

Sea level rise in Sri Lanka poses significant risks to electricity supply, primarily through the degradation of hydropower infrastructure and increased vulnerability to saltwater intrusion and flooding. This impacts both generation and transmission systems. Rising sea levels threaten hydropower dams and reservoirs, potentially reducing water availability for power generation. Additionally, coastal power plants and transmission lines are at risk of damage from inundation and saltwater intrusion, leading to disruptions in electricity supply.

Impacts on sea level rise in electricity sector includes followings;

- Climate change, including rising sea levels, can lead to changes in rainfall patterns and increased evaporation, reducing the water available for hydropower generation in reservoirs.
- Rising sea levels can directly damage hydropower dams and reservoirs through inundation and increased erosion, impacting their ability to store and generate electricity.
- As sea levels rise, saltwater may intrude into freshwater reservoirs and rivers, contaminating them and rendering them unsuitable for hydropower generation.
- Coastal power plants and transmission lines are vulnerable to flooding and inundation due to sea level rise, leading to power outages and system disruptions.
- Saline water can corrode and damage electrical equipment, further reducing the reliability and longevity of power infrastructure.
- Sea level rise exacerbates the risk of coastal storms and flooding, which can cause significant damage to power infrastructure and lead to widespread power outages.

Table 2.29: Level of Exposure of Power Stations (Generation) to Sea Level Rise and Sea Surge Hazard

District	Name of Element at Risk	Ownership	Exposed to Sea Level Rise and Sea Surge Hazard		
			High	Moderate	Low
Colombo	Kelanitissa	CEB	No	No	No
Gampaha	Sapugaskanda PS		No	No	No
	Kerawalapitiya		No	No	No
Jaffna	Chunnakam		No	No	No
Kalutara	Kukule		No	No	No
Puttalam	Lak Wijaya Coal		No	No	No

Table 2.30: Level of Exposure of Grid Sub Stations (Transmission) to Sea Level Rise and Sea Surge Hazard

District	Element at Risk	Ownership	Exposed to Sea Level Rise and Sea Surge Hazard		
			High	Moderate	Low
Ampara	Ampara	CEB	No	No	No
Batticaloa	Vavunativu		No	No	No
	Valachchanai		No	No	No
Colombo	Kesbewa GSS		No	No	No
	Ratmalana		No	No	No
	Pannipitiya		No	No	No
	Dehiwala		No	No	No
	Padukka GSS		No	No	No
	Oruwala GSS		No	No	No
	Sri Jayawardanapura		No	No	No
	Sub A-Havelock Town		No	No	No
	Athurugiriya		No	No	No
	Sub E-Kollupitiya				×
	Sub N-Hunupitiya		No	No	No
	Sub M-Slave Island				×
	Sub I-Maradana		No	No	No
	Sub F-Fort		No	No	No
Kolonnawa	No		No	No	
Sub B- Pettah	No		No	No	
Kosgam	No		No	No	
Sub C-Kotahena	No	No	No		
Seethawaka	No	No	No		
Galle	Galle	No	No	No	
	Ambalangoda GSS	No	No	No	
Gampaha	Sapugaskanda GSS	No	No	No	
	Kelaniya GSS	No	No	No	

	Biyagama		No	No	No
	Aniyakanda GSS		No	No	No
	Kotugoda		No	No	No
	Katunayake		No	No	No
	Veyangoda		No	No	No
Hambantota	Beliatta		No	No	No
	Hambantota		No	No	No
Kalutara	Matugama		No	No	No
	Kaluthara GSS		No	No	No
	Panadura		No	No	No
	Horana GSS		No	No	No
Kilinochchi	kilinochchi		No	No	No
Mannar	Mannar GSS		No	No	No
	Nadukkuda		No	No	No
Matara	Matara				×
	Deniyaya		No	No	No
Puttalam	Bolawatta		No	No	No
	Madampe		No	No	No
	Puttalam		No	No	No
Trincomalee	Kappalthurai		No	No	No
	Trincomalee		No	No	No

Table 2.31: Level of Exposure of Distribution System to Sea Level Rise and Sea Surge Hazards

District	Total No of Distribution system 132 KV line Poles			Primary Stations		
	High	Moderate	Low	High	Moderate	Low
Ampara						
Batticaloa						
Colombo			9			
Galle			34			5
Gampaha			32			
Hambantota						
Jaffna						
Kalutara						4
Kilinochchi						
Mannar			4			
Matara			68			

2.6. Vulnerability Assessment

Technically, vulnerability assessment can be done through following steps namely:

- Defining system with elements or element set considered for analysis.
- Identifying the hazards and threats on the element.
- Modelling hazard environment and fixing the damage scale to measure the adverse consequences.
- Analyze the element for similar hazard environment (mostly simulated) using technical tools.
- Post-process the amount of damage in analyzed element with respect to predefined damage scale
- Declare element's risk as a fragility/vulnerability function with intensity of hazard considered and updating the same. The power structures & building in areas prone to multi hazards should be designed taking into consideration all the hazards.

Apart from that vulnerability of any system or an element at risk could be evaluated as a function on exposure and sensitivity which lead to the impact of the sector. Hence vulnerability of each group of elements at risk was evaluated based on the level of exposure identified and the sensitivity of each group of elements at risk to the respective hazards for the continuous power supply in qualitatively.

Table 2.32: Vulnerability of Power Plants (Generation)

District	Power Plants (Generation)	Exposure					Sensitivity				
		Flood	Drought	Landslide	Tsunami	Coastal Hazards	Flood	Drought	Landslide	Tsunami	Coastal Hazards
Colombo	Kelanitissa	Yes	Yes		No	No	Yes	Yes		No	No
Gampaha	Sapugaskanda PS		Yes					Yes			
	Kerawalapitiya	Yes	Yes				Yes	Yes			
Jaffna	Chunnakam		Yes					Yes			
Kalutara	Kukule		Yes					Yes			
Kandy	Kotmale		Yes	Yes				Yes	Yes		
	Nilambe		Yes					Yes			
	Rantembe		Yes					Yes			
	Randenigala		Yes	Yes				Yes	Yes		
Kegalle	Broadlands		Yes	Yes				Yes	Yes		
Matale	Ukuwela		Yes	Yes				Yes	Yes		
	Bowatenna		Yes	Yes				Yes	Yes		
Moneragala	Udawalawa 2		Yes					Yes			
	Uma Oya		Yes					Yes			
	Inginiyagala PS		Yes					Yes			
Nuwara Eliya	Canyon		Yes	Yes				Yes	Yes		
	Wimalasurendra		Yes					Yes			
	New Laxapana		Yes	Yes				Yes	Yes		
	Laxapana	Yes	Yes	Yes			Yes	Yes	Yes		
	Polpitiya		Yes	Yes				Yes	Yes		
	Upper Kotmale		Yes	Yes				Yes	Yes		
	Victoria		Yes					Yes			
Puttalam	Lak Wijaya Coal		Yes					Yes			
Ratnapura	Embilipitiya ACE Power		Yes					Yes			
	Udawalawa 1		Yes					Yes			
	Samanalawewa		Yes					Yes			

Table 2.33: Vulnerability of Transmission (Grid Substations)

District	Transmission (grid Substations)	Exposure					Sensitivity				
		Flood	Drought	Landslide	Tsunami	Coastal Hazards	Flood	Drought	Landslide	Tsunami	Coastal Hazards
Ampara	Ampara										
Anuradhapura	Habarana										
	New Habarana GSS										
	New-Anuradhapura										
	Anuradhapura										
Badulla	Badulla										
	Mahiyanganaya GSS										
Batticaloa	Vavunativu										
	Valachchanai										
Colombo	Kesbewa GSS	Yes					Yes				
	Ratmalana										
	Pannipitiya										
	Dehiwala										
	Padukka GSS										
	Oruwala GSS										
	Sri Jayawardanapura	Yes					Yes				
	Sub A-Havelock Town										
	Athurugiriya										
	Sub E-Kollupitiya					Yes					Yes
	Sub N-Hunupitiya										
	Sub M-Slave Island					Yes					Yes
	Sub I-Maradana										
	Sub F-Fort										
	Kolonnawa	Yes					Yes				
	Sub B- Pettah										
	Kosgam										
Sub C-Kotahena	Yes										
Seethawaka			Yes					Yes			
Galle	Galle										
	Ambalangoda GSS										
Gampaha	Sapugaskanda GSS										
	Kelaniya GSS	Yes					Yes				
	Biyagama										
	Aniyakanda GSS	Yes					Yes				
	Kotugoda										
	Katunayake	Yes					Yes				
Veyangoda											
Hambantota	Beliatta										
	Hambantota										
Kalutara	Matugama			Yes				Yes			

	Kaluthara GSS										
	Panadura			Yes							
	Horana GSS	Yes		Yes			Yes		Yes		
Kandy	Nawalapitiya GSS			Yes					Yes		
	Kiribathkumbura										
	Pallekele GSS										
Kegalle	Maliboda GSS			Yes					Yes		
	Kegalle GSS										
	Thulhiriya										
Kilinochchi	kilinochchi										
Kurunegala	Pannala										
	Kurunegala										
	New Chilaw GSS										
	Maho Grid Substation										
Mannar	Mannar GSS										
	Nadukkuda										
Matale	Naula GSS			Yes				Yes			
Matara	Matara	Yes				Yes	Yes				Yes
	Deniyaya			Yes					Yes		
Moneragala	Monaragala GSS										
Nuwara Eliya	Nuwara Eliya			Yes					Yes		
	New Polpitiya GSS			Yes					Yes		
	Ragala GSS										
Polonnaruwa	Polonnaruwa GSS										
Puttalam	Bolawatta										
	Madampe										
	Puttalam										
Ratnapura	Embilipitiya										
	Balangoda										
	Ratnapura										
	Wewalwatta GSS										
Trincomalee	Kappalthurai										
	Trincomalee				Yes				Yes		
Vavuniya	Vavunia										

Table 2.34: Vulnerability of Distribution (132 KV line Poles and Primary Stations)

District	Distribution		Exposure					Sensitivity				
	Distribution-Poles	Distribution-Primary Stations	Flood	Drought	Landslide	Tsunami	Coastal Hazards	Flood	Drought	Landslide	Tsunami	Coastal Hazards
Ampara	282		Yes					Yes				
Anuradhapura	997		Yes					Yes				
Badulla	442		No		Yes					Yes		
Batticaloa	221		Yes					Yes				
Colombo	642	20	Yes		Yes		Yes	Yes		Yes		Yes
Galle	292	10	Yes		Yes		Yes	Yes		Yes		Yes
Gampaha	695	14	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes
Hambantota	175		Yes		Yes			Yes		Yes		
Jaffna	98		Yes					Yes				
Kalutara	345	10	Yes		Yes			Yes		Yes		
Kandy	643		Yes		Yes			Yes		Yes		
Kegalle	516		Yes		Yes			Yes		Yes		
Kilinochchi	134		Yes					Yes				
Kurunegala	527		Yes		Yes			Yes		Yes		
Mannar	157		Yes			Yes	Yes	Yes			Yes	Yes
Matale	601		No		Yes					Yes		
Matara	241		Yes		Yes		Yes	Yes		Yes		Yes
Moneragala	174		No		Yes					Yes		
Mullaitivu	87		Yes					Yes				
Nuwara-Eliya	522		Yes		Yes			Yes		Yes		
Polonnaruwa	292		Yes					Yes				
Puttalam	693		Yes			Yes	Yes	Yes			Yes	Yes
Ratnapura	438		Yes		Yes			Yes		Yes		
Trincomalee	152		Yes			Yes		Yes			Yes	
Vavuniya	331		Yes					Yes				

2.7. Capacity Assessment

The electricity sector's disaster response capacities involve a range of actions taken during and after a disaster to ensure continued power supply and safety. These capacities include organizing plant shutdowns, prioritizing emergency maintenance, ensuring safety equipment is available, and facilitating evacuation of personnel and materials. Additionally, they involve activating emergency operations plans, providing emergency response, rescue services and recovery efforts coordinating with disaster management and responding authorities such as DMC & Military.

Capacity assessment of electricity sector was carried out using indicators given in following table. As the data is not available risk assessment was conducted without considering the capacity of Ceylon Electricity Board and Lanka Electricity Company.

Table 2.35: Indicators for Capacity Assessment

District	Indicators for Capacity Assessment												
	Emergency Operations				Emergency Maintenance and Repair			Evacuation and Support		Communication and Coordination	Long-term Recovery		
	Plant Shutdown	Support Services	Task Force	EOC	Priority Maintenance	Safety Equipment	Emergency First Aid	Evacuation	Rescue and Search		Damage Assessment	Restoration	Mitigation and Preparedness
Ampara													
Anuradhapura													
Badulla													
Batticaloa													
Colombo													
Galle													
Gampaha													
Hambantota													
Jaffna													
Kalutara													
Kandy													
Kegalle													
Kilinochchi													
Kurunegala													
Mannar													

Matale													
Matara													
Moneragala													
Mullaitivu													
Nuwara-Eliya													
Polonnaruwa													
Puttalam													
Ratnapura													
Trincomalee													
Vavuniya													

2.8. Risk Assessment

Compiling hazard, element at risk (Electricity generation, transmission, distribution), level of exposure and vulnerability of electricity infrastructure risk of flood, drought, landslide and coastal hazards were assessed by districts.

Table 2.36: Risk Assessment- Flood

District	Flood Risk (Hazard x Element at Risk X Exposure x Vulnerability)		
	Generation	Transmission	Distribution
Ampara	No Generation	No Exposure	Moderate
Anuradhapura	No Generation	No Exposure	Low
Badulla	No Generation	No Exposure	No Exposure
Batticaloa	No Generation	No Exposure	Moderate
Colombo	High	High	High
Galle	No Generation	No Exposure	High
Gampaha	High	High	High
Hambantota	No Generation	No Exposure	Moderate
Jaffna	No Generation	No Exposure	High
Kalutara	No Generation	High	High
Kandy	No Generation	No Exposure	Low
Kegalle	No Generation	No Exposure	Moderate
Kilinochchi	No Generation	No Exposure	High
Kurunegala	No Generation	No Exposure	Moderate
Mannar	No Generation	No Exposure	Moderate
Matale	No Generation	No Exposure	No Exposure
Matara	No Generation	High	High
Moneragala	No Generation	No Exposure	No Exposure
Mullaitivu	No Generation	No Exposure	No Exposure
Nuwara-Eliya	Moderate	No Exposure	Low
Polonnaruwa	No Generation	No Exposure	High
Puttalam	No Generation	No Exposure	Moderate
Ratnapura	No Generation	No Exposure	Low
Trincomalee	No Generation	No Exposure	High
Vavuniya	No Generation	No Exposure	Low

The table 2.36 outlines the flood risk to Sri Lanka’s electricity infrastructure by district, considering Generation, Transmission, and Distribution components. Risk levels vary significantly depending on the presence of facilities and their exposure to flooding.

1. High-Risk Districts for All Three Components

- Colombo and Gampaha: Both districts face high flood risk across generation, transmission, and distribution. This reflects the concentration of critical infrastructure and dense urban exposure.

2. High Transmission & Distribution Risk (No Generation)

- Kalutara, Matara: Both districts show high risk for transmission and distribution but have no generation facilities.

- Galle, Jaffna, Kilinochchi, Polonnaruwa, Trincomalee: Identified as high distribution risk zones, despite lacking generation and transmission exposure.

3. Moderate Risk Districts

- Ampara, Batticaloa, Hambantota, Kegalle, Kurunegala, Mannar, Puttalam: Marked with moderate flood risk mainly in distribution, highlighting localized vulnerabilities.
- Nuwara Eliya: Presents moderate generation risk but low distribution risk, indicating potential localized hazards to generation infrastructure.

4. Low Risk Districts

- Anuradhapura, Kandy, Ratnapura, Vavuniya: Registered low flood risk, limited primarily to distribution.

5. Minimal or No Exposure Districts

- Badulla, Matale, Moneragala, Mullaitivu: Indicate no significant flood exposure across all three components, suggesting relatively safer conditions for electricity infrastructure.

Table 2.37: Risk Assessment- Drought

District	Drought Risk for Power Generation (Hydro)
Ampara	No Element at Risk
Anuradhapura	No Element at Risk
Badulla	No Element at Risk
Batticaloa	No Element at Risk
Colombo	No Element at Risk
Galle	No Element at Risk
Gampaha	No Element at Risk
Hambantota	No Element at Risk
Jaffna	No Element at Risk
Kalutara	Moderate
Kandy	Low
Kegalle	Moderate
Kilinochchi	No Element at Risk
Kurunegala	No Element at Risk
Mannar	No Element at Risk
Matale	High
Matara	No Element at Risk
Monaragala	Moderate
Mullaitivu	No Element at Risk
Nuwara Eliya	Low
Polonnaruwa	No Element at Risk
Puttalam	No Element at Risk
Ratnapura	High
Trincomalee	No Element at Risk
Vavuniya	No Element at Risk

The table 2.37 assesses the exposure of hydroelectric power generation to drought risk across districts in Sri Lanka. Since hydro generation depends heavily on water availability, only districts with significant hydro resources show measurable risk.

1. High-Risk Districts

- Matale, Ratnapura: Classified as high drought risk zones due to their heavy reliance on river-based hydro generation. Reduced rainfall or prolonged dry spells could critically impact hydro capacity here.

2. Moderate-Risk Districts

- Kalutara, Kegalle, Monaragala: Exposed to moderate drought risk, reflecting their hydro dependency balanced with alternative supply or moderate exposure to prolonged dry conditions.

3. Low-Risk Districts

- Kandy, Nuwara Eliya: Categorized under low drought risk despite being key hydro catchment areas. Their diversified reservoirs and geographical conditions help mitigate the severity of drought impacts.

4. No Element at Risk

- Majority of Districts (e.g., Ampara, Anuradhapura, Colombo, Galle, Gampaha, Hambantota, Jaffna, Kurunegala, Puttalam, Trincomalee, Vavuniya, etc.): Indicate no direct risk since they do not host significant hydropower facilities.

Table 2.38: Risk Assessment- Landslide

District	Landslide Risk		
	Generation	Transmission	Distribution
Badulla	No Element at Risk	Moderate	High
Colombo	No Exposure	Low	Low
Galle	No Element at Risk	No Exposure	Low
Gampaha	No Exposure	No Exposure	Low
Hambantota	No Element at Risk	No Exposure	Low
Kalutara	Moderate	Moderate	Moderate
Kandy	High	High	High
Kegalle	No Exposure	High	High
Kurunegala	No Element at Risk	Moderate	Low
Matale	No Exposure	High	Moderate
Matara	No Element at Risk	Low	Low
Monaragala	Low	Moderate	Low
Nuwara Eliya	High	High	High
Ratnapura	Moderate	High	Moderate

The table 2.38 evaluates landslide-related risks to electricity infrastructure, covering power generation, transmission, and distribution across selected districts. Landslides are concentrated in hilly and mountainous areas, with significant variations by district and infrastructure type.

1. High-Risk Districts

Kandy & Nuwara Eliya: These are the highest risk districts with high exposure across generation, transmission, and distribution. Their mountainous terrain and reliance on hydro generation make them highly vulnerable.

Kegalle: Although it has no generation facilities, transmission and distribution are highly exposed, reflecting its central role in power grid connectivity.

2. Moderate-to-High Risk Districts

Badulla: No generation facilities, but moderate transmission risk and high distribution risk, highlighting threats to local networks.

Ratnapura: Moderate risk in generation and distribution, but high in transmission, due to steep terrain and weather sensitivity.

Kalutara: Classified as moderate risk across all three components, showing balanced exposure.

Matale: High transmission risk and moderate distribution risk, although no generation assets exist.

3. Moderate Risk Districts

Monaragala: Low generation and distribution risk, but moderate transmission risk due to localized landslide-prone areas.

Kurunegala: Moderate transmission and low distribution risk, though generation is not exposed

Table 2.39: Risk Assessment- Cyclone/High Wind

District	Risk of Cyclones and High Winds		
	Generation	Transmission	Distribution
Ampara	No Generation	Low	Low
Anuradhapura	No Generation	Low	Low
Badulla	No Generation	High	High
Batticaloa	No Generation	Moderate	Moderate
Colombo	Low	Low	Low
Galle	No Generation	Low	Low
Gampaha	High	Moderate	Moderate
Hambantota	No Generation	Low	Moderate
Jaffna	High	No Element at Risk	High
Kalutara	Low	Low	Low
Kandy	High	Moderate	Moderate
Kegalle	Low	Moderate	Moderate
Kilinochchi	No Generation	Moderate	High
Kurunegala	No Generation	Low	Low
Mannar	No Generation	High	High

Matale	Moderate	Moderate	Moderate
Matara	No Generation	Low	Moderate
Monaragala	Moderate	Moderate	Moderate
Mulaithiu	No Generation	No Element at Risk	Moderate
Nuwara Eliya	Moderate	High	Moderate
Polonnaruwa	No Generation	Low	Low
Puttalam	High	Moderate	High
Ratnapura	Moderate	Moderate	Moderate
Trincomalee	No Generation	Moderate	Moderate

This table 2.39 evaluates the exposure of electricity infrastructure to cyclones and high-wind hazards across districts. Risks vary based on geographical location, coastal proximity, and infrastructure vulnerability.

1. High-Risk Districts

Badulla: Despite no generation, both transmission and distribution face high risks, reflecting exposure of grid infrastructure in elevated, wind-prone terrain.

Gampaha: High generation risk, with moderate transmission and distribution risks, indicating significant vulnerability due to urban infrastructure density and windstorms.

Jaffna: High generation and distribution risk, reflecting its coastal exposure to cyclones. Transmission shows no element at risk.

Mannar: High risk in transmission and distribution, though no generation exists, due to its exposed coastal location.

Puttalam: High generation and distribution risks, with moderate transmission exposure, aligning with coastal vulnerability and presence of major power facilities.

2. Moderate-Risk Districts

Batticaloa, Kilinochchi, Matale, Monaragala, Nuwara Eliya, Ratnapura, Trincomalee: These districts show moderate risks across most components, with variations depending on terrain and coastal exposure.

Hambantota, Matara: Low risks in generation (where applicable), but moderate risks in distribution, reflecting wind impacts on extended grid lines.

Kandy & Kegalle: Both show moderate transmission and distribution risks, with high generation risk in Kandy.

3. Low-Risk Districts

Ampara, Anuradhapura, Colombo, Galle, Kalutara, Kurunegala, Polonnaruwa: These districts show low cyclone and high-wind risk across most components, due to either inland positioning, lower cyclone exposure, or absence of major generation facilities.

4. Special Cases

Mullaitivu: No generation or transmission elements at risk, but moderate distribution risk, reflecting rural coastal exposure.

Table 2.40: Risk Assessment Costal Hazards (Tsunami, Sea Level Rise & Sea Surge)

District	Tsunami			Sea Level Rise & Sea Surge		
	Generation	Transmission	Distribution	Generation	Transmission	Distribution
Ampara	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	No Exposure
Anuradhapura	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Badulla	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Batticaloa	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	No Exposure
Colombo	No Exposure	No Exposure	No Exposure	No Exposure	No Exposure	Low
Galle	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	Moderate
Gampaha	No Exposure	No Exposure	Low	No Exposure	No Exposure	Moderate
Hambantota	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	No Exposure
Jaffna	No Exposure	No Exposure	No Exposure	No Exposure	No Exposure	No Exposure
Kalutara	No Exposure	No Exposure	Low	No Exposure	No Exposure	No Exposure
Kandy	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Kegalle	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Kilinochchi	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	No Exposure
Kurunegala	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Mannar	No element at Risk	No Exposure	Moderate	No element at Risk	No Exposure	low
Matale	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Matara	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	Moderate
Monaragala	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Mulaithiu	No element at Risk	No Exposure	No Exposure	No element at Risk	No Exposure	No Exposure
Nuwara Eliya	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Polonnaruwa	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Puttalam	No Exposure	No Exposure	Moderate	No Exposure	No Exposure	Moderate
Ratnapura	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard
Trincomalee	No element at Risk	No Exposure	Moderate	No element at Risk	No Exposure	No Exposure
Vavuniya	No hazard	No hazard	No hazard	No hazard	No hazard	No hazard

The table 2.40 highlights the risk of power sector infrastructure (generation, transmission, distribution) to tsunami and sea-level-related hazards across districts. The risks are localized mainly to coastal areas, with inland districts showing no significant hazard.

1. High- and Moderate-Risk Districts

Puttalam: While no generation or transmission is exposed, distribution shows moderate risk for both tsunami and sea-level rise. This reflects vulnerability of coastal grid infrastructure and settlements to flooding and surges.

Mannar: Distribution faces moderate risk from tsunami and low risk from sea-level rise, though no generation is present. Coastal exposure and island geography increase sensitivity.

Trincomalee: Distribution faces moderate tsunami risk, though sea-level rise does not currently pose a distribution hazard. Presence of major ports and coastal communities drive exposure.

Galle: Distribution faces moderate sea-level rise risk, though tsunami exposure is minimal. Coastal lowlands are at risk of inundation.

Matara: Distribution shows moderate risk from sea-level rise, with minimal tsunami-related exposure.

2. Low-Risk Districts

Colombo: Distribution faces low risk from sea-level rise, reflecting gradual exposure in urban coastal areas. Tsunami exposure is negligible.

Gampaha: Distribution has low tsunami risk and moderate sea-level rise risk, due to exposure along the Negombo coastal belt.

Kalutara: Distribution shows low tsunami risk, with no significant sea-level rise hazard recorded.

3. No-Risk or No-Exposure Districts

Ampara, Batticaloa, Hambantota, Jaffna, Kilinochchi, Mullaitivu: Despite being coastal districts, no generation or transmission exposure is reported, with distribution risk generally minimal.

Inland districts (Anuradhapura, Badulla, Kandy, Kurunegala, Matale, Monaragala, Nuwara Eliya, Polonnaruwa, Ratnapura, Vavuniya): These show no hazards, as they are outside tsunami and sea surge impact zones.

Chapter 3:

Disaster Mitigation Plan for Ceylon Electricity Board (CEB) and Lanka Electricity Company (LECO)

3.1. Introduction

The electricity supply system of Sri Lanka, managed primarily by Ceylon Electricity Board (CEB) and Lanka Electricity Company (LECO), is highly vulnerable to both natural and man-made hazards. Floods, droughts, landslides, cyclones/high winds, and tsunamis, along with technical failures and accidents, can severely disrupt power generation, transmission, and distribution.

This mitigation plan outlines measures to reduce risks, enhance system resilience, and ensure continuity of supply. It emphasizes vulnerability analysis of physical infrastructure, organizational management, and financial resources, while proposing design, construction, and operational strategies.

3.2. Objectives of the Mitigation Plan

The overarching objective of this mitigation plan is to strengthen the resilience of Sri Lanka's electricity supply system against disaster risks. Specific objectives are to:

1. **Protect critical power infrastructure** against natural and technological hazards.
2. **Ensure continuity of electricity supply** during and after disasters to minimize socio-economic disruption.
3. **Integrate risk reduction** into the design, construction, and operation of all new and existing energy projects.
4. **Promote sustainable and climate-resilient energy sources** to reduce dependency on vulnerable hydro resources.
5. **Strengthen institutional, technical, and financial capacity** of CEB and LECO for disaster risk management.
6. **Enhance coordination** with government agencies, local authorities, and communities to ensure effective mitigation and preparedness.

3.3. Mitigation Strategies by Hazard and Infrastructure

The Disaster Risk Mitigation Plan for CEB and LECO is designed as a comprehensive framework to safeguard Sri Lanka's electricity generation, transmission, and distribution systems against a wide range of natural and man-made hazards. Recognizing that hazards such as floods, droughts, landslides, cyclones, high winds, and tsunamis—as well as accidents and

technical failures—can severely disrupt energy supply and adversely affect socio-economic stability, the plan emphasizes both preventive and corrective measures.

It integrates vulnerability assessments, risk-informed planning, and multi-stakeholder coordination, ensuring that the resilience of the power sector is enhanced at every stage—from design and construction to daily operations and long-term maintenance. The plan focuses not only on protecting physical assets such as power plants, substations, transmission poles, and distribution networks but also addresses institutional and financial vulnerabilities that could undermine effective disaster response.

Mitigation measures are structured into clear phases

- Design phase actions such as site selection, hazard mapping, climate-proof engineering, and catchment protection.
- Construction phase measures including slope stabilization, robust structural standards, and avoidance of high-risk zones.
- Operational phase practices such as monitoring hazard forecasts, early warning dissemination, rapid response protocols, and rehabilitation of affected infrastructure.

Cross-cutting strategies—such as institutional strengthening, capacity building, financial preparedness, community partnerships, and the use of advanced technology (e.g., GIS mapping, SCADA monitoring, and climate projections)—form the backbone of the plan. These measures ensure that mitigation is not limited to physical resilience, but also builds organizational efficiency and adaptive capacity.

The plan ultimately aims to:

1. Safeguard critical electricity infrastructure from hazard impacts.
2. Ensure uninterrupted power supply to households, industries, and essential services during crises.
3. Minimize recovery time and economic losses.
4. Mainstream disaster risk reduction and climate resilience into all future energy projects.

By adopting this integrated approach, CEB and LECO will be better equipped not only to reduce disaster-related disruptions but also to contribute to national resilience, energy security, and sustainable development.

3.3.1. Mitigation Measures for Hydro and Thermal Power Plants

Table 3.1: Possible mitigation measures for hydro and thermal power plants

Hazard	Issues and Impact	Possible mitigation measures
---------------	--------------------------	-------------------------------------

Floods

Hydro and thermal power plants are highly exposed to a range of hazards. Floods reduce the effectiveness of reservoirs and pose risks to water intakes.

In the design phase;

Conduct a comprehensive risk assessment (considering deferent flood scenarios and dam breach scenarios) to identify high flood risk areas and established proper adequate early warning systems for communities and decision makers to ensure the safety of the downstream people, property, development and environment

Operation phase

- Automatic gate-clearing systems should be
- installed to prevent blockages. During operations, coordination with the Irrigation Department (ID), Mahaweli Authority (MASL), DMC and the Armed Forces is vital to ensure timely clearing of intakes and dissemination of early warnings to downstream communities.
- Enhance coordination among all relevant stakeholders enabling to get relevant information appropriately 9 Rainfall data, Weather reports and warning, Flood information and warning, water release and utility information etc.). As example EW messages issued by ID specially those at four power stations exposed to floods as given Table 16 in Risk assessment report

Drought

- Drastic reduction of the water levels of reservoirs limiting generation or/ completely shutting down of hydro power plants.

In the design phase:

- A long-term strategy should diversify generation sources, particularly wind and solar energy, to compensate for reduced hydro output during droughts. Climate change projections

Losses were compensated by switching to thermal power plant increasing cost of production.

must be incorporated into new renewable energy plant designs. (Details of hydro power stations exposed to drought given in Table 24 of Risk Assessment Report)

In the operational phase, consider:

- Reduction of the surface water flow in to reservoirs during dry season due to the clearance of trees /vegetation in catchment areas
- Risk assessment study has identified several hydro power plants highly and moderately exposed to drought.
 - water resources should be managed in collaboration with the National Water Supply and Drainage Board (NWSDB) and ID to optimize allocation between electricity and essential services. (Details of hydro power stations exposed to drought given in Table 24 of Risk Assessment Report).

Landslides

- Kothmale power station is most likely exposed to landslides. Bowathenna Power station at Naulla divisional secretary division is located at landslides expected land.
- Level of exposure is identified in the risk assessment study.
- If any Penstock structures lying on the surface could be damaged by falling boulders during rainy season (data

In the design phase, take into account:

- Detailed hydro-geological studies are required for plants located in landslide-prone areas such as Kotmale and Bowathenna. Mitigation includes slope stabilization through reforestation, construction of drainage ditches, and installation of protective structures for penstocks. Rehabilitation and relocation of affected facilities should be prioritized if risks become unmanageable
- **In the construction phase, take into account:**
 - Ensure stability of soil at the site before any earth work commences.

In the operational phase, consider:

not available to identify lines)

- Monitor and maintain all piezometers and other earth monitoring system to identify any land movement in the nearby areas.

Cyclones/High Winds

- Fallen trees could damage the power station and penstock lying on the surface.
- Roof of the buildings (Permanent or temporary) at the power station could be blown off due to high wind.

In the design phase, take into account:

- In design and construction, roofing structures must be properly tied and secured, with wind direction and speed considered in building design.

In the operational phase, consider:

In the operational phase, advance warnings must trigger preventive action such as pruning trees and strengthening exposed structures.

3.2.2. Mitigation measures for Grid Substations

Grid substations are critical for the stability of the transmission system. 10 substations have already been identified as exposed to floods, while others are vulnerable to landslides and cyclonic activity. Loss of substations due to disasters could lead to widespread blackouts

Table 3.2: At Grid Sub Stations (GSSs) maintain by CEB

Hazard	Issues and Impact	Possible mitigation measures
Floods	<ul style="list-style-type: none"> • Road leading to GSS could be inundated denying access to GSS • 	<p>In the design phase, take into account:</p> <ul style="list-style-type: none"> • Substations should be constructed only on land assessed for flood safety, with equipment elevated above maximum predicted water levels. <p>In the operational phase, consider:</p> <ul style="list-style-type: none"> • During floods, staff mobility must be ensured through the provision of boats and safe

access routes, and substations should be switched off in extreme cases to prevent damage.

Landslides

- Total or partial destruction of the structures lying in the path of the landslide.
- Equipment at the GSS could be damaged

In the design phase, take into account:

Site selection must be informed by geotechnical investigations, with slope stabilization and vegetation cover integrated into project design.

In the operational phase, consider:

- In operation, alternative access routes should be planned, and coordination with the National Building Research Organisation (NBRO) is essential for receiving early warnings.

Cyclones/High Winds

- Fallen trees could damage the equipment at GSS
- Roof of the buildings (Permanent or temporary) at the GSS could be damaged due to high wind.

In the design phase, take into account:

- Construction near large trees must be avoided, and roofing materials must be robust.

In the operational phase, consider:

- Regular removal of unstable branches is necessary, and spare equipment should be stored on-site for immediate repair.

Although not directly affected by floods or droughts, transmission poles are vulnerable to landslides and wind damage. Historical data shows significant exposure in Gampaha, Kegalle and Kandy districts.

Table 3.3: 132 KV poles in CEB distribution system

Hazard	Issues and Impact	Possible mitigation measures
Landslides	<ul style="list-style-type: none"> • A total of 442 poles in 8 districts is located in most likely areas exposed to landslides. Highest number of poles mostly exposed are in Kegalle (39) and Kandy (22) districts. Table 23 • Poles footings may get disturbed if landslide destabilized the soil close to the footing, 	<p>In the design phase, take into account:</p> <p>Transmission routes should avoid unstable terrain where possible. Detailed geotechnical studies should be undertaken, and slope stabilization techniques, including drainage systems and reforestation, should be implemented.</p> <p>In the operational phase, consider:</p> <ul style="list-style-type: none"> • Footings should be regularly inspected for signs of instability.
Cyclones/ high winds	<ul style="list-style-type: none"> • Fallen trees could damage the lines 	<p>In the design phase, take into account:</p> <p>design improvements to withstand high wind speeds.</p> <p>In the operational phase, consider:</p> <p>The risk of falling trees damaging transmission lines can be reduced through preventive tree removal and</p>

Power distribution system for houses, high consumers (such as industries, hotels, housing complexes, etc.

Distribution systems are most exposed to household-level hazards, with floods, cyclones, and tsunamis causing widespread damage in the past.

Hazard	Issues and Impact	Possible mitigation measures
Floods	<ul style="list-style-type: none"> Consumers located in low lying areas could be affected and houses/buildings may get inundated. 	<p>In the design phase, take into account:</p> <p>Transformers should be elevated above maximum flood levels,</p> <p>In the operational phase, consider:</p> <ul style="list-style-type: none"> and power supply should be disconnected from inundated households to prevent electrocution.
Landslides	<ul style="list-style-type: none"> Supply lines installed in landslide prone areas could get affected 	<p>In the design phase, take into account:</p> <ul style="list-style-type: none"> Distribution poles and transformers must be located away from unstable slopes, with safe site identification incorporated into design.
Cyclone and High winds	<ul style="list-style-type: none"> Fallen trees could damage the power distribution lines 1978 cyclone damage almost all power distribution system in Batticaloa district depriving power supply to consumers for few months. . 	<p>In the design phase, take into account:</p> <p>No action</p> <p>Design standards for local power distribution lines should be revised to withstand gust wind speeds.</p> <p>In the operational phase, consider:</p> <p>Preventive pruning of trees is essential before monsoon seasons, and operation staff should be guided by clear preparedness plans.</p>
Tsunami	<ul style="list-style-type: none"> Distribution lines located within 2 Km belt from the shore affected by Tsunami. Worst affected was from Galle to Negombo 	<ul style="list-style-type: none"> Coastal distribution networks should have automatic disconnection mechanisms linked to tsunami early warning systems. After an event, systematic damage assessments and recovery plans must be implemented.

Chapter 4:

Preparedness for Emergency Response Plan

4.1. Introduction

Sri Lanka's electricity sector faces increasing hazard exposure (floods, cyclones, landslides, drought, heat, wildlife/third-party incidents and grid failures) and a policy environment actively pushing for renewable expansion and sector reforms. Applying Build Back Better (BBB) means recovery activities should not only restore power but deliberately increase resilience — through risk-informed planning, greener/ decentralized systems, stronger standards, social protections and financing that reduces future vulnerability. This report lays out risk assessment priorities, preparedness and emergency response measures, and short-to-long term recovery actions (with institutional, legal and financing recommendations) tailored to Sri Lanka's national context and internationally proven BBB guidance.

This electricity sector emergency response plan establishes the framework for coordinated preparedness, response, and early recovery actions across Sri Lanka's electricity sector to ensure the continuity, safety, and resilience of electricity generation, transmission, and distribution during and after emergency events.

4.2. Disaster Preparedness, response and recovery

The Risk Preparedness Plan contains both a national and regional risk assessment related to uninterrupted supply of electricity. Building on the identified electricity crisis scenarios, it identifies existing and planned measures to prevent, prepare for and manage electricity crises both on a national and a regional level.

4.2.1. Purpose and Objectives

The purpose and objectives of the Electricity Sector Emergency Response and Recovery Plan are to establish a coordinated and systematic framework to manage emergencies affecting Sri Lanka's electricity generation, transmission, and distribution systems.

The plan primarily aims to protect human life and ensure the safety of staff and the public by promoting a culture of preparedness, clear safety protocols, and well-trained response teams. It seeks to maintain or rapidly restore electricity supply to critical and priority customers, including hospitals, water supply systems, communication networks, and other essential services, to safeguard public welfare and continuity of operations. The plan provides mechanisms to coordinate effective sector-level response and recovery activities among the Ministry of Power and Energy, CEB and LECO, to ensure timely decision-making, efficient resource mobilization, and information sharing. Furthermore, it emphasizes measures to protect vital electricity infrastructure and assets from further damage through rapid assessment, preventive reinforcement, and resilient design standards. By enabling the sector to minimize economic and social disruption, the plan contributes to stabilize livelihoods, industries, and essential services during emergencies.

Importantly, it integrates the Build Back Better principles to ensure that recovery and reconstruction efforts not only restore pre-disaster functionality but also enhance the long-term resilience, reliability, and sustainability of Sri Lanka's electricity sector in the face of future hazards.

4.2.2. Legal Framework for the Emergency Preparedness for Response and Recovery Plan

The Preparedness for Emergency Response Plan (ERP) for Sri Lanka's electricity sector, jointly developed by the Public Utilities Commission of Sri Lanka (PUCSL), Ceylon Electricity Board (CEB), and LECO, provides a structured framework to guide electricity supply utilities in preparing for, responding to, and recovering from emergencies in compliance with the Ceylon Electricity Board Act, No. 17 of 1969, the Sri Lanka Electricity Act, No. 20 of 2009, the Public Utilities Commission of Sri Lanka Act, No. 35 of 2002, and the Sri Lanka Disaster Management Act, No. 13 of 2005. This Plan is formulated under the broader National Emergency Operation Plan (NEOP) issued by the Disaster Management Centre (DMC) and operates within the national Incident Command System (ICS) framework with the coordination of the National Emergency Operation Centre (NEOC), ensuring structured command, control, and communication for sectoral and national emergency response activities. Legal provisions underpinning the ERP include Section 4(2)(b) of the Sri Lanka Electricity Act No. 20 of 2009, which mandates that CEB and LECO ensure the availability and continuity of electricity supply, and Clause 6(c) of the regulations under Section 54 of the same Act, which requires the utilities to take measures to safeguard equipment commensurate with the nature and class of risk. Furthermore, the Disaster Management Act No. 13 of 2005 obliges all public corporations to prepare disaster management plans to mitigate the impact of disasters or pending emergencies. Consequently, the ERP serves as a critical instrument for the uninterrupted delivery of electricity services, encompassing strategies, resources, plans, and procedures to respond effectively to incidents whether natural or man-made that threaten life, property, or the environment. It addresses hazards ranging from localized to large-scale floods, droughts, landslides, cyclones, high winds, and tsunamis affecting coastal areas. The ERP incorporates the establishment of an institutional response structure, personnel recall procedures, and notifications to external agencies such as the DMC, Police, Fire Department, and first responders including the Tri-Forces. It defines position-based emergency roles and responsibilities for staff and emphasizes the prompt documentation of expenditures, decisions, and actions taken, which is essential for cost justification and potential post-incident reimbursement. The Plan's development was guided primarily by the Institutional Disaster Management Plan guidelines issued by the DMC, ensuring alignment with national disaster management policies and sectoral resilience objectives.

4.2.3. Preparedness options followed by Hazard and Risk

Preparedness in the electricity sector is a critical component of ensuring reliable service delivery and the safety of personnel and the public during emergencies. The sector faces a range of hazards, each posing distinct risks that require targeted mitigation and planning. Table 4.1.

Table 4.1: Hazard type, impact and preparedness Focus

Hazard Type	Likely Impacts on Electricity Sector	Preparedness Focus
Floods	Substation inundation, tower collapse, short-circuits	Elevate substations, waterproof critical control panels
Cyclones / High Winds	Transmission line failure, roof loss, disruption of coal supply for thermal plant at Norichhole	Design to wind load standards, tree trimming, ensure sufficient coal supply to cover cyclone/high wind period.
Landslides	Tower/line base failure	Relocate assets, slope stabilization
Drought	Reduced hydro output, overheating transformers	Diversify energy mix, cooling management
Lightning	Equipment failure, outages	Lightning arrestors, grounding upgrades
Coastal Hazards (Sea level rise, Sea surge)	Disruption to distribution system at house hold level, short-circuits	Disconnect the supply lines,
Tsunami	Disruption to distribution system at house hold level, short-circuits	Disconnect the supply lines,

4.2.4. Institutional Roles and Responsibilities for the Preparedness of Electricity Sector

Effective emergency preparedness in Sri Lanka’s electricity sector relies on clearly defined institutional roles and responsibilities to manage hazards such as floods, droughts, landslides, cyclones, high winds, coastal erosion, tsunami, and lightning. Table 4.2.

Table 4.2: Institutional responsibility to manage hazards

Institution	Key Responsibility
Ministry of Power and Energy	Policy direction, resource mobilisation, liaison with Cabinet and DMC
CEB	Overall coordination, incident command, activation of response tiers
Transmission Division	System restoration, protection coordination, damage assessment
Generation Division	Safe shutdown/start-up, maintaining generation balance, fuel management
Distribution Divisions (CEB / LECO)	Field-level restoration, public safety communication
PUCSL	Regulatory coordination, safety oversight, monitoring service continuity
DMC	National coordination, resource mobilisation, situational reporting
Local Authorities / Police / Armed Forces	Access control, logistics, safety assistance
Media / Communication Units	Dissemination of official updates and safety messages

4.2.5. Command and Coordination Structure

A robust command and coordination system is essential for effective emergency preparedness, response, and recovery in Sri Lanka's electricity sector, ensuring that all stakeholders act in a timely, organized, and coordinated manner during disasters.

The proposed system operates within the national Incident Command System (ICS) framework under the guidance of the Disaster Management Centre, to integrate sectoral actions with national disaster response.

At the top of the hierarchy, the Minister of Power and Energy provide overall policy direction and approves strategic decisions during emergencies. The Emergency Operations Centre, located at the CEB and LECO headquarters, functions as the primary coordination hub, with an Incident Commander responsible for sector-level decision-making and operational oversight. Supporting the Incident Commander are designated chiefs for Operations, Planning, Logistics, Safety, and Public Information, each responsible for specific functional areas.

Regional office and District Disaster Management Coordinating Units of DMC ensure decentralized command, rapid situational awareness, and field-level operational control,

enabling prompt deployment of crews, equipment, and resources in collaboration with district and divisional administrative set up.

The system incorporates formalized communication channels among CEB, LECO, independent power producers, PUCSL, DMC, local authorities, and first responders such as Police, Fire Services, and Tri-Forces, ensuring that emergency alerts, status reports, and restoration priorities are efficiently shared.

Pre-established mutual aid agreements, clear escalation protocols, and structured decision-making processes allow for rapid response, effective allocation of resources, and prioritization of critical infrastructure restoration. This command and coordination framework ensures that electricity sector operations are resilient, responsive, and capable of sustaining service continuity while protecting personnel and infrastructure during floods, droughts, landslides, cyclones, high winds, tsunamis, coastal hazards and lightning events.

Table 4.3: Disaster Activation Levels

Level	Description	Activation Authority
Level 1 – Routine Alert	Localised incidents manageable within division	Regional Manager
Level 2 – Sector Emergency	Major outage in one province, inter-regional assistance required	General Manager (CEB)
Level 3 – National Emergency	Widespread multi-provincial impact or national grid threat	Chairman CEB/ Secretary, Ministry of Power & Energy

4.2.6. Preparedness measures

4.2.6.1. Early warning integration

Establish direct link with DMC’s Early Warning System and the technical agencies responsible to generate early warning are as follows;

Table 4.4: Technical agencies responsible for formulating and providing EW messages

Hazard	Technical Agency
Flood	Department of Irrigation, Sri Lanka Land Development Cooperation
Drought	Meteorological Department. Sri Lanka Mahaweli Authority
Cyclone/ high wind	Meteorological Department

Landslide	National Building Research Organization
Coastal hazards	Coast Conservation and Coastal Development Department
Coastal Erosion	Meteorological Department
Sea surges	Disaster Management Centre
Sea Level rise	
Tsunami	Meteorological Department, Geological Surveys and Mines Bauer
Lightning	Meteorological Department

Consequently, the establishment of robust early warning dissemination mechanisms within the CEB and LECO is a critical component of emergency preparedness, enabling timely and coordinated actions to protect personnel, infrastructure, and customers during disasters such as floods, droughts, landslides, cyclones/high winds, tsunamis, and lightning events.

Within the institutions, dedicated Early Warning Units are responsible for continuously monitoring alerts from the Disaster Management Centre (DMC), the Meteorological Department, and other relevant national authorities as explain in above Table 4.4. These units ensure rapid internal communication of hazard information through multiple channels, including email alerts, SMS notifications, mobile apps, internal intranet systems, and emergency broadcast lines, enabling management, operational teams, and field crews to activate predefined response protocols immediately.

For external stakeholders, the mechanism is designed to disseminate timely warnings to critical customers, industrial users, hospitals, bulk water users, and the general public via SMS alerts, official websites, social media platforms, automated voice messages, and media announcements, providing guidance on protective actions, anticipated power interruptions, and restoration timelines.

The system incorporates tiered messaging, ensuring that information is tailored to the type and severity of the hazard, and prioritizes messages for high-risk areas and critical infrastructure.

Regular tests, drills, and system audits are conducted to ensure the reliability, redundancy, and effectiveness of the early warning dissemination network, while coordination with local authorities and emergency services ensures that messages are reinforced at the community level. By integrating both internal and customer-focused communication, these mechanisms enhance situational awareness, enable proactive operational adjustments, minimize damages, and strengthen overall sector resilience.

For effective risk communication in the electricity sector, it is essential that separate communication modes and up-to-date contact details are prepared and readily available for use during emergencies. This approach ensures that messages can reach the appropriate personnel and stakeholders rapidly, without bottlenecks or delays, regardless of the nature or scale of the hazard. Within the institution, dedicated channels—such as email alerts, SMS notifications, internal phone trees, mobile apps, intranet platforms, and emergency radio networks—should be established to communicate with management, operational teams, field crews, and support staff. Each channel must have verified and current contact details, including phone numbers,

email addresses, and alternate contacts for all staff members, ensuring that critical instructions, hazard warnings, or operational directives reach personnel even if primary communication modes fail. Similarly, separate channels should be designated for external communication, targeting critical customers, industrial users, hospitals, municipal authorities, and the general public, using SMS alerts, automated voice messages, social media updates, websites, and traditional media outlets. Maintaining these distinct communication modes allows for simultaneous and targeted messaging, reducing confusion, prioritizing messages for vulnerable or high-risk groups, and enabling timely dissemination of protective measures, service interruptions, and restoration updates. Regular verification, testing, and updating of contact lists and communication channels are essential to ensure reliability and resilience, particularly during crises when rapid, accurate, and continuous information flow is critical for safeguarding lives, protecting infrastructure, and maintaining public trust.

Personal protection during Emergency response is need to be focused on the safe response to an emergency and covers Evacuation Procedures, Assembly Areas/Staff Accountability, Shelter Locations, and First Aid Equipment. Collect information using Table 4.5.

Table 4.5: Safe response to an emergency

Activity	Responsibility
1. Evacuation procedure	Head of the local Department / Sub-Department / Office / Safety officer or Delegated officer
2. Assembly areas	Pre-determined assembly area as per the type of disaster
3. Responsibility of personal safety	Head of the local Department / Sub-Department / Office / Safety officer or Delegated officer
4. Safety Shelter location	Pre-determined assembly area as per the type of disaster
5. First Aid equipment	Head of the local Department / Sub-Department / Office / Safety officer or Delegated officer

Head of the local Department / Sub-department or Office / Safety Officer (e.g. CE of Area Engineer’s office, ES of Consumer Service Center, ES of field work site, CE of Power Station, ES of Grid Substation, DGM of System Control center etc. in CEB and Branch Manager, OE of Distribution Control Centre etc. in LECO) shall assign himself or delegate officer for the responsibility of each activity. For each type of disaster, assembly areas and safety shelter locations shall be pre-determined and all employees shall be informed of these locations.

4.2.7. Resource Readiness for Preparedness

4.2.7.1. Critical Spares and Equipment Management

- Maintain a detailed and regularly updated **database of critical spares**, including transformers, switchgear, protective devices, insulators, and conductors.
- Stockpile **mobile generators, portable transformers, fuel reserves, and repair kits** for rapid deployment during emergencies.
- Assign **regional warehouses** strategically across provinces to reduce response times to disaster-affected areas.
- Conduct **pre-disaster stock verification** at least every six months to ensure readiness and functionality of all equipment.

Table 4.6: Infrastructure Protection and Hazard-Specific Preparedness

Hazard	Preparedness measures
Floods	Elevate substations, waterproof control panels, reinforce foundations, and install drainage systems around critical infrastructure.
Droughts	Diversify energy mix with non-hydro generation options, monitor reservoir levels, implement transformer cooling strategies, and maintain emergency fuel supplies
Tsunami	<ul style="list-style-type: none">○ Relocate coastal substations or critical equipment to elevated locations; reinforce coastal transmission lines; develop rapid shutdown and isolation procedures.
Cyclone / High Winds	<ul style="list-style-type: none">○ Strengthen transmission towers and poles to wind-load standards, trim trees near power lines, and secure roofs and facility enclosures. Ensure sufficient stocks of Coal for thermal Plant at Norichhole to cover cyclone period.
Coastal hazards	<ul style="list-style-type: none">○ develop rapid shutdown and isolation procedures.
Lightning	Install lightning arrestors, improve grounding systems, and implement surge protection measures for critical control and communication equipment

4.2.7.2. Workforce and Operational Readiness for Preparedness

- Maintain **emergency staff rosters**, including on-call personnel and clear protocols for recall during disasters.
- Train crews for hazard-specific interventions, including **substation safety during floods, line restoration after wind damage, and hydro unit adjustments during droughts**.
- Conduct **regular drills and simulations** at regional and national levels to test deployment of personnel, equipment, and emergency response procedures.

4.2.7.3. Communication and Coordination for Preparedness

- Establish robust **internal communication networks** (SMS, mobile apps, intranet) for rapid alerts to operational teams.

- Maintain **external communication channels** (SMS, websites, social media, media announcements) to inform critical customers and the public of outages, restoration timelines, and safety measures.
- Ensure **contact lists for internal and external stakeholders** are updated and accessible for immediate use during emergencies.

4.2.7.4. Resource Mobilization and Mutual Aid for Preparedness

- Develop **mutual aid agreements** with neighboring regions, private sector operators, and contractors for emergency equipment and personnel sharing.
- Pre-position **logistics supports** such as vehicles, boats (for flood areas), and fuel tankers to ensure rapid response.
- Maintain **emergency financial provisions** for procurement and rapid mobilization of resources.

4.2.7.5. Monitoring and Early Action for Preparedness

- Integrate **early warning systems** for floods, cyclones, high winds, lightning, and drought alerts into operational planning.
- Adjust grid operations proactively, including **load redistribution, sectionalization, and controlled shutdowns** to protect infrastructure.
- Conduct **periodic audits** to ensure that emergency equipment is functional and ready for deployment.

4.2.7.6. Documentation and Post-Disaster Review for Preparedness

- Document **all actions, expenditures, and resource deployment** during disasters to support post-event analysis and insurance claims.
- Conduct **after-action reviews** to identify gaps in resource readiness and update emergency preparedness plans accordingly.

4.2.8. Emergency Preparedness

Training and Awareness in the Electricity Sector

Emergency preparedness in the electricity sector critically depends on systematic training and awareness programs for internal staff and external stakeholders to ensure continuity of electricity services during disasters.

4.2.8.1. Internal Staff Training

- Conduct annual national-level simulation exercises combining tabletop discussions with field operations, coordinated with the DMC.
- Exercises help personnel practise incident response, decision-making, and coordination under realistic disaster scenarios.
- Conduct quarterly regional restoration drills to familiarise field teams with:
 - Hazard-specific interventions
 - Resource mobilisation
 - Rapid repair procedures

- Ensure operational readiness for hazards such as floods, droughts, cyclones, high winds, lightning, landslides, and tsunamis.

4.2.8.2. Community and Stakeholder Engagement

- **Conduct awareness sessions for:**
 - Local government officials
 - Hospitals
 - Industries and other critical service providers
- **Provide information on:**
 - Power restoration priorities
 - Safety protocols
 - Coordination procedures
- **Maintain a public hotline and complaint mechanism for:**
 - Timely reporting of outages
 - Communication with customers
 - Guidance during emergencies

4.2.9. Preparedness Measures for Continuous Service in Disasters

To ensure continuous electricity service during disasters, the CEB must operationalize preparedness measures focused on alternative power sources. This includes maintaining mobile generators and portable transformers that can be rapidly deployed to provide electricity to critical customers such as hospitals, water treatment facilities, communication centers, and emergency shelters. Additionally, these resources should be pre-positioned strategically across regions that are most vulnerable to hazards such as floods, cyclones, droughts, high winds, lightning, landslides, and tsunamis, allowing for immediate activation when normal infrastructure is disrupted. Regular checks and maintenance of these alternative power assets are essential to ensure they remain operational during emergencies, and staff must be trained in their rapid deployment and integration with existing grid systems. By implementing these measures, CEB can maintain service continuity, protect critical infrastructure, and support emergency response operations effectively, even under extreme disaster conditions.

For effective operationalization, it is essential to systematically collect, validate, and maintain the relevant data and information to ensure availability for planning, decision-making, and response actions.

Table 4.7: Water Intakes of Hydro power plants

Name of the water Source/ reservoir	Depth/location	Available Yield	Remarks

Table 4.8: Penstock

Name of power plant	Location of penstock	Type Pipe or canal	Length

Table 4.9: Hydro power generators

Name of power plant	Location	Generating Capacity MW	Maximum and Average generation per year <i>MW max / MWavg</i>

Table 4.10: Thermal power plant

Name of power plant	Location	Generating Capacity MW	Maximum and Average annual generation MW max / MWavg

Table 4.11: Coal Power plant

Name of power plant	Location	Type of fuel used	Generation Capacity MW	Maximum and Average annual generation MW max / MWavg

Table 4.12: Grid sub-Station

Name of the GSS	Location	No of Transformers with capacity	Any other critical equipment

Table 4.13: Transmission lines High voltage

Name of the Line	Length of the line	Number of Towers	Comments

Table 4.14: Transmission lines medium voltage

Name of the Line	Length of the line	No of poles	Comments

Table 4.15: Transmission lines low voltage

Name of the Line	Length of the line	Number of poles	Comments

Table 4.16: Available Electricity Supply Connections

Type of consumer	Type of connection Single /Three Phase	Number of connections	Comments

4.2.9.1. Purchase of Electricity

In the event of drought or any other calamity where demand exceeds the CEB capacity, CEB will have to purchase extra required amount from private vendors maintain uninterrupted supply.

Table 4.17: Purchase of electricity in the event of drought or any other disaster

Provider's Name and Contact Info	Location(s)	AMOUNT TO BE PURCHASE D DAILY MW	COST IN RS	REMARKS

4.2.9.2. Preparedness for Electricity System Contingencies & Priorities

Electricity Usage

To ensure the efficient and reliable operation of the electrical supply during emergencies, this section focuses on optimizing resource allocation and defining electricity utilization priorities within the service area. The accompanying chart delineates the hierarchy of electricity uses, assesses the required supply for each category, and specifies the methodology for maintaining service levels classified as high, medium, or low priority.”

Table: 4.18: Evaluation of electricity needed

	System Capacity:					
	2021		2022		2023	
Demand (MWh)	MWh Per day	% Purchased from private vendors	MWh Per day	% Purchased from private vendors	MWh Per day	% Purchased from private vendors
Average Daily						
Maximum Daily						
Peak Daily						

Table 4.19: Prioritization

Use Category	Priority (High, Medium, Low)	Daily Electricity Demand MW and (MWh)	Method of Sustaining Use / Emergency Contingencies Beyond Standard Response
Sensitive Populations- Hospitals, Pumping units of sewerage system,			
Large scale Industrial/Commercial users			
Airports, Tourist industry			

4.2.9.3. Primary Component Emergency Provisions

Table 4.20: Details contingencies for sustaining primary components:

Primary Component	Emergency Contingency Procedures
Generation	
Grid Sub station	
Transmission Lines High, medium and low voltages	
Distribution system	

Table 4.21: Restrictions in supply of electricity

CEB/LECO has to restrict the supply of electricity in the event of disasters. Adopted water use restrictions to be implemented by NWSDB during emergency or disasters are also important for the uninterrupted water supply

<p>PHASE I Restrictions (available water supply levels determined to be below normal)</p> <p>PHASE II Restrictions (substantial threat to the public health and welfare)</p> <p>PHASE III Restrictions (disaster stage)</p>
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4.2.10. Resource Inventory

4.2.10.1. Physical Plant Resources

The purpose of this section is to provide a concise overview of the inventory of available resources, including power generators with private vendors, equipment, and supplies, that are accessible off-site. Additionally, this section furnishes contact information for purveyors who offer emergency services, parts and equipment

4.2.10.2. Auxiliary Power Sources

The auxiliary power capabilities provide adequate auxiliary power to provide uninterrupted power supply in the event of an emergency. Information could be recorded in following tables.

Table 4.22: Fixed Auxiliary Power Sources

Location	Power Sources: (facility and/or equipment)	Details (Type/Capacity/Fuel & Rate of Consumption)	Specific Instructions (Location of manual/exercise schedule/etc.)	Inventoried

Table 4.23: Portable Auxiliary Power Sources

Location	Capable of Power source: (facility and/or equipment)	Details (Type/Capacity/Fuel & Rate of Consumption)	Specific Instructions (Location of manual/exercise schedule/etc.)	Inventoried

Auxiliary power sources should be inventoried to determine voltage, phase configuration, horsepower/amperage and other requirements.

Table 4.24: Auxiliary Fuel Storage

Type	Tank Capacity	Location

Table 4.25: Pumping Equipment /Spare Pump Parts

Type/Manufacturer	Service Capabilities	Location

Table 4.26: Distribution Components

Part	Location

Table 4.27: Spare Parts

Part	Location

Table 4.28: Contact Information for Equipment Repair, Supplies & Services

Organization	Name/Contact/ Contract Information	Phone (day)	Phone (24/7)
Electrician			
Generator operators			
Excavator/Backhoe Operator			
Equipment Rental or Cooperative (e.g. heavy equipment)			
Equipment Repair			
Transformer supplies			
Supplies of electric cables			
Suppliers of Concrete poles			
Subcontractor for clearing obstructions of distribution lines (branches, trees)			
Primary Fuel Supplier (s)			
Alternate Fuel Supply			

4.2.11. Documentation/Guidance

Documents that establish the daily operational protocols, such as routine operation and management procedures and operational monitoring requirements, are listed in this section. In the event of an emergency, the individual who has been designated should be capable of executing the requisite procedures to guarantee the continuity of operations. Information on Manuals, report and plans, user advisories and Public Notices and distribution methods could be recorded in following tables:

Table 4.29: Operational manuals and reports

Item	Location
Generator start up manuals	
Daily Operator Reports	
Technical Manuals	
Business Continuity Plan (Essential Functions/Resources)	
Lockout-Tag out Manual	
Other	

Electricity Use Advisories/Public Notices

Table 4.30: Templates for electricity Use Advisories: (Include here or reference where they may be found)

Detail of advisories	Location

Table 4.31: Distribution Methods: (Protocols for Email, newspaper, door to door, etc.)

Detail of material for distribution	Method of distribution

4.3. Emergency Response

4.3.1. Major Steps for Emergency Response

The objectives of emergency response and management are to:

- Evaluate the emergency situation,
- Take necessary steps to protect public from electric shocks while the emergency is being evaluated
- Confirm the emergency,
- Remediate the electricity supply system, if necessary,
- Return the system to safe, normal operation as soon as possible.

The response to a disaster/emergency must be promptly managed in order to achieve these objectives. A variety of steps, actions, and decision factors are involved in disaster/emergency response and management. The most critical information in this chapter is the comprehension of these critical components and the process of moving from one decision point to the next in order to accomplish these goals. The following is a concise summary of the primary components of disaster/emergency response:

Step 1: Determine whether a catastrophe or emergency is "possible," implement the necessary preliminary response measures to safeguard the infrastructure of electricity supply schemes.

Step 2: Establish contact with technical agencies issuing Early Warning messages. GM to name a senior level officer to coordinate with these agencies.

Hazard	Decision making on Possible disaster/emergency	Responsibility
Flood	<p>Collect information disseminated from Meteorological Department/Irrigation Department/ Sri Lanka Land Development Corporation, Disaster Management Centre (DMC), Mahaweli Authority Sri Lanka (dg@mahaweligov.lk), Department of Agrarian Development (info@agrariandep.gov.lk), Etc.,</p> <p>Monitor localized rainfall and wind visually and provide information to GM</p> <p>Analyze all data/information collected on weather forecasting and review past experience of the electricity supply infrastructure</p>	<p>Person in charge of EW function at Head Office under GM</p> <p>Area / Branch Engineer of distribution system</p> <p>Person in charge of EW function at Head Office under GM.</p>

	<p>(Sources, generation, penstock, grid substation, Transmission/Distribution System etc.) assess the level risk</p> <p>Inform GM the developing situation</p> <p>Risk information to be disseminated to Addl. GM Generation, Addl. GM distribution.</p>	<p>---Do -</p> <p>GM</p>
Drought	<p>Drought is a slow onset hazard and information on rainfall at local level, water levels of rivers, reservoirs where water used for hydropower generation intakes, to be collected from local office of ID, Mahaweli Authority, DAD and disseminated to GM</p> <p>Collect information on seasonal weather forecasting and water management from relevant agencies, (Information disseminated from Meteorological Department/Irrigation Department/ Sri Lanka Mahaweli Authority, Disaster Management Centre, Department of Agrarian Development,(DAD) (info@agrariandep.gov.lk), Natural resource Management Centre(NRMC) http://www.doa.gov.lk/nrmc/en/, review past experience of the electricity supply at highly affected areas and determine the risk level. Disseminate formation to officers at provincial, regional and local level.</p> <p>Maintain communication continuously with ID, MASL, DAD and</p>	<p>Engineer in charge of local level distribution and generation units</p> <p>Person in charge of EW function at Head Office under GM.</p> <p>Do -</p>
Landslide	<p>Regularly visit locations where critical structures located within landslide high risk zones and report any changes</p> <p>Study the information available on weather forecasting and landslide field indicators, review past experience of the landslide prone areas with respective to the critical infrastructure and information from engineer at local level. Assess the risk and inform Addl. GM Generation and Distribution. Collect information disseminated from Meteorological Department/National Building Research Organization, Disaster Management Centre Etc., also.</p>	<p>Engineer in charge of local level distribution system and generation units</p> <p>Person in charge of EW function at Head Office under GM.</p>

Cyclone/ high winds	Collect EW messages issue by Meteorological department on developing cyclone and wind situation.	Person in charge of EW function at head office under GM
	Analyze the satiation and disseminate the EW messages to Addl.GM Generation and Distribution.	GM
Tsunami	Collect EW messages issued by Meteorological department and other international agencies monitoring development of tsunami hazard	Person in charge of EW function at head office under GM
	Disseminate EW messages to Head of Operation and Engineering	GM

Step 2:

Determine the credibility of a "possible" disaster/emergency by consulting with DMC, other hazard-specific technical agencies, the Department of Health, etc., and other relevant agencies. If it is "credible," notify the relevant agencies and the public, implement the appropriate response measures to safeguard people and electricity supply schemes and infrastructure, and then proceed to

Step 3:

Hazard	Decision making credible disaster/emergency	Responsibility
Flood	Consult Meteorological Department/Irrigation Department/ Sri Lanka Land Development cooperation, Disaster Management Centre (DMC) Ministry of Health Etc.	GM CEB GM LECO
Drought	Study the seasonal weather forecast issued by Meteorological Department, International Water Management Institute and the rainfall in catchment areas to determine the impact on electricity generation. Continuously monitor water levels at the intake (River, reservoir, etc.) and report to provincial and national level authorities.	Person in charge of EW function at GM office CEB Engineer in charge of the generation unit.

Landslide	Consult Meteorological Department/National Building Research Organization, Disaster Management Centre Etc.	GM CEB
Cyclone/High winds	Consult Meteorological Department and Disaster Management Centre Etc.,	GM CEB GM LECO
Tsunami	Consult Meteorological Department and Disaster Management Centre Etc., Collect EW messages issued by international agencies	GM CEB GM LECO

Step 3: Confirm a "credible" threat, which results in a "confirmed hazard incident." Activate the response plan and other response actions to safeguard public and electricity supply schemes, and then proceed to

Step 4:

Hazard	Decision making credible disaster/emergency	Responsibility
Flood	Evaluate all information received, identify infrastructure exposed to floods and local level distribution system that could be affected by flood. Disseminate information to Addl. GMs Generation and Distributions provincial to activate the response plan Disseminate information to Regional Engineer to activate the response plan	GM CEB GM LECO GM CEB GM LECO
Drought	The drought is a slow onset hazard and develop over a long period of time. Continuously evaluate information collected and determine to what extent generation of electricity would be affected. The risk assessment report provides information on highly and moderately exposed infrastructure. Disseminate information to Addl. GMs Generation and Distribution	GM GM CEB
Landslide	NBRO issue LS early warning in three stages; alert, warning and evacuation. Officers in charge of Critical infrastructure in the electricity supply system such as water intakes, generating units, grid substations, Transmission towers, local distribution systems identified in the study as highly and moderately exposed to be more vigilant. In the event LS threat is imminent implement the LS Response plan.	Engineers in charge of Generations and distribution

Cyclones/high winds	<p>Be alert to the Early warning messages issued by the Met Dept., on the formation cyclonic condition in the Bay of Bengal in the east or in Arabian sea in the west well in advance.</p> <p>Officers in charge of Critical infrastructure in the electricity supply system such as water intakes, generating units, grid substations, Transmission lines and towers, local distribution systems identified on the path of cyclone high wind areas to be more vigilant. If the cyclonic threat or high wind situation is imminent, implement response plan.</p>	<p>GM CEB</p> <p>GM LECO</p> <p>Engineers in charge of generation and distribution.</p> <p>Engineer in the region in charge of distribution LECO</p>
Tsunami	<p>Met dept., issue early on the formation of tsunami conditions. Collect information from global level institutions monitoring earthquakes and predicting tsunami hazard</p> <p>If the tsunami threat is imminent, inform regional engineers to implement emergency response plan.</p>	<p>GM/LECO</p> <p>GM/LECO</p>

Step 4: Involves the remediation of the electricity system.

Step 5: involves the restoration of the electricity supply system to its normal, secure operation (recovery).

In order to ensure the safety of customers and staff operating the electrify supply and distribution system, it is essential to take precautionary measures before connecting the supply to the distribution system

act to achieve the tasks listed in the Table ... which will cover all aspects of ERP which will pave the way to prepare the ERP for national and regional level layers of CEB and LECO.

Table 4.32: Persons responsible to take decision and act on activities to pave the way for ERP

No.	Tasks to be fulfilled for effective and efficient emergency response in electricity sector	Officer responsible	
		CEB	LECO
1	Decide on the level of response and who will be in charge of response operations		
2	Decide on the level of personal protection required by responders in order to ensure their safety?		
3	Provide information on emergency/disaster support and advocacy.		

- 4 Identify officers who make disaster/emergency response decisions.
- 5 Conducting disaster Damage and Loss assessment
 - i. Decide on the framework of assessment (Rapid assessment or Detail assessment or Recovery& Reconstruction assessment) and the time frame for conducting the assessment
 - ii. Appointment of teams for conducting damage and loss assessment at national and regional level
 - iii. Training of assessment team on the methodology for conducting assessment
- 6
 - i. Who will manage remediation and recovery activities?
 - ii. Decide on the level of repair/recovery activities

4.3.2. Standard Operation Procedure for specific Hazard

a. Flood Response

Before the Flood

Keep flood Water Out

Item	Activity	Officer responsible
01	Sand bag, if possible, around structures and at building entrances located in the flood prone areas.	Engineers in charge

Surface Water Intake and generators preparations

Item	Activity	Responsibility
	During a flood event, debris often increases within associated surface water bodies. Surface water intakes are at risk of becoming damaged or blocked. Ensure water storage tanks are filled to capacity and make provisions for temporary intakes in case the intake requires flushing or is completely blocked.	Engineers in charge of Generation
	Impact of flood water on penstock is minimal. However, if the penstock or open channel taking water to generating units are within the flood inundation areas, prevent floating debris damaging penstock pipes or blocking channel.	Engineers in charge of Generation

<p>In designing thermal power plant maximum flood water level has been considered. Therefore, impact of flood water could be minimal. However, due to unusual devastating floods caused by climate change could affect the generating units. Erecting temporary barriers using sand bags could prevent flood water inundating generators and other equipment.</p>	<p>Engineers in charge of Generation</p>
---	--

Grid Substations Response

Item Activity

<p>In designing grid sub stations max flood water level in the area is considered. However, due to impacts of climate change there could be a significant increase in the intensity of rainfall which could create flood and inundate sub stations. Consider protecting the area over the water line using sand bags.</p>	<p>Engineers in charge of distribution</p>
---	--

<p>If access roads are inundated, make arrangements to move staff using boats.</p>	<p>Engineers in charge of distribution</p>
--	--

Secure Electrical Assets

Item Activity

<p>Remove generators and motors not in use to a safe location and make preparations for quick removal of those in service. It is recommended that generators and motors be equipped to accommodate quick removal with disconnect fittings rather than conventional pigtails.</p>	<p>Regional Engineers generation CEB</p>
--	--

<p>If flood waters are anticipated to inundate areas where electronic controls are housed, shutdown system components, programmable controllers, computers, and other field instruments. Shutdown any backup uninterruptible power supply (UPS) systems also because the UPS could maintain sufficient current to the equipment to destroy the instrumentation package when inundated by the flood waters. If household level distribution system affected shutdown the supply to prevent electrocution.</p>	<p>Regional engineers CEB and LECO</p>
--	--

Secure Other Assets

Item Activity

<p>Move mobile equipment to higher ground, identified in advance as a preparedness measure, to prevent damaged by flood waters or debris.</p>	<p>Officer responsible Regional Engineers CEB /LECO</p>
---	---

Customer Notification

Item Activity

Officer responsible

In order to ensure the electricity supply system is prepared to issue the notice as soon as possible, a precautionary preparedness need to be taken including public awareness prior to the flood event occur. However, it is essential to issue customer notification on the status of the electricity supply together with precautionary measures to ensure the safety of the consumers. GM CEB LECO

Contact officers from National Relief Services Center at divisional level to identify location of safe centers established and electricity supply required. Regional engineers CEB/LECO

During and After the Flood

Item	Activity	Officer responsible
	Once the flooding has subsided, responsible officers of the distribution system need to inspect area and ensure that the supply system of household, industrial and commercial is not affected by floods before providing connection	Engineers responsible CEB/LECO
	If affected inform customers to attend to required repairs before	Engineers responsible CEB/LECO giving connection.
	If intake was inundated ensure that the generators were not affected by flood water before re starting generators	Regional Engineers generation
	Take action to recover cost of electricity supply to evacuation centers during flood.	Finance Manager regional CEB/LECO

b. Drought

Before Drought

Item	Activity	Officer responsible
01	Establish a drought monitoring cell under the Addl,GM (Generation) CEB to continuously monitor the development of drought condition impact of power generation.	GMCEB / Addl.GM (Gen)
02	Disseminate drought warning messages to Engineers in charge of power plants highly and moderately exposed to drought.	GM CEB / Addl.GM (Gen)
03	Assess power deficiency to meet the consumer needs and inform GM.	Engineer Generation
04	Estimate total deficiency and additional cost to power supply during drought.	GM CEB / Addl.GM (Gen)
05	Identify priority customers who need continuously supply and Summaries total requirement of the Country	GM CEB
06		

Install a generator to provide power to priority customers in the event the drought condition prevails for longer period	Engineer Distribution
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Customer Notification

Item	Activity	Officer responsible
12	Prepare to issue public notices about impending drought condition and precautionary preparedness needs before drought.	GM CEB
13	Develop guidelines to improve public awareness on the expected drought situation and customer responsibility to minimize power use for essential services minimize wastages (Eg shutting down air conditioning system). Use public address system to disseminate the messages to customers	GM CEB
14	It is essential to issue customer notification on the status of the electricity supply and possibility of limiting supply hours.	GMCEB GM LECO

During and After Drought

Item	Activity	Officer responsible
	Reduce the power purchase from private producers based on the improvement of water levels in reservoirs.	FM Regional level\
	Provide electricity to priority customers using the portable generators.	Regional Engineers CEB and LECO

c. Landslide

Before Landslide

Item	Activity	Officer responsible
	Nominate an officer at national and regional level to receive and disseminate EW messages	GM CEB GM LECO
	Register the Name and contact numbers of the officer at National level with EOC/DMC	GM CEB GM LECO
	Check the communication system is established to receive and disseminate early warning messages and other communication from DMC/NBRO/DoM	Officers nominated by CEB and LECO
	Record the EW messages (watch, alert and evacuation) on landslides send by DMC	Officers nominated by CEB
	Confirm the receipt of relevant EW messages and record the time and mode of communication	Do -

Verify the messages from NBRO	Do -
Inform GM record the time and mode of communication	Do -
Disseminate the EW messages to regional engineers. Record the time & mode of communication	Do-
If officer not contactable inform the next senior officer.	Do -
Confirm receipt of messages. Record the time and mode of communication.	Regional engineer
Verify from local NBRO office and the GN in the area latest information on LS.	Regional Engineer

During and After Landslide

Item	Activity	Officer responsible	
05	Record the EW messages (watch, alert and evacuation) on landslides send by DMC	Regional CEB	Engineer
06	Confirm the receipt of relevant EW messages and record the time and mode of communication	Do -	
07	Verify the messages from NBRO	Do -	
12	Verify from local NBRO office and the GN in the area latest information on LS.	Regional CEB	Engineer
13	Continuously monitor the distribution lines of the electricity supply system exposed to landslide, restore electricity supply to consumers who are returning after ensuring safety.	Regional CEB	Engineer
14	Acknowledge the all-clear messages received from DMC	GM office	
15	Disseminate the message to regional office generation and distribution	-do-	
16	Support the team of officers appointed to conduct the damage and loss assessment	Regional CEB	Engineer
17	Release all hired vehicles and equipment when the emergency phase is over.	Regional CEB	Engineer

d. Cyclone/ high winds

Before Cyclone/high winds

Item	Activity	Person responsible	
01	Inspect distribution system and identify and trees and branches that could fall on the distribution lines	Regional Distribution	engineer
02	Cut and remove overhanging branches and trees that could damage to distribution system.	Regional Distribution	engineer

03	Check all buildings and stores for loose roofing sheets fix those to the roof and building so that strong will not blow the roof off.	Regional Distribution	engineer
04	Made arrangements to receive EW messages issue by Met Department. Keep DMC inform of process.	Regional Distribution	engineer
05	Procure electrical poles and wire of required sizes to attend to and damaged distribution lines without delay.	Regional Distribution	engineer
06	Cancel leave of technical staff keep them inform of the developing situation and be ready to mobilize with short notice.		
07	Identify additional staff from other regions not affected by cyclone/high winds to call for help.	Regional Distribution	engineer

After Cyclone/high winds

Item	Activity	Person responsible	
	Personal Precautions		
	Immediately disconnect the supply to transmission lines and distribution system in the affected area.	Regional Distribution CEB/LECO	engineer
	Assess the damages to transmission lines, grid sub stations and distribution system and inform GM CEB and LECO	Regional Distribution CEB/LECO	engineer
	Repair transmission lines damaged and restore supply to distribution system		
	Conduct detail loss and damage assessment submit summaries data to GM CEB and LECO	Regional Distribution CEB/LECO	engineer
	Summaries the damages and losses at National Level and submit to the Ministry	GM/CEB and LECO	

4.3.3. Emergency Recording

Keeping records of each hazard is also essential and following format is recommended for the purpose

Emergency situation: _____

Recovery Time Assessment: _____

Action Plan:

- **Assessment:**

- **Immediate Actions:**

- **Notifications:**

- **Follow up:**

- **Review:**

4.2.4. Damage, loss and need assessment

Assessments estimate, first, the short-term government interventions required to initiate recovery and second, the financial requirements to achieve overall post-disaster recovery, reconstruction and disaster risk management or reduction.

4.2.4.1. Preliminary Damage Assessment

Preliminary Damage Assessment important after an emergency to quickly assess the extent of the damage and the need for repair, replacement or recovery of facilities. Results of preliminary assessment will help to find out funds required to attend to urgent repairs before people are resettled at the original places of residence. Preliminary assessment Form in Table 4.41 given below could be used to enter the assessment results

4.2.4.2. Preliminary Damage Assessment

Preliminary Damage Assessment important after an emergency to quickly assess the extent of the damage and the need for repair, replacement or recovery of facilities.

Table 4.33: Preliminary assessment Form

Power Generating units		Yes	No	
N/A				
Physical damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Failure of generating unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Damage to intakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Damage to penstock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Grid Substation		Yes	No	N/A
Physical damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment operating properly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transformers operating properly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>				
Distribution lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Medium Voltage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low voltage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other system damage (e.g. Portable generators, vehicles, etc.)				
Description of Damage:				
Estimated Cost to Repair Damage:				
Estimated time to repair and restoration services				

4.3.4.2. Detail Damage, Loss and need Assessment

The objective of the Damage and Loss Assessment (DALA) in the electricity sector is to quantify the physical damages and economic losses resulting from disaster impacts, to inform recovery planning, financial mobilization, and the prioritization of “Build Back Better” (BBB) reconstruction efforts. The assessment provides evidence-based inputs for decision-making by the Ceylon Electricity Board (CEB), Lanka Electricity Company (LECO), the Ministry of Power and Energy, the Disaster Management Centre (DMC), and the National Planning Department.

Assessment Framework

Phases of Assessment

The DALA process is implemented through three distinct phases:

- 1. Rapid Assessment (0–72 hours):**
Conducted immediately after a disaster to identify the extent of service disruption, critical infrastructure damage, and emergency restoration needs.
- 2. Detailed Assessment (within 2–3 weeks):**
Involves a systematic evaluation of physical and functional impacts on generation, transmission, and distribution infrastructure.
- 3. Recovery and Reconstruction Assessment:**
Determines long-term repair and reconstruction costs, incorporating Build Back Better (BBB) and climate-resilient design principles.

Methodological Steps

Step 1: Establish Assessment Teams

- Teams are led by the **CEB and LECO Disaster Management Units** in coordination with the **DMC and District Disaster Management Coordinating Units (DDMCUs)**.
- Each team should include engineers, economists, GIS and remote-sensing experts, financial analysts, and field inspectors.
- Coordination with the **National Emergency Operations Centre (NEOC)** ensures information consistency and policy alignment.

Step 2: Define Assessment Scope

- Identify affected regions and infrastructure categories (generation plants, substations, transmission lines, transformers, poles, and customer service centres).
- Specify the hazard type (flood, drought, landslide, cyclone/high wind, tsunami, or lightning) and its geographic extent.

- Determine the time frame and data needs for each assessment phase.

Step 3: Data Collection and Verification

Data should be collected from multiple validated sources to ensure accuracy and consistency.

- **Field Surveys:** Use standardized inspection forms and mobile GIS applications (e.g., Kobo Toolbox, ArcGIS Survey123).
- **Remote Sensing and GIS Mapping:** Apply satellite imagery, LiDAR, or drone technology for spatial analysis of affected assets.
- **Operational Data:** Obtain outage logs, SCADA data, system load reports, and maintenance records from CEB and LECO.

Table 4.34: Impacts and assessment Focus

Hazard	Typical Impacts	Assessment Focus
Floods	Substation inundation, short circuits, tower base erosion, equipment corrosion	Inspect substation waterproofing, foundation stability, and asset replacement cost
Cyclones / High Winds	Tower collapse, broken conductors, roof loss, pole damage	Evaluate wind load performance, structural damage, and conductor failures
Landslides	Tower base failure, pole displacement, access road damage	Assess geotechnical stability, slope reinforcement needs
Drought	Reduced hydropower output, equipment overheating	Quantify generation losses, cooling equipment failures
Tsunami and Coastal hazards	Coastal infrastructure destruction, saltwater corrosion	Estimate total replacement cost, assess corrosion mitigation requirements
Lightning	Transformer burnouts, control panel failure	Assess grounding, arrester effectiveness, and equipment loss

- **Stakeholder Inputs:** Include observations from regional engineers, divisional

Step 4: Damage Assessment (Physical Impacts)

Quantify the direct physical damage to electricity infrastructure across the value chain.

Key Damage Indicators:

- Number and type of assets damaged or destroyed.
- Cost of repair or replacement per asset category.
- Estimated duration of service outage and restoration priority.

Step 5: Loss Assessment (Economic and Functional Impacts)

Economic losses are assessed by estimating the reduced electricity supply, additional costs, and downstream economic effects.

Components include:

- Revenue loss due to service interruption.
- Cost of emergency power supply (e.g., mobile generators, diesel use).
- Increased operational and maintenance expenses.
- Economic impact on industries, hospitals, water utilities, and households.

Loss Calculation Example:

$$\text{Loss} = (\text{Expected Output} - \text{Actual Output}) \times \text{Average Tariff}$$

Step 6: Indirect and Social Impact Assessment

Assess the broader consequences of electricity disruption:

- Impact on essential services (healthcare, education, water supply, telecommunications).
- Livelihood losses and reduced productivity.
- Social impacts such as safety risks and access to emergency services.

Step 7: Data Consolidation and Reporting

- Compile results into a **Damage and Loss Assessment Report** detailing asset-level damage, financial losses, and recommended recovery actions.
- Submit the report to the **DMC, Ministry of Power and Energy**, and **National Planning Department** for integration into the **Post-Disaster Needs Assessment (PDNA)**.
- Store assessment data in the **National Disaster Loss and Damage Database** for long-term analysis and policy use.

Institutional Coordination

- **Lead Agency:** Ceylon Electricity Board (CEB)

- **Supporting Agencies:** LECO, Sustainable Energy Authority, PUCSL, DMC, and the Ministry of Power and Energy.
- **Coordination Mechanism:** Operates within the **Incident Command System (ICS)** framework under the **National Emergency Operations Centre (NEOC)**.
- **Information Flow:** Field data → Regional control centers → Sector Emergency Operations Centre → NEOC.

Integration of Build Back Better (BBB) Principles

DALA findings should directly inform reconstruction and resilience-building measures, ensure sustainability and reduce future risk. Recommended actions include:

- Relocating substations away from flood-prone or coastal areas.
- Reinforcing towers and poles to meet cyclone/wind load standards.
- Upgrading grounding and lightning protection systems.
- Incorporating renewable and decentralized generation systems for redundancy.
- Using durable, climate-resilient materials and environmentally sustainable designs.

Electricity supply system operated by CEB

The Electricity supply is characterized by a system of processes (from electricity generation, transmission and distribution) where electricity is supplied to individual households for a certain amount of fee paid to the CEB and LECO, Table 4.42

Table 4.35: Baseline information on assets of CEB in the Area

Name of Area				
Number of consumers/Employees				
Types of Users	Number of Clients	Daily Demand	Annual Demand	Rate of supply
		KW hours day	Hours/Year	LKR/KWh
<i>Residential</i>				
<i>Commercial</i>				
<i>Industrial</i>				
<i>Others</i>				
Total				
Average Income Per Year (LKR)				
Assets				
Components	Average Replacement Cost (LKR)		Average Repair Cost (LKR)	
Power Plants				
<i>Generators of different capacity</i>				
<i>Hydro</i>				
<i>Thermal</i>				
<i>Coal</i>				
<i>Wind</i>				
<i>Solar</i>				
Sub stations				
<i>Structures</i>				
<i>Equipment</i>				
<i>Others</i>				
Transmission lines				
<i>Towers</i>				
<i>Transmission lines,</i>				
<i>MV Distribution Lines</i>				
<i>Distribution Transformer</i>				
<i>low voltage</i>				
<i>Service connection and</i>				
<i>Metering</i>				
<i>Control Equipment</i>				
<i>Others</i>				
Main Office				
<i>Structures</i>				
<i>Equipment</i>				
<i>Inventories</i>				
<i>Vehicles</i>				
<i>Others</i>				

Notes in filling out Table:

- It is possible that electricity supply system located in one area serves the needs of other / Areas or even the whole Province. In such a case, the assets of the electricity supply system may be

located in several /Areas. The assessment team must be cautious about the possibility of double counting.

- For the structures and equipment, the table can be expanded to include all the types of structures or buildings and equipment, especially those that are vital in the operation of the electricity supply system.
- Year 1 and Year 2 refer to the estimated electricity demand after the current year.

Electricity supply distribution system operated by LECO

LECO provide electricity to consumers in certain portions of Urban areas in Gampaha, Colombo, Kalutara, Galle and Matara districts. LECO maintain overhead distribution lines erected on concrete poles at 11kV lines and low voltage, distribution transformers and associated equipment, service drops up to customer service metering and Baseline information need to be collected before disaster occur.

Table 4.36: Baseline information of distribution system maintains by LECO in the district.

Name of Branch:		
Type of Supply	Average Replacement Cost (LKR)	Average Repair Cost (LKR)
<i>Distribution lines 11kV / low voltage</i>		
<i>Distribution Transformer</i>		
<i>Distribution lines low voltage</i>		
<i>Single phase meters</i>		
<i>Three phase meters</i>		
<i>Electricity poles</i>		
<i>Others</i>		

Chapter 5:

Recovery and Reconstruction Plan

5.1. Introduction

Every community recognizes the significance of secure and consistent power supply. Disaster recovery planning is a critical component of electricity system management. The infrastructures of electricity supply system are susceptible to natural and man-made hazards, which result in minor to severe scale damages. Consequently, the electricity supply to the communities or customers is disrupted. The effects of each catastrophe are distinct and affect various components of an electricity supply system. Floods can result in blocking of intake gates, damage to infrastructures and distribution systems. Landslides can also cause damage to infrastructures and distribution systems. Droughts will reduce the water availability for hydro power generation increasing the cost of generation using thermal power plants. Cyclone and high wind could affect the transmission lines and distribution system. Disaster recovery planning for power sector is a process that assists CEB and LECO in enhancing long-term resilience by integrating disaster risk reduction measures into the recovery process. This is achieved by adhering to the Build Back Better principles, which include the restoration and improvement of facilities as appropriate during the recovery and reconstruction phases.

5.2. Disaster Recovery Plan

Recovery can be accomplished by providing electricity to the disaster-affected population at the same rates or tariffs, in the same quantity and quality, as they were prior to the disaster. Furthermore, the process of reconstruction is not complete until all physical assets that were devastated have been rebuilt and are operational, with the goal of achieving disaster risk reduction and resilience standards. The restoration of institutional governance in relation to system operation is a unique concern that must be addressed. Recovery needs encompass the financing requirements necessary to cover the higher-than-average cost of operating electricity supply systems from the time of the catastrophe until complete recovery and reconstruction take place. This may involve the transient expense of distributing electricity using thermal generators during the emergency, and the increased cost of purchasing power from private generators. The government may be obligated to introduce or increase subsidies until reconstruction is complete in order to guarantee the financial stability of the utility.

Key steps of Recovery and Reconstruction is illustrated as follows for drinking water sector with additional requirements for disaster recovery

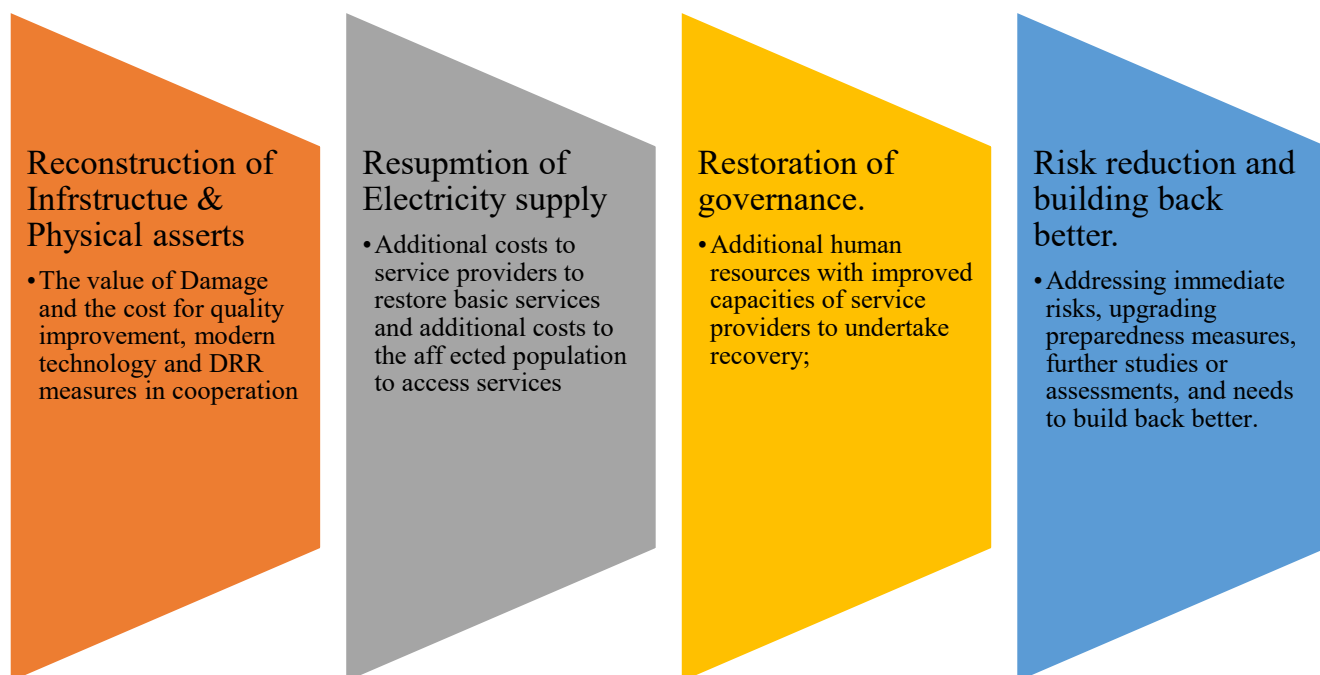


Figure 5.1. Key steps of Recovery and Reconstruction

5.2.1. Recovery for Small disaster Event

The DRF will fluctuate in accordance with the magnitude of the disaster, as the requirements and procedures will be altered. In general, after carrying out damage estimation within the institution following its own method, the annual budget allocation for the rehabilitation vote of CEB /LECO could be utilized for small-scale annual disasters, and the implementation could be conducted in accordance with the standard rehabilitation and maintenance procedures of CEB/LECO

5.2.2. Recovery for Catastrophic Events

It is imperative to have a comprehensive disaster recovery plan in place following a calamitous disaster event, as the damages cannot be repaired using the organization's own resources or, in some cases, the internal budget. However, it may be necessary to solicit assistance from external sources during the interim period following the catastrophic event. In these circumstances, it is necessary to adhere to the internationally recognized procedures and methods for the identification of recovery needs and the assessment of post-disaster damage.

The recovery plan could be prepared in collaboration with the DMC, as the electricity sector has been identified as an important service sector. It is crucial to adhere to the Post Disaster Need Assessment, which includes a detailed damage and loss assessment of the sector. The DRP could then be formulated based on this assessment.

Given that it is impossible to plan during or immediately following a calamitous event, even pre-disaster recovery planning must be completed in advance of disasters. The entire staff must be informed of the recovery process, procedures, responsibilities, and funding mechanism well in advance.

5.3. Process of Disaster Recovery Planning

A disaster recovery plan (DRP) is a formalized, structured approach that specifies how an organization can restart operations efficiently following a disaster caused by natural or human intervention. The purpose of disaster recovery planning is to minimize the impact of disasters on Electrify Supply operation and provide electricity to consumers without or minimum interruption. Disaster Recovery planning could be in two stages.

Stage 1: Pre-Disaster recovery planning

Stage 2. Post disaster recovery planning

5.3.1. Pre-Disaster Recovery Planning (PrDRP)

PrDRP is an endeavor to enhance disaster recovery initiatives, planning, and outcomes by preparing for them prior to the occurrence of a disaster. The concepts of PrDRP are predicated on the idea that numerous beneficial aspects can be established prior to a disaster in order to enhance recovery outcomes and facilitate Post-Disaster Recovery Planning (PoDRP).

PrDRP would prevent or mitigate the hurried decisions that result from post-disaster exigencies and enable development of a more comprehensive and effective Disaster Recovery Plan (DRP). It is a cyclical process that is continually enhanced by new information and experience of the situation. In addition, the process may involve the simultaneous execution of certain actions and steps, which enables the simultaneous execution of numerous PrDRP-related actions without the need to wait for the completion of certain previous steps.

Pre-disaster planning does not negate the necessity of post-disaster planning. Conversely, the pre-disaster planning process should be incorporated into the post-disaster recovery planning process. PrDRP guarantees that sufficient time and attention are allocated to the determination of critical recovery strategies and actions in the more difficult and demanding post-disaster conditions. PrDRP is also an effective method for integrating post-disaster lessons from previous disaster events into the PoDRP of future hazard events.

5.3.1.1. *Pr-DRP in principle would include followings*

- **Designating and identifying the divisions, regional offices, and officials (Staff) who are responsible for the planning and implementation of recovery.**

It is crucial to Identify the lead section or division within the institution in CEB and LECO, as well as the personnel within each agency who are designated to participate in various phases of Post Disaster Recovery Planning (PDRP), such as pre-disaster data management, Damage and loss data collection, and the production of Post Disaster Need Assessment (PDNA) and Disaster Recovery Framework (DRF). Conducting refresher training programme for those identified for conducting loss and damage assessment will facilitate the timely completion of post disaster assessment process.

- **Institutionalizing recovery and rehabilitation roles and responsibilities.** Incorporate recovery-related functions into the CEB/LECO policies and incorporate recovery responsibilities into the job descriptions of designated staff. Develop an intuitive organizational chart that includes the recovery process and/or generate an

organizational chart for recovery planning and implementation. Establish systems and procedures to facilitate the institutionalization of PrDRP and Post Disaster Recovery Planning (PoDRP) for specific infrastructure that are assigned to each division and regional office. This would entail the establishment of data management systems to acquire and update the baseline status of the respective assigned electricity supply infrastructure. These actions will reinforce the sense of ownership in the recovery process, and the designated staff will be more comfortable engaging in PodRP and implementation in the event of a disaster.

- **Acquiring political commitment and validation:** The recovery's success is contingent upon political ownership at all levels. Sensitization and awareness-raising among identified key actors, as well as ongoing communication and dialogue, are essential components of pre-disaster recovery measures. The GM or any other senior officer responsible for emergency response actions should provide comprehensive briefing to the Minister and the Secretary under whose purview the subject of electricity supply and convince them of the significance of the recovery framework and its implementation. They must be updated on a regular basis to ensure that they can inform the Cabinet of Ministers and the treasury, as well as to allocate the necessary resources for recovery.
- **Building capacity:** Evaluate the capabilities of the designated divisional and regional offices and personnel to manage disaster recovery, and develop or improve their capabilities. Financial systems are included in capacity building to expedite the recovery process. Training can be technical, such as the development of data management systems, including the design of databases, the identification of data sets, the frequency of updates, and the Post Disaster Need Assessment (PDNA) methodology, as well as the drafting of DRFs.
- In addition to **coordination and negotiations with stakeholders**, individuals involved in PDRP and implementation should also comprehend the role of communication, donor requirements, and the use of and management of recovery finance. Trainings can also serve as opportunities to establish baseline databases, establish pre-disaster data collection and updating mechanisms, and implement rapid data collection and assessment methodologies to expedite PDNAs, among other things.
- **Establish post-disaster procurement arrangements:** the development of recovery-related standards and protocols during the pre-disaster phase will expedite the recovery process, including data collection, assessments, prioritization, planning, and implementation. i.e., the establishment of common standards for reconstruction, the adaptation of standards to the local context, the reporting of changes and the related budgeting, monitoring, and evaluation, as well as the training of the appropriate personnel.

- **Training and enhancing the capacity of designated personnel:** Recovery planning is designed to reconstruct the existing infrastructure to reduce risks, incorporate DRR measures to make it more resilient, and equip it with efficient technologies (through BBB measures) to better meet the needs of the people and ensure uninterrupted services are provided. The planning and implementing capacities of the key designated staff of the CEB/LECO will be enhanced by the implementation of properly planned training and capacity development.
- **Establishing a coordination system:** One of the primary strategies of DRP/PDNA is the establishment of common platforms for coordinated action within the various divisions' regional offices. This enables effective coordination with the primary disaster recovery framework, which is coordinated by the Disaster Management Centre.
- **Stakeholder engagement and validation:** It would be preferred to establish a validation team within the CEB /LECO
- **Updating baseline data:** The absence of pre-established baseline data is a significant obstacle to the efficient conduct of a PDNA and the development of a sound DRF. In order to ensure that baseline data or the status of infrastructure prior to disasters is accessible, the designated division should have systems in place to collect and update it.

The following measures must be taken to ensure the effective and efficient implementation of the entire process when establishing the DRF within the CEB/LECO

5.3.1.2. Develop Capacity to Implement Disaster Assessments

- Determine the most suitable assessment tool for disaster scenarios in accordance with the CEB's and LECO's specifications. Designate the divisions/sections or regional office that are responsible for the preparation and execution of post-disaster assessments in advance.
- Create training programs that replicate real-world conditions and offer examples of effective practices and lessons learnt in the context of assessments.
- Formulate rapid assessment methodologies to expedite PDNAs.
- Develop the pre-disaster (baseline) database (national and sectoral) to facilitate its rapid mobilization following the disaster.
- Develop recovery frameworks in advance of a disaster to enhance resilience.

5.3.1.3. Prepare Recovery Frameworks Prior to a Disaster to Improve Resilience

- Define the vision and guiding principles of recovery processes.
- Clarify the roles and responsibilities of all potential of responsible officials in a recovery,
- Define pre-established coordination mechanisms.
- Share standards for reconstruction.
- Standardize reporting tools, whether they are related to budgeting or monitoring and evaluation.
- Define standards of eligibility of government assistance for the affected communities.
- Define sectoral standards for Building Back Better (BBB).

5.3.1.4. Develop Predictable Financing Arrangements

- Prioritize the key policy objectives and identify in advance the post-disaster spending priorities.
- Build an aid-tracking mechanism that enables the lead agency to manage, disburse, and account for funds with local implementers.
- Consider disaster risk insurance mechanisms to increase the financial response capacity of national and subnational governments and secure cost-effective access to adequate funding for emergency response, reconstruction, and recovery.

5.3.2. Post Disaster Need Assessment and Full-Scale Recovery & Reconstruction

The CEB/LECO can decide to conduct a more comprehensive evaluation of damages, losses, and requirements in the afflicted sectors and geographical regions, contingent upon the severity of the disaster. Depending on the national context and the nature and size of the disaster, assessments can take on a variety of forms. In order to deploy qualified teams on the ground to conduct the assessment once the disaster strikes, it is crucial that CEB/LECO develop their capacity with regard to the various assessment methodologies prior to a disaster. The Post-Disaster Needs Assessment (PDNA) is a standardized methodology that was jointly developed by the EU, UN, and World Bank to assist governments in evaluating the damages, losses, and recovery requirements.

The DRF will establish realistic corresponding measures and available resources to implement the recovery in accordance with the requirements identified in a PDNA.

Major Steps in the PDNA is illustrated below Figure 5.2

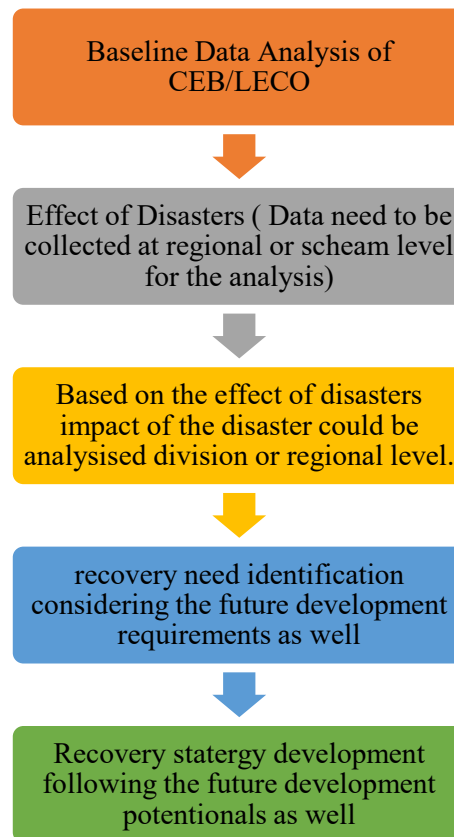


Figure 5.2. The five components of the PDNA methodology

5.4. Resource mobilization and implementation of DRP

The mobilization of resources necessary for recovery is predicated on a well-crafted recovery strategy/DRF. Consequently, the recovery strategy/DRF that is developed during the PoDRP must either generate resource mobilization plans or revise and enhance the ones that were developed during the PrDRP. The NPD and the NBD will receive guidance and a strategy from the DRF to rebuild following the calamity. The PDNA Team should present the objectives and anticipated outcomes of the DRF's resource mobilization strategy, which should be subsequently approved by the government. Advocacy and communication should also be incorporated into the resource mobilization strategy to increase awareness among policy makers, potential donors, the media, and key population groups.

Depending on the circumstances, public funding may be prioritized for urgent recovery. DRF may contemplate donor assistance, such as the organization of donor conferences, to mobilize balance resources when internal national resources appear insufficient to support the recovery that is prioritized by DRF.

Chapter 6:

Training Plan for Electricity supply Sector related to Disaster Risk Management

Training Schedule for Electricity Supply Sector (CEB/LECO) related to Disaster risk Management

Module 1 - Introduction and Concept of Disaster Risk Reduction (DRR), Development in Electricity Supply Sector Including Key Concepts, Frameworks and Terminologies

Session 1.1 - Understanding and definition of hazards, risks, vulnerabilities, capacities and disasters

Content :

- Understanding and definition of hazards, risks, vulnerabilities, capacities and disasters
- Classification and categories of disasters
- Types of vulnerabilities
- Disaster and human misery
- Vulnerabilities and disaster risks
- Link between risks, vulnerability
- From relief to preparedness and mitigation
- Risk Reduction
- Question and Answer Session:

Methodology: Power Point Presentation, Open house discussion interactive session

Duration 60 minutes

Target Group Officers engaged in DRR activities

Session 1.2 –Energy sector Development and Disaster Management

Content :

- Development and Disaster Management
- Definition and Relationship
- Disaster – Development linkages
- Development, sustainable development, climate change and disasters
- Question and Answer Session

Methodology: - Power Point Presentation, Open house discussion interactive session
Duration - 60 minutes
Target Group : Engineers at Operational level, Planning and Design Engineers, Sociologist.

Session : Session 1.3 - Overview of Disaster Context in Electricity supply

Content :

- Overview of Disaster Context in electricity supply sector
- Recent major disaster events and impact to electricity supply sector
- Disasters caused by natural hazards and Human interventions
- Hazard proneness of electricity supply sector – different hazards
- Risk Ranking and risk matrix for electricity supply sector
- Climate Change and Climate induced disasters – trends and impacts
- Question and Answer Session

Methodology: Power Point Presentation, Open house discussion interactive session
Duration 60 minutes
Target Group Engineers at Operational level, Planning and Design Engineers.

Training Schedule for Electricity Supply Sector (CEB/LECO) related to Disaster risk Management

Module 2 - Mainstreaming DRR in Development Planning Process with Reference to Electricity Supply Sector

Session 2.1 Mainstreaming DRR into Electricity Supply Sector Planning

Content :

- Mainstreaming DRR into electricity supply Sectoral Planning
- What is mainstreaming?
- Why mainstreaming is important?
- Multi-stakeholder involvement - why involvement of other stakeholders in planning and implementation should be prioritized and be a part of the planning process
- Development, sustainable development and disaster risk reduction
- Global initiatives, experiences and debates

- Sendai Framework for Disaster Risk Reduction and why and what activities are required for integration of DRR into electricity supply sectoral developmental plans
- Why mainstreaming DRR in to development planning process is cost effective and how it will ensure sustainable development keeping in mind the increasing disaster risks in the national contexts
- Approaches for mainstreaming DRR in the developmental planning process in electricity supply
- Guidelines for mainstreaming Disaster Risk Reduction in electricity supply sector Planning
- Case study of a selected national flagship programme and how it can be utilized
- Tracking public investment on DRR: Case Studies from CEB/LECO
- Groups exercise to analyses risks, their ranking,
- Type of investment required for enhancing resilience and risk governance in electricity supply

Methodology: - Power Point presentation Open house discussion interactive session Plenary for presentation of group exercise

Duration -240 minutes

Target Group : Engineers at Operational level, Planning and Design Engineers

Session 2.2 Mainstreaming DRR into Electricity supply sector development Plan

Content

- Impact of unplanned electricity supply development projects with unplanned urbanization & city Development
- Mainstreaming DRR in environment planning and city development plans and Electricity supply sector development: case studies and discussion

Methodology: Power Point presentation, Open house discussion, an interactive session Plenary for presentation of group exercise

Duration: 90 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 2.3 Issues related to women, children, elders, marginalized/Disadvantaged and underprivileged sections of the society, differently-able, youths in mainstreaming DRR in National and sub-national plans on electricity supply enhancement

- Content Issues related to women, children, elders, marginalized/ disadvantaged and underprivileged sections of the society, differently-able, youths in mainstreaming DRR in National and sub-national plans

Methodology: Power Point presentation Open house discussion interactive session Plenary for presentation of group exercise

Duration: 60 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 2.4: Climate Change and DRR – need for integration

Content :

- Climate Change and DRR – need for integration historical Risks, Future Threats” and follow-up discussion on the impact of climate change on communities living in Sri Lanka
- Integration of DRR and CCA and Mitigation into Development Planning
- Why and how • Ecosystem Based Adaptation – Rationale and Process
- Need for innovation, pilot projects and strategies for up scaling

Methodology: Power Point presentation Open house discussion interactive session Plenary for presentation of group exercise

Duration: 90 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 2.5: Incorporation of DRR and CCA into Sectoral Plans

Content:

- Incorporation of DRR and CCA into Sectoral Plans
- Linkage between National and provincial Climate Change Plan of Action and the DM Act, Policy and Plan
- Analyzing sectoral hazard and risk data and risk ranking
- Cost benefit ratio in terms of reduced per capita (unit) expenditure on response and recovery, decreased dependence on borrowings and subsidies and realization of planned targets
- Priority areas/sectors of integration
- Types of intervention for ensuring reduction in disaster loss, increasing resilience
- Group exercise on strategy for integrating DRR and CCA and mitigation into sectoral plans

- Group exercise to develop plans for f the sector

Methodology: - Power Point presentation Open house discussion interactive session
Plenary for presentation of group exercise

Duration - 60 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers.

Module 3 - Tools and Processes to Mainstream DRR and CCA into Developmental Planning, Financing, Incentives and Sustainability Issues for Mainstreaming

Session 3.1: Mainstreaming DRR in electricity supply sector development planning: issues and challenges

Content -

- Mainstreaming DRR in electricity supply sector development planning: issues and challenges-
- Mainstreaming DRR into electricity supply sector national and sub-national planning national flagship programmes
- Group work for incorporating and mainstreaming issues and priorities of women, children, senior citizens, differently abled persons into electricity supply sector plans

Methodology - Power Point Presentation Open house discussion interactive session Plenary for Group Presentation

Duration 120 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 3.2: Challenges in mainstreaming DRR in key Divisions at CEB/LECO

Content :

- Challenges in mainstreaming DRR in electricity supply sector
- Instruments and incentives for mainstreaming DRR in electricity supply sector development
- Developing partnerships and advocacy for mainstreaming DRR into electricity supply sector
- Coordination and synergy across sector and levels, including the national and sub-national level for mainstreaming DRR -a panel discussion

- Initiatives and programmatic approaches for mainstreaming DRR – an in-depth analysis of selected national flagship programmes

Methodology : Panel discussions by 2 selected representatives from each group of exercise

Duration : 90 minutes

Target Group : Engineers at Operational level, Planning and Design Engineers,

Session 3.3: Financing, strategic learning and action planning

Content:

- Financing, strategic learning and action planning
- Management Approach to DRR focusing on drinking water supply sector
- Financing options and budgetary allocations for mainstreaming DRR into electricity supply sector
- Hazard specific or multi-hazard mitigation through developmental plans for specific ecosystem/location, communities, local governance and other institutions at different levels at electricity supply section
- Hazard specific or multi-hazard prone mitigation plans specific ecosystem/location, communities, local governance and other institutions at different levels for (a) structural – roads, irrigation, flood embankments, landslide control walls, housing, plantation for soil stabilization, etc., bio-engineering interventions, etc.; and (b) non-structural – improvement in capacity building, training, incorporation DRR and climate change issues/challenges in education and health programme, advocacy, improved coordination
- Monitoring and evaluation as an exercise in strategic learning and action for mainstreaming DRR in electricity supply sector development, including development of indicators for measuring outcomes
- 2 Group exercises

(a) Exploring specific opportunities for DRR budget allocation for various Government schemes

(b) Developing outcome indicators

Methodology: Plenary Session Group Presentation and summary of the presentation and its key learnings Plenary Session

Duration ; 90 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

- Who and how will manage remediation and recovery activities?

Session 3.4: Tools to be used for the Exercise

Content;

- Tools to be used for field exercise – Group Exercise
- Detailing tools like Sectoral Checklists, mapping tools, etc. for integration of DRR/CCA into sectoral plans and schemes
- Group Exercises
- Group Presentation

Methodology Power Point Presentation Open house discussion interactive session
Plenary for presentation of group exercise

Duration: 90 Minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 3.5: Partnerships for mainstreaming DRR into electricity Supply sector development

Content;

- Successful partnership between national agencies at various levels as well as between national and external development agencies.

Methodology: Power Point presentation Open house discussion interactive session
Plenary for presentation of group exercise

Duration: 90 Minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 3.6: Group Exercise for Revision and final preparation of the suggested sector plans

Content;

- Group Exercise for Revision and final preparation of the electricity supply sector plans with brief methodology,
- Budgets, source of finance, monitoring indicators and linkages with existing (or proposed) schemes based on field experience Strategic action planning
- Preparation of road map for mainstreaming DRR

- Responsibility Sharing Matrix Role of different stakeholders for facilitating and improving upon the efforts to mainstream DRR into electricity supply sector planning

Methodology: Power Point presentation Open house discussion interactive session
Plenary for presentation of group exercise

Duration: 90 Minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Training Schedule for electricity Supply Sector (CEB/LECO) related to Disaster risk Management

Module 4 - Understand the Post Disaster Need Assessment and Recovery Planning

Session 4.1. Understand the Post Disaster Need Assessment

Content :

- Concepts and definition of Post Disaster need assessment
- Conceptual framework on Resilient Recovery
- Inter sector linkages
- Cross cutting issues

Methodology: - Power Point presentation Open house discussion interactive session

Duration - 60 minutes

Target Group :WSP Team members, planning and Design Engineers.

Session 4.2 Pre-disaster base line Data for NWSDB to conduct a PDNA efficiently

Content

- Overview of Pre-Disaster Data Sets (PDBD) focusing on NWSDB
- Why PDBD is required and how it will facilitate the Post Disaster Damage and Loss Assessment process.
- Present the Case study on developing a data set for CEB/ LECO regarding the damage and loss assessment process.

Methodology: Power Point presentation, Group exercise based on the case study and
Plenary for presentation of group exercise

Duration: 90 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Session 4.3 Post Disaster Need assessment focusing CEB/LECO

Content

- Introducing the case study.
- Estimating Disaster Losses and Damages based on the case study
Data sets developed during training session 4.2
- Introduction of formats for collection and assessing the losses and damages in the electricity sector
- How to assess the recovery needs based on the disaster damages assessed above.
- Building Back Better Concept and how to develop a disaster recovery plan
- How and from where to mobilize resources to implement recovery plan

Methodology: Power Point presentation. Hand on exercise on assessing the needs based on damages in water sector due to the disaster. Presentation, Open house discussion interactive session Plenary for presentation of group exercise

Duration: 90 minutes

Target Group: Engineers at Operational level, Planning and Design Engineers

Chapter 1: Appendix 1

Existing Disaster Management practices in the organization – Form 01

Data/information to be collected from Focal Point of the CEB and LECO HQ

Question/ Data Requirement	Expert opinion/answer	Expert opinion/answer	Expert opinion/answer
<p><u>Post Disaster Damage and Loss Assessment</u></p> <p>1. Did the organization conducted a post disaster damage and loss assessment prior to repairing/rehabilitating damaged infrastructure?</p>	No, it shall be repaired immediately because the electricity supply is an essential service	Yes.	Attend to breakdowns immediately. Loss assessment is done after the restoration of supply.
1.1 Is there an institutional policy relating to the conduct of damage and loss assessment after a disaster and mainstreaming disaster risk into development?	Some extent. Anyway, repairing is compulsory	Yes. A provincially prepared Draft Business continuity plan is available.	<u>No formally established institutional policy.</u>
1.2 Availability of database or document system to record past hazard and disaster information, damage and loss Assessment/Risk assessment/ Hazard assessment, vulnerability assessment data/information	Not specifically for disasters only general records	Manual Filling System	<u>No centralized database</u>
1.3 Has the utility service made arrangements for the protection/conservation/preservation of important documents, data etc.	In CEB disasters related to power failure, not to buildings	Yes.	<u>Backup documents are available for some, but not for all important documents.</u>

2.	<u>Disaster Risk Reduction measures in Planning activities</u>	To some extent but really happening the sudden increase of the number of power breakdowns		
2.1	Does your organization use the format introduced by the National Planning Department as per circular MNPEA0/2019 of 10.01.2019 to develop project proposals for treasury Funding? Circular could be downloaded www.npd.gov.lk , download, circulars	No	No	yes
2.2	Are the available plans for the expansion of services considered Disaster Risk Reduction measures at the project planning stages? (Conceptual and design stages)	Up to some extent	Yes	<u>Yes</u>
2.3	DRR practices/ guidelines; Are there guidelines/practices available to incorporate DM and DRR concepts into the new projects or expansion of services?	Some extent	Yes. To some extent	<u>No formally established guidelines</u>
2.4	Are there institutional arrangements to incorporate disaster risk into the Corporate Plan and strategic Plan? If yes, please provide a copy	No	No	<u>No</u>
2.5	Does the institution consider DRR components at the implementing stage of any improvement/ development projects?	Some extent	Yes. To some extent	Yes, for major projects only.

3.0	Disaster Response			
3.1	Is there a disaster Response Plan with the service organization to address different types of disasters? (Please provide a copy)	<u>No</u>	Draft is available	<u>No, but few units such as KPS has disaster response plan.</u>
3.2	If Yes; Is there an Institutional mechanism to implement the plan at national, regional and local levels?	-	No	<u>N/A</u>
3.3	If there is no plan; What institutional mechanism established to respond to disasters?	Increase the work force		Head of the relevant Unit/Branch take the decisions.
3.4	Does the utility service have an established response committee at different levels of operations/ hierarchy?	Some extent	Yes. To some extend	<u>No</u>
3.	Has the organization developed fire safety plans for main administrative units?	Yes	Yes	<u>Available for some units</u>
4.0	Standard Operating Procedures (SOP)			
4.1	Does the organization incorporate DRR measures in to SOP for critical operations?	No	A Standard System Operating Manual is used	<u>Yes, available for main critical locations such as power stations</u>
4.2	Are SOP developed and made available to all officers at the national regional and local level to respond to emergencies? (Provide a copy)	No	Yes. To some extend	<u>No</u>
5.0	Human resources, equipment, and supplies			

5.1	Has the organization assessed the additional human resources required to respond to a disaster of different types and magnitude?	Yes, routine works are stopped, and allocate the crews to rectify the power	Yes	<u>No</u>
5.2	Has the organization assessed the additional equipment and supplies required to respond to disasters of different types and magnitude? Eg. generators, fuel etc.	Some extent	Yes	<u>No</u>
5.3	Are there arrangements to outsource some of the services/operations in the water industry (in general)? (Provide details of outsourced services)	No	Not Relevant	<u>N/A</u>
5.4	Is there a pre-arranged practice to procure additional resources during a post disaster stages?	No	Yes.	<u>No</u>
6.0	Human Resource development for mainstreaming DRR into electricity sector			
6.1	Does the organization conduct regular drills to test the disaster contingency/Response plan and fire safety plan?	No	Yes. To some extent	Yes, for most of the locations
6.2	Has the organization enhanced the HR capacities (eg. Training) to use SOP in disaster response?	No	Yes. To some extent	No
6.3	What disaster related capacity development programmes/plans conducted			

during the last five years or to be conducted to enhance the capacity of officers at all levels on:

	Disaster awareness	=	Brainstorming and training sessions.	<u>No</u>
	Disaster risk assessment	=	Brainstorming and training sessions.	<u>No</u>
	Damage and loss assessment	=	Brainstorming and training sessions.	<u>No</u>
	Disaster Recovery planning		Brainstorming and training sessions.	<u>No</u>
	Emergency Operations	=	Brainstorming and training sessions.	<u>Yes, for critical locations</u>
	Conduct drills to evacuate people during emergencies such as fire.	=	<u>Training sessions.</u>	<u>Yes, for most of the locations</u>
	Any other	=		
6.4	Number of staff at different levels trained on disaster-related activities	=		<u>Information not available</u>
	Recovery Plans;	No	Yes. A provincially prepared Draft Business continuity plan is available.	No
	Has the organization prepared a disaster recovery plan in the past? (Provide a copy)			
8.	Does the institute have a business continuity plan to provide uninterrupted service to consumers at a time of a disaster?	Some extent	Yes. A provincially prepared Draft Business continuity plan is available.	No
9.	Early Warnings	No		

9.1	What are present arrangements to receive disaster Early Warning messages, sharing risk information and networking?	-	Meteorological Department Announcements are used.	Through Police stations, Divisional secretariats
9.2	Does the utility service use weather forecasting/ seasonal forecasting information to minimize service interruptions?	Yes	Yes. To some extend	Yes
10	Does the utility service have alternative, temporary solutions for demand management in emergencies?		Yes. To some extend	Yes for identified locations
11	<u>Risk Financing Mechanism</u>			
11.1	Availability of Risk financing mechanism (insurance, contingency funding catastrophe bonds, and other DRR financing tools) for implementation	No	No	No
11.2	How does the service organization find funds for financing recovery programmes	From Annual Budget	From annual budgets as available.	From ESCROW accounts
	<ul style="list-style-type: none"> • From annual budgets; • Existence of Additional budget/ budget lines • Other provisions for recoveries? 			