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Monographic issue

Disaster Risk Profile of Sri Lanka

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Letter from the editors

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above-mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This monographic issue is about disaster risk profile of Sri Lanka.
Sri Lanka is an island situated at the south eastern tip of India, in South Asia. The country experiences several disasters, natural, man-made and technological, that has a huge and damaging impact on human lives and livelihoods, infrastructure and resources as well as on the economic standing of the country.

This monographic issue gives an overview of the various hazards and vulnerability in Sri Lanka and an analysis of the corresponding risk of disasters.

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Country profile and demographics of Sri Lanka

Sri Lanka, often referred to as the 'Pearl of Indian Ocean' is an island situated at the south eastern tip of India, in South Asia. Sri Lanka is densely populated with a population of 20.48 million people (as of 2013) on an island of approximately 65, 610 sq km, and is a multi-ethnic country with Sinhalese (74%), Tamils (18%), Muslims (7%) and Christians and other groups (1%) living together[1].

According to the last complete census in 2012, 18.2% of Sri Lanka's population lives in urban areas, and the remaining 87.8% live in rural areas[1]. In terms of population distribution across the different provinces of the country, more than 80% of the population lives in the south-western region of Sri Lanka in six provinces, namely, Western, Southern, Sabaragamuwa, Central, Uva and North Western, with the remaining 20% of the population living in the Northern, Eastern and North Central provinces (figure 1). These three provinces in the north and east of the country are less densely populated due to drier, harsher climates with less resources (e.g. water) for agricultural and cultivation purposes.

Figure 1: Map of Sri Lanka showing the 9 different provinces of the country

Sri Lanka's population growth is estimated at 1% a year, and has shown a decline over the last 60 years, with a peak of 3.5% in 1948[1]. About 25% of the population are below the age of 15 years, with the working population of youth, young adults and adults between 15-59 years comprising a bulk of 63%. Approximately 23.3% of all households are headed by women[1].

As of 2014, Sri Lanka's GDP per capita stood at USD 2,135.7[2]. Due to a long and impressive history of significant investment in health and education, Sri Lanka has a life expectancy of 72, and a literacy rate of 92%. With a Human Development Index of 0.743 (in 2012), Sri Lanka ranked at 92, mainly due to factors such as universal primary school enrolment, high literacy rates and high gender equality[3]. However, there still remain significant disparities in economic income between the population living in the Western province, and those in the rest of the country, mainly due to capital-centric economic infrastructure and activities; about 20% of the country's population are still poor, and approximately 15.2% of the population were living below poverty line in 2007. The largest population of poor reside in the rural sector (82%), followed by the estate sector (11%) and urban sector (7%)[3].The situation was further compounded by the ethnic conflict and the Indian Ocean Tsunami, both of which caused widespread destruction and suffering as well as undermined economic growth and development potential in the country. Though official figures on poverty levels among the internally displaced persons (IDPs) due to the tsunami and the ethnic conflict are not available, it is known that a large proportion of the IDPs have fallen into poverty due to the loss of employment, death or injury to the breadwinner or loss of productive assets[3].

Geography

Being an island strategically located in the Indian Ocean, near many of the major sea lanes, Sri Lanka boasts of a beautiful coastline of about 1340km long. The coast is therefore home to important industries such as tourism and fishing, and a large proportion of people in Sri Lanka depend on this coastal economy for their income and livelihood. These communities in particular were severely affected for many months in the aftermath of the 2004 Indian Ocean Tsunami.

Moving inward, erosion of the land over time has produced a wide range of topographic features with 3 distinct zones in terms of elevation: the Central Highlands where tea, rubber and other plantations are located, the plains, and the coastal belt. Approximately 50% of the land in Sri Lanka's 6.3 million hectares is dedicated to cultivation and agriculture. About 13.96% is arable land, with another 15.24% being permanent crops (2005), with a total of 5,700 km² (2003) making up the total irrigated land[4]. Supporting large-scale agriculture and cultivation are total renewable water resources amounting to 52.8 km^3. This water supply comes from thousands of small man-made tanks dependent on rainwater and another 500 medium and large reservoir based irrigation systems which largely depend on river systems as their sources of water. Sri Lanka is also rich in natural resources, such as gems and precious stones, limestone, clay, phosphates, graphite, mineral sands and hydropower[4].

Sri Lanka's climate is largely tropical and is often described as hot and wet; the country experiences two annual monsoons: the northeast monsoon (December to March), and the southwest monsoon (June to October)[5]. The average temperature ranges as low as 16 °C in the Central Highlands to as high as 32 °C in the northeast coast. The average yearly temperature for the country as a whole ranges from 28 to 30 °C.

The rainfall pattern in Sri Lanka is mainly influenced by monsoon winds from the Indian Ocean and the Bay of Bengal and is marked by four seasons (Figure 2)[5]. The first is from mid-May to October, when winds originate in the southwest, from the Indian Ocean. When these winds reach the slopes of the Central Highlands, they cause heavy rains on the slopes and the southwestern sector of the country. The second season occurs in October and November;

during this season, periodic storms occur and sometimes tropical cyclones result in rain in the southwest, northeast, and eastern parts of the country. During the third season, December to March, monsoon winds come from the northeast, from the Bay of Bengal. Another inter-monsoonal period occurs from March until mid-May, with light, variable winds and evening thundershowers.

An increase in average rainfall coupled with heavier and longer rainfall events in the last decade has resulted in recurrent flooding and subsequent damages to infrastructure, livelihoods and the economy, as well as the tragic loss of lives in some instances. Other environmental issues that affect the country include soil erosion, pollution, coastal degradation from mining, deforestation; wildlife threatened by poaching and urbanization; freshwater sources being polluted by industrial wastes and sewage runoff and improper waste disposal.

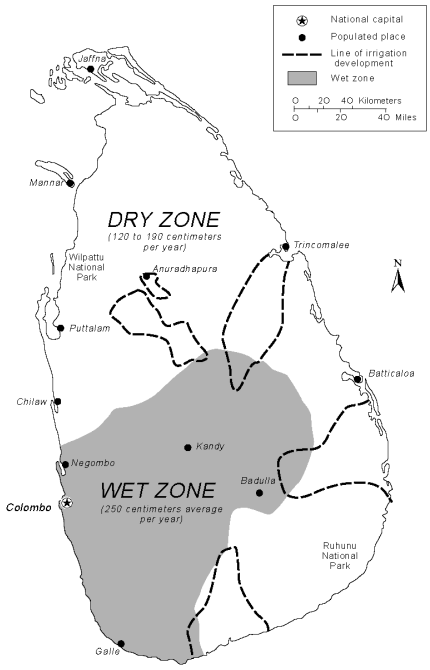


Figure 2: Wet and dry zones of Sri Lanka.

Economic Development Profile

Sri Lanka gained independence from the British in 1948, and in the subsequent years has undergone substantial economic transformation. In 1977, there was a major shift in Sri Lanka's economic policies from its previous socialistic principles to an open market policy instead, thus making free markets and private enterprise as the main drivers of economic development. Of special regard are the Indian Ocean Tsunami of 2004, and the ethnic conflict that affected the country for 26 years, that have had an adverse effect on the economy, particularly in the coastal regions and the north and east of the country respectively[3].

With a current economic worth $80.591 billion[6] and a growth of 7.4% in GDP to USD 3,625 in 2014[7], Sri Lanka's economy has shown resilience despite many internal challenges in recent years, and is ahead of many of the other countries in the South Asian region. The main economic sectors of the country are tea, tourism, garments, textile and apparel manufacture,

rice production and the industrial and service sectors. In addition to these economic sectors, overseas employment contributes a significantly high proportion of foreign remittances, with 90% of expatriate Sri Lankans residing in the Middle East. The average rate of unemployment (as of 2015) is 4.5%, and has remained at an annual average of 5.6% from 1996 to date[8].

In recent years, the agricultural sector has been showing a declining contribution towards the GDP, with most of the rural workforce opting for white collar jobs in urban or sub urban areas, giving rise to the migration of large numbers of young adults out of rural farming areas. The tourism sector was for many years affected by the war, but has recently shown promising growth potential with the end of the conflict in 2009. The industrial sector (mainly textile and garment manufacturing) is also facing an increasing rate of competition from other South Asian countries such as Bangladesh. Sri Lankan policy makers are optimistic and have targeted a growth rate of over 8% over the next few years, despite the various shortcomings in the economy[3].

Population health and health Indicators

As of 2014, Sri Lanka was still on track for achieving most of the MDG targets. Due to historical investments in healthcare and supporting infrastructure over the years, Sri Lanka has an extensive network of public health care centres and hospitals spread across the country, which are adequately staffed and equipped to meet the ever increasing health demands of the population[9]. The health indicators for Sri Lanka over the years 2006-2012 are shown in Table 1 below.

Although commendable achievements have been made in almost completely eradicating/eliminating vaccine-preventable diseases such as leprosy, malaria, Japanese encephalitis, congenital syphilis, neonatal tetanus and filariases, diseases such as dengue still continue to be a threat, sometimes almost reaching epidemic proportions during heavy rains or monsoon periods[9]. Noncommunicable diseases are increasing rapidly as well, particularly cardiovascular disease, cancers, diabetes and chronic respiratory diseases which account for about 70% of deaths in the country. Notably, the government has also made significant progress in curbing the rates of smoking tobacco use by increasing cigarette taxes together with other measures such as public smoking bans. The expansion of mental health services has also been made a priority, particularly among populations residing in post-conflict areas. However, the need for increased public health measures and interventions still remain a much needed health priority[9].

The end of the war in the northern and eastern provinces of the country has brought the need to rebuild the health system in these areas. The recovery and reinstatement of the health system in these areas has remained a challenge, together with the need for response to immediate health needs of the resettled population[9].

Table 1: Health indicators in Sri Lanka (2006-2012)

Health indicators	
Life expectancy at birth (2012) Total; male; female	75 (across genders) 71 (male)

	78 (female)
Neonatal mortality rate per 1000 live births (2012)	6 (5-8) (both genders)
Under- 5 mortality rate per 1000 live births (2012)	10 (9-11) (both genders)
Maternal mortality ratio per 100,000 live births (2010)	35 (25-49)
% DPT3 immunization coverage among 1-year olds (2012)	99
% births attended by skilled health workers (2007)	98.6
Density of physicians per 100 population (2006)	0.492
Density of nurses and midwives per 100 population (2006)	1.93
Total expenditure on health as % of GDP (2011)	3.4
Govt. expenditure on health as % of total govt. expenditure (2011)	7.2
Private expenditure on health as % of total expenditure on health (2011)	55.4
Adult (above 15 years) literacy rate (2010)	92
% of population using improved drinking water sources (2011)	93 (total) 99 (urban) 92 (rural)
% of population using improved sanitation facilities (2011)	91 (total) 93 (urban)83 (rural)
% of population living at a poverty headcount ratio of $1.25 a day (PPP)	4.1
Gender-related development index (2012)	75 (out of 148 countries)
Human development index rank (2012)	92 (out of 186 countries)

A look back at history:
A summary of disasters in Sri Lanka (1965-2015)

In the past 50 years, Sri Lanka has experienced several disasters, natural, man-made and technological, that have had a huge and damaging impact on human lives and livelihoods, infrastructure and resources as well as the economic standing of the country. Apart from a few unique disastrous events such as the Indian Ocean Tsunami in 2004 and the Civil War that affected the country for 26 years, disasters that occur frequently (sometimes on a yearly basis) in the country include floods, landslides, cyclones, drought and animal attacks, as well as transport or road accidents.

Natural disasters
Based on information from the Desinventar database, between the years 1974 to 2015 approximately 35, 670 people have died in natural disasters, with another 33.8 million people being affected in the same time period which is an average of 675,000 people a year. However, it should be noted that this includes figures for the Indian Ocean Tsunami and excludes lives lost and affected by the Civil War.

The most damaging of the natural disasters that occur frequently in Sri Lanka have been floods, cyclones, landslides and droughts, as well as animal attacks. The figures and graphs below are a snapshot of the destruction, death and damage caused by each of these disasters during the period 1974-2012.

Floods, landslides and cyclones have caused the most severe destruction to infrastructure, housing and livelihoods in the past 50 years, and unfortunately are still a frequent occurrence in the country (Tables 2-6). Drought as well as floods have also extensively impacted crop harvests and livelihoods dependent on this. Animal (elephant) attacks and related damage to buildings and crops have also been a frequent occurrence in recent years, mainly due to the encroachment of the land where these animals graze, for agricultural and housing purposes.

Table 2: Extent of death and damage due to floods in Sri Lanka (1974-2012)
(Source: Desinventar database DMC)

Year	*No. of lives lost*	*No. of people injured*	*No. of people affected*	*No. of houses destroyed and damaged*	*No. of people evacuated*	*Economic losses (Rs.)*
1974-1982	1	1	542,138	18,059	6,530	No data available
1983-1992	76	35	2,049,187	30,310	386	No data available
1993-2002	28	2	2,569,167	24,150	3,030	No data available
*2003-2012**	368	249	7,999,331	130,464	62,837	1,285,178,500
Total	**491**	**287**	**13,159,823**	**202,956**	**72,783**	**1,285,178,500**

* In 2011 alone, there were 3 flood events in the months of January, February and September

Table 3: Extent of death and damage due to cyclones and strong winds in Sri Lanka (1977-2012) (Source: Desinventar database DMC)

Year	*No. of lives lost*	*No. of people injured*	*No. of people affected*	*No. of houses destroyed and damaged*	*No. of people evacuated*	*Economic losses (Rs.)*
1977-1992	3	17	4,040	756	0	77,900
1993-2002	5	12	10,895	1,858	65	1,000,000
2003-2012	55	265	146,424	24,043	638	No data available
Total	**63**	**294**	**161,359**	**26,660**	**703**	**1,077,900**

Table 4: Extent of death and damage due to landslides in Sri Lanka (1974-2012) (Source: Desinventar database DMC)

Year	*No. of lives lost*	*No. of people injured*	*No. of people affected*	*No. of houses destroyed and damaged*	*No. of people evacuated*	*Economic losses (Rs.)*
1974-1982	119	29	1,490	78	12	No data available
1983-1992	348	62	8,224	365	336	No data available
1993-2002	77	31	8,898	322	67	No data available
2003-2012	326	159	89,549	9,584	1,954	1,038,000
Total	**870**	**281**	**108,161**	**10,349**	**2,369**	**1,038,000**

Table 5: Extent of death and damage due to drought in Sri Lanka (1974-2012) (Source: Desinventar database DMC)

Year	*No. of lives lost*	*No. of people injured*	*No. of people affected*	*No. of houses destroyed and damaged*	*No. of people evacuated*	*Economic losses (Rs.)*
1974-1982	0	0	702,392	0	0	No data available
1983-1992	0	0	4,466,789	1	600	No data available
1993-2002	0	0	42,98,475	0	0	No data available
2003-2012	2	0	3,454,858	87	0	No data available
Total	**2**	**0**	**12,922,514**	**88**	**600**	**No data available**

Table 6: Extent of death and damage due to animal attacks (elephants) in Sri Lanka (1974-2012) (Source: Desinventar database DMC)

Year	*No. of lives lost*	*No. of people injured*	*No. of people affected*	*No. of houses destroyed and damaged*	*No. of people evacuated*	*Economic losses (Rs.)*
1974-1982	50	53	397	67	0	No data available
1983-1992	59	31	618	77	0	No data available
1993-2002	492	301	19,363	3,346	0	No data available
2003-2012	346	203	59,637	4,398	59	No data available
Total	**947**	**588**	**80,015**	**7,888**	**59**	**No data available**

It is interesting to note that the numbers of lives lost and those affected as well as statistics on damage and injury have increased dramatically for the period 2003-2012, across all disaster types. This could be due to better reporting structures and data collection practices, particularly given the disaster management policies, strategies, early warning systems and interventions that were formally put in place to mitigate and respond to disasters after the Indian Ocean Tsunami in 2004.

Economic expenditure due to disasters

In Sri Lanka, the government has borne the main responsibility for the economic support for disaster victims, which includes the provision of food, relief items, financial compensation, rehabilitation and reconstruction, and other aspects related to early recovery[10]. Damages and losses resulting from disasters both halt and even reverse development, as well as requiring large sums of money that would otherwise have been used for education, health and development of the country. While there has been some progress in reducing the loss of lives during disasters, disaster related expenditure is still significant and a cause for concern, often leading to a ripple effect due to the interdependency of different sectors and industries. Often the huge expenditures result from a lack of contingency planning for immediate recovery and medium/long term financial needs in the aftermath of a disaster, and this only further emphasizes the importance of integrating DRM into development planning.

Another issue is that in certain instances, the same disaster victims in an affected or disaster prone community are repeatedly provided with compensation, creating dependency on government relief (the Good Samaritan Paradox) while failing to actually reduce the causes and risks of disasters due to the reactive nature of these recovery and relief measures[10]. This can be addressed by preventing the population from residing in or returning to hazard-prone areas, and incentivizing them to relocate to safer areas, a crucial aspect in building more resilient communities.

For the period 1974-2007, the largest proportion of funds spent for disaster relief and emergency response has been on droughts, followed by floods, cyclones, the tsunami, epidemics, coastal erosion and landslides, as shown in Table 7 below.

Table 7: Amount of money spent on different aspects of disaster relief and compensation for different disasters (1974-2007)

Amount of money spent (Rs.)

Event	***Emergency Supplies***	***Fully Damaged Houses***	***Partially Damaged Houses***	***Loss of Life***	***Injuries***	***Livelihood options***
Drought	1,110,434,179	-	-	-	-	-
Flood	636,614,913	74,510,000	2,636,187	30,000	-	5,661
Cyclone	223,520,392	446,750	303,330	-	-	753,850
Tsunami	31,180,200	1,250,000	7,00,000	110,500,000	-	3,330,000
Epidemic	24,647,000	-	-	-	-	-
Coastal	18,620,429	-	-	-	-	-
Landslide	15,350,969	-	-	10,000	-	-
Animal attack	2,000	41,000	83,030	200,000	4,650	-
Total	2,060,370,082	76,247,750	10,222,547	110,740,000	4,650	4,089,511

Technological disasters: Road traffic accidents

According to the World Health Organization (WHO)'s Global Status Report on Road Safety (2013), road traffic injuries are globally the 8th leading cause of death, and the leading cause of death for young people aged 15–29[11]. Each year, more than a million people die from accidents (in 2010 alone, 1.24 million people were killed) and the economic losses resulting from both the accidents, the loss of life and compensation for injuries and victims amounts to billions of dollars. Ironically, the years 2011-2020 was declared as the Decade of Action for Road Safety, and though there have been some improvements in recent years, there still remains much to be done in terms of reducing the death, damage and disability caused by road accidents.

Statistics on transport accidents in Sri Lanka for the years 2006-2010 indicate that on average, 2420 people lose their lives in traffic fatalities every year, with another 24,000 injured (grievous and non-grievous injury). Tables 8 and 9 below shows the breakdown of the types of accidents that occurred annually, for the years 1989-2005[12], and Tables 10 and 11 show the figures for 2006-2010.

Table 8: Number of reported accidents in Sri Lanka (1989-2005) (Source: Police Headquarters, Colombo 2006)

Year	*Fatal accidents*	*Grievous (accidents involving serious injuries)*	*Non-grievous (accidents involving slight injuries)*	*Damage only (property damage only, no casualties)*	*Total no. of accidents*
1989	1,454	1,287	2,233	21,222	26,196
1990	1,714	1,703	9,462	21,584	34,463
1991	1,255	1,899	9,685	21,305	34,144
1992	1,302	2,112	10,386	23,977	37,777
1993	1,346	2,299	1,687	26,163	31,495
1994	1,414	2,554	11,992	27,855	43,815
1995	1,481	2,588	12,233	31,837	48,139
1996	1,560	2,615	11,510	32,990	48,675
1997	1,705	3,310	10,037	34,481	48,533
1998	1,874	2,393	14,417	35,275	50,969
1999	1,913	3,144	16,258	34,129	55,444
2000	1,992	3,006	11,765	16,724	54,250
2001	1,952	3,413	11,560	16,109	52,092
2002	2,029	3,719	12,935	36,348	55,031
2003	1,933	3,919	13,744	39,848	59,444
2004	2,116	4,560	13,918	32,864	53,458
2005	2,141	4,968	14,376	21,686	43,171

Table 9: Number of accident fatalities by road user type in Sri Lanka (1989-2005) (Source: Police Headquarters, Colombo 2006)

Year	*Total number of fatalities*	*Pedestrians*	*Passengers*	*Cyclists (bicycle riders)*	*Riders (motorcycle riders)*	*Drivers*	*Others (such as roadside businessmen)*
1989	1,596	648	417	224	226	77	4
1990	1,795	686	417	265	324	96	7
1991	1,532	542	529	195	181	85	0
1992	1,515	528	485	231	187	84	0

1993	1,421	603	304	222	208	65	19
1994	1,611	586	438	271	220	147	3
1995	1,681	636	366	246	244	177	12
1996	1,755	753	354	153	272	192	31
1997	1,835	662	347	251	244	319	12
1998	2,023	814	367	238	232	294	78
1999	2,059	713	358	307	172	288	221
2000	2,058	827	470	306	237	213	5
2001	2,118	791	431	338	294	261	3
2002	2,160	750	380	317	451	188	74
2003	2,096	747	397	311	281	171	71
2004	2,214	748	381	298	385	194	208
2005	2,304	747	428	326	406	178	221

Table 10: Traffic fatalities in road accidents by road user groups (2006-2010) (Source: http://www.police.lk/index.php/traffic-statistics/112)

Category	***2006***	***2007***	***2008***	***2009***	***2010***	***Total***
Driver/Rider	918	1,050	1,059	1,124	1,203	**5,354**
Pedestrian	695	827	748	785	898	**3,953**
Passenger/pillion passenger	507	439	433	428	531	**2,338**
Passenger falling out of vehicle	78	58	60	54	45	**295**
Passenger entering or leaving bus	40	28	28	22	44	**162**
Total	**2,238**	**2,402**	**2,328**	**2,413**	**2,712**	**12,102**

Table 11: Traffic injuries in road accidents (grievous and non grievous injury) by road user groups (2006-2010)

Category	***2006***	***2007***	***2008***	***2009***	***2010***	***Total***
Driver/Rider	9,835	10,311	10,173	11,821	12,517	**54,657**
Pedestrian	5,490	5,962	5,540	6,246	6,083	**29,321**
Passenger/pillion passenger	6,105	5,924	5,709	6,465	7,587	**31790**
Passenger falling out of vehicle	581	547	520	482	372	**2,502**
Passenger entering or leaving bus	521	394	376	268	288	**1,847**
Total	**22,532**	**23,138**	**22,381**	**25,282**	**26,847**	**120,117**

Historical disaster milestones in Sri Lanka

Complex emergency: The civil war (1983-2009)

For 26 years, the civil war between the Sri lankan Government (Armed forces) and the Liberation Tigers of Tamil Eelam (LTTE), a guerilla terrorist group fighting for a a separate state in the North and East of the country, took a significant toll on the population, economy and environment of Sri Lanka, with an estimated 80,000–100,000 people killed during the course of the war[13]. In particular, the death toll of civilians during the war has been a much debated topic and estimates vary significantly between sources. A US State Department report and the U.N Secretary General's experts panel report have suggested that the actual casualty figures were probably much higher than the estimates from Sri Lankan government sources, and that significant numbers of casualties were not recorded, with upto 40,000 civilians probably being killed in the final stages of the war[14]. In 2011, two years after the end of the war, Sri Lanka still ranked #16 with a score of 5.68 on the Global Terrorism Index[15]; as of 2014, this rank has dropped to #36, but still remains on the list of 13 countries at risk of increased terrorism activities[16].

The total economic cost of the 26-year war was estimated at US$200 billion, which is approximately 5 times the GDP of Sri Lanka (in 2009)[17]. The war was one of the longest running civil wars in Asia and left the terrain and infrastructure of the North and East of the country shattered; many people lost their homes, their families and their sources of income and livelihood in the air raids and bomb attacks that took place during the war[18].

The last phases of the war have also been the subject of investigations into human rights violations and war crimes. The alleged war crimes include attacks on civilians and civilian buildings by both the Sri Lankan Military and the LTTE (UN satellite images suggested the government launched several attacks in the no-fire zone, where more than 50,000 civilians were trapped); executions of combatants and prisoners by both sides; enforced disappearances by the Sri Lankan military and other groups supported by them; shortages of food, medicine, and clean water for civilians trapped in the war zone; and child recruitment and attacks on targeting civilian including suicide bombings and attacks on civilian aircraft by the LTTE.. The final stages of the war also created 300,000 IDPs who were transferred to camps and detained there against their will, amidst widespread reports of torture, abuse and rape[19].

Natural disasters: The Indian Ocean Tsunami (2004)

Sri Lanka was one of the countries that was devastatingly affected by the Indian Ocean tsunami resulting from the 9.1 magnitude earthquake that originated in Sumatra, Indonesia, on December 26, 2004. Sri Lankan authorities reported over 35,000 confirmed deaths, many of whom were adults and the elderly, with a further 1.5 million people displaced from their homes[20].

The agricultural sector, one of Sri Lanka’s primary sources of income and subsistence, was adversely affected. 259 km² of paddy land was destroyed in the northern, eastern, southern and western coastal belts. In addition, the extensive salinization of paddy lands rendered them unsuitable for paddy cultivation. Garbage and debris also deposited on paddy lands and a large number of agricultural vehicles and equipment were destroyed and canals and drains were blocked. Underground sources of water also became salinated.

Apart from homes, many hotels as well as shops were reported to have been damaged. Hotels along the south coast were full of both tourists and Sri Lankans over the Christmas and Boxing Day weekend. Twenty thousand soldiers were deployed in government-controlled areas to assist in relief operations and maintain law and order after sporadic looting. Curfews were imposed in some areas to curb looting[21].

In the aftermath of the disaster, the main coastal highway in the south of Sri Lanka was closed, delaying relief supplies. An initial effort to deliver supplies was made by large numbers of private individuals filling their own vans and pickup trucks with food, clothing and bottled water and driving to affected areas. Subsequently, reports of measles, cholera and diarrhea surfaced, causing concern for potential epidemics to break out but these were contained and managed in due time.

The Indian Ocean Tsunami was an important milestone in the history of disaster events in Sri Lanka because it gave reason and cause for the subsequent formulation and implementation of stringent risk reduction strategies, as well as proper disaster risk response and mitigation programs and policies in 2005.

Sri Lanka's hazard profile

As seen from the previous section highlighting the major disaster types over the last 50 years, Sri Lanka is most prone to hazards such as floods, landslides, cyclones, drought, wind storms, coastal erosion, sea surges and sea level rises. In addition to these, the country is also impacted by manmade disasters such as deforestation, coral, sand and gem mining, and industrial accidents or spills.

According to the Index For Risk Management (INFORM)'s country profile and ratings, Sri Lanka ranks 56 out of 191 countries in INFORM's risk index, with a rating of 4.5 (though this has seen a declining trend over the last 3 years). Sri Lanka also ranks 31 in the Hazard and Exposure Index with a rating of 5.8, a trend which has alarmingly shown increase over the last few years. In terms of the Vulnerability and Lack of Coping indices, Sri Lanka ranks lower at 84 and 118 respectively, with the former showing a decreasing trend and the latter showing a stable trend over the last 3 years. Among the major hazard factors for Sri Lanka, exposure to floods and tsunamis ranks highest under natural hazards, while the projected conflict risk ranks high under human factors. On the flipside, however, coping capacity in terms of healthcare access and governance rank relatively well for the country (the full report can be found in Appendix ABC).

The following section will describe the different hazards risks in Sri Lanka, and extent of their impact in greater detail (Road map for DRM in Sri Lanka, SLCDMP).

Hydrological hazards: Floods

Floods are the most common disasters that occur in Sri Lanka. There are 103 river basins of which about 10 rivers are considered as major, and several of these are prone to flooding. The increase in urbanization and population shifts have resulted in an increased need for land, forcing more people to reside and work in flood-prone vulnerable areas, thereby increasing the risk to life and property in the event of major floods. Compounded by the global problem of climate change, rapid urbanization coupled with insufficient infrastructure facilities such as drainage systems can also trigger urban flash floods. Heavy rainfall, deforestation, improper land use and the lack of soil conservation practices are major risk factors for floods in Sri Lanka.

Major floods are associated with the two monsoon seasons, and the South-West and North-East regions of the country show distinct flood seasonality due to heavy rainfall in the South-Western and Eastern slopes, respectively; the Western slopes receive rainfall during the September- January and May-August seasons, while the Eastern slopes of the country receive most of the rainfall during September- January (Figure 7). At times this is further impacted by cyclones and storms that can occur at the same time, resulting in heavy rainfall over a relatively short time period.

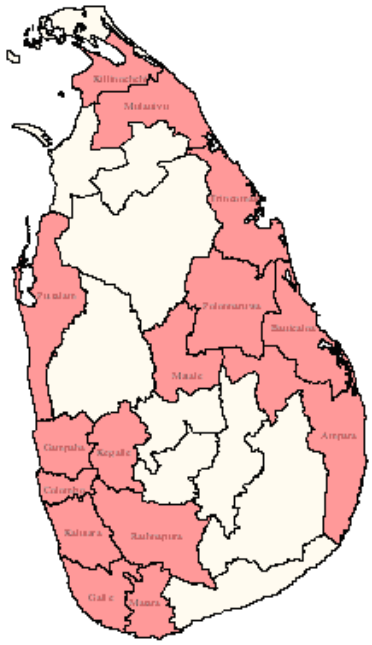


Figure 7: Districts Vulnerable to Flood Hazard in Sri Lanka

Hydrological hazards: Landslides

The Central and South Western slopes of Sri Lanka are most prone to landslides, more so in the last two decades with the increase in excessive rainfall, deforestation, poorly planned land use and population pressure in vulnerable areas (Figure 8). Furthermore, changes in land use, for example the cultivation of tobacco on steep slopes, land clearing in the hills, blocking of drainage paths, and the impact of large reservoir construction increase the hazard risk.

Landslides, as seen from historical data, like threaten the life, livelihoods and property of people living and working in these regions.

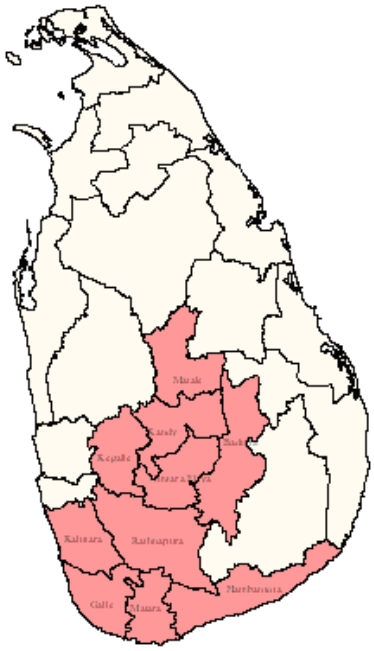


Figure 8: Districts Vulnerable to Landslide Hazard in Sri Lanka

Climatological hazards: Drought

Droughts are the most extensive hazard in Sri Lanka, in terms of the number of people affected, and the amount of economic relief provided. The fact that droughts occur is somewhat surprising, given the amount of rainfall (upto 1,800mm annually) that Sri Lanka experiences. Unfortunately, the rainfall distribution is uneven and low in certain areas even during monsoons; drought most often occurs in the south-eastern, north central and north-western areas of Sri Lanka (Figure 9). These regions are most drought-prone from February to April and at times in September if the monsoon from May to June is not heavy.

In some regions, continuous drought has greatly impacted the livelihoods of people in these areas, particularly farmers and families whose subsistence and lives depend on crop harvests. Deforestation, improper land use and unplanned cultivation which puts pressure on the land can further impact the problem.

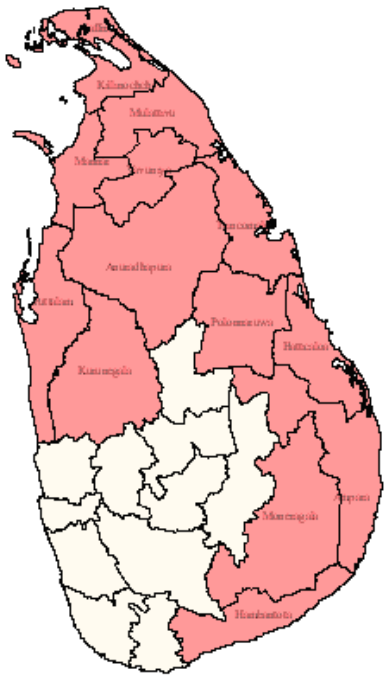


Figure 9: Districts Vulnerable to Drought Hazard in Sri Lanka

Meteorological hazards: Cyclones and storms

Sri Lanka is mostly prone to cyclonic activity in the Bay of Bengal, during the North-East monsoon which develops in November for a few months, making the Eastern, Northern and North Central regions the most at risk. Although cyclones do not occur frequently in Sri Lanka, when they do occur they cause large-scale destruction and damage to property as well as the loss of lives at times.

In the last 100 years, Sri Lanka has experienced four severe cyclones as well as a number of less severe and moderate storms. The incidence of cyclones is seasonal, and approximately 80% of all cyclones and storms occur during the months of November and December (Figure 10).

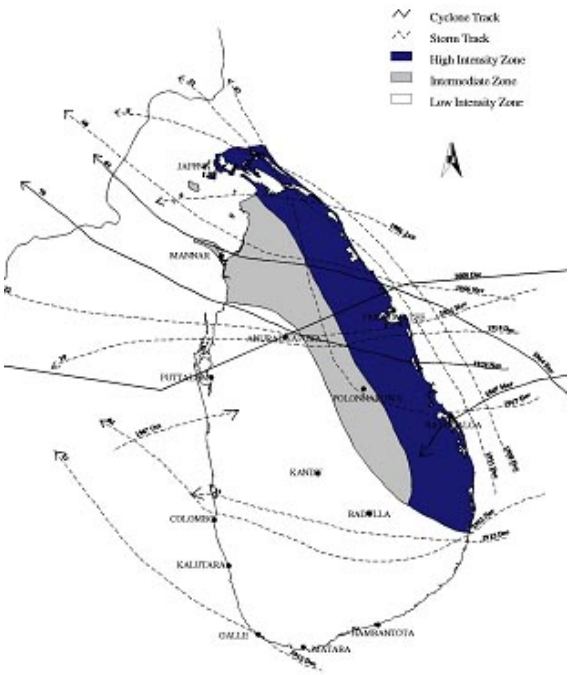


Figure 10: Areas prone to cyclone hazard in Sri Lanka

Meteorological hazards: Coastal Erosion and Sea Level Rise

More than half of Sri Lanka's population reside in villages, towns and cities along the coastal belt of the island. The economic significance of the coastal areas has increased further in recent years with the rapid urbanization, main lines of communication and transport (road and rail), tourism and the development of three commercial harbours in Colombo, Galle and Trincomalee. At the same time, it is estimated that over 50-55% of the coastline is subject to or threatened by coastal erosion, which can severely affect critical infrastructure facilities such as roads and railways, thereby impacting economic coastline activities such as fishing. Sea level rises greatly impact the marine ecosystem of Sri Lanka, as well as increasing the salinity of the soil and causing a deterioration in water quality.

The effects of coastal erosion are largely felt in the west, south-west, and southern coastal belt, and coupled with occasional sea surges and sea level rises, greatly increases the hazard risk to the country (Figure 11).

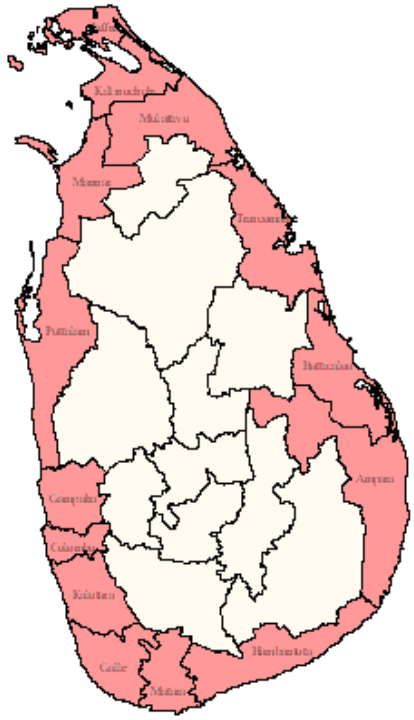


Figure 11: Districts Vulnerable to Coastal Erosion Hazard in Sri Lanka

Technological hazards: Road and traffic accidents

Road accidents in Sri Lanka kill an estimated 6 people every day[22], while injuring many more in the process and causing significant economic losses. In the year 2014 alone, 2436 deaths were reported, with a further 6688 critical accidents and 13051 minor accidents. Compensation paid for deaths and damages in 2014 amounted to Rs. 1.65 million (USD 11,671)[23].

Death rates tend to be higher among men, across all age groups, though this difference reduces among the elderly. Death rates also tend to be increase among the age groups of 10-14 and 15-19 years (teenagers and young adults), and continue to rise with upto about 49 years of age (Figure 12). This could be due to men being more exposed to rad traffic accidents, combined with higher risk-taking behaviours. Death rates among the elderly may still remain significant due to their reduced ability to cope and recover after an accident, even if they are exposed to a lesser number of such events[24].

Figure 12: Deaths from road accidents across age and gender in Sri Lanka (2002-2003 World Health Surveys)

There are a multitude of reasons for such high numbers of road accidents and traffic fatalities in Sri Lanka, which seem to be increasing at an alarming rate and have shown little or no improvement in the last decade. One of the main reasons is the lack of enforcement of the law around driving and obtaining a driving license. An estimated 40% of all three- wheel (or tuk tuk) drivers have no licenses, and are often let go with the payment of a bribe or a fine if caught by the police. Hence there exists an urgent need for public service vehicle licensing for all buses, three wheelers and other public transport vehicles, with stringent training and the award of a specialized licence based not only on driving skills but also on correct attitudes, safety and discipline with regards to driving[22].

Another reason is the lack of careful, disciplined driving, and obeying the road rules in place. Often motorcycles, buses and three-wheelers cut into different traffic lanes without appropriate signals or warning and with no respect for the right of way, and rarely stop for pedestrians to cross at pedestrian crossings. Unfortunately there aren't many effective punitive measures or deterrents for drivers in Sri Lanka to not commit driving offences, such as suspension of licenses or the accumulation of penalty points

Given that traffic in the cities are often dense and haphazard, pedestrians, pavement hawkers and cyclists are also at great risk of being injured in road accidents. While pavement infrastructure for pedestrians are well developed, this is almost non-existent for cyclists and there is often a high risk attached to cycling through the city. Pedestrian safety also requires improvement. Many pedestrians cross the roads at places other than the designated crossings, and no punitive measures are in place for such instances.

Other reasons that contribute to the high incidence of road accidents are the lack of safe practices such as wearing a seatbelt (though recently a law was implemented in Sri Lanka making this mandatory together with the imposition of a large fine if drivers and passengers are caught not wearing seatbelts), using mobile phones for calls and texting while driving, and poor vehicle maintenance[25].

Prevention and response strategies

1991-2004: The beginnings of Disaster Management in Sri Lanka

In 1991, a cabinet sub-committee was appointed by the Sri Lankan Government to prepare disaster preparedness and mitigation plan, and a national policy framework. An initial framework `Disaster Counter Measures Act` was prepared in 1992, which was to be passed in the Parliament. However, political circumstances such as changes in government, and the turbulent political climate in the country kept it from being passed; it was last tabled in Parliament in 2001, with the Act to be amended once again. However, despite the absence of a disaster policy and accompanying legislation, the National Disaster Management Center (NDMC) was established in 1996 under the Ministry of Social Services to initiate the activities proposed in the draft policy framework[26].

2005-2012: Towards a Safer Sri Lanka: A Road Map for Disaster Risk Management[27]

In the aftermath of the Indian Ocean Tsunami in 2004, Sri Lanka was forced to take a long hard look at its disaster response strategies and programs, most of which had been of a reactive nature in the past. The country, at the time, did not have a framework for disaster management and response, both at the national and local levels, and this urgent need led to the enactment of the *Disaster Management Act* in May 2005, in an attempt to push for both political and social will to manage disaster risks before they become a reality.

The Act provided Sri Lanka with the legal basis for putting in place a Disaster Risk Management (DRM) system in the country, and consecutively established the National Council for Disaster Management (NCDM), and the Disaster Management Centre (DMC) as the implementing arm of the NCDM. This is chaired by the President and Prime Minister of the country as well as involving several other high-level Ministers. The Ministry of Disaster Management (MoDM) was subsequently created in November 2005, with the main function of leading on and formulating the national strategy for preparedness planning, disaster response and risk reduction and mitigation.

In December 2005, the MoDM proposed a holistic, comprehensive framework on DRM, involving all stakeholders, public, non-governmental and private organizations and international agencies in at effort to manage and coordinate multiple efforts in DRM over a period of 10 years. This framework, titled 'Towards a Safer Sri Lanka: A Road Map for Disaster Risk Management', focused on 7 key components (and 60 outcomes) for DRM and sustainable development planning. The Roadmap was developed through a consultative process with multiple stakeholders involved in DRM efforts) and was also in line with the principles and strategic thrusts of the Hyogo Framework for Action (2005-2015). The 7 components are, namely:

- ***Policy, Institutional Mandates and Institutional Development***, to focus on aspects such as a national policy for disaster management and identifying capacity building needs of involved agencies and institutions, to 'establish a culture of safety against disasters through policy support and institutional mandates';
- ***Hazard, Vulnerability and Risk Assessment***, to identify the probability of the occurrence of hazards and developing a vulnerability 'atlas' for the country, as a part of the planning process using a multi-hazard approach;

- ***Multi Hazard Early Warning Systems***, to invest in such systems for floods, cyclones, droughts, landslides and other such natural disasters;
- ***Preparedness and Response Plans***, to call attention to the development of a national emergency preparedness and response plan and emergency operation centres, with the goal of minimizing the adverse effects of disasters;
- ***Mitigation and Integration of Disaster Risk Reduction into Development Planning***, to incorporate disaster risk considerations into development plans in order to reduce the impacts of droughts, floods and cyclones as well as disasters that could affect coastal populations such as sea surges and storms;
- ***Community-Based Disaster Risk Management***, to focus on the crucial aspect of community mobilization in teams, training of volunteers and establishing resource centres as the first line of defence and response is often members of the community in areas hit by disasters;
- ***Public Awareness, Education and Training***, to provide capacity building and empowering members of the public with skills and knowledge to disaster awareness and disaster losses among both professionals as well as children in schools and youth.

The Sri Lankan government takes responsibility for DRM systems and their implementation, but also acknowledges that they alone cannot implement this successfully without the active involvement and participation of the different stakeholders mentioned above, as well as policy makers and local government structures. Specific areas of focus in DRM also include Risk Identification, Risk Evaluation, Risk Management, Risk Communication and Monitoring and Evaluation.

Each of the seven overarching themes in DRM above are further contextualized to set targets and outcomes, with specific activities, outputs and a timeframe and budget for execution. An example is shown below in Figure 13 and 14 for Community Based Disaster Risk Management (the detailed outcomes and activities for each theme can be found in Appendix A):

Component	Time Frame			Budget (Short-term)	
	S	M	L	USD (mil)	Total
6. Community Based Disaster Risk Management					
6.1 Promoting CBDRM Volunteerism	●	●	○	5.00	
6.2 Establishing CBDRM Resource Centres	●	●	○	2.00	
6.3 Preparedness and Mitigation through Small Grants Programmes	●	●		6.00	**13.30**
6.4 Micro-finance Schemes	●	●		0.30	
6.5 Applied Research Grant Scheme for CBDRM		●			

Figure 13: Priority projects with funding for Community Based Disaster Risk Management

Figure 14: Examples of outputs, activities and outcomes related to Community-Based Disaster Risk Management, together with budget information and partner agencies

2013- 2018: Sri Lanka Comprehensive Disaster Management Programme[10]

In the nine years following the launch and implementation of the Road Map, Sri Lanka saw significant improvements in disaster management and response, both in terms of reducing the impact on lives as well as the damage to infrastructure and the economy. In May 2012, the NCDM approved of the next phase of the DRM in the form of a strategic programme titled 'Sri Lanka Comprehensive Disaster Management Programme, 2014-2018' (SLCDMP) based on consultations with the different stakeholders who were involved in the previous Road Map implementation, as well as on feedback and lessons learned from both national and global disasters in the previous years. The new directive and reasoning behind the SLCDMP is as quoted below:

> *"Though there is a declining trend in loss of lives due to disasters, economic losses and damage to infrastructure are still significant and increasing. Considering the increasing number of disasters, including natural, human and climate change induced events, it is prudent to invest in preventive and mitigatory measures to ensure Sri Lanka's fast tracked development is resilient and scarce resources are not used repeatedly in response and post disaster processes.*
> *During the 2005 to 2013 period much needed enabling environment for planning and implementation of risk reduction measures had been established through number of interventions, including the development of nine hazard profiles, a 30-year disaster event database, disaster management policy and amended 2005 DM Act. Necessary materials for awareness/education and local authority guidelines on mitigation have been also made available. A world class coordination system of stakeholder entities had been evolved in the form of the National Disaster Management Coordinating Committee (NDMCC).*
> *Therefore,Sri Lanka is well positioned to embark on a new Disaster Management Programme developed through a well co-ordinated, multi-hazard, multi-sector, multi-stakeholder partnership approach. In doing so, the envisaged Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) for 2014 to 2018 will focus on mainstreaming Disaster Risk Reduction and Climate Change Adaptation in the development processes."*

The SLCDMP was also in alignment and integrated with the Development Policy Framework and National Climate Change Adaption Strategy for Sri Lanka (2011-2016), indicating a move towards a more integrated and coordinated approach to DRM to prevent any duplication of efforts by the different stakeholders involved. Furthermore, key areas of the Post-2015 Framework for Disaster Risk Reduction (HFA2) (also known as the Sendai framework) were also considered in the formulation process. The 8 key strategies of the SLCDMP are as follows:

- Policy environment and legal/institutional framework
    - Policy environment
    - Legal environment
    - Strengthening institutional mandates and collaborations
- Multi-hazard early warning and effective dissemination
- Hazard, vulnerability and risk assessment
- Disaster mitigation and DRR mainstreaming into development
    - Integrated water resources management
    - Land use and natural resources management
    - Diverting attention from relief to risk reduction

    - Risk transfer mechanisms
    - Minimizing disaster risk in urban areas
- Reconstruction and rehabilitation
- Targeted and effective capacity building at all levels through training and awareness
    - Enhanced simulation, modeling and scenario analysis capacity
    - Training on DRM
    - Enhanced information access and levels
- Preparedness and response
    - Increased attention to changing disaster trends
    - Strengthening the national, provincial, district and divisional DRM planning
    - Community-based disaster risk management
    - Enhanced role of the private sector in disaster management
- Results-based monitoring and evaluation

As with the Road Map for DRM, the SLCDMP also outlines activities, programme outcomes and indicators, timelines and budget considerations for the implementation of each of the above strategic thrusts. An example is shown below for Hazard, vulnerability and risk assessment (the full list can be found in the SLCDMP document at: ref). Additionally, it has identified gaps that existed in the implementation of the Road Map, and proposed measures and initiatives to address some of these. For instance, despite the disaster response capacity being commendable on a national level, the capacities of local governments and communities could be greatly improved by supporting local action on national level policies and by improving provincial and district planning, sector level coordination at local levels, capacity building of local authorities and the operationalizing of National Emergency Operations procedures at the local and community levels.

In a similar vein, rather than looking at investments in DRM as a loss-reduction measure in silo, the SLCDMP attempts to look at these investments in Sri Lanka's economic development context as upstream benefits in terms of disaster reduction contributing to resilience of the country as part of sustainable development plans. This also calls for mainstreaming DRM into the agendas and targets of different ministries and stakeholders involved in the development and progressive growth of the country, while at the same time ensuring that resources from the national budget (that are allocated to the different ministries) are therefore automatically better aligned and harnessed towards DRM.

Strategy C: Hazard, Vulnerability and Risk Assessment
Main Output: 1.5 Disaster risk profiles are available at national level to capture the elements at risk and assess damage to capital assets and economic losses
Output indicators: Disaster risk profiles available for all districts

Description
Risk profile will provide the risk information for taking decisions for planning and investment, minimizing exposure to natural disasters. Further risk information will assist the decision makers to assess the acceptable risk and select suitable mitigation measures. It also helps to assess the probable damages and losses of a natural disaster before it strikes. Using the risk information, people in hazard prone areas could be made aware of risks faced by them to take preventive measures. This information will also be useful in moving settlements in high risk areas at present to safe locations and also in planning new settlements avoiding high risk locations.
For development of risk profiles, the services of universities and research organizations could be obtained.

Activities
1.5.1 Complete the drought hazard maps taking in to account meteorological, hydrological and agricultural drought conditions - (DMC)
1.5.2 Develop landslide hazard maps at 1:10,000 scale for all hazard prone districts. (Galle and Nuwara Eliya already completed) - (NBRO)
1.5.3 Develop flood inundation maps for eight selected river basins at 1:10,000 scale - (ID)
1.5.4 Prepare vulnerability and risk maps for landslide, drought and flood prone areas - (DMC)
1.5.5 Analyze risk, and provide information to policy makers and development agencies - (DMC)

Geographical Area of Implementation: Island wide
Organization responsible for implementation:

- Flood: ID
- Landslide: NBRO
- Drought: DoM, DA, ID, WRB, NWSDB, MASL
- Vulnerability maps: DMC
- Risk maps: DMC

Supporting organizations: Survey Department
Duration: 4 years
Period: 2014-2017
Budget (LKR Million): 708

Strategy B: Multi-Hazard Early Warning and Effectiveness in Disemination
Main Output: 1.2 Timely issuance of flood early warning is streamlined
Output indicators: Flood early warning is issued on time for riverine, reservoir/tank induced and urban floods EW system established for riverine, reservoir / minor tank induced and for urban floods; base maps available for 17 ULAs; Fl. models & flood inundation maps developed for identified ULAs; system to issue and practice flood EW available.

Description
Presently, Irrigation Department maintains river gauges only in Kelani River and issue early warning messages to residents in downstream Kelani River. No early warning on floods issued for other major rivers. Technical agencies managing reservoirs issue an advisory before opening spill gates. However, there is no formal system to issue warnings to the communities living downstream of reservoirs. In the case of cascading reservoirs/ tanks, a coordinated system of information sharing for gate operators as well as downstream communities is essential.
Dam safety and Water Management Project of the Ministry of Irrigation has initiated action to establish rain gauges and river gauges at identified locations of river catchments and in major rivers. In order to further reduce life and property losses due to floods, issuance of early warning messages in time for major rivers and reservoir gate opening is a necessity.
Considering the extreme flood events experienced during last few years there is a need to issue early warning for urban floods. Under the Metro-Colombo Urban Development Project,the SLLRDC has undertaken to develop a flood model for local authorities covered by the project. This model can be adapted to other urban areas as well.

Activities
1.2.1 Establishment of Early Warning system for riverine floods (Kelani Ganga, Kalu Ganga, Gin Ganga and Nilwala Ganga, Malwathuoya, Deduruoya, Yanoya, Mundaliaru) – (ID).
1.2.1.1 Develop the capacity of irrigation Dept. to prepare flood inundation models for above rivers - (ID)
1.2.1.2 Prepare inundation maps for different return periods of flood (5, 10, 25 and 50 year) - (ID)
1.2.1.3 Develop and practice a flood early warning system for identified rivers – (ID)
1.2.2 Establish an EW system for floods generated by opening of spill gates of reservoirs – (ID /MASL).
1.2.2.1 Identify list of large and medium level reservoirs that could generate flood in the downstreamin the event of opening of spill gates– (ID / MASL).
1.2.2.2 Prepare inundation maps for identified reservoirs at three levels of gate opening – (ID / MASL).
1.2.2.3 Issue flood early warning to communities in downstream of reservoir – (ID / MASL).
1.2.2.4 Establish a mechanism to disseminate EW message to communities at high risk areas – (DMC)
1.2.3 Introduce an early warning system for floods generated by overflow/ breach of small (minor) tanks in village cascade – (DAD).
1.2.4 Establishment of an early warning system for urban floods (Colombo, Moratuwa,Wattala, Jaela, Peliyagoda, Galle, Matara, Kalutara, Ratnapura, Baticaloa, Mannar and Puttalam).
1.2.4.1 Develop base maps 1:5000 scale for 17 Urban Local Authorities prone to floods and landslides (Colombo, Moratuwa,Wattala, Jaela, Peliyagoda, Galle, Matara, Kalutara, Ratnapura, Batticaloa, Mannar and Puttalam, Kandy, Nuwaraeliya, Badullla, Bandarawela, Kegalle) – (Survey Dept.).
1.2.4.2 Obtain the services of Sri Lanka Land Reclamation and Development Corporation (SLLRDC) or any other technical agency to develop a flood model and flood inundation maps for 5,10, 25 and 50 year return periods for identified urban centers – (ULA)
1.2.4.3 Develop a system to issue and practice flood early warning to rate payers at high risk areas – (relevant urban local authority).

Geographical Area of Implementation: Island wide
Organization responsible for implementation: Riverine floods: ID
Reservoir induced floods: ID, MASL and DAD
Urban floods: ULAs
Supporting organizations: Department of Meteorology, DMC, Survey Department
Duration: 5 years
Period: 2014-2018
Budget (LKR Million): 100

Sri Lanka's progress on the implementation of the Hyogo Framework for Action[28]

Based on the interim reports that Sri Lanka has submitted for the years 2007-2009, 2009-2011, 2011-2013 ad 2013-2015 on the implementation of the Hyogo Framework for Action, the country has shown slow yet steady progress in the 3 strategic goals and 5 priority areas and their respective core indicators. A summary of the main points of the report for the years 2013-2015 is provided below:

Strategic Goal	Strategic Goal Statement	Outcomes Statement
Area 1: The more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction.	• Disaster risk reduction measures have been introduced to National housing policy. • Disaster Risk Assessment is being considered in the urban development planning process. Guideline on Mainstreaming DRR into Urban development has been completed. • Clearance from the Disaster Management Centre is mandated to the development in tourist sector. • DRR concerns were in cooperated into Local government policy and Local Authority Act is being prepared incorporating DRR concerns and the draft amended act submitted to legal draftsman for further improvements. • DMC has been recognized as member of scoping committees to evaluate EIA with respect to Disaster concern of new development projects by Central Environment Authority, Coast Conservation and Coastal Resources Management Department, and Wayaba Environment Authority which are responsible to conduct EIA in Sri Lanka. • National Physical Planning Department agreed to establish a system to consider DRR into national physical planning process.	• Disaster Management Center has taken steps to mainstream DRR into urban development planning process in Collaboration with the Urban Development Authority. Further Disaster Impact Assessment based on check list system has been introduced to road development sector of the country jointly with Road Development Authority. • Disaster Management Center has been recognized as a scoping committee member of the EIA evaluation under Central environment authority and the Coastal Conservation and coastal resources Management Department.

	• Urban Development Plans for 25 identified urban areas including Municipal, Urban Councils and Pardeshiya Sabas are being prepared incorporating hazard maps in1:5000 scale. • Initiative has been taken to disseminate disaster risk information using Geonode open source software. • Initiatives have been taken to introduce National Spatial data infrastructure in collaboration with Ministry of land. • MOU on Emergency Response among the South Asian countries has been signed and ratified Under SAARC Disaster Management Center.	
Area 2: The development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards.	• Ministry of Disaster Management lunched Comprehensive disaster management plan for next five years and 2020 strategy for disaster risk reduction in Sri Lanka. • Climate Resilience Improvement Project(CRIP) Supported by World Bank loan has commenced under Ministry of Irrigation and Water Resources Management with objective of making efforts to integrate disaster risk management by implementing CRIP. The Objectives are achieved through addressing the areas that have most impacted by recent major floods, landslides and droughts. • Dam Safety & Water Resource Planning Project implemented in collaboration with Mahaweli Authority, Department of Irrigation, Ceylon Electricity Board, National water supply and Drainage Board, Water Resources Board, Department of meteorology, Disaster Management Center to ensure safe operationally efficient and risk minimized reservoir/ head works system with a safety monitoring system in place , modernized and efficient hydro meteorological information system, river	• Amended National Disaster Management Policy has been approved by the cabinet Ministers. National Disaster Management Plan followed by it action plan, "Comprehensive Disaster Management Programme" have been launch. Disaster Risk Reduction measures were considered in National housing policy and the local government policy. • Search and Rescue teams were established in district level under Sri Lanka Army and the Rapid Response Relief Squadron under Sri Lanka Navy has also been established for the rescue activities. • Separate division has been established in Irrigation Department under the supervision of Director disaster management to ensure the quick action on flood and drought hazard in the country.

	basin based water development and management master plan addressing both surface and ground water • Separate division has been established within Irrigation Department under Director Disaster Management for quick response and better coordination during flood and drought situations. • Disaster Preparedness and Response unit has been established under Ministry of Health to enhance the quick response during emergency situation. • 300 numbers of local government officials were trained on mainstreaming DRR into local government sector. 150 numbers of craftsmen were also trained on resilience construction. Modules completed for sustainability of the program. • Mainstreaming Disaster Risk Reduction into education sector has been initiated under Education for Social Cohesion Programme –Disaster Safety Education implemented in Ministry of Education • Disaster Risk Reduction has been identified as major sector under National climate change policy of Sri Lanka and CCA Strategy • Disaster risk reduction has been identified as major component to be addressed under action plan of Ministry of women affairs.	
Area 3: The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery	• Enhance the strength, of Local communities providing disaster response and early warning equipment, raising awareness on emergency response and disaster risk reduction under resilient city programme implemented in collaboration with UN Habitat • Coastal communities were made aware to respond to the early warning messages disseminated through the tsunami	• Disaster Response and Preparedness plans for all 25 districts have been completed. Divisional level and village level preparedness and response plans also completed with the assistance of many stakeholder agencies. • Under the resilience city programme pilot

programmes in the reconstruction of affected communities.	early warning towers erected along the coastal belt. • Checklist system enabling to assess disaster impact on road development has been introduced to Road Development Authority in collaboration with the Japan International Cooperation Agency • Community participatory early warning and emergency response system has been introduced to selected villages in Eastern and Southern part of the country under the Regional Integrated Multi-Hazard Early Warning System • Introduced climate change adaptation and disaster risk reduction into livelihood development programmes implementing grassroots level under Ministry of Economic Development. • Pilot project on mainstreaming community participation to incorporate disaster risk management elements into the local development planning and target resources was completed covering 25 divisions in North and eastern province. Inclusive disaster management has been identified under the project.	project has been implemented covering 15 Local government authorities to enhance their knowledge and capabilities to response on emergency situation. Training and awareness programmes were conducted to enhance decision making Capacity at the local government sector on development planning, emergency preparedness and response based on disaster risk assessment • The Disaster Management Center has taken the initiative to summon elected representatives and district officials to discuss Preparedness Plans before every monsoon.

Priority for Action	**Core Indicators**	**Level of Progress Achieved**
Priority for Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation	**1-** National policy and legal framework for disaster risk reduction exists with decentralized responsibilities and capacities at all levels.	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
	2- Dedicated and adequate resources are available to implement disaster risk reduction plans and activities at all administrative levels	
	3- Community Participation and decentralization is ensured through the delegation of authority and resources to local levels	**3** Institutional commitment attained, but achievements are neither comprehensive nor

		substantial.
	4- A national multi sectoral platform for disaster risk reduction is functioning.	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
Priority for Action 2: Identify, assess and monitor disaster risks and enhance early warning	**1-** National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.	**3** Institutional commitment attained, but achievements are neither comprehensive nor substantial.
	2- Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
	3- Early warning systems are in place for all major hazards, with outreach to communities.	
	4- National and local risk assessments take account of regional / trans boundary risks, with a view to regional cooperation on risk reduction.	
Priority for Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels	**1-** Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems etc)	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
	2- School curricula, education material and relevant trainings include disaster risk reduction and recovery concepts and practices.	
	3- Research methods and tools for multi-risk assessments and cost benefit analysis are developed and strengthened.	**3** Institutional commitment attained, but achievements are neither comprehensive nor substantial.
	4- Countrywide public awareness strategy exists to	**4**

	stimulate a culture of disaster resilience, with outreach to urban and rural communities.	Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
Priority for Action 4: Reduce the underlying risk factors	**1-** Disaster risk reduction is an integral objective of environment related policies and plans, including for land use natural resource management and adaptation to climate change	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
	2- Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.	
	3- Economic and productive sectorial policies and plans have been implemented to reduce the vulnerability of economic activities	**3** Institutional commitment attained, but achievements are neither comprehensive nor substantial.
	4- Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.	**4** Substantial achievement attained but with recognized limitations in key aspects, such as financial resources and/ or operational capacities.
	5- Disaster risk reduction measures are integrated into post disaster recovery and rehabilitation processes	**3** Institutional commitment attained, but achievements are neither comprehensive nor substantial.
	6- Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.	
Priority for Action 5: Strengthen disaster preparedness for effective response at all levels	**1-** Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective are in place.	**3** Institutional commitment attained, but achievements are neither comprehensive nor substantial.
	2- Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.	

	3- Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.	
	4- Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.	

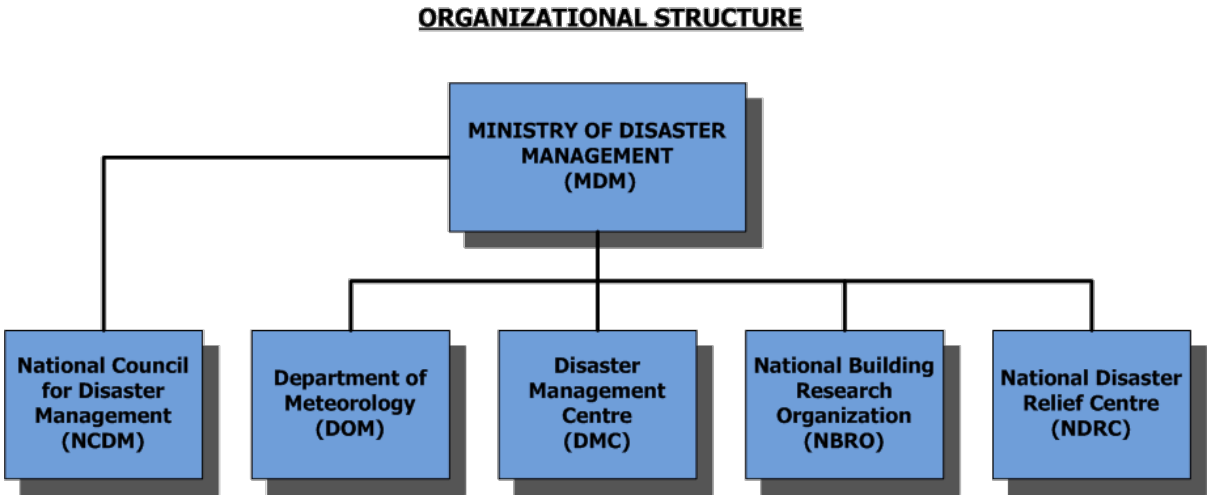
Recent initiatives- Development Policy Loan under the Catastrophe Deferred Draw Down Option[29]

In September 2014, the Ministry of Disaster Management, in partnership with the World Bank, launched the Climate Resilient Program, an initiative to look at climate change and associated hazard risks holistically, and consequently implement short, medium and long-term measures to address the physical, economical and social aspects of DRM, as well as improve resilience to disasters.

The initiative centers around the Climate Resilience Improvement Project (an estimated US$ 110 million) and a Development Policy Loan (DPL) under the Catastrophe Deferred Draw Down Option (CATDDO) (amounting to US$ 102 million). CATDDO is a new tool which provides immediate cash liquidity to a government (in the form of payouts or a line of credit) when a state of emergency has been declared after a disaster; Sri Lanka is the first country in South Asia to use this. The idea is that with this money, the country will be able to respond more effectively to reach out and assist people who are affected in the face of a disaster, while still ensuring that financial resources and economic support remains intact for the country's progress and continuous development.

The DPL initiative under CATDDO was first launched by the World Bank in 2008, with the first countries to use it being middle-income countries in Latin America and the Caribbean. The initiative has since been approved for use in the Philippines, Costa Rica, Colombia, El Salvador, Guatemala, Panama and Peru. Countries using this initiative in the aftermath of disasters have found it to be a flexible and prompt financial tool that allowed for governments to immediately focus on emergency response rather than spend time and resources trying to raise and secure funding for this. The DPL with a CAT DDO can be disbursed over a period of three years and may be renewed up to four times for a total of 15 years.

Structure and characteristics of the emergency and disaster response system



The Disaster Management Centre (DMC)[30]

As mentioned above, the DMC is the principle implementation arm of the National Council for Disaster Management (Figure 15). Under the Disaster Management Act passed in 2005, the hazards that are under the purview of the DMC are:

- Floods
- Landslides
- Industrial Hazards
- Tsunami (Seismic Wave)
- Earthquakes
- Air Hazards
- Fire
- Epidemics
- Explosions
- Air Raids
- Civil or Internal Strife
- Chemical Accidents
- Radiological Emergency
- Oil Spills
- Nuclear Disaster
- Urban and Forest Fire
- Coastal Erosion
- Tornadoes, Lightening Strikes and Severe Thunder Storms

The Act also provides a framework for DRM in Sri Lanka and aims to address disaster management holistically, resulting in a policy shift from response-based mechanisms to a proactive approach towards DRM and risk mitigation.

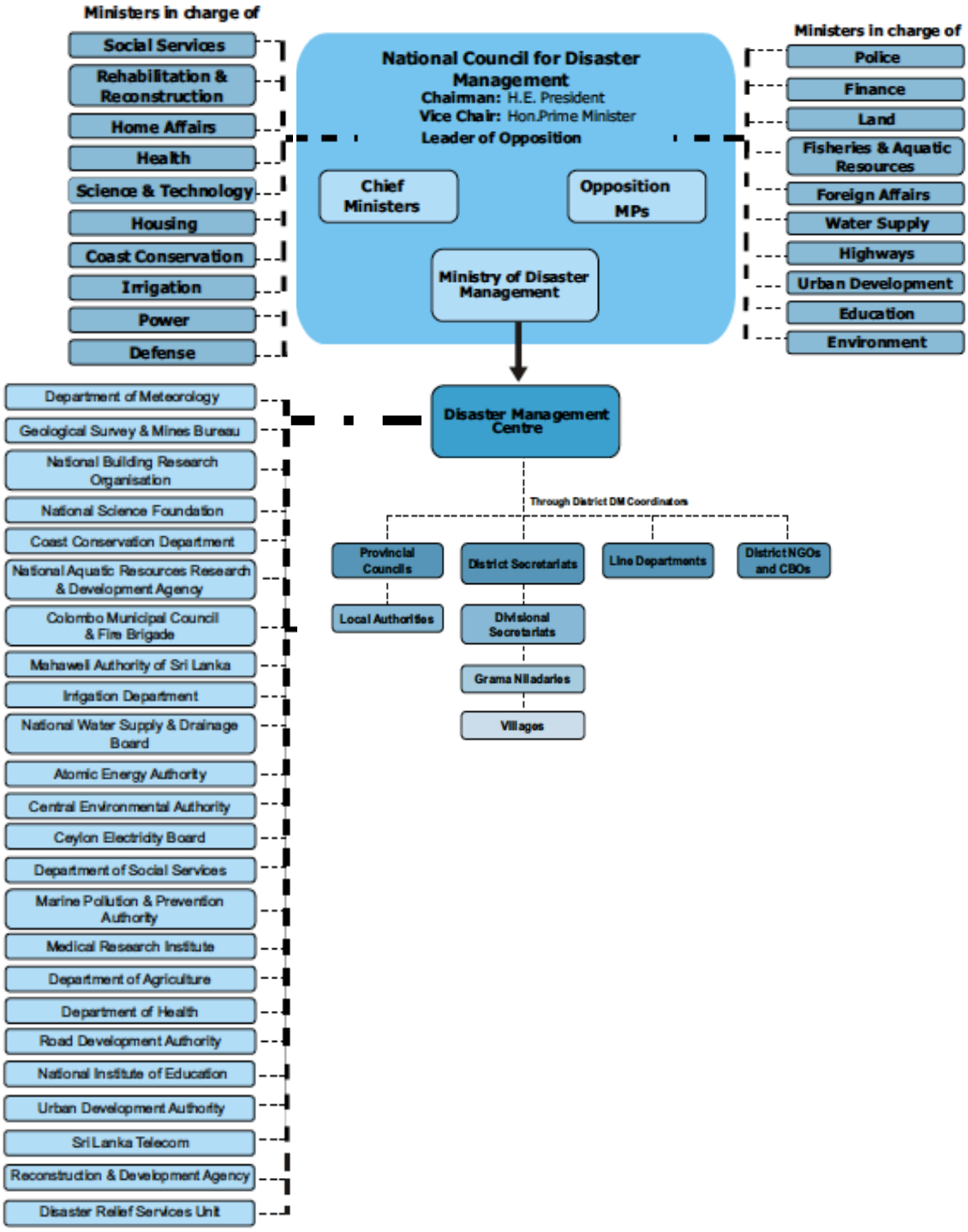


Figure 15: The organizational structure of the NCDM, the DMC and the other organizations that work together in DRM in Sri Lanka.

At the district level, District Disaster Management Coordinating Units (DDMCUs) have been established in all 25 districts, headed by an Assistant Director and a team of Disaster Management assistants and volunteers, as well as army and airforce personnel. The structure of the District Disaster Management Coordination Mechanism is shown below in Figure 16.

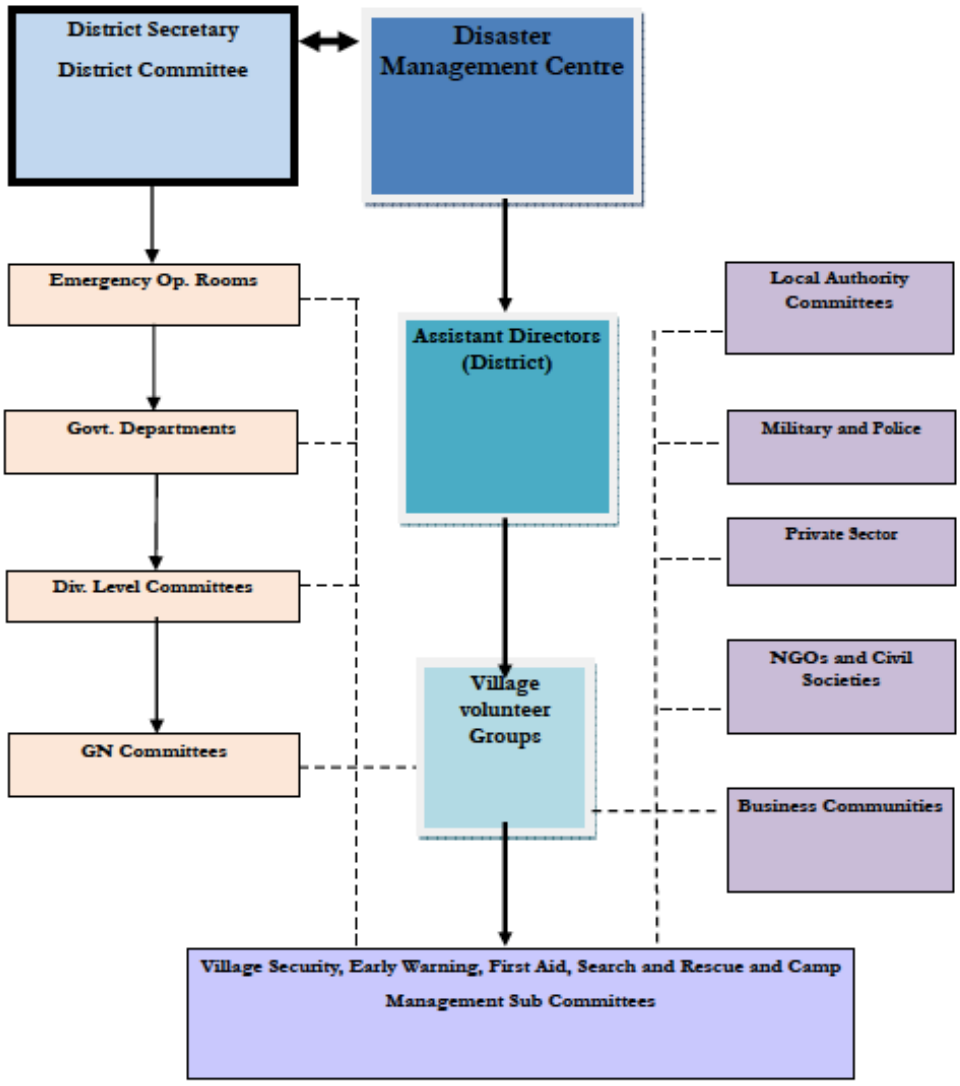


Figure 16: Structure of the Disaster Management mechanism at the district level.

Under the DMC, 4 key divisions operate to ensure that a DRM plan is in place. These divisions- Preparedness Planning; Emergency Operations Centre (EOC); Mitigation, Research and Development; and Training, Awareness and Public Education- and their functions are described briefly below.

Preparedness Planning Division

The main activities of this Division include:

- Coordinating, directing and monitoring of preparation of disaster preparedness and response plans at provincial, district, local authority and divisional levels
- Coordinating and assisting health authorities on preparation of preparedness plans for emergency response for hospitals
- Coordinating and assisting the Ministry of Education in the implementation of the School Disaster Safety Programme

- Strengthening Local Authorities for emergency response
- Development of response plans for different hazards such as cyclone, floods, landslides, etc.
- Identification of vulnerable communities for different hazards and implementation of preparedness activities to ensure the safety of people during disasters
- Increasing awareness on disaster management, hazards and vulnerability
- Preparation of hazard maps for different villages, showing safe locations and routes to safety
- Conducting mock drills and distributing equipment such as megaphones for early warning dissemination within the village
- Distribution of equipments such as boats for emergency response

In 2013, 17 District Disaster Preparedness and Emergency Response Plans (DPERPs) were completed, together with another 97 Community Disaster Preparedness and Emergency Response Plans which involved workshops and training sessions on the various hazards and response strategies (evacuation routes, setting up of camps, etc) at the village level. (ministry of disaster management progress report 2013)

Early warning dissemination

The DMC is also the main organization responsible for coordinating early warning alerts to the population in the case of a disaster, along with the relevant technical agencies and Technical Committees. The Multi Hazard Early Warning Dissemination Division of the DMC coordinates this with all technical agencies responsible for natural and man-made hazards, and in instances of any imminent disaster this Division takes action to inform the responsible officers for real-time updates and progressive communication to the sub-national levels and communities.

Other responsibilities of this division include maintaining and operating Early Warning Towers and other early warning dissemination equipment, ensuring the receipt of early warning alerts at remote vulnerable villages, initiating awareness on activities related to early warning among the various agencies and public, guiding District Disaster Management Units in the coordination and implementation of early warning dissemination related activities in the Province, district, Local Authority, Division and community levels, establishing a reliable communication system (telephones, radio communication etc.) from technical agencies to the EOC and subsequently to Provincial / District Control Rooms directly or through the EOC, having a system of communication in placed with media and ensuring the accurate timely dissemination of information to them, and creating awareness among communities and all concerned (including the police) on the communication systems in use for early warning and what immediate actions need to be taken and by whom, for instance in rapid onset disasters.

Emergency operations Centre (EOC)

The basis of an EOC is a centralized body for the effective and coordinated response to any level. Under the DMC, the EOC operates at the national level on a 24/7 basis, with the main function of coordinating all information pertaining to disasters and resources for management. Apart from receiving, analyzing, and displaying information about the incident to enable decision-making, the EOC also allocates, prioritizes, deploys, and tracks critical resources with

the sole purpose of enhacing decision making, communication, collaboration, and coordination. In order to do this, the EOC is sufficiently staffed with personnel from different skills and technical backgrounds required for operations under different disaster conditions.

In the event of a disaster, members of the public can call the EOC at +94-011-267002 to stay informed about emergencies as well as provide information if they are at the disaster site. The organization of the EOC is shown in Figure 17 below.

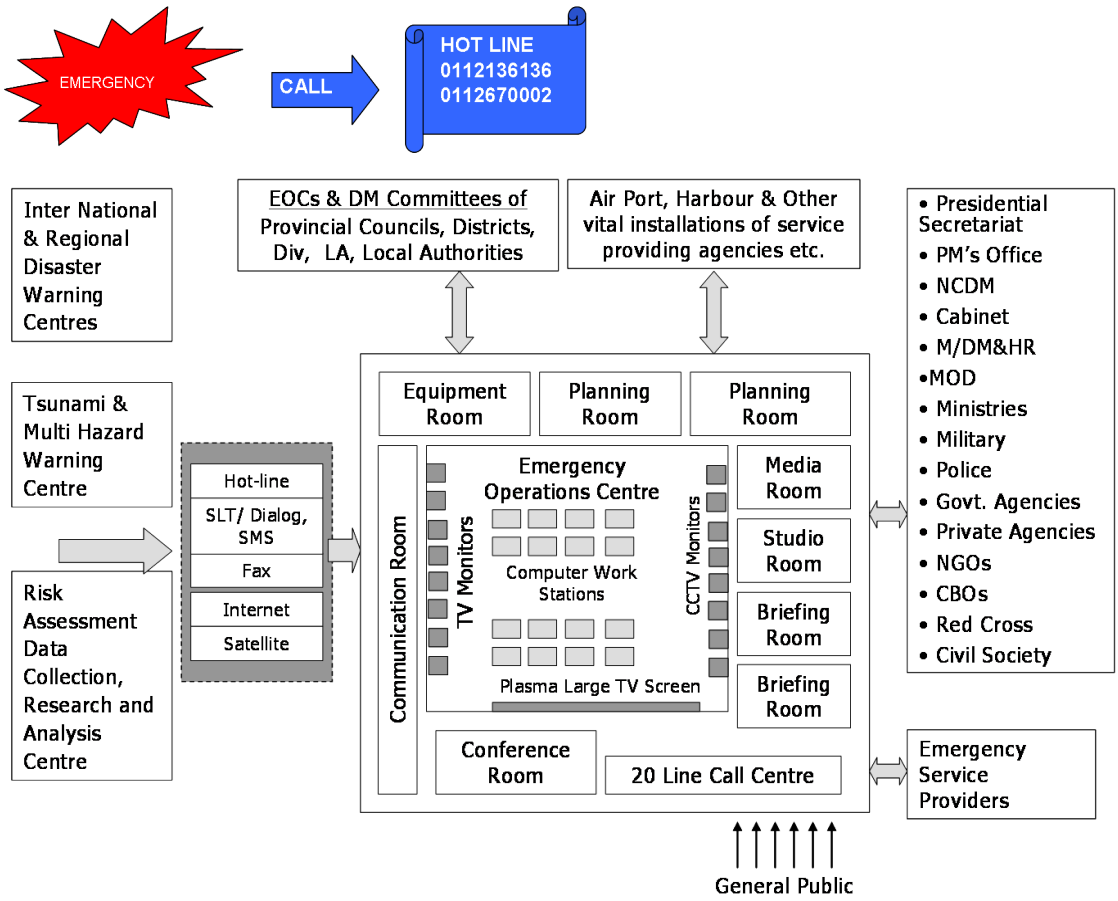


Figure 17: Structure of the 24/7 EOC and the different stakeholders and functions involved

Mitigation, Research and Development

The Mitigation, Research and Development Division holds responsibility for national level disaster mitigation and risk-reduction based on structural non-structural activities.as well as the technological aspects of DMC, such as managing national level IT infrastructure, risk analysis and mapping. The key activities of this division include:

- The development of project proposals for minimizing the hazards and implementation through District and Divisional Secretariats
- Assisting the mainstreaming of Disaster Risk Reduction into the Development Process of the country
- Capacity building for risk analyses and the development of Disaster mitigation action plans

- Coordination with agencies providing satellite data to acquire data in an emergency situations and provide analyzed data for decision making
- The development of guidelines for planning and construction in disaster-prone areas
- Coordination with relevant organizations to reduce vulnerability due to animal attacks (wild elephants)

Training, Awareness and Public Education

The role of the Training, Education & Public Awareness Division is to provide training and increase public awareness around disasters for relevant government agencies departments and other stakeholders including different community groups in Sri Lanka. This involves

- Promoting and increasing public awareness on DRM and Disaster Risk Reduction (DRR) among school children, academic institutes, government officials, general public, non Government Organizations/International Non Government Organizations
- Promoting awareness and training university graduates through integration of DRR into university curricula
- Raising awareness on School Safety programs among schools in collaboration with the Ministry of Education
- Promote awareness on DM/DRR among professional groups and key decision makers through training and short courses, as well as integrating DM training into the curricula of continuous education programmes
- Representing the DRM at key national and international forums and platforms.

The National Disaster Relief Services Centre

As the principle relief services organization in Sri Lanka, the National Disaster Relief Services Centre (NDRSC) was originally established in 1996 under the Ministry of Social Services and Social Welfare. In 2010, it was transferred to the Ministry of Disaster Management and tasked with the planning and implementation of disaster relief, rehabilitation and reconstruction activities in the country, driven by policy guidance from the Ministry and within the overall objective of minimizing suffering of the population and loss and damage to infrastructure[31].

Some of the key activities of the NDRSC are listed below:

Activities

- To provide both short-term and long-term relief for the affected population in the aftermath of a disaster.
- To formulate and implement programmes to rescue people from both natural and man-made disasters and coordinate relief operation during an emergency.
- To coordinate and direct relevant parties to ensure the implementation of reconstruction and rehabilitation activities with the goal of restoring livelihoods of people who have been affected by disasters.
- To collect, analyse and disseminate information in disaster situations.
- To conduct awareness programmes for the public on how to face disaster situations and the relief mechanisms in place.
- To plan and implement projects to minimize disaster impacts (examples include the construction of cultivation wells, rain water harvesting, etc.)

Other stakeholders in DRM
Some of the key organizations that work together with the Ministry of Disaster Management and the DMC are:

- Department of Meteorology (DoM)
- Ministry of Health and Nutrition (MHN)
- Colombo Municipal Council (CMC)
- Central Environment Authority (CEA)
- Landslide Studies and Services Division (NBRO)
- Atomic Energy Authority (under the Ministry of Science and Technology)(AEA)
- Sri Lanka Land Reclamation and Development Corporation (SLLR&DC)
- Geological Survey and Mines Bureau (GSMB)
- Sri Lanka Institute of Local Governance (SLILG)
- Water Resources Board (WRB)
- Urban Development Authority (UDA)
- Medical Research Institute (MRI)
- Irrigation Department (ID)
- Sri Lanka Red Cross Society (SLRCS)

Road accidents

In Sri Lanka, the two main authorities overseeing and involved with traffic and road accidents are the National Road Safety Council, and the Traffic Police. Some of the responsibilities and measures in place from each organization to curtail this problem are described below.

National Road Safety Council

In Sri Lanka, the National Council for Road Safety (NCRS), established under the Motor Traffic Act in 1998, is principally responsible for creating a safe and secure road system for road users, and functions under the Ministry of Transport[32]. This includes improving the different aspects of safety with the overall goal of supporting sustainable growth and progressive, continued social and economic development of the country.

Some of the key functions of the NCRS are as follows[31]:

- Maintaining a database on
    - Vehicle populations
    - Traffic accidents
    - Local and international statistics on road safety
- Dispersing knowledge and information to relevant government and non-government agencies responsible for road safety and related projects.
- Formulating and implementing projects on road safety, as well as adivisng the government policies and programmes related to road safety.
- Coordinating road safety-related activities in government and non-government agencies and working together with the different stakeholders involved.
- Compensating hit and run accident victims.

Traffic Police

The Traffic Police headquarters in Sri Lanka were established in 1953 and currently serves the main function of proposing policies around road traffic in Sri Lanka, as well as assisting in the implementation and monitoring of these subsequently. Additionally, the Traffic Police are also in charge of policing road traffic in Sri Lanka, together with the implementation and enforcement of regulations and laws concerning traffic, preventing violations of traffic regulations and prosecution of offenders. Other functions include investigating road accidents, controlling traffic on highways and coordinating and assisting public in events where motor traffic is involved[33].

Discussion

Sri Lanka has come a long way in the last 10 years since the establishment of the Ministry of Disaster Management, the National Council for Disaster Management and the Disaster Management Centre in 2005. Unfortunately, in the same time period, the country has continued to experience several disasters, some on a yearly basis such as floods and landslides.

Gaps and challenges

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