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# Natural disasters and population impact in Sri Lanka, 2010–2025

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## Abstract

# Background

Sri Lanka is highly vulnerable to climate-sensitive natural hazards, yet long-term national evidence on disaster patterns and human impacts remains fragmented. Robust synthesis of historical disaster data is essential to inform prevention, preparedness, and public health resilience. This study aimed to characterize temporal trends, dominant hazard types, and population-level impacts of natural disasters in Sri Lanka from 2010 to 2025.

# Methods

A retrospective secondary analysis was conducted using publicly available humanitarian reports published between January 1, 2010, and December 31, 2025, retrieved from ReliefWeb, operated by the United Nations' Office for the Coordination of Humanitarian Affairs. Reports describing natural disaster events in Sri Lanka and documenting disaster type, date, location, affected population, displacement, or mortality were included. Events were cross-checked to avoid duplication. Descriptive epidemiological analysis summarized disaster frequency, temporal patterns, and aggregate human impacts.

# Results

Between 2010 and 2025, natural disasters affected 15,586,967 people, displaced 1,497 277 individuals, and caused 1,328 deaths. Floods, frequently occurring in combination with landslides, were the most frequent and impactful hazards, accounting for over 6 million affected individuals and 479 deaths. Cyclone-related disasters, although less frequent, were associated with the highest mortality (538 deaths). Droughts affected more than 4.1 million people but were rarely linked to displacement. Substantial inter-annual variability was observed, with major peaks in 2011, 2014, 2016, and 2025.

# Conclusions

Natural disasters impose a sustained and substantial public health burden in Sri Lanka, predominantly driven by hydrometeorological hazards. Strengthening national disaster surveillance systems, integrating health impact reporting into disaster databases, and prioritizing flood- and landslide-risk reduction are critical to enhance population resilience aimed at increasing climate variability.

## Background

Natural disasters are sudden or slowly developing hazardous physical events caused by natural processes of the Earth's system [1]. These events include hydrometeorological hazards (such as floods, cyclones, storm surges, and droughts), geological hazards (including earthquakes, landslides, tsunamis),

as well as climate-related hazards such as heatwaves and wildfires [1–3]. Natural disasters can produce immediate loss of life and long-term adverse health, social, and economic consequences through the disruption of health services, food and water systems, housing, and livelihoods [4]. Globally, those events impose substantial strain on health and economic systems by damaging infrastructure, interrupting essential services, and diverting limited resources toward emergency response and recovery [2].

Sri Lanka is a tropical island with diverse climatic zones and complex geographical features, rendering highly vulnerable to a range of natural disasters [5]. The frequently reported natural disasters in Sri Lanka are seasonal and localized flooding events, often occurring in association with landslides. Tropical cyclones accompanied by storm surges, recurrent droughts, and periodic flooding are also common in the country [6–7]. These events result in deaths, injuries, population displacements, and extensive damage to housing, transport, infrastructure, and agriculture, with rural and low-income communities disproportionately affected. Monitoring and reporting are primarily conducted through the Disaster Management Centre (DMC) and the National Disaster Management Information System, which consistently identify flooding and landslides as the predominant risks in Sri Lanka.

Despite the frequency and impacts of natural disasters, Sri Lanka lacks comprehensive, consistent, and accessible long-term national disaster data [7]. Previous studies have documented limitations in disaster data collection, storage, and inter-agency data sharing, which constrain longitudinal analyses and evidence-based policymaking. The lack of standardized historical records limits the ability to accurately assess national trends in disaster frequency and associated human impacts, including mortality, displacements, affected populations, and broader socio-economic consequences.

Recent catastrophic events, including major cyclone Dithwa 2025 and extreme monsoon-related flooding, continue to cause substantial and at times rapidly escalating risks for the island nation. The recurrence and intensity of such events underscore the need for a robust disaster surveillance system capable of systematically analyzing disaster occurrence and impacts to strengthen preventive strategies, preparedness planning, and health system resilience in the context of increasing climate vulnerability.

Accordingly, this study aimed to retrospectively synthesize 16 years of historical data on natural disasters in Sri Lanka. By consolidating and analyzing multi-year records where previously only fragmented records existed, the study sought to (i) describe temporal and spatial patterns of disaster occurrence, (ii) quantify reported human and population-level impacts, and (iii) identify gaps in national disaster surveillance and reporting that should be prioritized to strengthen disaster-related public-health planning and research.

## Methods

# Study designs

This study employed a retrospective descriptive design using secondary humanitarian data to characterize the occurrence and population impacts of natural disasters in Sri Lanka between 1st of January 2010, and 31st of December 2025, based on data availability at the time of extraction. The study aimed to synthesize routinely reported disaster information to describe disaster types, temporal trends, and associated human impacts at the national level.

## Data source

All data were obtained from ReliefWeb, a global humanitarian information service operated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). OCHA, a United Nations Secretariat entity, is mandated to coordinate international humanitarian responses during emergencies and disasters. ReliefWeb was selected for its comprehensive coverage, standardized reporting format, and public accessibility. However, variations in reporting competencies across events were acknowledged.

## Inclusion criteria

Records were included if they:

Reported natural disaster events occurring in Sri Lanka published between 2010 and 2025; were official situation reports, assessments, or humanitarian updates published on ReliefWeb; and contain one of the following variables: Disaster type, date and year of occurrence, affected population, injuries, deaths, or displacements. Natural disasters were defined in accordance with internationally recognized classifications, including hydrometeorological and geological hazards.

## Exclusion criteria

Records were excluded if they: Focused exclusively on conflicts, economic crises, or epidemics without an associated natural hazard component; or were opinion pieces, editorial, or non-factual commentaries lacking event data.

## Search strategy and data extraction

A structured search was conducted on ReliefWeb using the country filter as Sri Lanka, and a time frame filter from 2010to 2025. Searches were performed using disaster-related keywords (e.g., floods, droughts, landslides, cyclones, tsunamis, heatwaves). Initially, screening was conducted at the title and summary level, followed by the full text review where applicable.

Data extraction was conducted by a single researcher using a standardized Microsoft Excel extraction framework. Extracted variables included year of the occurrence, type of the disaster, geographic location, number of people affected, mortality and injury counts (if reported), displacement figures, and source

organization. When multiple reports referred to the same disaster event, data were cross-checked and consolidated to avoid duplication. The use of a single extractor was recognized as a potential limitation and was mitigated by systematic cross-referencing of reports.

# Data management and quality assurance

Extracted data were compiled, cleaned, and reviewed before the analysis. Duplicate records were removed, and inconsistencies across reports were resolved through triangulation of sources. Missing data were handled on a variable-specific basis, with analysis conducted using available case reporting for each outcome. No imputation was performed.

## Statical analysis

Data were entered and analyzed using SPSS V.26. Descriptive statistics, including frequency, percentages, and annual counts, were used to summarize disaster types, temporal trends, disaster occurrence, and aggregate human impacts. Given the descriptive nature of the study and reliance on aggregated secondary data, inferential or causal analyses were not performed.

## Ethical considerations

The current study utilized publicly available de-identified secondary data and did not involve human participants, personal identifiers, or confidential information. Therefore, ethical approval and informed consent were waived. However, the study complies with principles of data transparency, responsible data use, and acknowledgment of original data sources.

## Results

As illustrated in Figure 1, Sri Lanka experienced multiple types of disasters with varying temporal patterns between 2010 and 2025. Flooding was the most recurrent hazard, with isolated flood events in six different years (2010, 2011, 2018, 2020, 2024, and 2025). Multi-hazard events involving Floods and landslides were the most frequently observed combined disasters, reported across ten years, indicating a persistent co-occurrence of these events throughout the study period. Severe storms were infrequently reported, with occurrence limited to a single year (2012). Cyclone-related events, typically accompanied by flooding and landslides, were reported intermittently in four years (2013, 2016, 2024, and 2025), without a clear periodic pattern. Drought events were observed sporadically across five years (2012, 2014, 2016, 2020, and 2023).

Landslides occurring independently were rare and were documented only once, in 2014.

**Human Impact of Disasters**

**Human Impact of Disasters by Disaster Type**

The human impact of disasters varied substantially by disaster type with respect to the size of the affected population, displacement, and mortality (Table 1). Floods occurring in isolation affected over 1.6 million people, resulting in the displacement of  283,428 people and 100 reported deaths. In contrast, flood events accompanied by landslides produced the greatest overall impact, affecting over 6.0 million people, displacing 894,179 individuals, and resulting in 479 deaths.

Compound disasters involving cyclones in combination with flooding and landslides were associated with the highest mortality burden, accounting for 538 deaths, while affecting approximately 1.94 million people and displacing 319,670 individuals. Drought events affected over 4.18 million people and were associated with 201 deaths; however, there was no population displacement, but resulted in 10 deaths. Landslides occurring independently had a limited population impact, affecting 1,875 people with no reported displacement.  Data on affected population size, displacement, or deaths were not available for severe storm events.

Table 1. Human impact of disaster by hazard type in Sri Lanka (2015-2025)

| Disaster type | Affected people | Displaced people | Death |
|---|---|---|---|
| Flood only | 1,613,162 | 283,428 | 100 |
| Flood and landslide | 6046859 | 894179 | 479 |
| Severe strom | NR | NR | NR |
| Cyclone with flood and landslide | 1936002 | 319670 | 538 |
| Drought | 4189069 | 0 | 201 |
| Landslide only | 1875 | 0 | 10 |

*NR= Not reported*

**Human Impact of Disasters by year of occurrence**

As shown in Table 2, natural disasters affected a total of 15,586,967 people, resulted in the displacement of 1,497,277 individuals, and caused 1,328 deaths from 2010 to 2025.  In 2011, it recorded the highest number of affected people (2,460,740), followed by 2016 (2,228,671) and 2014 (3,006,351). Displacement was greatest in 2011 (663,696 people), followed by 2010 (282,291 people) and 2025 (233,015 people). The highest number of deaths was reported in 2025 (420 deaths), followed by 2016 (305 deaths) and 2017 (203 deaths). 2021 reported the lowest impact, with 2,113 people affected, no displacement, and one death.  No disaster-related deaths were reported in 2020.

Table 2. Human impact of disasters by year of occurrence in Sri Lanka (2015-2025)

| Year of occurrence | Affected people | Displaced people | Death |
|---|---|---|---|
| 2010 | 1684502 | 282291 | 80 |
| 2011 | 2460740 | 663696 | 82 |
| 2012 | 2135209 | 56000 | 36 |
| 2013 | 7399 | 3881 | 7 |
| 2014 | 3006351 | 0 | 76 |
| 2015 | 59800 | 664 | 8 |
| 2016 | 2228671 | 21484 | 305 |
| 2017 | 630000 | 73560 | 203 |
| 2018 | 249310 | 11000 | 26 |
| 2019 | 64608 | 17766 | 2 |
| 2020 | 323659 | 928 | 0 |
| 2021 | 2113 | 0 | 1 |
| 2022 | 75000 | 58602 | 6 |
| 2023 | 325000 | 0 | 4 |
| 2024 | 1179829 | 74390 | 72 |
| 2025 | 1154776 | 233015 | 420 |
| Total | 15586967 | 1497277 | 1328 |

## Discussion

To the best of the authors' knowledge, this study is the first to provide a consolidated national overview of natural disasters in Sri Lanka over 16 years, highlighting clear temporal patterns, dominant hazard types, and substantial population-level impacts. Floods, particularly when combined with landslides, emerged as the most frequent and consequential disasters. These findings reinforce Sri Lanka’s classification as a hydrometeorological disaster-prone country and align with regional risk profiles in South and Southeast Asia [8].

According to the current findings, flood-related disasters accounted for the largest proportion of events and affected the largest population. The predominance of floods and flood-associated landslides is consistent with Sri Lanka’s monsoonal climate, high rainfall variability, and increasing land-use pressures in the vulnerable district[8]. In South Asia, floods affected approximately 750 million people between 2000 and 2021, representing nearly half of the global flood-affected population [9]. India, Bangladesh, and Nepal consistently report floods as the leading cause of disaster-related displacement, accounting

for over 60% of annual disaster displacements in the region [9, 10]. However, the magnitude of people affected by flood–landslide combinations in Sri Lanka appears proportionally higher than that reported in several middle-income Asian countries. This suggested heightened exposure linked to settlement patterns, slope instability, and population density in hazard-prone areas in Sri Lanka when compared with other Asian countries.

Cyclone-related disasters, although less frequent, are associated with the highest mortality burden. This pattern mirrors evidence from coastal South Asia, where cyclones contribute fewer than 10% of disaster events but account for over 30% of disaster-related deaths [11, 12]. In the Bay of Bengal region alone, tropical cyclones caused more than 500,000 deaths between 1970 and 2019, despite advances in forecasting [12, 13]. The rising mortality observed in recent cyclone-associated events in Sri Lanka, particularly in 2024 and 2025, may reflect intensifying storm severity linked to climate change, as well as residual gaps in early warning dissemination and evacuation compliance.

According to the current findings, droughts affected a large population but resulted in comparatively lower immediate mortality and no reported displacement. Globally, droughts accounted for approximately 35% of disaster-affected populations between 2000 and 2020, while contributing to less than 5% of reported disaster-related deaths [9].

The observed pattern is consistent with evidence from Sub-Saharan Africa and South Asia, indicating that droughts predominantly produce indirect health consequences mediated through food insecurity, livelihood disruption, and long-term nutritional stress rather than acute fatalities [14]. The absence of reported displacement during drought events likely reflects under-documentation rather than true non-occurrence, as slow-onset disasters are frequently under-represented in humanitarian reporting systems due to gradual onset, diffuse geographic distribution, and weaker emergency response triggers.

The temporal analysis demonstrated substantial inter-annual variability, with the peak impacts observed in 2011, 2014, 2016, and 2025. These peak years coincide with documented extreme monsoon anomalies and major flood episodes across South Asia, where observational records indicate a 10–20% increase in rainfall intensity over recent decades [15]. The sharp increase in disaster-related mortality in 2025 represents a significant deviation from preceding annual averages and may indicate escalating disaster severity, compounded exposure, or increasing population vulnerabilities. Comparable upward trajectories in disaster-related mortality have been reported across parts of Southeast Asia, where climate-driven hydrometeorological extremes have contributed to an estimated 25% increase in flood-related deaths since 2010 [16].

The minimal disaster impact recorded in 2021 across all indicators may reflect genuine climatic variability; however, it is also consistent with pandemic-related disruptions to disaster surveillance and humanitarian reporting systems. During the COVID-19 period, institutional priorities shifted toward public health emergency response, potentially reducing detection, verification, and reporting of disaster events. Global estimates indicate that disaster reporting completeness declined by approximately 15–20%

during 2020–2021 [17, 18]. These findings underscore the susceptibility of secondary disaster datasets to systemic shocks affecting monitoring infrastructure and data governance.

The cumulative burden identified in this study - over 15.5 million affected individuals, nearly 1.5 million displaced persons, and more than 1,300 deaths- demonstrates the sustained public health significance of natural disasters in Sri Lanka. When compared with island nations of similar population scale, such as the Philippines and Madagascar, Sri Lanka demonstrates a comparable magnitude of affected population but a relatively higher displacement-to-death ratio. For example, the Philippines reported approximately 18 million disaster-affected individuals annually during the same period, with proportionally lower displacement-associated mortality[19]. This pattern suggests effective short-term survival outcomes alongside persistent vulnerability affecting housing security and livelihood stability.

The study identifies critical limitations in national disaster surveillance capacity. Several disaster categories lacked complete reporting of affected populations, displacement, and mortality. Indicators with severe storm events demonstrate particularly consistent data deficiencies. Comparable reporting limitations have been reported across low- and middle-income countries, where fewer than 60% of disaster events include complete health impact metrics [20]. These gaps constrain robust longitudinal analyses and hinder evidence-based disaster risk reduction planning.

Strengthening disaster surveillance requires harmonized national reporting frameworks, integration of health sector information systems, and routine across-agency data validation mechanisms. Evidence from regional counterparts such as Vietnam and Thailand demonstrates that centralized disaster information platforms can improve reporting completeness by more than 30% within five years of implementation [17]. Adopting interoperable, multi-sector surveillance architectures would substantially enhance national preparedness, risk assessment accuracy, and resilience.

**Strengths and limitations**

The principal strength of this study is its extended observation period and the use of an internationally recognized humanitarian data repository, enabling consolidation of fragmented reports into a comprehensive longitudinal overview of disaster trends in Sri Lanka. However, the findings are constrained by reliance on secondary data sources, potential reporting bias, and inconsistent operational definitions across datasets. Mortality and displacement estimate likely underestimate true impacts, particularly for slow-onset disasters and geographically remote populations.

**Public health implications**

These findings emphasize the urgent need to prioritize flood and landslide risk reduction within national public health and disaster management strategies. Evidence from comparable settings suggests that investments in early warning systems, risk-informed land use planning, and community preparedness programs can reduce disaster mortality by up to 40% (UNDRR, 2023). Integrating disaster surveillance

within routine health information systems would enable real-time assessment of health impacts, facilitate targeted resource allocation, and strengthen adaptive health system resilience.

## Conclusions

Natural disasters represent a sustained public health challenge in Sri Lanka rather than isolated episodic events. This retrospective analysis demonstrates that climate-sensitive hazards, particularly hydrometeorological events, account for a substantial proportion of disaster occurrence and associated population impacts. Observed pattern reflects the integration between environmental exposure and existing social and infrastructural vulnerabilities contributing to recurrent pressures on health systems and essential services, with implications for equity and long-term resilience.

The analysis underscores the critical role of robust disaster surveillance in supporting evidence-informed public health decision-making. Vulnerability in reporting incompleteness and consistency limits the accuracy of the assessment of temporal trends and population impacts, thereby constraining the effectiveness of disaster risk reduction and preparedness strategies. Strengthening national disaster data systems and improving their integration with health information platforms would enhance situational awareness and support more responsive decision-making.

From a policy and planning perspective, the study supports a transition from predominantly reactive disaster response models towards prevention and preparedness -oriented approaches. Greater alignment between disaster risk reduction frameworks and public health planning is necessary to mitigate avoidable health impacts and safeguard population well-being in the context of increasing climate variability and disaster frequency.

## Abbreviations

DMC
Disaster Management Centre
NR
Not Reported
OCHA
Office for the Coordination of Humanitarian Affairs
UN
United Nations
UNDRR
United Nations Office for Disaster Risk Reduction

## Declarations

***Ethics approval and consent to participate***

Not applicable

***Consent for publication***

Not applicable

***Availability of data and materials***

The datasets generated and/or analyzed during the current study are available in the Figshare repository, https://doi.org/10.6084/m9.figshare.31249120

***Competing interests***

The authors declared no competing interests.

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***Authors' contributions***

SDD and DKMD conceptualized the study. Formal analysis was conducted by DKMD and SDD, while all authors contributed to data collection and investigation. Supervision was provided by SDD and SSPW. DKMD drafted and edited the manuscript, and SDD and SSPW contributed to its review and final editing. All authors had full access to the raw data, verified its accuracy, and approved the final version for submission.

***Clinical trial number***

Not applicable

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Not applicable

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# Figures

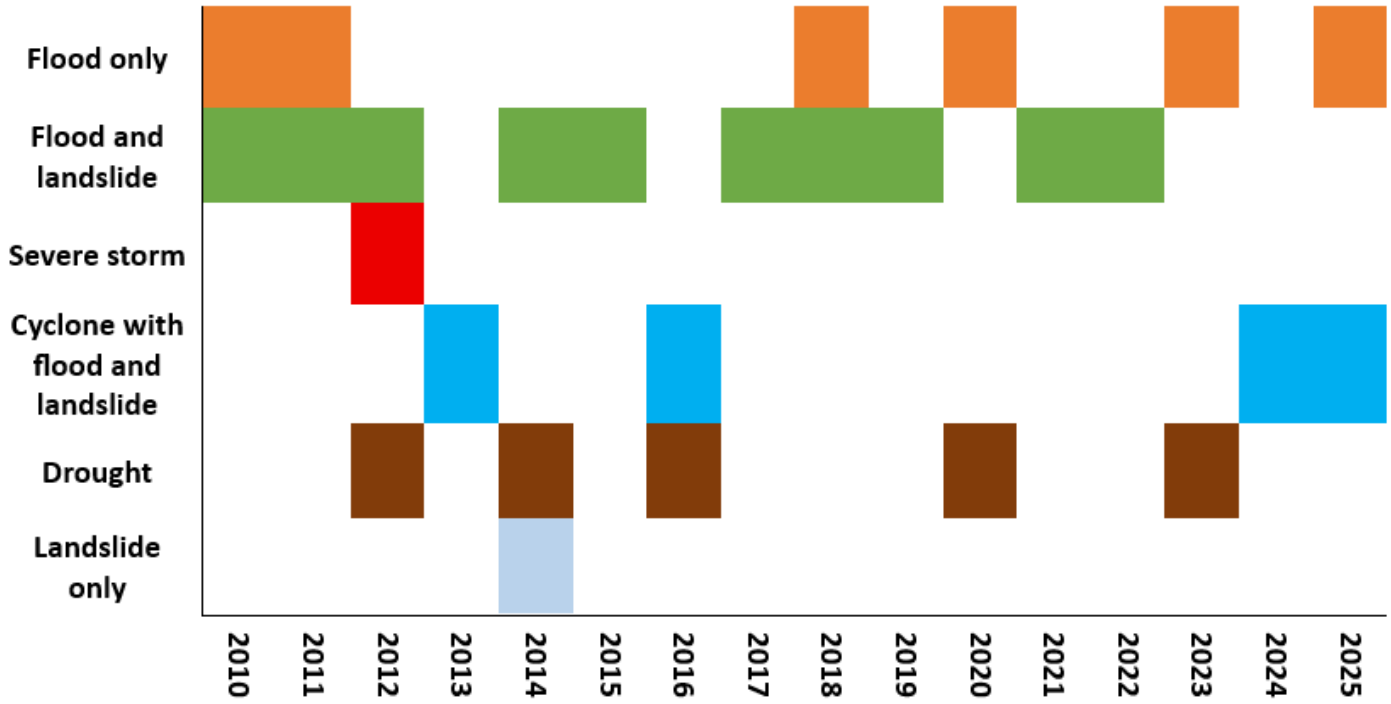



**Figure 1**

Annual distribution of natural disaster types in Sri Lanka (2010–2025)

*Figure caption: Annual distribution of natural disaster events in Sri Lanka from 2010 to 2025, categorized by hazard type. Hazard types include: Flood only, Flood and Landslide, Severe Storm, Cyclone with Flood and Landslide, Drought, and Landslide only. The figure illustrates temporal trends and the relative frequency of each disaster type over the 16-year period.*