

Post-Disaster Needs Assessment as an Evidence Base for Smart, Resilient Urban Infrastructure Recovery: A Case Study of Cyclone Ditwah, Sri Lanka (2025–26)

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Case Report

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Abstract

Cyclone Ditwah made landfall on Sri Lanka's east coast on 28 November 2025, triggering widespread flooding and over 1,800 landslides across 22 of the country's 25 districts, and prompting the Government of Sri Lanka to commission a rapid Post-Disaster Needs Assessment (PDNA) under the “Rebuilding Sri Lanka” Presidential Task Force. This case study synthesises the PDNA's damage, loss and recovery needs data with the wider international literature on PDNA effectiveness and geospatial disaster risk management to evaluate where smart, data-driven infrastructure planning could plausibly reduce future losses. Cross-country evidence indicates that PDNAs, while methodologically robust for costing physical damage, systematically under-detect certain dimensions of social vulnerability and are rarely linked to the real-time hazard-monitoring infrastructure a country already operates. Applying this lens to Sri Lanka, the study finds that recovery needs are heavily concentrated in transport and housing (accounting for two-thirds of the estimated USD 3.4 billion required), are spatially clustered in six districts, and coincide with a landslide and flood early-warning architecture including a 325-gauge automated rainfall sensor network that remains institutionally fragmented across at least three implementing agencies. The case study argues that consolidating this existing monitoring capacity into a shared, geospatially indexed recovery-tracking platform, rather than procuring new sensor hardware, represents the most fiscally realistic and evidence-aligned entry point for smart urban governance in a disaster-exposed, debt-constrained coastal state, and proposes this as a transferable model for comparable middle-income contexts.

1. Introduction

Rapid, unplanned urbanisation in low-lying, flood-prone floodplains is a well-documented driver of disaster vulnerability in South Asian coastal states [1]. Sri Lanka, an island nation of approximately 23 million people, is exposed to cyclones, floods, landslides, coastal erosion and drought, and its topography a steep central highland ringed by densely populated coastal floodplains concentrates population and infrastructure in precisely the areas most exposed to extreme rainfall runoff [2]. On 28 November 2025, Cyclone Ditwah made landfall on the island's east coast, bringing rainfall of 150–500 mm across affected areas, exceeding 300 mm within 24 hours in several districts, and sustained winds of 65–90 km/h [2]. The World Weather Attribution initiative subsequently assessed that climate change had intensified the associated extreme rainfall, characterising the event as consistent with an approximately 1-in-30-year rainfall event under current climate conditions [3].

Post-Disaster Needs Assessments (PDNAs) have been the dominant international instrument for costing such events and structuring recovery financing since the joint European Union–World Bank–United Nations methodology was formalised in 2013 [15], with over fifty PDNAs conducted worldwide by the time of the joint UNDP–GFDRR decade-in-review evaluation in 2017 [13]. That review, alongside more recent empirical work, finds that PDNAs are methodologically strong at costing physical asset damage but structurally weaker at capturing which population groups actually experience the worst recovery outcomes: a household-survey-based evaluation of Nepal's 2015 earthquake PDNA found that while the

assessment correctly flagged some vulnerable groups, it failed to identify others notably indebted households and that its narrow focus on housing and income left health-related recovery needs largely unaddressed four years on [14]. This case study asks a correspondingly narrow and practical question: given this known gap between what PDNAs cost well (physical damage) and what they capture poorly (distributed, real-time risk and vulnerability), what does Sri Lanka's own hazard-monitoring infrastructure already offer toward closing it, and how could that capacity be integrated into the Cyclone Ditwah recovery programme at low fiscal cost? Rather than proposing new primary data collection or new hardware procurement, the study synthesises the PDNA's own findings [2] with humanitarian and macro-fiscal assessments [4–6], pre-disaster urban governance baselines [7], and the technical literature on Sri Lanka's existing rainfall and landslide sensor networks [12] to identify a concrete, evidence-grounded entry point for smart urban governance. This falls within the Case Study article type and speaks directly to this journal's smart urban governance, intelligent disaster prevention, and climate-driven city sustainability themes.

2. Case Context

2.1 The Event and its Physical Footprint

Cyclone Ditwah inundated an estimated 1.1 million hectares of land and exposed over 2.2 million people across 22 of Sri Lanka's 25 districts [2]. Torrential rainfall over the central highlands rapidly channelled runoff into densely populated river basins; the Kelani, Kala Oya, Malwathu Oya and Mahaweli rivers overflowed, severely affecting Colombo, Gampaha, Puttalam, Mannar and Trincomalee districts, while more than 1,800 landslides were triggered nationwide [2]. As of 19 January 2026, the Disaster Management Centre (DMC) reported 646 fatalities, 173 people still missing, 8,294 people remaining in 113 government-run safety centres, and a further 169,642 people staying with host families or in rented accommodation [2]. Among those affected were an estimated 522,000 children, 263,000 older persons and more than 21,000 pregnant women [2].

2.2 Pre-Existing Urban and Fiscal Vulnerability

The cyclone struck a country still recovering from its 2022 balance-of-payments crisis and sovereign default. National poverty stood at 25.9 percent in 2023 roughly double its 2019 level informal employment accounted for 67.6 percent of the workforce, and social protection coverage reached only 41.3 percent of the population [2, 8]. A decade earlier, the UN DESA-supported State of Sri Lankan Cities report had already flagged uneven municipal WASH coverage, weak inter-city connectivity, and limited local-government fiscal and planning capacity as structural constraints on urban resilience [7]. The IMF's most recent Article IV consultation similarly notes that recovery and reconstruction needs, estimated at up to LKR 500 billion, will require a 2026 supplementary budget precisely as the country manages an ongoing Extended Fund Facility programme [6]. This pre-existing fiscal and institutional fragility is the backdrop against which any “smart” reconstruction strategy must be evaluated: digital and sensor-based

solutions are only useful to the extent that they are affordable, maintainable, and embedded in functioning local institutions.

2.3 Sri Lanka's Existing Hazard-Monitoring Infrastructure

Sri Lanka is not starting from zero on hazard sensing. Since 2007, the National Building Research Organisation (NBRO) has operated a Regional Landslide Early Warning system based on rainfall thresholds of 75 mm/day (watch), 100 mm/day (alert) and 150 mm/day or 75 mm/hour (evacuation), supported by an automated network of 325 rain gauges positioned in landslide-prone areas nationwide [12]. This infrastructure was built in direct response to prior catastrophic events, most notably the 2016 Aranayake landslide in Kegalle District, in which a fluidised landslide mass travelled two kilometres and killed 125 people [12] the same district that the Cyclone Ditwah PDNA identifies as one of six districts accounting for the bulk of national recovery needs (Section 4.3). NBRO's network operates in parallel with a separate automated rain-gauge network maintained by the Irrigation Department and a hydro-meteorological station network supported by the Asian Disaster Preparedness Center [2]. The technical capability to sense extreme rainfall in the areas that matter most already exists; what Section 4.4 and Section 5 examine is whether that capability is currently organised in a way that supports smart, coordinated urban recovery governance.

3. Data Sources and Methods

This case study is a secondary synthesis of publicly available disaster-assessment, urban-governance and technical hazard-monitoring literature; no primary data were collected. Four categories of source were used. First, the Government of Sri Lanka's PDNA for Cyclone Ditwah (Disaster Management Centre and Department of National Planning, March 2026), which applies the internationally recognised EU–World Bank–UN PDNA methodology [15] and triangulates administrative data from the Disaster Data Collection System with the Joint Rapid Needs Assessment, the World Bank's Global Rapid Post-Disaster Damage Estimation (GRADE) exercise, remote sensing, and field verification [2]. Second, humanitarian and macro-fiscal assessments from OCHA, the World Bank and the IMF [4–6, 9]. Third, pre-disaster urban governance and infrastructure baselines, principally the UN DESA-supported State of Sri Lankan Cities report [7], the National Treasury's Public Investment Programme 2026–2028 [10], and UN-Habitat's country programme reporting [11]. Fourth, the peer-reviewed technical literature on Sri Lanka's landslide early-warning infrastructure [12] and the cross-country evaluative literature on PDNA effectiveness [13, 14]. Figures are reported in Sri Lankan Rupees (LKR) and United States Dollars (USD) at the PDNA's stated exchange rate of LKR 304.2 per USD [2]. Because the underlying sector reports were compiled under time constraints with partial field access, the PDNA itself flags several figures as provisional; this is discussed further in Section 6, alongside the documented limitations of the PDNA instrument more generally [13, 14].

4. Findings

4.1 Damage, Loss and Recovery Needs Profile

The PDNA estimates total physical damages of LKR 618.1 billion (USD 2.0 billion) and economic losses of LKR 416.0 billion (USD 1.4 billion), yielding a combined total effect of LKR 1,034.1 billion. Recovery needs which incorporate a 15–25 percent Build Back Better adjustment for resilience upgrading are estimated at LKR 1,022.5 billion (USD 3.4 billion) over a three-year recovery horizon, of which LKR 391.3 billion is required within the first twelve months [2]. Table 1 summarises the sectoral distribution of these figures.

Table 1
Summary of damages, losses and recovery needs by sector, Cyclone Ditwah PDNA [2]

Sector	Damages (LKR Bn)	Losses (LKR Bn)	Total Effect (LKR Bn)	Recovery Needs (LKR Bn / % of total)
Transport	295.7	25.7	321.4	397.1 (38.8%)
Housing and Settlements	126.8	10.9	137.7	275.5 (26.9%)
Commerce and Industry	61.3	151.3	212.5	119.1 (11.7%)
Irrigation	48.8	0.7	49.5	61.1 (6.0%)
Agriculture and Food Systems	25.4	136.7	162.1	51.3 (5.0%)
Energy	23.9	5.8	29.7	28.7 (2.8%)
Education	11.4	0.4	11.8	15.4 (1.5%)
WASH	13.7	1.0	14.6	14.6 (1.4%)
Environment	1.1	65.0	66.1	10.2 (1.0%)
Health	4.1	0.1	4.1	26.8 (2.6%)
Disaster Risk Reduction	0.5	6.1	6.6	2.8 (0.3%)
Governance	1.7	0.5	2.1	2.5 (0.2%)
Tourism	3.9	6.5	10.4	7.2 (0.7%)
Employment and Livelihoods	–	5.4	5.4	10.3 (1.0%)
Grand Total	618.1	416.0	1,034.1	1,022.5 (100%)

4.2 Concentration in Infrastructure, Particularly Transport

Infrastructure sectors transport, energy, irrigation and water/sanitation together account for approximately 49 percent of total recovery needs, the largest of any sector cluster [2]. Transport alone

accounts for LKR 397.1 billion, or 38.8 percent of total needs, reflecting extensive damage to roads, bridges and the national railway network; at the height of the emergency, only around 30 percent of the railway network remained operational, and electricity supply was disrupted for 3.9 million consumers [4]. Within the social sectors, housing and settlements represent the largest single requirement (LKR 275.5 billion, 26.9 percent of total needs), reflecting both direct damage to residential structures and the PDNA's recommendation for planned relocation from high-risk floodplains where necessary [2]. Transport and housing combined therefore account for close to two-thirds of total national recovery needs a concentration that sharpens, rather than dilutes, the case for prioritising smart-governance tools in exactly these two sectors.

4.3 Spatial Concentration of Recovery Needs

Recovery needs are not evenly distributed. Six districts Kandy, Nuwara Eliya, Badulla, Puttalam, Kegalle and Colombo account for a disproportionate share of the national total (Table 2), a finding the PDNA itself uses to argue for geographically sequenced rather than uniformly distributed recovery financing [2]. Notably, Kegalle the district containing Aranayake, site of Sri Lanka's deadliest recent landslide and the direct catalyst for NBRO's current early-warning architecture [12] remains among the highest-need districts nearly a decade later, suggesting that hazard exposure in this corridor is structural rather than a one-off event. This spatial concentration is precisely the kind of pattern that geospatial dashboards and open district-level data portals are designed to make visible to planners and the public alike, and represents a concrete, low-cost entry point for smart urban governance tools in the Sri Lankan context.

Table 2
Six highest-need districts by estimated recovery cost [2]

District	Estimated Recovery Needs (LKR Bn)
Kandy	154.6
Nuwara Eliya	126.1
Badulla	97.9
Puttalam	78.4
Kegalle	63.8
Colombo	44.4

4.4 Fragmented Early-Warning and Monitoring Infrastructure

The PDNA's Disaster Risk Reduction chapter documents NBRO's automated rain-gauge network operating alongside a separately administered rain-gauge network run by the Irrigation Department, and a further hydro-meteorological station network supported by the Asian Disaster Preparedness Center [2]. The technical literature confirms that NBRO's network alone comprises 325 gauges feeding a threshold-based regional warning system that has been operating since 2007 and was strengthened following the

Aranayake disaster through a joint NBRO–International Consortium on Landslides research programme from 2019 [12]. Despite this, the PDNA's own recovery strategy identifies “data, digital systems, and risk information” as a distinct cross-cutting enabler still to be institutionalised, rather than as an existing integrated capability [2]. This is the clearest gap in the current evidence base: three separate agencies (NBRO, the Irrigation Department, and ADPC-supported hydro-meteorological services) operate technically capable but administratively separate sensor networks, none of which is described in the PDNA as feeding a single, government-wide, geospatially indexed platform.

5. Discussion: Toward Smart, Resilient Urban Reconstruction

5.1 Data and Digital Systems as a Recovery Enabler

The PDNA recovery strategy explicitly names “data, digital systems and risk information” as one of five cross-cutting enablers of recovery, alongside sustainable finance, strategic communication, inclusion, and ecosystem-based resilience [2]. Read against the cross-country PDNA literature which finds that assessments of this kind reliably cost physical damage but are weaker at tracking distributed, evolving risk to specific population groups [13, 14] the practical implication is to consolidate Sri Lanka's existing rain-gauge and hydro-meteorological networks [2, 12] into a shared district-level early-warning and asset-monitoring platform: an information system and big-data application for infrastructure maintenance squarely within this journal's remit. Given that six districts account for the bulk of recovery cost, including Kegalle's recurring landslide exposure (Section 4.3), a geospatially indexed dashboard combining PDNA damage data, satellite-derived flood extent already produced through the GRADE and Joint Rapid Needs Assessment processes [2, 9], and NBRO/Irrigation Department sensor feeds [12] would let national planners and local authorities track both reconstruction progress and residual risk in the highest-need areas directly addressing the vulnerability-tracking gap the Nepal evaluation identified [14], without requiring new data collection infrastructure beyond consolidation of what already exists.

5.2 Risk-Informed Reconstruction Standards

The PDNA's Build Back Better costing already embeds a 15–25 percent uplift for resilience-enhancing design in reconstruction budgets across sectors [2]. Translating this budgetary provision into practice in the transport and housing sectors which together account for roughly two-thirds of total recovery needs implies systematic use of updated hydrological and geotechnical hazard mapping in siting and design decisions, consistent with the PDNA's own recommendation that recovery investment be guided by “updated hazard and risk assessments, climate projections, hydrological and geotechnical analyses” [2]. NBRO's decades of landslide hazard zonation mapping [12] already provide a partial technical foundation for this in high-risk districts such as Kegalle and Nuwara Eliya; the recovery programme's task is to operationalise these existing maps as binding siting inputs for reconstruction, rather than treating them as a separate technical reference. This is a direct application of smart-construction principles GIS-based siting, geotechnical monitoring and hazard-zone-constrained design to a live, funded reconstruction programme rather than a hypothetical pilot.

5.3 Institutional and Fiscal Constraints on Adoption

Any recommendation for digital or sensor-based infrastructure must be read against Sri Lanka's fiscal position. Public and publicly guaranteed debt remained at 103.2 percent of GDP at end-2024, and the government approved a LKR 500 billion supplementary allocation for 2026 reconstruction on top of an already-constrained budget under its IMF Extended Fund Facility [6]. The National Treasury's Public Investment Programme 2026–2028 shows urban development as one line among many competing capital priorities [10]. This suggests that the most immediately viable smart-governance intervention is not new hardware procurement NBRO's 325-gauge network, the Irrigation Department's parallel network, and ADPC-supported hydro-meteorological stations already exist [2, 12] but the integration and public dissemination of data these agencies already collect: a governance and data-architecture problem rather than a capital-intensive infrastructure one, and therefore realistic within current fiscal constraints. This also responds directly to the PDNA effectiveness literature's broader finding that recovery programmes tend to under-invest in the institutional and data-governance work needed to translate assessment findings into equitable outcomes [13, 14].

6. Limitations

This case study relies entirely on secondary, publicly disclosed data and does not independently verify PDNA sector estimates, which the assessment's own authors describe as provisional and subject to revision as previously inaccessible areas are surveyed [2]. The PDNA's bottom-up, sector-validated damage estimate (USD 2.0 billion) differs substantially from the World Bank's earlier top-down GRADE estimate (USD 4.1 billion), reflecting differences in methodology, timing and exposure assumptions rather than measurement error [2]; this case study reports the PDNA's own preferred figures throughout, but the divergence illustrates the general caution required when synthesising rapidly produced post-disaster datasets. More fundamentally, the international evaluative literature on PDNAs including the UNDP–GFDRR decade-in-review [13] and the household-survey-based Nepal evaluation [14] finds that PDNAs are reliably strong at costing physical damage but empirically weaker at identifying which population groups experience the worst long-term recovery outcomes, and that health-related and debt-related vulnerabilities in particular tend to be under-captured relative to housing and income. Because Cyclone Ditwah's PDNA has not yet been subject to an equivalent longitudinal household-survey evaluation, this case study cannot determine whether the same specific gaps apply in Sri Lanka; this is proposed as a direction for future primary research, ideally conducted three to five years post-disaster in partnership with the Department of Census and Statistics. Finally, the study does not model the technical feasibility, cost or interoperability of a consolidated early-warning platform; this too would require dedicated primary research, ideally in partnership with NBRO, the Irrigation Department and DMC.

7. Conclusion

Cyclone Ditwah generated one of the most comprehensive, publicly available disaster-impact datasets yet produced for Sri Lanka, spanning physical damage, economic loss, recovery costing, and spatial and

demographic vulnerability. Read alongside the international evaluative literature on PDNA effectiveness and Sri Lanka's own peer-reviewed hazard-monitoring research, the PDNA's findings point toward a specific, low-capital-cost smart-governance intervention: consolidating already-operational hydro-meteorological and geospatial monitoring capacity including NBRO's 325-gauge landslide early-warning network into a shared, publicly accessible platform aligned with the Build Back Better reconstruction programme, prioritised in the two sectors and six districts where the PDNA shows recovery needs are concentrated. For a lower-middle-income, disaster-exposed coastal state operating under significant fiscal constraint, this data-integration approach offers a more immediately replicable model of smart urban governance than capital-intensive sensor or digital-twin deployment, and may be of comparative relevance to other South and Southeast Asian states facing similar recurrent flood, cyclone and landslide exposure.

Statements and Declarations

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Data Availability: All data underlying this case study are drawn from publicly available sources cited in the reference list, including the Government of Sri Lanka Post-Disaster Needs Assessment for Cyclone Ditwah (Disaster Management Centre / Department of National Planning, 2026), OCHA and World Bank humanitarian and macro-fiscal reporting, UN DESA urban governance baseline data, and peer-reviewed literature on Sri Lanka's landslide early-warning infrastructure. No new primary data were generated for this study.

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No Clinical Trial Required

Ethics, Consent to Participate, and Consent to Publish declarations: not applicable

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