Methodological challenges in assessing loss and damage from climate-related extreme events and slow onset disasters: Evidence from India

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Introduction

- **Loss and Damages (L&Ds)**

- UNFCCC definition: "*The actual and/or potential manifestation of impacts associated with climate change in developing countries that negatively affect human and natural systems, including impacts from extreme events and slow-onset events*" (Janzen et al., 2021)

- Impacts exceeding limits to adaptation – residual risks including unavoided and unavoidable impacts (Boyd et al., 2017)

  - Economic and Non-Economic L&Ds (Bahinipati, 2020)

  - UNFCCC 1992 – first discussed (AOSIS), CoP 13 in 2007 held in Bali, and further developments in Cancun 2010 and Doha 2012, and institutionalised at CoP 19 in Warsaw 2013 (Johansson et al., 2022)

  - Article 8 of the Paris agreement (CoP 21): third pillar (OECD, 2021)

  - CoP 27, 2022: breakthrough agreement to provide 'loss and damage' funding for vulnerable countries – curative and risk financial mechanisms

  - Lack of estimations of L&Ds across the countries, particularly for slow-onset disasters and NELD – methodological limitations

Estimations of L&Ds in India: where do we stand?

- In India, post-disaster impact assessment comprises of two components: situation assessment and needs assessment (GoI, 2019)

- L&D – situation assessment

- GoI (2019) – loss refers to negative impact on production of goods and services and damage means value of assets and infrastructure devastated

- Post-disaster assessment includes extent of damage to infrastructure, agricultural crops, assets and livelihoods, loss of life and ecosystem services and cost towards recovery (GoI, 2019)

- Limited information: slow onset disasters - sea-level rise, salinization, urban drought, etc. (see Kumar et al., 2016; Singh et al., 2021).

- Post-disaster L&Ds: government agencies, state disaster management authority, special relief commissioner, and international agencies like World Bank, ADB, etc.

Table 1. List of ELD and NELD indicators

L&D indicators	Occurring due to		Estimated by	
	Extreme events	Slow onset disasters	Government agencies	Research studies
Direct Economic L&D				
Damage to house	Y	Y	Y	Y
Loss of crops	Y	Y	Y	Y
Damage to public properties	Y	Y	Y	Y
Loss and damages to industries	Y	Y	Y	Y
Land degradation	Y	Y	N	Y
Cattle/livestock lost and affected	Y	Y	Y	N
Damage to nets and boats of fisherman	Y	N	Y	Y
Indirect Economic L&D				
Loss of 'net revenue' during recovery period by different sectors, e.g., industries, service sectors, etc.	Y	Y	Y	Y
Loss of wages	Y	Y	Y	Y
Reduction in tourism revenue	Y	N	Y	Y
Loss to human capital (long term economic impact of school dropout of children)	Y	Y	N	N
Direct Non-Economic L&D				
Human casualties	Y	N	Y	N
People affected	Y	Y	Y	N
Impact on health (including mental and emotional wellbeing)	Y	Y	Y	Y
Destruction of cultural heritage	Y	Y	Y	Y
Impact on ecosystems and biodiversity	Y	Y	Y	Y
Impact on environment and cultural heritage	Y	Y	Y	Y
Impact on territory/geographical boundary	Y	Y	N	Y
Sense of Place and Social Cohesion	Y	Y	N	Y
Indirect Non-Economic L&D				
Migration[1]	Y	Y	N	Y
Impact on social capital (e.g., trust)[2]	Y	Y	N	N
Crime	Y	Y	N	Y
Suicide	Y	Y	Y	Y
Conflicts and disputes	Y	Y	N	Y
Identity and Dignity	Y	Y	N	N

[1] This includes both physical damages, and loss of associated pleasure and aesthetic values.
[2] See Fleming et al. (2014) for Chile in the case of 2010 earthquake.

Note: 'Y' means Yes (i.e., estimated) and 'N' means No (i.e., not calculated); Source: Author's observation based on different disaster assessment reports and research papers

L&Ds Estimations: Methods and Approaches - India

- Relief based approach: ignores financial aid required for recovery and reconstruction (GoI, 2019)

- For example, the L&D indicators in monetary terms are reported for houses damaged, agricultural crops and public properties in the case of floods in India, and total L&D is calculated as sum of these three indicators (Bahinipati and Patnaik, 2020)

- Post-Disaster Needs Assessment (PDNA) approach: to evaluate L&Ds for different sectors and cross-cutting themes (see Government of India, 2019)
  - For instance, the 2018 flood in Kerala (GoK, 2018) and the 2019 Fani cyclone in Odisha (see ADB, 2019)

- PDNA: comprehensive damage assessment - rehabilitation, reconstruction and recovery needs

- The climate risk management (CRM) framework: jointly developed by NIDM and GIZ-India to guide the government agencies in India to do an ex-ante identification of climatic risks: Tamil Nadu, Odisha, Uttarakhand (Kumar et al., 2016; Stoffel et al., 2019a and b)

CRM Approach
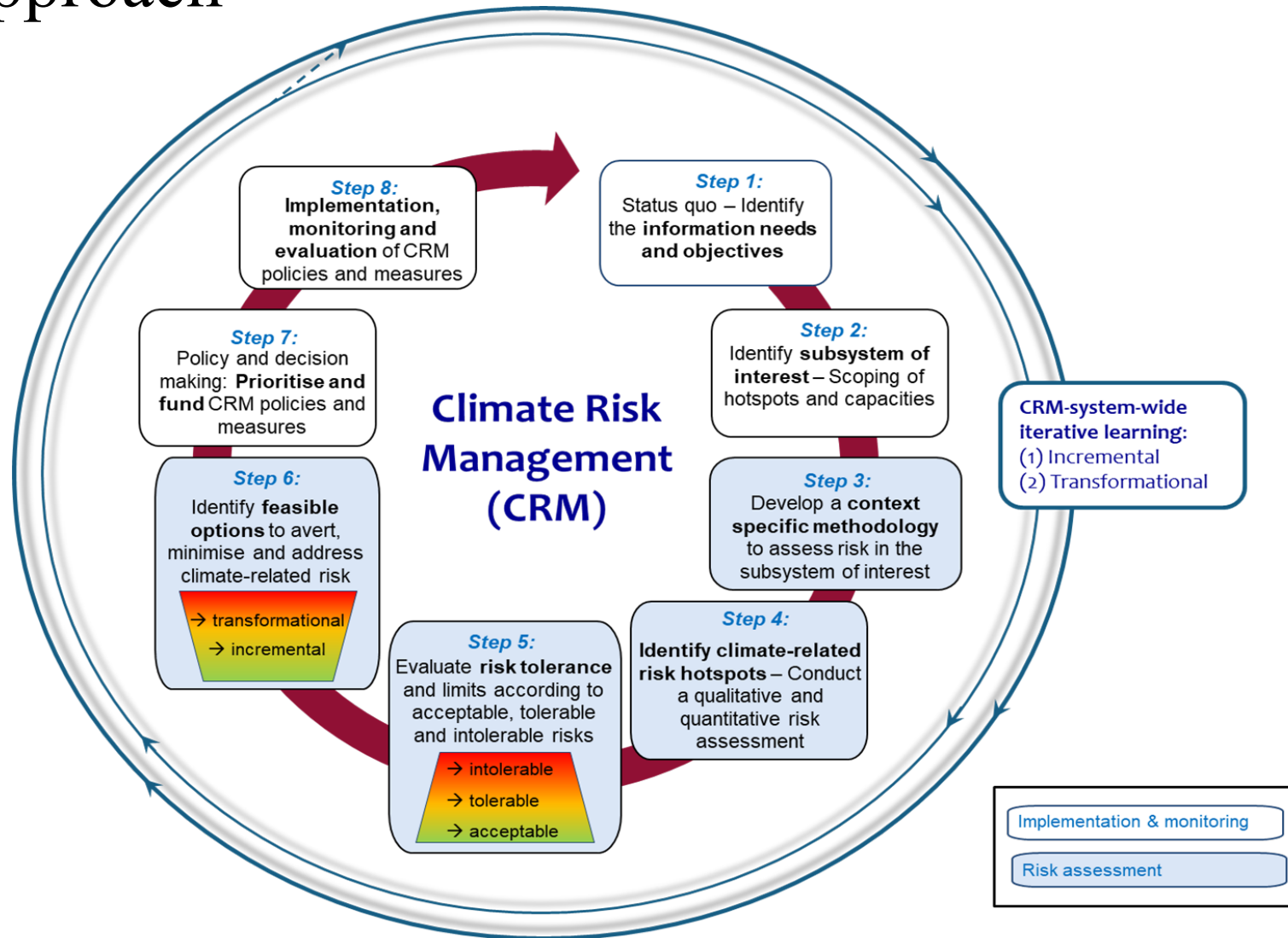
- There are three types of discrepancies observed from these computations:

    (i) No assessment for slow-onset disasters such as salinization, sea-level rise, depletion of groundwater, urban drought, etc. (Kumar et al., 2016; Singh et al., 2021), and

    (ii) Cyclonic storms, floods and droughts are computed consistently - not calculated for all ELD and NELD indicators and limited sectors (Bahinipati, 2020; Bahinipati and Patnaik, 2020)

    (iii) Different methods and indicators for each disaster and across the states. (Bahinipati, 2020).

- For instance, the economic cost of some recent events is as follows: 2018 Kerala flood (USD 4.25 billion), 2017 Bihar flood (USD 1.6 billion), 2015 Chennai flood (USD 2.2 billion), 2014 Jammu & Kashmiri flood (USD 16 billion), 2014 Hudhud cyclone Odisha (USD 7 billion) and 2013 Phailin cyclone Odisha (USD 0.64 billion).

- Further, the total damage from the 2019 Fani cyclone in Odisha was USD 2,352 million while the losses were around USD 1,102 million (Asian Development Bank, 2019).

- These figures would have been much higher if we could have computed the monetary value of the missing indicators

- Patankar and Patwardhan (2016: quantify L&Ds for households, including both direct and indirect - higher than that of public infrastructure in the case of the Mumbai floods in 2005

Methodological Challenges in Calculating ELD

- Relief Based Approach: houses damaged and crop loss
- Four steps are involved in the PDNA approach, namely:
  - (i) pre-disaster context and baseline information, (ii) the assessment of disaster effects, (iii) the assessment of disaster impacts, and (iv) the recovery strategy and determining the sector recovery needs – 'Build back better' (GoI, 2019).
- PDNA method covers social sectors (housing, health, education, cultural heritage, etc.), productive sectors (agriculture, livestock and fisheries), infrastructure sectors (water, sanitation, transport, power, irrigation, water resources), cross-cutting sectors (environment, employment and livelihoods, disaster risk reduction, gender equality and social inclusion, local governance) (GoI, 2019; see GoK, 2018; ADB, 2019).
- The major limitations of the PDNA approach are
  - inadequate baseline data on socio-economic, demographic and ecosystem
  - Lack of qualitative information on vulnerable communities regarding social conditions and human development indicators
  - sector-wise calculation of impact and calculating aggregate impact based on the L&Ds estimated for each sector and
  - accounting for the spillover effects

- With reference to sector-wise impact, the major lacunae are:
  - pricing each L&D indicator,
  - avoiding double counting of impact among the sectors, and
  - clear identification of L&D indicators, i.e., both direct and indirect.

- GDDP: Extreme event usually hits a few districts and not the entire state. In this context, it is a difficult task to estimate L&D for each sector, given the absence of GDDP

- 2019 Fani cyclone, GDDP was calculated for the affected districts in the state, so the sector-wise impact can be evaluated (Mishra and Gaurav, 2020) - it was not an issue in the 2018 flood in Kerala as it affected the entire state.

- Hallegatte et al. (2013) have estimated city level GDP

- Other challenges arise due to the mismatch between sectoral themes of PDNA and reported sector-wise contribution to GSDP - budgetary allocation of resources for recovery and reconstruction (Mishra and Gaurav, 2020).

- Direct impact on the fiscal measures: reducing revenue collection – not estimated

- Indirect L&Ds: lack of information (Ranger et al., 2011; Bahinipati et al., 2017; Patankar, (2019)

- Estimating L&Ds for the informal sector: MSME is one of the major informal sectors in India and absorbs a large number of migrant workers.

- Pre-disaster information related to stock and flow of capital assets, employment scenario, supply chain, etc. are not available for a particular location hit by an extreme event.

- These sectors are mostly out of insurance coverage, otherwise, insurance claim could have been considered as a proxy for L&Ds.

- For instance, according to Patankar (2019), around 93 per cent of business units in Mumbai do not have insurance coverage for floods

- Bahinipati et al. (2017) find that one-fourth of total L&Ds was covered through insurance and government supported compensation for textile units in Surat.

- Identity crisis: migrant workers (i.e., no voting power in the place where they migrate and identity card has village address) (see Patankar, 2019).

- Denied relief and compensation, for example 2015 Chennai flood (Patankar, 2019). It indicates that the L&Ds incurred by the migrant workers are not included in the total L&D assessment.

- Reverse migration is much rampant followed by an extreme event - shortage of labour force and delayed normalcy period for the business units in the city - 83% of textile owners in Surat reported (Bahinipati et al., 2017).

Methodological Challenges in Calculating NELD

- NELD: items have both intrinsic and instrumental value and not traded in the market (Hirsch, 2017)
- Strategic workstream of ExCom under WIM 2018-2022 and an expert group formulated in 2020 (Johansson et al., 2022)
- UNFCCC eight dimensions: life, health, migration, geographical region, biodiversity, ecosystems, cultural heritage and indigenous knowledge (Serdeczny et al., 2018)
- Based on 106 case studies, Tschakert et al. (2019) listed 20 indicators: others are social fabric, knowledge, identity, self-determination, dignity, sovereignty, community oriented solving issues
- Recognising and acknowledging NELD is the first step and particularly not documented in the low income countries (Tschakert et al., 2019)
- Methods: Quantitative assessments (economic valuation), multi-criteria analysis, qualitative, semi-structured interviews, composite risk indicaes,, etc.
- In India, acknowledged in National policy on disaster management (Kumar et al., 2016)
- Recent L&D assessment reports, e.g., GoK (2018), ADB (2019) & Gupta et al. (2022) - accounted the L&Ds tangible benefits provided by cultural heritage and environmental goods and services.
- Tangible L&Ds – loss of revenue, but unaccounted intangible L&Ds – existence and bequest value

- L&D to ecosystem services, Janzen et al. (2021) have reviewed 64 PDNAs
  - All the PDNAs have estimated the L&D to provisioning services, i.e., loss of agricultural crop whereas less than half of the PDNAs (27) recognised L&Ds to other services of ecosystems, i.e., regulating, supporting, cultural, etc.
  - The disaggregated level values were reported in 12 papers, and the economic values for regulating and cultural services are mentioned in only one paper (Janzen et al., 2021).
  - Among the studies calculated aggregated L&Ds to ecosystem services, around 4 papers consider more than one ecosystem services, and in fact, there is not a single study from India (Janzen et al., 2021).

- In the case of NELD, the major constraints are
- (i) conceptualizing, (ii) accounting and methods to monetize each L&D indicator, (iii) attribution, and (iv) context dependen (Fankhauser et al., 2014; Serdeczny et al., 2016).

- The most important challenge is the identification of all the NELD indicators.
- Accounting: no detailed records about the stock of non-economic goods and services - difficult to attribute ex-post NELDs

- Monetary terms - i.e., to price NELD indicators
- Bahinipati (2020): CV method to estimate NELD - more weight to immediate ELD - endowment effect and hyperbolic discounting
- Attributing L&Ds as a result of climatic or non-climatic stressor as another challenge - school dropout rates, migration, loss of identity and psychosocial stress
- For instance, scarcity of water in the cities is perceived to be due to poor land use practices, population increase and environmental degradation rather than climatic shocks (Singh et al., 2021).
- The value of particular biodiversity and livelihood are context dependent - will not value it in the same way - an issue to value L&D to biodiversity and the ecosystems.

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- Janzen et al. (2021):
  - (i) availability of information related value of ecosystem services, and initiating ecosystem inventories to have baseline information and track the changes over the years, and
  - (ii) facilitate collaboration for advancement in data accumulation related to ecosystem services
- There has been no study so far conducted by government agencies to assess NELD indicators such as a sense of place, identity, emotional attachment to ancestral property, dignity, etc.

Concluding Remarks

- The following major points have drawn

- *First*, L&D is being defined differently at the international and national levels – no official definition from UNFCCC even after nine years of setting up the WIM for L&D and ExCom under the WIM

- *Second*, the PDNA method: non-availability of baseline data for socio-economic indicators, ecosystem services and biodiversity (Janzen et al., 2021), methodology for sector-wise impact, accounting for actual and spillover effects

- *Third*, the estimations are provided for limited sectors like agriculture, fishing, and artisans, and many sectors are omitted such as industry, commerce, tourism, mining and others (Government of India, 2019b)

- *Fourth*, recovery assistance is allocated for damaged public buildings and private houses belong specific groups of households - the estimation figure missed the damage incurred to infrastructure owned by private people

- *Fifth*, it is always recommended to evaluate the impact on sectors in line with the sectors reported in the GSDP to avoid further ambiguity in the allocation of funds to return to normalcy and enhance the resilience capacity

- *Sixth*, lack of estimates for indirect impacts, and the impact on informal sector, MSME in particular

- *Seventh*, the major constraints – NELD - conceptualizing, accounting and methods to monetize each L&D indicator, attribution, context-dependence, etc. (Fankhauser et al., 2014; Serdeczny et al., 2016)

- *Eighth*, having no voting rights (migrant workers) in the city is the major constraint for the non-inclusion in L&Ds

- *Ninth*, the other NELD indicators which are not yet recognised in the post-disaster assessment reports and published papers are the sense of place, identity, emotional attachment with ancestral property, dignity, etc.

- From the policy perspective, this study urges for steps to be taken at the international and national levels.

- L&D information through the transparency framework to UNFCCC, but there is no compulsion to furnish NELD information (Johansson et al., 2022) - the supply of NELD information as part of the national communication to UNFCCC should be declared compulsory, and the WIM should encourage all the nations to include omitted ELD indicators and NELD indicators while furnishing L&D information under the transparency framework; this may push the nations to advance knowledge and estimation of NELD.

- Further, given the non-availability of a definition and method - an unbalanced and inaccurate representation of the true L&Ds

- At the national level, this study recommends framing national-level guidelines for both extreme events and slow-onset disasters, especially focusing on the recognition of ELD and NELD indicators, the definition for each indicator, and methods to be adopted to account for them.

- While designing definition and methods, the national policy makers should look into how it is being defined and calculated in both disaster and climate change discourses.

- Further, an effort should be made at the policy level to estimate L&Ds from several slow-onset disasters that are at present going unnoticed.

- Estimation of NELD warrants the availability of baseline data and values for ecosystem services, and thus, it is advocated to create ecosystem inventories to have baseline information and make available economic values for ecosystem services to both researchers and policymakers (see Janzen et al., 2021).

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A B S T R A C T

Estimations of losses and damages (L&Ds) from climate-related extreme events and slow-onset disasters have received significant attention in all the Conference of Parties (CoP) meetings in the last two decades, particularly after the CoP-13 held in Bali in 2007. Society incurs two types of L&D, i.e., economic and non-economic, and the latter is mostly found ignored in L&D assessment reports, because it cannot be estimated directly, either in pecuniary or non-pecuniary terms. While the financial part of L&Ds has taken centre stage in international negotiations, estimations of ex-ante and ex-post L&Ds could assist policymakers in assessing unavoided and unavoidable L&Ds, provide inputs to demand compensation, insurance, and risk management options, and facilitate further progression of L&D scholarship. Although the computation of L&Ds is imperative, a few estimations are available from developing nations, including India, because of a lack of clarity in the existing definition, methods and several limitations associated with estimating L&Ds. Hence, this paper points out methodological issues that emerged while assessing post-disaster L&Ds in India from extreme events and slow-onset disasters, particularly cyclonic storms, floods, and droughts. This study, on the one hand, provokes scholarly communities and policymakers to address these methodological gaps to further increase the number of L&D studies, and on the other, furnishes suggestions to redefine L&D and to improvise estimation methods, so that both economic and non-economic L&D indicators may be covered to a large extent.

1. Introduction

India frequently experiences both extreme events/sudden-onset and slow-onset disasters such as cyclonic storms, floods, droughts, sea-level rise, salinization, heat waves, cold waves, desertification, etc. and these episodes are affecting lives and livelihoods of people, infrastructure, ecosystems and biodiversity, cultural heritage, indigenous knowledge, etc. [3,10,13,39]. India ranked third, after China and the US, in terms of the highest number of natural disasters, including hydrological and meteorological disasters, over the past 20 years [57]. Three-fourths of states and union territories are prone to climate-related stressors, namely cyclonic storms, floods, and droughts [13]. Cyclonic storms and floods are, in particular, considered as two major disasters in terms of losses and damages (L&Ds) reported in pecuniary terms in India [3]. Droughts are also a vital challenge but, the documentation is sparse in terms of vari-

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