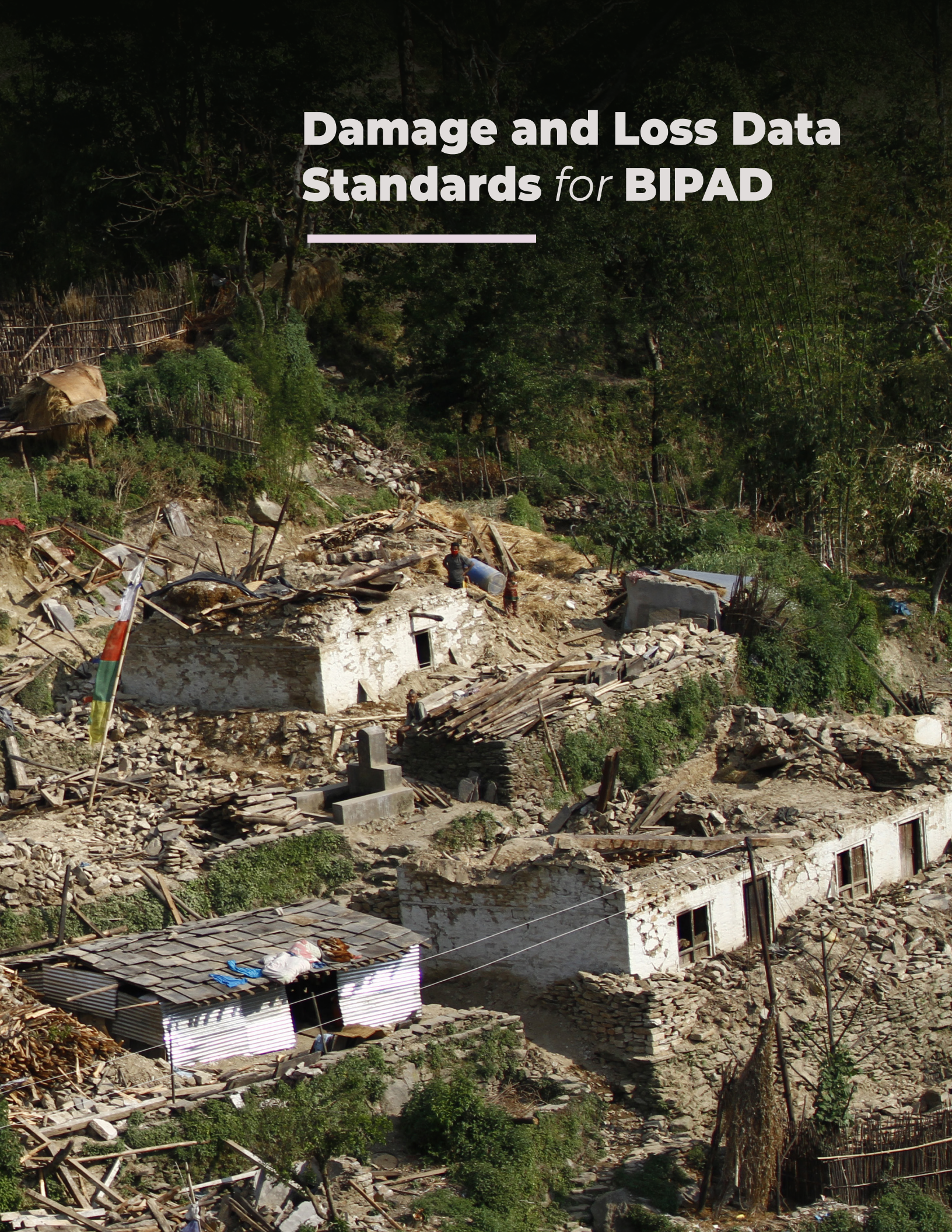
Damage and Loss Data Standards *for* BIPAD



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CONTENTS

FIGURES & TABLES

ACRONYMS

BIPAD	Building Information Platform Against Disasters
CBO	Community Based Organization
CRED	Centre for Research on the Epidemiology of Disasters
DAO	District Administration Office
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
DWIDP	Department of Water Induced Disaster Prevention
EM-DAT	Emergency Events Database
GAR	Global Assessment Report
GLOF	Glacier Lake Outburst Flood
NGO	Non-Government Organization
SFDRR	Sendai Framework for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
VDC	Village Development Committee

Executive Summary

Lack of clear standards and definitions is often considered as one of the major challenges in the compilation of reliable disaster loss data, as well as evidence-based disaster risk management and reduction. Sharing of information among different actors would be greatly facilitated by developing a common terminology and adopting standard measurement indicators, as well as interoperable assessment formats with a minimum set of standard indicators.

The aim of this document is to provide guidance on recording and aggregating damage and loss data pertaining to human and economic impacts of disaster events in the context of Nepal. The report provides an assessment of existing sources of data together with their associated methodologies and presents definitional guidance that can be applied in future for creating and maintaining damage and loss database.

The report provides a brief overview of some of the global damage and loss recording frameworks such as Desinvetar, EM-DAT and Natcat Service and the indicators used in these databases. For Nepal, and particularly in BIPAD context, only DesInventar could be used as a reference to the historical dataset given its wide spatial and temporal coverage as compared to other global databases. However, the Desinventar database does suffer from the lack of completeness and consistency.

The report provides an assessment of existing data sources that are currently available for immediate use and makes a comparative analysis on various indicators used. These data sources include Desinventar (1971-2011); DRR portal (2011-present) and Nepal Police incident reports. These data sources lack spatial and temporal comprehensiveness and consistency. However, in order to have a holistic understanding of disaster's damage and loss across Nepal all these data sources need to be properly standardized before making any analytical judgements.

The guiding principles for recording and maintaining loss and damage database are briefly discussed. There is a need for incorporating these principles while collecting the damage and loss figures after the disaster event. The report further proposes a conceptual framework for measuring the human and economic impact of disasters in line with international standards and national initiatives. It provides a definition for the proposed indicators that are language independent to be clearly understood by diverse stakeholders in disaster risk management sector irrespective of their roles and levels.

Gaps in BIPAD's Damage and Loss module are identified against the global frameworks and recommendations are made. The unique identifier for each disaster events, associated metadata and the provision for hazard classification are some of the components that can be readily incorporated in the module.

While the format developed by Nepal Police is comprehensive and is in line with global frameworks it has not been implemented to its full extent. The format itself is not intuitive for enumerators to understand its essence and record the damage and loss figures accurately. For this reason, there is an opportunity to develop an app that mirrors the methodology and indicators of Nepal Police format. This way, data could be recorded digitally with functionality to retroactively edit the figures as information may start to emerge several days after the event.

Currently, Nepal police and a few other government organizations seem to be involved in disaster loss assessment and subsequent data collection. More actors could be encouraged for these processes while ensuring consistency through standardized apps or assessment templates. It would, however, require substantial capacity building initiatives and investment in IT infrastructure.

To conclude, this report could act as a step further towards strengthening the systematic and standardized collection of information and data on the occurrence and impacts of disasters as an essential tool for governments and institutions in charge of relief and recovery activities, as well as for disaster risk management and reduction.

01

Introduction

Comprehensive assessment of disaster impacts can only be ascertained through the systematic collection and analysis of spatially, temporal and socially disaggregated disaster damage and loss data (Fakhruddin, et al., 2019). The need for a standardized approach to damage and loss data collection and recording is widely recognized (CRED, 2011; Wirtz et al., 2014; DeGroeve et al., 2013, 2014) as it helps in risk interpretation and provides valuable opportunities to acquire better information about the human, economic and environmental costs of disaster events and provide evidence-based information for disaster risk management policy, practise and financing.

Although the information on damage and loss is rapidly growing (Fakhruddin, et al., 2019) as a result of increased awareness and number of actors involved in disaster risk management, the disaster data landscape is generally complex due to the lack of standardized definitions and methodologies (Gall et al., 2009; Gall et al., 2011; Panwar and Sen, 2019). In an aftermath of a disaster, different organization collect extensive data on human, economic and environmental losses. However, the consistency and accuracy of data differ from one another. Therefore, a standardized approach to data collection is one of the keys to achieving considerably improved loss estimation, risk assessment and, ultimately cost benefits, for different hazards.

Standardizing and archiving disaster loss data in a comprehensive manner may be challenging when common terminologies for hazards, measurements methodologies, and damage and loss indicators do not exist, or the different agencies involved in collecting data do not share the common guidance and processes (IRDR, 2015). This leads towards the difficulty in comparing and analysing loss across different hazards, geographical locations, and time thereby hampering the assessment of the impact of the disasters from national to local levels.

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"An overview of the Targeting Report demonstrates that, by February 2019, 89 out of 195 nations had started reporting data, but most reports remain incomplete" (Fakhruddin, et al., 2019). This scenario demonstrates that member states, including Nepal have been facing obstacles in the reporting process, data standards and action must be taken in order to improve compliance and enable a reliable monitoring assessment by 2030.

The advantage of collecting data through a standardized approach, as well as in a standardized format is to foster effective data sharing. This is enhanced when common data collection protocols are used. Although data sharing is subject to various potential barriers and constraints — such as data ownership, data use provisions and acknowledgement of data sources — overall data sharing reduces data acquisition costs and time. Data quality in disaster databases can be improved by agreeing on working definitions of loss measures. This will also improve the interoperability of loss information between databases, especially those that rely on data providers for inputs. Furthermore, establishing measurement guidance or standards will inform the collection of loss information, which ultimately improves data accuracy and data quality. By harmonizing loss measures, integration of different databases becomes possible and new understanding of loss patterns can emerge. A common approach to loss accounting will facilitate data analyses across space, over time and by event, and enable comprehensive analyses on the burden of disasters.

At present, there are mainly three global loss databases. However, the international disaster loss databases have issues related to comparability and the lack of data in particular with the economic losses (UNISDR, 2015).

EM-DAT (MAINTAINED BY CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS (CRED) AND UCLOUVAIN,): EM-DAT is a global database at national resolution with public access. The EM-DAT uses United Nations and United States' government agencies, research and intergovernmentalorganizations as their source of data and does not take into account the information available on local newspapers, national police and public health records. Therefore, many events are missed and in particular reference to Nepal, only 202 events are recorded from 1954 to 2020. The database is accessible with the following link https://public.emdat.be/ and includes the following indicators.

Killed, missing, injured, homeless, affected, economic losses (direct/indirect), aid contribution, and composite indicators

- **Total affected:** Sum of injured, homeless and affected
- **Victims:** Sum of killed and total affected

DESINVENTAR: DesInventar is a national based accounting system. However, given its implementation in a large number of countries, it is becoming rapidly a global dataset and is used for example in the Global Assessment Report (GAR) on Disaster Risk Reduction. Moreover, DesInventar has largely been the underlying source of data for the Sendai Framework for Disaster Risk Reduction (SFDRR) process and monitoring. At the country level, there exist more than 55 databases (IRDR, 2014), with a large majority utilizing the DesInventar database model, although they have major differences in data quality, temporal coverage, loss indicators, and update frequency. The database is accessible with the following link. https://www.desinventar.net/ and includes the following indicators.

Deaths, missing, injured, victims, affected population (directly/indirectly), relocated, evacuated, houses destroyed, houses damaged, losses ($USD), losses ($Local), education centers, hospitals damages at crops in hectare, lost cattle and damages of roads in meters.

NATCATSERVICE: (MAINTAINED BY MUNICH REINSURANCE COMPANY): NatCatSERVICE is a global database at national resolution with no public access. This database predominantly reports insured losses or losses that probably are reported because the insurers indemnified part of the monetary and quantifiable insured losses. It is not publicly accessible and includes the following indicators.

Killed, missing, injured, displaced, evacuated, economic losses (direct/indirect), insured losses (divided by sectors), lines of business affected (business interruption, industry, supply industry, commercial sector, construction sites, agriculture, aquaculture, livestock, forestry marine, onshore, offshore), infrastructure/lifeline (roads, railways, bridges, water supply, irrigation, sewage, food supply, food supply, electricity, communication, transport), environmental damage, housing (damaged/destroyed), health centers, public buildings, boats and cars.

The various dimensions of loss data will be discussed further on. For comparing or combining data from multiple sources, it is important to have standard terminology and definitions as well as a good understanding of which dimensions are considered in a methodology or a database.

1.1 BIPAD'S DAMAGE AND LOSS MODULE ARCHITECTURE: Building Information Platform Against Disaster (BIPAD) is an integrated and comprehensive Disaster Information Management System created in line with the DRRM act endorsed by Parliament of Nepal in September 2017. BIPAD is built upon the concept of creating a national portal incorporating data and information from multiple sources including but not limited to government bodies, non-governmental organizations, academic institutions and research organizations. It is comprised of six core modules; Dashboard, Incidents, Damage and Loss, Real time info, Profile and RiskInfo. The data and information contained in these modules have a potential to create an evidence base in all stage of the disaster cycle; mitigation, preparedness, response and recovery. National and subnational governments can make use of the data and information for policy making, resource allocation and introducing effective disaster risk management plans and actions. The scope of BIPAD, however, is not limited to the governments but expands to other actors of DRM landscape such as multinational and bilateral development partners, international and national NGOs, research organizations and civil societies at large. The damage and loss module acts as an inventory of all recorded disaster events and the associated damages and losses.

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1.1.1 EXISTING DATA SOURCES: DESINVENTAR: Data on damage and loss for Nepal can be downloaded freely from DesInventar (https://www.DesInventar.net/DesInventar/profiletab.jsp?countrycode=npl&continue=y) which hosts the data from 1971 to 2013. The database includes: event, region, district, village, date, cause, description of cause, source, magnitude, deaths, injured, missing, houses destroyed, houses damaged, victims, affected, relocated, evacuated, losses ($USD), losses (NRS), damages at crops in hectare, lost cattle and damages of roads (Mts). The data is mostly collected from newspapers, the Department of Water Induced Disaster Prevention (DWIDP), and special bulletins. The DesInventar largely covers earthquake, floods, landslides, drought, and epidemics events, and at all scales of disaster impact. (GoN, 2017).

DRR PORTAL: The DRR portal managed by National Emergency Operation Centre at Ministry of Home Affairs is hosting disaster damage and loss data from 2011 onwards. A full set of damage and loss indicators are not usually reported, and it is officially named as incident report database. The database includes:

1. **Geographical information:** District, VDC (data missing in earlier years), Ward Number (available only after 2015)
2. **Temporal information:** Incident date
3. **Incident related information:** Incident type
4. **Human loss indicators:** Death (people), missing (people), affected population (households), displaced population
5. **Economic loss indicators:** Total economic loss
6. **Damage indicators:** Government houses fully/partially damaged, private houses fully/partially damaged, displaced population, displaced families

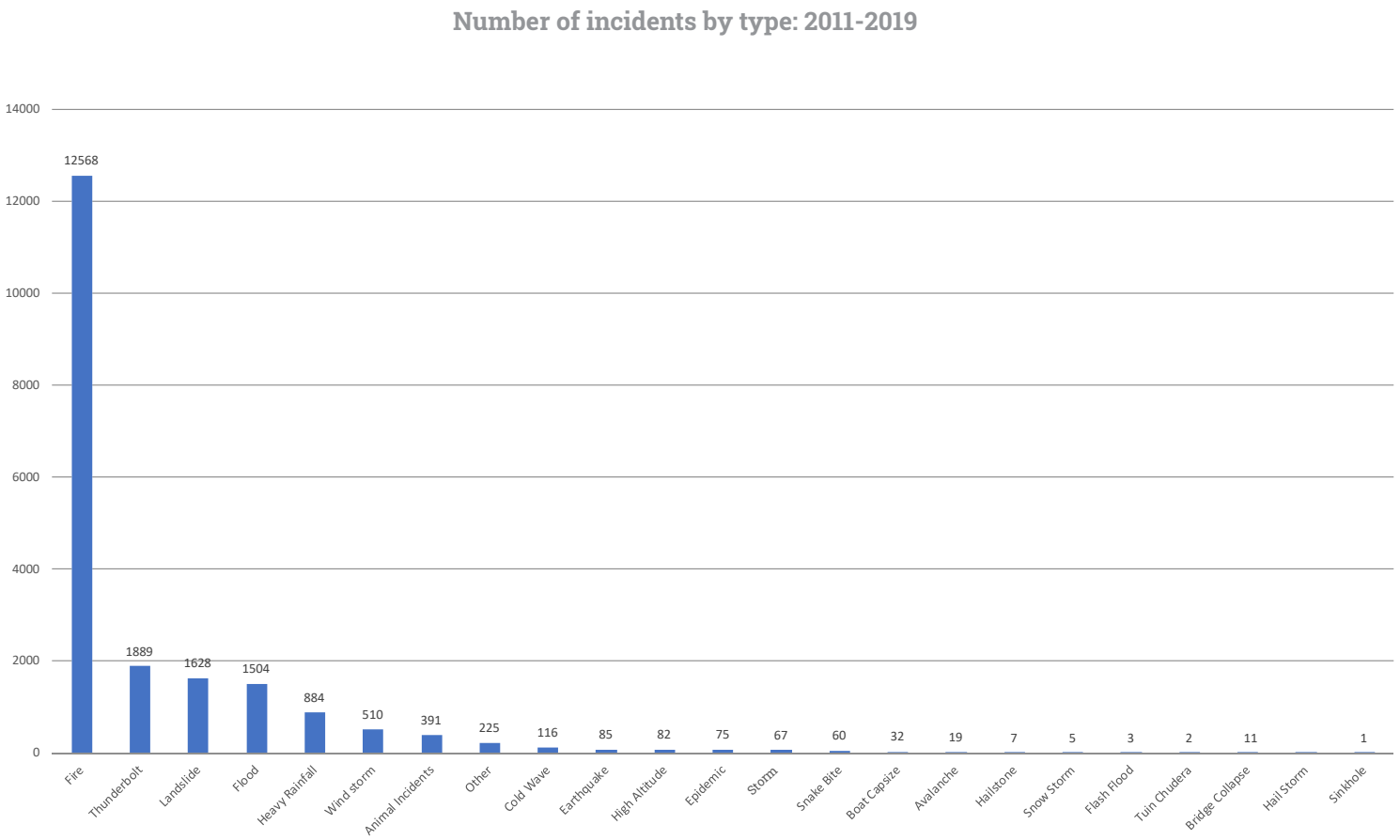


Figure 1: Number of incidents between 2011 and 2019 by type

Between 2011 and 2019, a total of 20,162 incidents were recorded in DRR Portal and 62% of the incidents were fire related. Figure 1 shows the comparison of different incident types in terms of their occurrence between 2011 and 2019 from the data available at DRR portal. Overall, there exist data gaps in this database. There are gaps regarding: a) temporal coverage with missing years and/or months; b) spatial coverage with missing reports from some districts, VDC, etc.; c) loss estimation with no losses reported for some events; and d) loss indicators with inconsistent completeness across events. Moreover, spatial data transformation is required as Nepal adopted a new administrative structure in the period which makes comparison misleading across different administrative units. Sectoral economic losses, which are mostly relevant in large scale disasters are not captured in this database.

NEPAL POLICE INCIDENT REPORTING SYSTEM: Nepal police has developed a data collection format (https://bit.ly/2QznJYt) for incident reporting, which is comprehensive and includes most of the indicators recommended in global damage and loss recording frameworks. However, there seems to exist a major gap in its effective implementation. While human loss indicators are generally well captured, the economic loss indicators are largely left neglected and it is unclear how the total estimated economic loss per event is calculated.

There is a need for data transformation from DesInventar and DRR portal model to existing data model developed by Nepal police. While the past datasets cannot be manipulated further, it can be transformed in a way the common indicators across different timescales are migrated to the new database as per the Nepal Police data model. Going forward, implementation of the current incident recording system should be reinforced for more precise, comprehensive and comparable damage and loss data recording.

The following table shows the comparative analysis of different damage and loss indicators available/ proposed in three different data sources.

	Indicators	Unit of measurement	DesInventar	DRR Portal	Remarks	Nepal Police *(not implemented in full scale)*
Human Loss Indicators	Injured	number of persons	✔	✔		✔
	Injured	number of persons	✔	✔		✔
	Indirectly Affected	number of persons	✔	✘		✘
	Directly affected	number of persons	✔	✔	expressed in terms of families	✔
	Missing	number of persons	✔	✔		✔
Damage Indicators	Houses damaged	total number	✔	✔	disaggregated into private and government houses	✔
	Houses destroyed	total number	✔	✔	disaggregated into private and government houses	✔
	Education centres	total number	✔	✘		✔
	Hospitals	total number	✔	✘		✔
	Damages in crops Ha.	total area in Ha	✔	✘		✔
	Lost Cattle	total number	✔	✔	✔	✔ (livestock)
	Damages in roads Mts	length in meters	✔	✘		✔
Secondary Human Indicators	Relocated	total number	✔	✔	expressed in terms of displaced population	✔
	Evacuated	total number	✔	✘		✔
Economic Loss Indicators	Total estimated Losses $USD	monetary value	✔	✘		✘
	Total estimated Losses $Local	monetary value	✔	✔		✔
Sector based economic loss indicators	House	monetary value	✘	✘		✔
	Land	monetary value	✘	✘		✔
	Health	monetary value	✘	✘		✔
	Education	monetary value	✘	✘		✔
	Industry	monetary value	✘	✘		✔
	Road	monetary value	✘	✘		✔
	Bridge	monetary value	✘	✘		✔
	Electricity	monetary value	✘	✘		✔
	Telecommunication	monetary value	✘	✘		✔
	Water Supply	monetary value	✘	✘		✔
	Irrigation	monetary value	✘	✘		✔
	Drainage	monetary value	✘	✘		✔
	Tourism	monetary value	✘	✘		✔

Table 1: Comparative analysis of indicators across three data sources

1.2 GUIDING PRINCIPLES FOR DAMAGE AND LOSS DATA:

Systematically collected, robust and comparable damage and loss data are an essential element of disaster risk assessment and management process. The damage and loss recording system and the associated indicators thus should incorporate the following principles which are originally proposed by (De Groeve et al., 2014). These principles are widely endorsed in globally recommended guidelines such as EU Loss and Damage Recording guidelines, IRDR guidelines on recording losses from disaster among others.

PRECISE: All indicators and terminologies must be clearly and unambiguously defined and should have mutually exclusive definitions that are consistently applied. In order to embed this principle in BIPAD, all the indicators for damage and loss are clearly defined in the report. The indicator's definition provided in this report can be changed and adapted to align with other national initiatives and legislation and may require an endorsement through wider stakeholder consultations.

COMPREHENSIVE: Damage and loss indicators should cover all damage/loss in terms of sectoral, spatial and loss ownership coverage (who bears the loss) in order to be an accurate and objective reflection of the extent of the disaster. The existing data sources in BIPAD's damage and loss module does not provide the comprehensive overview of damage and losses in terms of sectorial and ownership coverage because of multiple data sources across different time frames, differences in methodologies adopted and technological barriers. However, the data model developed by Nepal police is mostly comprehensive and going forward strong emphasis must be given in its effective implementation.

COMPARABLE: Damage and loss data are linked with particular hazard event and therefore accompanied with a unique event identifier number. Damage and loss figures should be comparable among the event of the same hazard types as well among the events of different hazard types, across different administrative units and across sectors. Event identifier number is something that can be assigned even at the later stage in the database. Indicators such as human loss and total economic loss are currently comparable across time and administrative units in BIPAD to some extent, but sectoral comparison is still not feasible because of data incompleteness.

TRANSPARENT: Damage and loss values should be geo-referenced, accompanied with temporal information, verified by relevant local or provincial authorities and should include an assessment of degree (uncertainty generally expressed in terms of numerical value). For BIPAD to be more transparent in terms of recorded damage and loss values all the attributes; geocoordinates (where applicable), timestamp and a degree of uncertainty should be recorded for each event. The data format developed by Nepal Police does not offer these possibilities, however, it is recommended that some adjustments are made in the format such that these attributes are recorded in future.

Furthermore, damage and loss database should incorporate following fundamental characteristics

- should be compliant with similar global and local directives and initiatives;
- should have the ability to collect and aggregate data to report to the Sendai Framework and UNFCCC
- contribute to the preparation of the national disaster reports, national level risk, vulnerability and capacity assessment;
- contribute to monitor the national level SDG targets and initiative;

1.3 COMMON QUESTIONS THAT CAN BE ANSWERED USING DAMAGE AND LOSS DATA:

What are the key hazards responsible for generating human and economic losses? Figure 2 and 3 are generated for illustrative purposes using data available at DRR portal between 2011 and 2019. It seems like economic loss resulting from Gorkha earthquake 2015 is not recorded in the database as a result earthquake doesn't appear in key hazard list for generating economic losses. This is slightly misleading information arose due to the lack of comprehensive data.

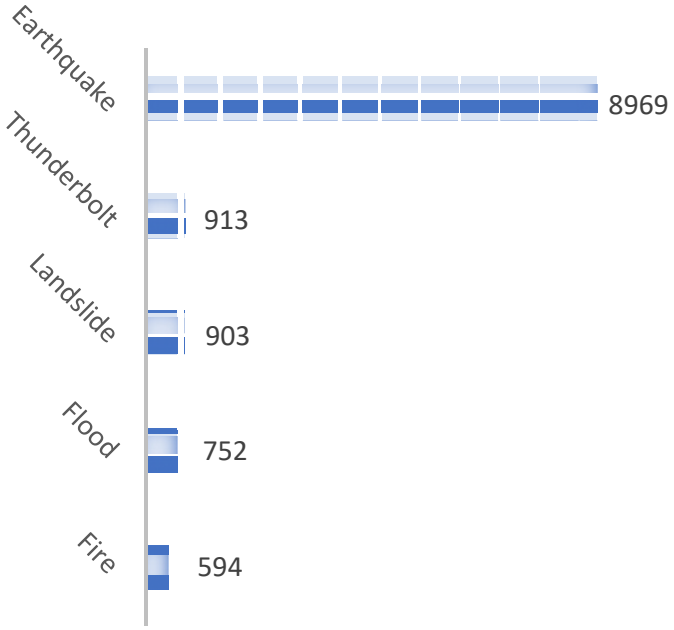


Figure 2: Key hazards generating human losses

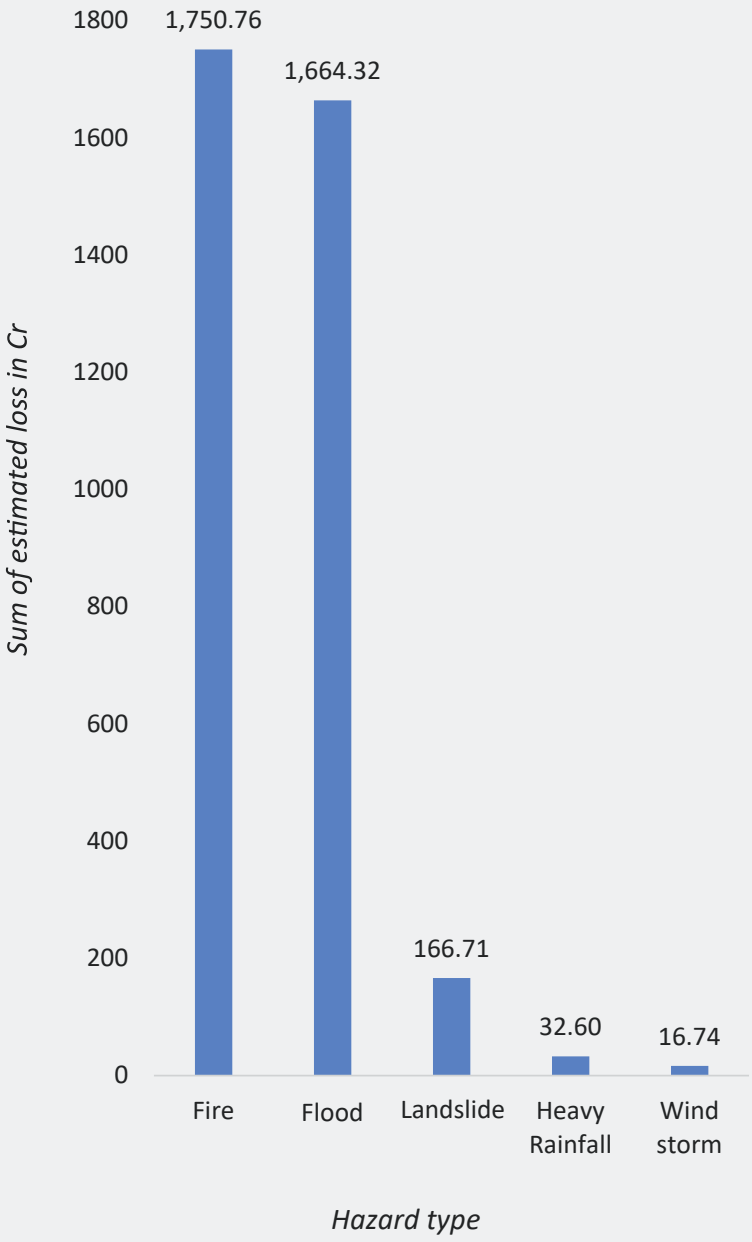


Figure 3: Key hazards generating economic losses

What assets are being damaged from these specific hazards? Due to the lack of sectoral data on assets; except private and government building - this analysis is currently not feasible in BIPAD. However, effective implementation of data collection format developed by Nepal Police will allow this analysis in future.

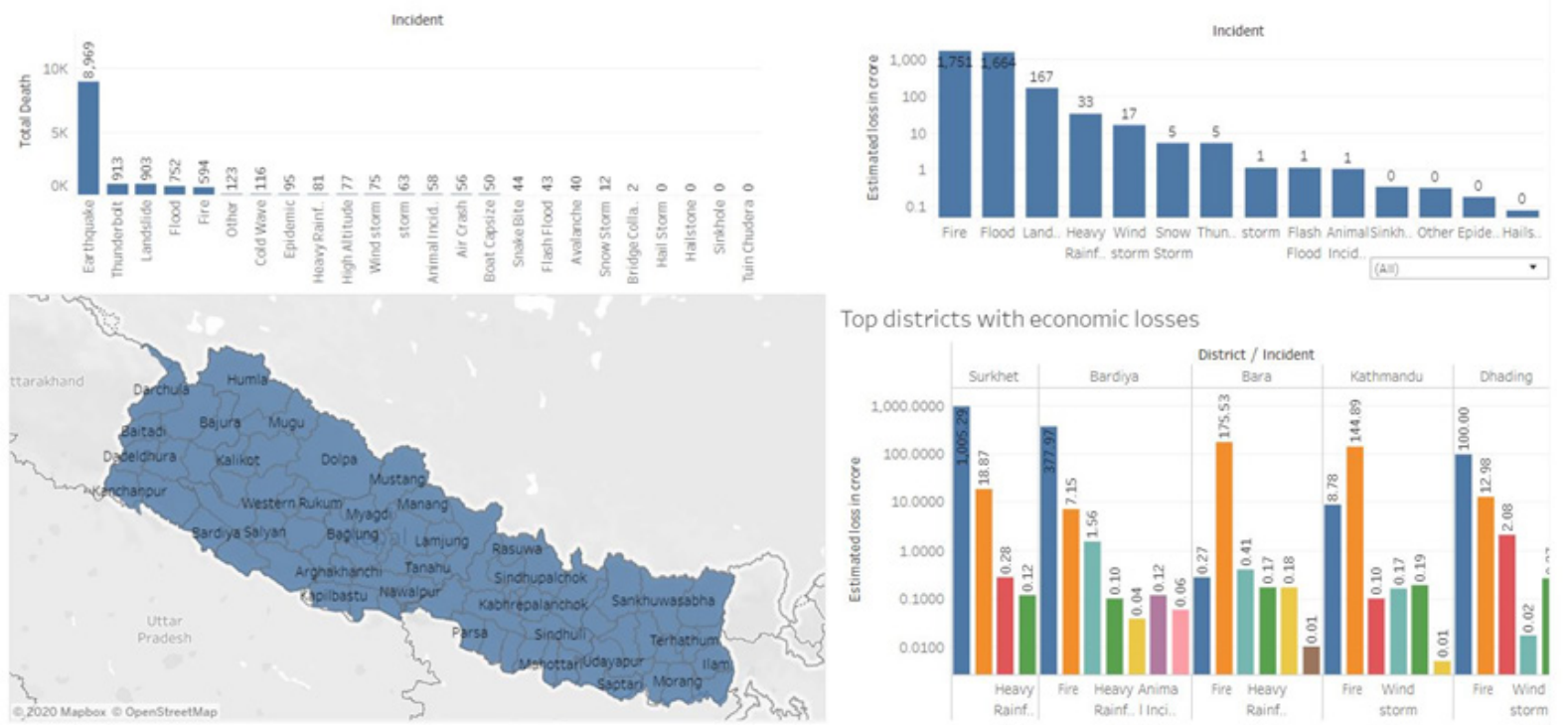
Where are losses occurring spatially? District level analysis of spatially disaggregated loss data is currently feasible. The proposed data visualization for damage and loss module contains the visualization where the users can analyse the spatial distribution of estimated economic losses.

What are the trends of disaster damage in the particular sector (for example Agriculture)? Lack of sectoral economic losses in the database will prevent this analysis.

Which district has the highest exposure for particular hazard event? The available data from DesInventar and DRR portal will only allow district level disaggregated data on human and economic losses. Thus, the exposure will only be dependent on the basis of past records and not on other factors such as vulnerability and socio-economy.

In order to objectively answer these questions BIPAD could make use of appropriate data visualizations techniques where users can sort, filter and compare damage and loss data geographically, temporally and sectorally. The existing damage and loss module in BIPAD already offer some of these capabilities but there are opportunities to make the visualization more intuitive. A visualization framework is proposed for BIPAD damage and loss module which can be accessed from the link (https://tabsoft.co/2FZesa8).

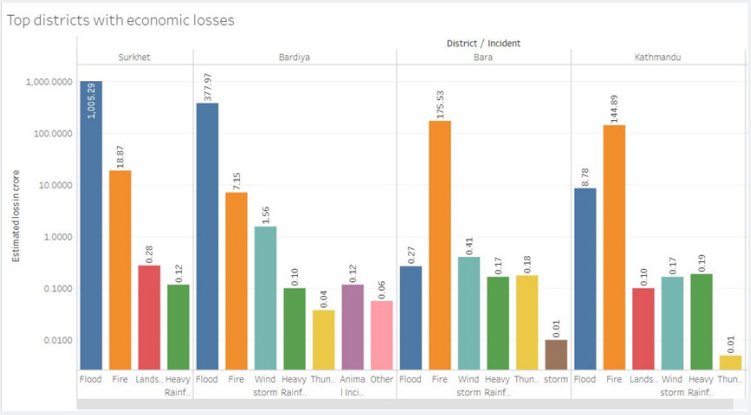
The examples of some visualizations are shown in next page.

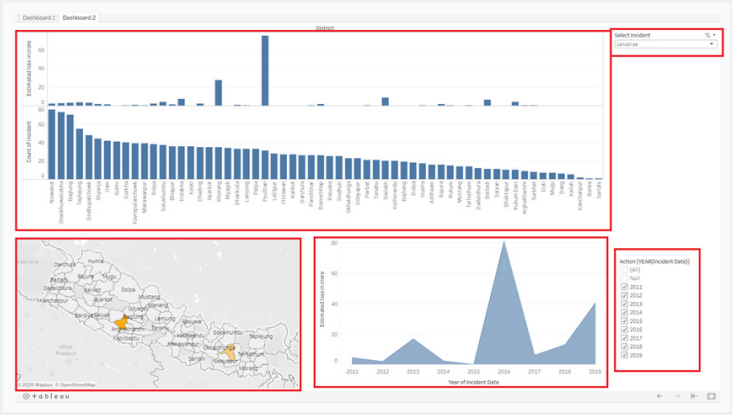


For illustration purpose, possible visualizations are recommended for BIPAD's damage and loss module. The map on the interface allows the selection of geographical units at different levels and associated visuals a. on total deaths and b. estimated losses are reflected based on geographical units selected by the user.

This allows user to see the damage and loss patterns from all hazards or individual hazard across different spatial units throughout the country.

The visual on lower right contains top districts with highest recorded economic losses. The data is further disaggregated into different hazards contributing to economic losses.





In the above interface, the visual on the interface allows user to disaggregate loss and damage spatially through map and temporally through date table. Furthermore, user can also see the metrics and visulas associated with particual hazard or hazard group by selcting the hazard from an exhastive list.

02

Conceptual framework for damage and loss data standards

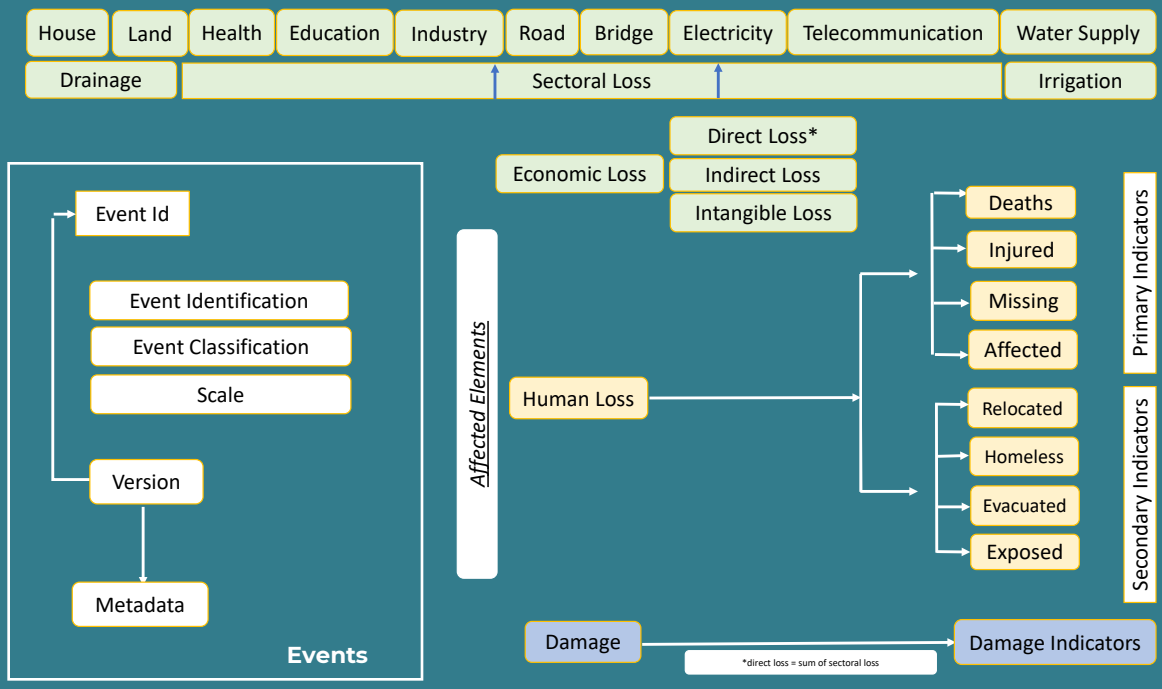


Figure 4: Conceptual framework for damage and loss data standards

Figure 4 shows a conceptual framework for the BIPAD's damage and loss module. It indicates the logical structure of a database. Most of the indicators are aligned with the existing Nepal Police incident reporting format. It starts from a disaster event identified with unique event identifier code. It can be assumed that there may be multiple versions of loss records associated to the event, e.g. through updates and corrections (where data becomes available), temporal versions to capture event dynamics (evolution of losses) or estimates of different organizations. For each version, damage and loss indicators can be recorded after the occurrence of a disaster as well as metadata and quality assurance information. Metadata contains information such as entry date, author, validation status and information on the methodologies used for assessing the damage and estimating the human and economic losses. The affected element may correspond to a house, a municipality, a district, a province or a country, etc. recording agency can record damage and loss data at given scale and the aggregate at coarser scales (e.g. the municipality level may be obtained by aggregating losses recorded at asset level).

2.1 DISASTER EVENT

Disaster events are generally considered as the main piece of information in damage and loss database. Every indicator revolves around the event and whole database is based on it. In the damage and loss database schema, the main element (disaster event) table would have the following information, common to all hazards:

- (Identification Data) event ID – currently not incorporated in BIPAD.
- Start date - Currently single date value is recorded per event, but for some hazards it is good to have the start and end date in order to deduce the duration of occurrence.
- Duration/end date
- Type of event- currently incorporated in BIPAD; select the disaster type from the pre-existing list of hazards.
- Event classification-currently not incorporated in BIPAD; classify the hazards based on hazard classification proposed in table 2.
- Update date- currently incorporated in BIPAD.
- Specific names codes of district, palika and wards along with the standard names (compatible with CBS codes if any)- Currently incorporated in BIPAD but is subject to spelling errors for which the validation is required at the later stage.
- Degree of uncertainty (1-5) – currently not incorporated in BIPAD.
- Methodology – optional

2.2 HAZARD CLASSIFICATION: To improve the comparability of existing loss databases, event classifications must be standardized (IRDR, 2014). A consistent hazard classification will allow data users to compare losses from different hazard groups.

Hazards are categorized into six groups as per IRDR peril classification (IRDR, 2014).

GEOPHYSICAL: A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.

HYDROLOGICAL: A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater.

METEOROLOGICAL: A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.

CLIMATOLOGICAL: A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.

BIOLOGICAL: A hazard caused by the exposure to living organisms and/or their toxic substances (e.g. venom, mold) or vector-borne diseases that they may carry. Examples are venomous wildlife and insects, poisonous plants, algae blooms, and mosquitoes carrying disease-causing agents such as parasites, bacteria, or viruses (e.g., malaria).

OTHER: Other non-natural hazards leading to human and economic losses.

Hazard Group	Hazards
Geophysical	Earthquake, Mass movement/Landslide (earthquake induced), Liquefaction, Debris/Mud Flow/Rockfall
Hydrological	Flood, Avalanche, Landslide
Meteorological	Extreme Temperature, Extreme Rainfall, Lightening/Thunderbolt, Cold Waves, Heat Waves, Windstorms/Blizzard, Fog, Hailstorm, Snowstorm
Climatological	Drought, Glacial Lake Outburst, Wildfire Forest Fire, Avalanche, High Altitude
Biological	Animal Incident, Animal Flu, Epidemic, Pandemic, Insect Infection
Others	Aircraft Accident, Fire, Industrial disaster, Mine disaster, Road Accident, Helicopter Crash, Water Incidents, Boat Capsize, Terrorism, Deforestation, Response Accident, Leakage (chemical), Leakage (radiation), Leakage (toxic gas)

Table 2: Hazard classification for BIPAD damage and loss module

2.3 HUMAN LOSS INDICATORS:

2.3.1 DEATH: Definition-"Corresponds to the number of people who lost their life because of the occurrence of certain type of hazard."

- To maintain the consistency and avoid ambiguity, the related terms such as 'killed,' 'victims' and 'fatalities' are preferably not used.
- The number of deaths (mortality) registered in a disaster loss database should be continuously monitored after the event and the latest figure should kept. The number should always be disaggregated by gender, age and geographical location.
- The figures for the number of deaths and the number of missing are mutually exclusive. The number of deaths should not include missing persons.
- While recording the death numbers an extra field for comment can be established. A comment field is useful to enter detailed information on the reported causes of death.

Secondary and tertiary death indicators

Number of deaths can be subdivided to include secondary information such as direct or indirect immediate deaths.

Direct deaths are persons who died as a direct result of a disaster (e.g., crushed by a building during an earthquake, or drowned in a flood).

Indirect immediate deaths include persons who died of other causes (within days, weeks to months depending on the hazard) that were the result of the disaster occurring such as heart attacks from earthquake, or traffic accidents during flood evacuations. Data sources used by global disaster loss databases often report the direct deaths and the indirect immediate deaths, but this is highly variable among the databases.

Indirect delayed deaths are caused by longer-term effects of a disaster and are only visible and measurable well after the disaster happened (years to decades) such as psychological stress. Indirect delayed deaths are not included in the registered number of deaths.

2.3.2 INJURED: Definition- "People suffering from physical injuries, trauma, or an illness requiring immediate medical treatment as a direct consequence of the disaster event." This figure does not include victims who die.

- The number of injured (morbidity) includes people who got sick and sought medical attention after the disaster event.
- For epidemics, people who need medical treatment are called cases or incidences, but for database consistency purposes they are classified as injured.
- The inclusion of the severity or degree of an injury can be optional for a database.

2.3.3 MISSING: Definition: "Corresponds to the number of people whose whereabouts since the disaster are unknown, and presumed dead based on official figures although there is no physical evidence."

- The number of missing people may not be applicable to all hazards for example extreme temperatures, fog, droughts and epidemics.
- The data on number of deaths and number of missing are mutually exclusive and should not be mixed. Clear description should be provided in the source reporting in order to know the difference between missing and actual recorded deaths.
- There should be a time limit for the period that the person is missing. For example, a person is presumed dead after being missing for a specified period. However, this is not usually taken into account in the registration of missing in a disaster loss database.
- Rather than the absolute figure, which is usually difficult to acquire, the number of missing people may be considered as a rough estimate or indication of the likely number.
- This indicator is important in guiding search and rescue operations after disasters.

2.3.4 AFFECTED POPULATION: Directly affected people are a subset of exposed people (people living in the affected area that are thereby subject to potential losses) that suffered because of impacts on their livelihood: Agriculture, businesses, and income immediately after the disaster (De Groeve et al., 2014). The number of affected population and the associated indicators are included in the data format of Nepal Police which are summarized below.

Indicators			Number of family affected	Amount value
Agriculture	Farming			
	Livestock	Cow		
		Buffalo		
		Yak		
		Sheep		
		Goat		
		Pig		
		Chicken		
		Duck		
		Others		
		Cash crops		
		Staple foods		
Business	Small			
	Medium			
	Large			
Salary	Monthly			

Table 3: Framework for calculating affected population information

2.3.5 EXPOSED: Definition: "Number of people who permanently or temporarily reside in the hazard area before or during the event."

- The most common method to determine the number of exposed populations is to account the number of administrative units such as wards, palikas and districts. This method should be followed if the exposed area cannot be spatially delineated through geospatial analyses. For most accurate estimation it can be determined geographically by delineating the potential hazard area (such as flood zone, or a GLOF Zone) and then use population data to ascertain the number of people in that area.
- The number of people exposed is often considered as a critical indicator, as it determines what percentage of the total population of the particular administrative units is at risk. It is also useful in determining the human impacts, e.g. number of deaths per exposed population rather than number of deaths per capita.

Secondary and tertiary death indicators

These additional indicators correspond to the three different stages of the disaster cycle: before and during a disaster (evacuated); immediate aftermath of a disaster (homeless); and at the recovery and reconstruction stage (displaced). The indicator affected is often reported and is widely used by different actors to convey the extent, impact, or severity of a disaster in non-spatial terms. The ambiguity in the definitions and the different criteria and methods of estimation produce vastly different numbers, which are rarely comparable. For this reason, affected population is no longer recommended for inclusion as a primary indicator, but is used as a secondary indicator to further characterize the exposed population.

It is important to note that 'evacuated,' 'homeless' and 'relocated' are not mutually exclusive, and they may involve double counting. For example, some of the evacuees may become homeless later (after the initial return to their houses), and some of the homeless may be relocated (some may rebuild in the same place or return after a period of time).

2.3.6 HOMELESS: Definition: "Number of people whose house is destroyed or heavily damaged and therefore need shelter after an event."

- The number of homeless should be reported as the number of individuals. Data sources may only report the number of families, and the size of families varies. The most appropriate procedure is to convert all figures into individuals by multiplying the number of families by the average family size of the affected area.
- Homeless populations can be further described with tertiary indicators such as gender, age, or location (street, neighbourhood, village, informal settlement, etc.).

2.3.7 EVACUATED: Definition: "People who mobilise or are mobilised as a precautionary measure before, during and after the event."

- This indicator relates to the period before, during and after a disaster, including the initial recovery phase.
- Evacuated populations can be further described based on the type of sheltering needs (optional), how many people are in public shelters, in private shelters or private accommodations, and those with no shelter.

2.3.8 RELOCATED: Definition: "People who have been moved permanently from their homes to new sites."

- This indicator is linked to the reconstruction phase, and not to the immediate aftermath of a disaster.
- The indicator can be further divided into temporary and permanent - those who require permanent relocation or short-term relocation until the reconstruction of their house is completed.

2.4 DAMAGE INDICATORS: Damage indicators represent the aggregated summary of damages. They correspond to the total or partial destruction of physical assets existing in the affected area. The intention of these indicators is twofold.

- To provide the agreed and minimum set of indicators summarized and aggregated at spatial units such as palika, districts and provinces (above asset level). If the data is not collected at asset level, these indicators will help to estimate and validate loss assessment and are useful in risk assessment processes.

- to ensure the minimum degree of computability with the global targets for disaster risk reduction set in sendai framework for disaster risk reduction and with the United Nations loss data collection initiative, based on DesInventar V10.0 (2015)

The minimum fields for damage indicators, based on Sendai global targets and the recommended measurement units are the following:

Houses destroyed: The number of household units damaged or collapsed to the extent that they are no longer habitable/ repairable.

Houses damaged: The number of household units with minor damage, not structural or architectural, which may continue being lived in, although they may require some repair or cleaning.

Education centres: The amount of pre-primary, primary, high School, college, university, training centres etc., destroyed or directly damaged by the disaster event.

Health facilities: The number of health centres, clinics, local and regional hospitals destroyed and directly or indirectly affected (damaged or destroyed) by the disaster event.

Additional aggregated damaged indicators could be considered based on DesInventar model.

Crops: Expressed in square meters, total cultivable land destroyed or affected by the disaster event

Livestock: Number of four legged animals lost

Government building: Number of administrative and government buildings damaged or destroyed by the disaster event

Industrial facilities: Number of industrial and manufacturing facilities damaged or destroyed by the disaster event

Commercial facilities: Number of individual commercial facilities (including stores, warehouses) damaged or destroyed

Transportation: Expressed in length in kilometres of damaged roads; number of bridges and airports

2.5 ECONOMIC LOSS INDICATORS: Economic losses are more difficult to define than human losses. The economic loss represents negative impact of disaster through market based monetary value. Economic losses are mostly best estimates and rarely an exact figure. The estimates vary with loss estimation methods, which depend on availability, completeness of existing data. This consists of direct, indirect and intangible losses.

Economic losses are mostly best estimates and rarely an exact figure. The estimates vary with loss estimation methods, which depend on availability, completeness of existing data.

2.5.1 DIRECT ECONOMIC LOSS: Direct loss is the monetary value of physical damage to capital and tangible wealth assets. Direct losses are concrete, comparable, countable, verifiable and easier to measure than indirect losses. Direct loss can be categorized into different sectors. Sector based economic losses are mostly relevant in case of large-scale events.

- Data on economic losses should be event based (i.e. data must be related to the specific event);
- Generally, direct losses need to be reported as a minimum requirement and is the sum of sectoral economic loss. To determine the overall amount of disaster impacts, economic losses for all affected sectors must be included, avoiding possible gaps or double accounting;
- For loss data-sharing purposes, only the sum of direct losses over all sectors is needed;
- For loss data recording, national currency is recommended. Global databases tend to convert local currencies into U.S. dollars for comparability purposes.
- It is recommended to record not only the results of economic loss assessments, but also the way the estimates have been produced, including well-documented method/ model, auxiliary data used, and assumptions made in the assessment in the form of metadata.

Direct losses are concrete, comparable, countable, verifiable and easier to measure than indirect losses. Direct loss can be categorized into different sectors. Sector based economic losses are mostly relevant in case of large-scale events.

Table below is adapted to align with the existing data format from Nepal Police.

Sectors	Classification	Unit of measurement	Disaggregation
House	Dhungako Garho Itako Garho Wooden House Thatched House RCC	Number of destroyed houses Number of damaged houses Total monetary value	Number of storey Damage levels (destroyed/damaged)
Land	Barren Crop Forest	Total area lost Total monetary value	Type of crop
Health	National Provincial Local Hospital Health Post Sub-health Post	Total number of destroyed health centers Total number of damaged health centers Total number of health centers with service disruption Total coverage population Total monetary value (includes equipment and building value)	Ownership: Public, private and both Damage levels (destroyed/damaged)
Education	Preprimary Primary High School College University	Total number of destroyed education facilities Total number of damaged education facilities Total number of education facilities with service disruption Total coverage population Total monetary value (includes equipment and building value)	
Industry	Cottage Micro Small: 1 to 5 lakhs (needs to be conPrmed) Medium: 5 to 25 lakhs Large: 25 lakh and more	Total monetary value	Ownership: Public, private and both Damage levels (destroyed/damaged)
Road	Earthen Gravel Black topped	Total length destroyed Total length damaged Total monetary value	Damage levels (destroyed/damaged)
Bridge	Wooden Bridge Suspension Bridge Culvert Belly Bridge Permanent Bridge	Number of destroyed bridges Number of damaged bridges Total monetary value	Damage levels (destroyed/damaged)
Electricity	Powerhouse Substation Dam Transmission Grid	Number/Length of destroyed infrastructure Number/Length of damaged infrastructure Number of beneficiaries (or households) affected because of service disruption Total monetary value	Damage levels (destroyed/damaged)
Telecom-munica-tion	Telecom station Optical Fiber	Number/Length of destroyed infrastructure Number/Length of damaged infrastructure Number of beneficiaries (or households) affected because of service disruption Total monetary value	Damage levels (destroyed/damaged)
Water supply	Storage Tank Treatment Plant Pipeline	Number/Length of destroyed infrastructure Number/Length of damaged infrastructure Number of beneficiaries (or households) affected because of service disruption Total monetary value	Damage levels (destroyed/damaged)
Drainage	Treatment plant Storage plant Drainage pipeline	Number/Length of destroyed infrastructure Number/Length of damaged infrastructure Number of beneficiaries (or households) affected because of service disruption Total monetary value	Damage levels (destroyed/damaged)
Irrigation	Dam Canal	Number/Length of destroyed infrastructure Number/Length of damaged infrastructure Number of beneficiaries (or households) affected because of service disruption Total monetary value	Damage levels (destroyed/damaged)

Table 4: Sectoral economic loss indicators

2.5.2 INDIRECT ECONOMIC LOSS: Indirect economic loss refers to damages to the flow of goods and services. It includes lower output from damaged or destroyed assets and infrastructure and loss of earnings due to damage to transport infrastructure, including business interruption. Some of the most common examples for indirect economic losses are given below.

- Price increases
- Increase in unemployment
- Decline of GDP
- Increase in government debt
- Business interruption

2.5.3 INTANGIBLE LOSS: Costs that accrue to assets without an obvious market price (difficult to depict in monetary terms) (cultural heritage, reputational risk).

- Environmental losses
- Heritage losses
- Loss of reputation
- Psychological stress

03

Degree of Uncertainty

The database for damage and loss should be evidence based and transparent as far as possible. Damage and loss data are subject to various errors while collecting, processing and disseminating. For data sharing, it is recommended to include information regarding the reliability of loss indicators in the form of a quality score or an uncertainty level to help the data users interpret the information. For each loss indicators, a quality score (ranging from one to five) can be assigned.

The uncertainty indicator could be qualitatively assigned to each of these uncertainty elements; precision, completeness, disagreement and credibility. There exists a robust quantitative technique to compute the uncertainty indicator in international frameworks (De Groeve et al., 2014), but it may not feasible to implement this currently as there are several other important gaps in the database. However, a semi quantitative approach could be followed by assigning a score (1-5) to each of the uncertainty elements and an overall uncertainty score could be calculated as an arithmetic mean of these individual elements.

Accuracy: Data was collected using an official and approved standard by the best available practice (1-5)

Completeness: The collected data has no missing values (1-5)

Credibility: The collected data is indisputable and verified (1-5)

Agreement: There is an agreement of data between all available assessments (1-5)

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04

Gaps and Recommendations

SUMMARY OF KEY GAPS

Data sources: Specifically, for Nepal, there are three main sources for historical damage and loss data. Desinventar (1979-2013); DRR portal (2011 onwards) and Nepal Police incident reports. These data sources are spatially and temporally not comprehensive as well as the associated damage and loss indicators lack consistency. Different indicators across these databases require merging and transformation such that the values for common indicators could be aggregated. The common indicators which can be aggregated are proposed in Table 1.

Database design: Currently there is no provision of assigning a unique event identifier number for each recorded event. The number ideally serves as a primary key in the database and is an important component in analysing and computing key indices. Furthermore, temporal information is not yet fully available as only dates are recorded and specific time and duration are still unknown. Lack of differentiation between zero (no losses) and missing values (no information) is another major issue requiring urgent attention.

Hazard classification: Currently there is no provision for hazard classification in the database. It is possible to classify all the historical as well as upcoming events into geological, hydrological, metrological, climatological, biological and others categories to have a better understanding of underlying drivers and their mitigating measures. The proposed hazard classification based on international and national practices is included in Table 2.

Implementation issues: The incident reporting format developed by Nepal Police has not been effectively implemented thus far. Although the reporting format is exhaustive and comprehensive most of the indicators are not being currently reported especially on sector based economic losses. Moreover, there is no guidance and methodologies to report sectoral economic loss and damage indicators.

Coordination issues: For a compressive and precise data on damage and losses it is imperative to have multi stakeholder's collaboration including government agencies at different levels, NGOs and private sectors. Currently, Nepal police and District Administration Offices are involved in data collection and reporting which is limiting data redundancy and comprehensiveness. Especially, sector based economic losses are not collected probably because of the lack of sectoral understanding and specifications. Sectoral governmental agencies such as the department of health, department of roads, department of agriculture are not currently involved in data collection and reporting. Similarly, local NGOs, CBOs and international agencies could be mobilized who may have better technologies, human resources and capacity to effectively collect and report the data on damage and loss.

The incident reporting format developed by Nepal Police has not been effectively implemented thus far. Although the reporting format is exhaustive and comprehensive most of the indicators are not being currently reported especially on sector based economic losses. Moreover, there is no guidance and methodologies to report sectoral economic loss and damage indicators.

4.1 USE OF STANDARDIZED TERMINOLOGIES: One of the main barriers for having consistent and comparable damage and loss database is the lack of precise and agreed definitions for hazard and loss/damage indicators. The consensus must be built across the nation on the hierarchies, terminologies and classification of natural hazards. Therefore, the definitions, conceptual framework and damage and loss indicators proposed in the report should be periodically reviewed and modified as necessary. This can be done through stakeholder consultations and focused group discussions. The established minimum set of loss indicators and an agreement on the terminology relating to loss categories are vital for consistent damage and loss database. Appropriately standardized disaster damage and loss data quantification can identify gaps in risk assessment, simultaneously improving disaster risk information which could provide common guidelines on methods of hazard, exposure and vulnerability assessments.
Consistency across damage and loss indicators is also required to ensure the effective dissemination of communication materials such as press releases, bulletins and updates through public media. The set of indicators proposed should be consistently used the during data collection, analysis and dissemination phase.

The consensus must be built across the nation on the hierarchies, terminologies and classification of natural hazards.

4.2 BOTTOM UP DATA COLLECTION: The key action for successful implementation of damage and loss data standards is to engage actors at local level. Almost every disaster event is a local event in a sense that it is at this level physical damage has occurred, and people can verify the impact of disasters on their home, workplaces and services. Municipalities (Palikas) in Nepal are in a better position to act as a focal point for data collection backed by Nepal Police and higher-level governmental agencies. It is therefore essential to empower the municipalities with the tools and the expertise for establishing and maintaining damage and loss databases.

The existing incident reporting data format from Nepal Police should be accessible to local authorities and related CBOs and NGOs for redundancy and quality assurance purposes. The current format is comprehensive, yet not user friendly. BIPAD can explore the possibility of developing a user-friendly mobile or web app, replicating the Nepal Police format (if this does not exist already) with a capability of retroactively changing the numbers and values after initial submission. Non-governmental agencies who may already be collecting some of the damage and loss data should be encouraged to use the same format to maintain the consistency and foster data redundancy for quality assurance.

4.3 LOSS OWNERSHIP: Loss ownership is something that is not currently adopted within BIPAD system. It is recommended to define the type of the owner (individuals, business, government, non-governmental organizations) for each economic loss recorded. This allows providing statistics on losses in the public sector, the industry sector, private citizens, etc. Separate from the owner type of the building, the losses of a particular building are typically borne by the owner and partially by insurance companies or public funds (e.g. disaster compensation funds). Therefore, also who bears the losses (individuals, business, government, non-governmental organizations and insurance companies) should be recorded.

This would require some adjustments to be made in Nepal Police incident reporting data format. Basically, one extra column can be created, for each monetary loss values recorded, to capture the information on ownership (individual, business, government, and insurance companies). This is an extremely important indicator for post disaster needs assessment and disaster risk financing.

4.4 INFORMATION ON DEGREE OF UNCERTAINTY: Uncertainty is inherent in every step (collection, analysis, interpretation, computation) of damage and loss data analysis. Disaster losses can only be the best estimate and it may vary for a single event based on the methodology used, agencies involved, and underlying data used- for example data on population and socio-economy. In order to be transparent on recorded damage and loss, a degree of uncertainty must be assigned to a collected dataset. Collecting data at asset level will decrease the uncertainty of loss indicators and increases the transparency of total economic loss caused by a hazard event.

4.5 DESIGN OF ADVANCED IT SYSTEM: To facilitate and optimize data collection, storage and interpretation it is essential to design and maintain the robust information technology infrastructure in all levels of government. A well-designed IT system is helpful for data collection and reporting at various spheres of the government, especially at local level. A key consideration needs to be resource mobilisation and consistency for improvement of data collection, recording and reporting at all levels. This may require further levels investment in building local and regional data collection capacity and, consequently, supporting IT infrastructure.

4.6 CAPACITY BUILDING: Capacity building of government officials, local representatives and other individuals responsible for collection and verification of damage and loss figures is imperative for maintaining consistent and accurate damage and loss database. They should be trained using hypothetical scenarios on a data collection tool developed by Nepal Police instead of creating a parallel system. Moreover, capacity building via the use of the Sendai Framework Monitor online tool and updating the tools regularly is essential especially at federal level to report aggregated figures. The mandated organization for damage and loss data collection i.e. Nepal Police and DAOs should have sufficient capacity of qualified staff, regular training of assessors to collect and achieve consistent quality of data as well as their coordination during the emergency.

4.7 MULTI-STAKEHOLDER COLLABORATION: Implementation of loss databases should be embedded ideally in a Public-Public Partnership (PUP) to ensure participation and ownership of all stakeholders. Improving partnerships between intra-government agencies, academic, private sector, NGOs and insurance authorities the national and local levels for data sharing and monitoring the Sendai framework and its global targets. The data collection system should be accessible to all the stakeholders such that all reports are consistent.

4.8 INFORMATION SHARING: Aggregated statistics should be shared in the form of tables and maps using an open data policy in a common data standard to support trans-boundary and international risk reduction processes (including the post-2015 Framework). Minimum requirements for a data-sharing standard aligned with current practices are proposed here.

Hazard event		Indicator fields	Primary unit of measurement	Degree of uncertainty
<Identification number>	Event	Geographical location	<province><palika><ward>	na
		Temporal information	<valid from> <valid to>	na
		Hazard event classification	<NaturalHazardClassification>	na
	Damage	Houses destroyed	<total number>	<value between 1-5>
		Houses damaged	<total number>	<value between 1-5>
		Education centres	<total number>	<value between 1-5>
		Health facilities	<total number>	<value between 1-5>
	Human Loss	Directly affected	< number of persons >	<value between 1-5>
		Deaths	< number of persons >	<value between 1-5>
		Missing	< number of persons >	<value between 1-5>
	Direct Loss	House	<in monetary value>	<value between 1-5>
		Land	<in monetary value>	<value between 1-5>
		Health	<in monetary value>	<value between 1-5>
		Education	<in monetary value>	<value between 1-5>
		Industry	< in monetary value>	<value between 1-5>
		Road	<in monetary value>	<value between 1-5>
		Bridge	<in monetary value>	<value between 1-5>
		Electricity	<in monetary value>	<value between 1-5>
		Telecommunication	<in monetary value>	<value between 1-5>
		Water Supply	<in monetary value>	<value between 1-5>
		Irrigation	<in monetary value>	<value between 1-5>
		Drainage	<in monetary value>	<value between 1-5>
		Tourism	<in monetary value>	<value between 1-5>

Table 5: Damage and loss for a specific event by unit of measurement and year (minimum requirement)

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For an assessment and evaluation purpose the damage and loss data for first seven months of the year 2020 is taken into consideration. i.e. January 01 – July 31, 2020

There are all together 349 recorded landslide events in the database. The indicators on human losses (death, injured and missing) are generally well reported, however, there is no mechanism currently to verify this information which in most cases is collected by Nepal Police and DAOs. It can be assumed that the reported deaths, injured and missing figures are verified from the local level authorities with a consensus of multiple stakeholders including Nepal Police and government officials.

The database records the number of affected families, but it is not clear that what actually constitutes affected family figures. It should be based on methodological process as discussed in the previous section of the report and disaggregated into the impacts on agriculture, businesses, and income if possible. Similarly, number of displaced people may not have been captured as there is no recorded displacement figures on the database. The database cannot provide differentiation between zero (no losses) and missing values (no information).

The major issue lies on estimated loss figures. It is unclear how the estimate of loss is calculated. Currently there exist no provision to disaggregate the total estimated loss in terms of sectoral losses. Loss could be related to individual property, damages in roads, damages in transmission lines, bridges etc. which is currently unknown. Only property losses (individual and government) are captured in the database and other sectoral losses are missed.

As discussed in the earlier section of this report, sectoral economic losses are important for mainstreaming DRR into development and infrastructures plans. For example, a number of landslide incidents may have occurred in close proximity of roads, highways and other critical infrastructures thereby affecting the services and incurring maintenance and rehabilitation costs. The framework proposed in the document allows to capture the information on the length of road destroyed/damaged and associated cost for rehabilitation. The aggregated figures on loss incurred due to damaged roads can help sectoral agency; department of roads in this case to do carry out proper disaster risk assessment and cost benefit analysis during the construction and planning phase. This is one of the benefits of properly documented and disaggregated damage and loss database which is currently missing.

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