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Concept note on Methodology to Estimate Direct Economic Losses from Hazardous Events to Measure the Achievement of Target C of the Sendai Framework

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UNISDR Secretariat
United Nations Office for Disaster Risk Reduction
Geneva, Switzerland

Sendai Framework for Disaster Risk Reduction 2015-2030

Target C: Reduce *direct disaster economic loss* in relation to global gross domestic product (GDP) by 2030	
C-1	Direct economic loss due to hazardous events in relation to global gross domestic product. (This indicator should be computed based on indicators C-2 to C-7 and GDP figures).
C-2	Direct agricultural loss due to hazardous events
C-3	Direct economic loss due to industrial facilities damaged or destroyed by hazardous events
C-4	Direct economic loss due to commercial facilities damaged or destroyed by hazardous events

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C-5	**Direct economic loss due to houses damaged by hazardous events** Note: C-5 and C-6 are mutually exclusive.
C-6	**Direct economic loss due to houses destroyed by hazardous events**
C-7	**Direct economic loss due to damage to critical infrastructure caused by hazardous events** (This indicator should be computed based on indicators D-2(hospital), D-3(school) and D-4 (road).)

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Sendai Framework Target C: Loss estimation methodology

What is a loss indicator?

An indicator, as the word itself suggests, is a number (or index) that gives an **indication** of the size of certain phenomena, in this case it ***estimates the value*** of direct economic losses that occur on each disaster.

This methodology aims to produce an approximate value (a "proxy") that *estimates* the dollar value of these losses.

It is important to emphasize that *no indicator will provide an absolutely precise, accurate and exhaustive measure of losses*. Direct economic loss estimations can be very subjective, depending on the methodology and criteria used to assign dollar value to the assets damaged or destroyed and the exhaustiveness of the data collection.

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This methodology is to be applied to potentially millions* of records of small, medium and large disasters.

- It will have to be applied retroactively to baseline data (2005 – 2015 decade)
- Data to be collected are mostly physical indicators of damage, therefore improved methodologies can be applied in the future.

•GAR 2015 applied a simplified version of this methodology to a database of half a million records with data from 83 countries.

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- SMART: Specific, Measurable, Achievable, Relevant, Time Bound.
- Consistent over time
- Consistent across countries
- Feasible
- Reliable
- Transparent
- Verifiable
- Can be refined/improved over time
- Useful for many purposes
- Take advantage of existing data

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C2 Direct Agricultural Loss:

C2a Number of hectares of crops affected

C2b Number of livestock lost

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C2 Direct Agricultural Loss:

C2a Number of hectares of crops affected [to be collected/reported]

The methodology to valuate agricultural damage is focused on determining **crop direct losses**, and the approach taken is to estimate **direct loss per hectare** as **a conservative percentage (25%) of the value of the *value of yield per hectare* under normal conditions**.

$$Ay = \sum (Area_i * Yield_i * Price_i / Total\ Area)$$

Calculated with MoA, FAO data.
$Area_i$ is the total area planted of each crop type i
$Yield_i$ is the yield per hectare for crop type i in the country
$Price_i$ is the **price to producer** per ton for crop type i

Therefore

Loss_agriculture = Ay * C2a * 0.25

UNISDR determined this 25% percentage comparing the estimations of value of yield per hectare with direct costs such as seeds, labour, fertilizers, pesticides, etc. in a number of countries

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C2 Direct Agricultural Loss:

C2b Number of livestock lost

To calculate a price per cattle lost, the methodology assigns the **weighted average cost of livestock** in the country per animal lost using the price to producer per kilo of meat on each country using also MoA or FAO datasets, Producer Price (USD/kg) for Meat live weight.

$$\textbf{AvLs} = \sum (Stock_i * Weight_i * Price_i / Total\ Stock)$$

Calculated with MoA, FAO data.
$Stock_i$ is the total number of livestock type i
$Weight_i$ is the weight per animal type I in the country
$Price_i$ is the price to producer per kilo of meat of type i

Loss_livestock= AvLs * C2b

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Direct economic loss due to affected buildings

Basic methodology: Replacement cost estimation

The ECLAC methodology suggests that the value of the physical damage to buildings can be calculated based on:

- the **size** of the building
- the **price per square meter** of construction
- the **damage to furniture and equipment** contained in the building (as % of the value of building)
- the **associated infrastructure** (utility networks access roads, landscaping, as % of the value of building)

*Full Replacement Cost = (building_size * Sqr_Mt_value + equipment + infrastructure)*

Cost of one partially damaged building:

*Partial Cost = (building_size * Sqr_Mt_value + equipment + infrastructure) * damage_ratio*

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Direct economic loss due to damaged destroyed buildings

Data Collection Options:

1. Report only total number of facilities affected
2. Report separately damaged and destroyed
3. Report separately by size
4. Report separately by size, damaged and destroyed
5. Report separately size and percentage damage per facility

Size	Damaged	Destroyed	Affected (damaged or destroyed)
Small facilities	Option 4	Option 4	Option 3
Medium facilities	Option 4	Option 4	Option 3
Large facilities	Option 4	Option 4	Option 3
Total number	Option 2 strongly recommended	Option 2 strongly recommended	Option 1 MINIMUM REQUIREMENT

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Direct economic loss due to damaged destroyed buildings

Additional information required (figures in table are examples)

Type of buildings	average size of facilities (m^2)	Size of small facility m^2	Size of medium facility m^2	Size of large facility m^2	construction cost per m^2	Examples of Data sources
Industrial (for C3)	2,000	150	500	20000	1,200	-Ministry of Industry/Economy - Public works
Commercial (for C4)	700	50	500	5000	800	-Ministry of Trade - Chamber Commerce
Housing (for C5 and C6)	55	40	60	150	350	- Ministry of Housing - Real State Assoc. - Public works
Health (for C7)	200	60	500	20000	1,800	- Ministry of Health - Public works
Education (for C7)	200	60	500	20000	800	- Ministry of Education - Public works
National Proxy (When data is not provided by countries nor other global database)	45 House 60 Health 75 School 100 Industrial 45 Commerce	n/a	n/a	n/a	Estimate based on COMPASS data	UNISDR

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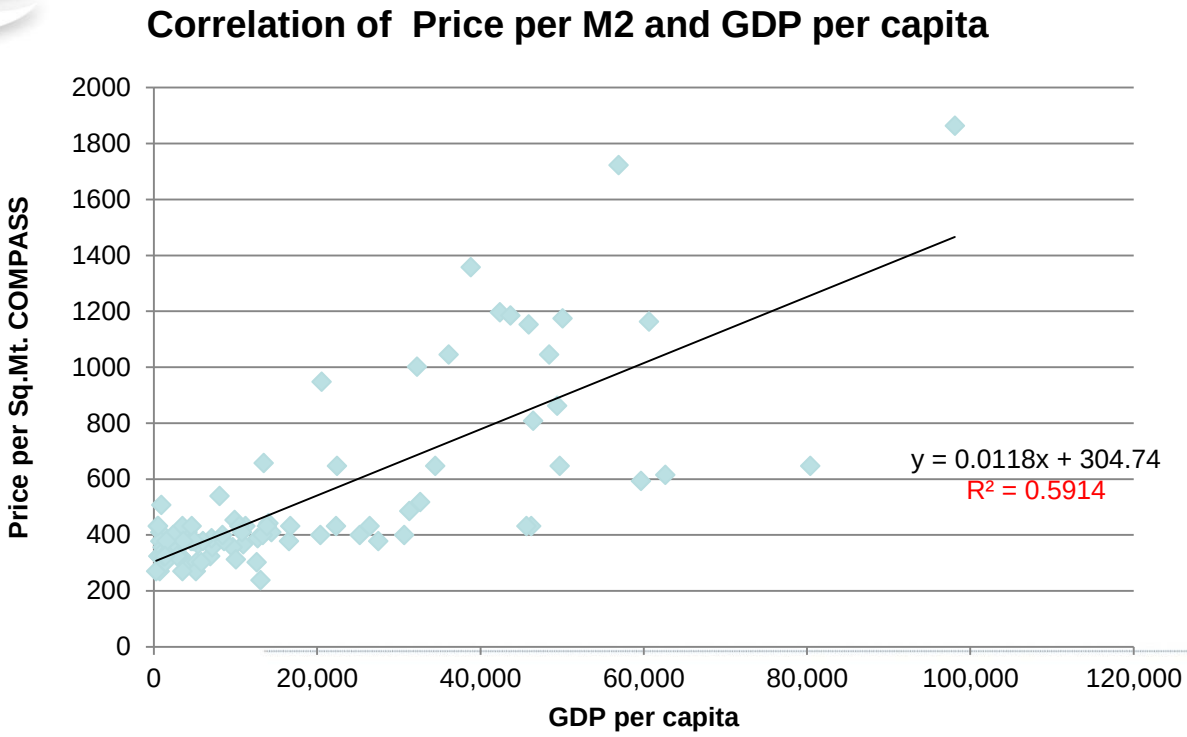
Built Environment Loss estimation: Value of Square Meter of construction

For GAR 15 test average prices per square meter for 93 countries obtained from Compass Construction Yearbook. Regression with GDPpc for countries with no data.



Note: Value of Construction may vary per sector (industrial, educational, commercial, health, housing), in rural and urban areas, per income/size, and per year.

$m^2 = 304 + 118 * GDP\_pc$

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C3 Direct Loss to Industrial Facilities

Minimum requirement (Option 1)

C3a Number of industrial facilities affected

*Loss = **C3a** * average_size * Sqr_Mt_value * overhead_equipment * av_damage_ratio*

Where

average_size could be :

- a fixed value, a very small and conservative Industrial facility, for example 100 m^2.
- a weighted average, median or mode of sizes of facilities in the country **(reported by the country)**

Sqr_Mt_value: the value of one square meter of construction

av_damage_ratio*: 25% (as suggested in ECLAC excercises)*

overhead_equipment*: 25% to account for equipment and products/materials stored.*

Suggested in ECLAC applications

To be validated – Experts suggest may be higher

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C3 Direct Loss to Industrial Facilities

Option 4 – reporting by damage level and size

C3g: number of Large industrial facilities damaged
C3h: number of Medium industrial facilities damaged
C3i: number of Small industrial facilities damaged
C3j: number of large industrial facilities destroyed
C3k: number of Medium industrial facilities destroyed
C3l: number of Small industrial facilities destroyed

Loss = C3g * average size of large facilities* construction cost per m^2 * average damage ratio
+ C3h* average size of medium facilities * construction cost per m^2 * average damage ratio
+ C3i * average size of small facilities * construction cost per m^2 * average damage ratio
+ C3j * average size of large facilities* construction cost per m^2
+ C3k* average size of medium facilities * construction cost per m^2
+ C3l* average size of small facilities* construction cost per m^2

Average damage ratio = 25%

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C4 Direct Loss to Commercial Facilities

Minimum requirement (Option 1)

C4a Number of commercial facilities affected

*Loss = **C4a** * average_size * Sqr_Mt_value * av_damage_ratio * overhead_equipment*

average_size could be :

- a fixed value, a very small and conservative commercial establishment, for example 50 m^2.
- a weighted average, median or mode of sizes of shops in the country **(reported by the country)**

Sqr_Mt_value: the value of one square meter of construction
av_damage_ratio*: 25% as suggested by ECLAC*
overhead_equipment*: 25% to account for products stored.*

To be validated – Experts suggest may be higher

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C6 Direct economic loss due to houses destroyed

C6a Number of houses destroyed

*Loss = **C6a** * average_size * Sqr_Mt_value * overhead_equipment_infrastr*

average_size calculated as the weighted average of houses (GAR: social interest housing solution, 45 $m^{2)}$

Sqr_Mt_value: the value of one square meter of construction**.**

Suggested by GAR risk assessment experts

***overhead**: **40**% to account for equipment/furniture and associated infrastructure*

C5 Direct economic loss due to houses damaged

C5a Number of houses damaged

*Loss = **C5a** * average_size * Sqr_Mt_value * overhead_equipment * av_damage_ratio*

***Average damage ratio**: 25% (average of different levels of damage)*

Suggested in ECLAC applications

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D2 Number of Health Facilities Affected

Minimum requirement (Option 1)

*Loss = **D2** * average_size * Sqr_Mt_value * overhead_equipment*

average_size could be :

- a fixed value, a very small and conservative heath care facility (GAR: 48 m^2).
- a weighted average, median or mode of sizes of shops in the country **(reported by the country)**

Sqr_Mt_value: the value of one square meter of construction

overhead_equipment*: 25% to account for products stored.*

To be validated – Experts suggest may be much higher

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D3 Number of Education Facilities Affected

*Loss = **D3** * average_size * Sqr_Mt_value * overhead_equipment*

average_size could be :

- a fixed value, a very small and conservative school (GAR: 60 m^2).
- a weighted average, median or mode of sizes of schools in the country **(reported by the country)**

Sqr_Mt_value: the value of one square meter of construction

overhead_equipment*: 25% to account for products stored.*

To be validated – Experts suggest may vary by country

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D4 Damage to transportation infrastructures

D4a Number of meters of roads destroyed

Methodology used by UNISDR used an average cost of Rehabilitation per meter of typical (medium) road (provided by MoPW or World Bank ROCKS data), and differentiating between paved and unpaved based on the percentage of the network that is actually paved.

*Loss = **D4a** * [(rehab_paved _cost* %paved) + rehab_unpaved _cost* %unpaved)]*

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How to assure proper comparison across time?

The construction cost per m^2 will change across time due to technical development and other market related factors (e.g. price increase of construction material in relation to other goods and services). Price level changes such as inflation will also influence unit price.

Option 1: The relative unit price increase of construction cost in relation to other goods and services indicates the increased influence of industrial facility loss on overall economy. Impact of general inflation will be considered in C1 if agreed so. Suggested to use nominal per unit price in each moment of time.

Option 2: Simply to observe affected volume trend, use the same unit price for all the moments from baseline period until 2030. A base year must be selected (2015 ?)

Final Step: Convert the value expressed in national currency into the one in USD and derive global loss value.

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Challenges and caveats

- Average/Minimal sizes may not reflect total losses
- Size average and distribution vary by country, and maybe by year
- Construction values vary by type of facility, and by year
- Reporting/collecting by size range will be an overhead
- Reporting/collecting by Urban/Rural or other criteria, also overhead
- Reporting/collecting by individual infrastructure item will be great overhead
- Estimates of equipment/stored products/associated infrastructure
- Transportation: Bridges and Railways not considered
- Agriculture: % defined to proxy direct losses to be reviewed/validated
- Agriculture: losses to built infrastructure (irrigation, warehouses, etc.)
- Livestock: other, like small (poultry) may need to be considered

Thank you

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