Xavier University
ATENEO DE CAGAYAN
Social Development Office

The Use of Maps in Building Community Resilience

Dexter S. Lo

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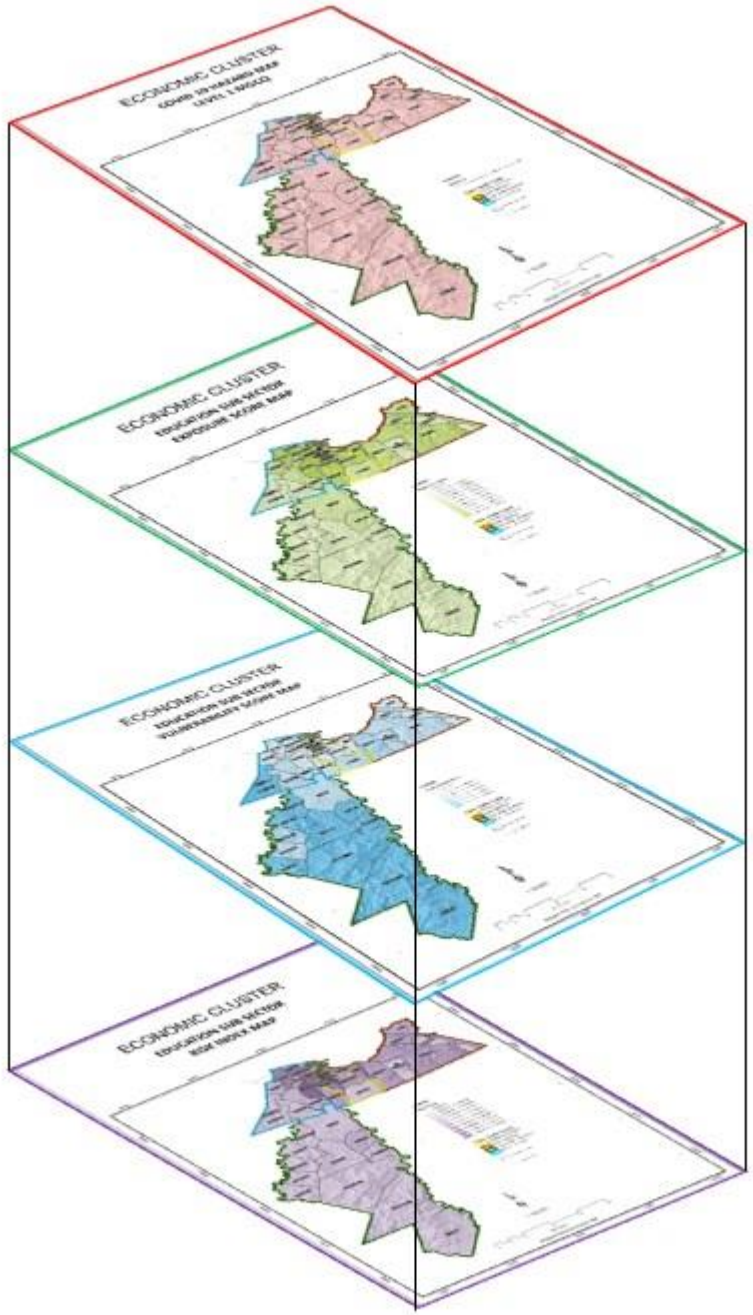
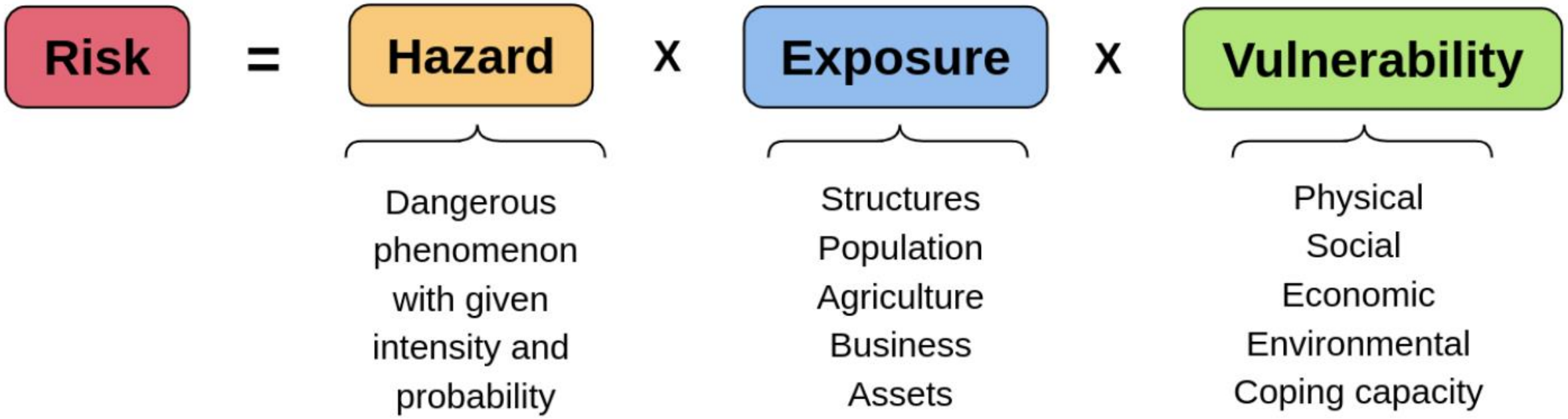
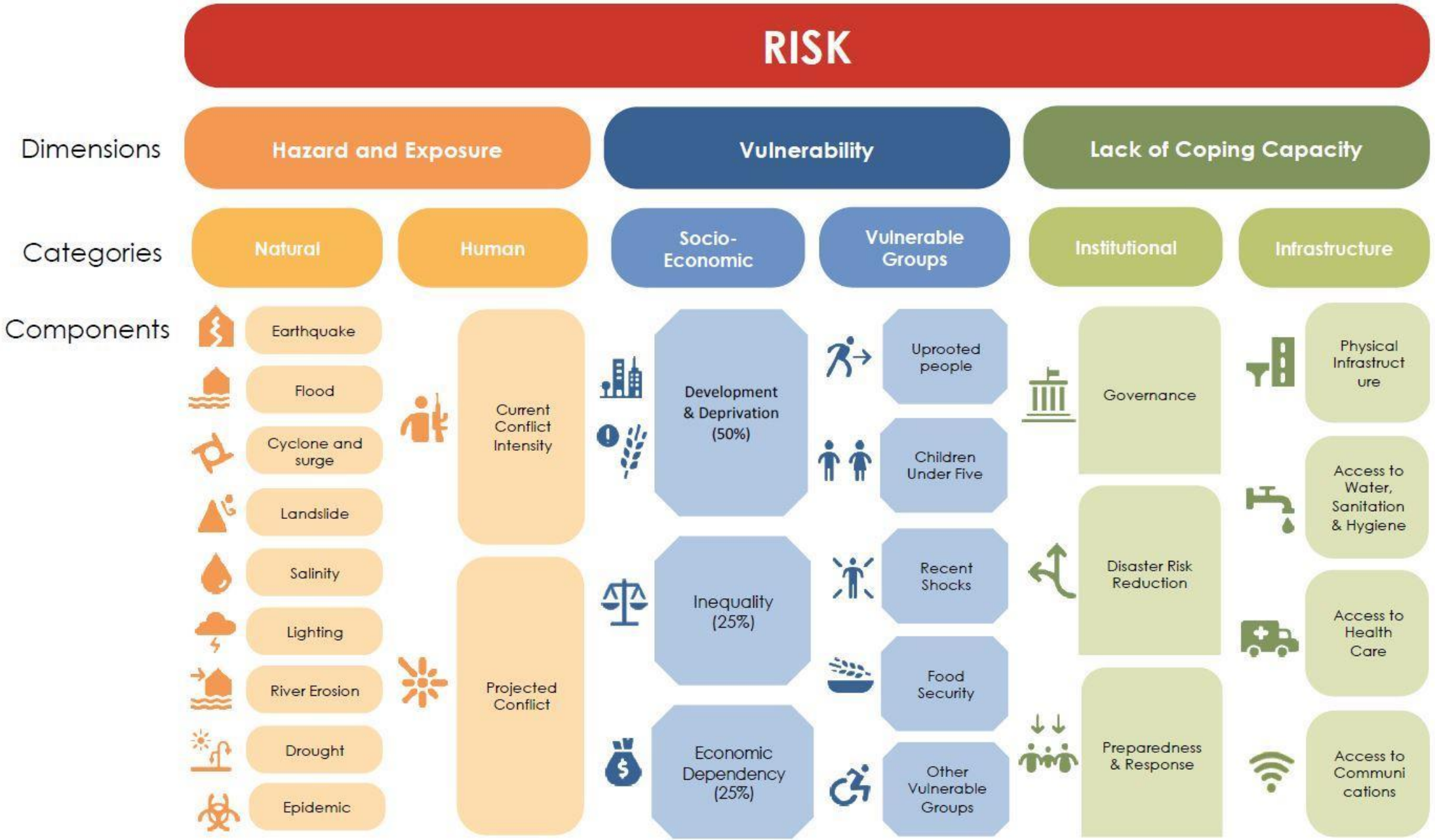


Why are Risk Maps useful in Building Resilience?

Disaster Risk is a complex interplay of several factors…




RISK
Dimensions
Hazard and Exposure
Vulnerability
Lack of Coping Capacity
Categories
Natural
Human
Socio-Economic
Vulnerable Groups
Institutional
Infrastructure
Components
Earthquake
Flood
Cyclone and surge
Landslide
Salinity
Lighting
River Erosion
Drought
Epidemic
Current Conflict Intensity
Projected Conflict
Development & Deprivation (50%)
Inequality (25%)
Economic Dependency (25%)
Uprooted people
Children Under Five
Recent Shocks
Food Security
Other Vulnerable Groups
Governance
Disaster Risk Reduction
Preparedness & Response
Physical Infrastructure
Access to Water, Sanitation & Hygiene
Access to Health Care
Access to Communications

UNDRR (2022)

$$R = H + E + V$$

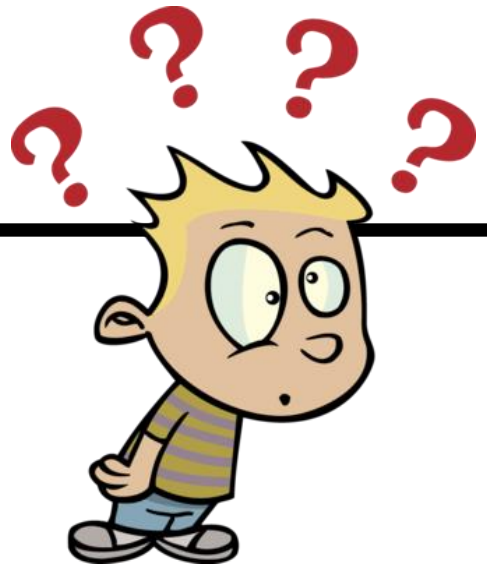
$$\mathbf{R = H \times E \times V}$$

$$R = H \times V - C$$

$$R = \frac{H \times V}{C}$$

$$R = \text{Freq} \times \text{Consq}$$

$$V = f(E, S, AC)$$



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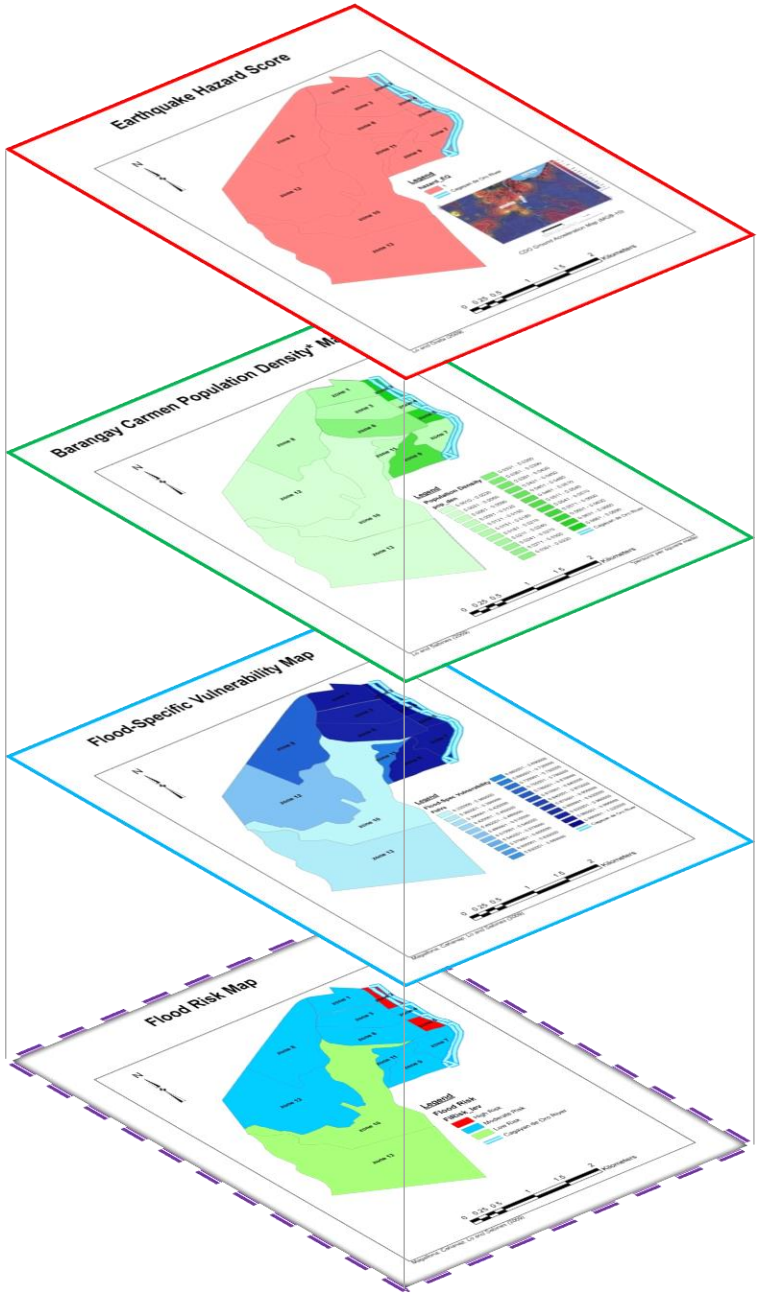
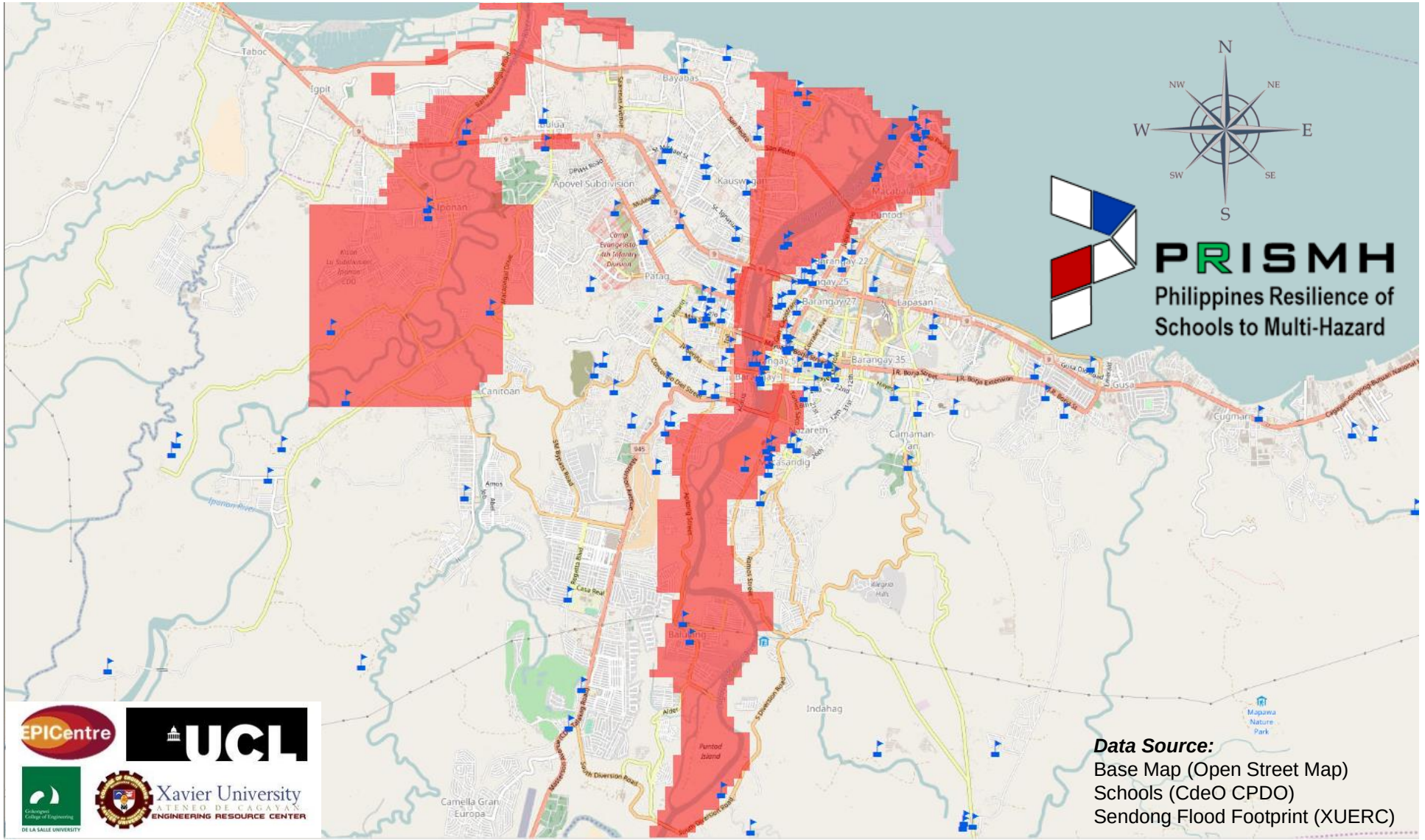


Cagayan de Oro *(downtown, roads, rivers)* + *SCHOOLS* + *SENDONG*



Parameters

PRISMH Workshop
29 - 30 April 2019
Manila - Philippines

Building

Roof Height

Footprint A

External Perimeter

Number of St

Height of Door (to Road/Basement)

Height of Pl (to Road)

Height of Window (to Road/Basement)

Column at Gr Floor (Yes/N

Building Condition (Poor/Good/Excellent)

Building Fa

Frame/ Wa (Timber/Masc oncrete)

Flood Vulnerability Map

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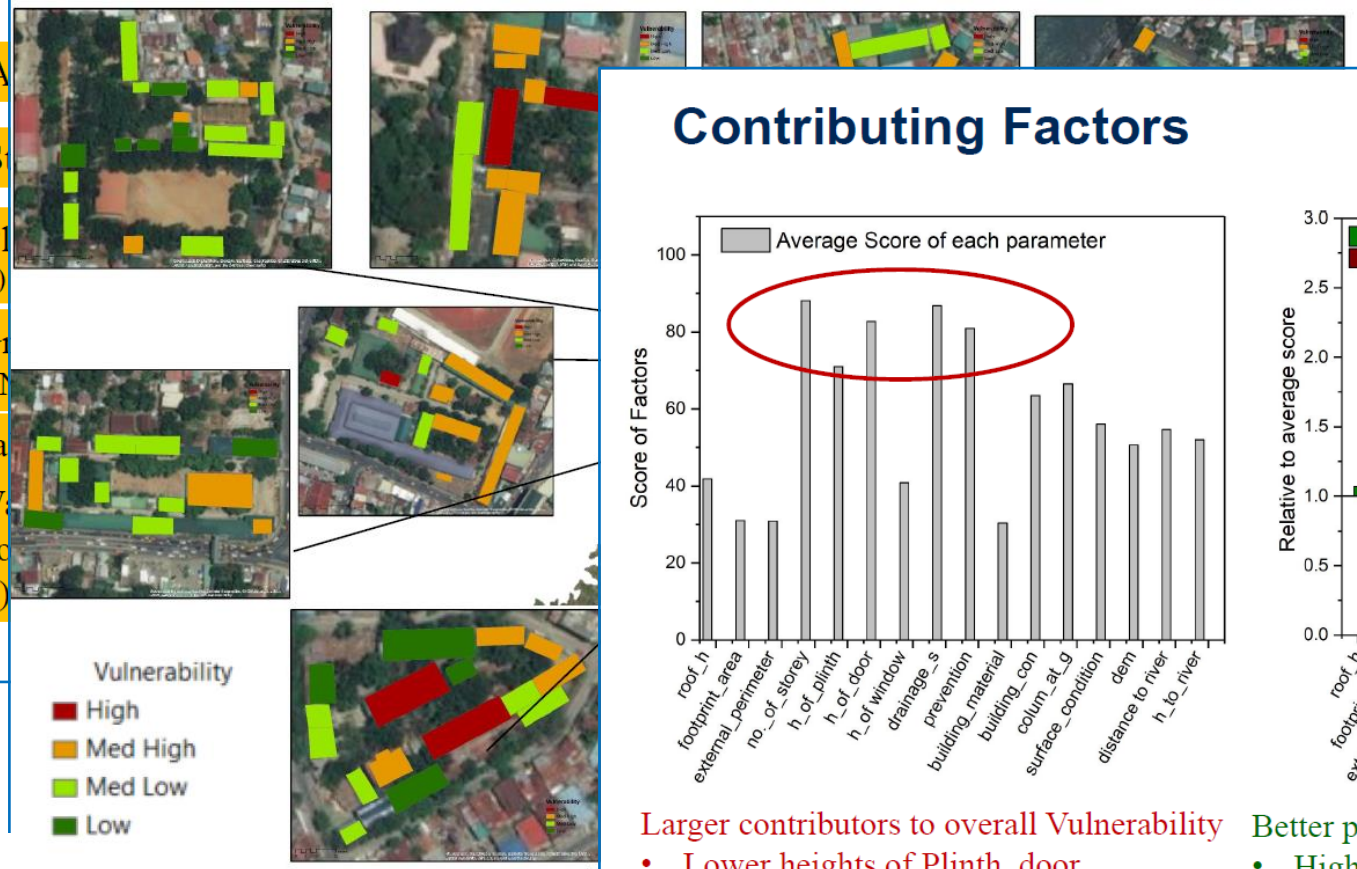

Contributing Factors

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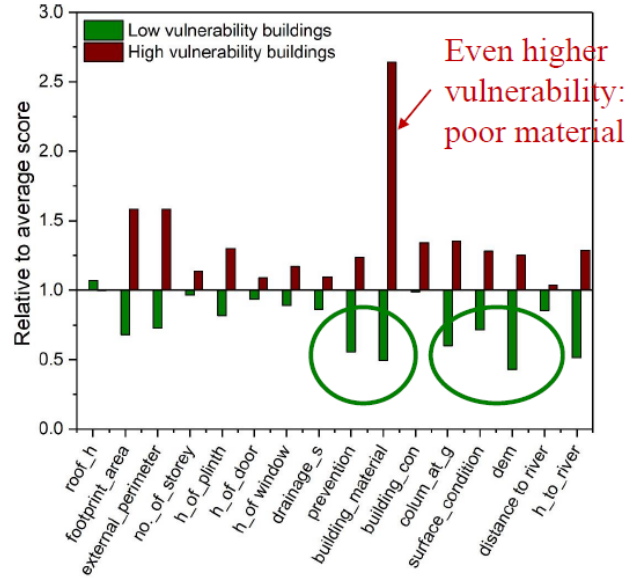


Larger contributors to overall Vulnerability

- Lower heights of Plinth, door
- Poorer drainage system
- Less prevention

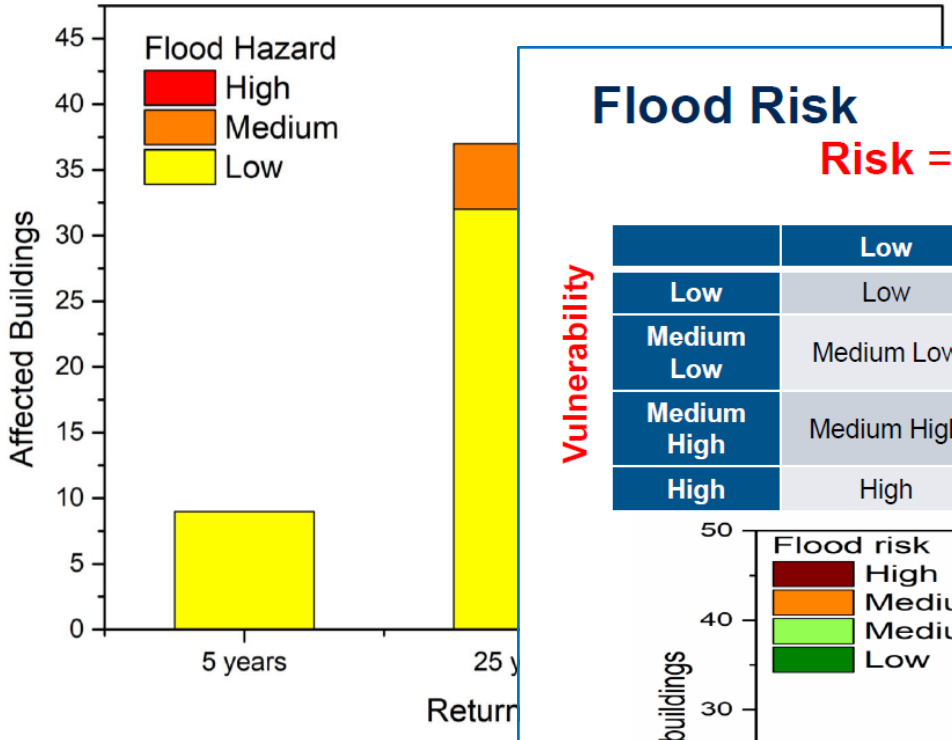
Better performance of low vulnerability buildings

- Higher location
- Better prevention
- Stronger Material

PRISMH
Philippines Resilience of Schools to Multi-Hazard

EPICentre UCL Xavier University ATENEO DE CAGAYAN ENGINEERING RESOURCE CENTER

Flood Hazard



More affected buildings under

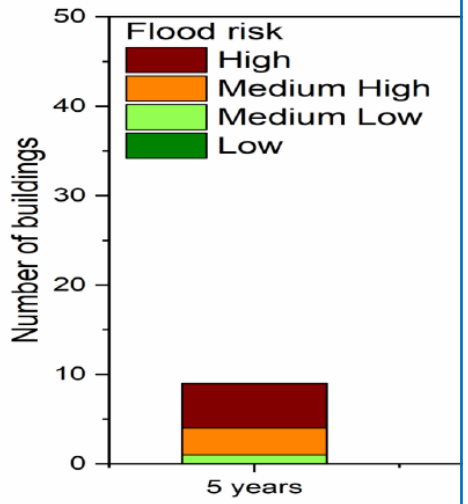
Flood Risk

Risk = Vulnerability X Hazard

Hazard

Vulnerability

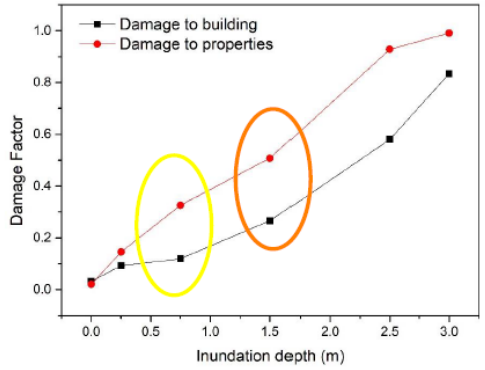
	Low	Medi	High
Low	Low	Mediun	
Medium Low	Medium Low	Medi Hig	
Medium High	Medium High	Medi Hig	
High	High	Hig	



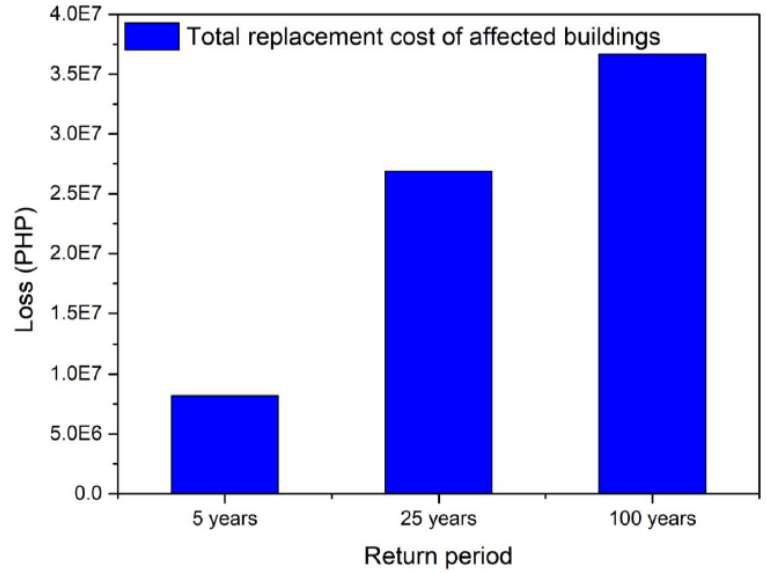
Loss

Loss = Df*Cc*Vr*A

Damage Factor



Damage factor for **low** and **medium** flood hazard



(Ministry of Land, Infrastructure, Transport and Tourism, 2005)

- Df: Damage factor
- Cc: Construction Cost (26550 peso/m^2)
- Vr: Normalised Vulnerability Rating
- A: Building footprint area

* Due to limited data, only damage to buildings are estimated here

PRISMH
Philippines Resilience of Schools to Multi-Hazard

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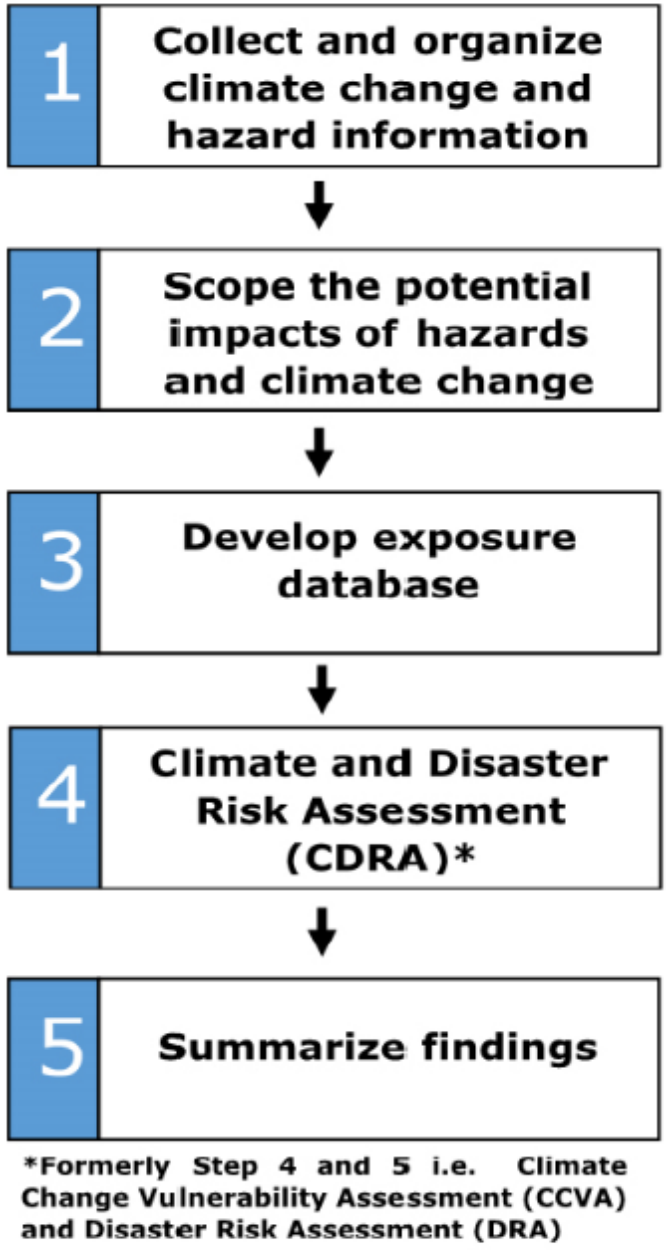


Figure 1: 5-Step CDRA Process (modified from HLURB et al., 2015; p. 13)

The CDRA Process

Step 1 *Collect climate change and hazard data and information*

- Gather and compile relevant data on local climate change scenario
- Gather and compile data on historical damages and loss caused by disasters
- Create an inventory of hazards and their characteristics
- Key outputs include local climate change projections, historical disaster damage/loss data and inventory of natural hazards, summary of barangay-level hazard inventory matrix

Step 2 *Scope the potential impacts of hazards and climate change*

- Conduct hazard mapping and climate impact chain analysis
- Summarize potential impacts of climate stimuli and hazards on exposed units
- Key outputs include hazard maps, impact chain diagrams and summary of potential impacts of climate stimuli and hazards on exposed units

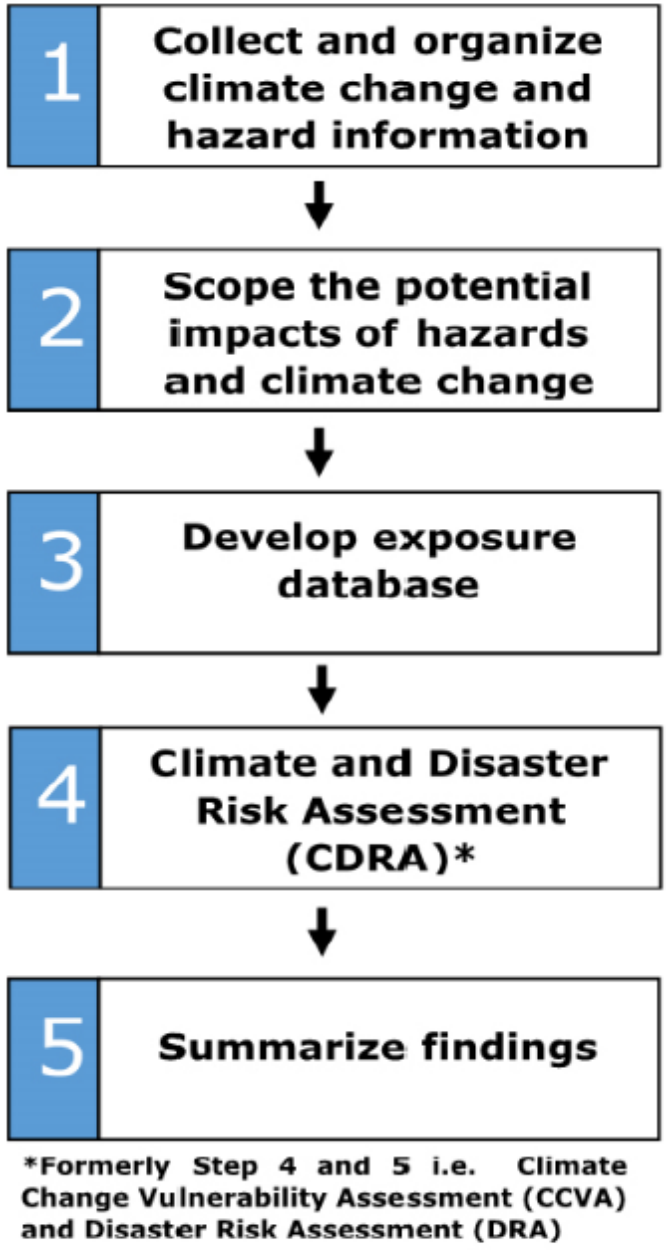


Figure 1: 5-Step CDRA Process (modified from HLURB et al., 2015; p. 13)

Step 3 *Develop exposure database*

- Identify, map, and create a database of the different exposure units, namely: population, urban use areas (e.g. commercial areas), natural resource-based production areas (e.g. agricultural farms), critical point facilities (e.g. hospitals) and lifeline utilities (e.g. water supply network), and other elements at risk (e.g. coastal area, urban area, agriculture, forest, etc.)
- Gather data on sensitivities and adaptive capacities of each exposure unit
- Key outputs include exposure databases with tables and maps

Step 4 *Conduct climate and disaster risk assessments*

- Compute for the risk score for (1) population; (2) urban use area; (3) natural resource-based production area; (4) critical point facilities; (5) lifeline utilities; and other elements at risk.

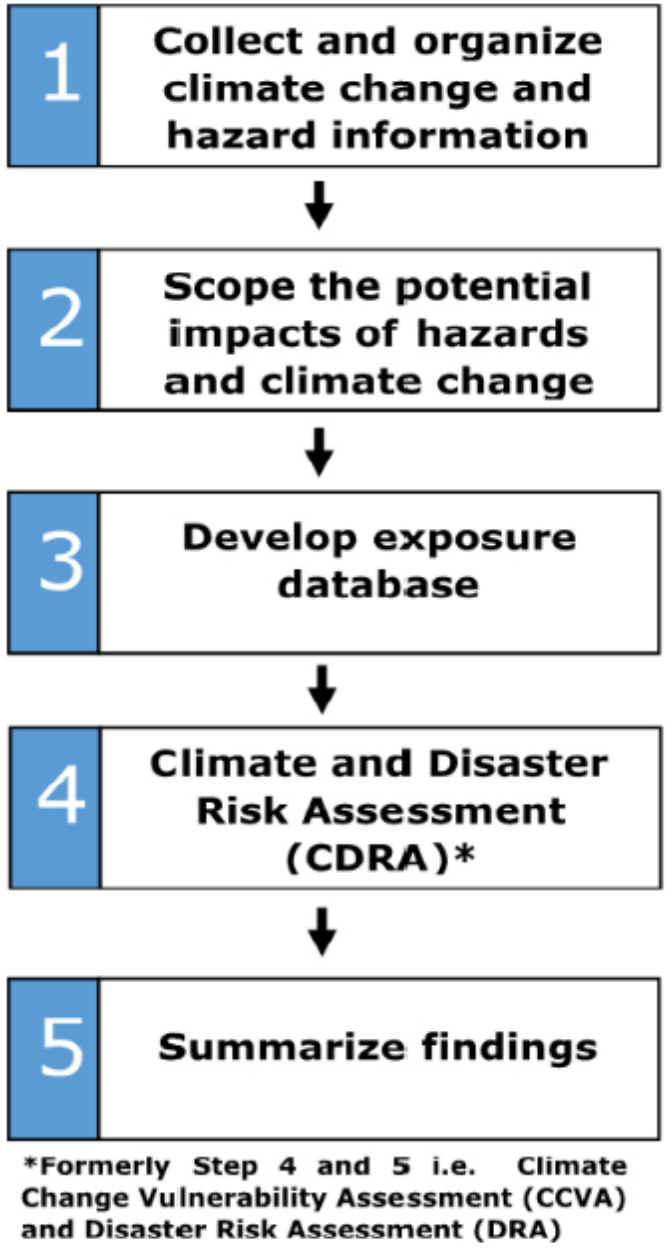


Figure 1: 5-Step CDRA Process (modified from HLURB et al., 2015; p. 13)

Step 5 *Summarize findings*

- Identify Major Decision Areas (MDAs) i.e. moderate to high or very high-risk category
- Identify risk management options

Risk management options	Action plans
Risk avoidance/elimination	avoid or eliminate risk by not locating in hazard prone areas or not engaging in development activities that create risks
Risk mitigation	reduce the frequency of occurrence and severity of disasters through prevention, mitigation and preparedness
Risk sharing or risk transfer	use insurance system to cover and pay for damages and other losses.
Risk retention or acceptance	this is the "do-nothing" scenario where risks are accepted and recovery is funded by affected people or businesses using their own resources

Table 1: Risk management options and action plans

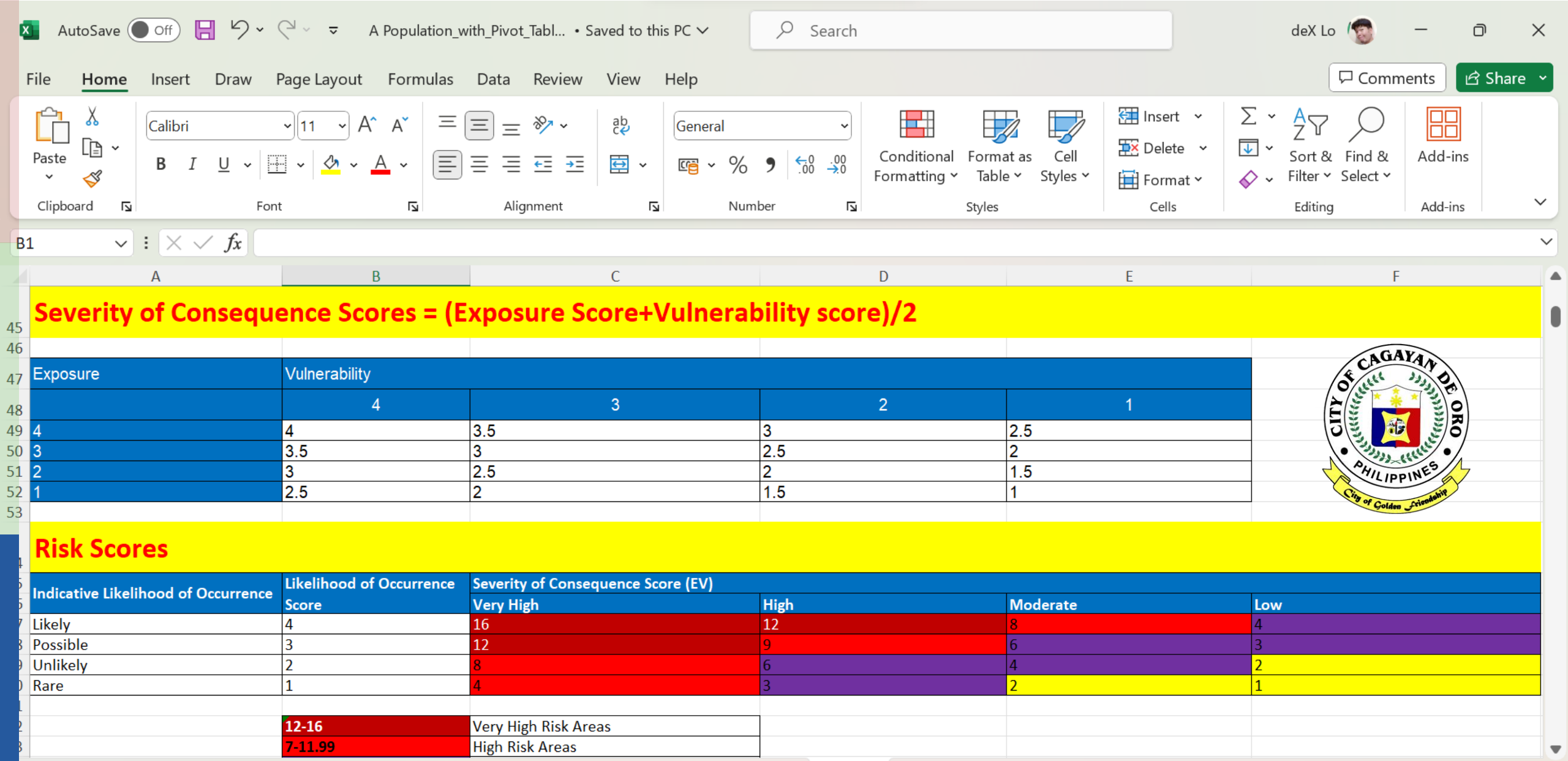
List of Risk Indicators and Corresponding Levels

INDICATORS	DATA LEVELS	SOURCES (guidelines, case studies, projects, etc.)
HAZARD		
Susceptibility	Low, moderate, high	HLURB Training module, HLURB (2015)
Likelihood of occurrence	1, 2, 3, 4	HLURB Training module, HLURB (2015)
Depth (flood, storm surge)	Measurement (1 meter, 2 feet, etc.)	HLURB Training module, HLURB (2015)
Magnitude score	1, 0.66, 0.33 (if there are 3 levels, 1 being the highest)	HLURB Training module, HLURB (2015)
	1, 0.75, 0.5, 0.25 (if there are 4 levels, 1 being the highest)	HLURB Training module, HLURB (2015)

SENSITIVITY		
Informal Settlers (IS)	Number or percentage	HLURB Training module, HLURB (2015)
People living in dwelling units made from light materials or salvageable materials	Number or percentage	HLURB Training module, HLURB (2015)
Young dependents (<= 5 years old)	Number or percentage	HLURB Training module, HLURB (2015)
Old dependents (>= 65 years old)	Number or percentage	HLURB Training module, HLURB (2015)
Persons with disabilities (mental and physical)/ chronic diseases	Number or percentage	HLURB Training module, HLURB (2015)
Families below the poverty threshold	Number or percentage	HLURB Training module, HLURB (2015)
Malnourished Individuals	Number or percentage	HLURB Training module, HLURB (2015)

Adaptive capacities		
People with access to infrastructure-related mitigation measures	Number or percentage	HLURB (2015)
People with access to financial assistance	Number or percentage	HLURB Training module, HLURB (2015)
People with capacity and willingness to retrofit or relocate	Number or percentage	HLURB Training module, HLURB (2015)
People with access to information	Number or percentage	HLURB Training module, HLURB (2015)
People who benefit from government investments on CCA-DRR	Number or percentage	HLURB Training module, HLURB (2015)
People who benefit from 4Ps or related government programs	Number or percentage	Cadag (2018)
Plan for relocation (barangay, municipal plan, national, NHA, etc.)	Yes or no; none, poor, fair, good	Cadag (2018)
Livelihood programs	Yes or no; none, poor, fair, good	Cadag (2018)

Source: Cagayan de Oro City – Climate and Disaster Risk Assessment Report (Population)



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B1

Severity of Consequence Scores = (Exposure Score+Vulnerability score)/2

Exposure	Vulnerability			
	4	3	2	1
4	4	3.5	3	2.5
3	3.5	3	2.5	2
2	3	2.5	2	1.5
1	2.5	2	1.5	1

Risk Scores

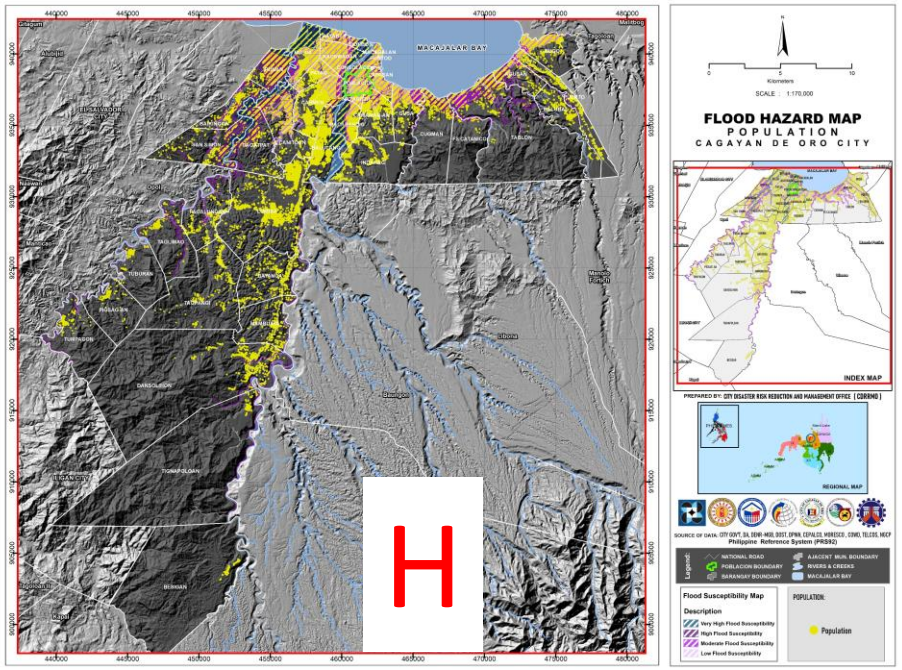
Indicative Likelihood of Occurrence	Likelihood of Occurrence Score	Severity of Consequence Score (EV)			
		Very High	High	Moderate	Low
Likely	4	16	12	8	4
Possible	3	12	9	6	3
Unlikely	2	8	6	4	2
Rare	1	4	3	2	1

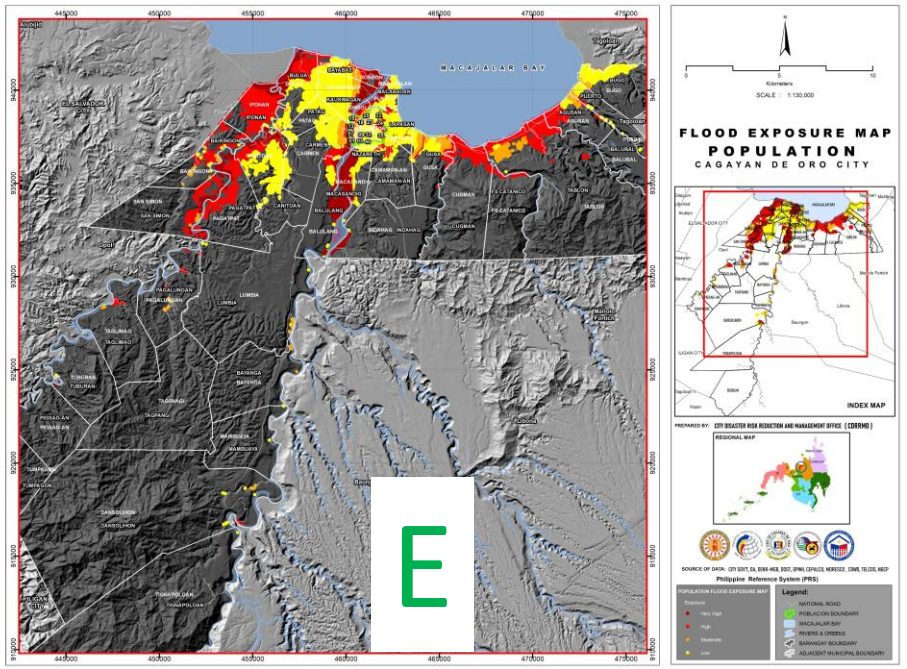
12-16	Very High Risk Areas
7-11.99	High Risk Areas

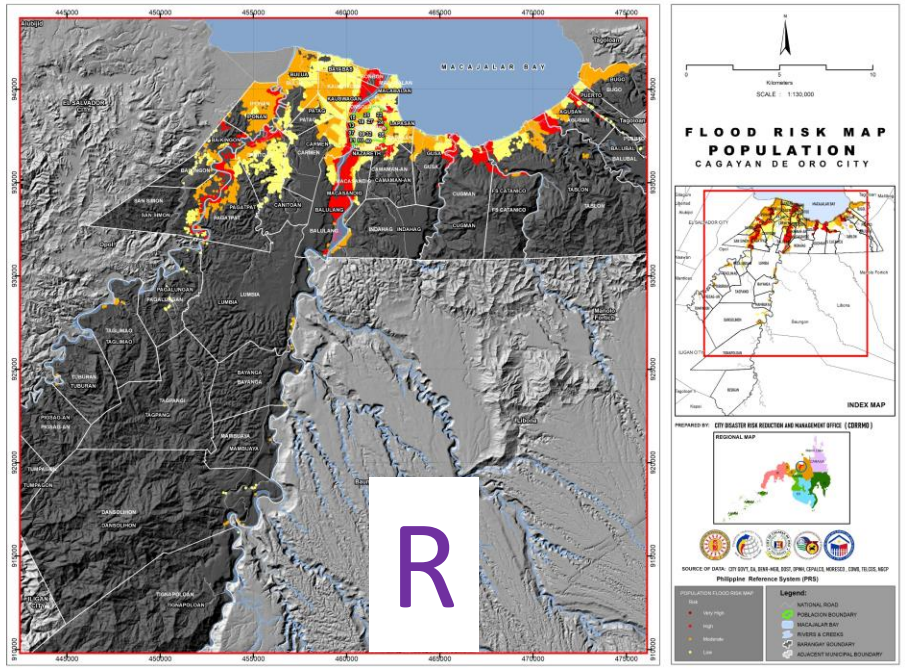
3.1.1 Flooding | 3.1.2 Landslide | 3.1.3 Storm Surge | Indicators | Distribution | Scoring | Population | Summary

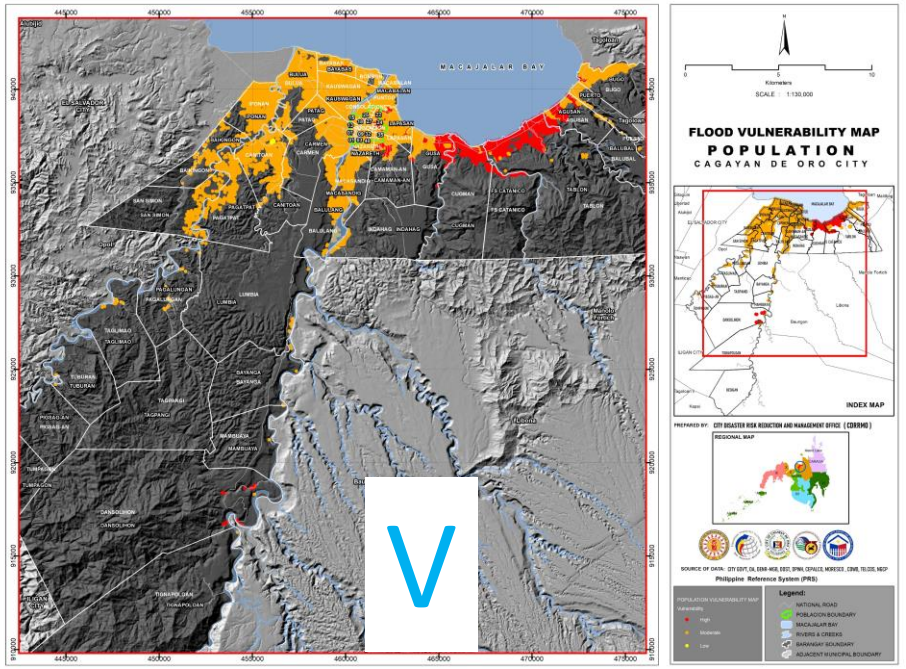
Ready | Accessibility: Investigate | 90%

Source: Cagayan de Oro City – Climate and Disaster Risk Assessment Report (Population)

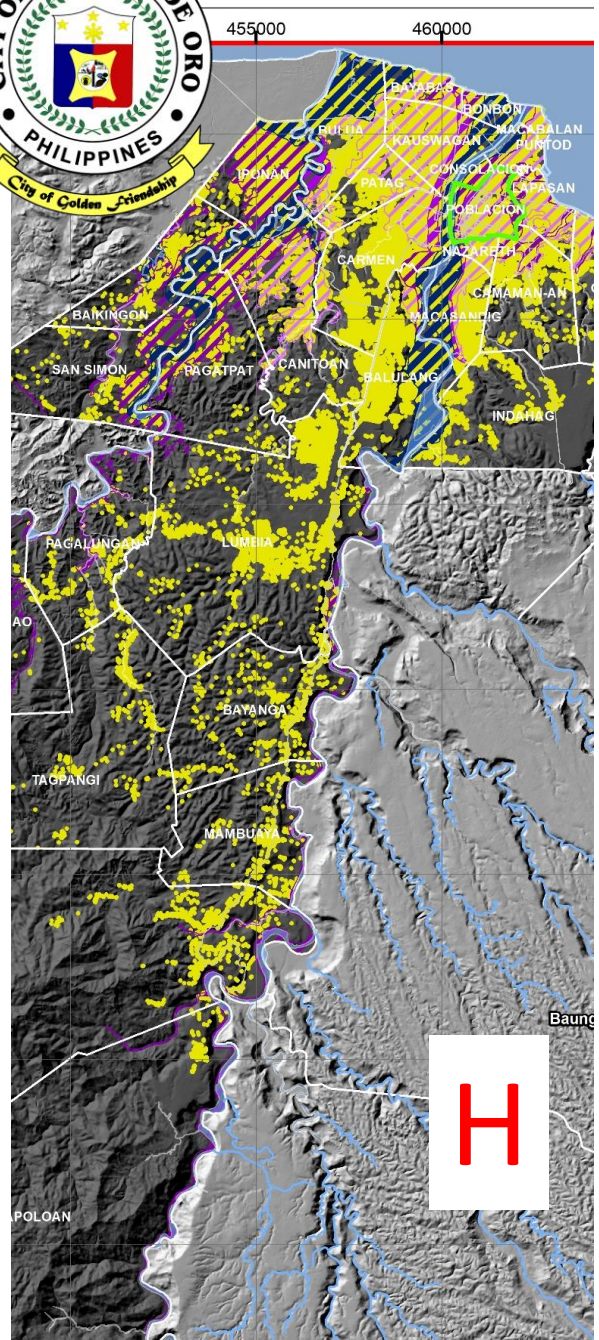


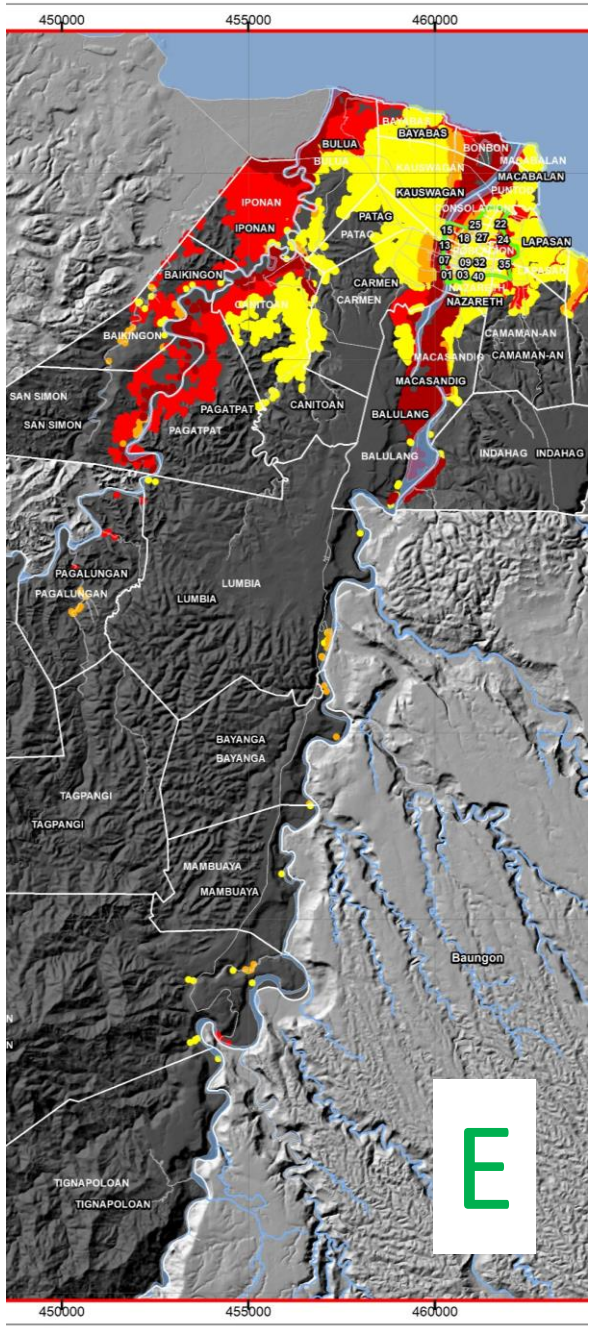


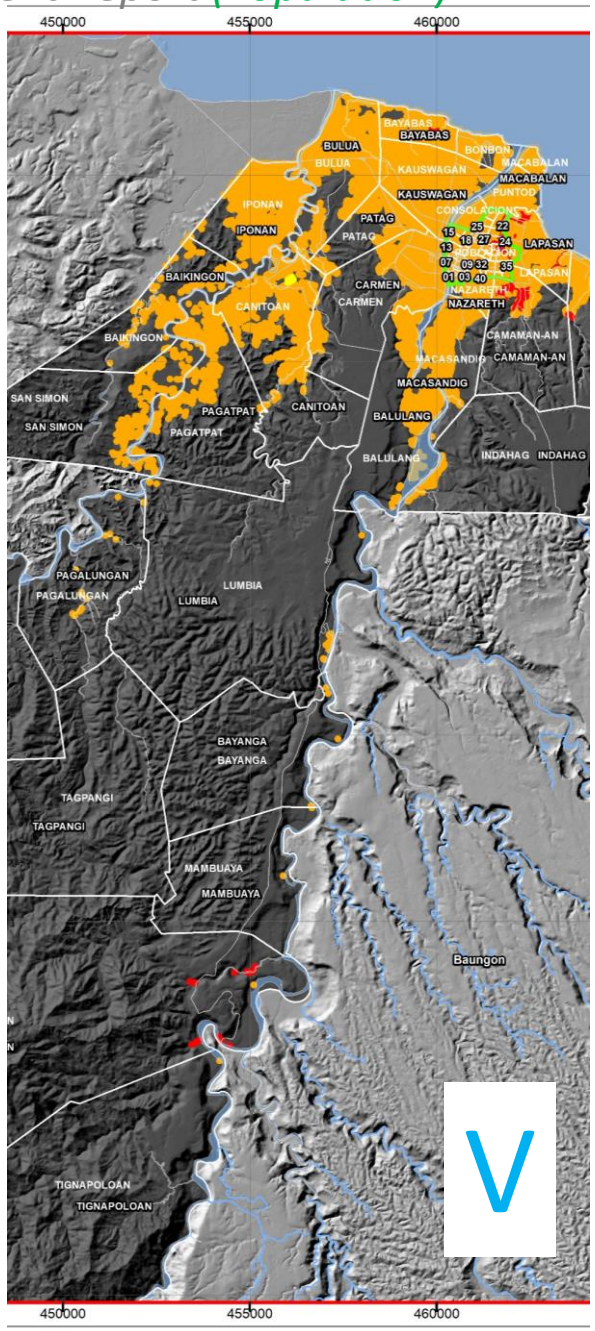


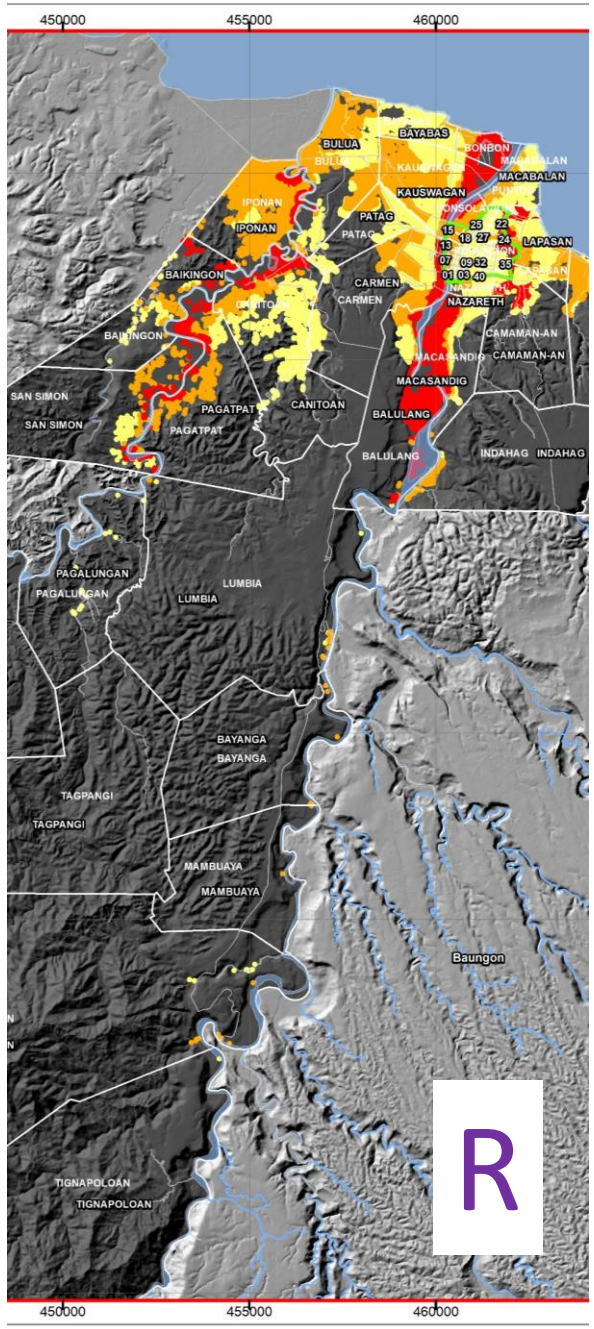


Source: Cagayan de Oro City – Climate and Disaster Risk Assessment Report (Population)

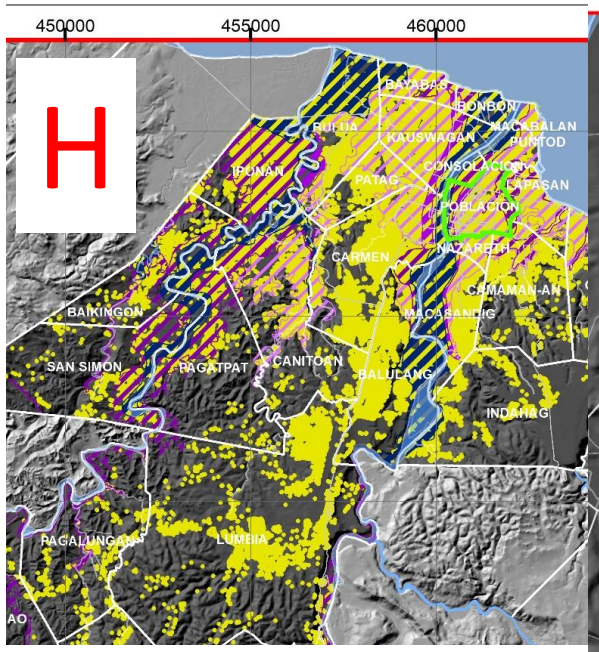


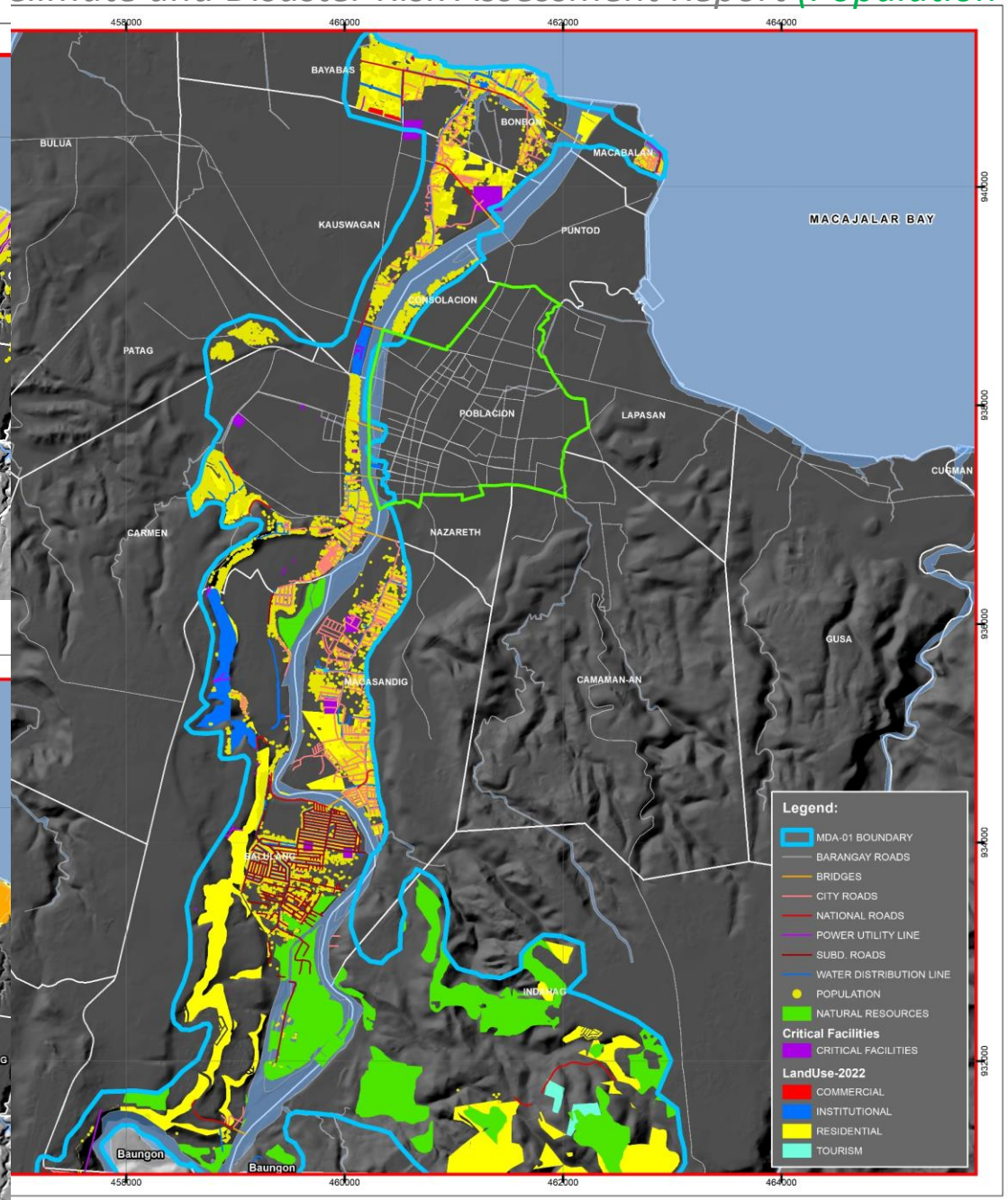


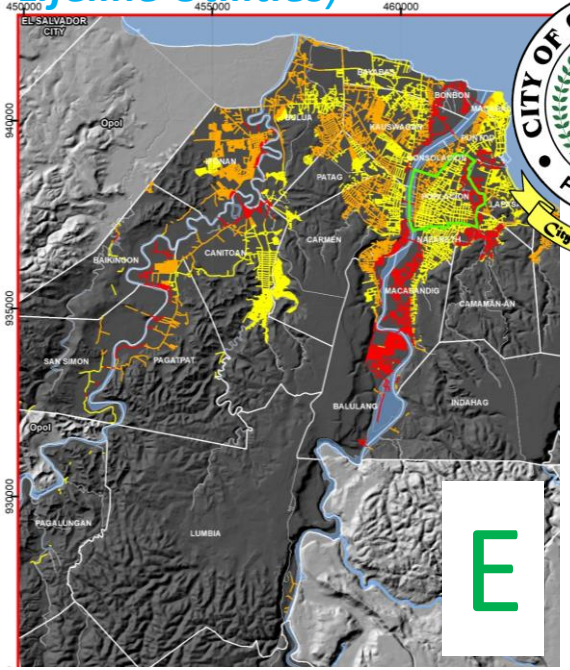


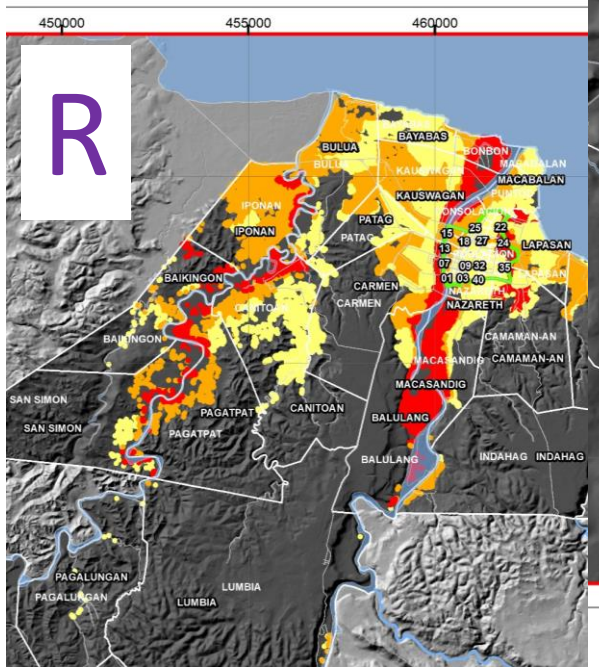


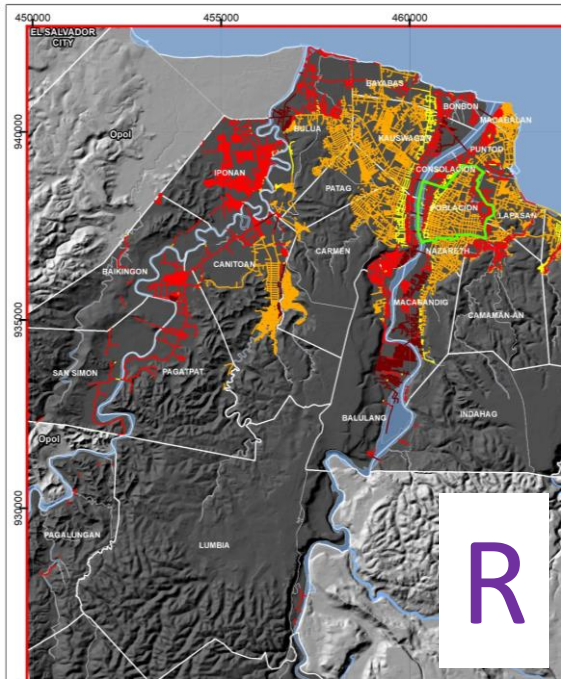
Source: Cagayan de Oro City – Climate and Disaster Risk Assessment Report (Population + Lifeline Utilities)











CITY OF CAGAYAN DE ORO
PHILIPPINES
City of Golden Friendship

Source: Cagayan de Oro City – Climate and Disaster Risk Assessment Report

DECISION AREA	TECHNICAL FINDINGS	HAZARD	IMPACT/ IMPLICATIONS	POLICY INTERVENTIONS
MDA 1 1. Lumbia 2. Indahag 3. Balulang 4. Macasandig 5. Carmen 6. Nazareth 7. 01 8. 02 9. 06 10. 07 11. 10 12. Consolacion 13. Kauswagan 14. Bonbon 15. Macabalan 16. Bayabas 17. Patag	**FLOODING:** **Affected Barangays** • Barangay 1 • Barangay 17 • Barangay 7 • Balulang • Bonbon • Carmen • Kauswagan • Macabalan • Macasandig **Population** • A total of **11,411 Households** are affected • **39,799 individuals** are affected • **3,230 affected Households** are living in light materials. • **6,100** affected **young and old dependents** • **98** affected **PWD** • **6,674** affected individuals **living under the Poverty Threshold** • **1,417** affected **ISF** **Critical Point Facilities** • **60 affected facilities** consisting of; • **2** Cell Site • **14** Education • **5** Gov't Offices • **3** Health	**Flooding** -Road flooding, Partly Residential and Commercial flooding -Increase Soil Erosion	**Health** Increase number of cases of Diseases & injuries High Volume of Stranded Commuters & Motorist Inaccessibility of medical Institutions Disruption of Livelihood, affect people's income, Increase IDP's Evac of Affected Families Hampered Schools Activities **Coastal** Negative effect to Sea grass and mangroves Growth, fish reproduction and survival rate **Water Resource** Water supply shortage, low pressure, contamination of water supply, salt water intrusion	Formulation/update Contingency Plan, Relocation of ISF,Identify additional relocation areas Establishment of early warning device Flood mitigation Infrastructure IEC Develop/improve drainage systems Land banking Implementation of dredging masterplan for CDO river

Xavier University
ATENEO DE CAGAYAN

Social Development Office

Rm 103, Agriculture Building
Xavier University Main Campus
Corrales Avenue, Cagayan de Oro
City Philippines

+63 88 853 9800 ext 9173

xu.edu.ph/social-development

vpsocdev@xu.edu.ph

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