Tomorrow's CITIES
Urban Risk in Transition

RISK INFORMED AND PARTICIPATORY PLANNING FOR RESILIENT FUTURE CITIES: SHOWCASING THE TOMORROW'S CITIES DECISION SUPPORT ENVIRONMENT (TCDSE) IMPLEMENTATION IN TOMORROW'S RAPTI

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Dr Prashant Rawal - Research Associate/Capacity Strengthening Instructor - Tomorrow's Cities.

June 21, 2024

UK Research and Innovation

GCRF
Global Challenges Research Fund

Economy, Jobs, Infrastructure,
Health, Education


WP0
City Scoping and Set ups
Incorporate what we missed - next iteration
OPTIONS FOR REDUCED-RISK FUTURES
Integration into ongoing pro-poor, risk based urban planning decision-making processes including capacity building; citizen participation
· Evaluation
WP5
Institutionalization
1. FUTURE VISIONING
· Communities
· Government
· Researchers
...
2. VISIONING SCENARIOS
POLICY BUNDLES
URBAN PLANNING
3. COMPUTATIONAL MODEL
MULTI-HAZARD MODELLING
SOCIAL IMPACT
PHYSICAL INFRASTRUCTURE IMPACT
COMPUTED IMPACT METRICS
IMPACT METRIC WEIGHTS
· Agreed Risk
4. RISK AGREEMENT
· Communities
· Government
· Researchers
VISIONING SCENARIO ASSESSMENT
· Consequences for the urban poor
· Consequences for Climate Resilient Development
Decision Support Environment
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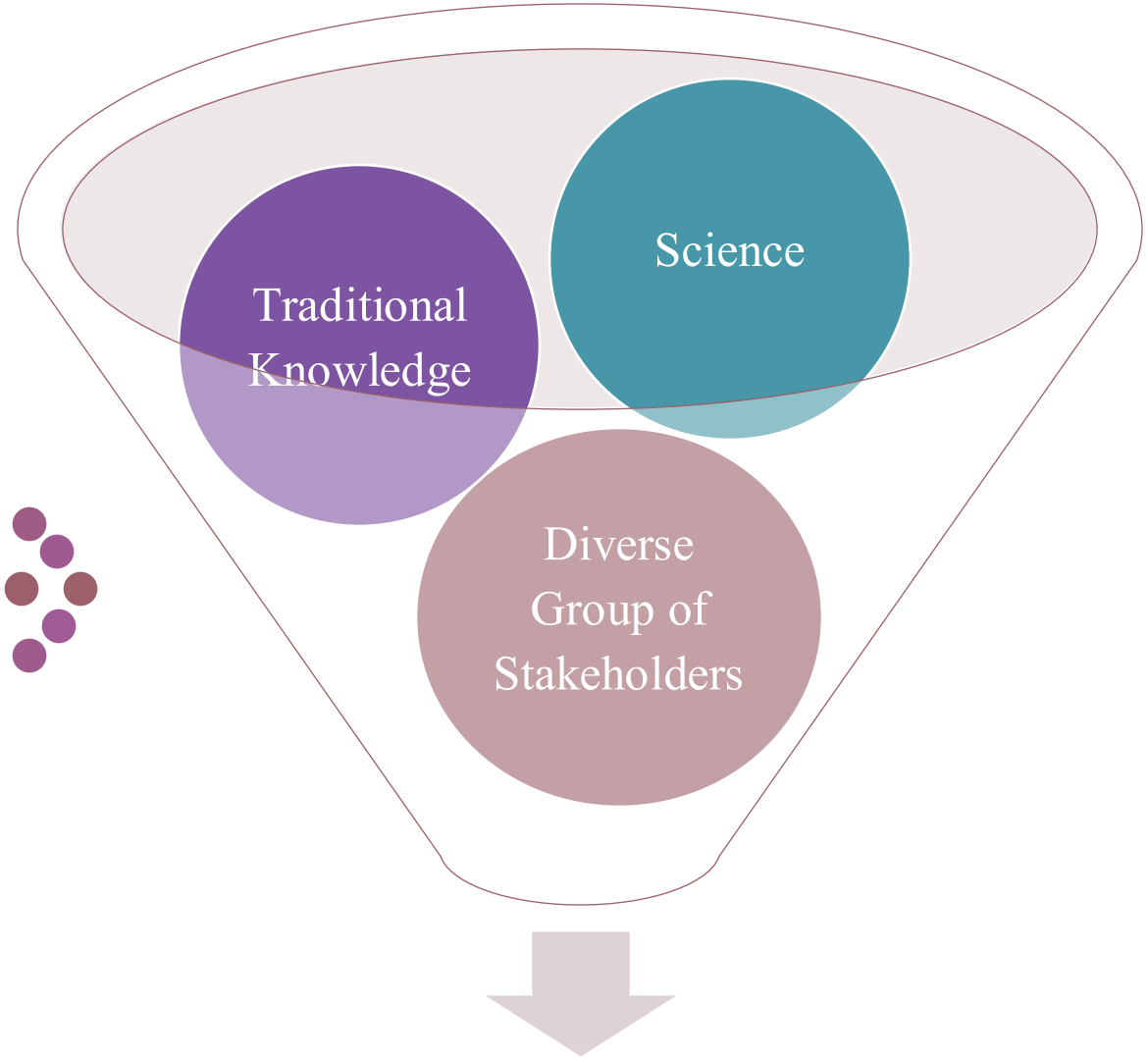
Discussing Aspirations and co producing a shared vision



Disaster Resilient Future

From Khokana to the World

From Khokana to the World

Towards Implementation at Rapti - Capital of the Lumbini Province

Participatory Process - Sowing the seed by the hands of the Community themselves

Individual Aspirations

Group Aspirations

Where they fit in the Urban assets

Co Mapping

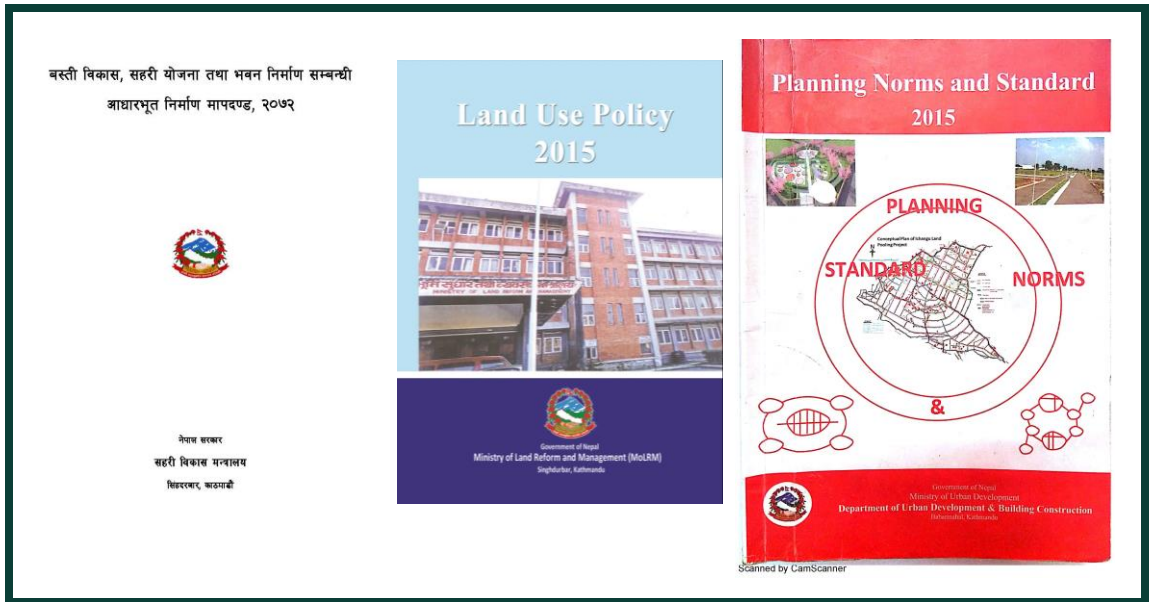
Aspired Policies

6 Co produced maps from the community

Morphing Co Produced maps to Realistic Visioning Scenarios

6 Co produced maps from the community

Urban Planners, Engineers, Social Scientists



Refined Digitized Visioning Scenarios

Validation of the Developed Scenarios

NSET Disaster Resilient Communities in Nepal | NDRI | SIAS SOUTHASIA INSTITUTE OF ADVANCED STUDIES | Practical ACTION | Tomorrow's CITIES Urban Risk in Transition | UK Research and Innovation | GCRF

भावी राप्ती शहरको परिदृश्य निर्माण सम्बन्धी कार्यशाला

Validation Workshop on Visioning Scenario Development for Tomorrow's Rapti

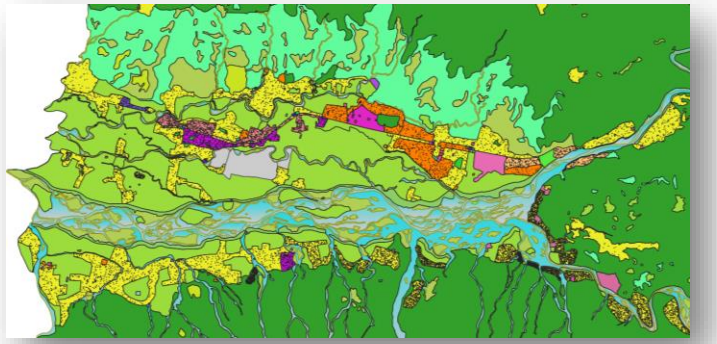
भदौ २८-२९, २०८० September 14-15, 2023

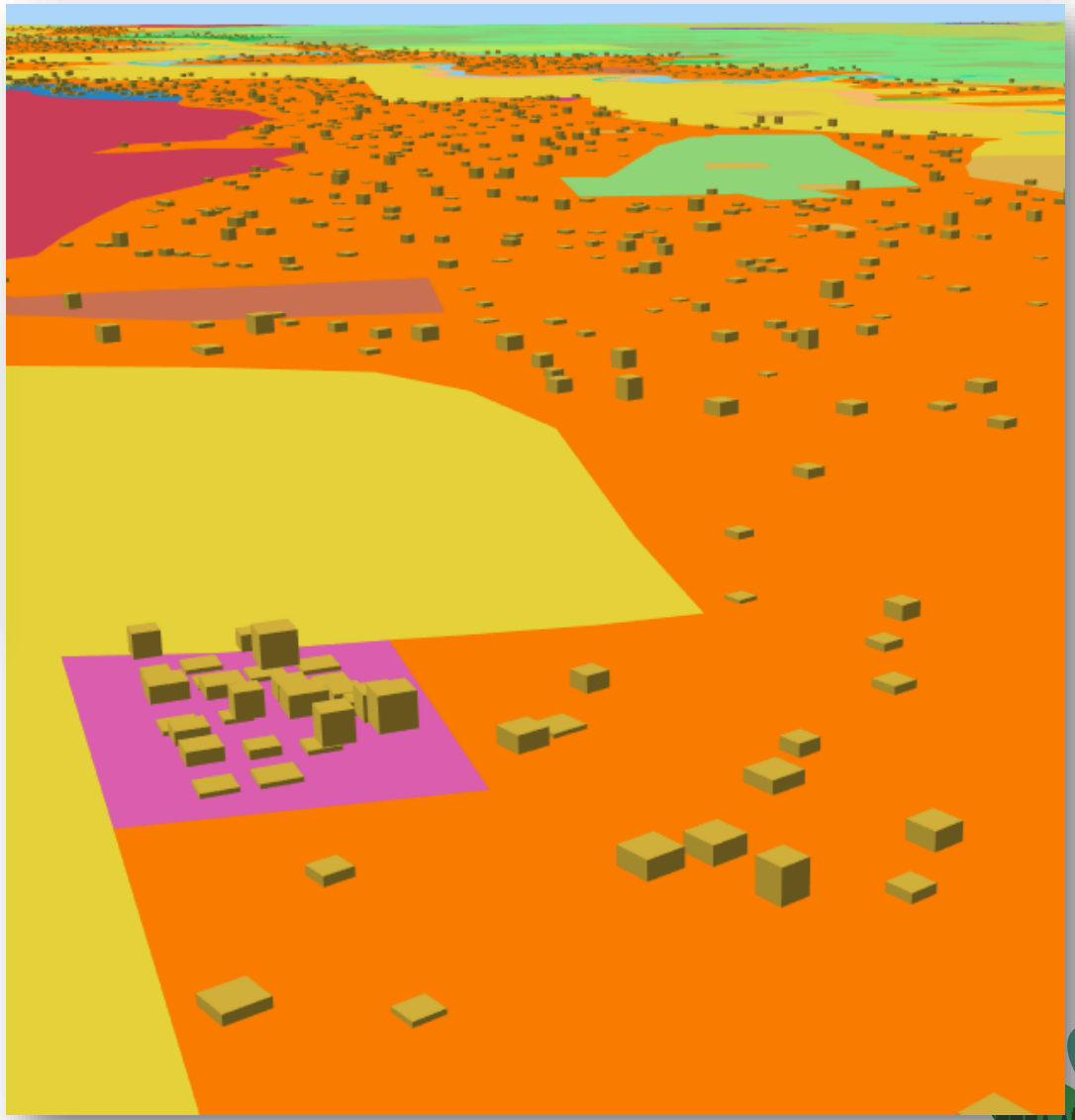
आयोजक:
प्रदेश पूर्वाधार विकास प्राधिकरण, लुम्बिनी प्रदेश, नेपाल
भोलिको शहर परियोजना, राष्ट्रिय तथा अन्तराष्ट्रिय अनुसन्धान टोली

Organizers:
Provincial Infrastructure Development Authority, Lumbini Province, Nepal
Tomorrow's Cities National and International Team

Exposure Data Generation

- No. of household
- Average income distribution
- Gender distribution
- Age distribution
- Storey height distribution
- Building Usage
- Building Type
- Education level
- Employment
- ……





Exposure Data Generation Process

The Tomorrow's Cities Framework uses the following exposure datasets:

- Building
- Household
- Individual
- Road network
- Power network

The building, household and individual exposure data is generated using the data generator module in Tomorrow's Cities WebApp.

The road and power network datasets are manually prepared, which are used for network analysis.

The exposure data is needed to compute the impact metrics, which are used to judge the resilience of a land use plan to natural hazards.

Number of workers unemployed

Number of households displaced

Number of children with no access to education

Number of homeless individuals

Number of households with no access to hospital

Population displaced

Number of individuals with no access to hospital

Number of casualties

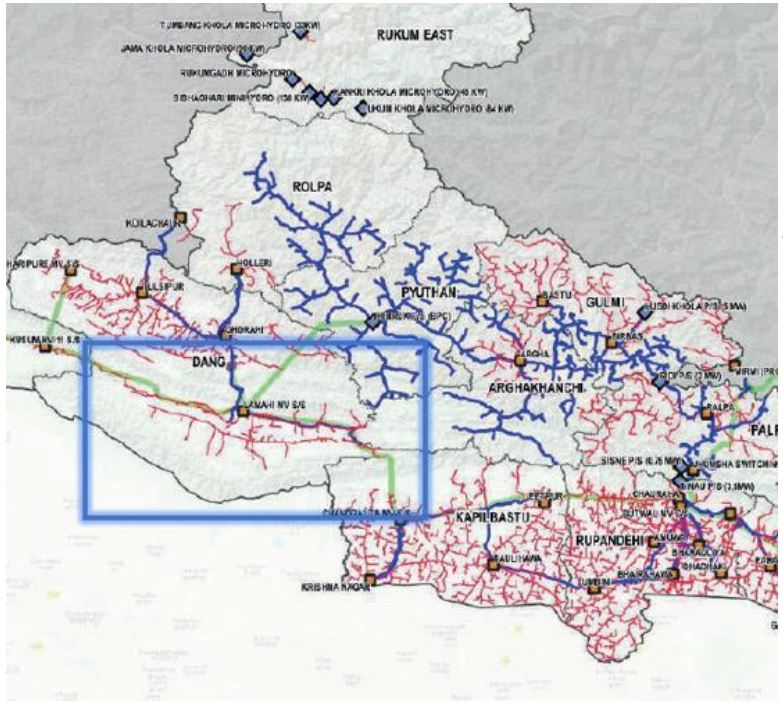
The power infrastructure input data for the network analysis currently includes:

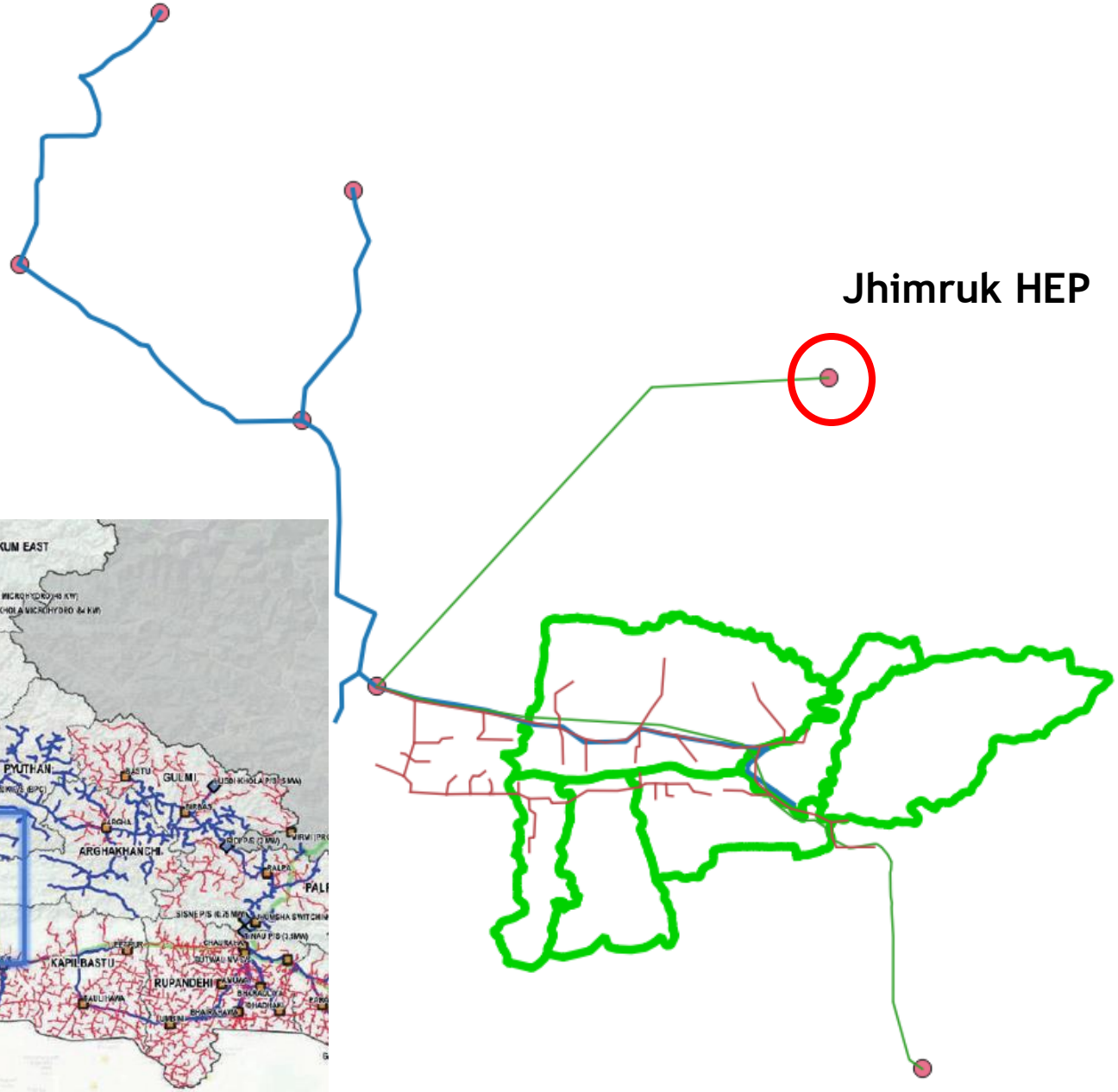
1) Substations

2) Transmission lines

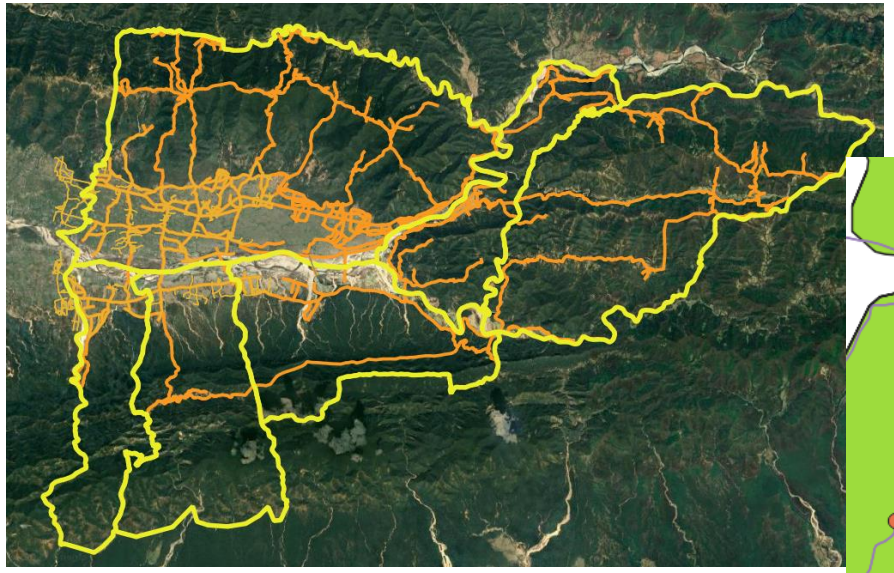
3) Hydropower plant

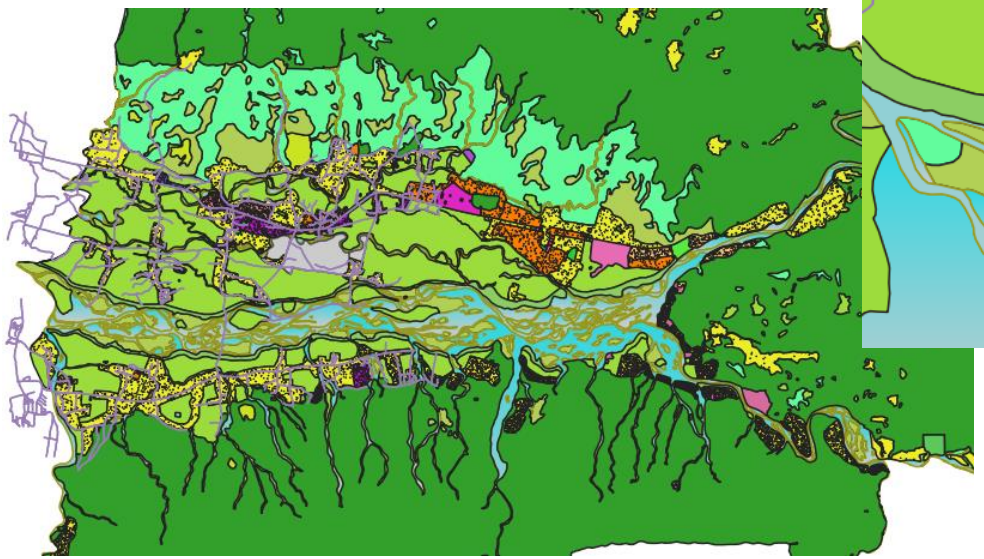
This has been prepared by digitizing the power network maps provided by the Nepal Electricity Authority





The road network data is also derived using existing data. Location of bridges is the key component here.



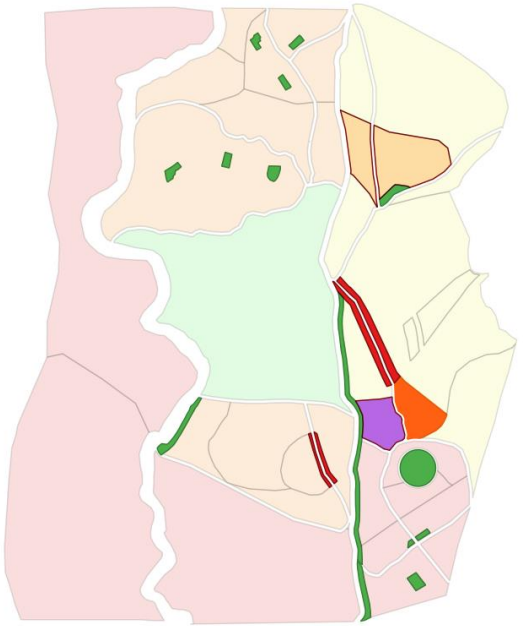


Why is exposure data generation needed?

Data generation is needed to simulate future data, and refers to:

The process of generating detailed attributes for **individuals**, **households** and **buildings** based on land use data and probability distributions.

Land use layer (input)



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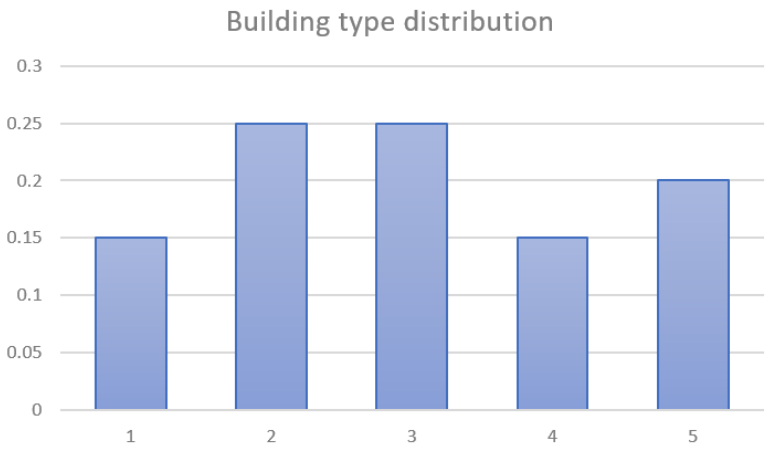
Probability distributions (input)



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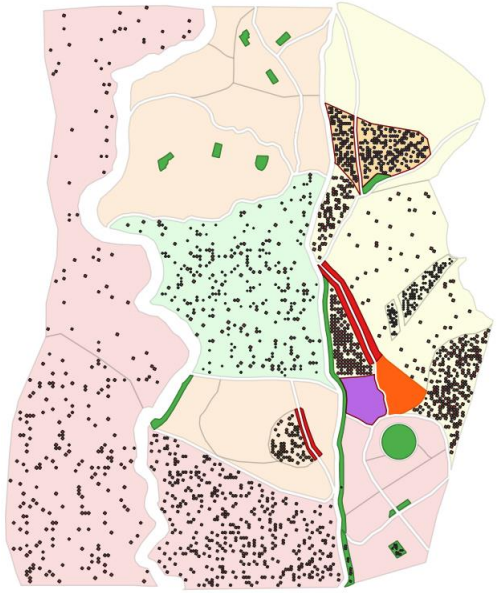
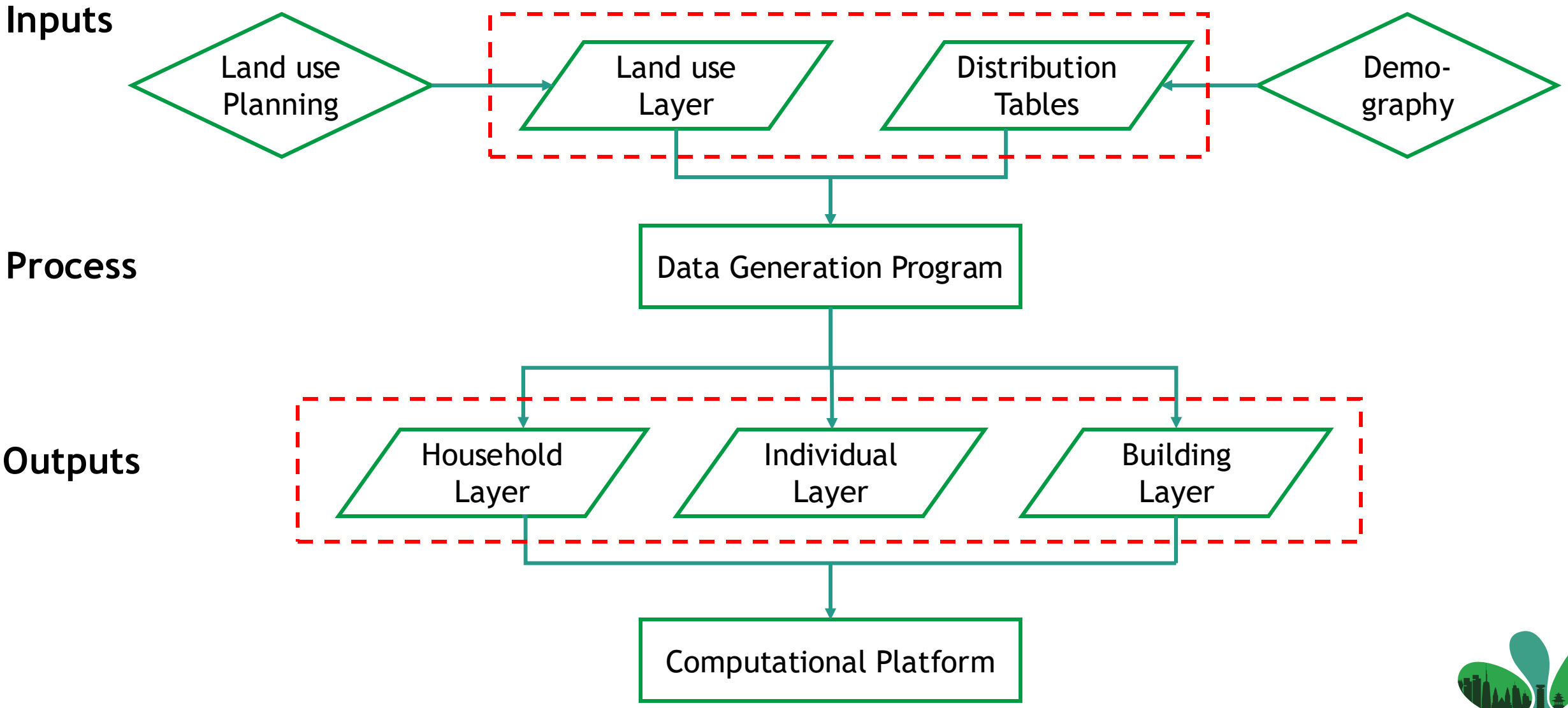
Attribute layers for individuals, households & buildings (output)



Data generation process overview



Github repository for exposure data generation program: https://github.com/TomorrowsCities/DataProductionPython

Spyder (Python 3.8)

File Edit Search Source Run Debug Consoles Projects Tools View Help

...ers\PR\Documents\NSET\TomorrowCities_CodeDev\DataProductionPython\p1_DataGeneration\DataGenerator.py

DataGenerator.py

```
169  #%% The data generation process begins here
170
171  #%% Step 1: Calculate maximum population (nPeople)
175  #%% Step 2: Calculate the number of households (nHouse), hhID
212  #%% Step 3: Identify the household size and assign "nInd" values to
248  #%% Step 4: Identify and assign income type of the households
278  #%% Step 5: Identify and assign a unique ID for each  individual
291  #%% Step 6: Identify and assign gender for each individual
307  #%% Step 7: Identify and assign age for each individual
325  #%% Step 8: Identify and assign education attainment status for each
350  #%% Step 9: Identify and assign the head of household to correspondi
386  #%% Step 10: Identify and assign the household that each individual
410  #%% Step 10a: Identify school enrollment for each individual
493  #%% Step 11: Identify total residential building area (totalbldarea_
512  #%% Note on Land use types (LUT), load resisting system (LRS) and st
544  #%% Steps 12,13,14,15:
662  #%% Assign zoneIDs
663  # Assign 'ResCom' status based on Table 9
664  # Assumption: Total residential buildings = Res + ResCom
665  # Convert Table 9 to numpy array
666  # Table 9 contains occupancy type with respect to various LUT
667  # Occupancy types: Residential (Res), Industrial (Ind), Commercial (
668  # Residential and commercial mixed (ResCom)
669  for row in range((len(tables['t9'][0]))):
670      tables['t9'][0][row]=np.fromstring(tables['t9'][0][row],dtype=fl
671  t9 = np.array(tables['t9'][0]) # Table 9
672
673  available_LUT = list(set(landuse_res_df['LuF']))
674  for lut in available_LUT: #Loop through zones
675      lut_zone = landuse_res_df['LuF'][i]
676      lutidx[lut_zone]
677      #print(lut_zone)
```

https://github.com/TomorrowsCities/DataProductionPython

TomorrowsCities / DataProductionPython

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DataProductionPython Private

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main 2 Branches 0 Tags Go to file t Add file Code

hkayabilisim Merge pull request #2 from TomorrowsCities/doc_test c3475f4 · 2 months ago 90 Commits

src	Non-unique building id issue debug	4 months ago
.gitmodules	Reorganized, added flood_vulnerability_generator	last year
README.md	docs: added a single line for tesing	2 months ago
TableStructure.xlsx	Add files via upload	2 years ago

README

Data Generator Engine

Demographic data tables (9)

Table number	Table name	Potential Data Source
1	Individuals in a household	Census
2	Average Income Distribution	Census + Economic reports
3	Gender Distribution	Census
4	Age Profile with respect to gender	Census
5	Education Attainment Status with respect to gender	Census
5a	School Enrollment with respect to Household income and Education attainment (EA) status of Household Head	This data may not be available directly from census and may need to be assumed reasonably.
6	Head of Household	Census
12	Labor Force participation with respect to Gender	Census + Economic reports
13	Employment Probability Distribution with respect to Education Attainment (EA) Status and Gender	This data may not be directly available and may need to be assumed based on census data and economic reports.

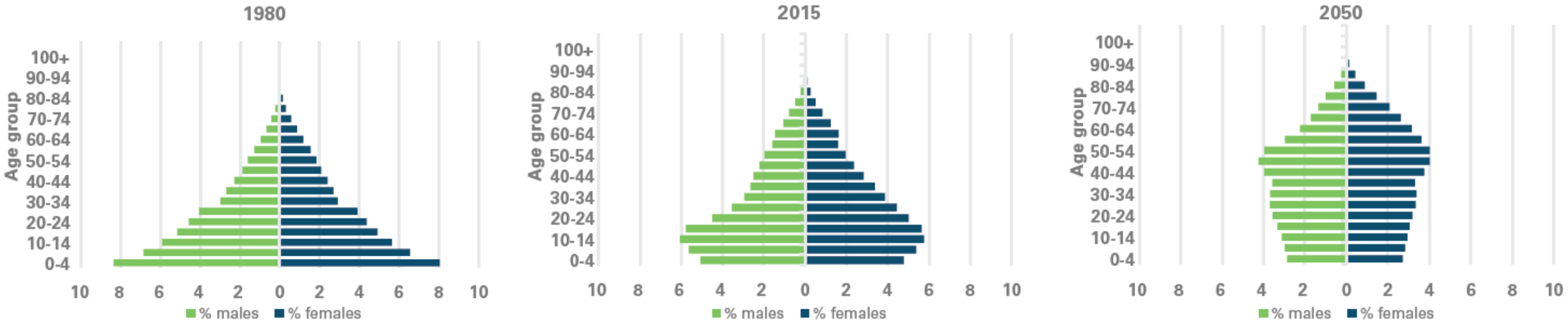
Building data tables (6)

Table number	Table name	Potential Data Source
9	Occupancy type with respect to land use type (Zone Assignment)	To be decided by land use planners
7	Number of storeys for different land use types and load resisting systems (LRS)	To be decided by land use planners
8	LRS with respect to land use type	To be decided by land use planners based on census data
11	Code compliance level with respect to LRS and land use type	This data may not be available, and may need to be assumed reasonably
10	Commercial and Industrial buildings information	GEM global exposure model or any national dataset
14	School and hospital buildings information	Assumptions based on GEM global exposure model or any national dataset

Other Assumptions (8)

Assumption	Potential Data Source
No. of commercial buildings per 1000 individuals	GEM global exposure model or any national dataset
No. of industrial buildings per 1000 individuals	GEM global exposure model or any national dataset
Area constraints in percentage (AC) for industrial and commercial zones. Total built-up areas in these zones cannot exceed (AC*available area)	To be assumed by land use planner
Individuals per school	National development goals or any other standards
Individuals per hospital	National development goals or any other standards
Average dwelling area and building footprint range	GEM global exposure model or any national dataset
Definition of low, medium and high rise	To be assumed by land use planner
Replacement cost	GEM global exposure model or any national dataset

The population projection for 2050 is the basis of all exposure data inputs.



Age pyramids for 1980, 2015 and 2050, from National Planning Commission, Government of Nepal

Division of the land into appropriate land use zones is one of the key inputs.

Agricultural

City Centre

Industrial zone

Recreational

Residential

Commercial

Then, the percentage of different building types for each land use zones can be assumed.

Traditional Tharu buildings

Adobe buildings (Adb)

Brick with mud mortar (BrM)

Brick in cement with flexible diaphragm (BrCfl)

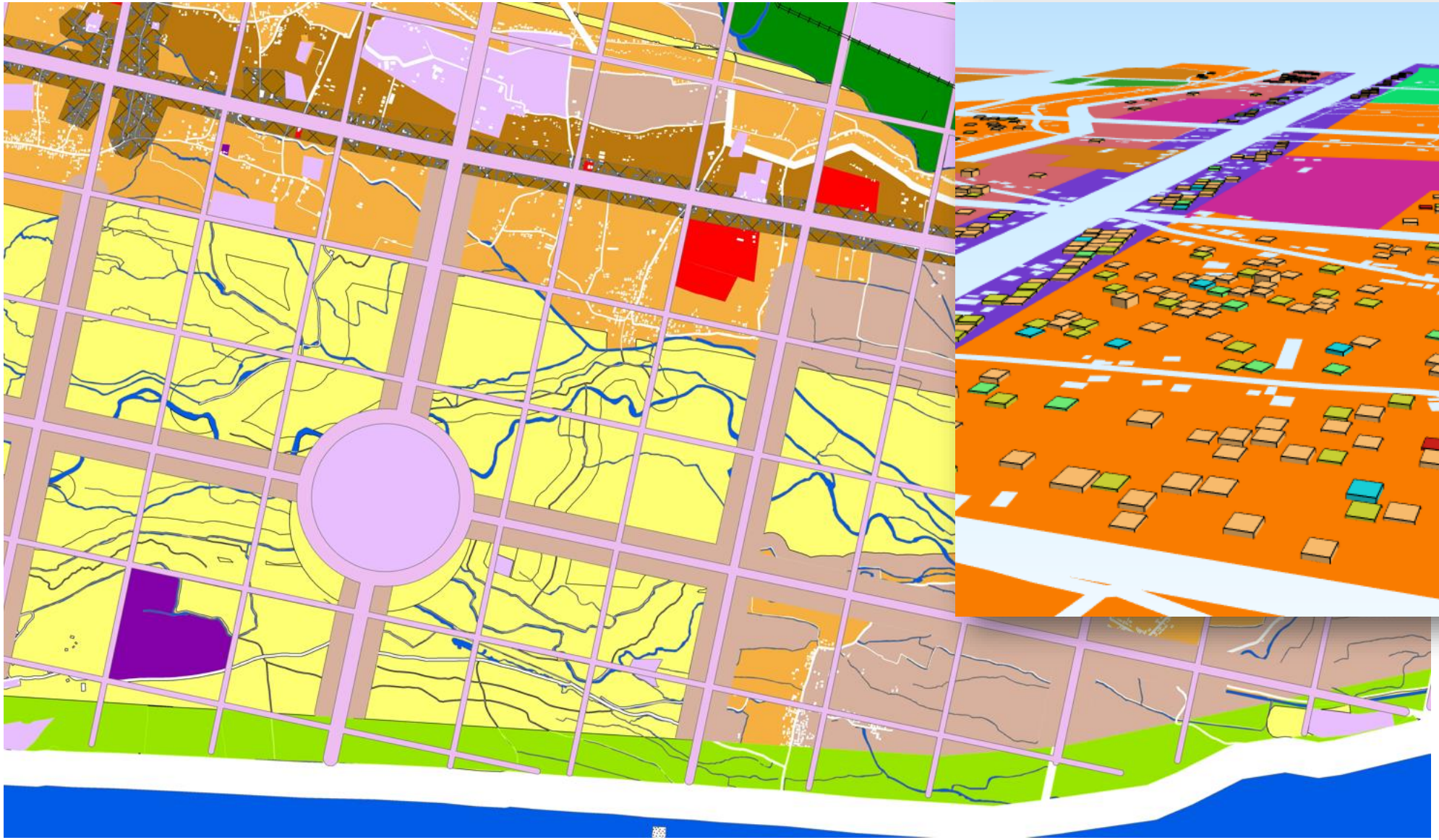
Brick in cement with rigid diaphragm (BrCri)

Reinforced Concrete (Rci)

An example of building type allocation for different land use zones.

Type of building	Residential	Commercial	Educational	Health	Industrial
Brick in cement with flexible diaphragm (BrCfl)	15	5	5	0	0
Brick in cement with rigid diaphragm (BrCri)	25	20	30	10	5
Brick with mud mortar (BrM)	25	5	10	5	0
Adobe (Adb)	15	0	0	0	0
Reinforced Concrete(Rci)	20	70	55	85	95

Structuring the land use as per planned grid layouts working directly with the implementing authorities

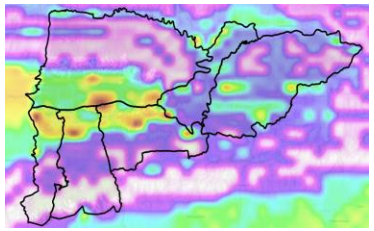


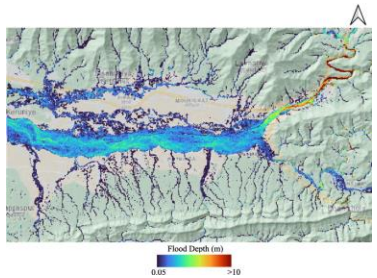
Physical and Social Impact Assessment

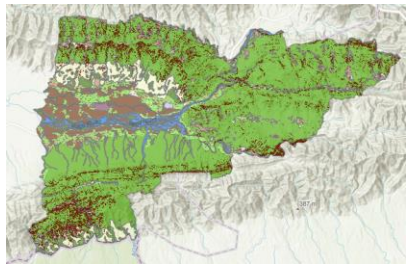
Earthquake

Flood

Landslide

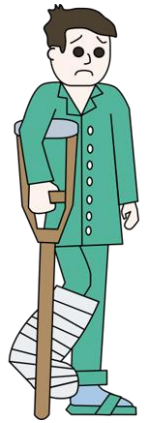






Hazard Assessment

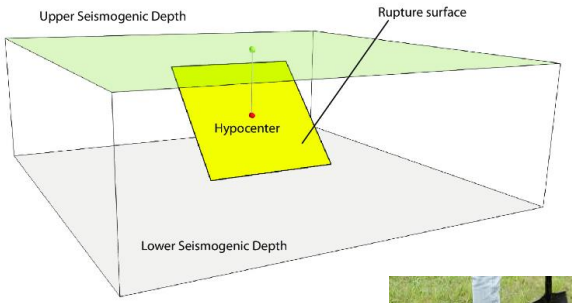
Physical Impact Assessment

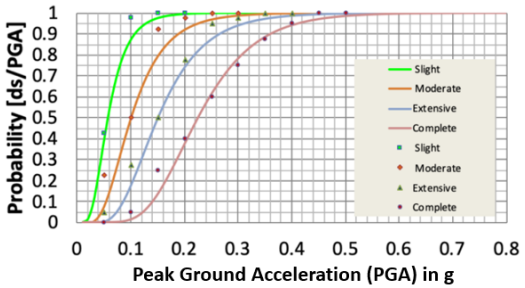


Social Impact Assessment

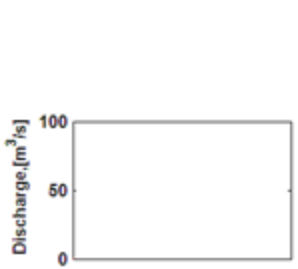
Source: NSET, freepik.com, stablediffusionweb.com, Richard Friedericks, Jenkins et al (2022)

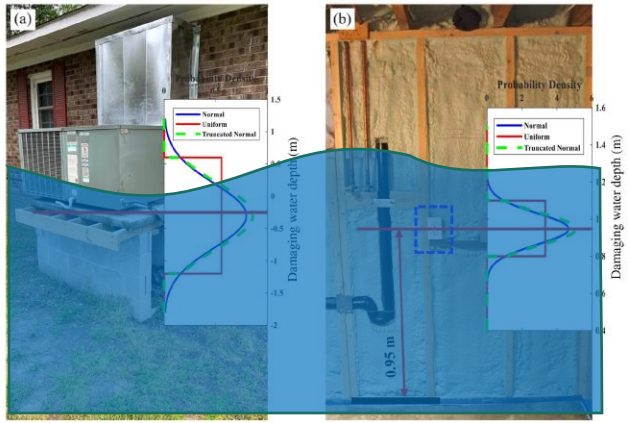
Hazard and Impact Assessments



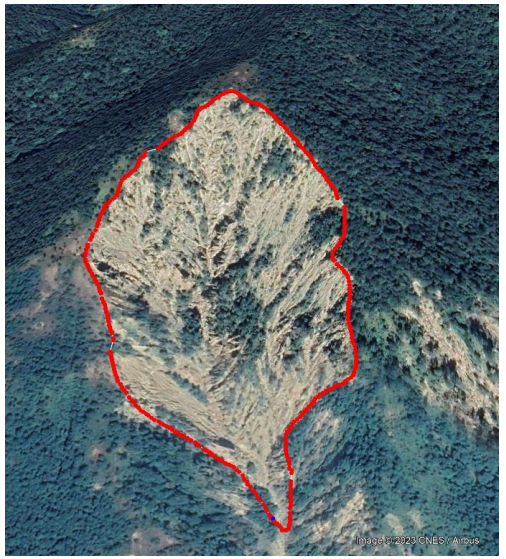


Earthquake





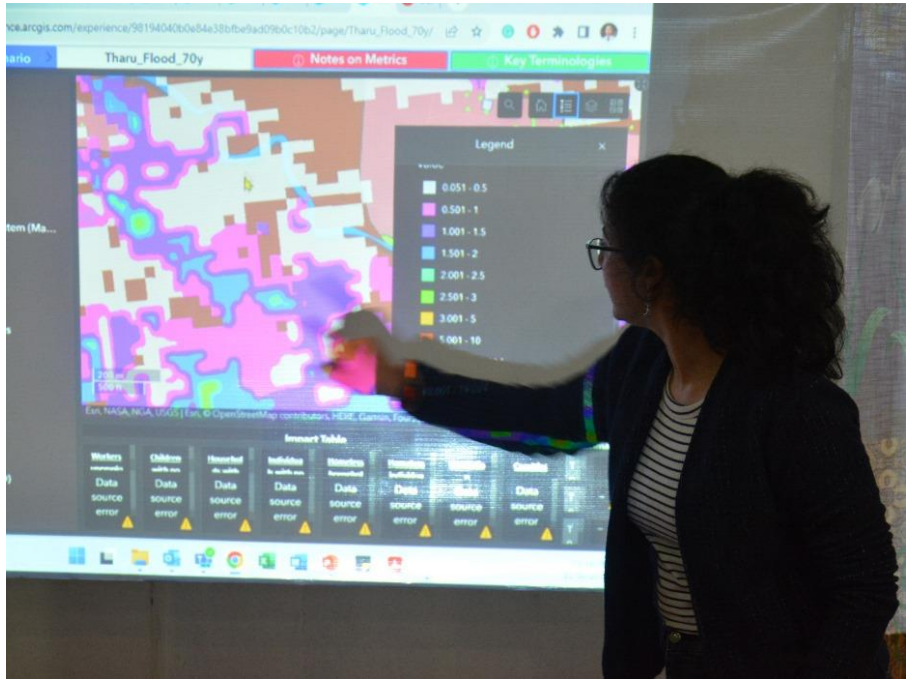
Flood



Landslide

Source : NSET, IOE, stablediffusionweb.com

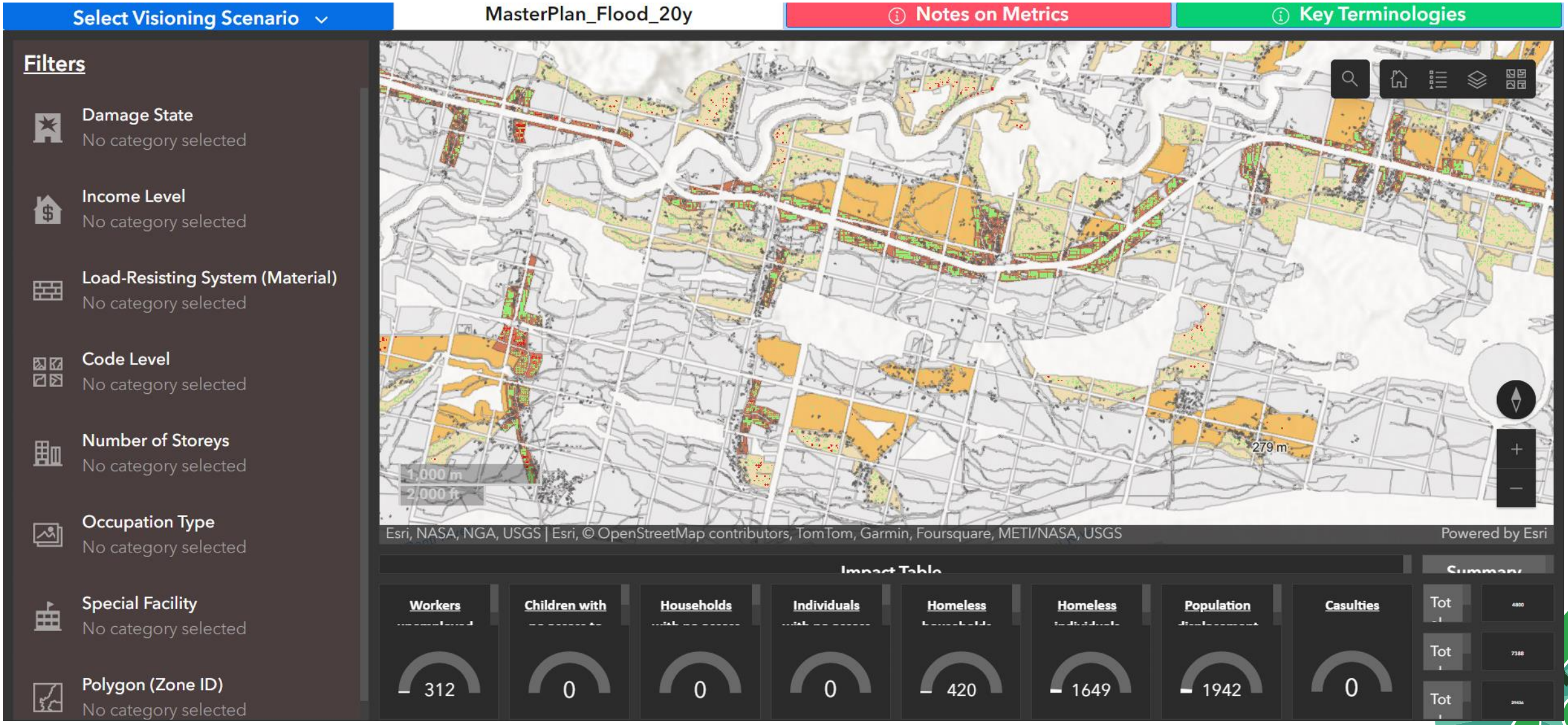
Going back to the Community with the results



Fostering Detailed and most importantly informed discussion on

Disaster Impact with the community

Presenting the exposure data, hazard maps and impact metrics using the TC dashboard



The exposure and hazard calculations finally allow us to ask the following questions to evaluate the land use plans.

- Which areas have high population?

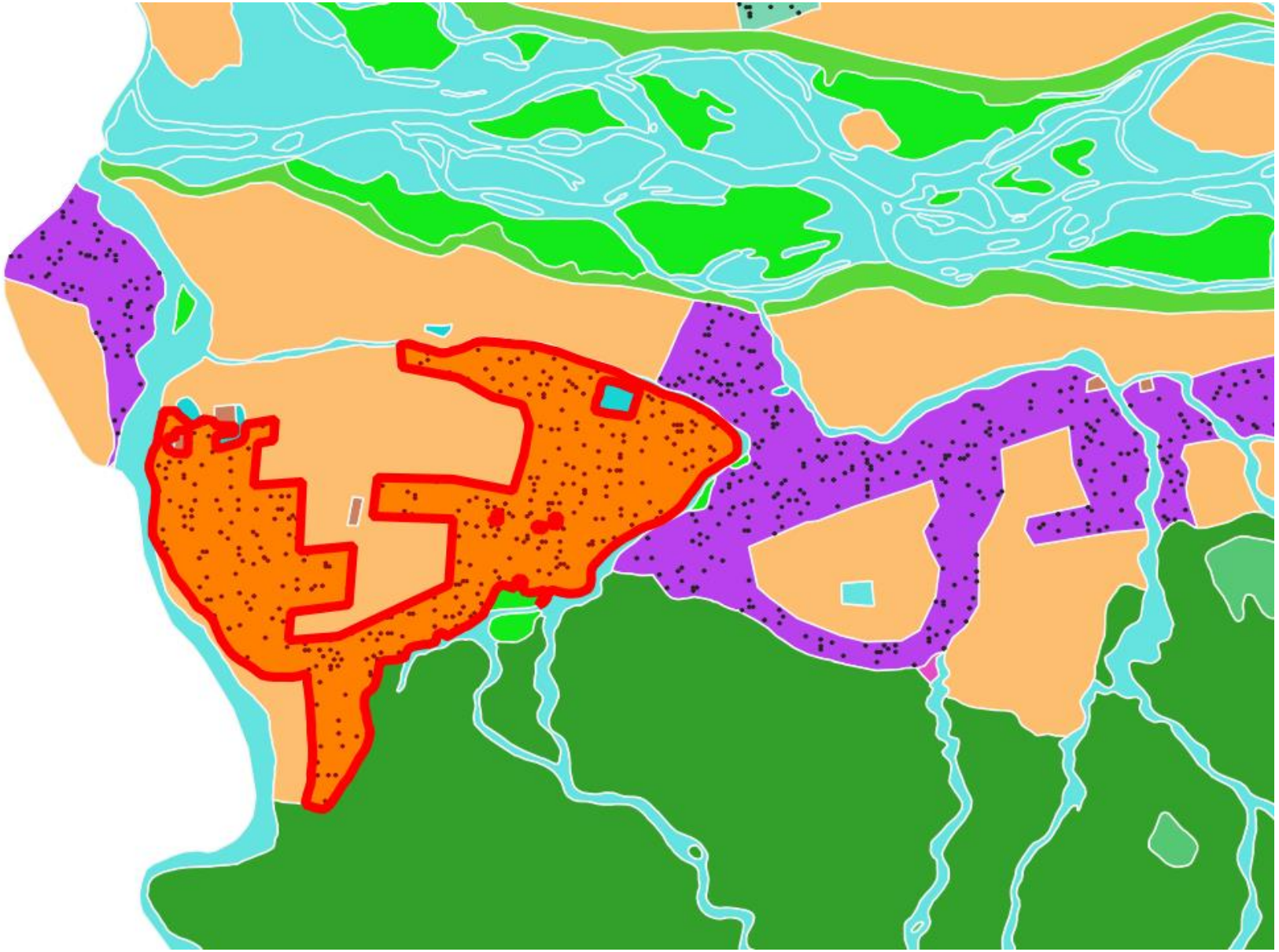
- Among high population zones, which areas have highest casualties? Why?

- Among high population zones, which areas have comparatively low casualties? What is the difference?

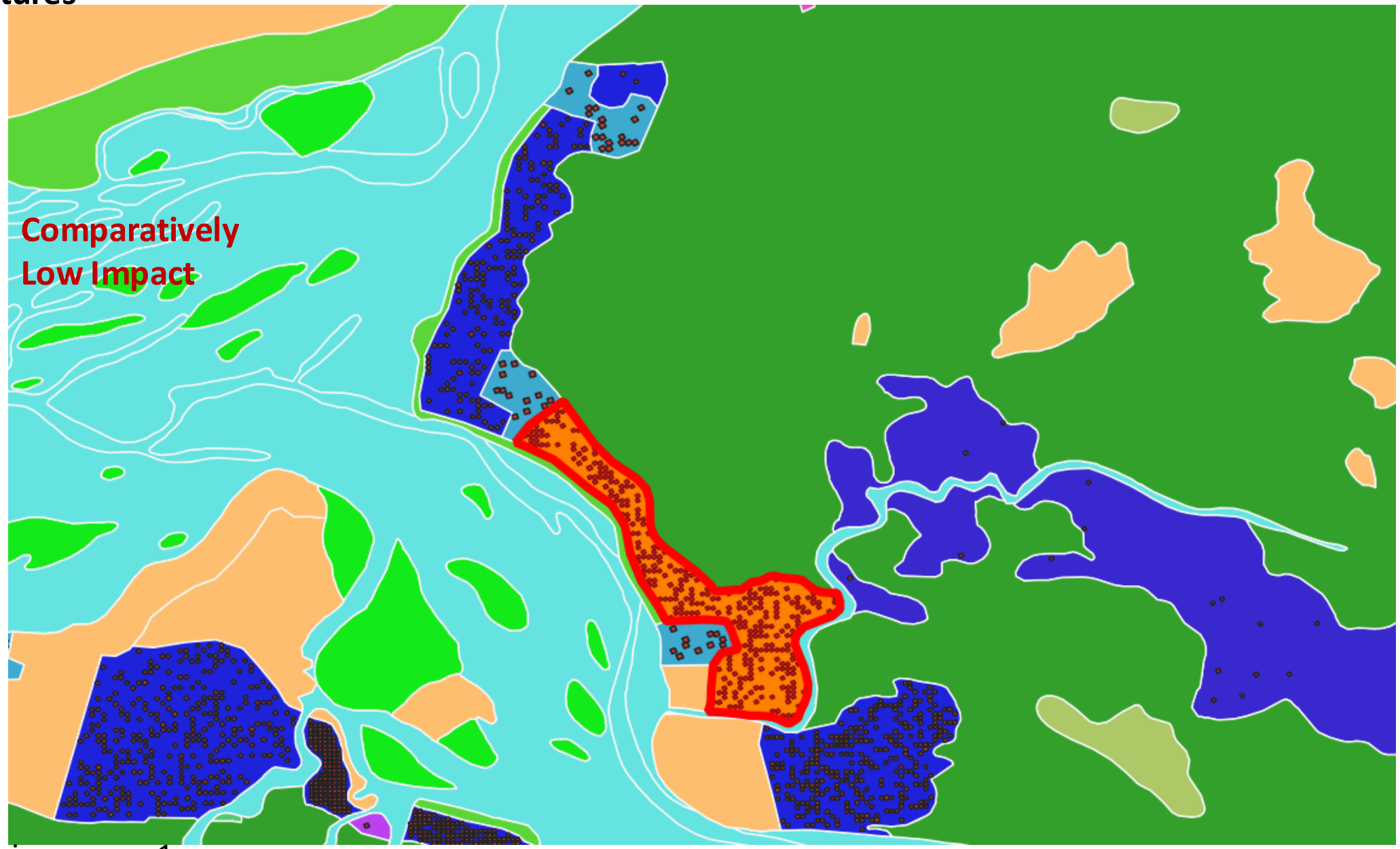
- What changes can be made to lower the casualties/impact?

Earthquake_8.2 for Polygon 587: **Population 4330, Casualties: 1461, Mostly Brick in mud masonry (BrM) structures**

High Impact



Earthquake_8.2 for Polygon 903: **Population 2054, Casualties: 333, Higher number of reinforced concrete structures**



ethnic_eq_case1

INFORMED discussion on Policies and Actions

The result of these informed discussions were then incorporated into the Masterplan

Resolution signed among Policy makers and Decision Makers at Lumbini Province for Implementation of the developed Masterplan and other DRR strategies

Discussion on the Prepared masterplan with the 14 ward chiefs

Action Planning and Institutionalization

Chief Secretary, Lumbini Province

Poster Presentation and Exhibition

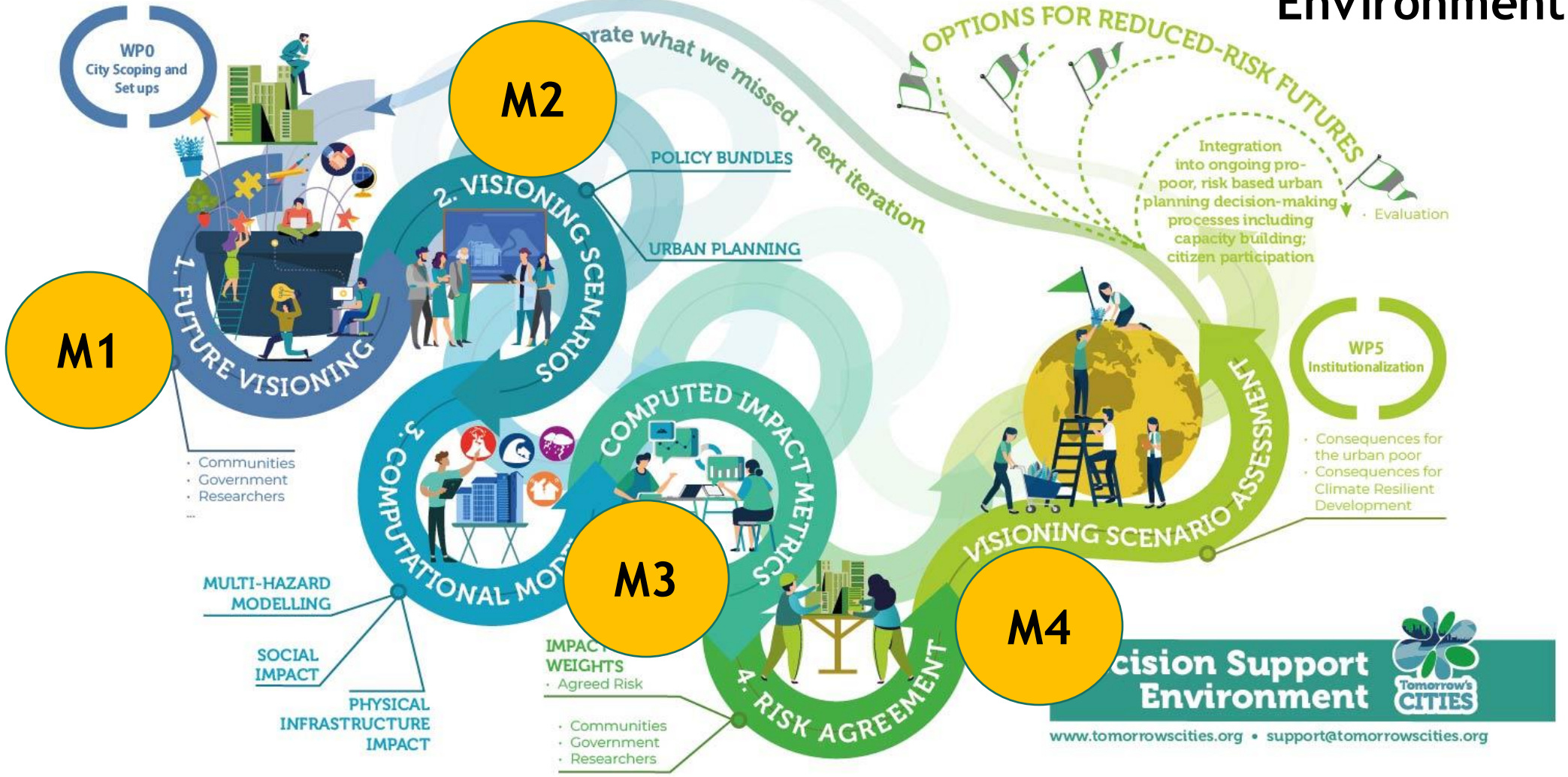
Chief Executive, NDRRMA

CEO, PIDA

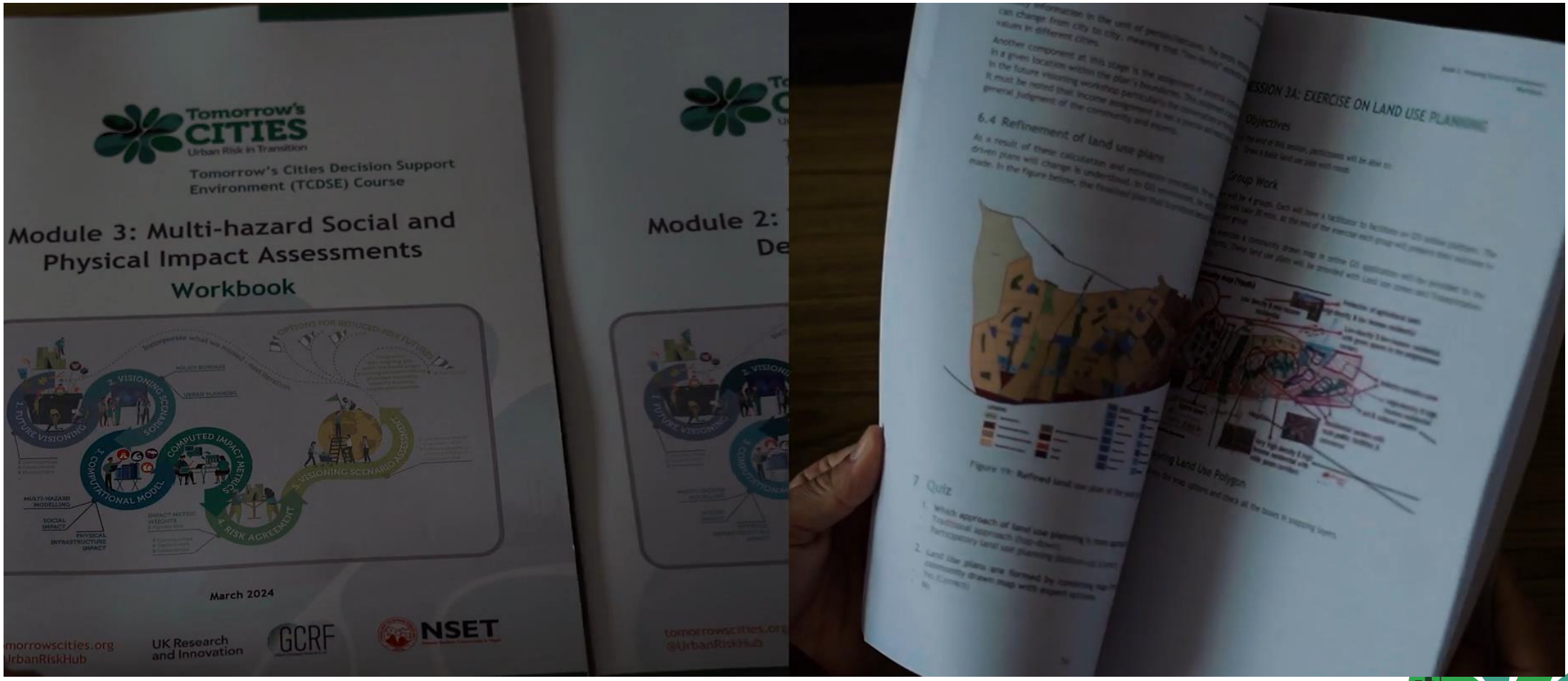
What NEXT ?

1. Capacity Strengthening

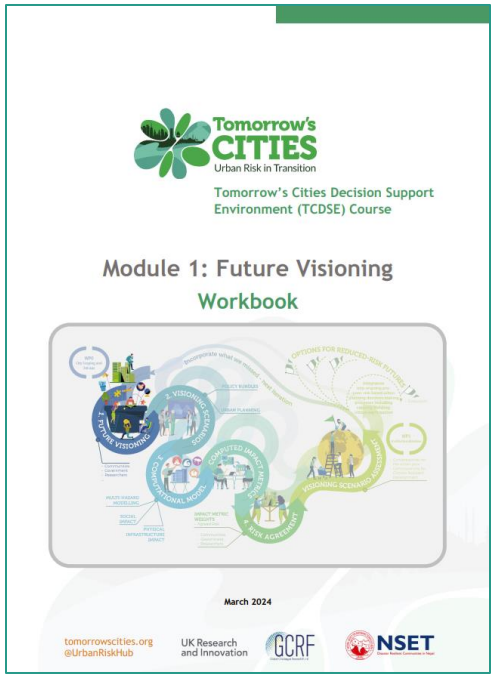
Modules based on Work Packages of Tomorrow's Cities Decision Support Environment (TCDSE)



Capacity Strengthening Program to empower local communities !



4 Modules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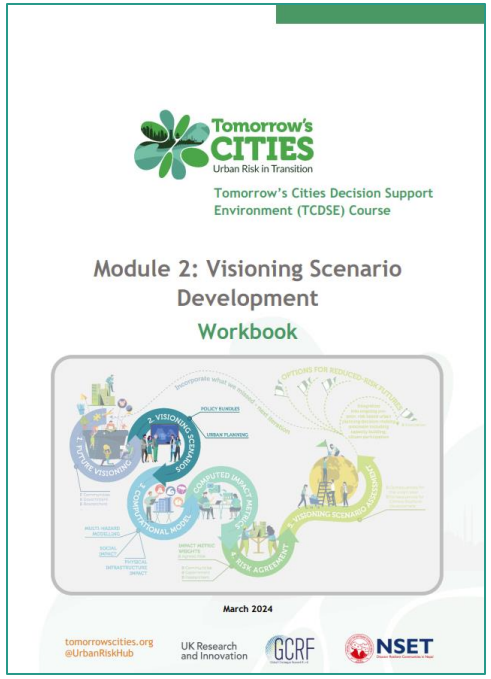
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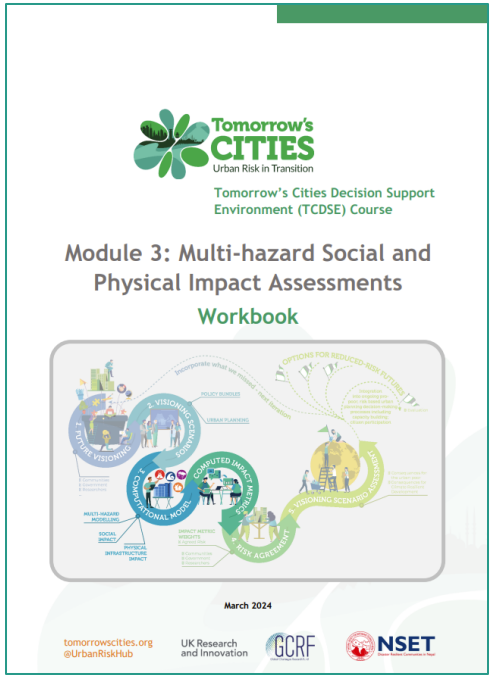
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Module 3: Multi-hazard Social and Physical Impact Assessments
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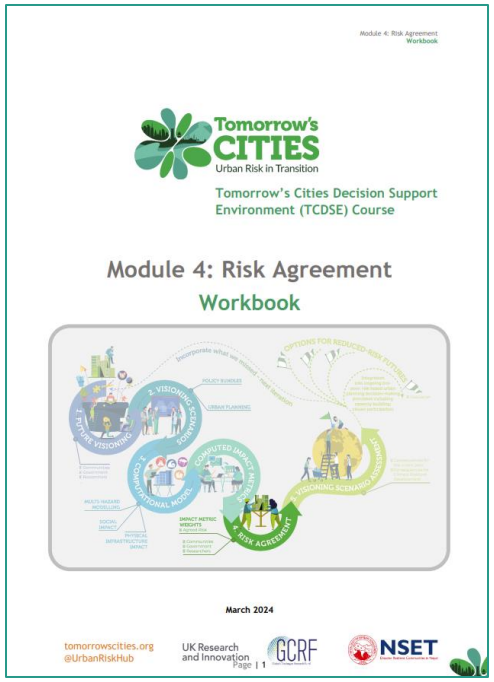
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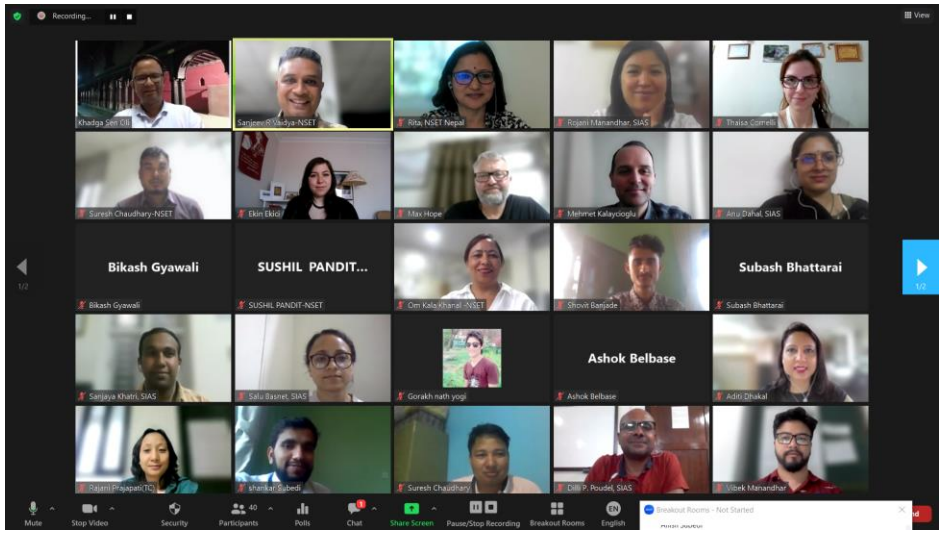
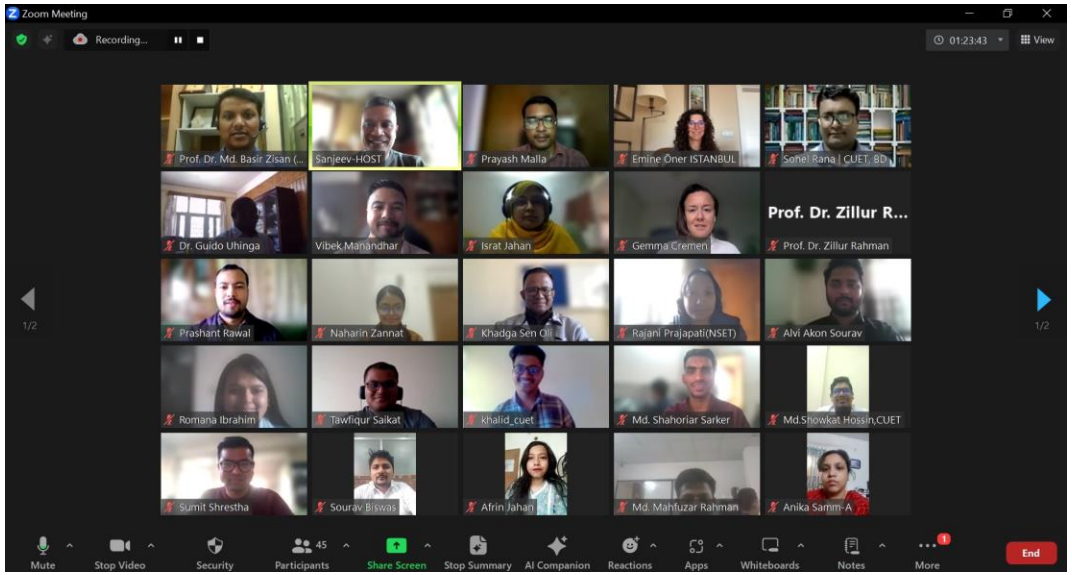
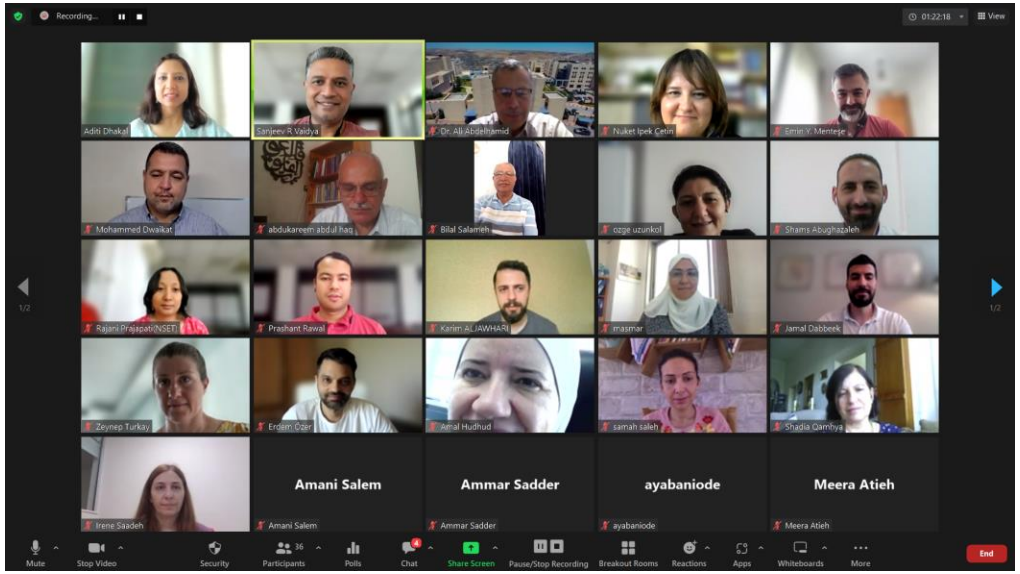
Online Trainings



Rapti

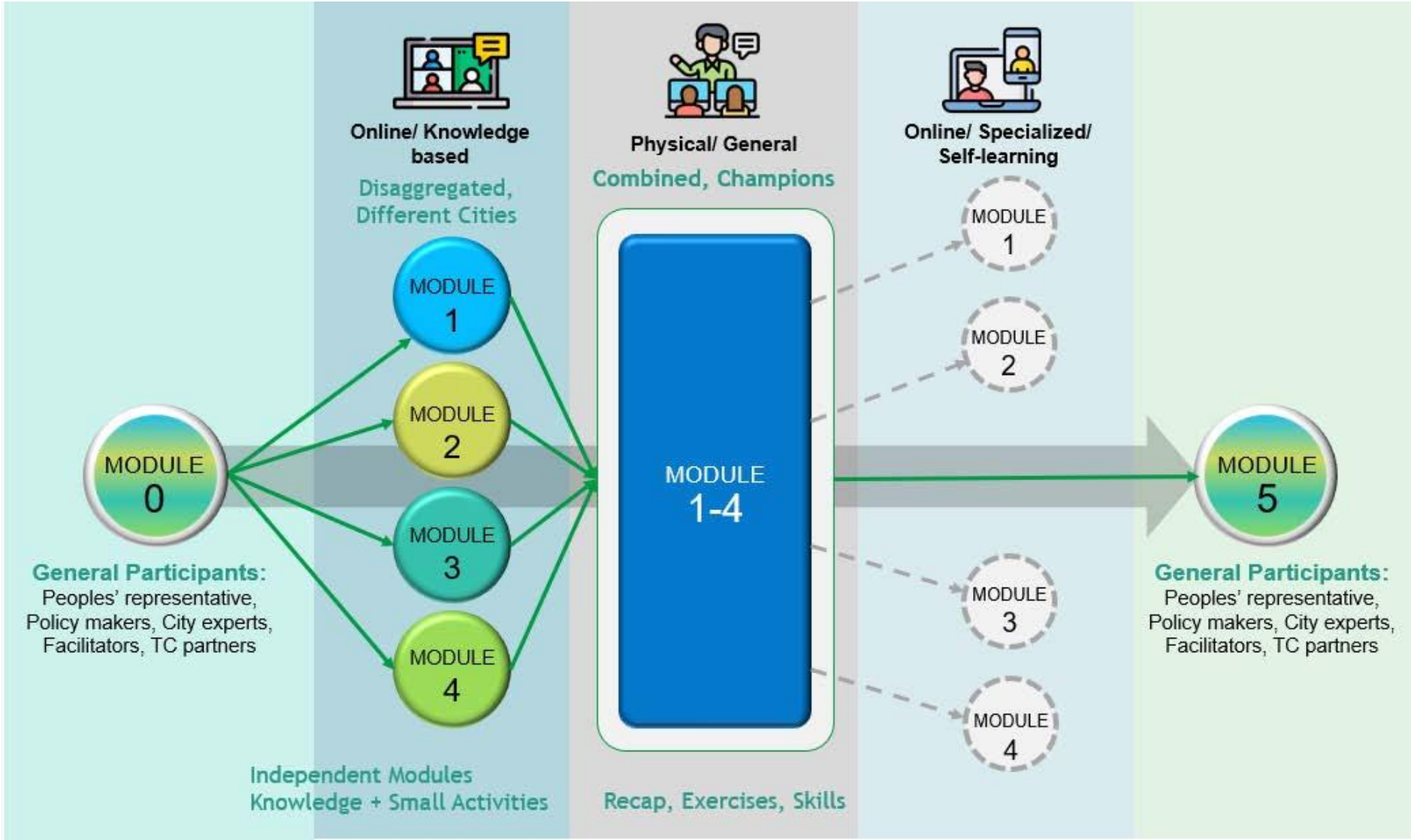


Chittagong, Cox's Bazar, Dar Es Salaam

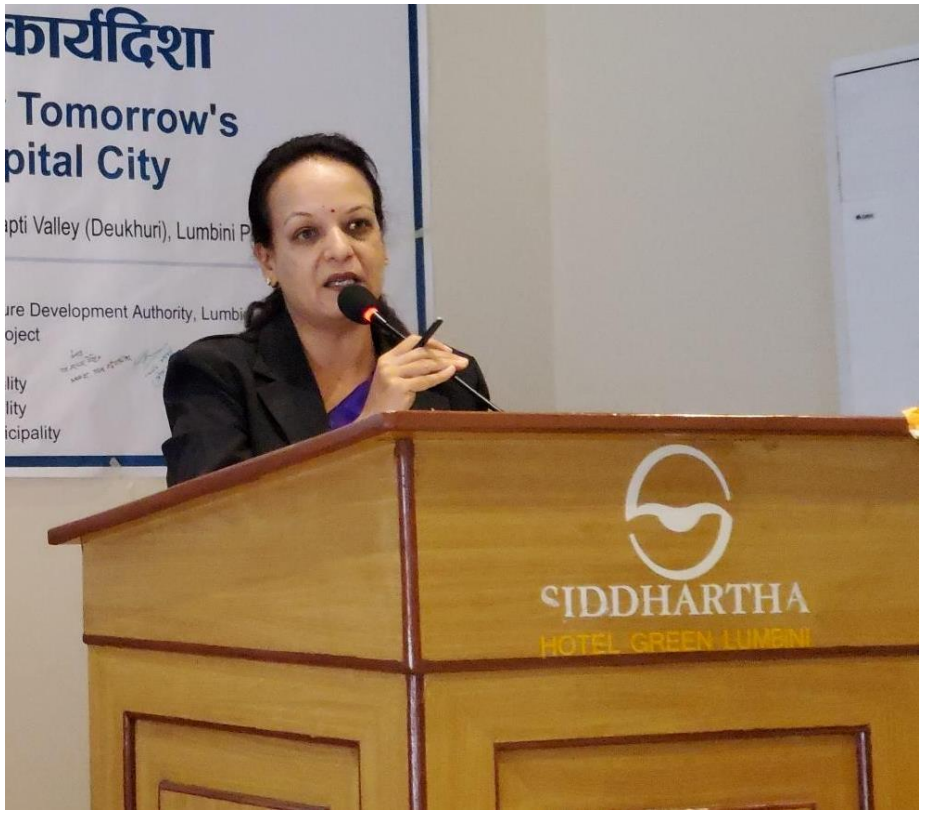


Nablus

Capacity Strengthening Program to empower local communities, academia, governments and practitioners



More than 400 Hundred Graduates of the Tomorrow's Cities Capacity Strengthening Program



Chief Secretary, Lumbini Province

2. Adaptable Framework

Leveraging the Rapport built through the project with the Local, Provincial Government and the Implementing Authority (PIDA) at Lumbini

Scope for the application of the TCDSE for other urbanizing and potential hubs

Heutada

Kamalamai

Triyuga

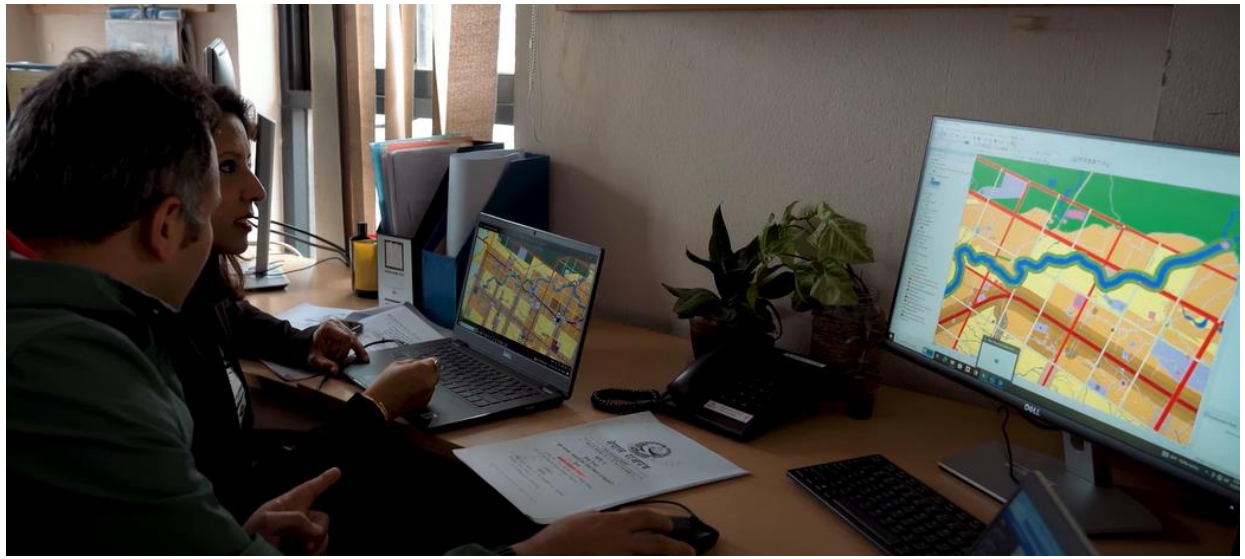
2. Adaptable Framework

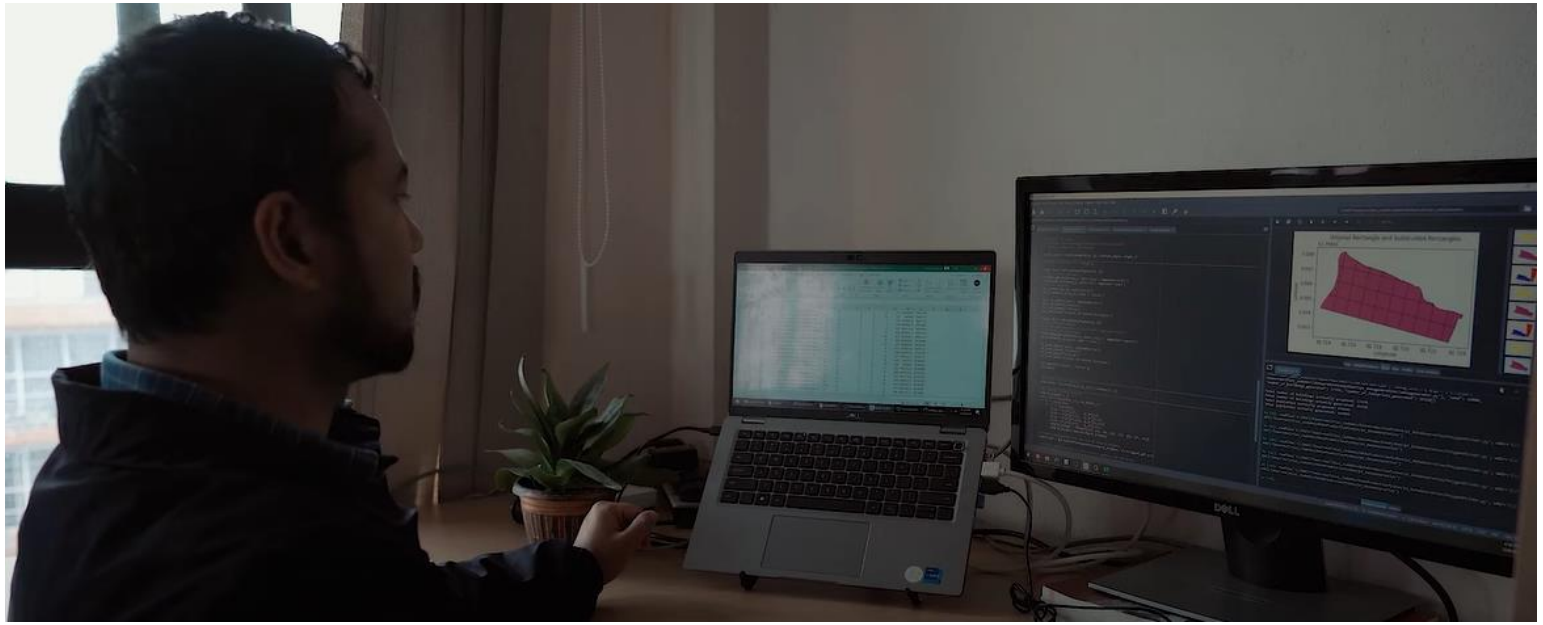
3. Policy Integration

“ Our responsibility is to engage how we can expand this approach of risk-informed urban development planning in other cities and make it nationwide.”

4. Community Engagement and Awareness

5. Application of advanced research and Innovation





Tomorrow's Cities Nepal Team

NSET
Disaster Resilient Communities in Nepal

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Practical ACTION

Thank you Team NSET !

















Thank you John McCloskey