LCS-RNet 8th Annual Meeting on 6-7 September in Wuppertal, Germany

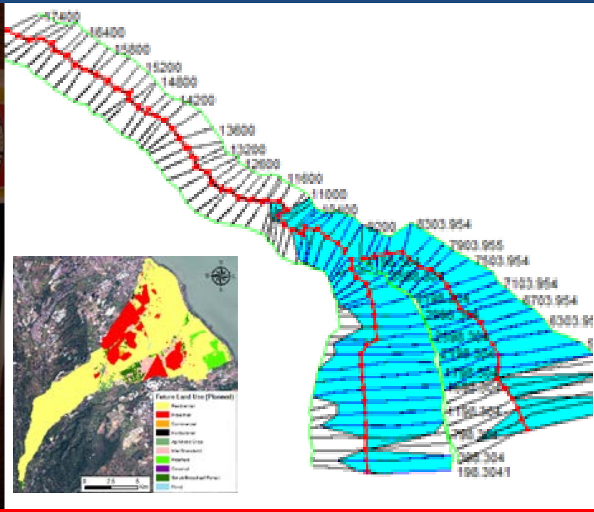
IGES Institute for Global Environmental Strategies

環境省 Ministry of the Environment Government of Japan

LCS·RNet

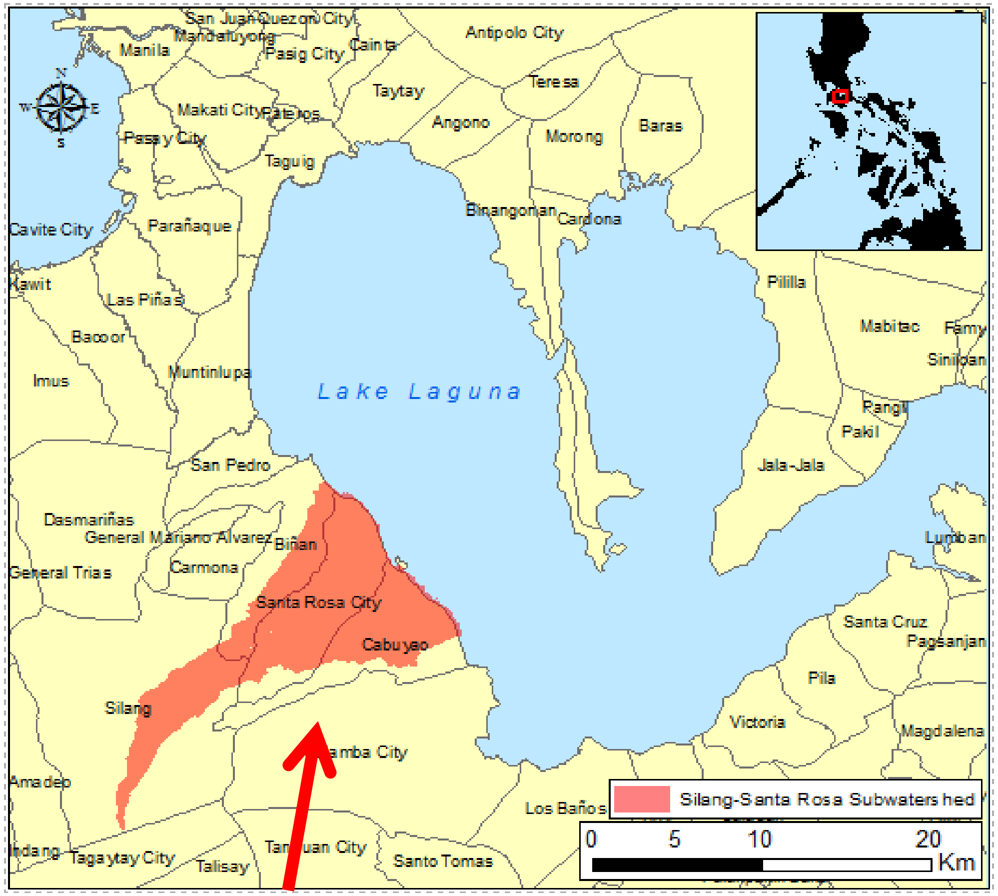
INTERNATIONAL RESEARCH NETWORK FOR LOW CARBON SOCIETIES 8TH MEETING

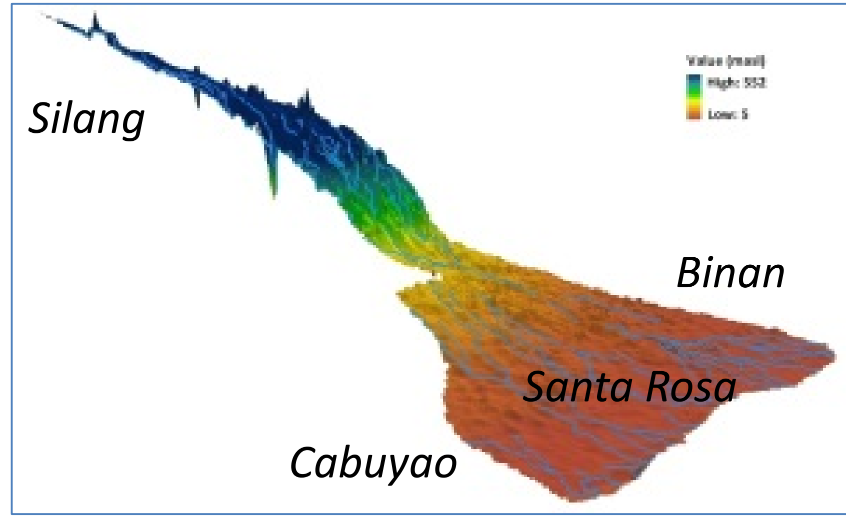
Approach to low-carbon and climate-resilient cities in the Philippines

Institute for Global Environmental Strategies
University of the Philippines Los Baños

Study site



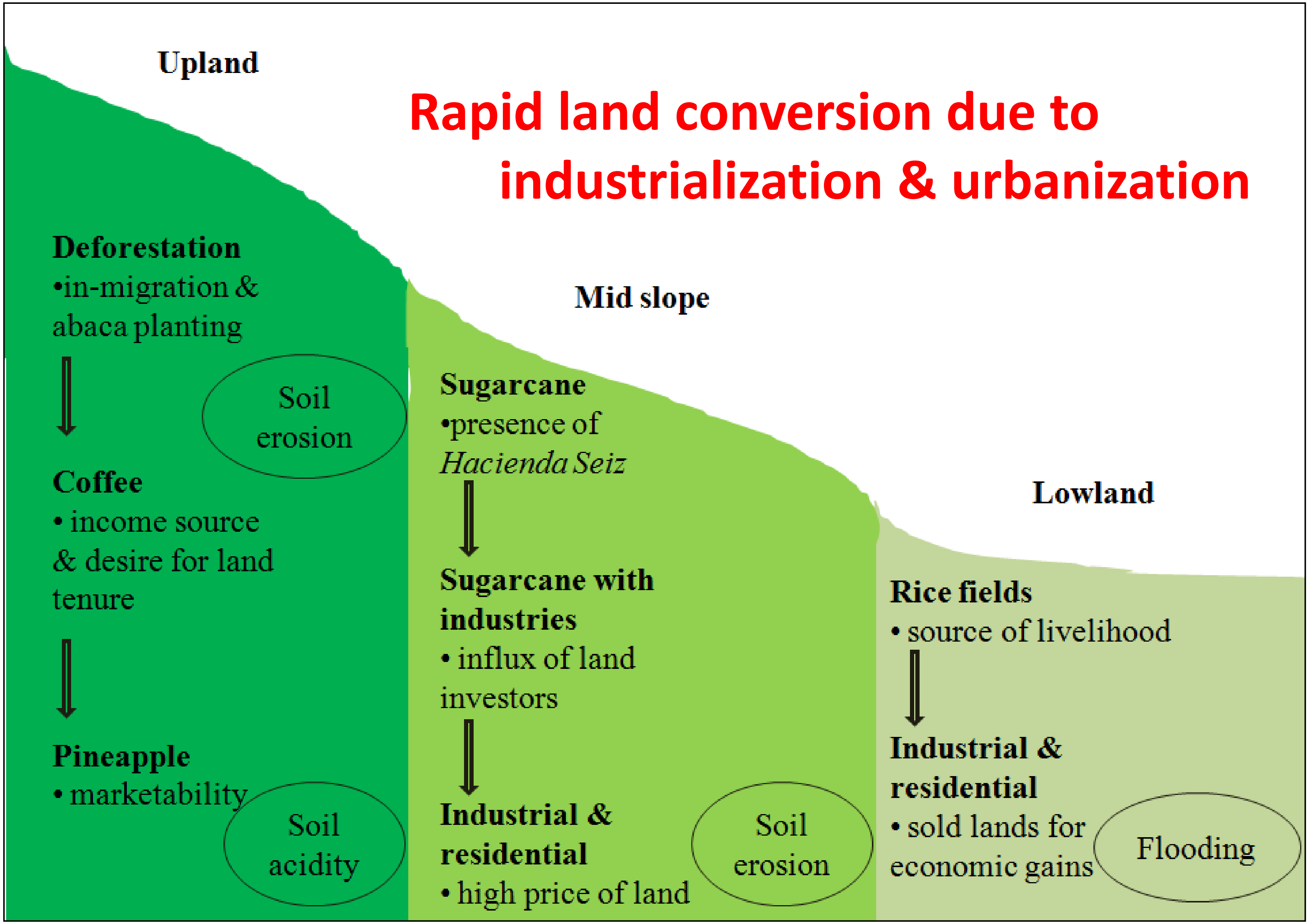


Silang-Santa Rosa Subwatershed, Philippines

Area shaded in red (above), topography (right)

- **Multiple cities in 120 km2**
- **Rapid economic growth**
- **Population growth and migration (570,000 people)**
- **Massive land use changes in past 2 decades**
- **Flooding, environmental degradation, pollution, waste**

Drivers and impacts of land cover change



Land Conversion in the Downstream Area

Year **2007 & 2014** Orthophotos in the downstream barangays of Sta. Rosa experiencing Land conversion from **Rice fields** to **Subdivisions**

Weather-related disasters: Flooding

Santa Rosa,
The Philippines
Sep. 2006
with Typhoon Milenyo

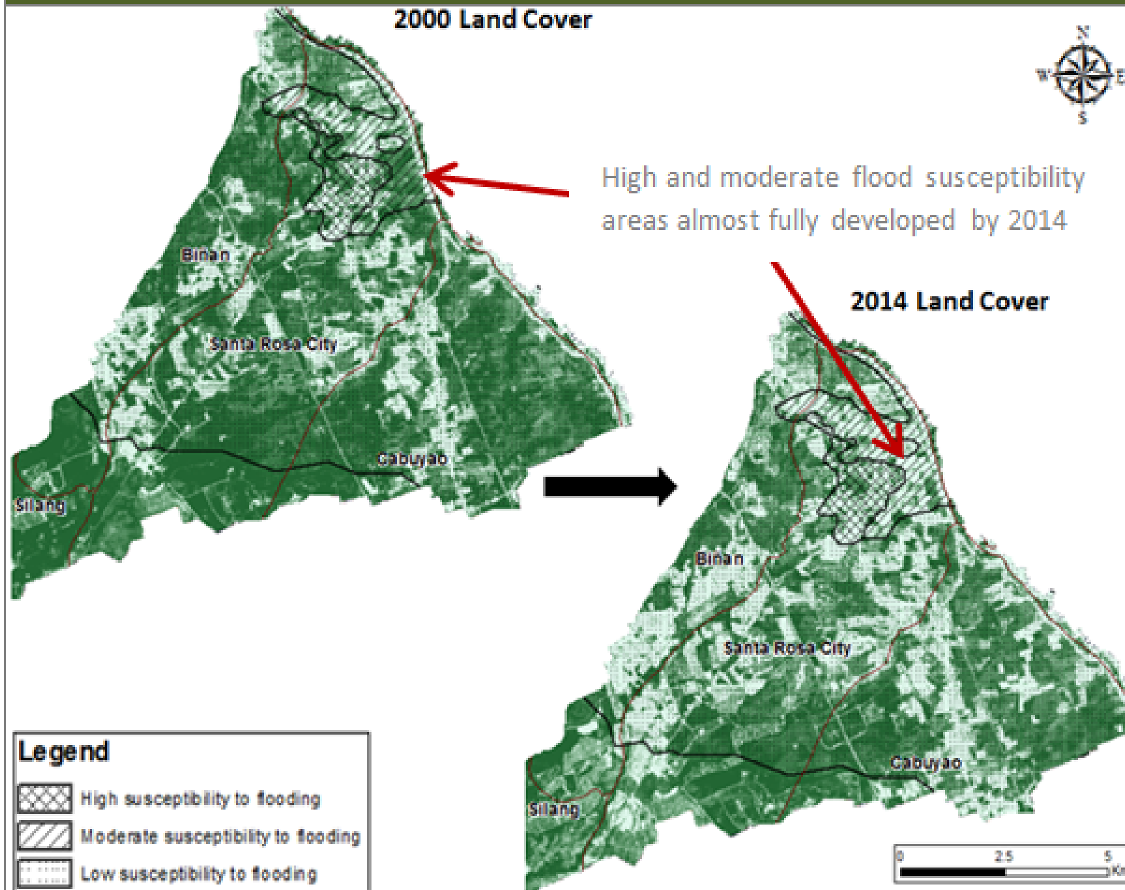
(Photos: E. C. Creencia)

Development in flooded areas

Key Messages

- Impervious area of sub-watershed increased by 54% (from 3,239 ha. to 4,988 ha.).
- Vegetated area decreased by 21% (from 8,509 ha. to 6,760 ha).
- **Upstream:** Impervious area increased by 102% in upstream municipality of Silang, and also increased in upstream parts of Biñan and Santa Rosa City, causing higher runoff (more frequent and intense floods downstream).
- **Downstream:** The most flood-prone areas in the watershed underwent some of the most development.

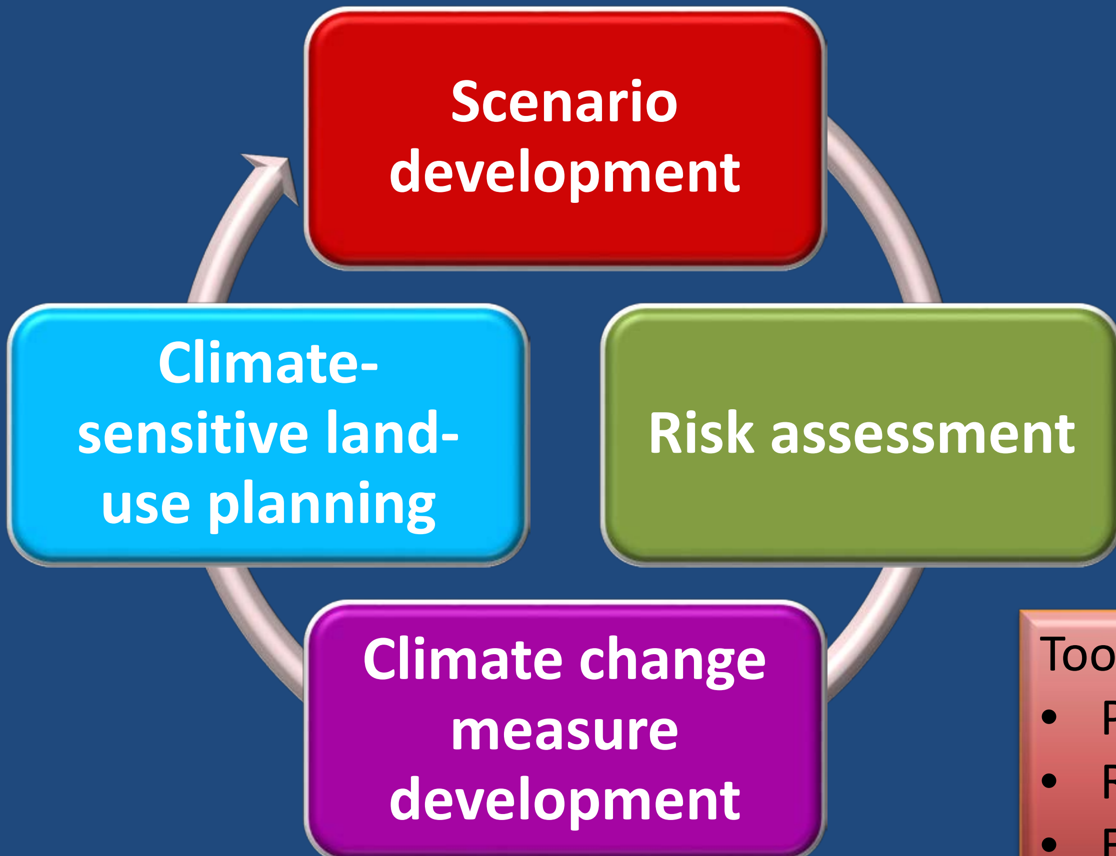
Significant development in flood-prone[2] areas



[1]Landsat satellite data courtesy of the United States Geological Survey (USGS). Spatial resolution (i.e. pixel size) of the images are 30m x 30m.
[2]Flood hazard data courtesy of the Philippine National Mapping and Resource Information Authority (NAMRIA).

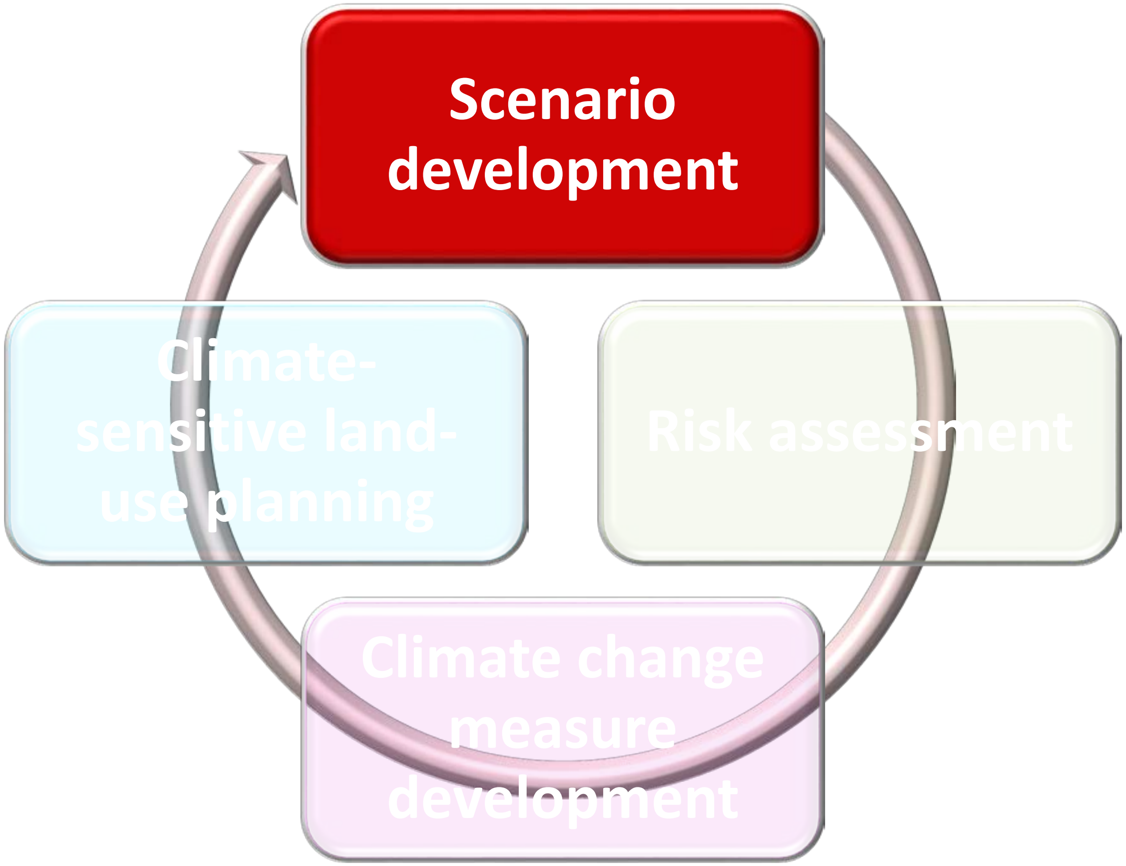
The Methodology

PARTICIPATORY WATERSHED LAND-USE MANAGEMENT (PWLM)



Toolkit:

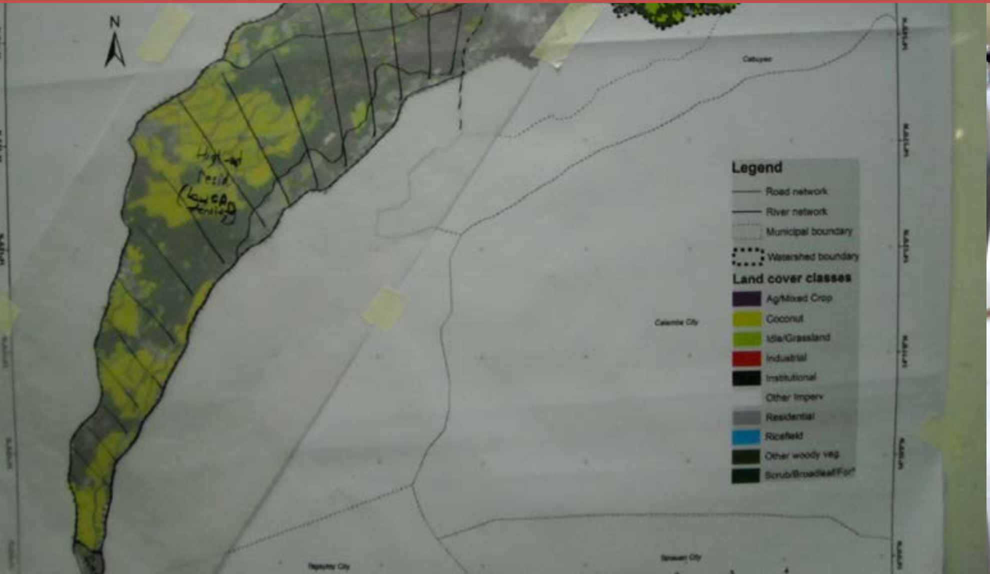
- Participatory GIS
- Remote sensing
- Effectiveness indicators
- Adaptation mitigation matrix

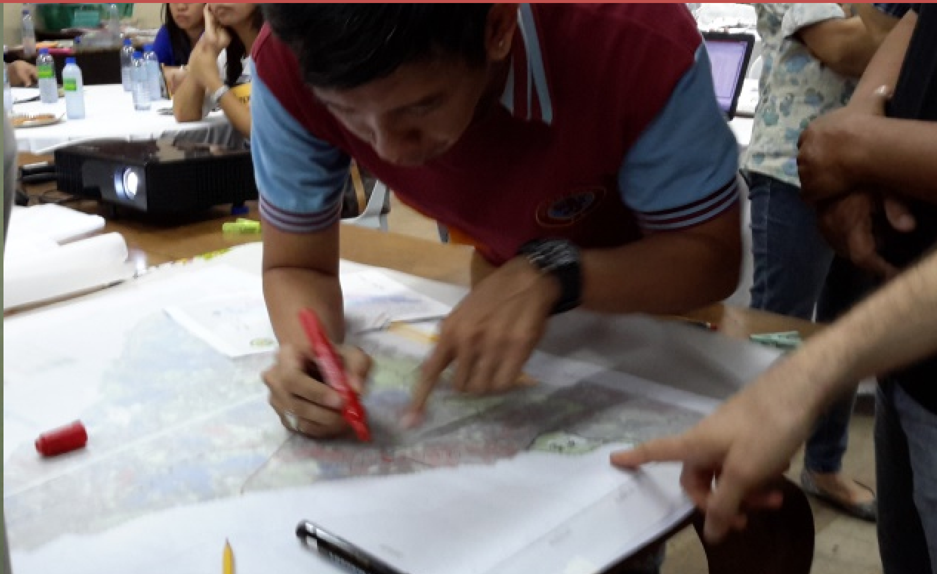


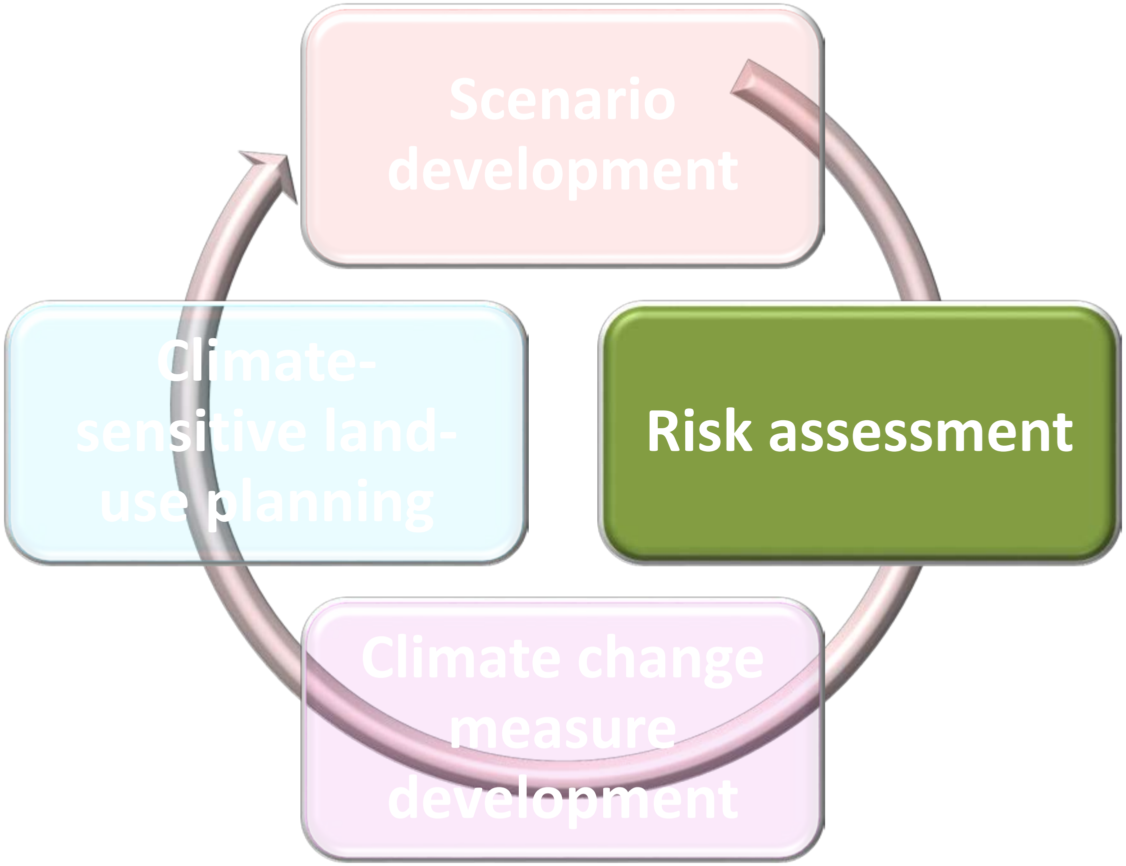
STEP 1

SCENARIO ANALYSIS

Participatory GIS
Revealing future development & land-use





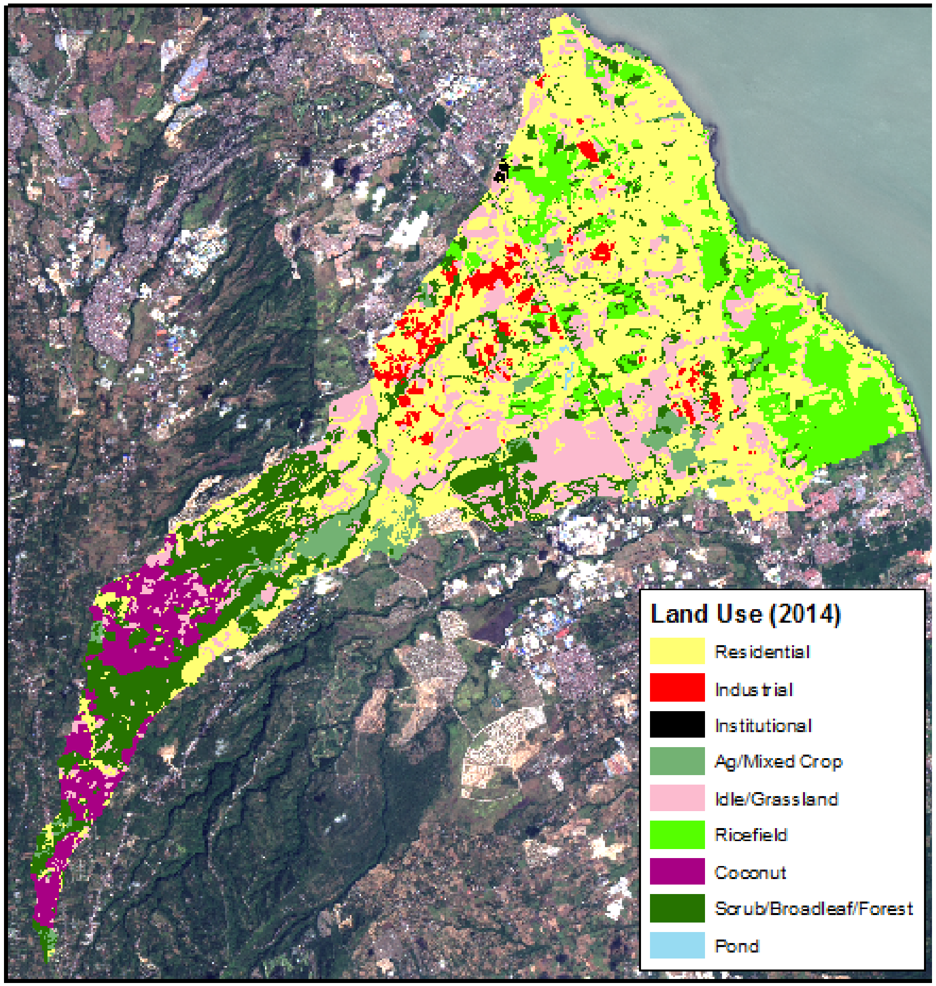


STEP 2

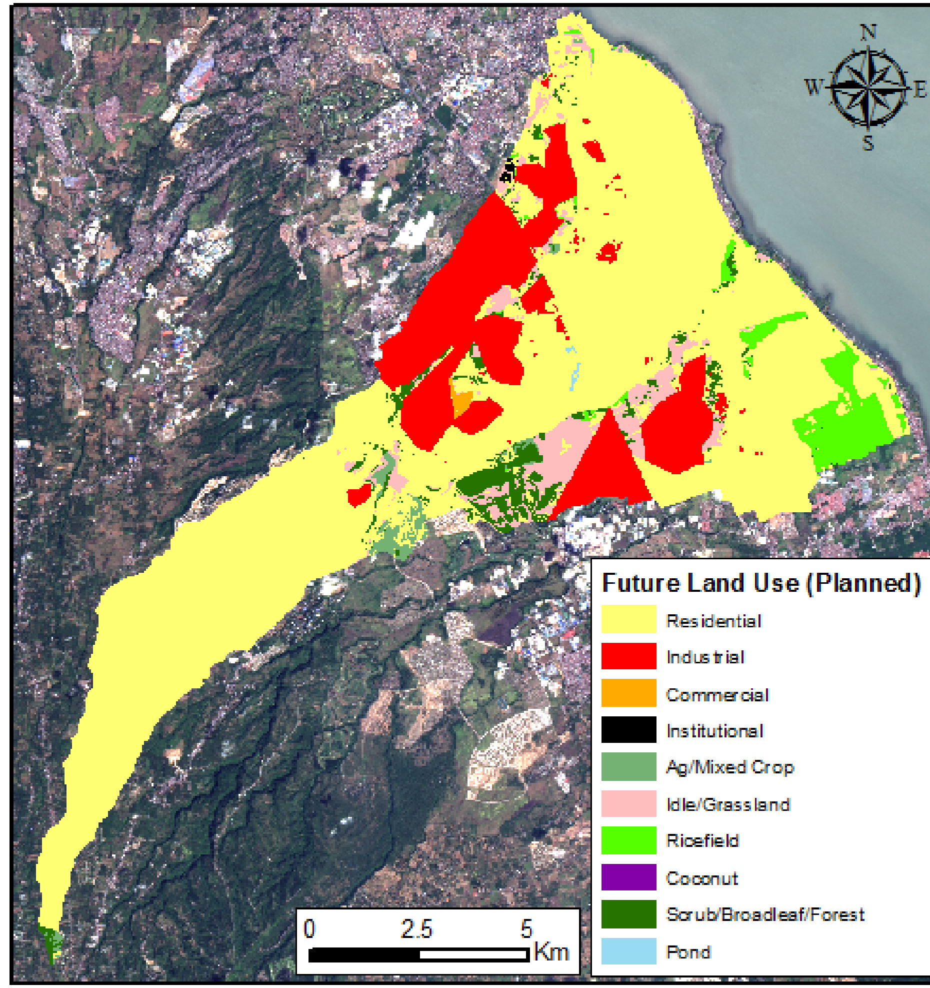
RISK ASSESSMENT

Mapping current & future land-use

Current Land Use (2014)



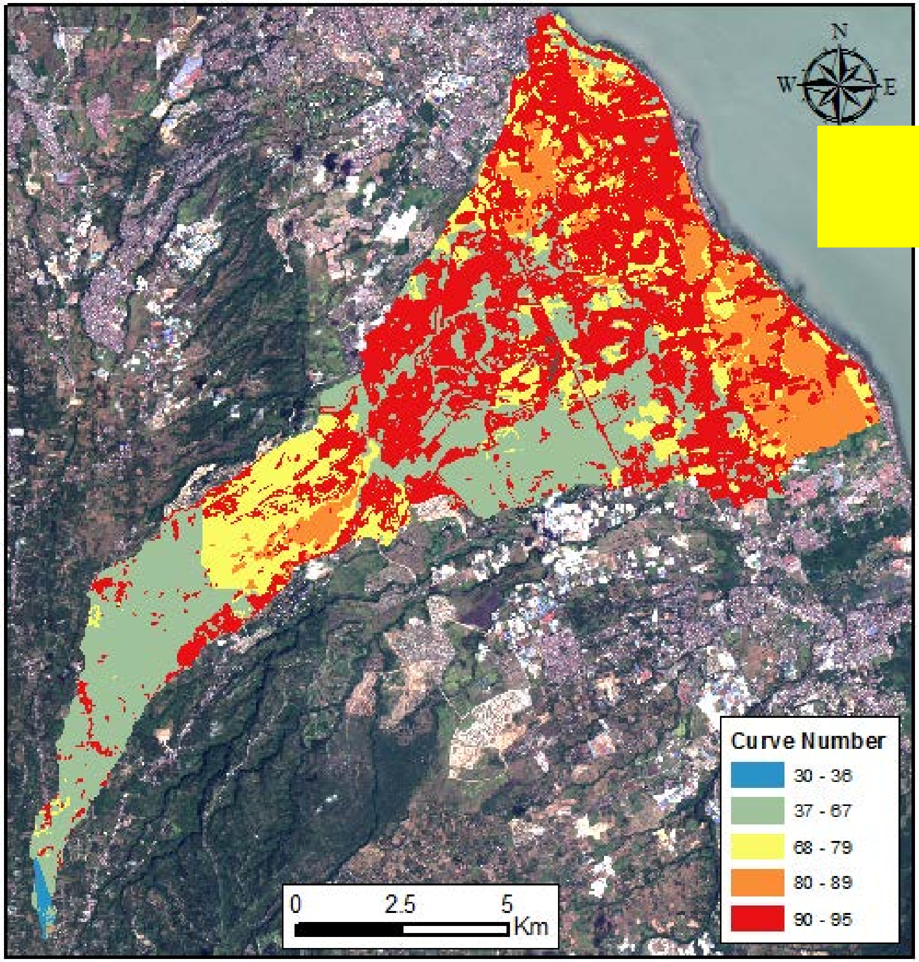
Future Land Use Plan (2025)*



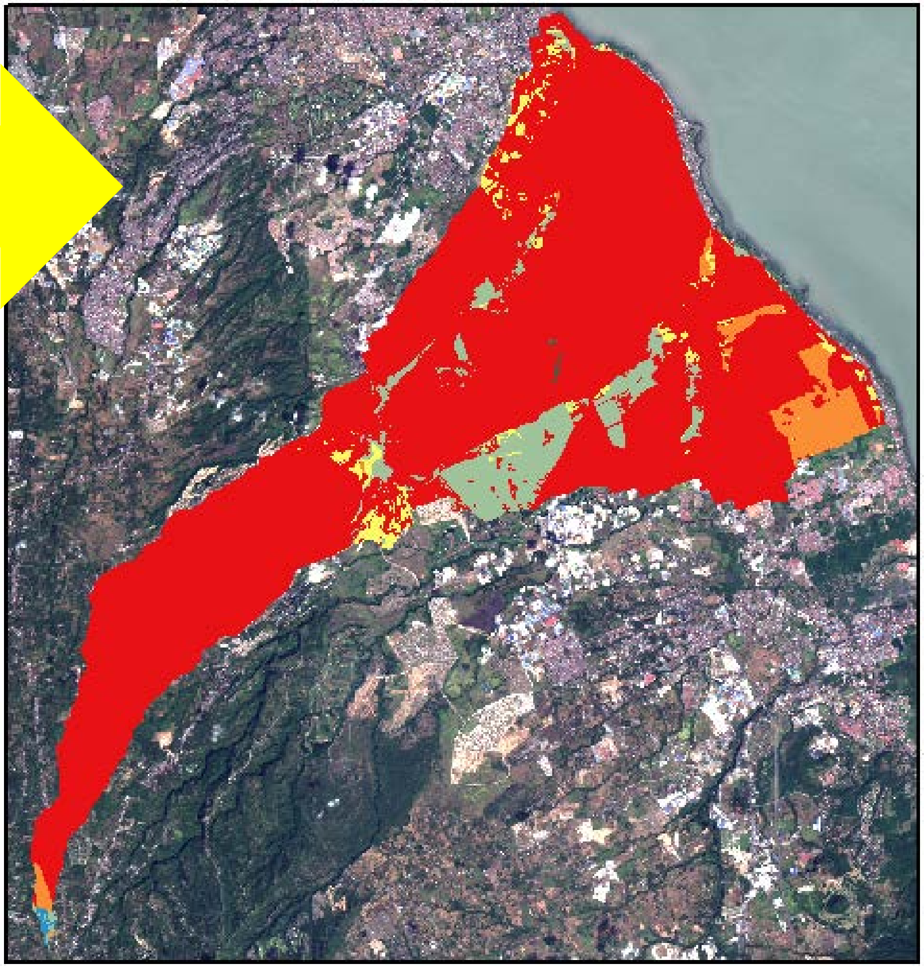
*Future land use plan map based on the results of a participatory land use mapping session with representatives from four local government units (LGUs)

More flooding

Current curve number (2014)



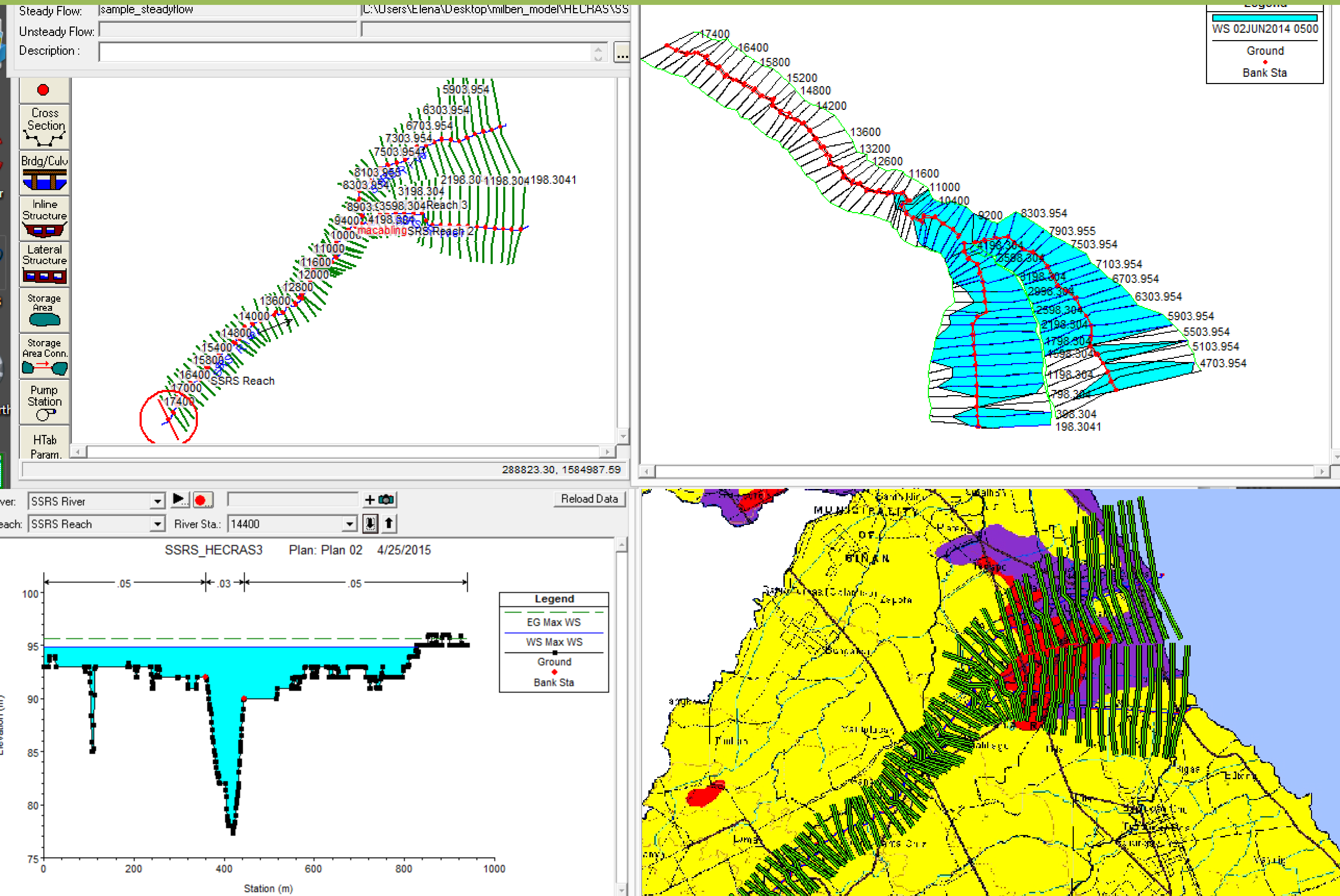
Future curve number (2025)



Higher Curve Number values indicate higher stormwater runoff.

Values are based on land use and soil type. Curve Numbers are used for flood hazard modeling.

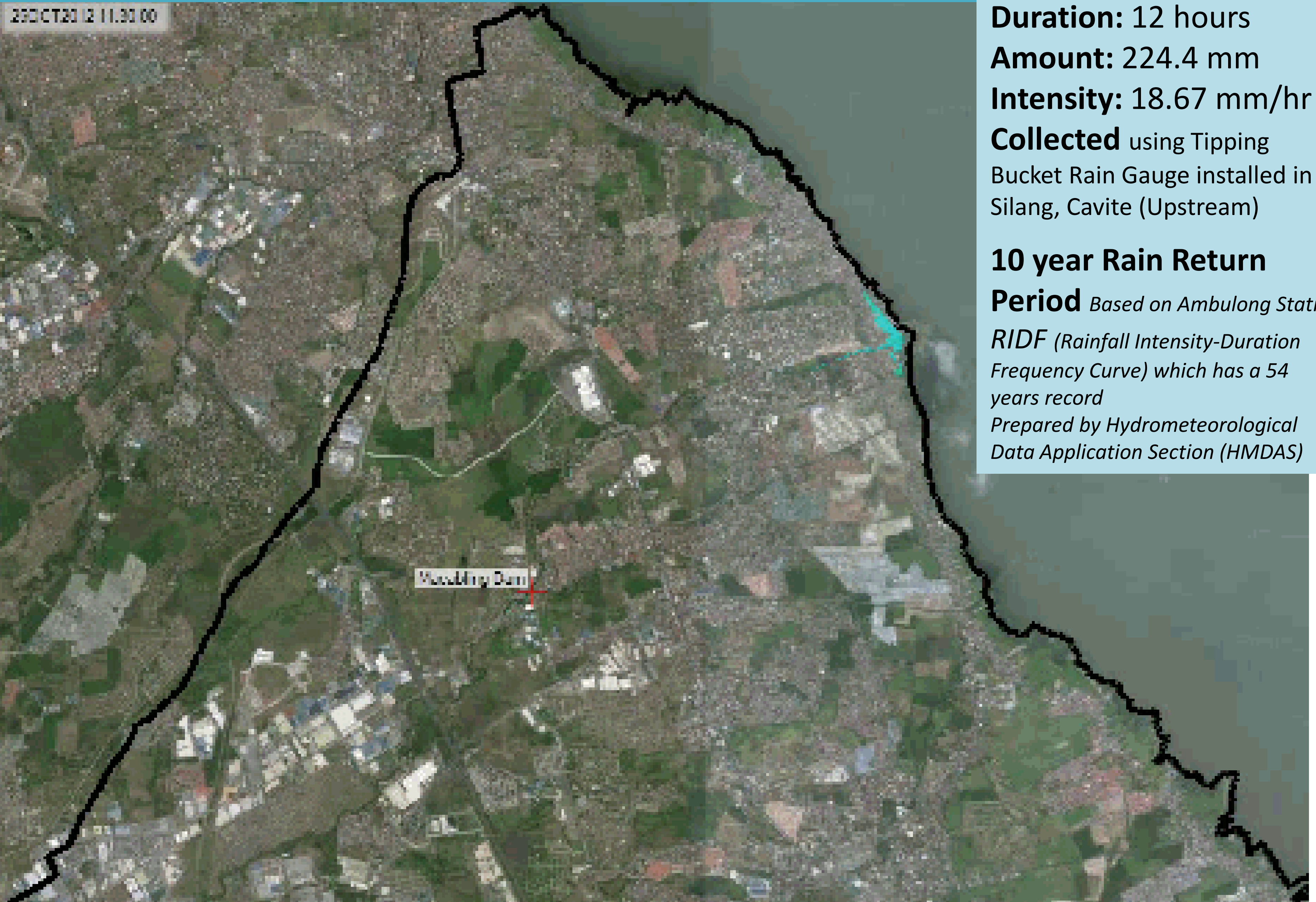
Hydrological modeling



Simulation Result:
FLOOD EXTENT

CURRENT SCENARIO (2014)

Simulation using 10 min. Time step

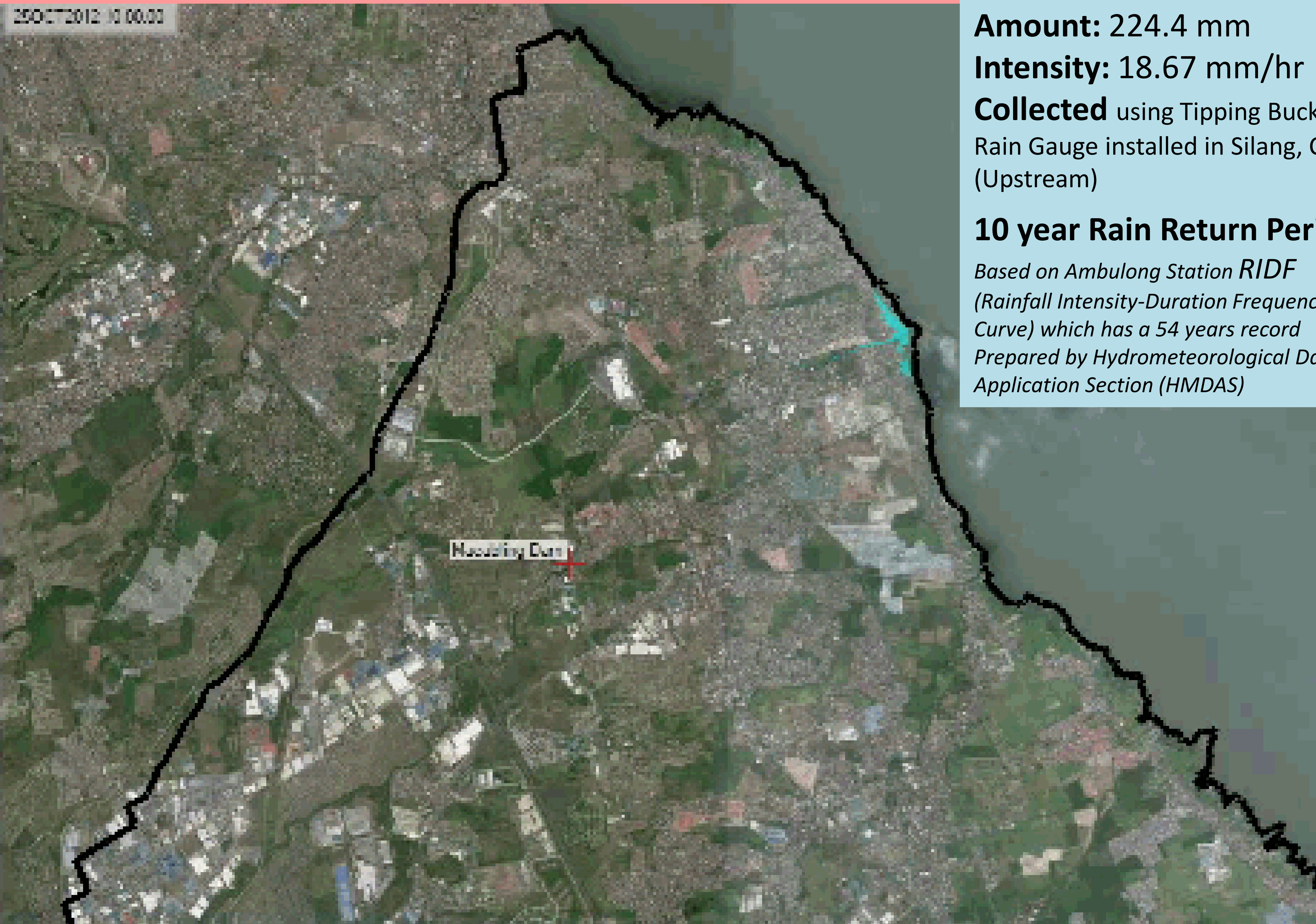


Rainfall: Typhoon Ofel
(Int. Name: Son-Tinh) Oct. 25, 2012
Duration: 12 hours
Amount: 224.4 mm
Intensity: 18.67 mm/hr
Collected using Tipping Bucket Rain Gauge installed in Silang, Cavite (Upstream)

10 year Rain Return Period *Based on Ambulong Station RIDF (Rainfall Intensity-Duration Frequency Curve) which has a 54 years record*
Prepared by Hydrometeorological Data Application Section (HMDAS)

FUTURE SCENARIO (2025)

Simulation using 10 min. Time step



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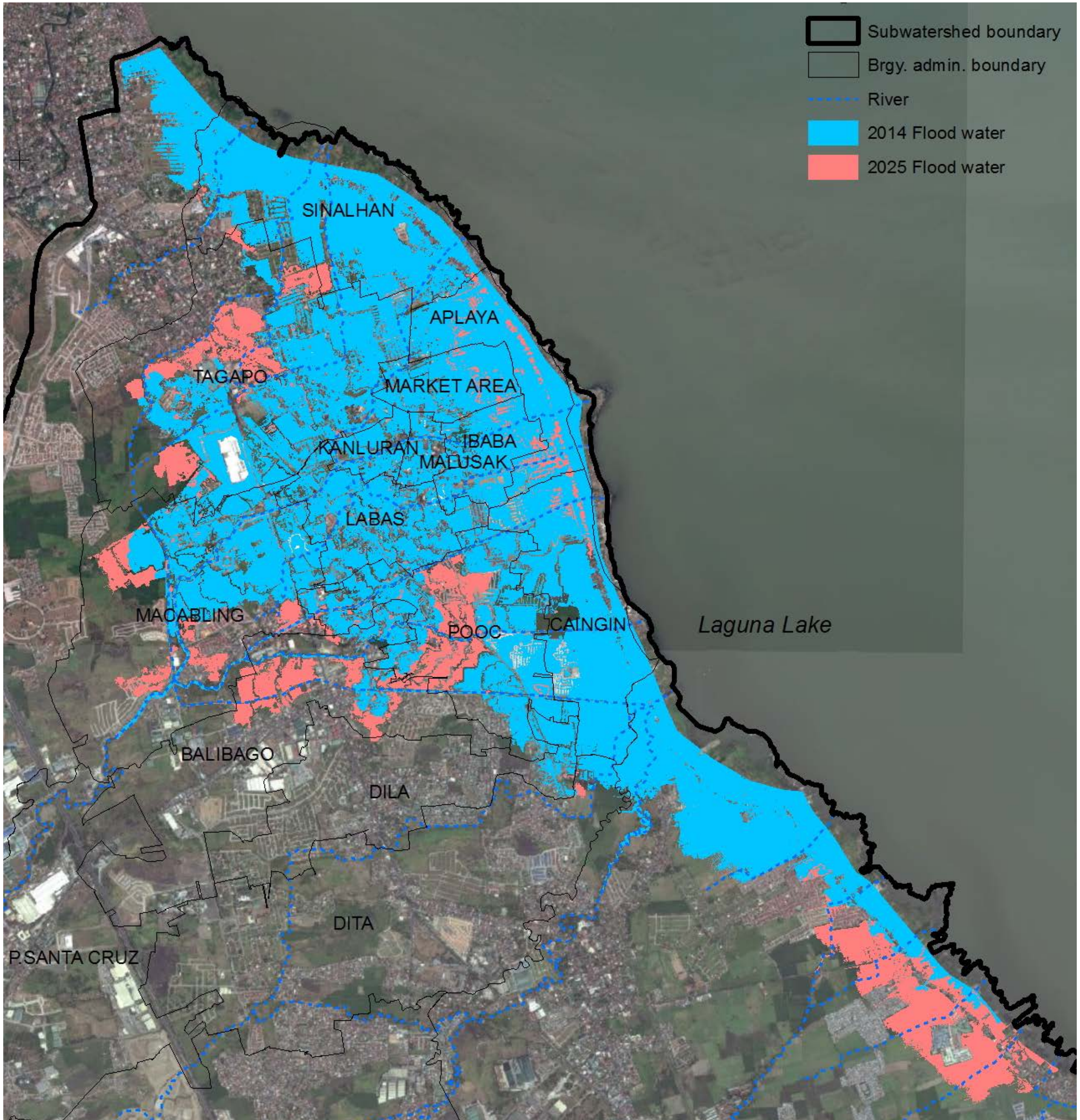
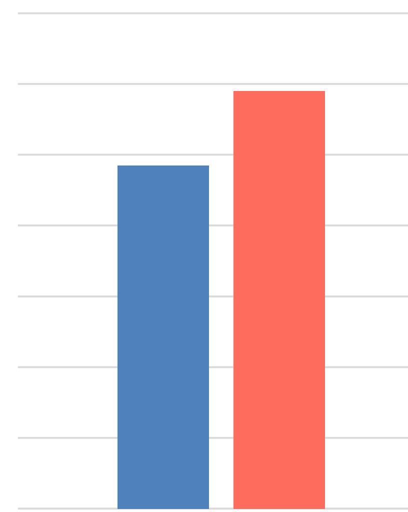
Current VS Future

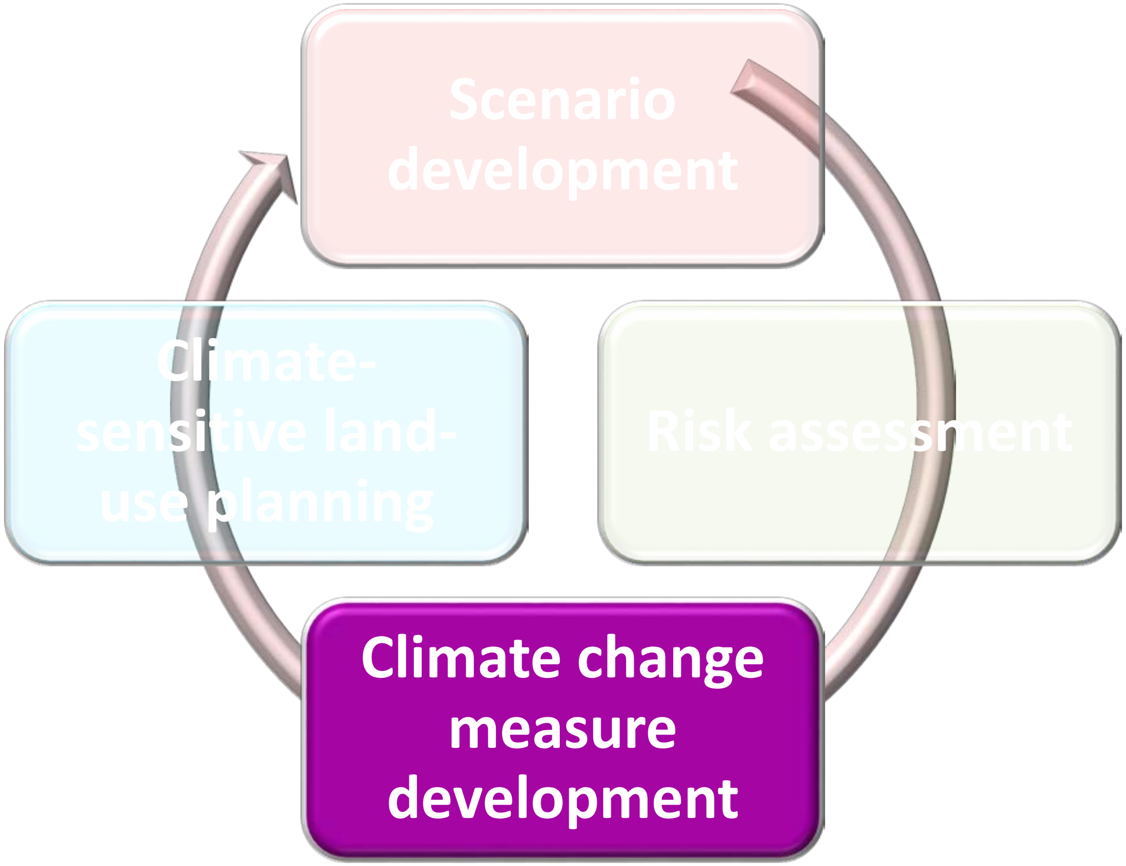




	AREA (Hectares)	% increase
Current 2014	969.83	
Future 2025	1,180.12	21.68
Difference	210.29	

Flooded area

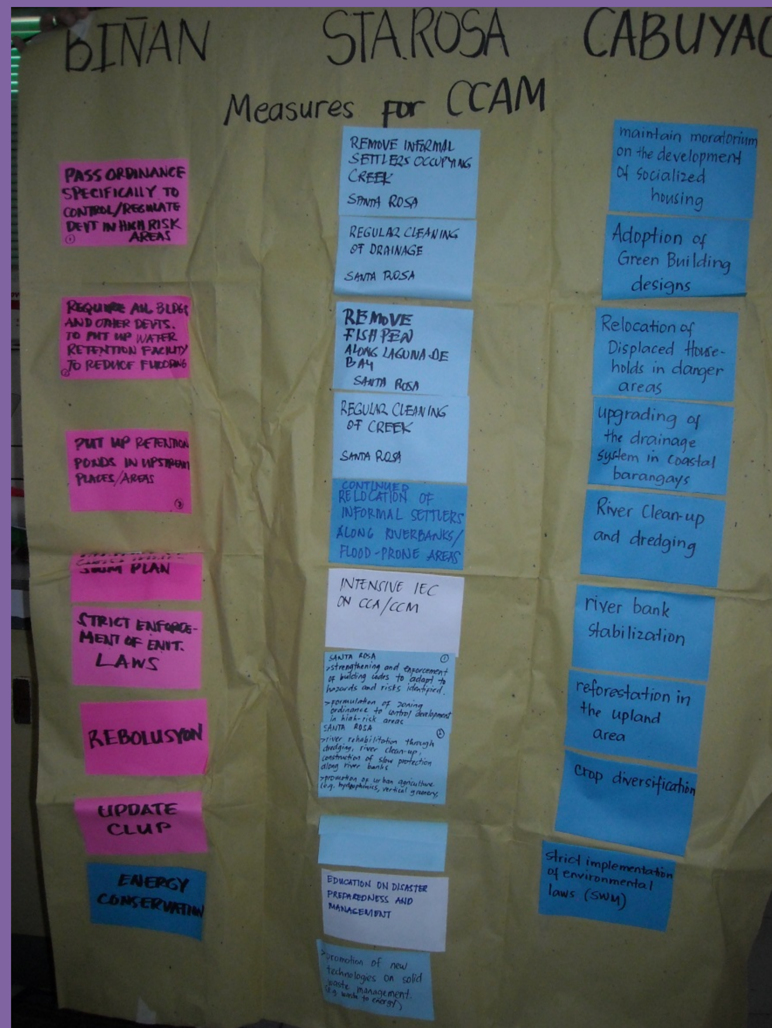
Portion of Downstream Area of the Silang-Sta. Rosa Subwatershed



STEP 3

CC MEASURE DEVELOPMENT

Consultation meeting with LGUs: Climate change measures



Possible measures for climate change mitigation (CCM) & adaptation (CCA) (example)

Category	Measures	CCM	CCA
Improved land-use	**Development control** in high-risk areas		●
	Green space, urban greening	●	●
Flood-tolerant, environment-conscious building	Strengthened **building codes** in high-risk areas (e.g., embankment, high-floored housing)		●
	Roof greening, **green building**	●	●
Ecosystem-based, integrated watershed management	Maintenance and improvement of watershed protection function (flood alleviation, water retention ability) of ecosystem		
	Development control in upriver areas		●
	Afforestation & reforestation	●	●
	Watercourse management (e.g., riverbank reinforcement, dredging, river cleaning)		●
	Change in varieties and cultivation methods of agricultural products to prevent soil runoff		●

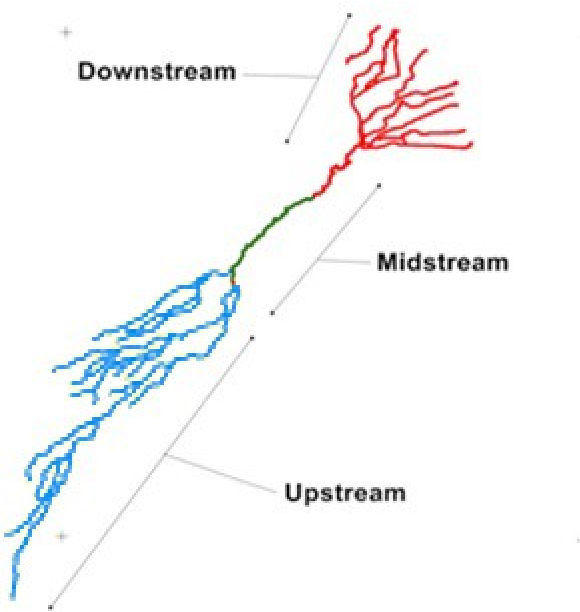
Source: Adapted from (IPCC, 2014)

Priority measures (1): Zoning enhancement

1. **Development controls** are enforced in areas highly susceptible to flooding, which prevent settlement construction and maintain as much vegetation as possible.
2. **Building codes** are strengthened in high-risk areas to mandate measures such as the construction of floodwalls and the introduction of elevated flooring to protect buildings and infrastructures against flooding.
3. Where forest and/or agricultural land is converted to residential or commercial areas, **runoff mitigation measures** such as tree planting, green parking design, water-permeable paving, and vegetated roofs must be taken.
4. Actions for the **strict enforcement** of zoning ordinances are taken.
5. **Land-use is harmonized** among the local governments to manage the river basin as a whole to address climate-related disasters such as flooding downstream by collective planning of the development upstream.

Priority measures (2): River rehabilitation

To reduce surface runoff and erosion, & speed flow of water in rivers (to reduce flooding)



- Upstream
  - Protection and improvement through replanting of endemic and indigenous plant species
- All area: Regular river cleanup

- Downstream
  - Control encroachment of settlements in easement areas
  - Dredging of sediments
  - Solid and liquid waste management
  - Planting of endemic and indigenous plant species
  - Improvement of drainage
- Midstream
  - Proper zoning and land use planning/implementation
  - Rehabilitation of easement and riverbanks
  - Construction of slope protection along riverbanks

Priority measures (3): Capacity building

- **Needs assessments (NA)** on CCA, CCM , disaster preparedness and management
  - Develop survey/assessment instrument to determine the needs for training and other IEC; Conduct the NA
- **Development of campaign materials and training modules** for CCA, CCM , disaster preparedness and management
  - Develop campaign materials and training modules for CCA, CCM , disaster preparedness and management
- **Conduct of trainings and events**
  - Organize trainings and events to increase awareness and preparedness

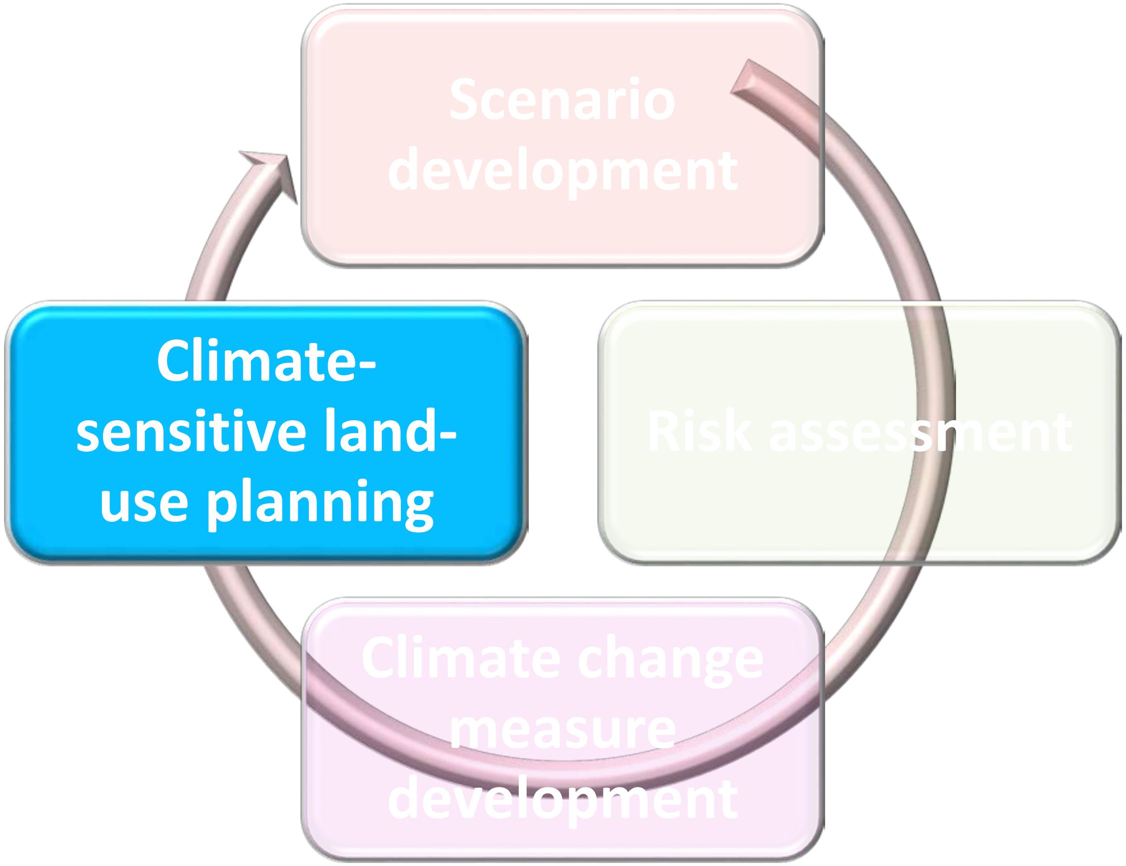
Priority measures (4): Inter-city cooperation

Memorandum of agreement (MOA) for cooperation

Establishment of Council for Integrated Watershed Management

December 2, 2014

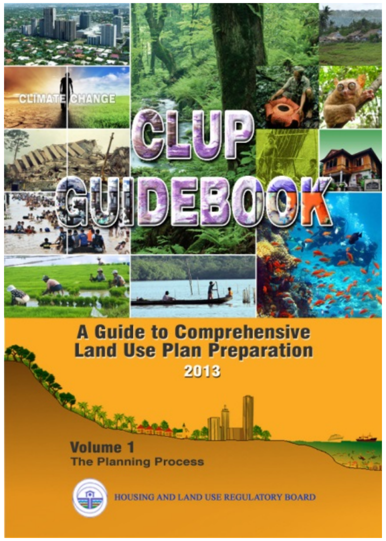
Catalyzed by 5-year WWF Hydrology Project



STEP 4

CLIMATE-SENSITIVE LAND-USE

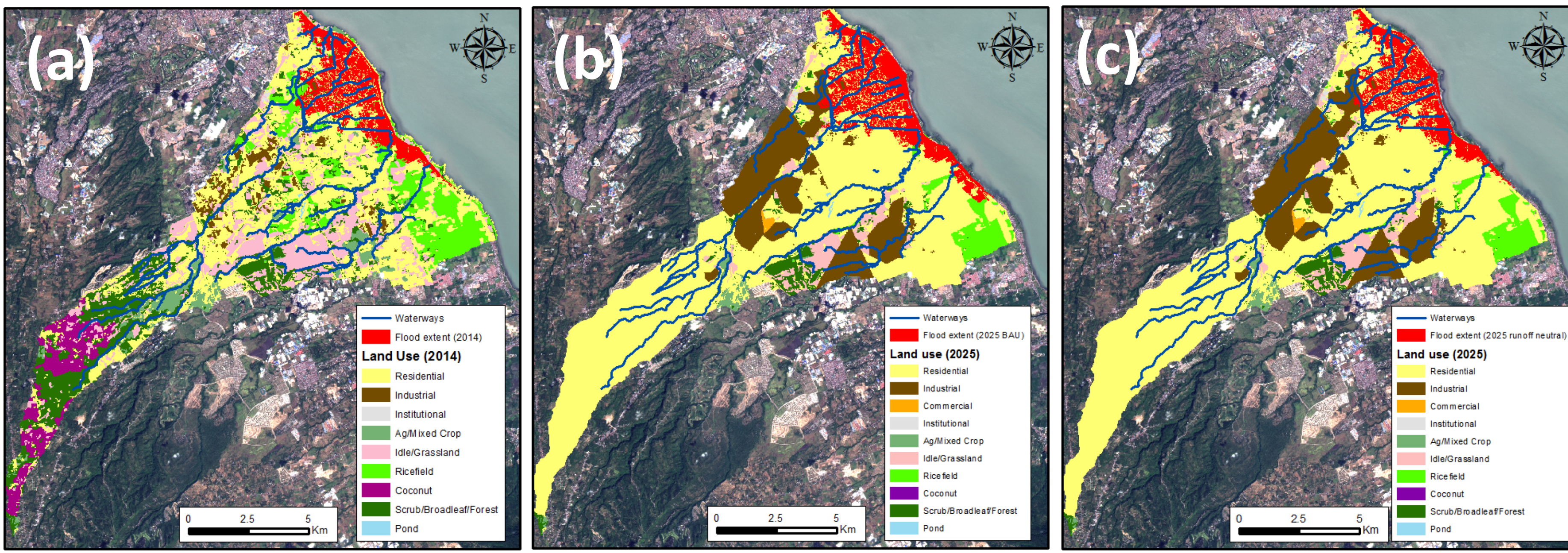
Improving Comprehensive Land-use Plan (CLUP)



- **Update CLUP**, paying attention to CCA&M
  - LGUs in Silang-Santa Rosa sub-watershed use flood-hazard maps & countermeasures to improve CLUPs
  - Project data used for local climate change action plan of Santa Rosa
  - Lake Laguna Development Authority use project results in master plan
- **Comply with laws and policies**
  - Republic Act 7160 (Local Government Code of 1991)
  - Climate Change Act of 2009 (RA 9729)
  - National Disaster Risk Reduction and Management Act (RA 10121)
- **Help materialize national agenda** e.g., Ecotown, Ridge-to-Reef

Adaptation benefits of taking actions

- Preservation of existing vegetation & development with runoff mitigation measures **reduce rainfall runoff**, leading to less intense and less frequent flooding.
- In the best-case (runoff neutral) scenario, population affected by flood in 2025 will be **reduced by 20% (down from 226,410 to 183,349)**.
- Exposure of people to floodwater could be **further reduced** by restricting development and/or reinforcing building standards in flooded areas.

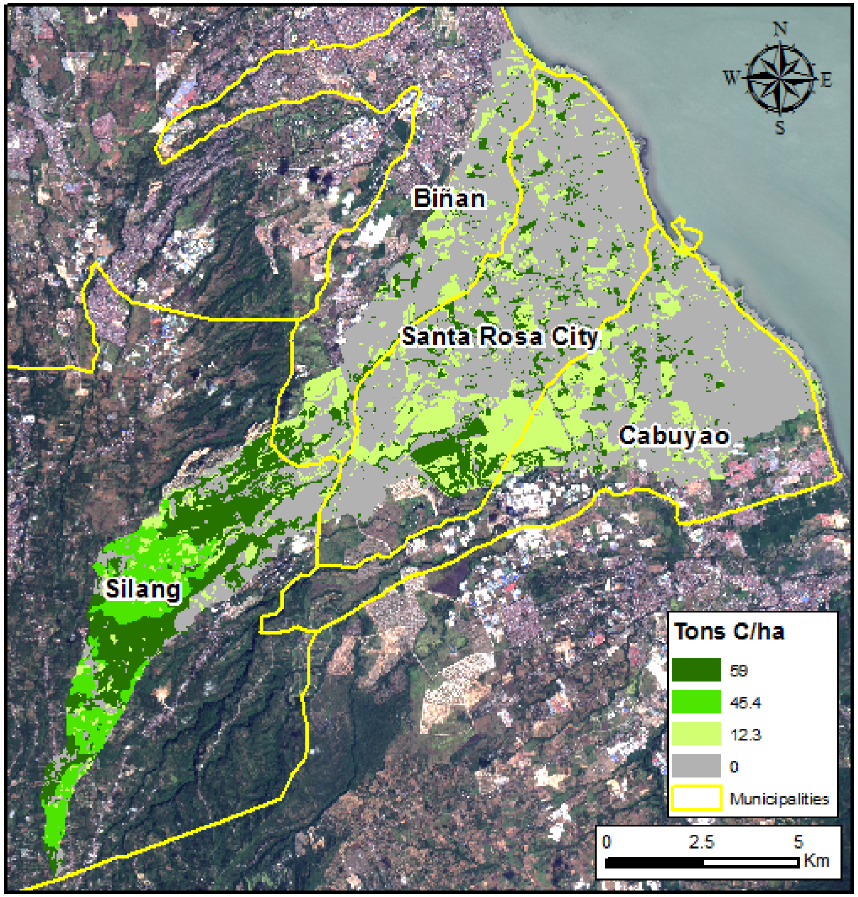


Land-use in the Silang-Santa Rosa subwatershed as of (a) 2014, (b) 2015 in business-as-usual scenario, and (c) 2025 in runoff-neutral development scenario. with flooded areas indicated in red

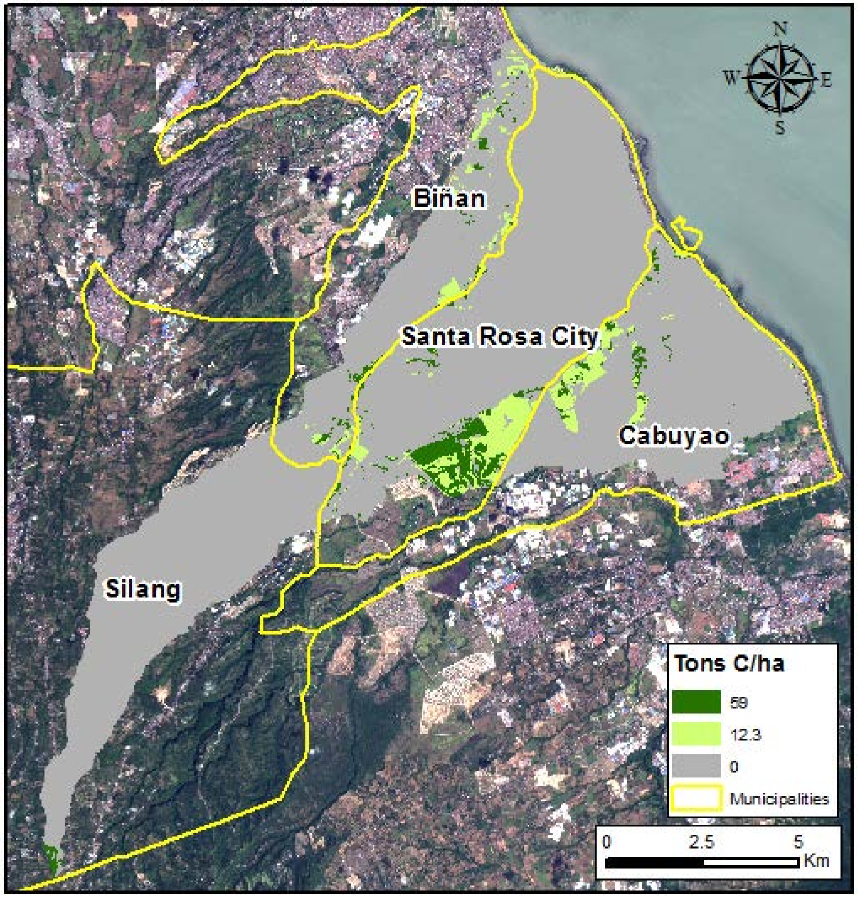
Mitigation benefits

528,142 tons of CO2 avoided if current vegetation preserved

2014 Above-ground Biomass



2025 Above-ground Biomass

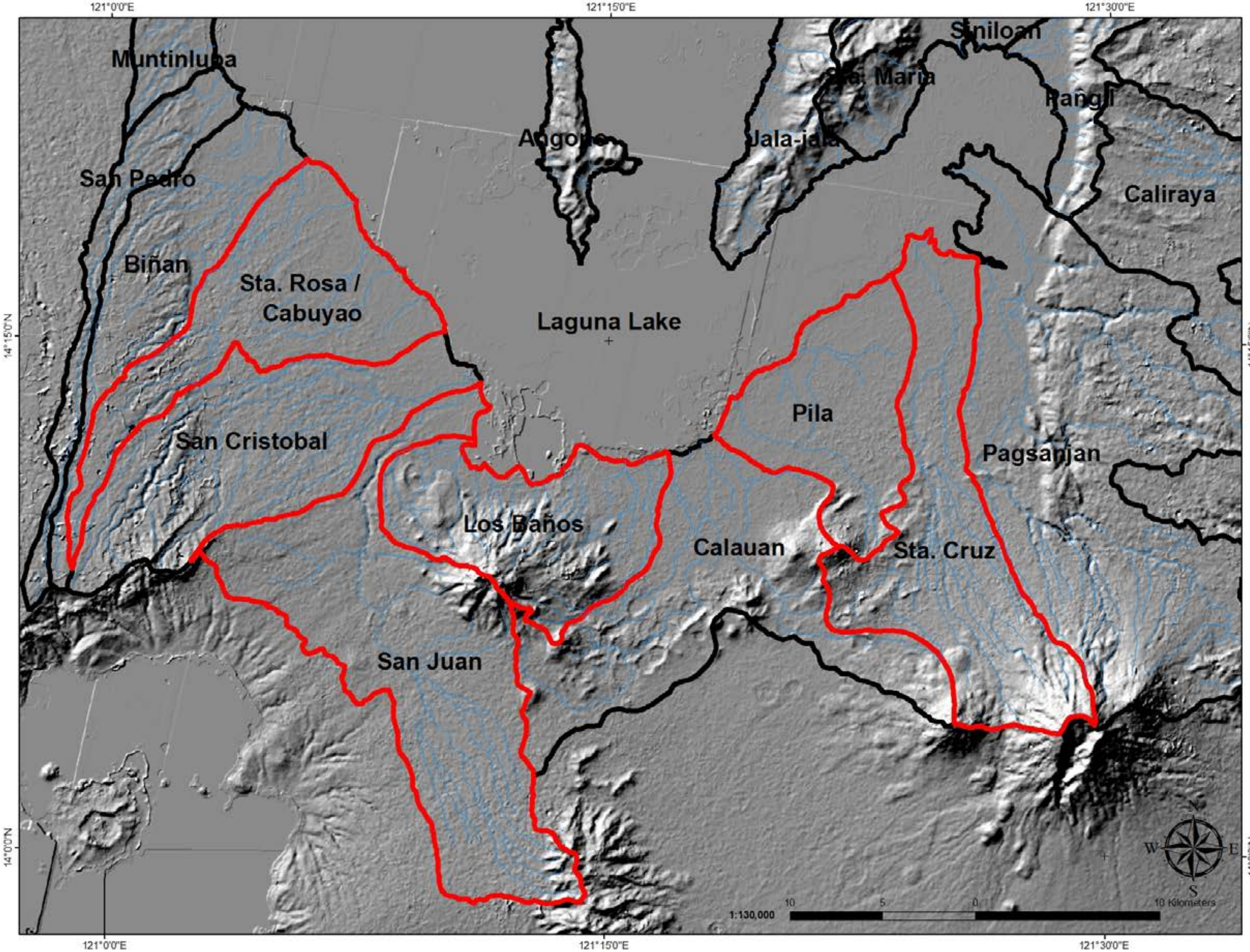


Change in C storage: 2014-2025

Conclusion

- Application of *Participatory Watershed Land-use Management* indicates that due to a vast land conversion, **flooded area will increase from 970 to 1,180 hectares by 2025**, and projected climate change is likely to worsen the situation.
- **Runoff neutral development**, lowering the intensity of floods associated with proposed land conversion, will reduce the number of **affected people by 19 percent from 226,410 to 183,349** in 2025.
- Preserving existing vegetation would also **avoid 528,142 tons of CO2** emissions.
- **Harmonizing land-use** within the same watershed is critical for an integrated response.
- Approach presented in this study provides a model to **integrate climate change** into local development planning.

Upscaling


121°0'0"E
121°15'0"E
121°30'0"E
14°15'0"N
14°0'0"N
San Pedro
Biñan
Sta. Rosa /
Cabuyao
Laguna Lake
Caliraya
Pila
Pagsanjan
San Cristobal
Los Baños
Calauan
Sta. Cruz
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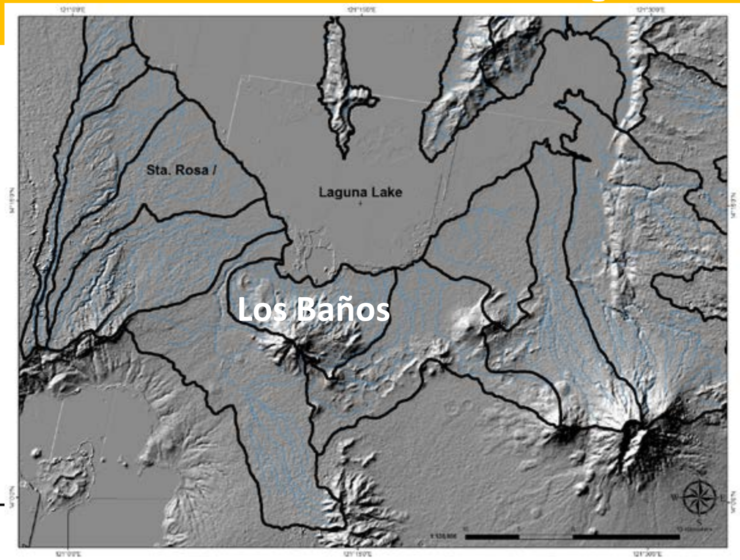
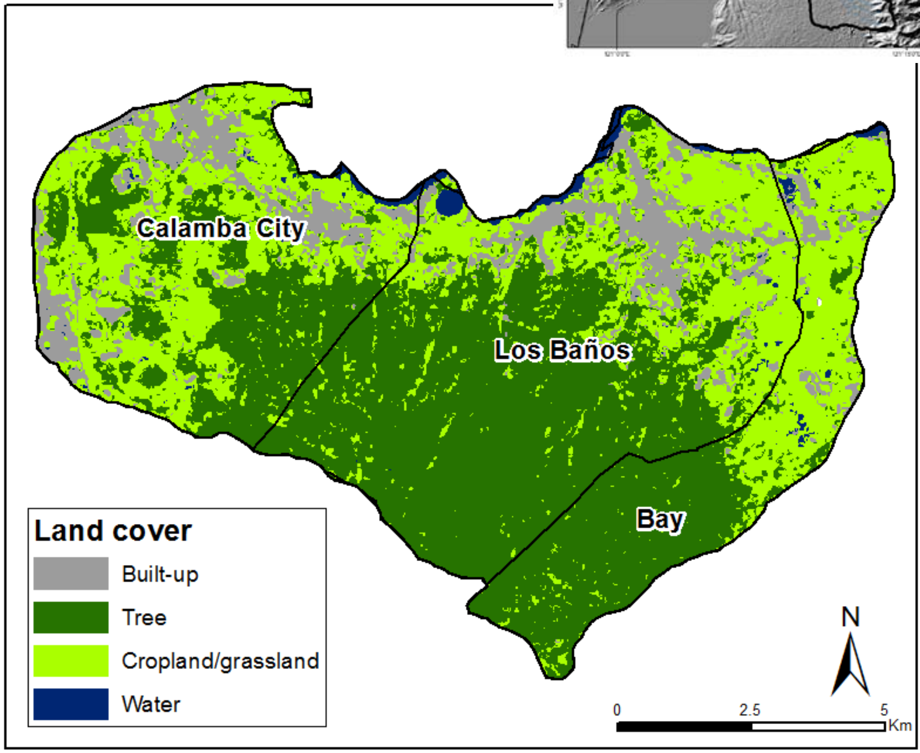
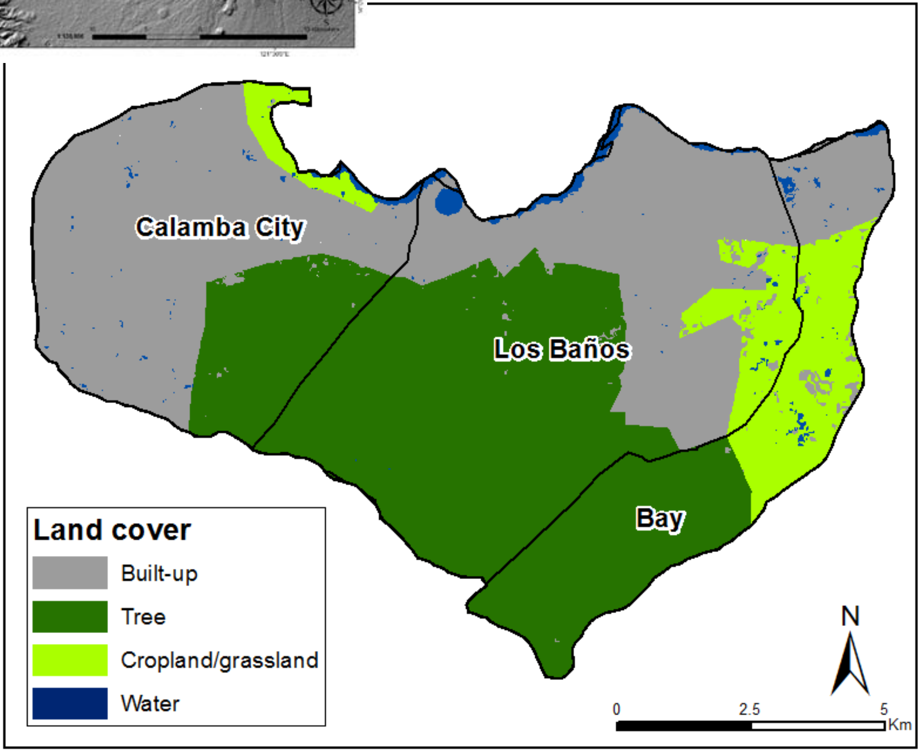
Initial Consultation

Participatory Mapping

Initial Output from Participatory Mapping



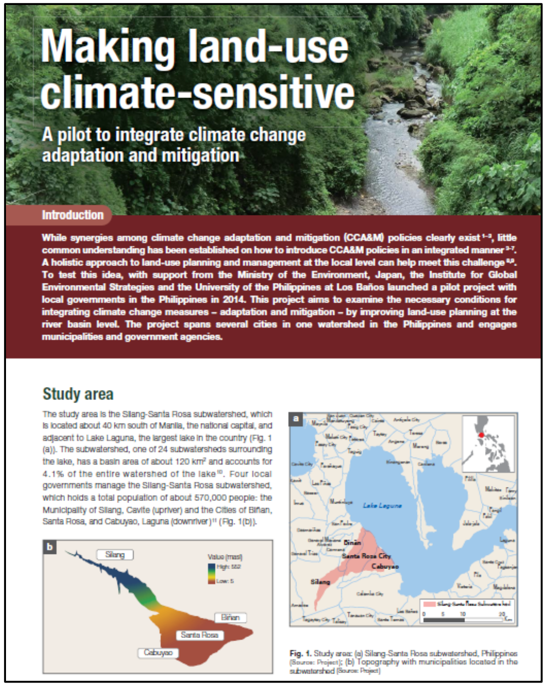




For more information

Visit the Natural Resources and Ecosystem Services area at IGES:
http://www.iges.or.jp/en/natural-resource/

Brochure



Making land-use climate-sensitive

A pilot to integrate climate change adaptation and mitigation

Introduction

While synergies among climate change adaptation and mitigation (CCA&M) policies clearly exist[1-3], little common understanding has been established on how to introduce CCA&M policies in an integrated manner[3-7]. A holistic approach to land-use planning and management at the local level can help meet this challenge[8,9]. To test this idea, with support from the Ministry of the Environment, Japan, the Institute for Global Environmental Strategies and the University of the Philippines at Los Baños launched a pilot project with local governments in the Philippines in 2014. This project aims to examine the necessary conditions for integrating climate change measures – adaptation and mitigation – by improving land-use planning at the river basin level. The project spans several cities in one watershed in the Philippines and engages municipalities and government agencies.

Study area

The study area is the Silang-Santa Rosa subwatershed, which is located about 40 km south of Manila, the national capital, and adjacent to Lake Laguna, the largest lake in the country (Fig. 1 (a)). The subwatershed, one of 24 subwatersheds surrounding the lake, has a basin area of about 120 km² and accounts for 4.1% of the entire watershed of the lake[10]. Four local governments manage the Silang-Santa Rosa subwatershed, which holds a total population of about 570,000 people: the Municipality of Silang, Cavite (upriver) and the Cities of Biñan, Santa Rosa, and Cabuyao, Laguna (downriver)[11] (Fig. 1(b)).

Fig. 1. Study area: (a) Silang-Santa Rosa subwatershed, Philippines (Source: Project); (b) Topography with municipalities located in the subwatershed (Source: Project)

Video

THANK YOU!