

# Geospatial Technologies in Natural Resource Assessment, Environment and Climate Change Related Studies

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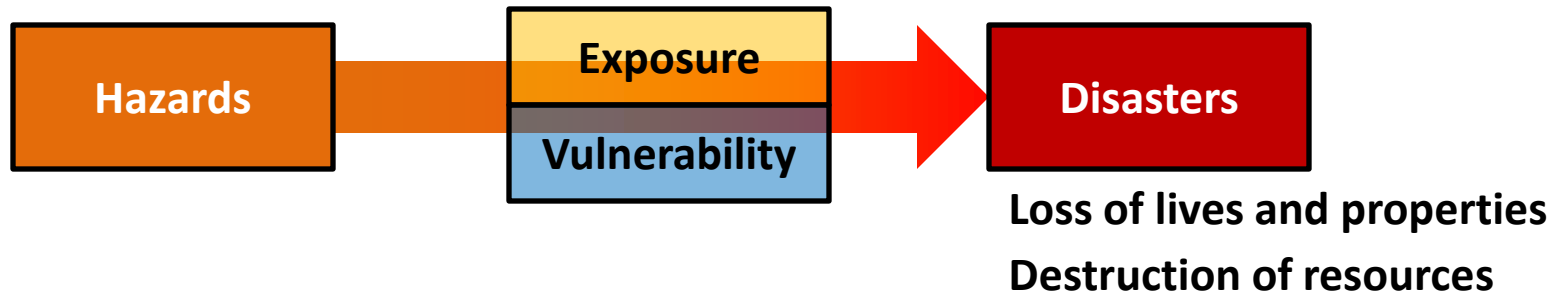
<sup>2</sup>Tokyo Institute of Technology



# Outline

- Introduction
- Natural Resource Mapping
- Natural Resource Assessment
- Integrated Decision Support Systems
  - CECAM Project
    - Phil-LiDAR 2 Program
  - UP-CCC RAPID NRA Project

# The Need for Detailed Resource Assessment



**INFORMATION NEEDED TO MITIGATE DISASTERS:**

**What resources exist where?**

**Characteristics and status of these resources?**

**Which resources are exposed and vulnerable to hazards?**

**How to protect and conserve resources?**

**Loss of lives and properties**  
**Destruction of resources**



**Severe Impacts on:**  
**POVERTY ALLEVIATION**  
**FOOD SECURITY**  
**ECONOMIC GROWTH**  
**ENERGY SUPPLY**

**THESE DETAILED INFORMATION ARE NEEDED BY GOVERNMENT AGENCIES AND LOCAL GOVERNMENT UNITS FOR BETTER PLANNING AND DECISION MAKING.**



## RECONSTRUCTION ASSISTANCE ON YOLANDA



- Overall results framework for monitoring progress consistent with Philippine Development Plan.

# Post-Disaster Needs Assessment (1)

The PDNA highlights a number of policy recommendations, including:

- Improving **baseline data** collection and **GIS capability**, improved **hazard mapping**, improved **environmental assessments**, and watershed monitoring and rivers for **early warning** for floods;
- **Reestablishment of environmental assets** (e.g. forests, mangroves, marine habitats) to provide protection against future hazards;

# Post-Disaster Needs Assessment (2)

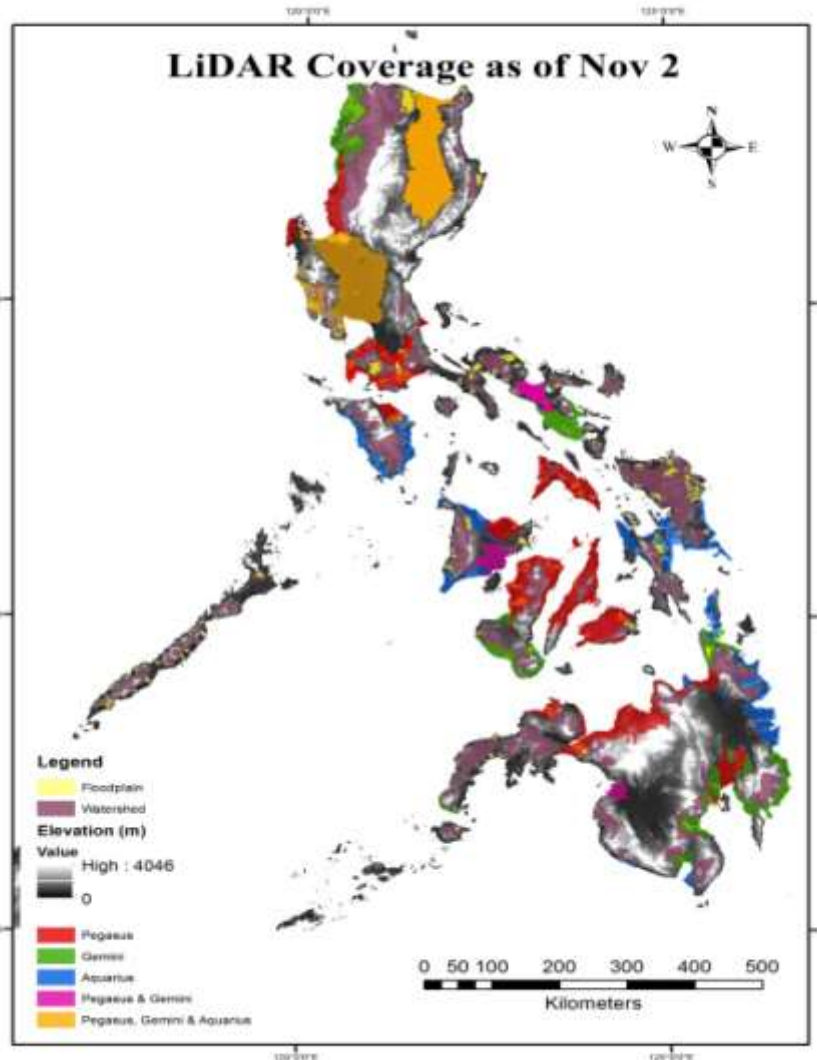
The PDNA highlights a number of policy recommendations, including:

- Development of **environmental management plans** and updating **land use and management plans** to guide long-term planning and development;
- **Integrating disaster risk reduction, climate change and environmental measures** into reconstruction programs; and
- **Reestablishing livelihood based on ecosystem services**, to build resilient households and income generation and enhance food security.

# DREAM → Phil-LiDAR 1

## PHIL-LiDAR 1 PROJECTS

-  LiDAR Data Acquisition Component (DAC)
-  LiDAR Data Validation and Bathymetry Component (DVBC)
-  LiDAR Calibration, Point Cloud Classification, and Image Orthorectification Component (DPCC)
-  Integrating High-Resolution Digital Elevation Models (DEMs) into GIS-based Flood Modeling Component (FMC)
-  Data Archiving and Distribution of LiDAR Datasets in the Philippines Component (DAD)
-  Training for LiDAR Data Acquisition, Processing, Validation, and Flood Modeling Component



# Objectives of Phil-LIDAR-2



- To complement on-going programs of government agencies (e.g. DA, DENR, DOE) by utilizing LIDAR data;
- To develop methodologies for extracting resource features from LiDAR and other RS data for various applications:
  - Production of high value crops
  - Irrigation assessment
  - Coastal resource conservation; aquaculture production
  - Forest protection
  - Discovery of renewable energy sources



# Objectives of Phil-LiDAR-2

- **Produce high-resolution** national resource maps;
- **Produce vulnerability assessment maps** for high-value crops and coastal resources;
- **Formulate recommendations** to help address future local supply and demand in agriculture, coastal, forest, and renewable resources.

# PHIL-LiDAR 2 PROJECTS



**Agricultural Resources Assessment  
(PARMap)**



**Aquatic Resources Assessment  
(CoastMap)**



**Forest Resources Assessment using LIDAR  
(FRExLS)**



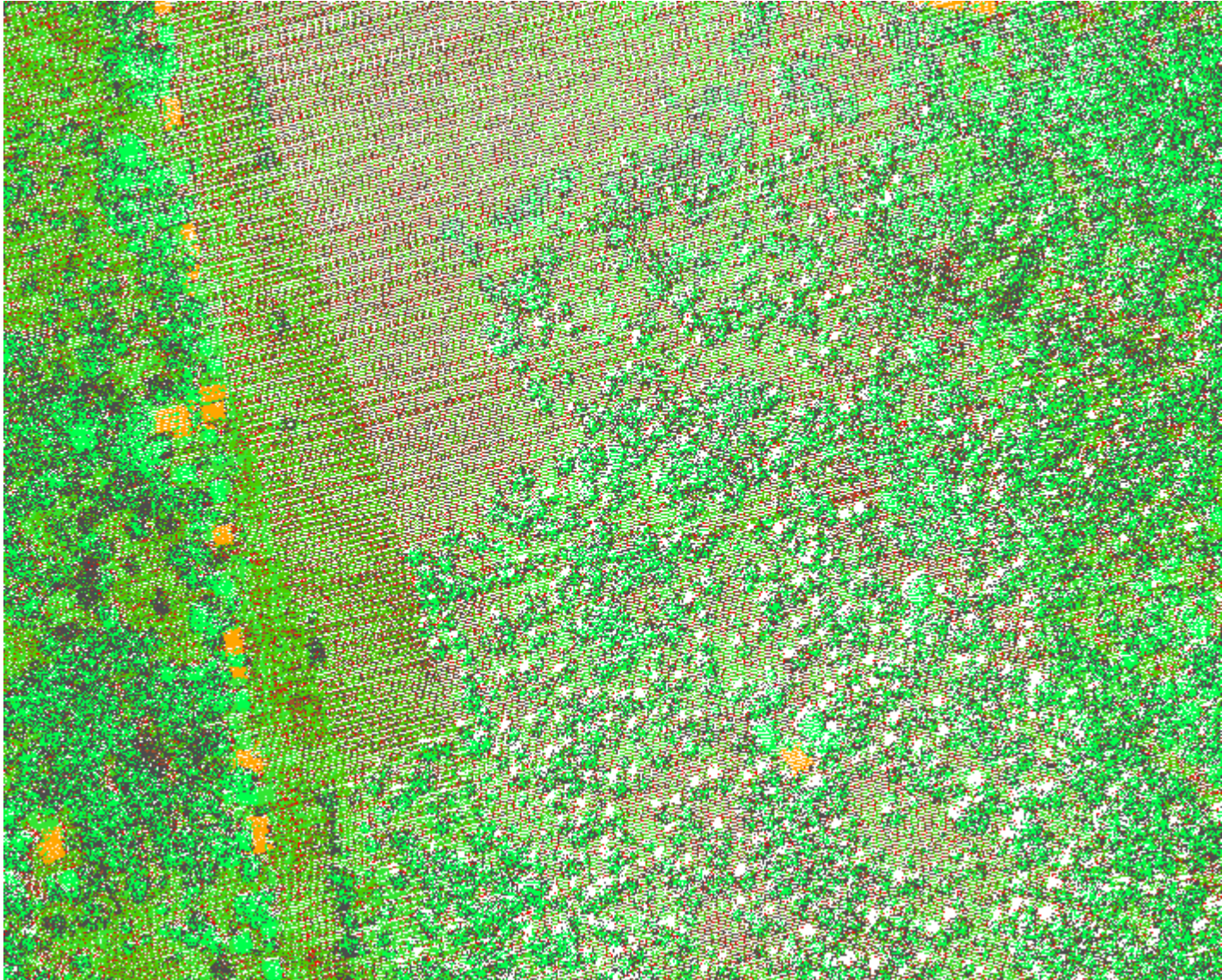
**Development of the Philippine Hydrologic  
Dataset (PHD) for Watersheds**



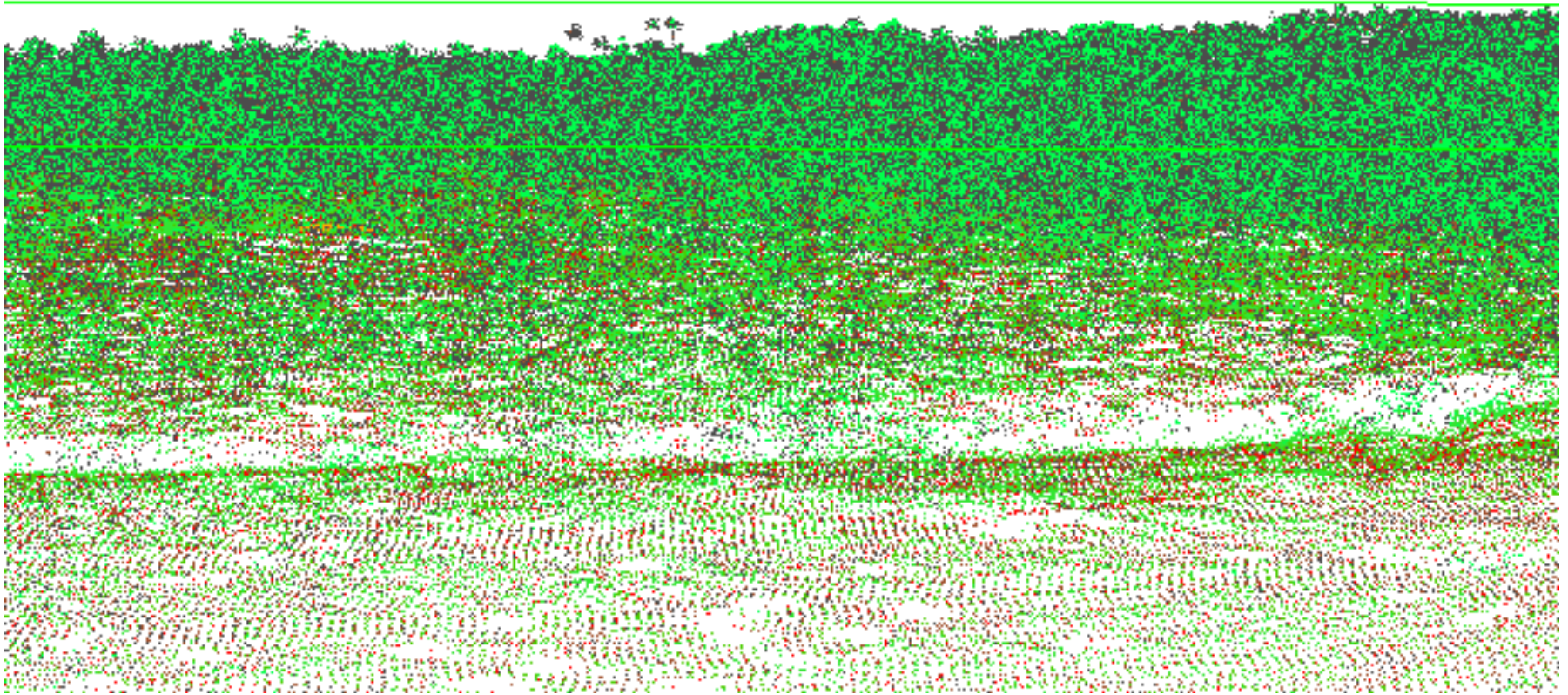
**Renewable Energy Resources Mapping  
(REMaps)**

# The Phil-LiDAR 2 Implementing Institutions

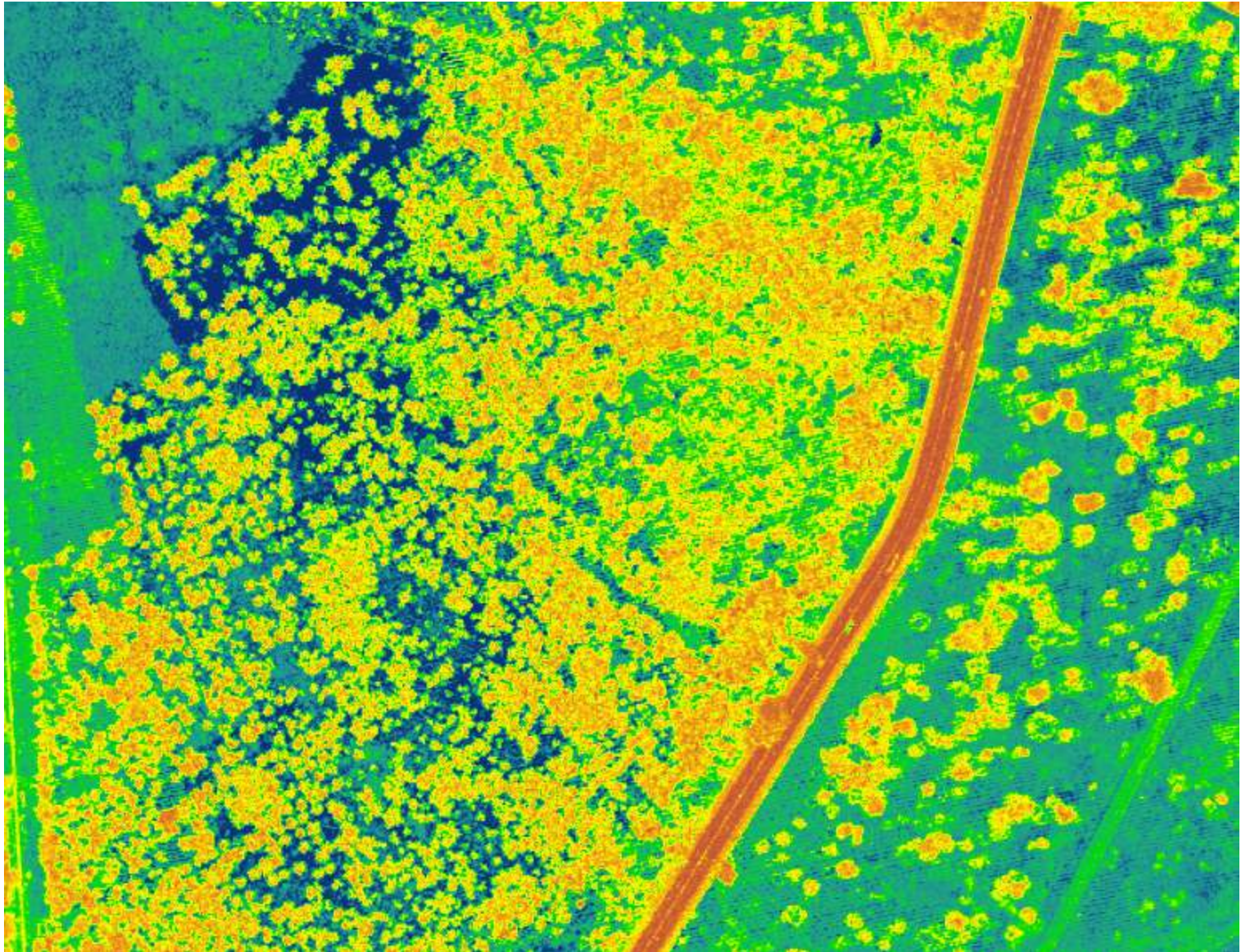




**COCONUT**



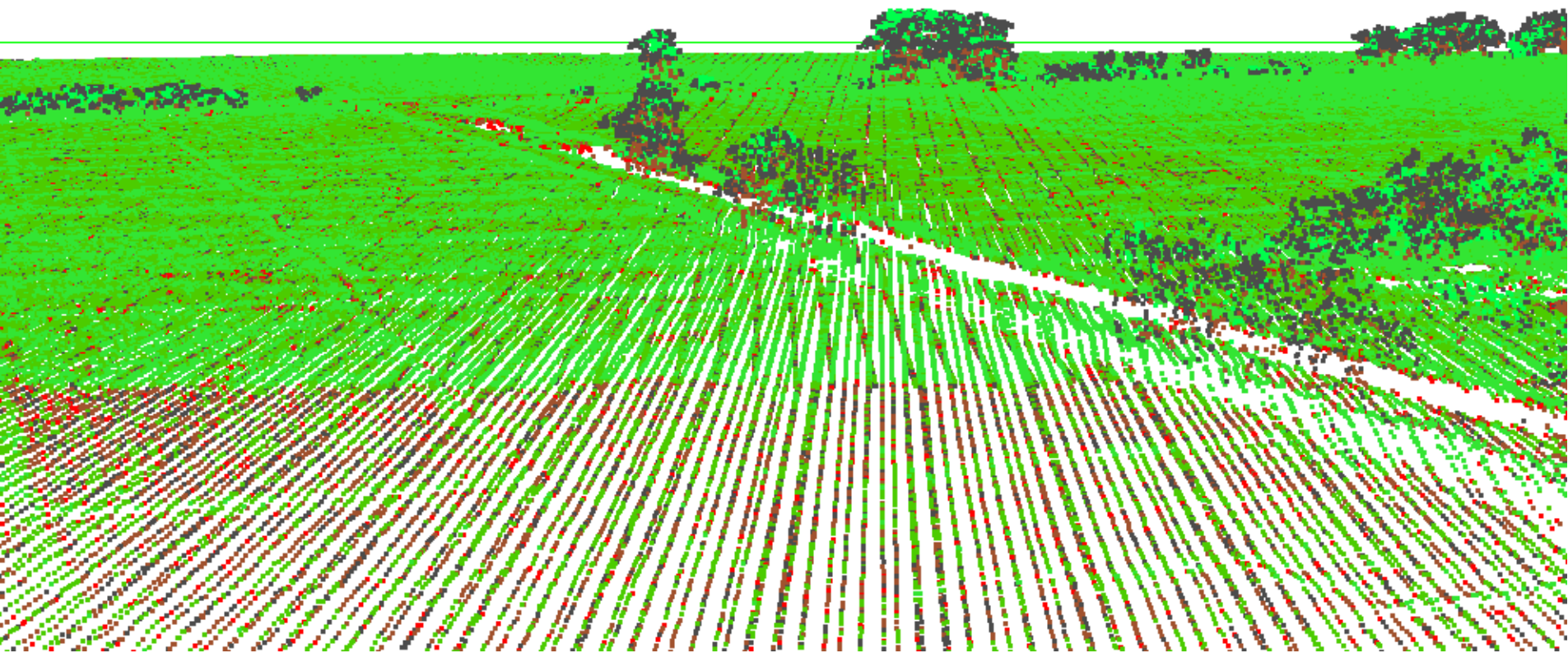
**COCONUT**



**COCONUT**



**RICE**



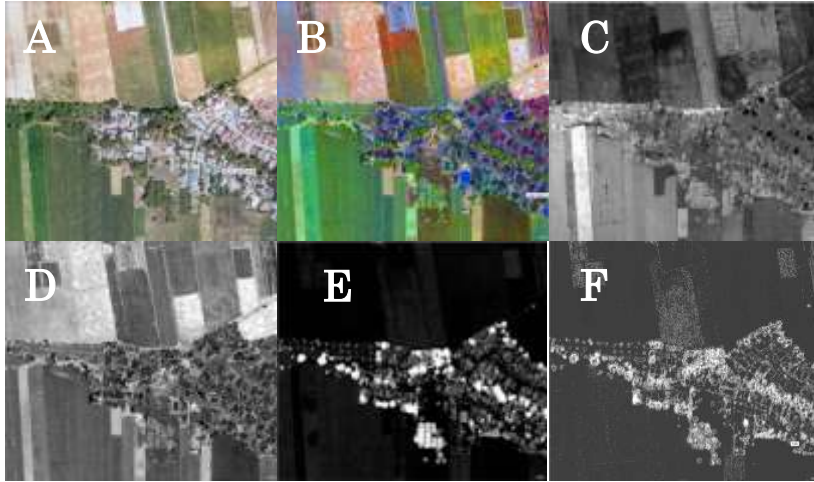
**RICE**



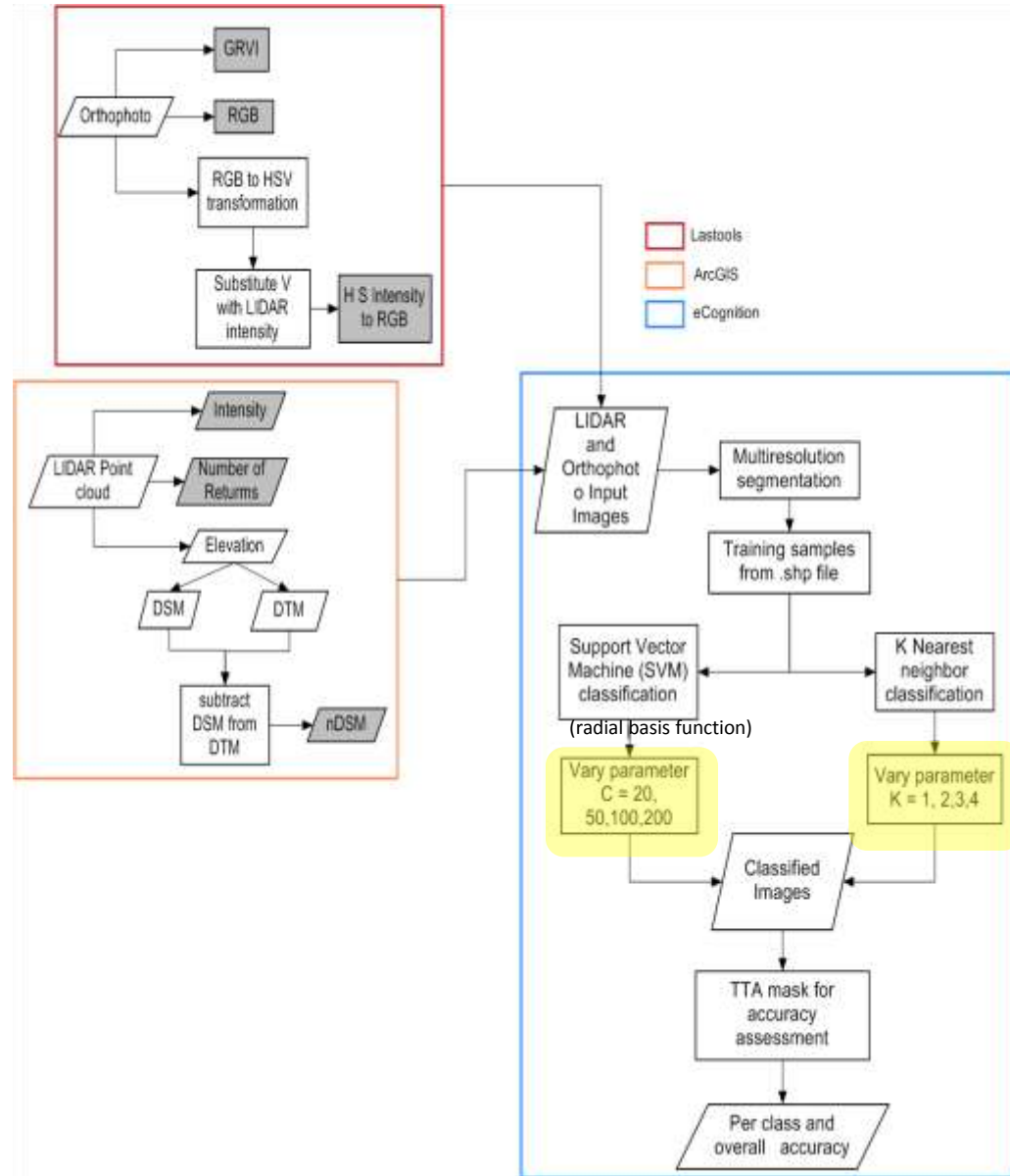


**RICE**

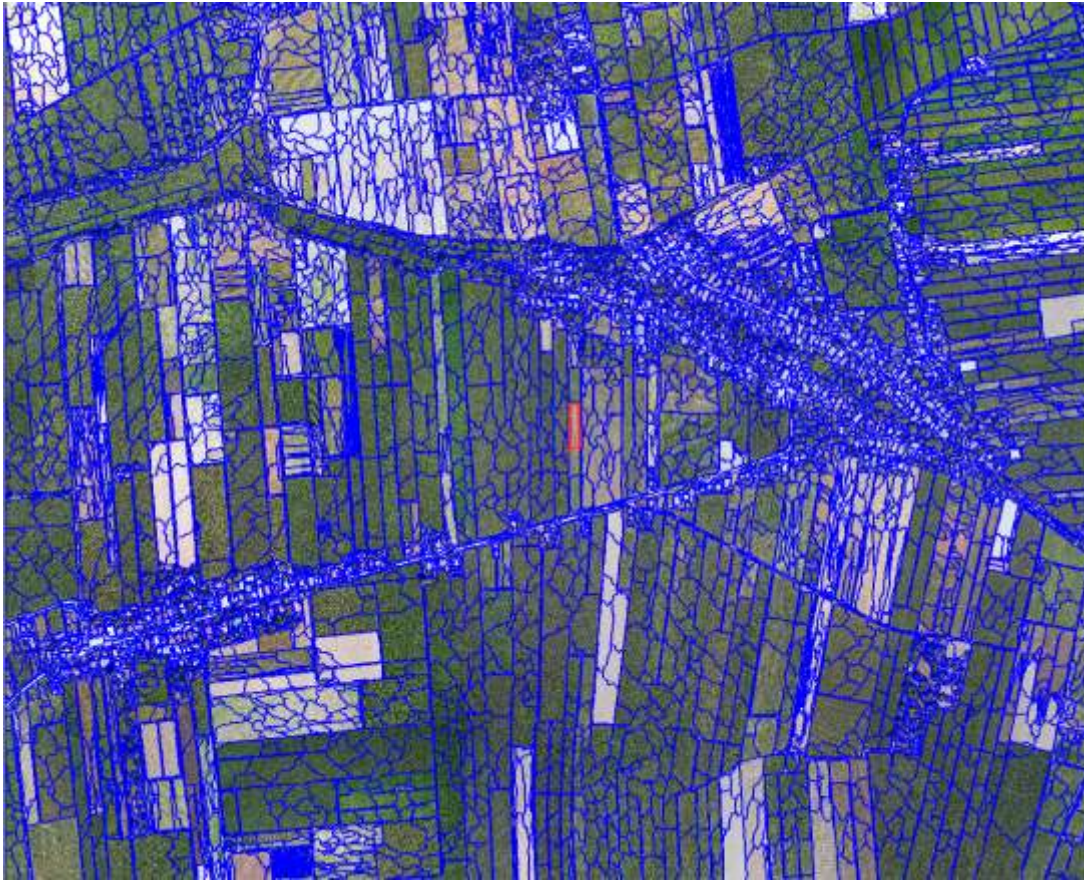
# Methods



(A) Orthophoto RGB, (B) HSV transformed with Value replaces by LIDAR intensity, (C) GRVI, (D) LIDAR intensity, (E) LIDAR nDSM, (F) LIDAR number of returns



# Methods



MULTIRESOLUTION SEGMENTATION

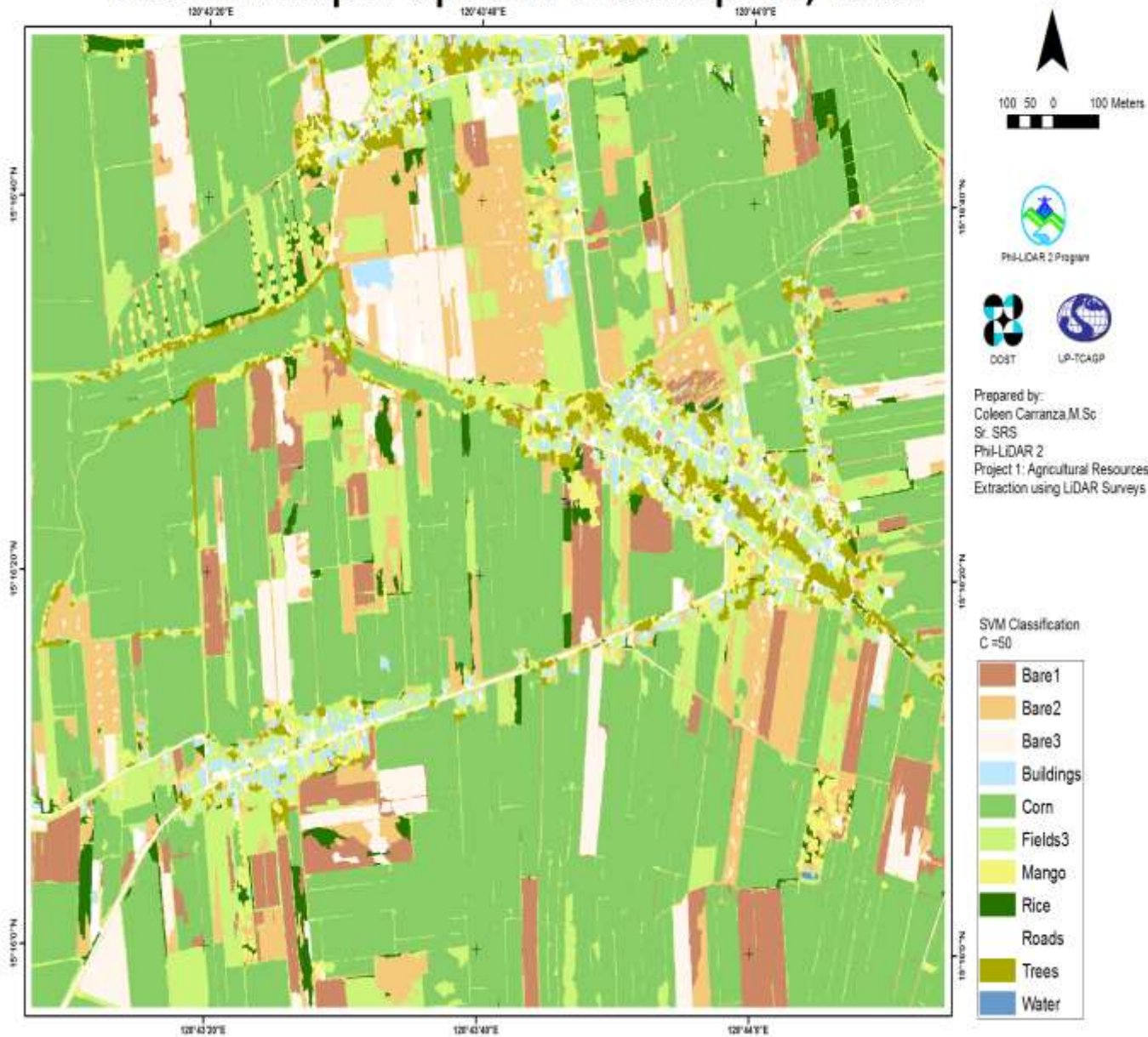
Shape: 0.2

Compactness: 0.5m

Scale:30

<i>Features</i>	<i>Image Layers</i>
• <i>GLCM Homogeneity</i>	R
• <i>GLCM Entropy</i>	G
• <i>GLCM 2nd Angle Moment</i>	NSM
• <i>GLCM St Dev</i>	Intensity GRVI
<i>GLDV Entropy</i>	Intensity NSM
• <i>St dev</i> • <i>Mean</i>	Orthophoto RGB HSV image GRVI Intensity NSM Num Ret

# Classified Map of a portion of Concepcion, Tarlac

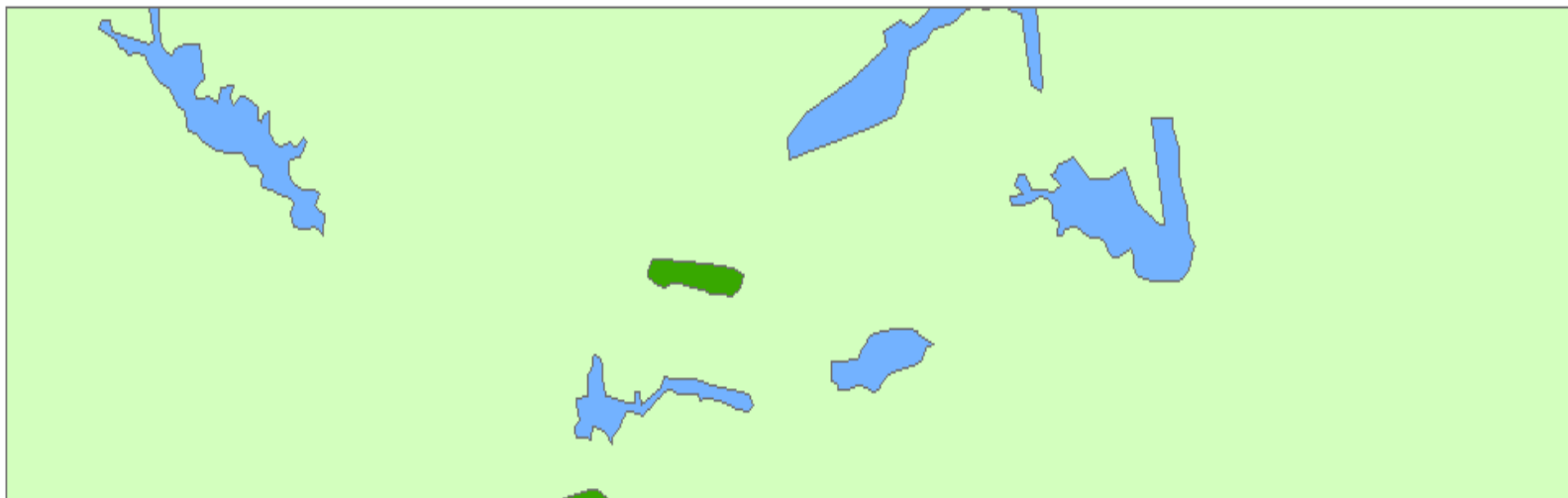


- Dominant Crop: Rice
- Large area of bare agricultural lands during data acquisition

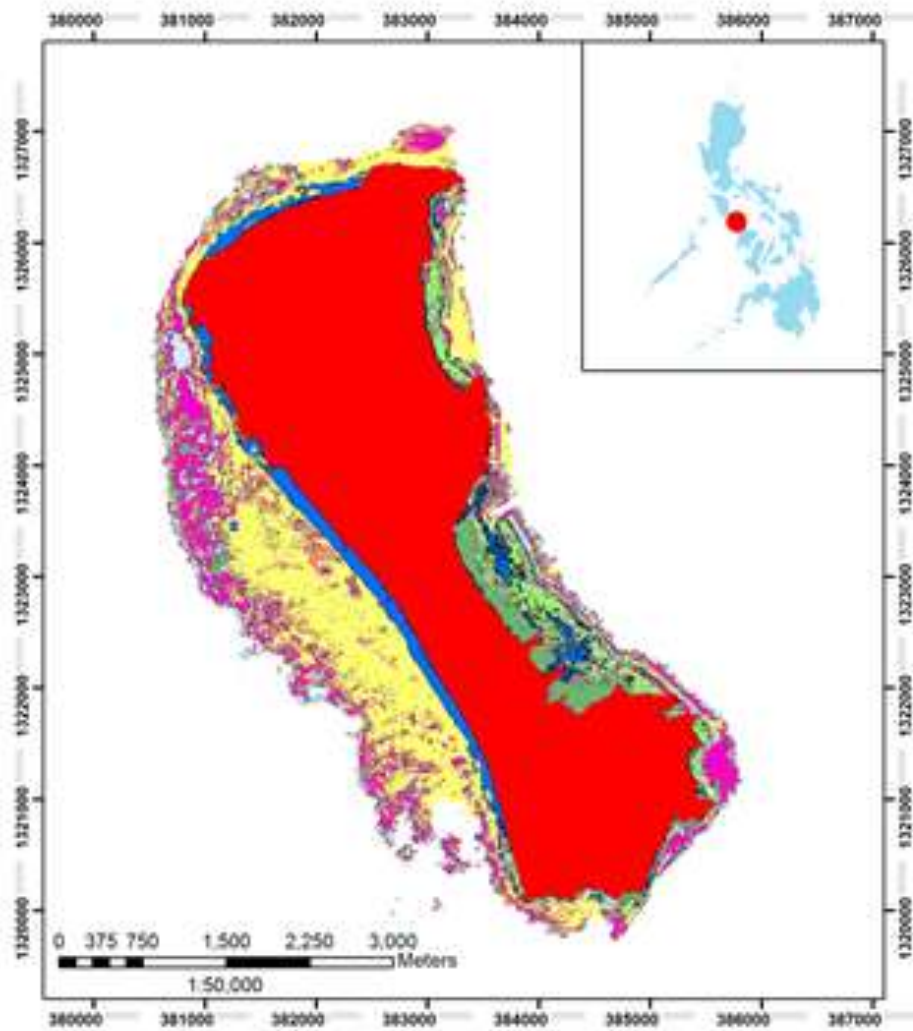
## Classified Map using LiDAR



## NAMRIA Land Cover Map 2010



# Benthic Habitat Map of Boracay Island using WorldView 2 Satellite Image (Scale 25)



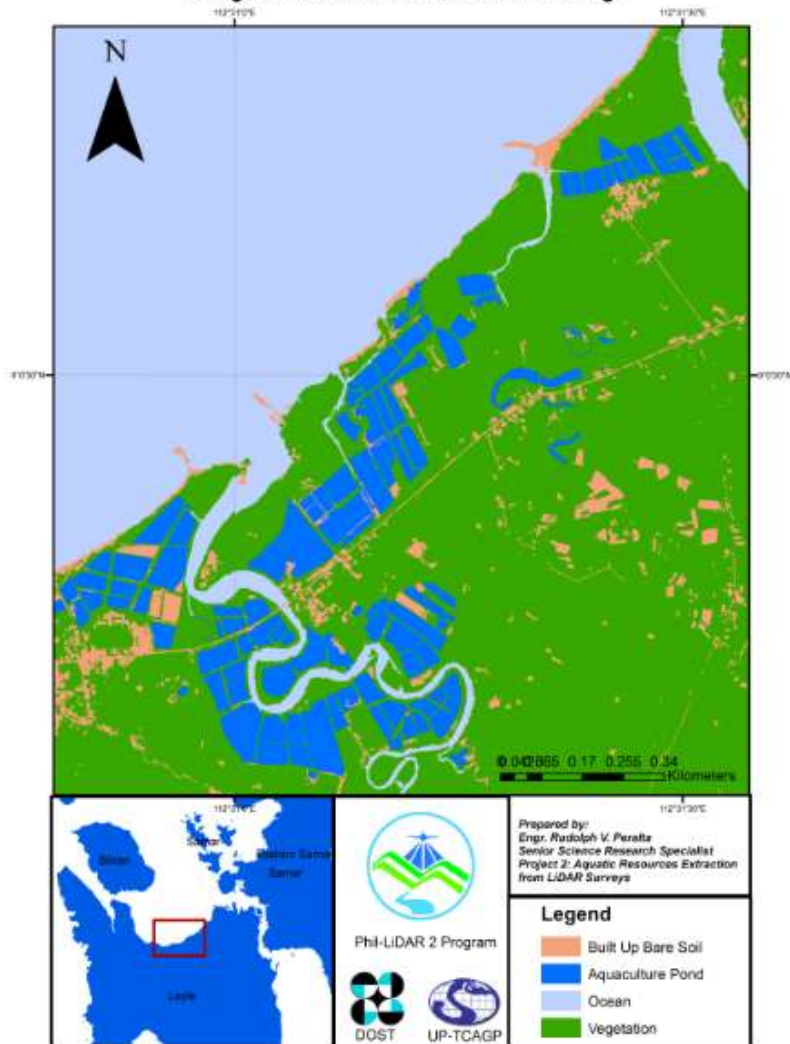
## Legend

- Sand
- Sand and Rubbles
- Sparse Seagrass
- Dense Seagrass
- Rocks
- Coral
- Corals and Rock
- Coral Sand Cay
- Land and Artifacts

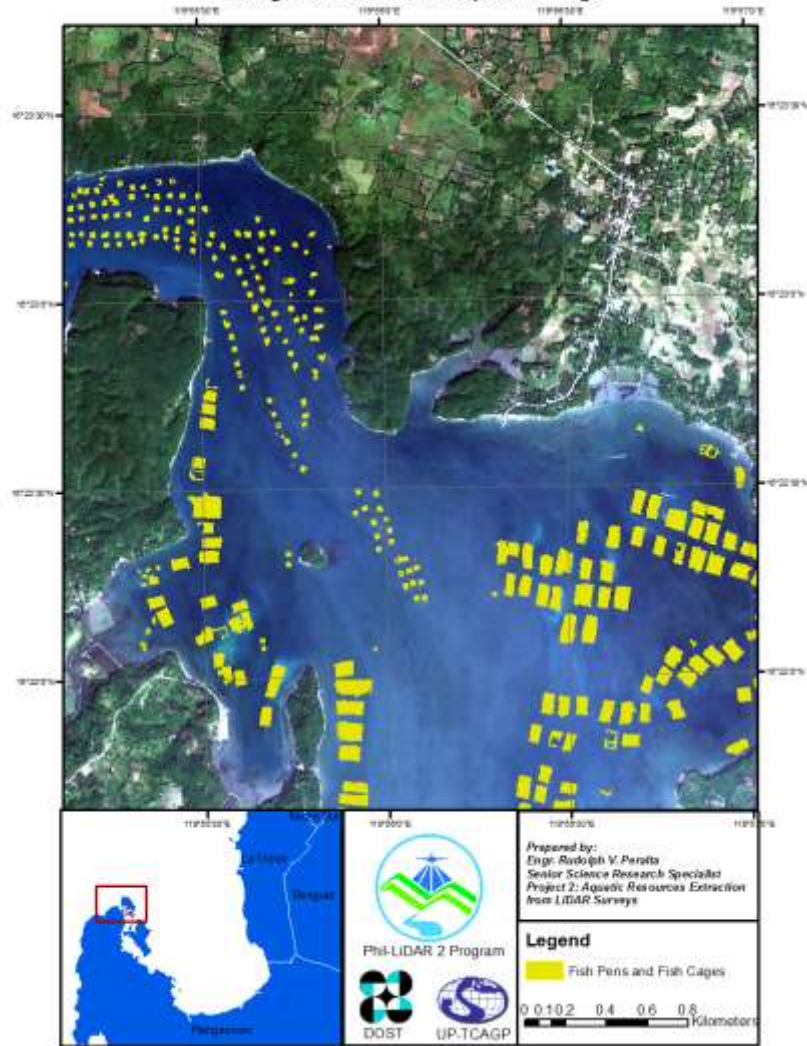


Prepared by:  
 Mia Shaira P. Estabillo  
 Research Associate  
 Project 2: Aquatic Resources Extr.  
 from LIDAR Surveys

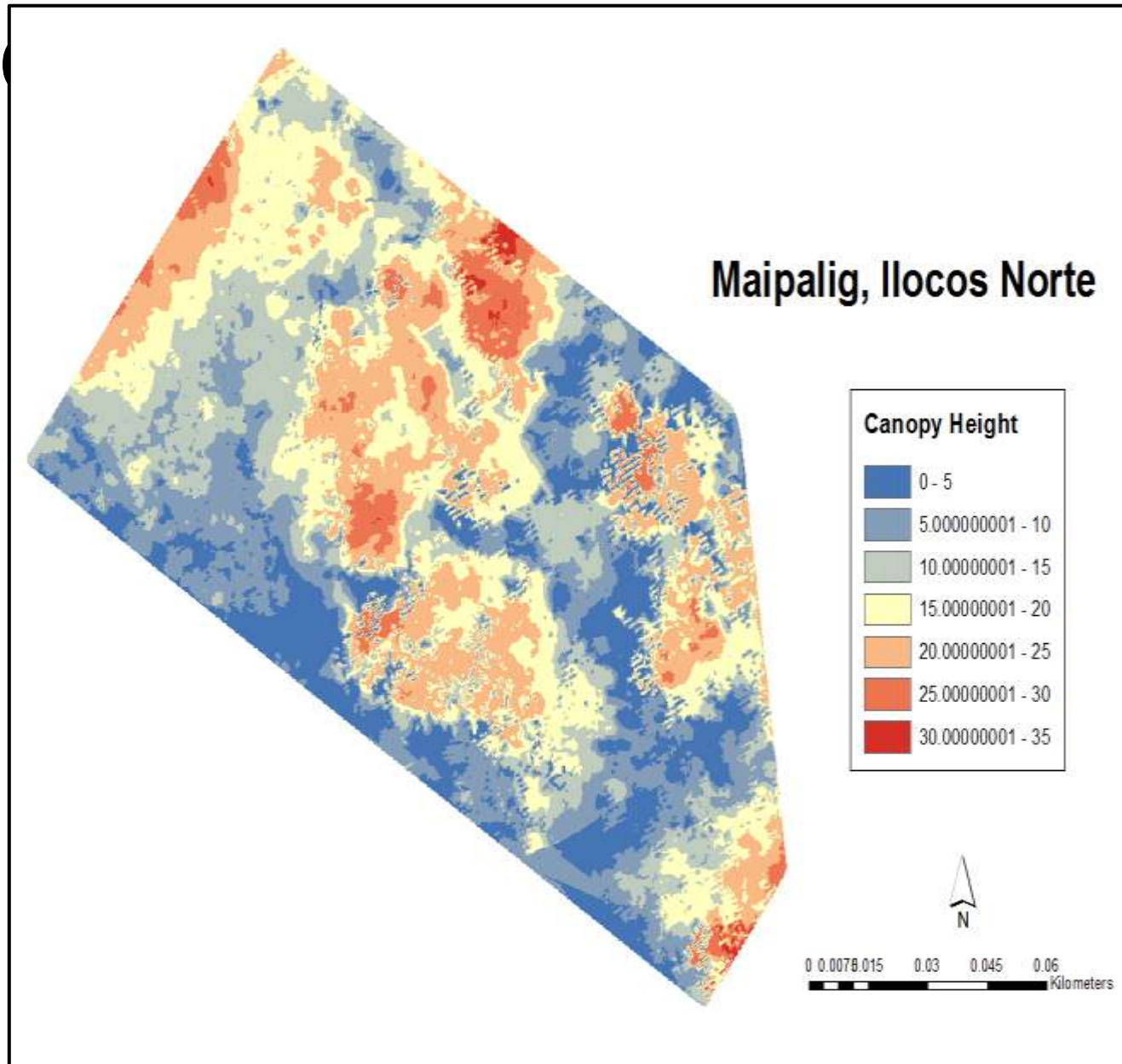
**Aquaculture Map in Barugo, Leyte using 4-Bands of WorldView-2 Satellite Image**



**Fish Pens and Fish Cages Aquaculture Map in Bolinao, Pangasinan using Worldview-2 MultiSpectral Image**



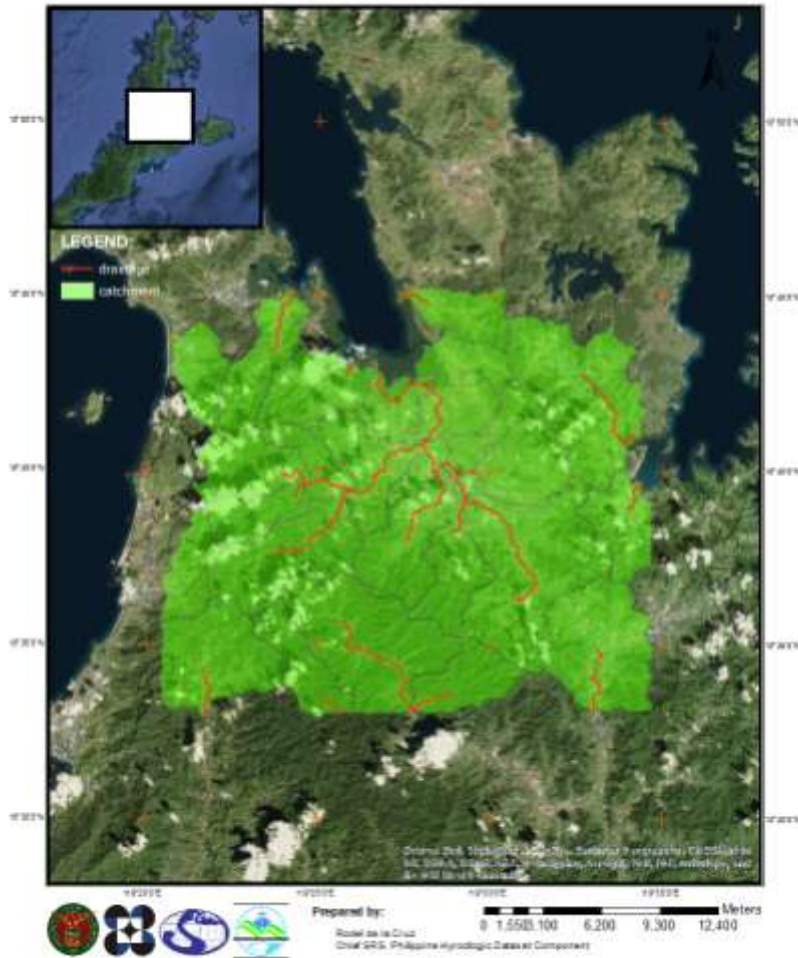
# Maipalig, Ilocos Norte:



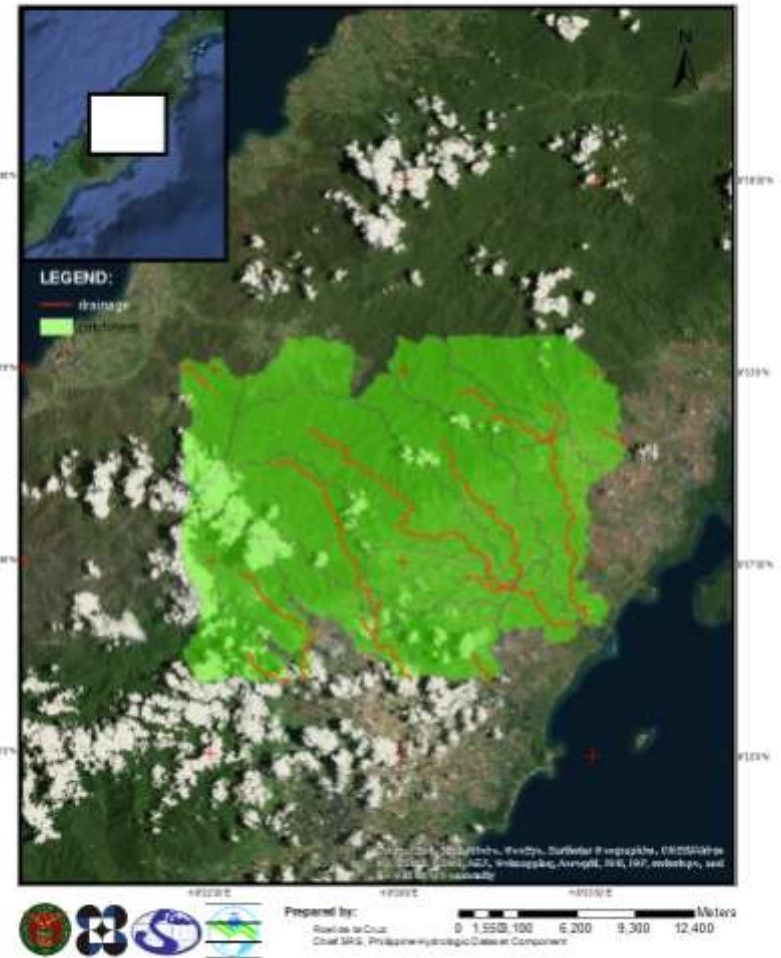


# Workflows and Initial Results: Stream Network

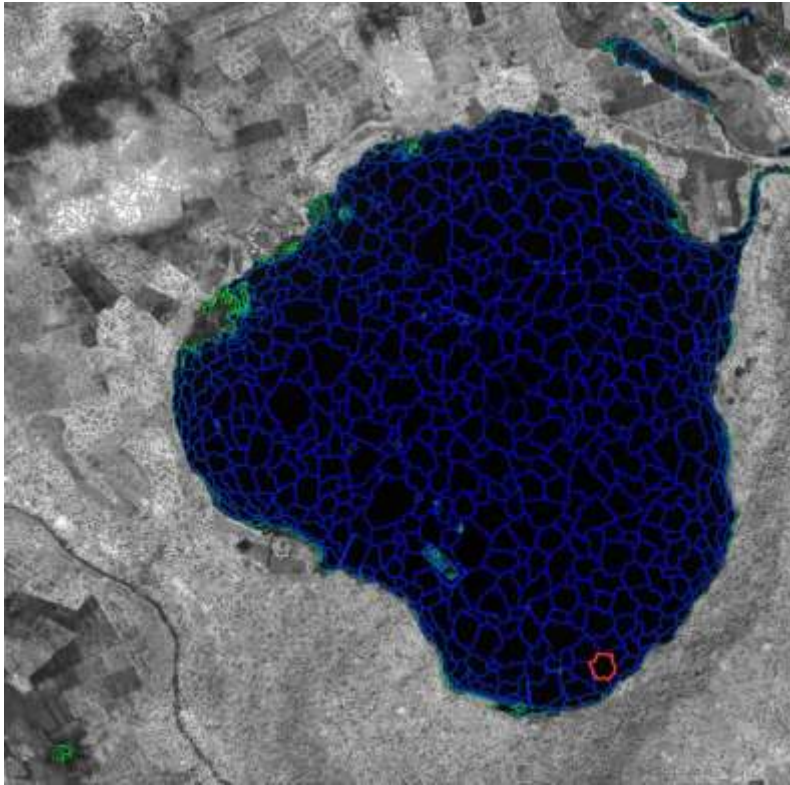
ABONGAN STREAM NETWORK



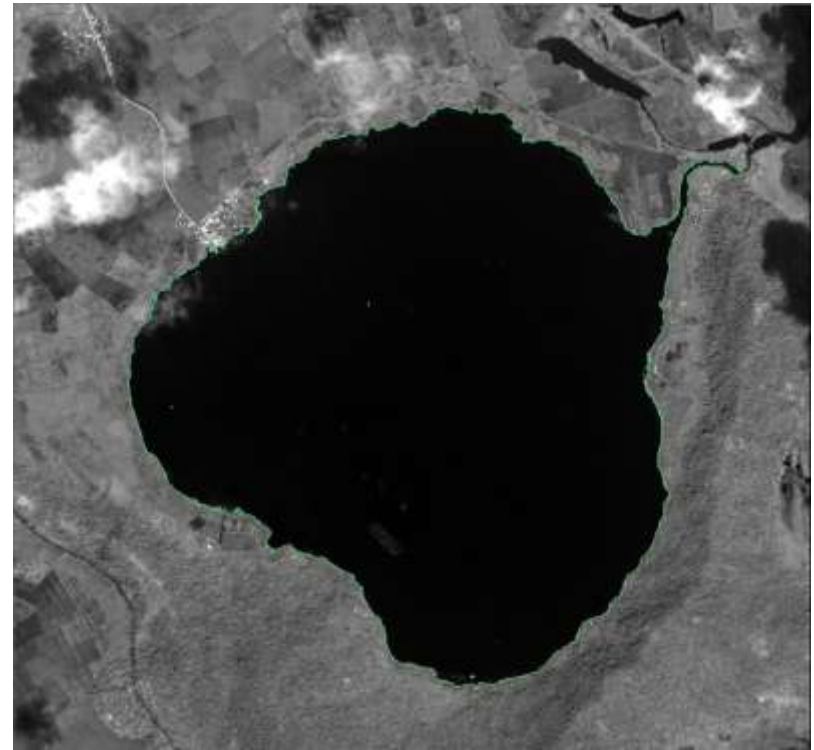
ABORLAN STREAM NETWORK



# Workflows and Initial Results: Wetlands Classification Process



Mean NIR < 279.45



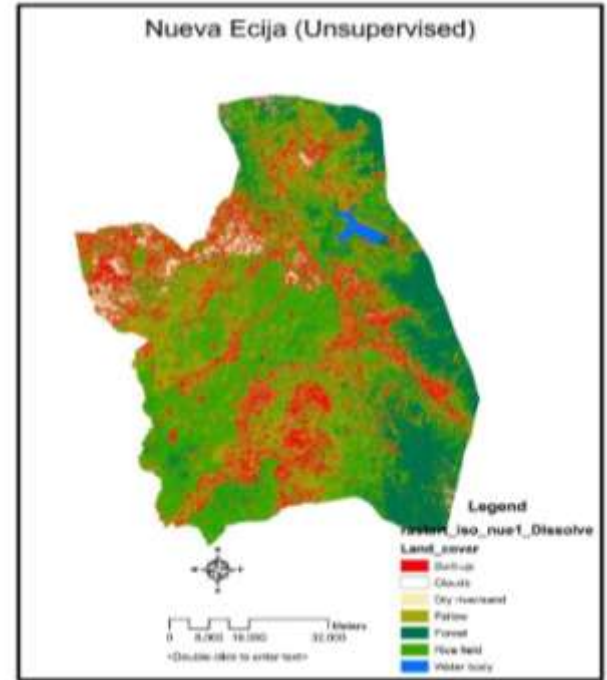
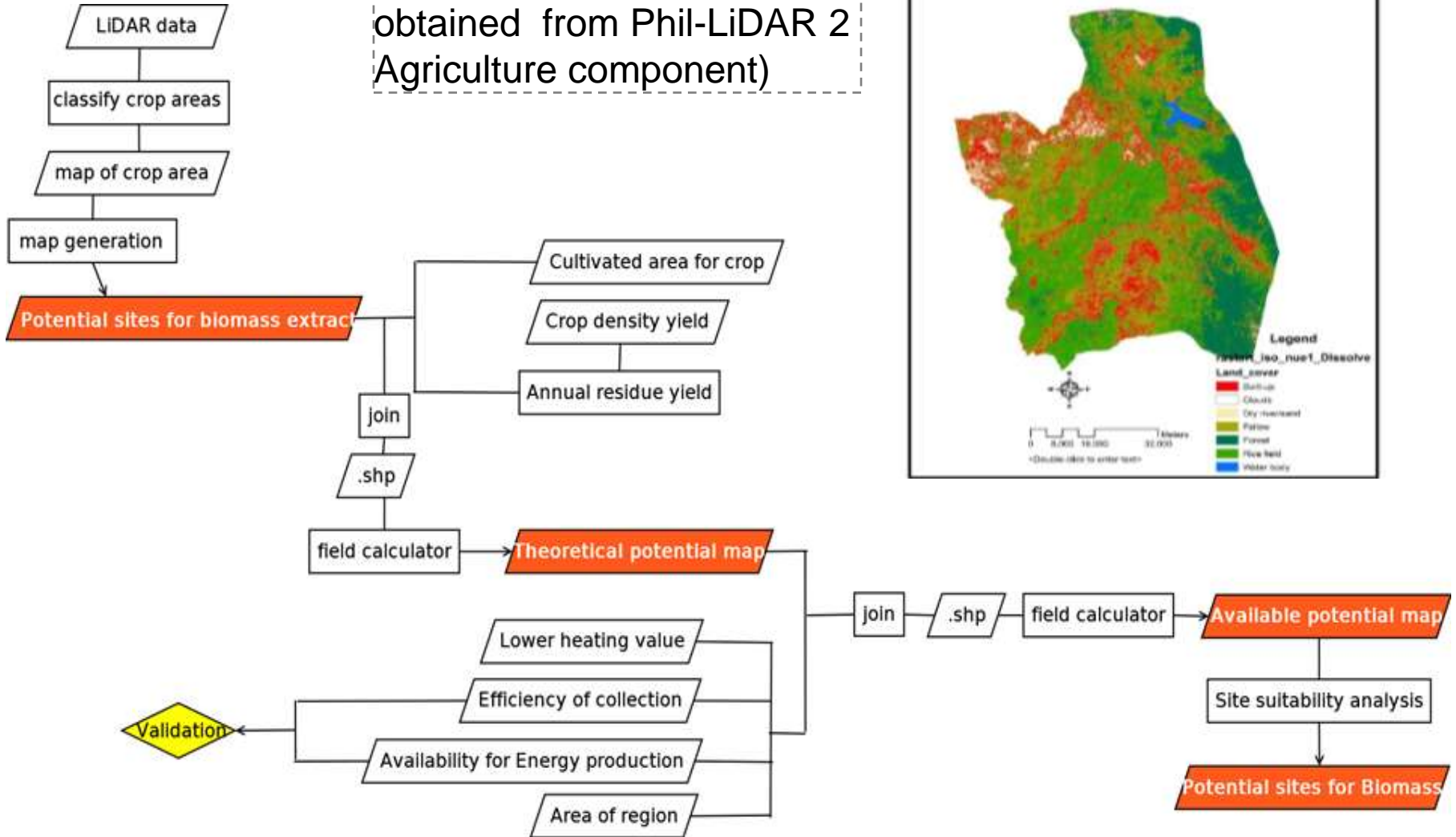
Mean NIR < 440

wetland		non-wetland		
Features	J	Direction	Threshold	
Mean nir	1.99365	<	279.449	▲
Brightness	1.83705	<	219.136	■
Max. diff.	1.75035	<	0.786976	
Mean pan	1.70616	<	207.870	▼

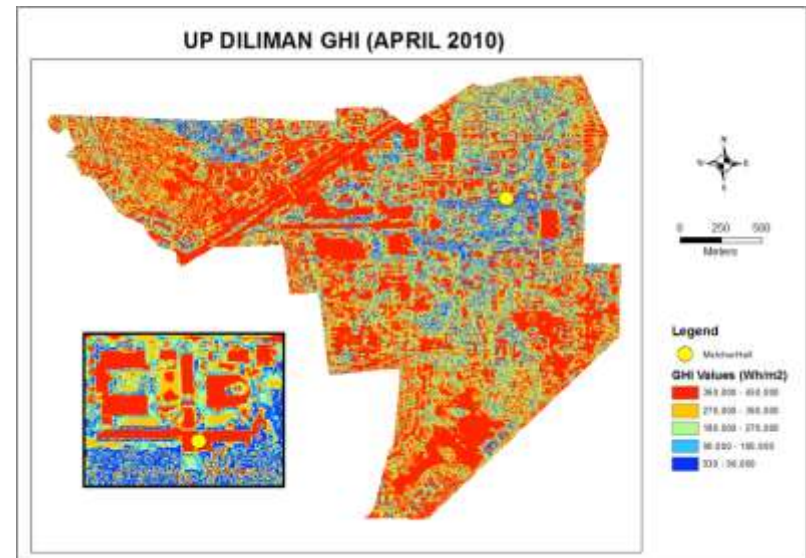
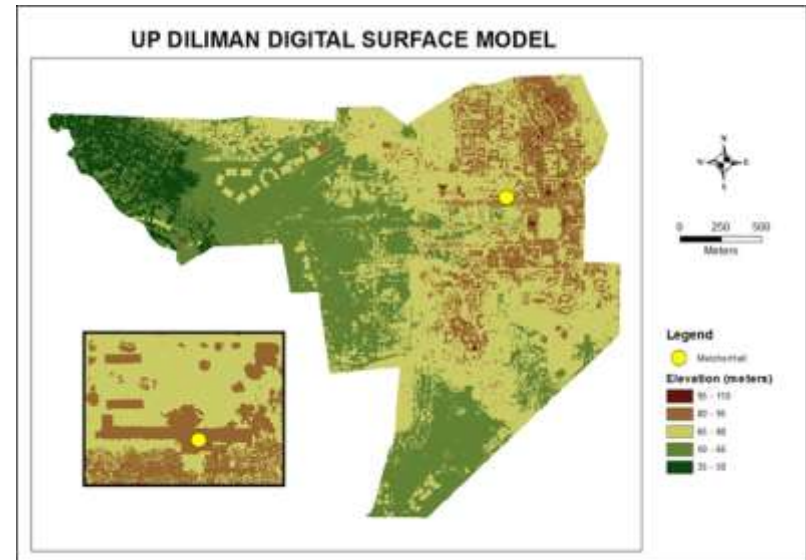
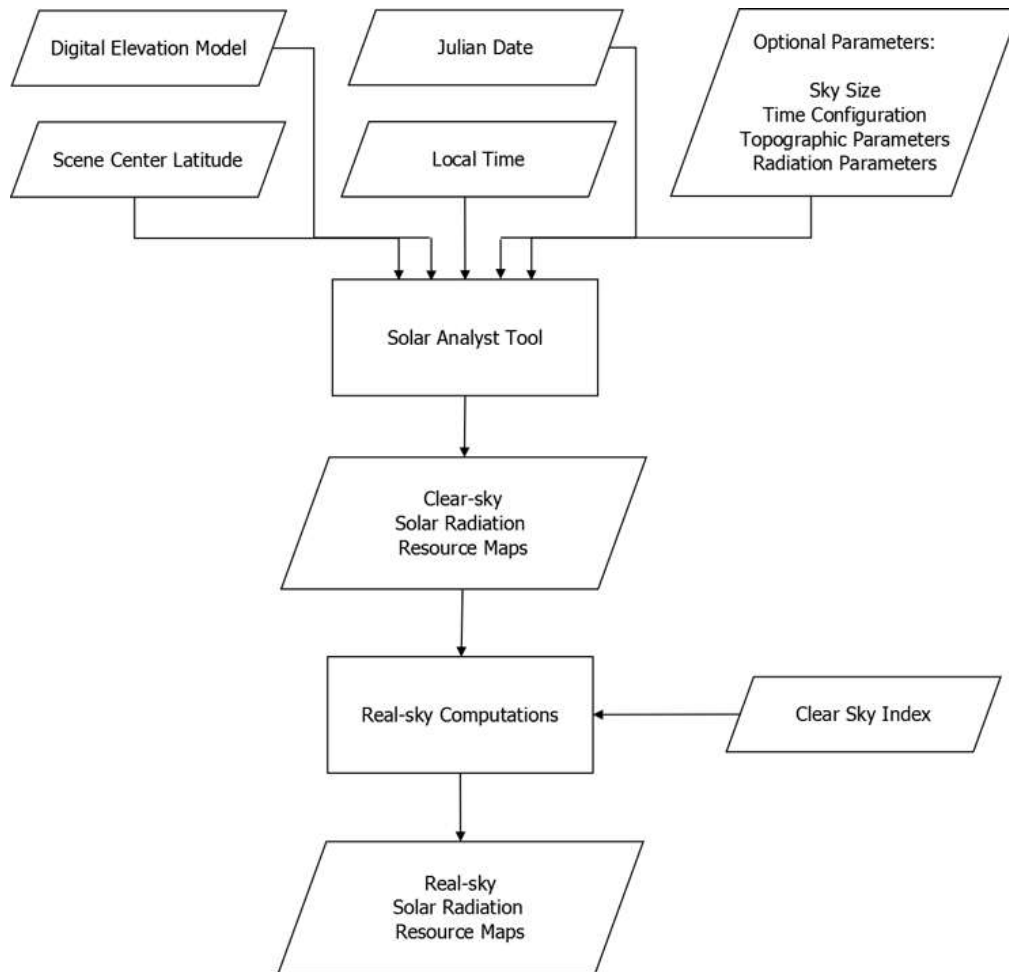
- classification
  - with Mean nir <= 440 at level 1: wetland
  - wetland at level 1: merge region
  - unclassified at level 1: non-wetland
  - wetland with Area <= 200000 Pxl at level 1: non-wetland
  - non-wetland at level 1: merge region
- exportation
  - wetland at level 1: export object shapes to lake1

# Biomass Workflow

(Final crop area map will be obtained from Phil-LiDAR 2 Agriculture component)

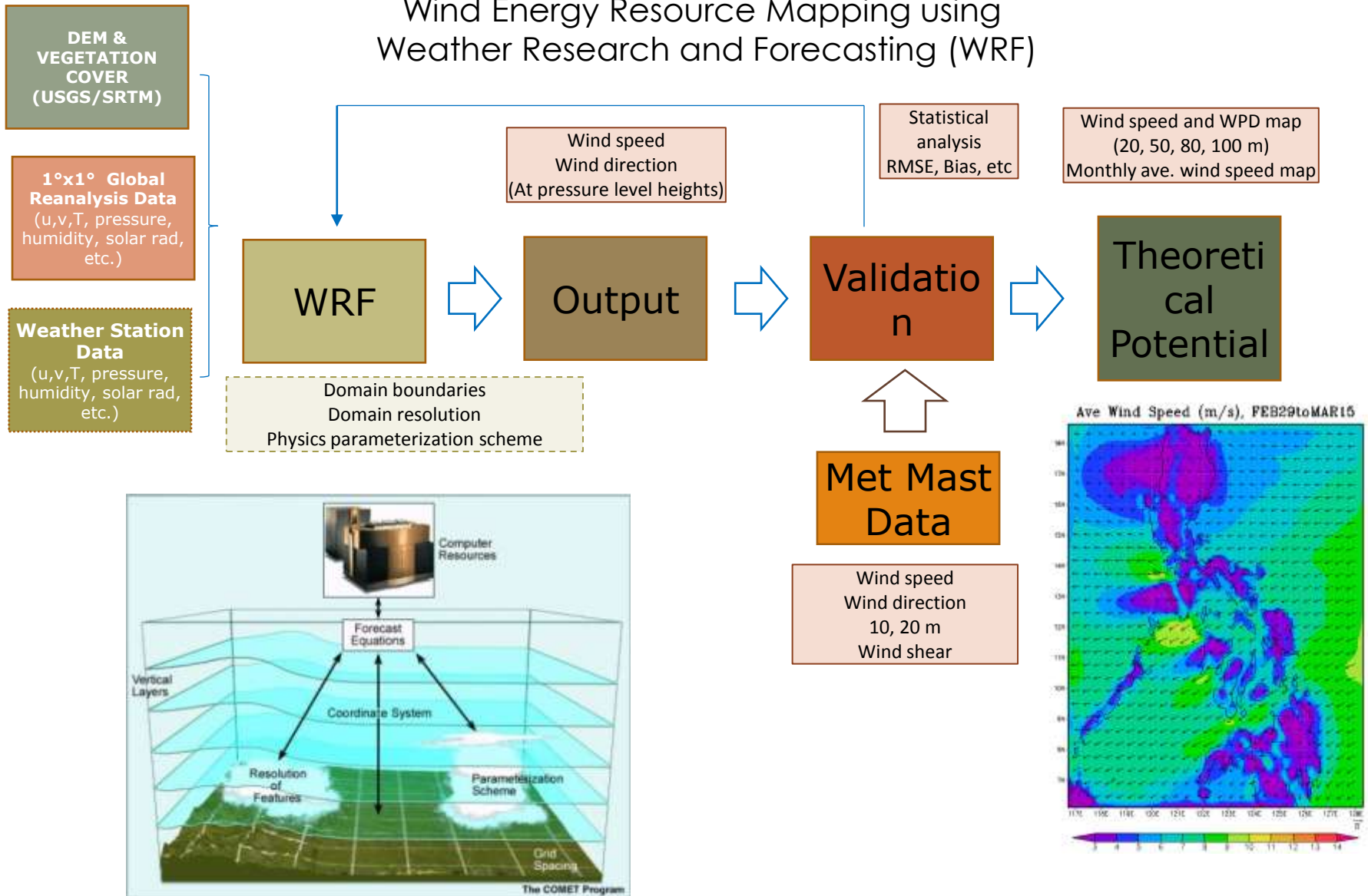


# Solar Workflow – Urban Scale



# Wind Resource Assessment Workflow (National Scale)

## Wind Energy Resource Mapping using Weather Research and Forecasting (WRF)





# The RAPID NRA Project



- NRA as part of the disaster and vulnerability risk assessments of RAPID.
- NRA results as important component
  - to fully understand the risk posed by climate change to the environment and the community;
  - to develop climate change adaptation strategies and natural resource management responses to enhance adaptive capacity and resilience of our target communities.

# The RAPID NRA Project

- The NRA is envisioned to **generate information** that will **guide development of more integrated strategies** for *reversing degradation*, *harnessing resources for productive purposes* and *maintaining their ecosystem services*.

# Objectives of NRA

- Provide an **updated and detailed inventory of selected natural resources**.
  - This includes the spatial distribution of these resources, how resources are being utilized for various purposes, and in general, the good and services they provide.
- Examine **historical changes of these resources** in order to analyse the **impacts of various activities** and **practices of the people** and of the **changing climate conditions**.



# Objectives of NRA

- Provide **projections and scenarios** on the **potential future distribution** and **condition** of these natural resources.
- **Valuation** of resources
- Develop a **community-based NRA system** that can provide quick assessments periodically and after typhoons and other calamities.



# Project Areas

## LEYTE

Tacloban City

Palo

Tanauan

Tolosa

Dulag

Mayorga

Macarthur

*(Javier)*

Abuyog

## SAMAR

Basey

Marabut

## EASTERN SAMAR

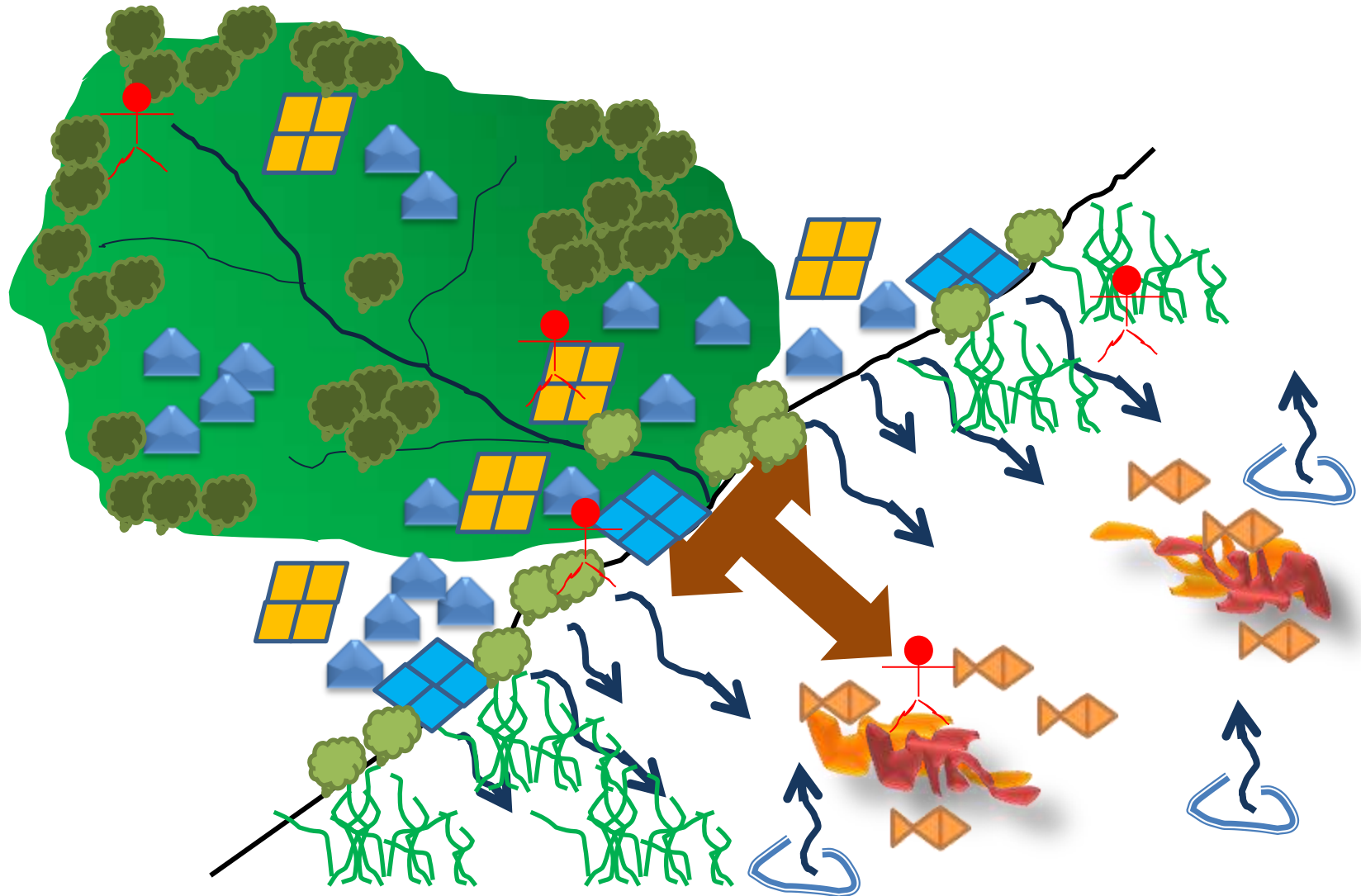
Lawaan

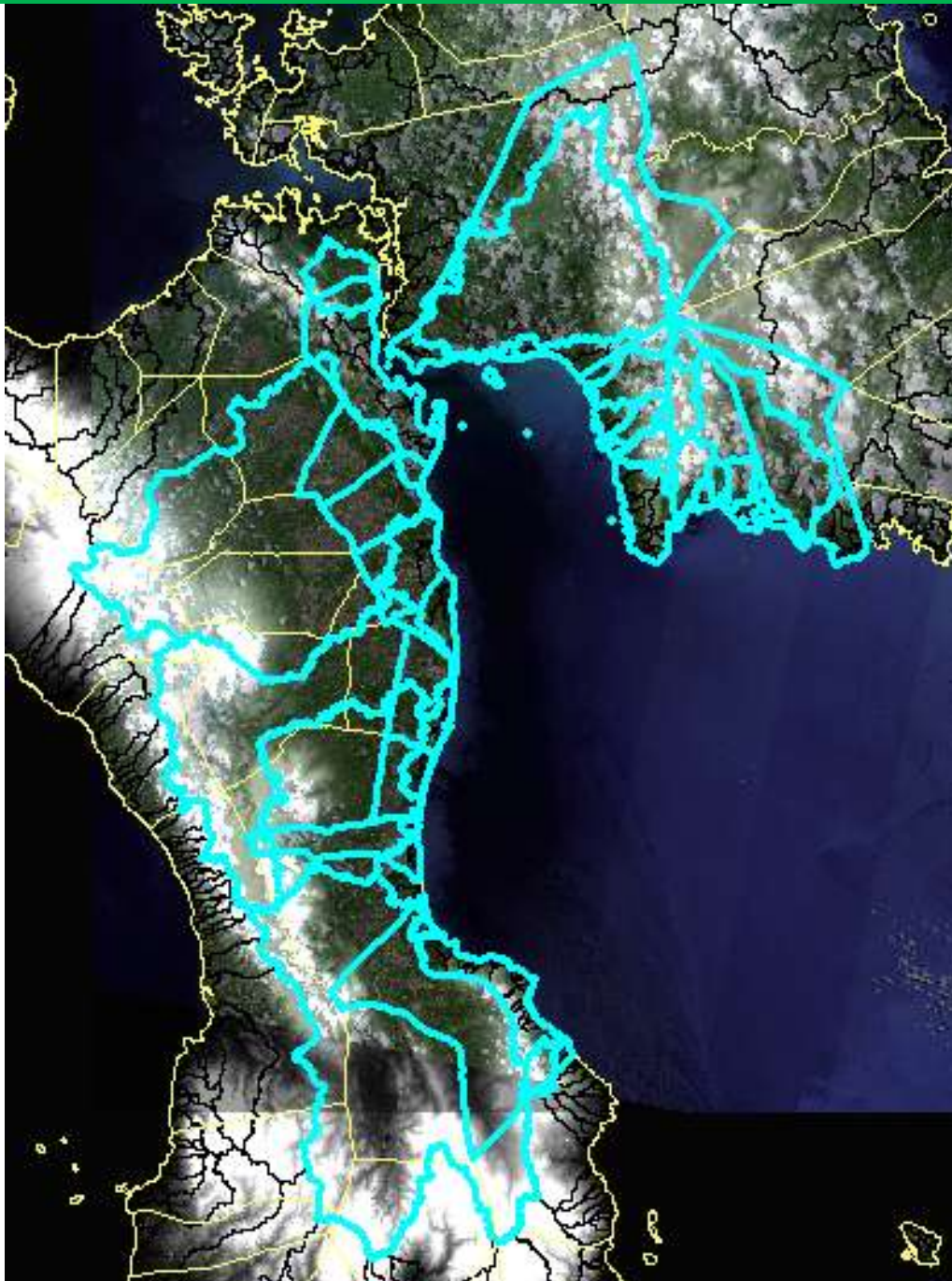
Balangiga

Focus Resources:

Forest, Agriculture, Water, Coastal and Marine

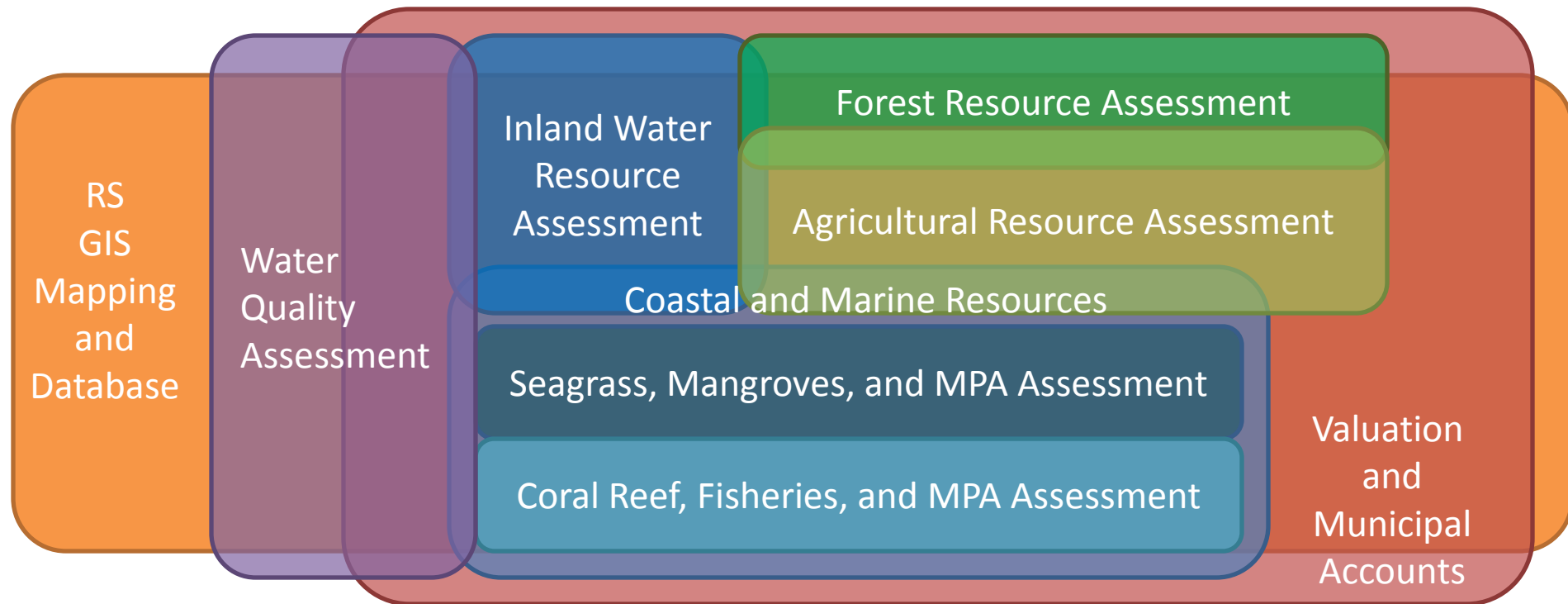
# Ridge-to-Reef: Interlinkages



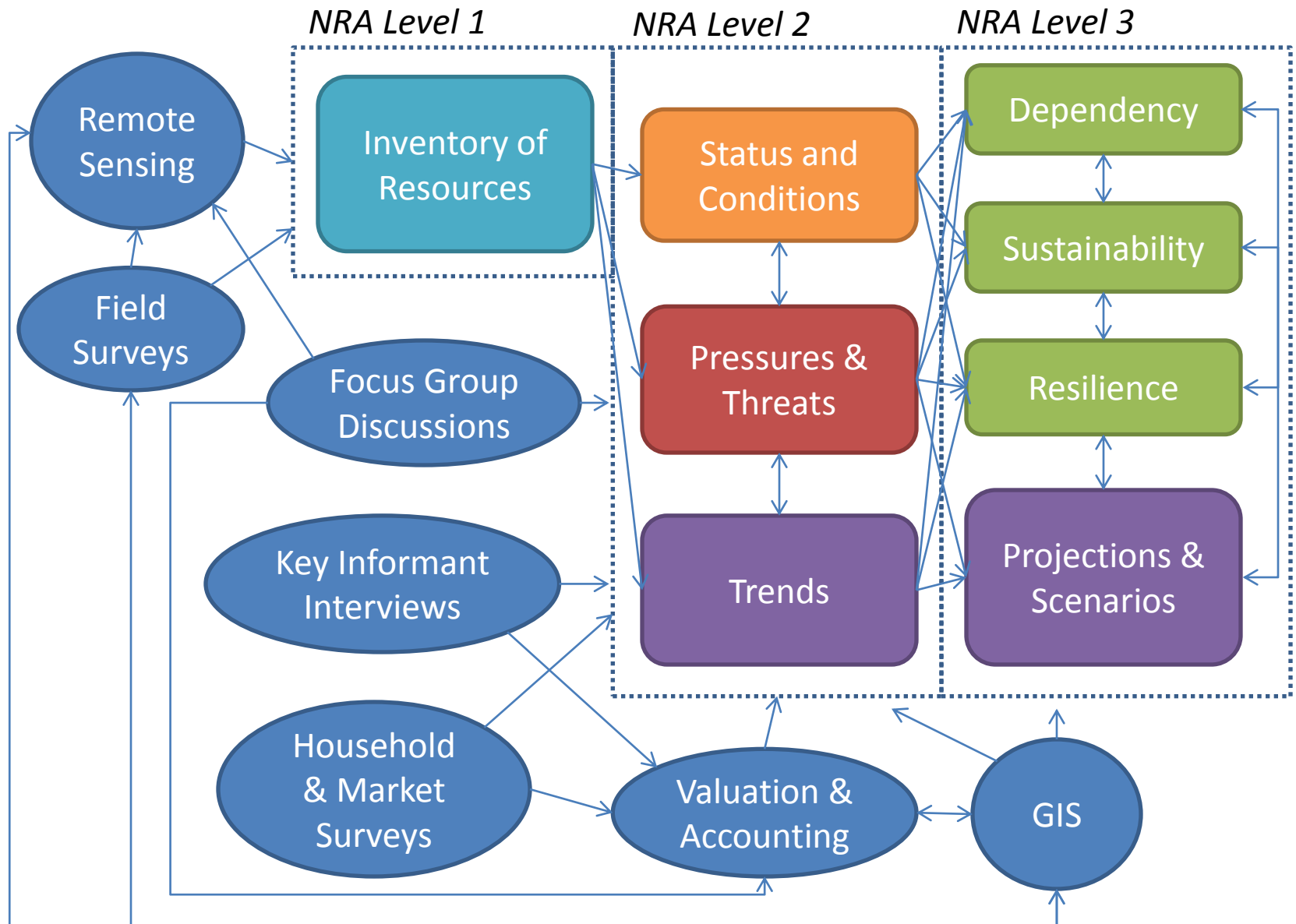


Ridge-to-Reef:  
Watersheds

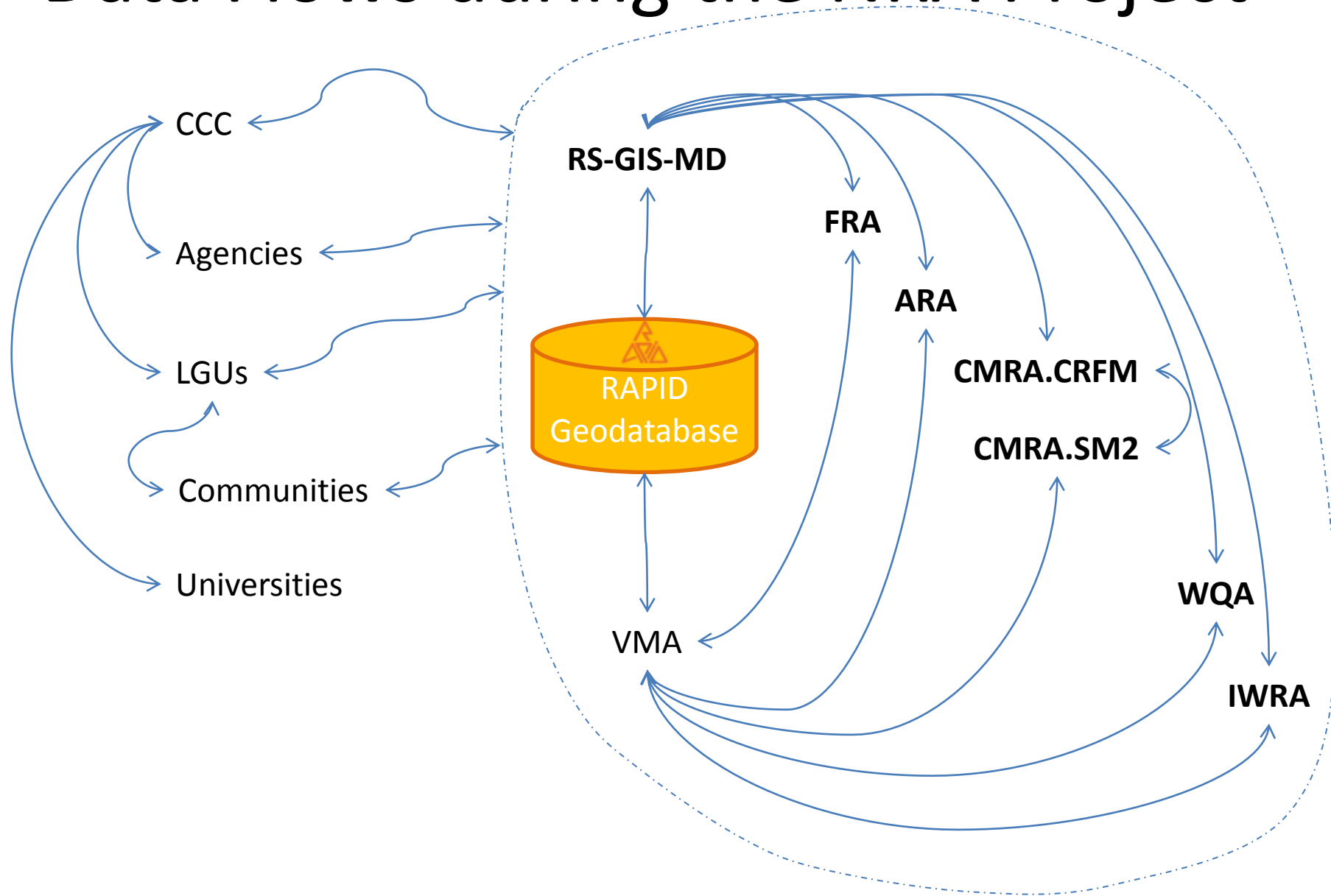
# RAPID NRA Modules



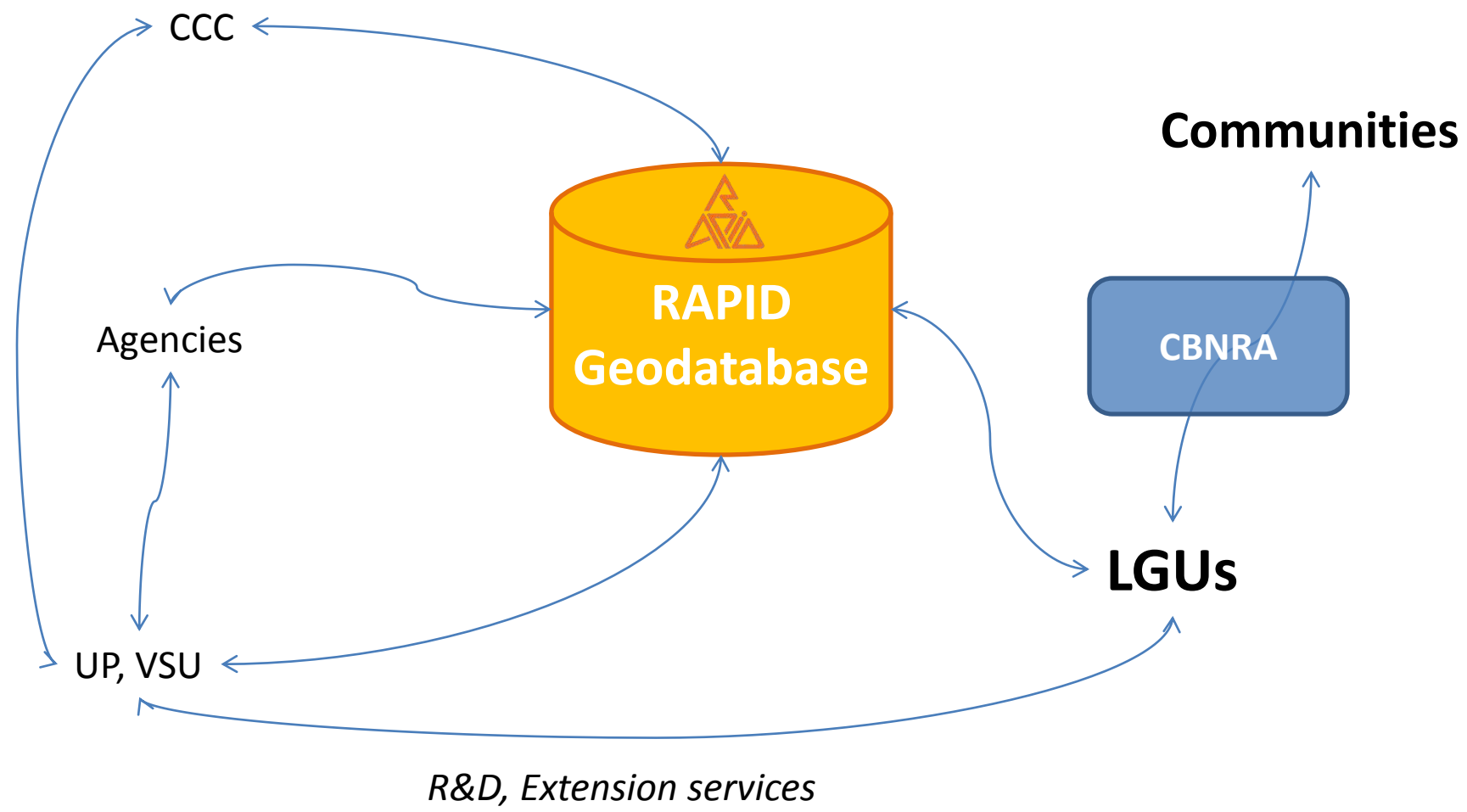
# RAPID NRA Framework



# Data Flows during the NRA Project



# Data Flows after the NRA Project?







**Intensive  
Mariculture  
Zones**



**Water quality degradation**

**Fish kills**

**Seagrass loss**

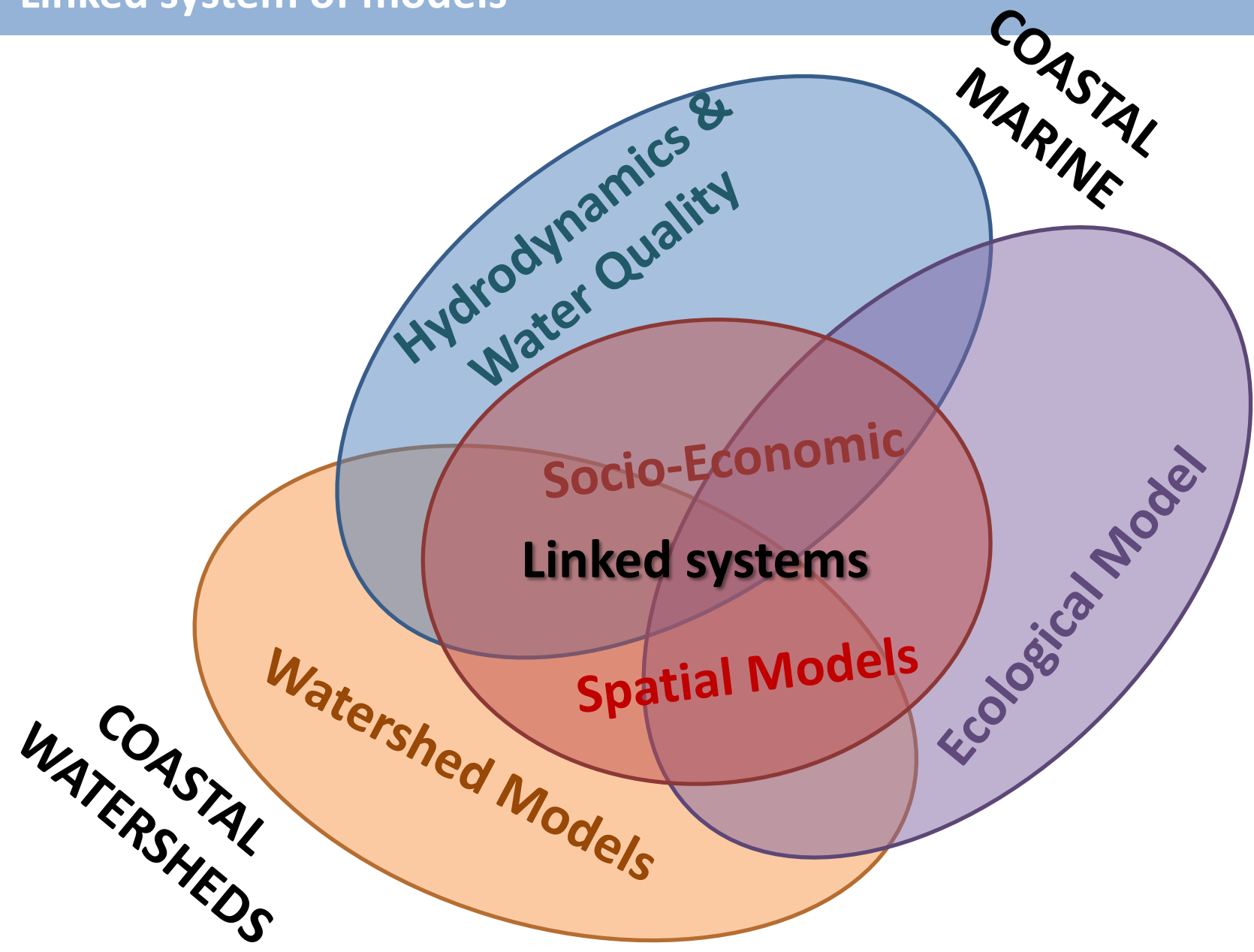
**Declining fish catch**

**Economic loss**

**Loadings  
from watersheds**

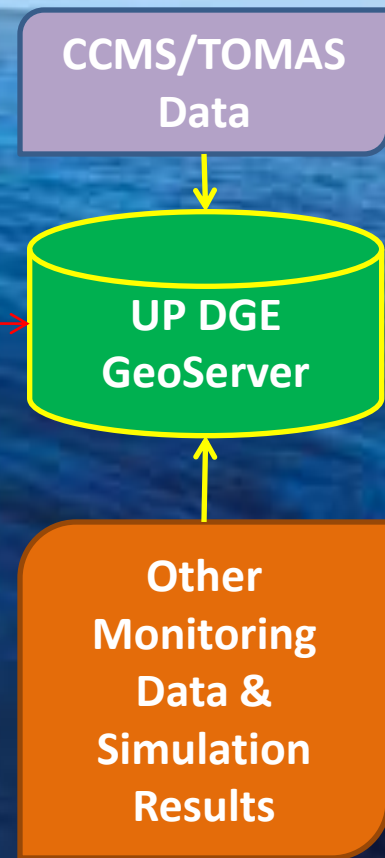
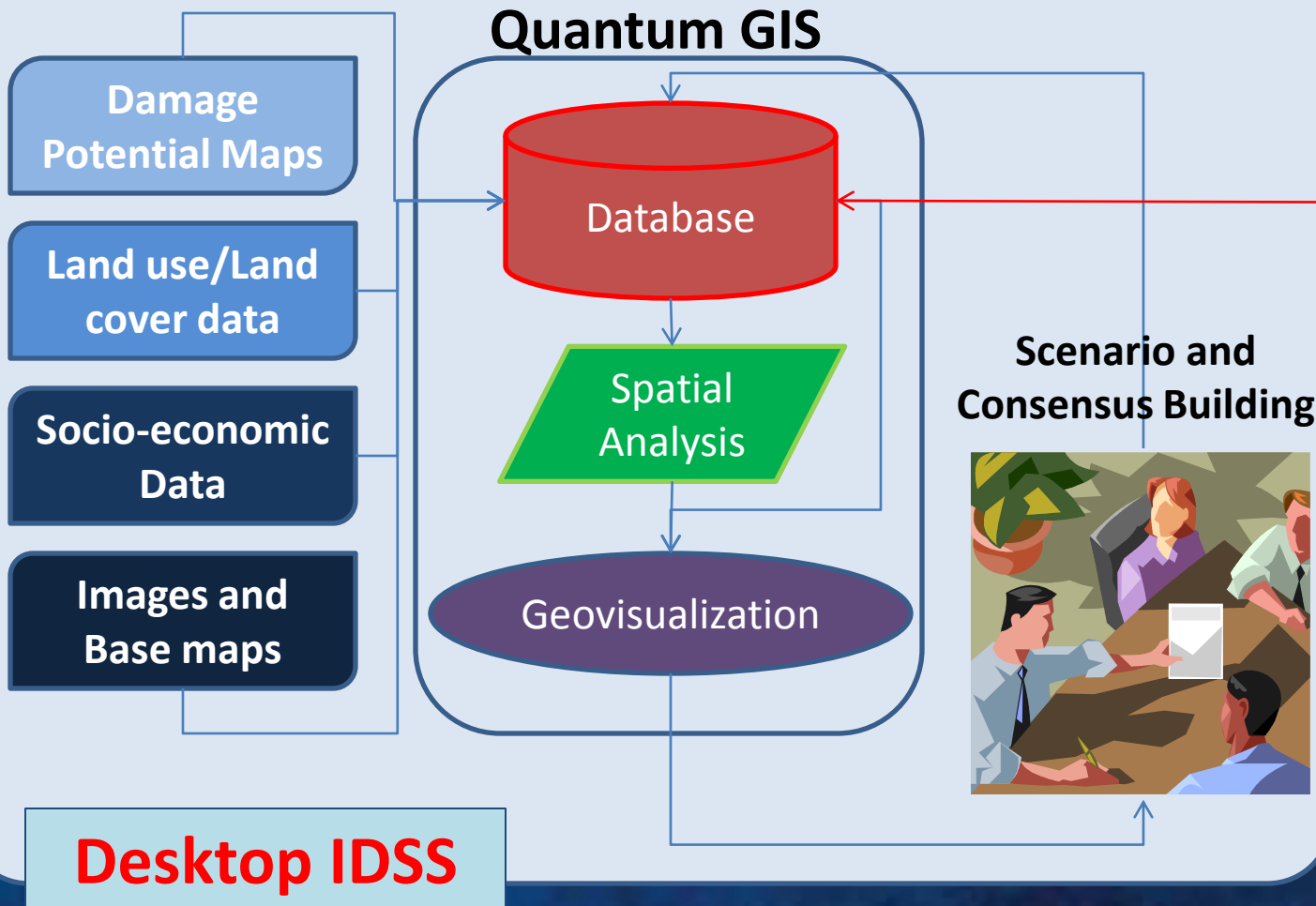
**Increase poverty incidence**

Linked system of models



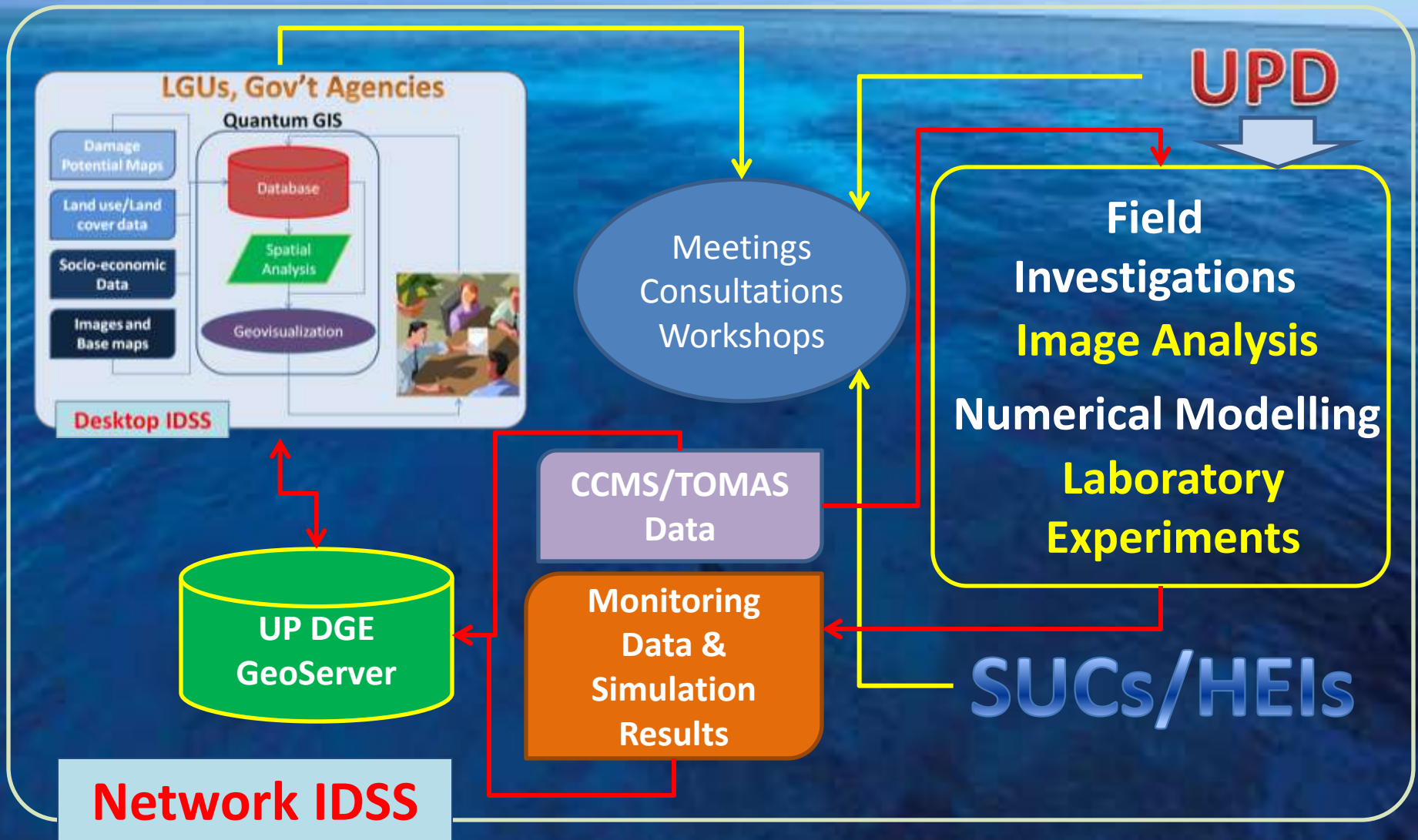
# Desktop IDSS Concept

## LGUs, Gov't Agencies

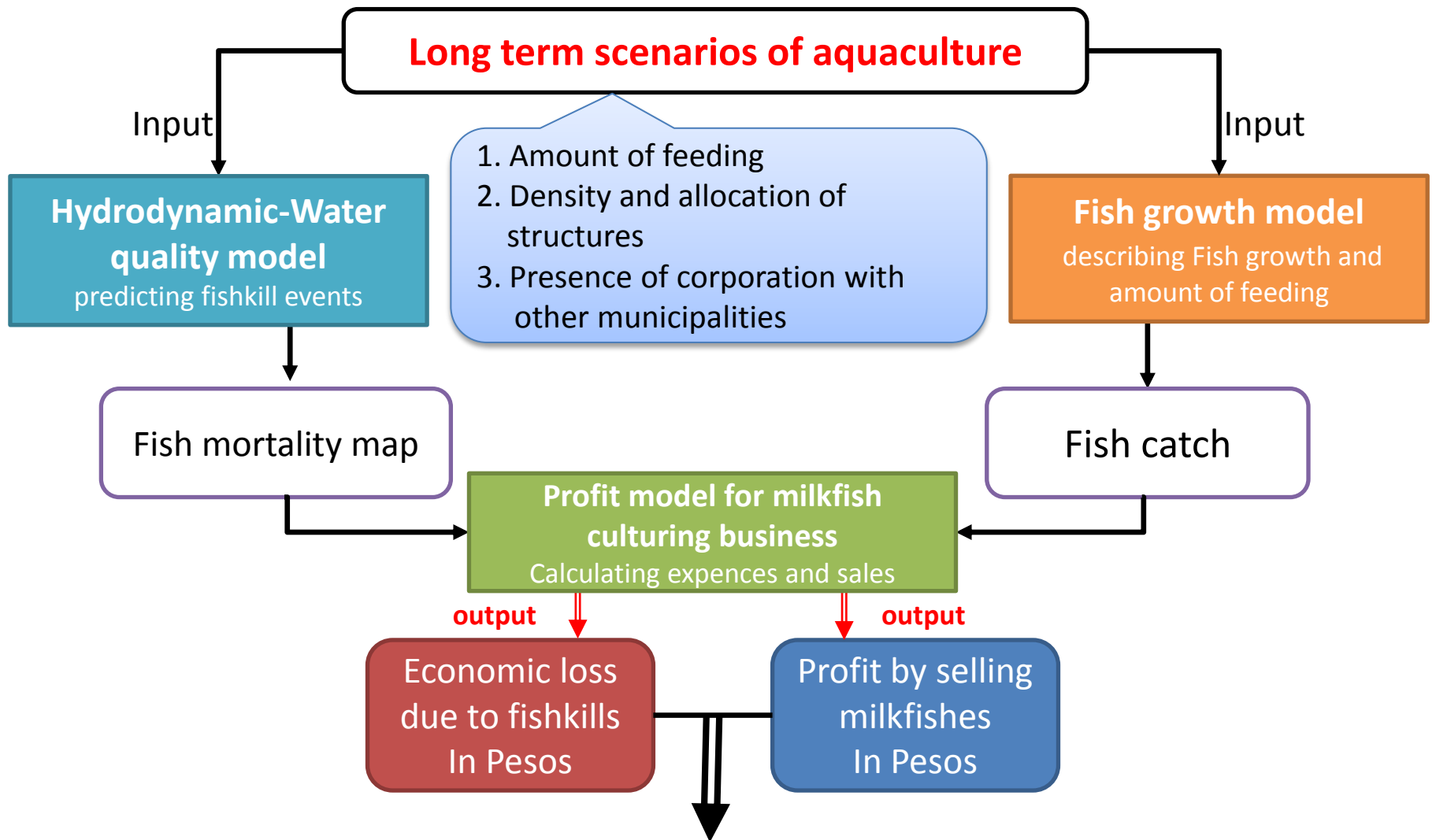


**Desktop IDSS**

# Network IDSS Concept



# Developmental use of models



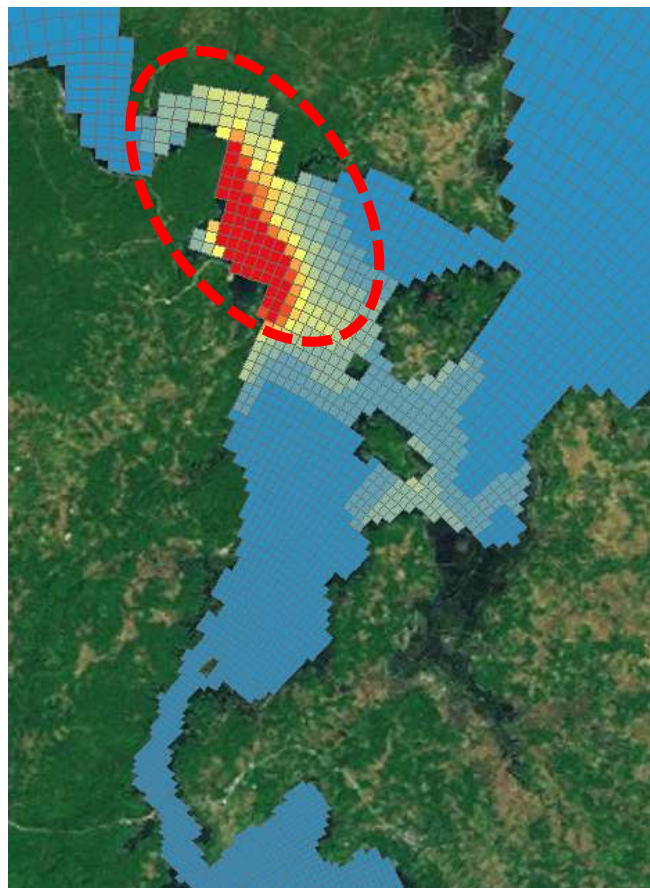
***Economical benefits which local communities gain from aquaculture business considering risks of fishkill events***

# Fish mortality map : Scenario analysis

## Calculated fish mortality for Feb to July

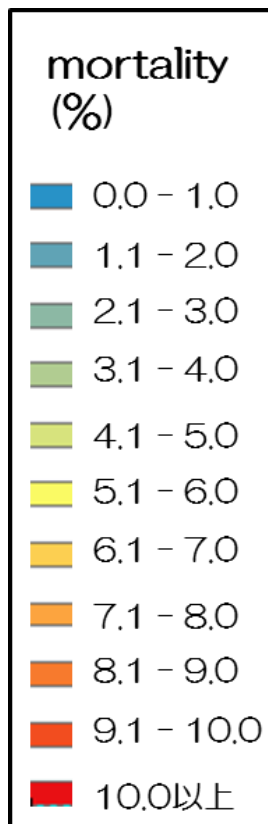
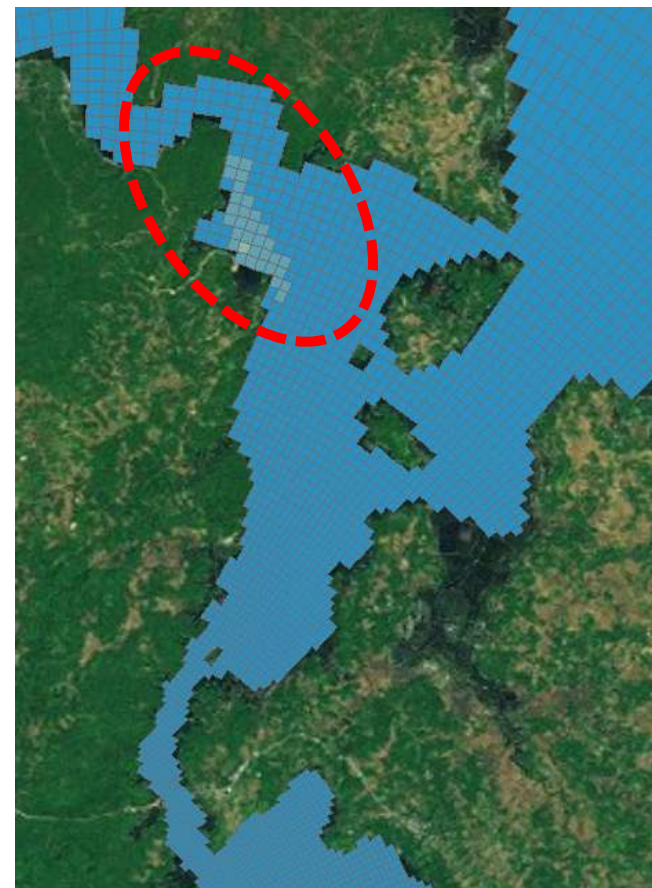
### Scenario 0

(keeping present condition)



### Scenario 1

(25% feed cut in all area)

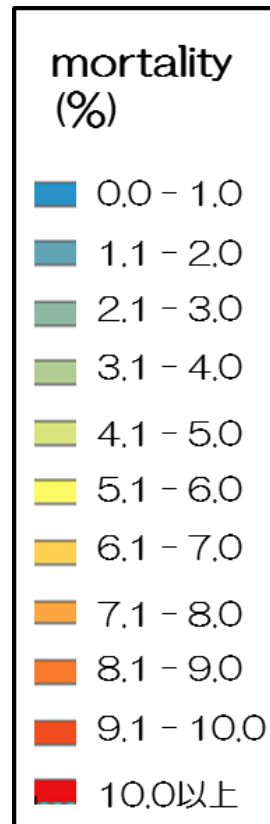
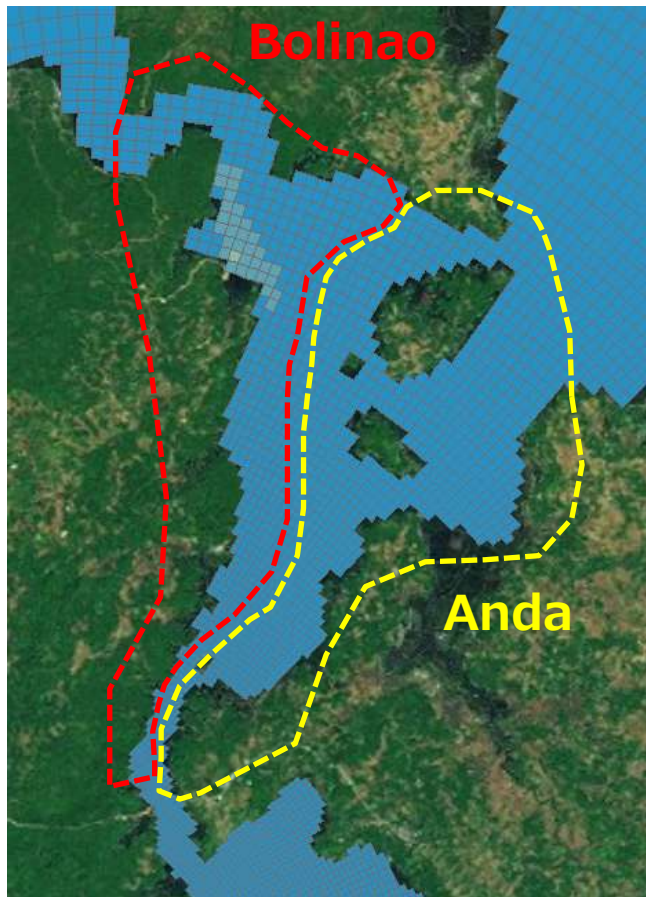


The fish mortality drastically decreases by cutting the fish feed by 25%.

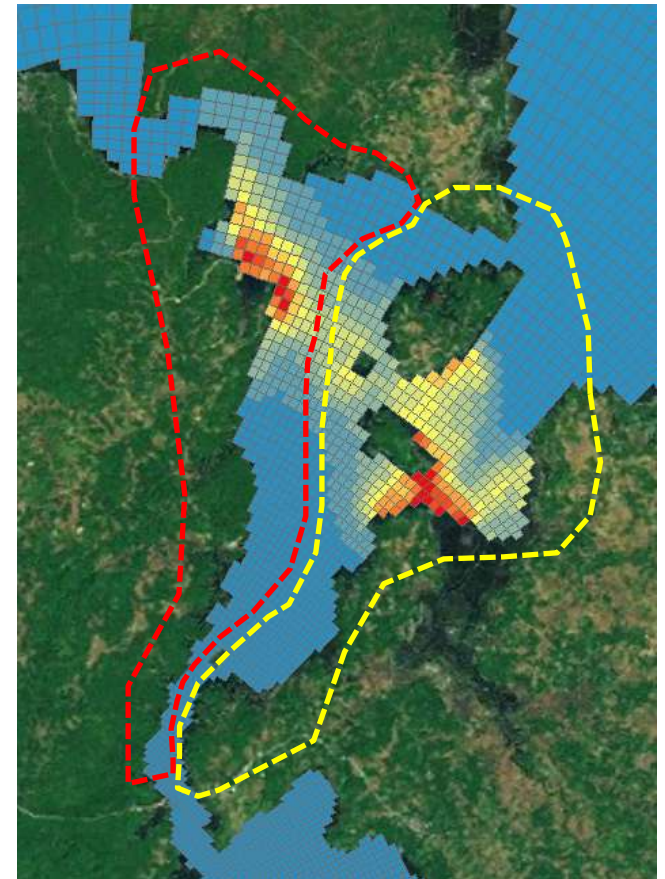
# Fish mortality map : Scenario analysis

## Calculated fish mortality for Feb to July

**Scenario 1**  
(25% feed cut in all area)

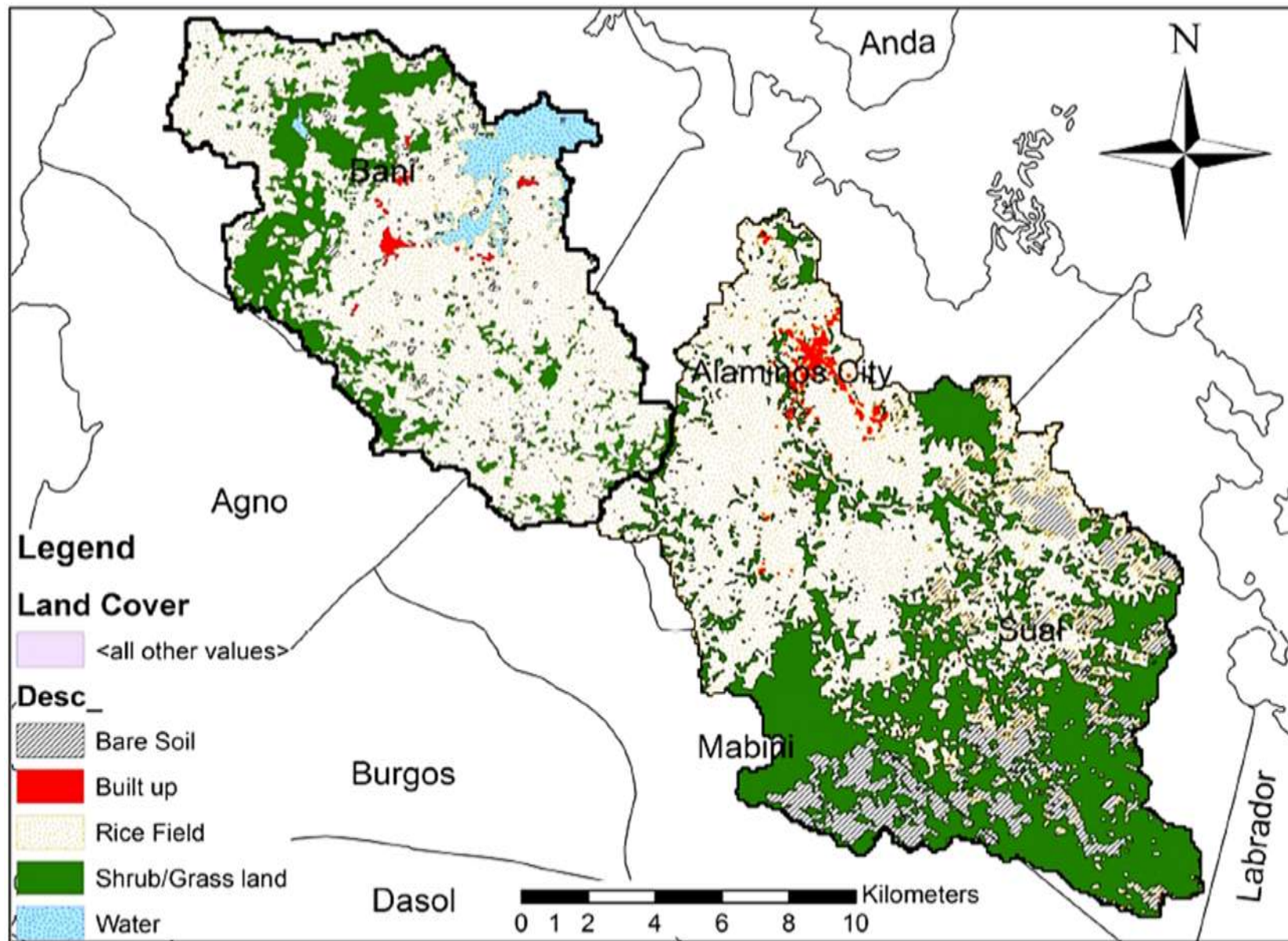


**Scenario3**  
(Bolinao -25%、 Anda +25% )



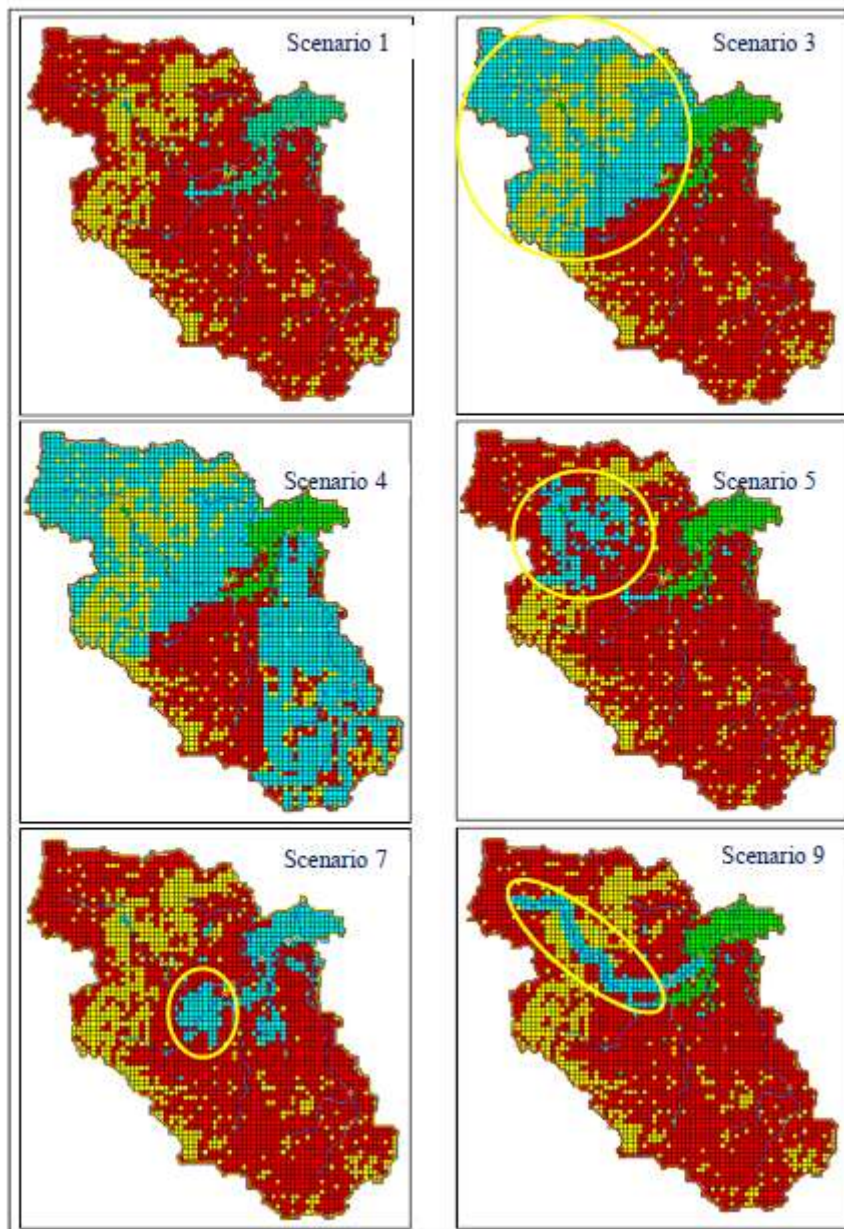
The effect of reduction is limited if Anda doesn't follow.  
→Importance of corporation between Anda and Bolinao

## Watershed Models (Bani and Alaminos Watersheds)





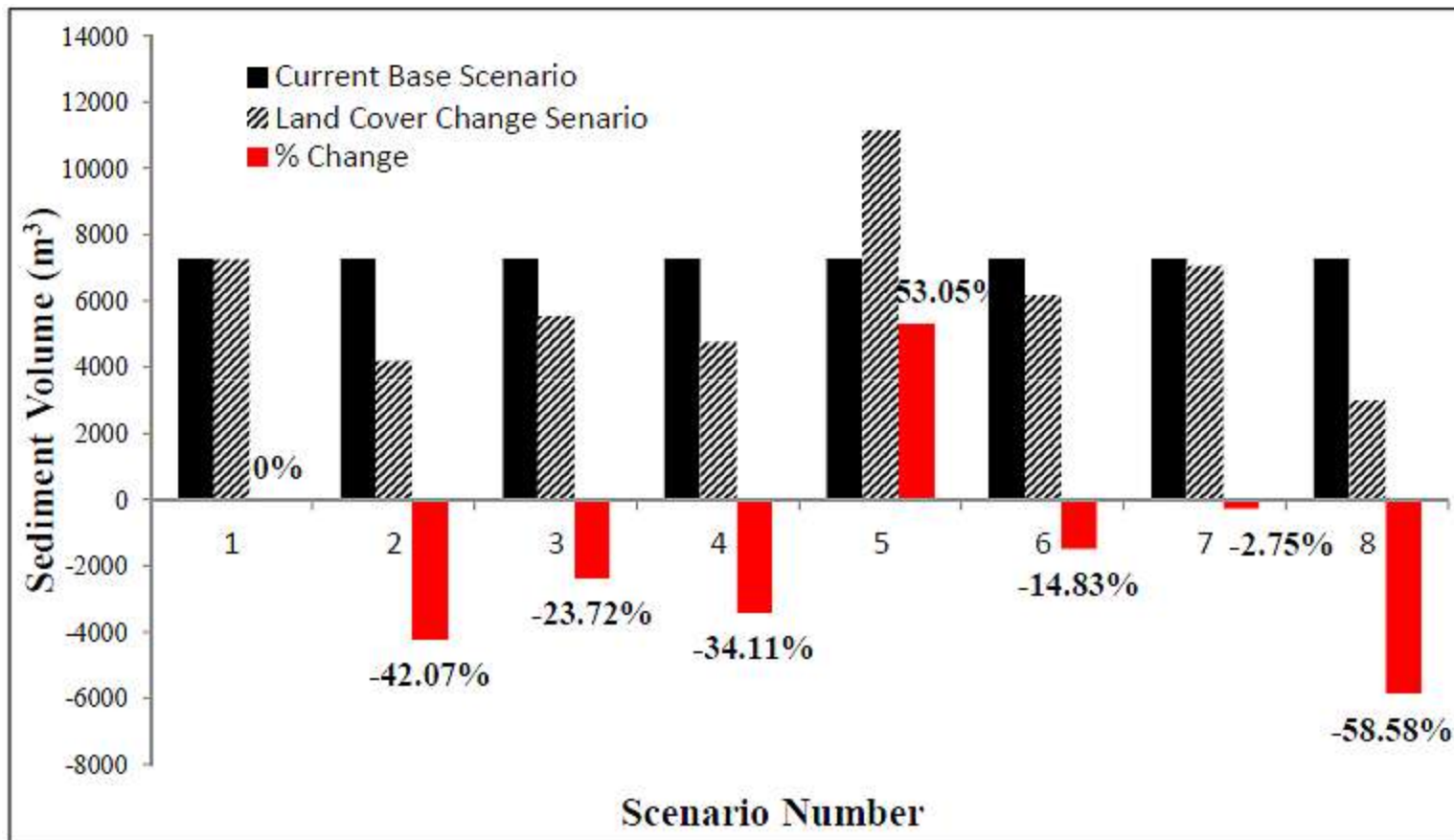
## Land Cover Change Scenarios (Example: Bani Watershed)



### Scenarios

1. Current Base Scenario
2. Current Base with Soil Conservation Scenario (0.38% decrease of SED\_K)
3. 30% Agricultural Cropland with Soil Conservation Scenario
4. 30% Agricultural Cropland without Soil Conservation Scenario
5. 30% Deforestation
6. 30% Deforestation Conversion (to rice field)
7. More Residential Area (4 sq.km.)
8. Lower Channel Buffer Zone
9. Upper Channel Buffer Zone

## Land Cover Change Scenarios (Example: Bani Watershed)

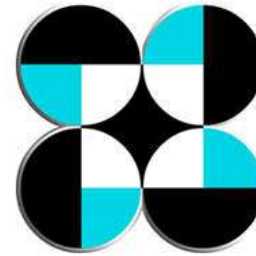


# Summary and Conclusions

- Accurate and detailed inventory of various natural resources (recent state and conditions) is being conducted.
- Various methodologies on the integrated use of LiDAR and other data sets have been developed.
- This is further extended to include assessment of changes, trends, dependency, sustainability, resilience, projections and scenarios geospatial approaches, field surveys and socio-economic surveys and workshops.

# Summary and Conclusions

- Capability building and enhancement and Sustainability will be achieved through
  - Active involvement of universities, LGUs, agencies, and communities
  - Establishment of system of data collection, processing, updating, sharing, and support mechanism
- Overall, this is expected to result in a more sustainable and responsive utilization of space technologies for improved natural resource assessment in the Philippines.



**THANK YOU VERY MUCH!**