Managing Environmental Risks for Water Security in the Laguna Lake Basin

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LAKEHEAD *Project:* ２０１０－１４

“Managing Environmental Risks to Food and Health Security in the Laguna Lake Watershed”

Laguna LAKE,

Health,

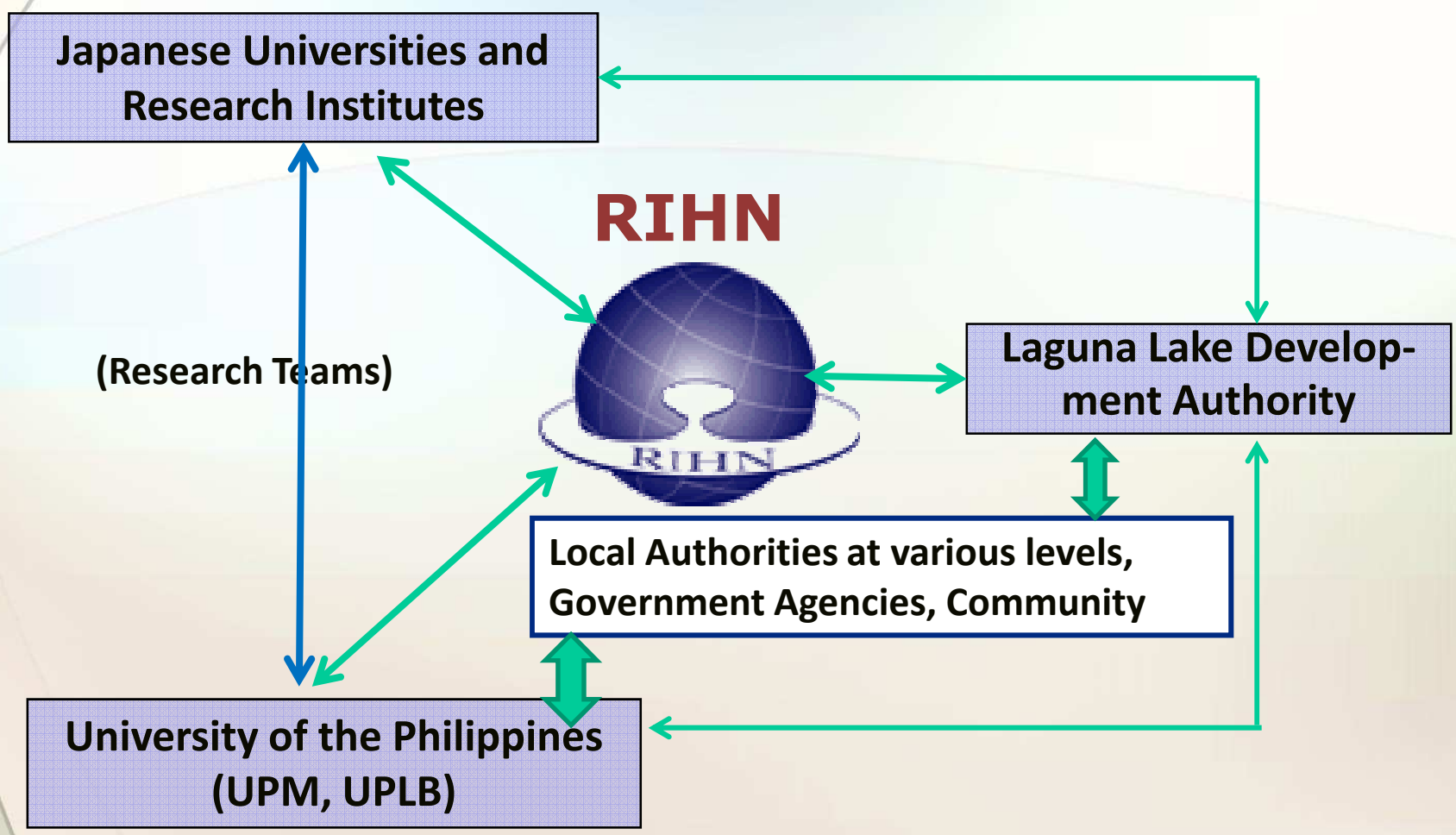
Environment ,

And &

Diversity

Research Institute for Humanity and Nature, Kyoto, Japan

Research Collaboration

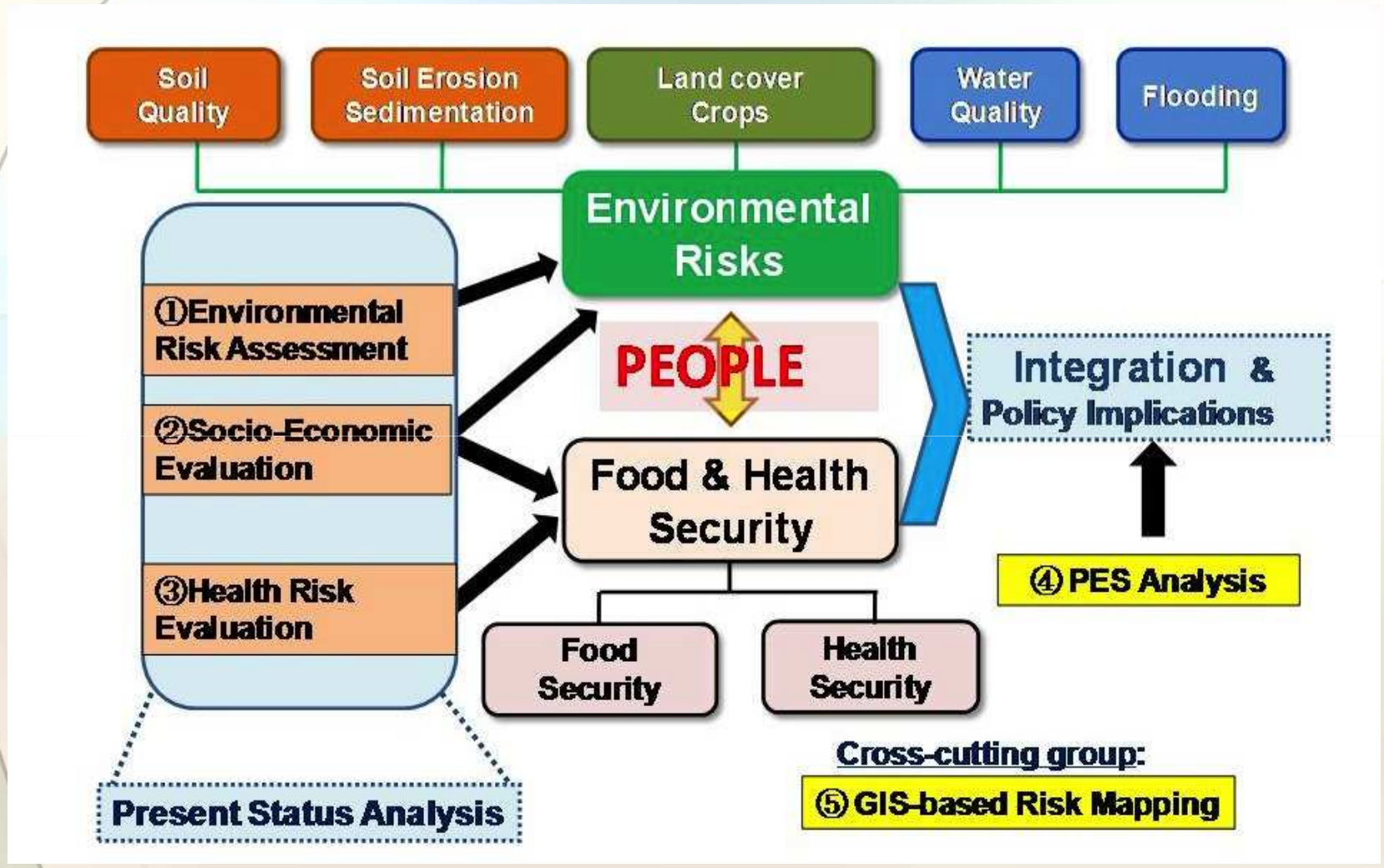


OBJECTIVES

- The general objective is to examine the issues of how pollution occurs in the watershed, from where the pollution originates and the way in which the pollution stresses the lake and the rivers, aquatic life, food, and subsequently, the public health.

- A special attention would be focused on how ecological risks impact the sustainable linkage between agricultural & fishery products and public health, from social and natural science perspectives.

General Framework of the Lake HEAD Project



Relationship between Ecological Deterioration and Food-Health risks

- **Deterioration of Environment** (heavy metal pollution; loss of biodiversity; soil degradation, sedimentation, changed water cycle, etc.

- **Impacts on food, health and water securities:** (water safety, food safety, contamination, diseases)

- **Transdisciplinary Approach**: （Community-Stakeholders-based, Early Warning System to Cope with Ecological Risks, Risk Communication）

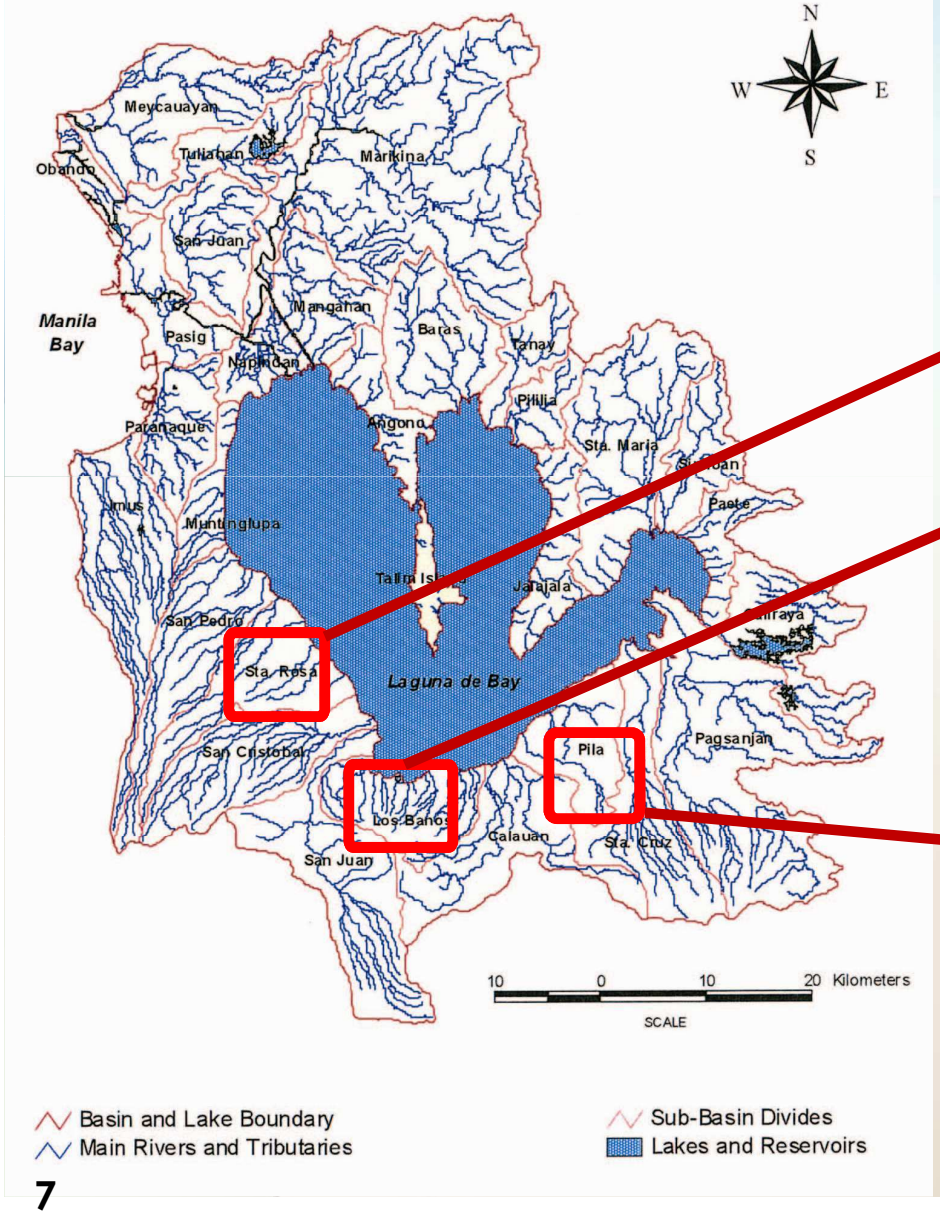
Modified from Dr. J.Galvez-Tan, UPM, HEI

Laguna Lake Watershed

*(24 **sub-watersheds**)*

Study Sites

Modified from Dr. Macandog, UPLB



1) Santa Rosa subwatershed — Highly-industrialized

2) Los Baños subwatershed — Rural-urban convergence

3) Victoria subwatershed — Agricultural-rural

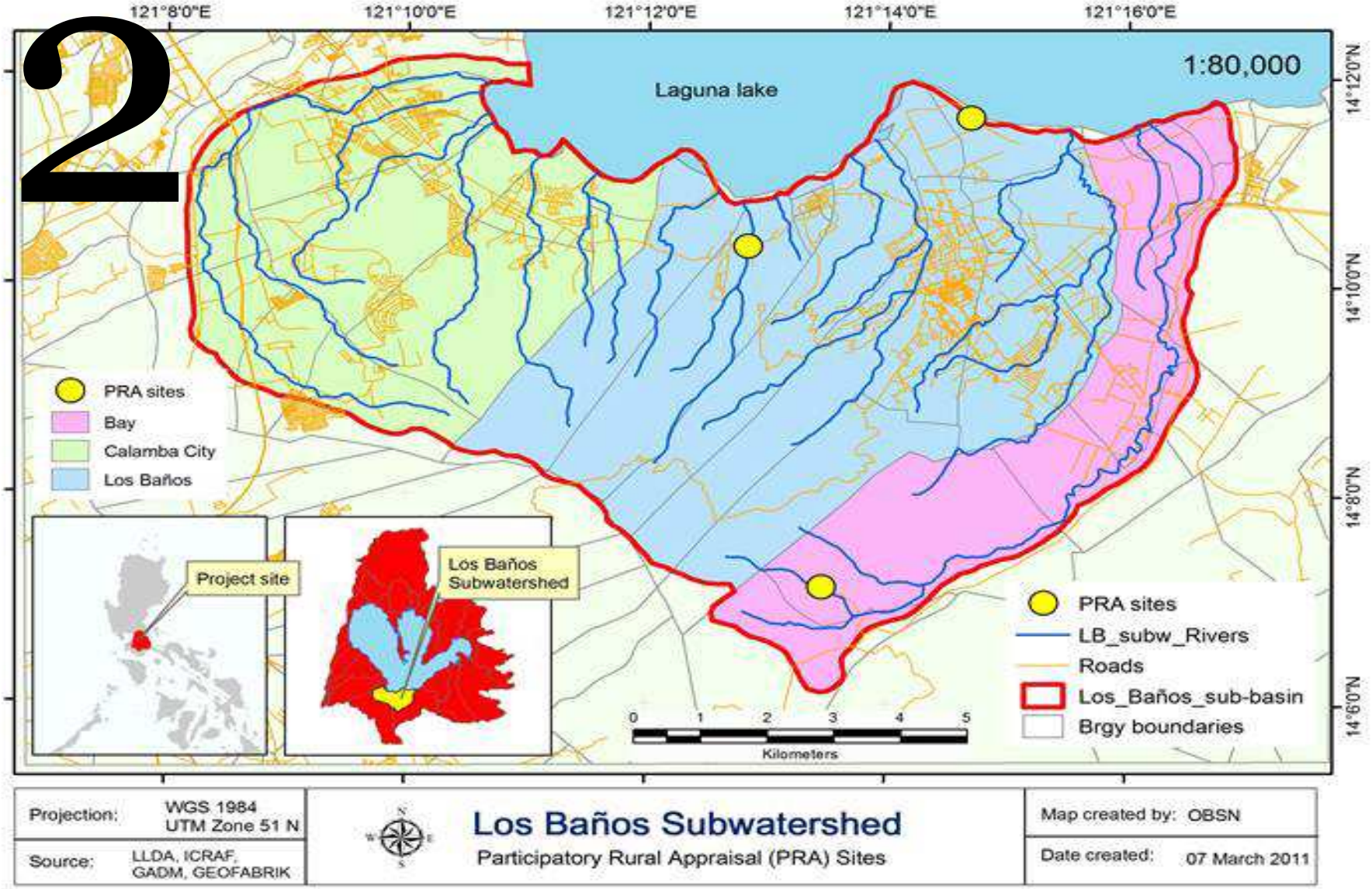
Upstream: Soil erosion easily occurs due to plantation (Silang, Cavite : Sta Rosa City)

Midstream: Less Water than before; more flooding

Downstream (7km from lakeshore) : Urban sprawl and housing development; the river turned to be a drainage.

Los Baños Subwatershed

2

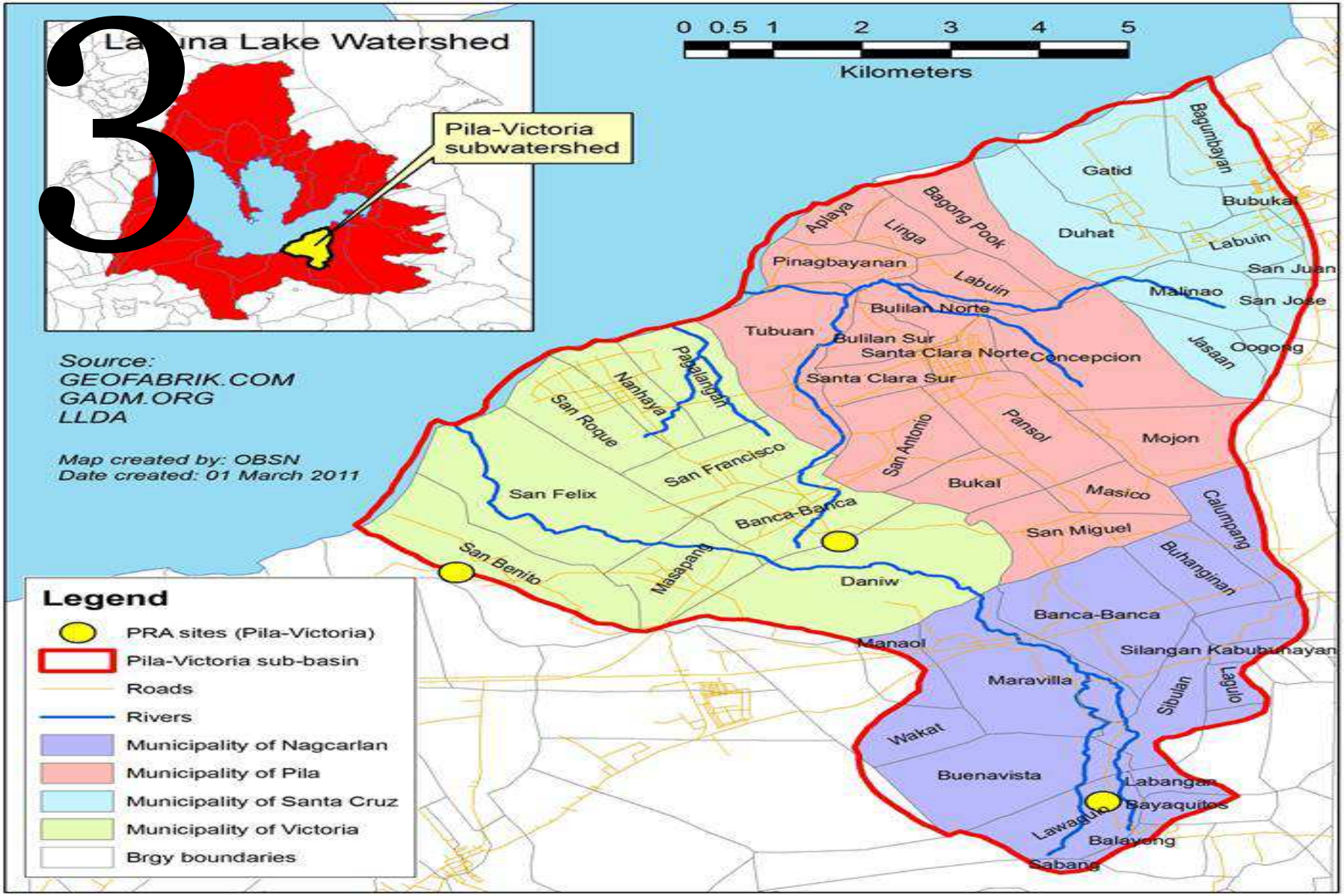


Dr. Macandog, UPLB

Los Baños Subwatershed

upstream	Midstream	Downstream
High biodiversity attributed to **Mt. Makiling Forest Reserve**	farming community -- agroforestry and growing vegetables	cut-flower farming; as replacement for the cultivation of rice
Most **upland areas** still forested		Coastal: fishing community
farming with multi-storey agroforestry systems	multi-storey agroforestry system composed of timber species and fruit trees	fish pens/ fish cages operations
		fisherfolks built settlements along the coastline

Pila-Victoria Subwatershed



Dr. Macandog, UPLB

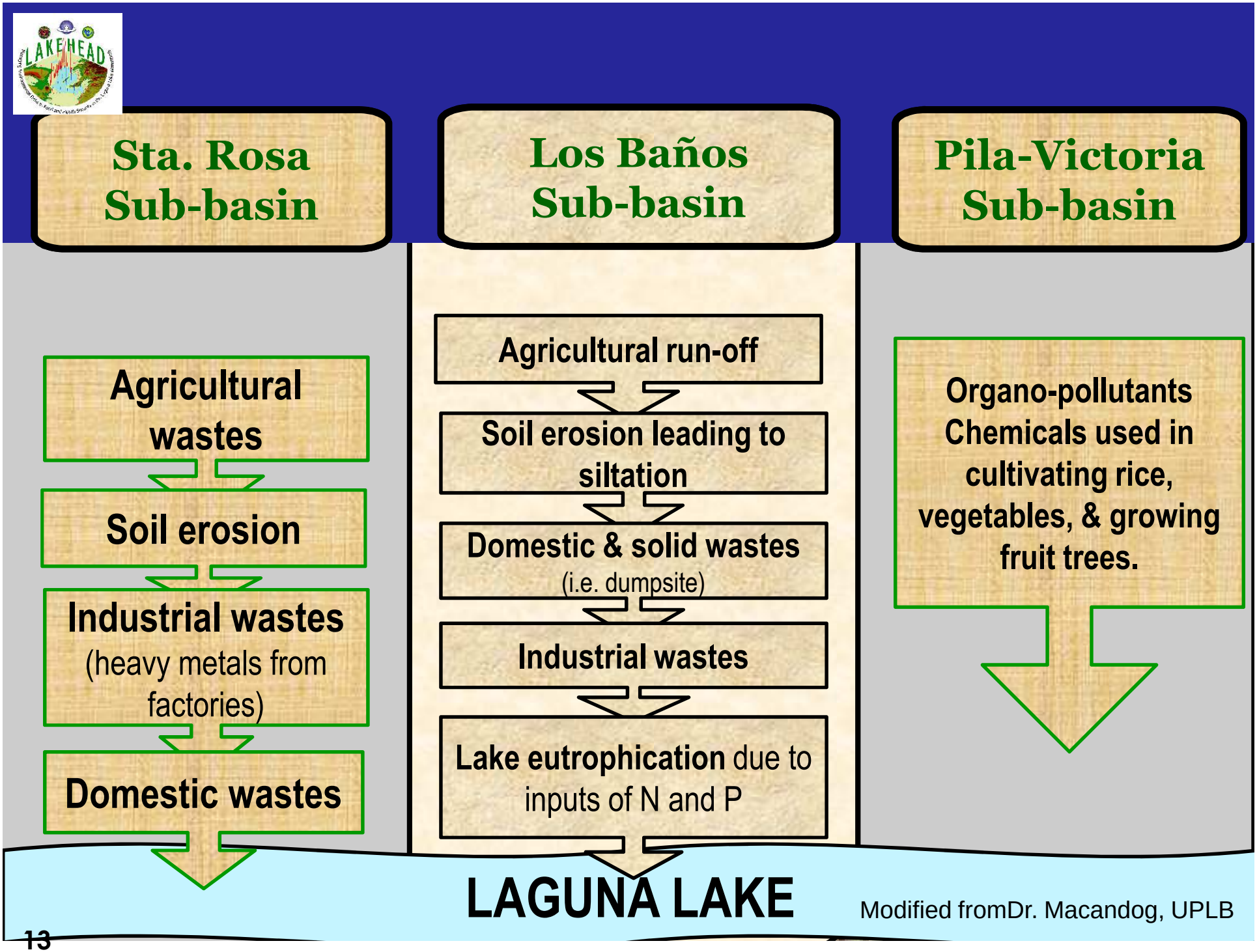
Pila-Victoria Subwatershed

mainly **rural** watershed

characterized by:

- ❑ forests & tree-based agroforestry systems **(upstream)**
- ❑ rice paddy fields & vegetable farms **(midstream)**
- ❑ duck industry along **(coastal areas)**
- ❑ fishing **(lake area)**

Dr. Macandog, UPLB

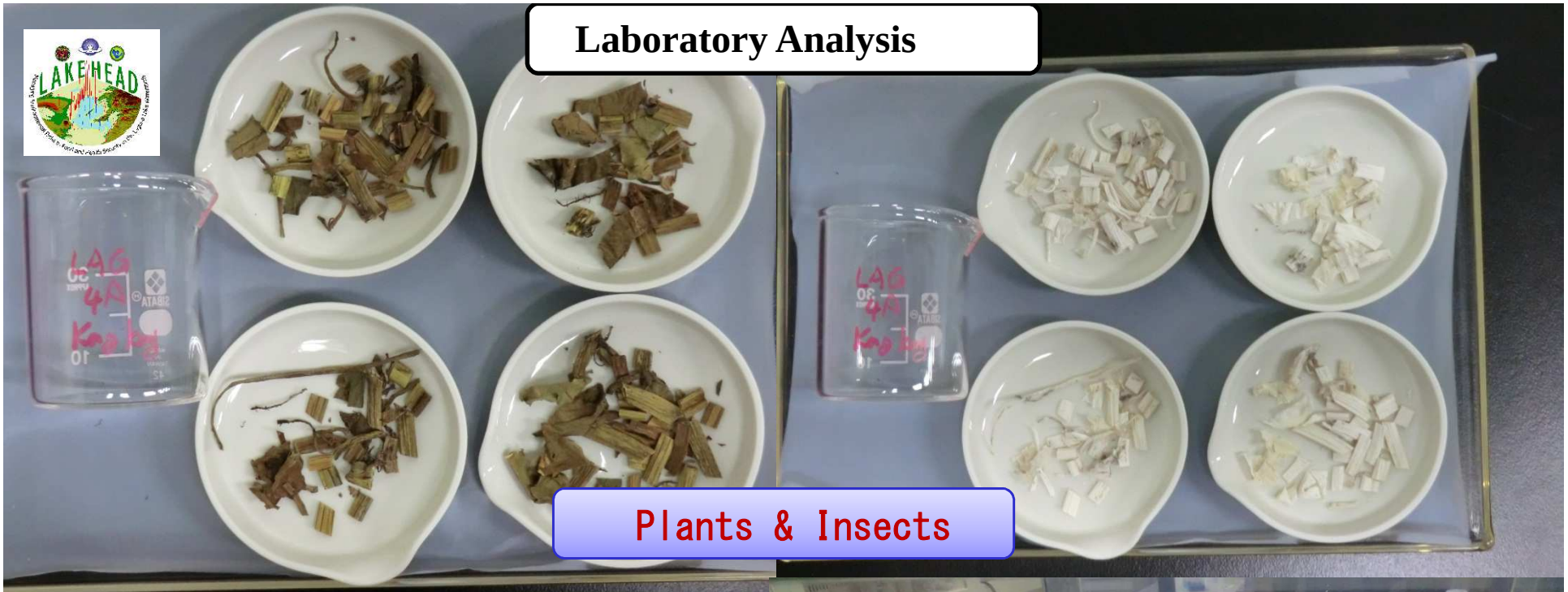


Modified fromDr. Macandog, UPLB

RESEARCH ACTIVITIES

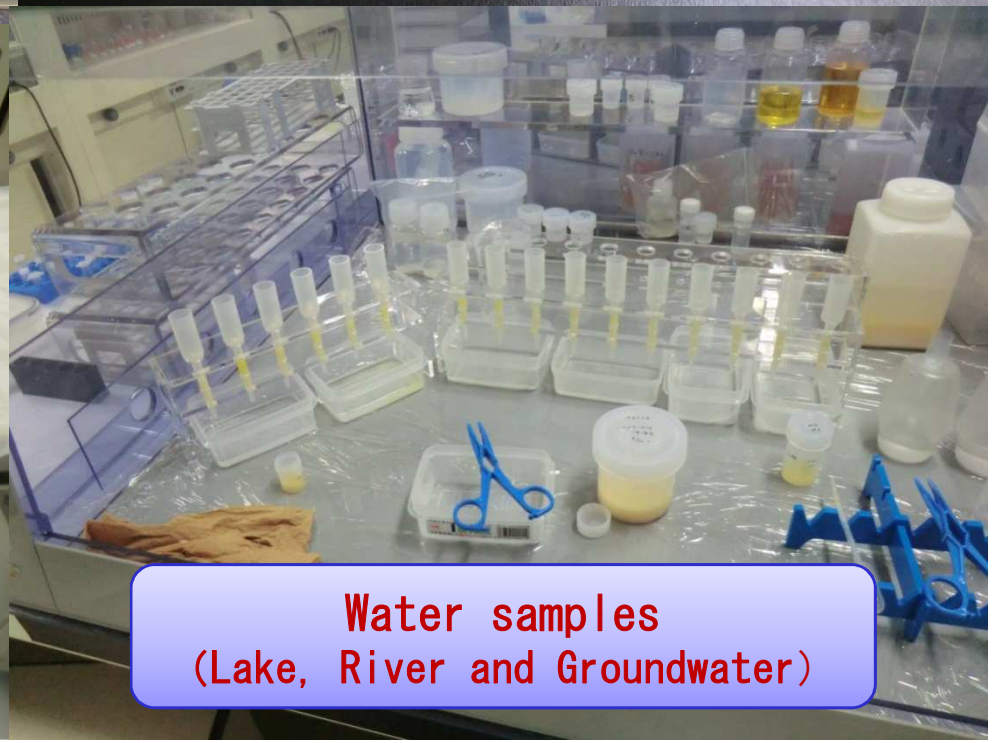
Lake water and sediment sampling

Laboratory Analysis



Plants & Insects

Sediments



Water samples
(Lake, River and Groundwater)

Fish Tissue Analysis

- Five fish species were sampled from different sites in Laguna Lake during the wet and dry seasons.
  - Bighead carp
  - Milkfish
  - Mudfish
  - Tilapia
  - Manila catfish
- The fish samples were analysed for cadmium, lead, arsenic, mercury and chromium

Tilapia

Milk Fish

Mudfish

Manila Catfish

Bighead carp

Water quality analysis at RIHN, focusing on Heavy Metal

Dionex ICS-3000

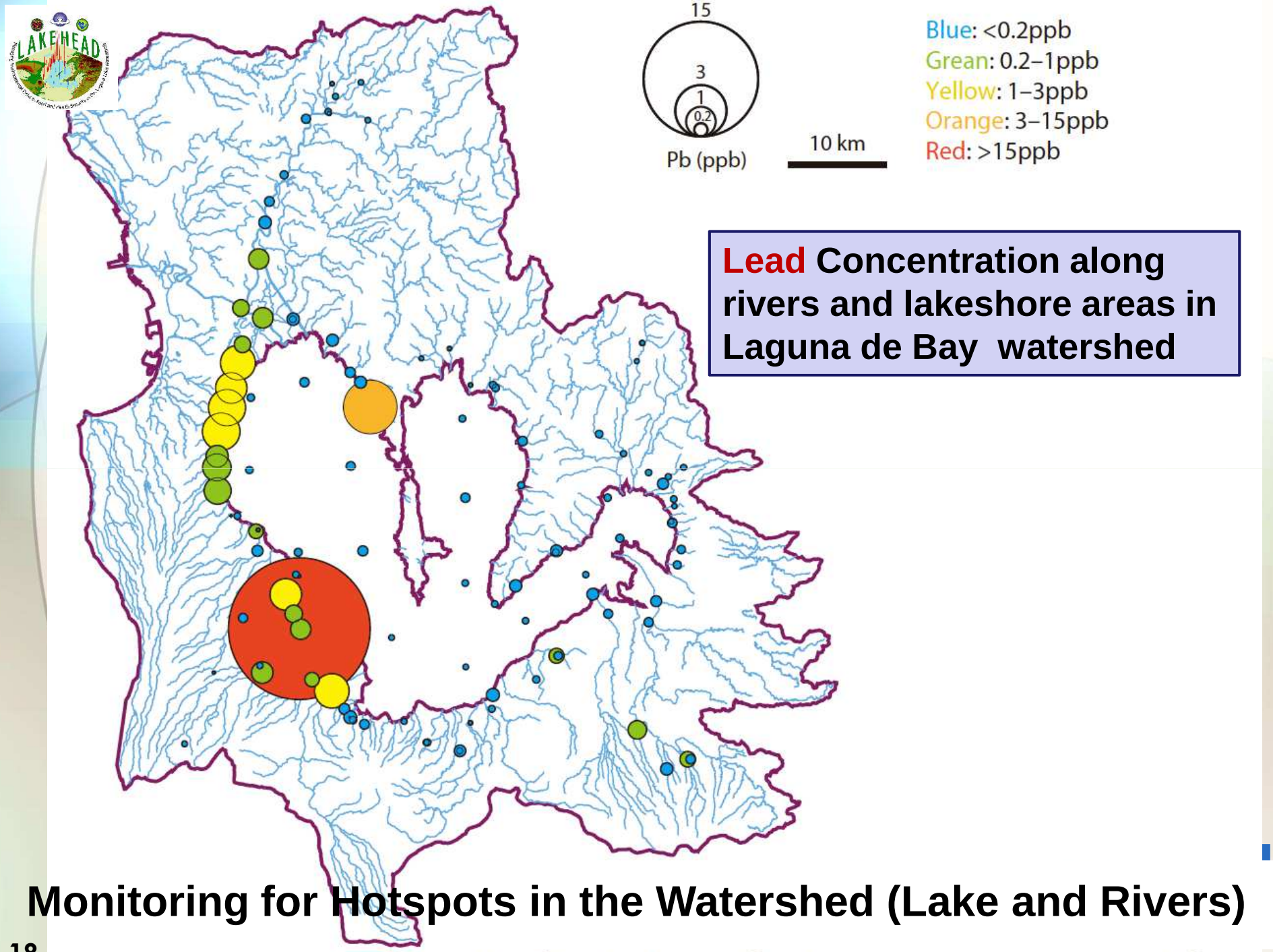
Ion Chromatography System (Dionex ICS-3000)

Major component analysis
(Cl^-, NO_3^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, Na^+, K^+)

Inductively Coupled Plasma Mass Spectrometer (ICP-MS) (Agilent Technologies 7500cx)

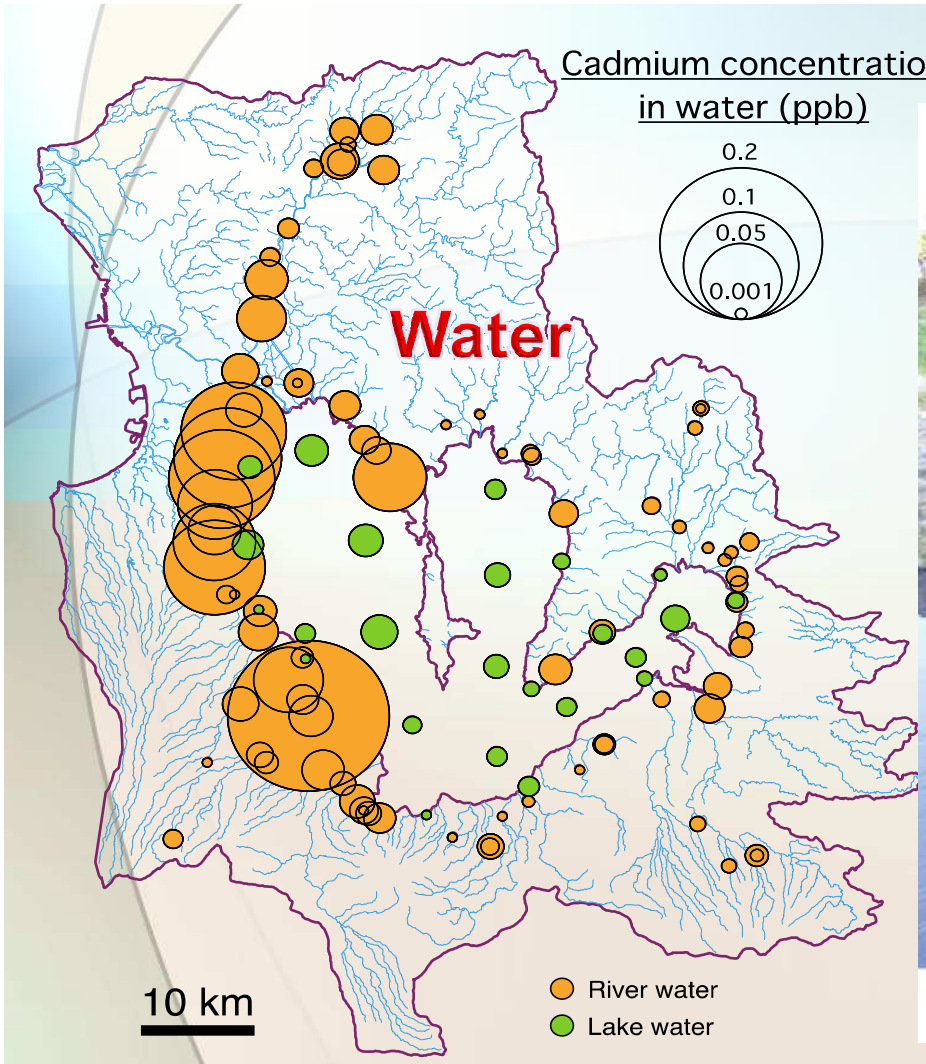
Trace element analysis
(Cu, Zn Ga, Ge, As, Se, Rb, Sr, Y, Zr, Mo, Ag, Cd, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, W, Pb, U)

Agilent Technologies 7500cx



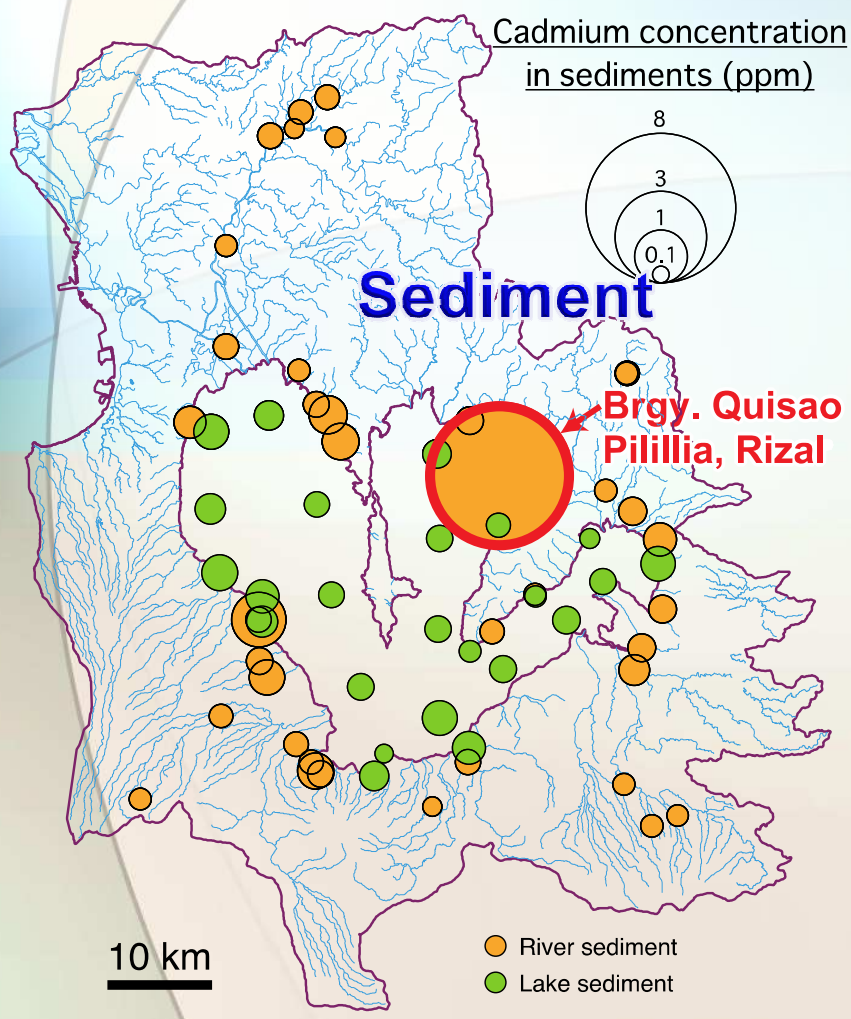
Monitoring for Hotspots in the Watershed (Lake and Rivers)

Cadmium concentration in water is high in western region (urbanized area).

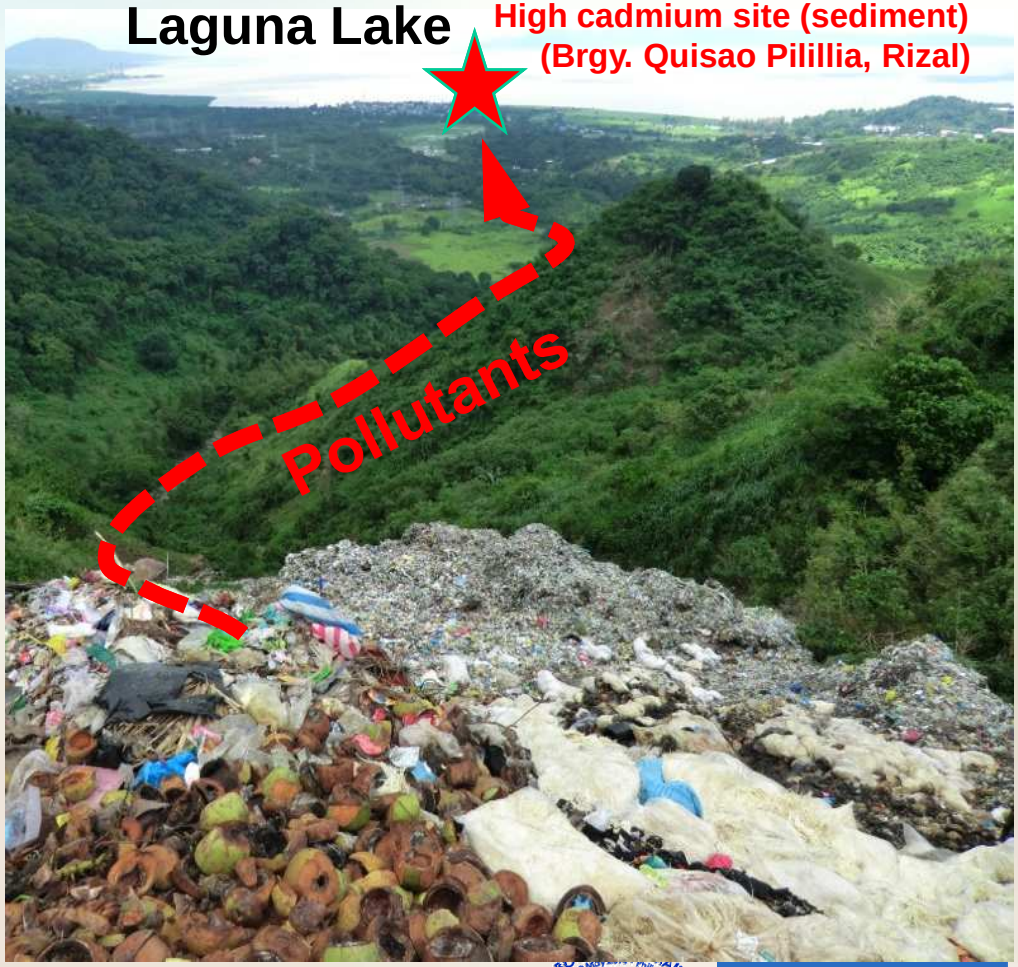


Sediment samples are collected during March & May in 2011.

‘Hot Spot’ of cadmium in sediment – areas with poor solid waste management.



Sediment samples are collected during March, May & August in 2011.



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Major Findings (Fish Tissue Analysis)

Among the five heavy metals investigated, lead is the most urgent pollutant of concern.

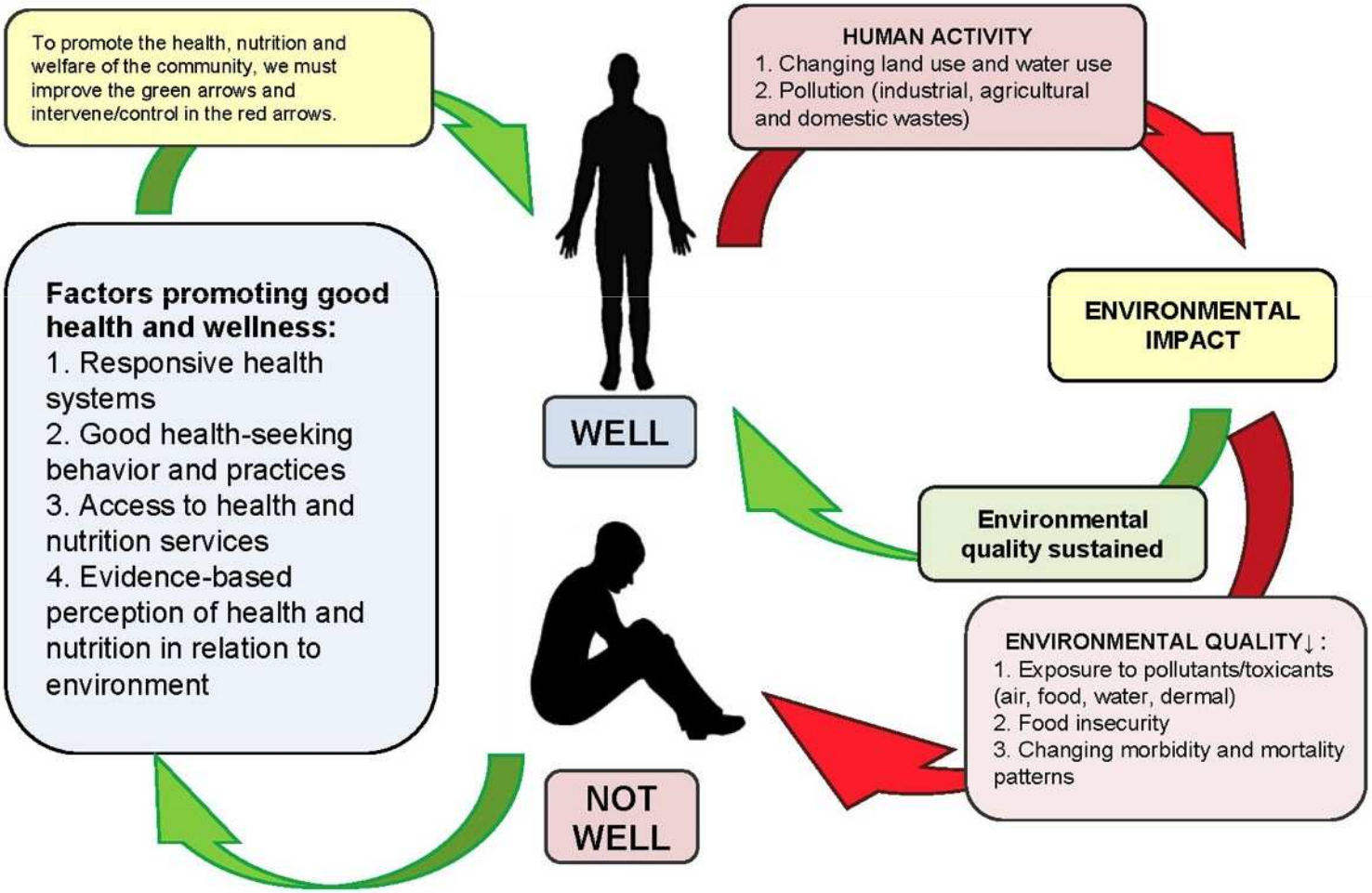
Non-carcinogenic Health Risk estimates (NHQ) for Lead in all sampling stations in all fish species were way above 1.0 indicating high risk of adverse health effects.

Major Findings (Sediment and Water)

Potential risk assessments employing consensus-based Sediment Quality Guidelines (SQG) and Mean Probable Effect Concentration Quotient (MPECQ) indicate that the aquatic ecosystem in the Laguna Lake watershed Is at a moderate level of heavy metal toxicity.

HEALTH RISK EVALUATION

Conceptual Framework



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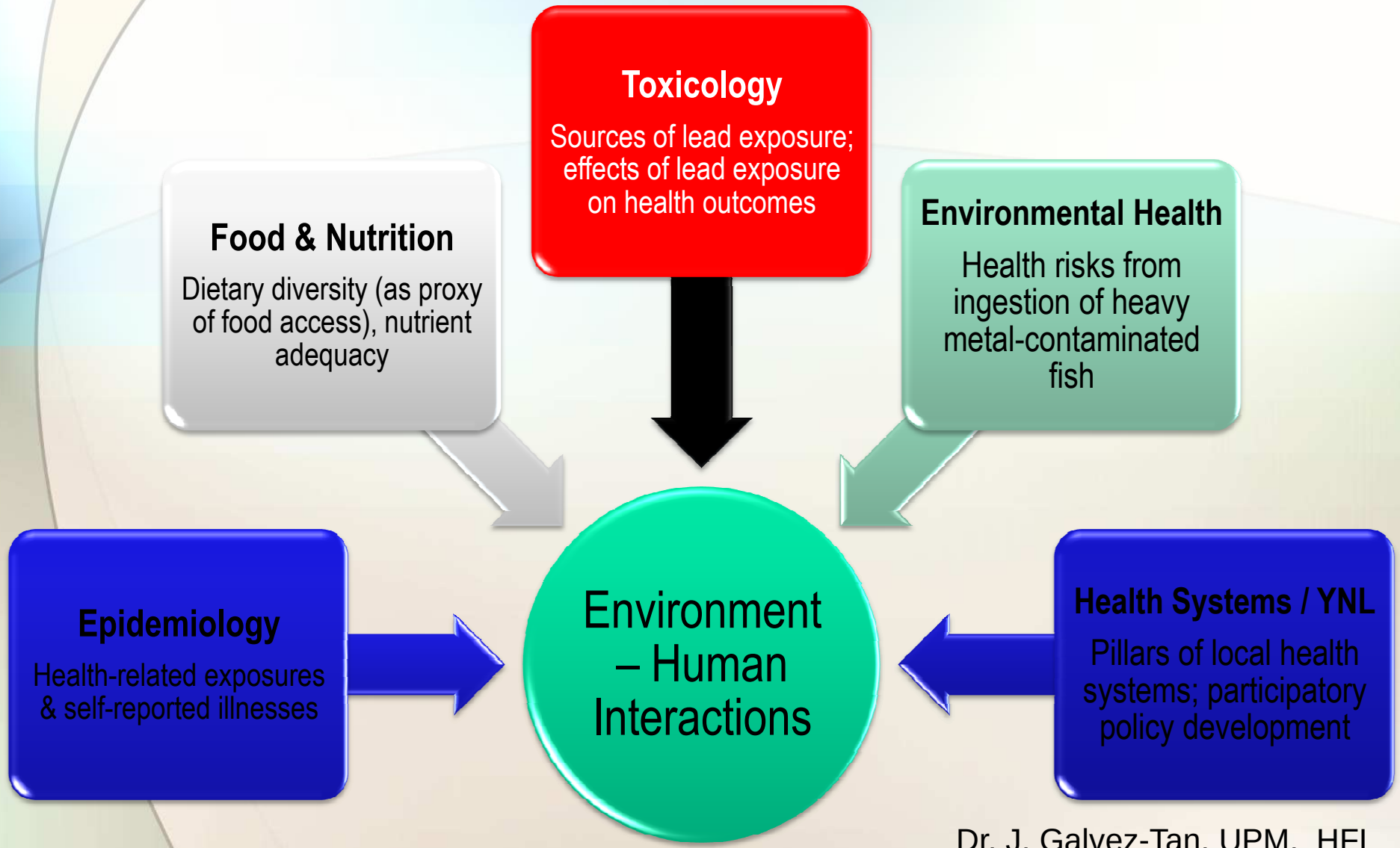
Components & Objectives



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Methodology

- Environmental exposures and health status were obtained from a **cross-sectional study** involving **108 mother-child pairs** in four (4) barangays (Aplaya, Caingin, Santo Domingo, Sinalhan) in Santa Rosa City, Laguna)



RESULTS

Summary statistics of blood lead levels (in ug/dL) in children in four barangays in Santa Rosa City, Laguna, 2012 to 2013, N = 100

Barangay	Mean	Standard deviation	Minimum	Maximum
Aplaya	4.11	2.54	1.50	12.70
Caingin	3.89	1.81	1.33	9.00
Santo Domingo	3.80	0.93	3.12	7.10
Sinalhan	6.33	4.58	2.71	22.40
OVERALL	4.56	3.01	1.33	22.40

22% have blood lead levels > 5 ug/dL

Mean BLL in Sinalhan > Mean BLL in Aplaya (p = 0.037), Caingin (p = 0.016), and Santo Domingo (p = 0.017)

Dr. L. Panganiban et al, 2013

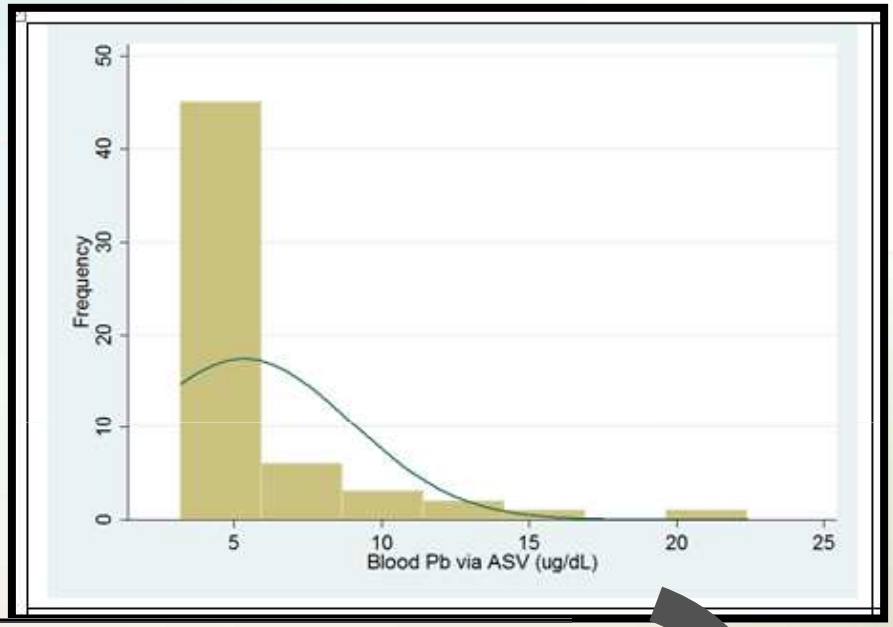
Chronic LEAD Poisoning in Children: Possible Causes and Effects

Children with levels > 5 ug/dL had…

- **Low average to extreme low scores in perceptual reasoning**
- **Borderline to low average in working memory**
- **Low average to extremely low in processing speed**

Dr. L. Panganiban et al, 2013

Blood lead levels among children, 7 – 9 years old



Blood lead level[a]	Median IQ		
	Perceptual reasoning	Working memory	Processing speed
≤ 5 ug/dL	Average	Average to low average	Average
> 5 ug/dL	Low average to extremely low	Borderline to low average	Low average to extremely low

NARBO
Network of Asian River Basin Organizations

Urgent Need !!

Risk Communication

Appropriate Strategies

Partnership in Saving Laguna de Bay

Community Forum 2012 – *Partnership in Saving Laguna de Bay*
Community Forum 2013 – *Ada;ptive Management for the Sustainable Use of the Wealth of Laguna Lake*

Yaman ng Lawa –
(Wealth of the Lake/ Blessing from the Lake)
Community-Based Exchange of Learning, Knowledge and Communication Project

Consultation Phase

Participation Phase

Implementation Phase

- **Harmonization of local knowledge and scientific investigations**
- **Community and scientists/researches seeking for practical solution on ecological problems in Laguna de Bay.**

SCIENCE FOR SOCIETY

Modified from Dr. R. Concepcion, UPLB

The LakeHEAD Project is the first project in the Laguna de Bay Basin that gave focus on public health. i.e. link between environmental degradation and human health

The results from the different components of the project are currently being synthesized.

The LakeHEAD Book is due for publication in June 2014

Thank You Very Much !!

LakeHEAD Core Team and Lead Scientists