課題解決型研究のための超学際のあり方に関する研究会
21 February, 2020（於：千葉大西千葉キャンパス）

［地球研・2010-13 研究プロジェクト］

Managing Environmental Risks to Food and Health Security in Asian Watersheds

（東南アジアにおける持続可能な食料供給と健康リスク管理の流域設計）

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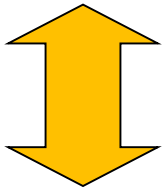
Outline of Presentation

- **Research Objective and Background; 「ラグナ湖・食リスクプロ」の概要**
- **Major outputs from our research; 主要な研究成果とTD研究の意義（①課題の設定、②主要ステークホルダーと関与、③成果の社会実装）**
- **Trans-disciplinary Approach (超学際) to Cope with Ecological Risks（科学と地域の関係性：*Science in Society*）**

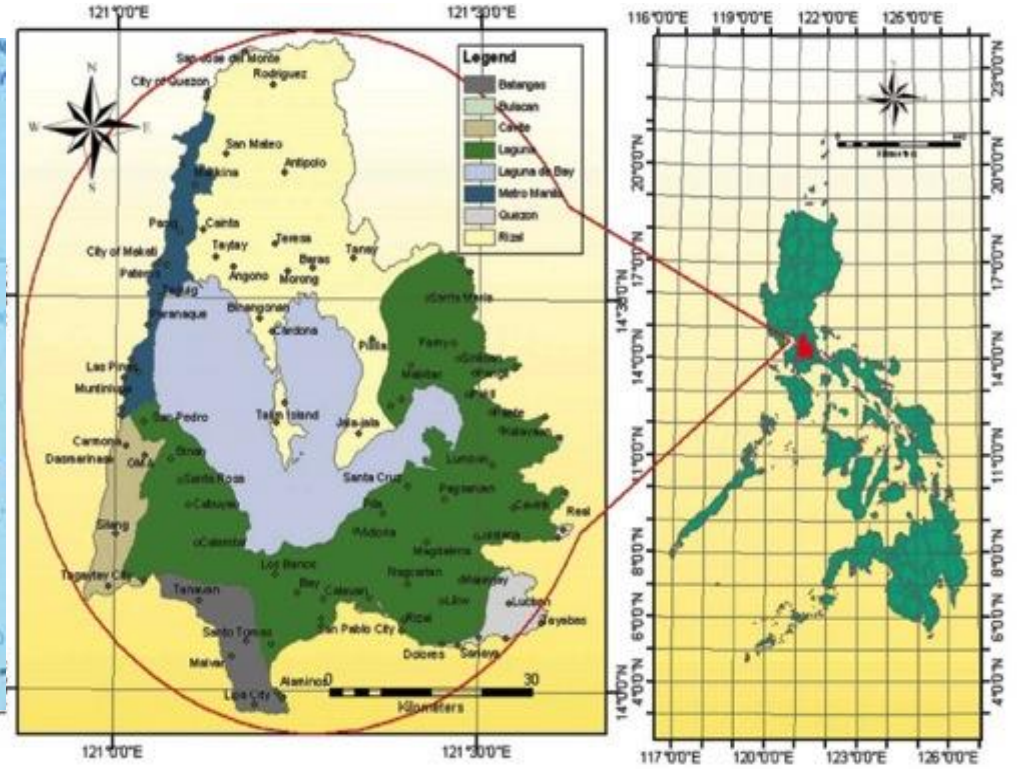
Key Question: Relationship between Ecological Deterioration and Food- Health risks

- **Deterioration of Environment (Ecosystem Services) e.g., heavy metal pollution; loss of biodiversity; soil degradation, lots of sediments, changed water cycle, etc.**



- **Impacts on food (decline of soil fertility, food supply) and human health securities (food safety, contamination, food-related infectious diseases, etc.)**

Research Sites



The Philippines and neighbouring countries (left); Location of the Laguna Lake watershed (right)

Watershed-based Analysis on Food and Health Risks

Ecological Changes in Upstream Area

Ecological Degradation

Impacts to Downstream

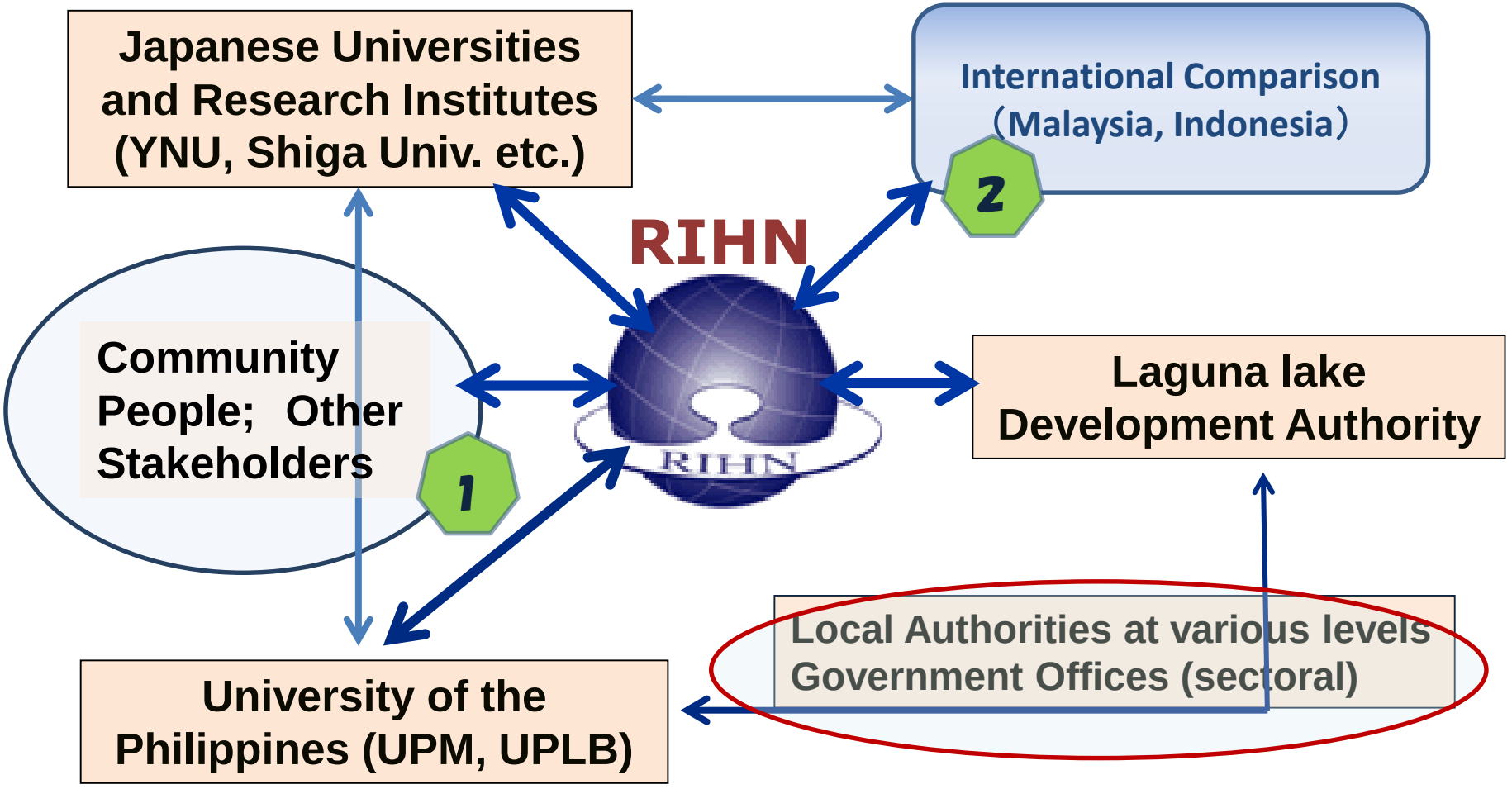
Climate Change

Food Insecurity

Health Insecurity

Poverty, Institutions

Research Collaboration



Emerging Ecological Risk: *Massive Fishkill*

Los Banos, Laguna (May, 28 2012)

Calamba, Laguna (May, 26 2012)

In Laguna Lake aquaculture, a number of Fishkill incidences are occurring, often in massive scale, in recent years.

Why do we focus on *Fishkill* issues in Laguna Lake?

— **More Flooding & Natural Disasters (caused possibly by Climate change);**

— **Pollution & Resource Degradation Environmental Issues; e.g., Fishkills;**

⇒ **Higher Risks and Vulnerability ⇒ Huge Social Cost in the Long Run**

⇒ **Need to Establish Food and Health Security by *Early Warning System* and Risk Communication.**

Research Result (1)

土地利用変化と生態リスクの高まり
Land use changes and Ecological Risk

科学的知見・Data収集・実証分析の成果から①
Results from Scientific Research

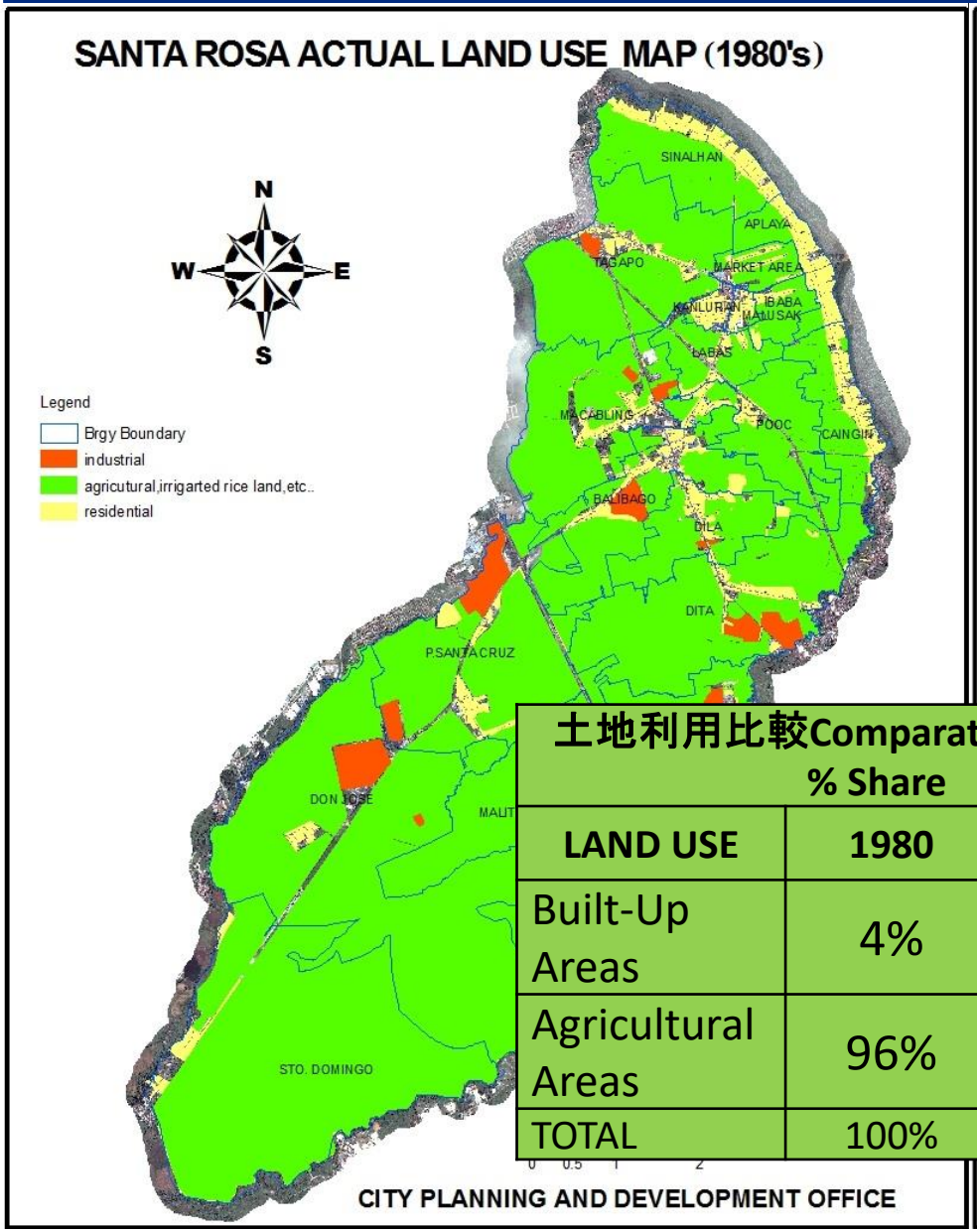
From Upstream to Downstream: Watershed-based Analysis

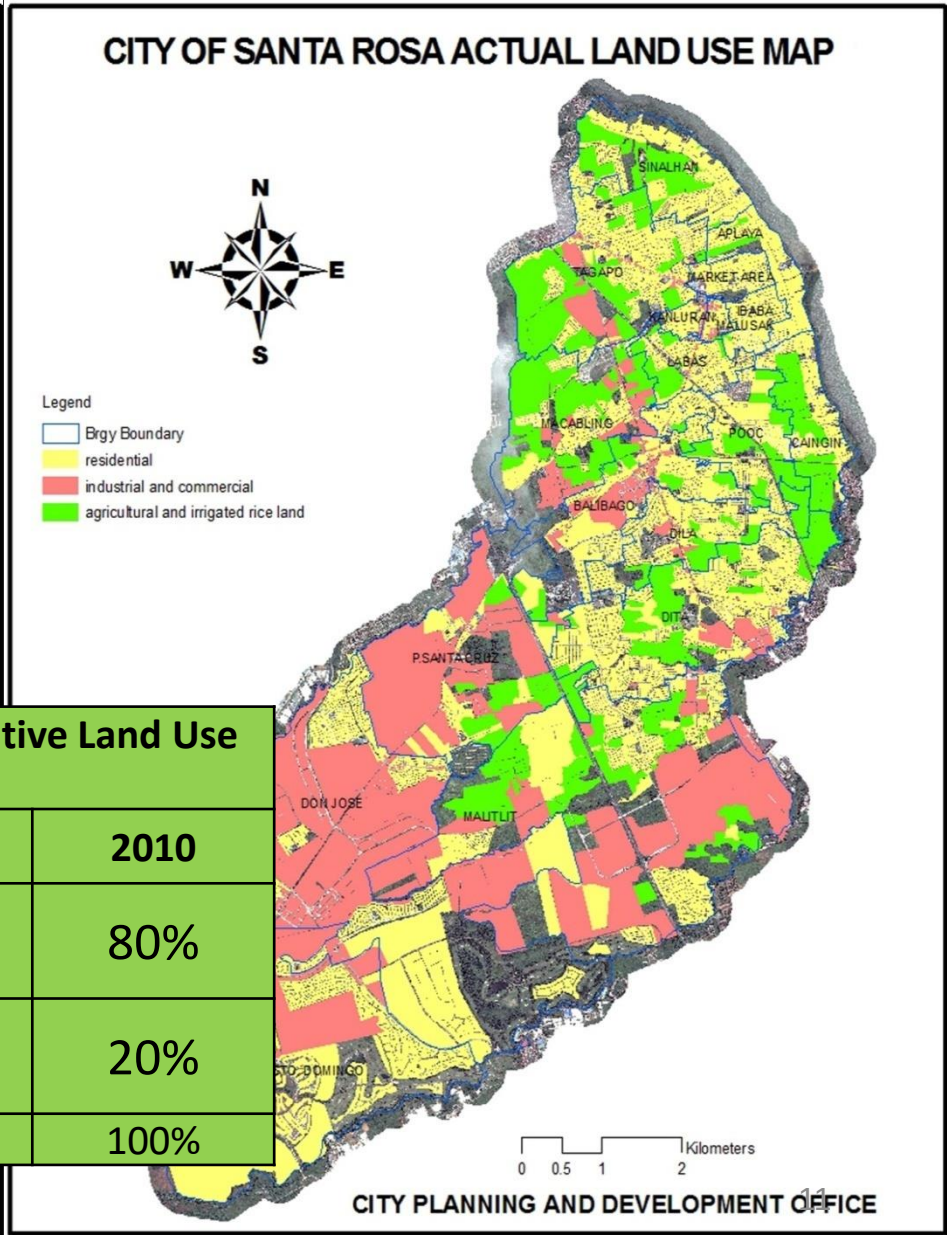
Upstream: Soil erosion easily occurs due to land use changes

Midstream: Less Water than before; more flooding

Downstream : Urban sprawl and housing development; river turned to be a drainage.

Land Use Changes : 1980 vs. 2010





土地利用比較Comparative Land Use
% Share

LAND USE	1980	2010
Built-Up Areas	4%	80%
Agricultural Areas	96%	20%
TOTAL	100%	100%

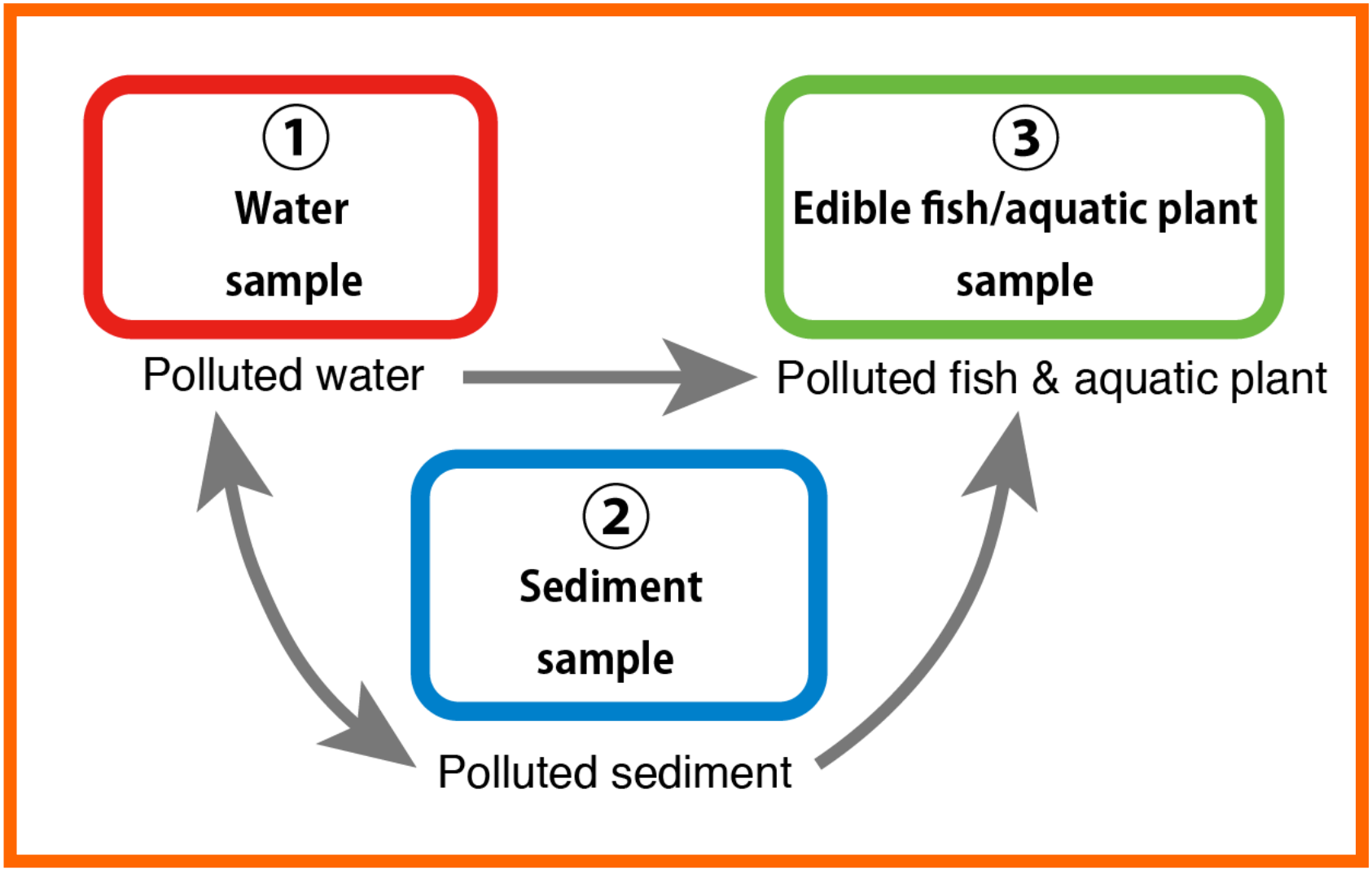
Locally produced fish and plants are mostly consumed by local people

Hito

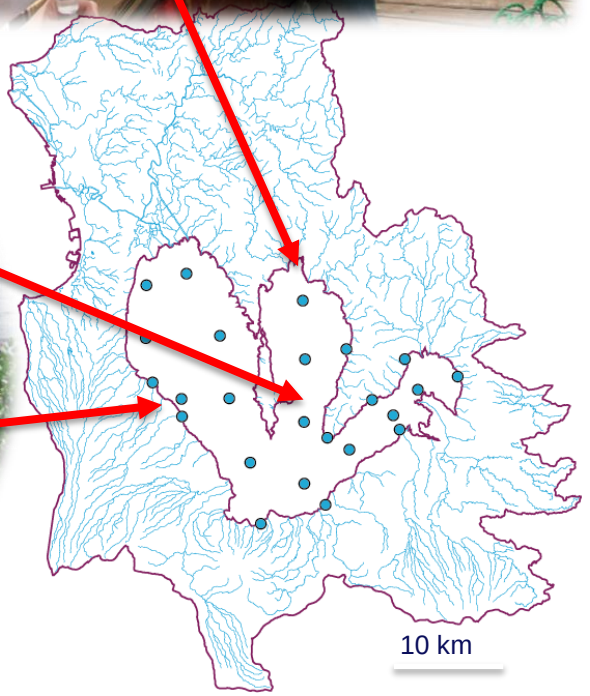
Tilapia

Kang kong

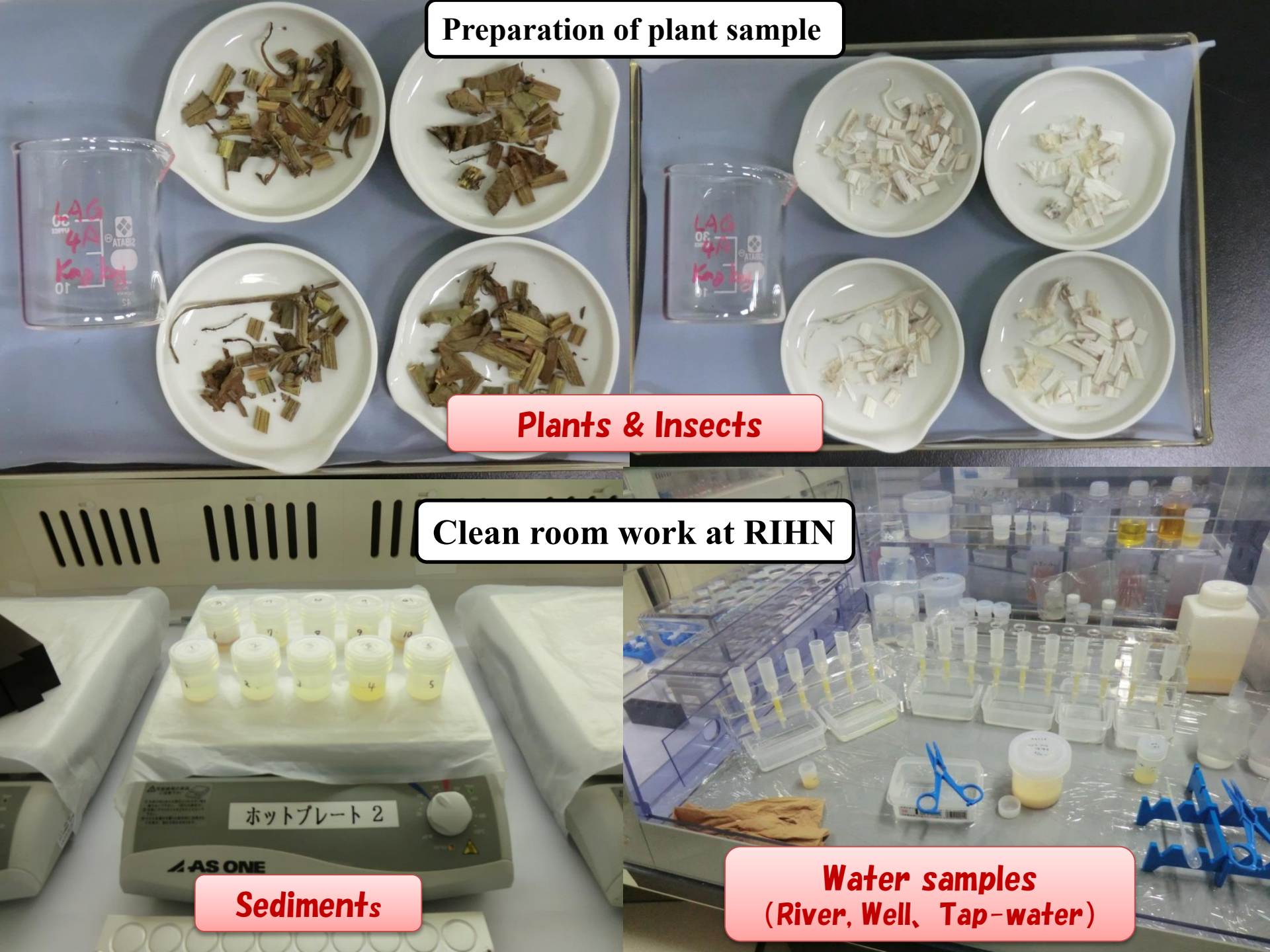
Unique Sampling (3 in one) in this Research



Water Sample Collection from Well in Applaya, Sta Rosa (Mar. 2011)



Lake water sampling (March and May, 2011)


Preparation of plant sample
Plants & Insects
Clean room work at RIHN
ホットプレート 2
AS ONE
Sediments
Water samples
(River, Well、 Tap-water)

Water quality analysis at RIHN

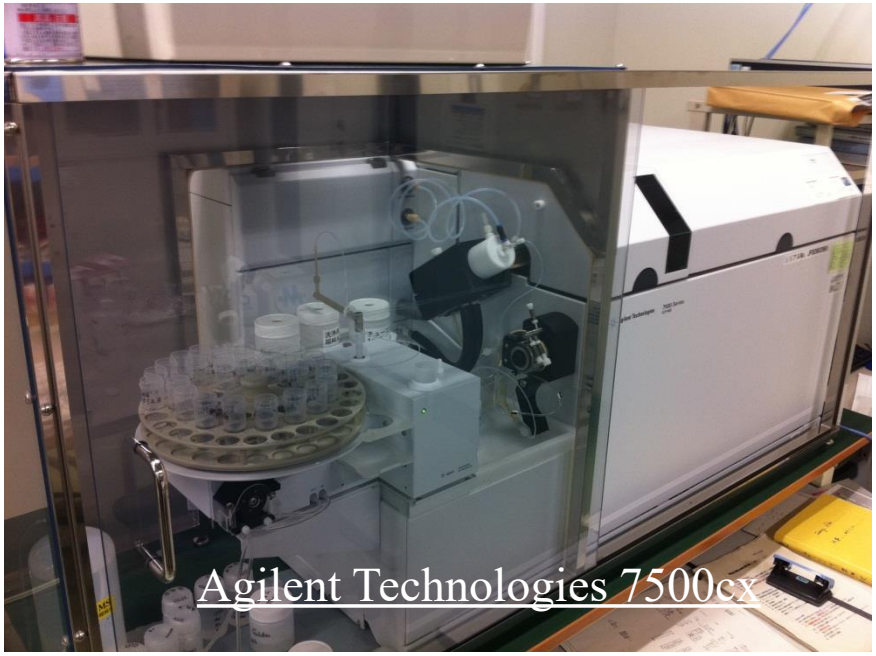

Dionex ICS-3000

Ion Chromatography System (Dionex ICS-3000)

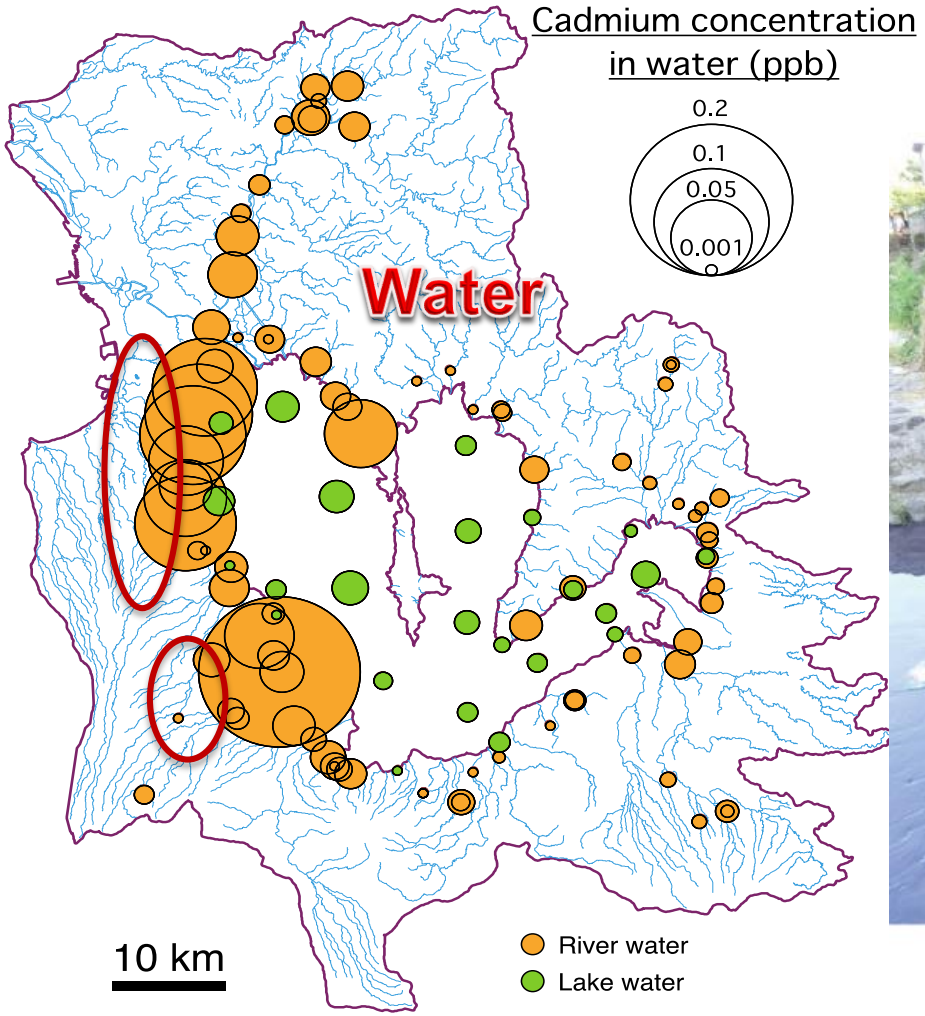
Major component analysis
(Cl^-, NO_3^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, Na^+, K^+)

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)

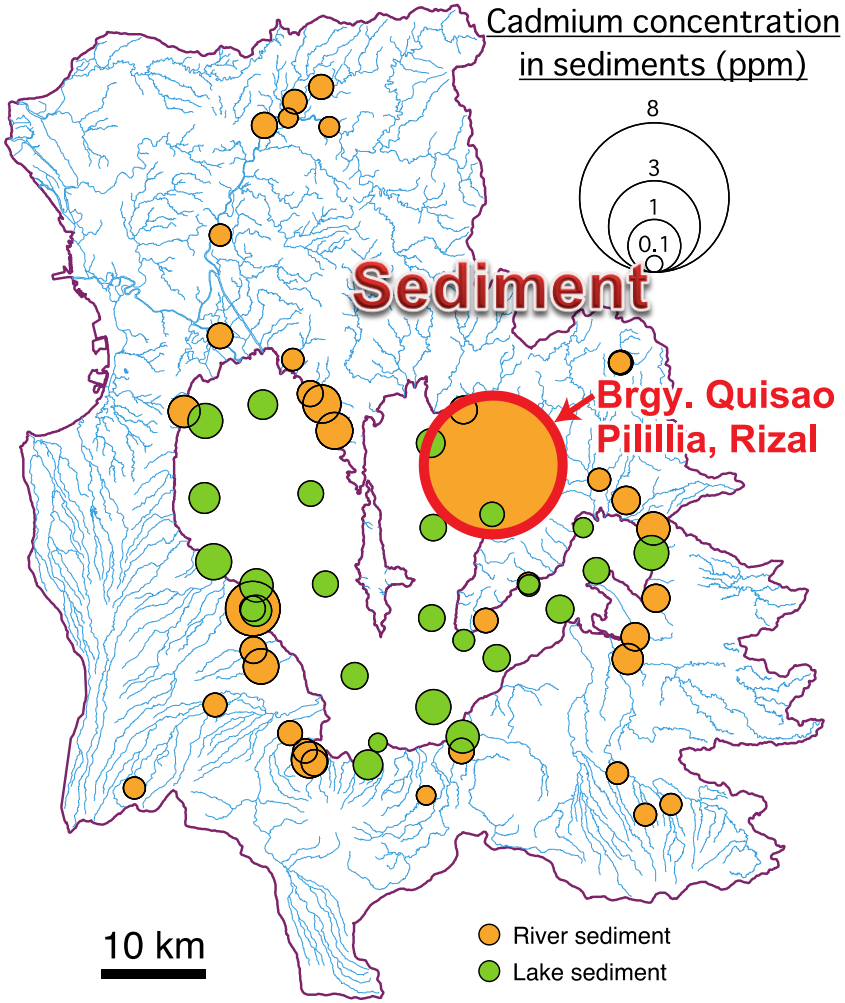

Agilent Technologies 7500cx

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 occurs in rural area (Brgy. Quisao Pilillia, Rizal).



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

Research Result（2）: *Health Risk Assessment*

（1）Bioaccumulation : fresh water fish from Laguna Lake
（2）Exposure of heavy metal and human health risk assessment

The main objective of the study is to assess the risks to human health from exposure to heavy metals bioaccumulation in fish products from Laguna de Bay.

?

Analysis of Possible Causes of Food and Health Risks

Availability

Decreasing productivity of the lake

Access

Poverty & sub-optimal institutional supports

Utilization

Unsafe foods and co-existing morbidities

FOOD INSECURITY and HUNGER (*individual* and *household* levels)

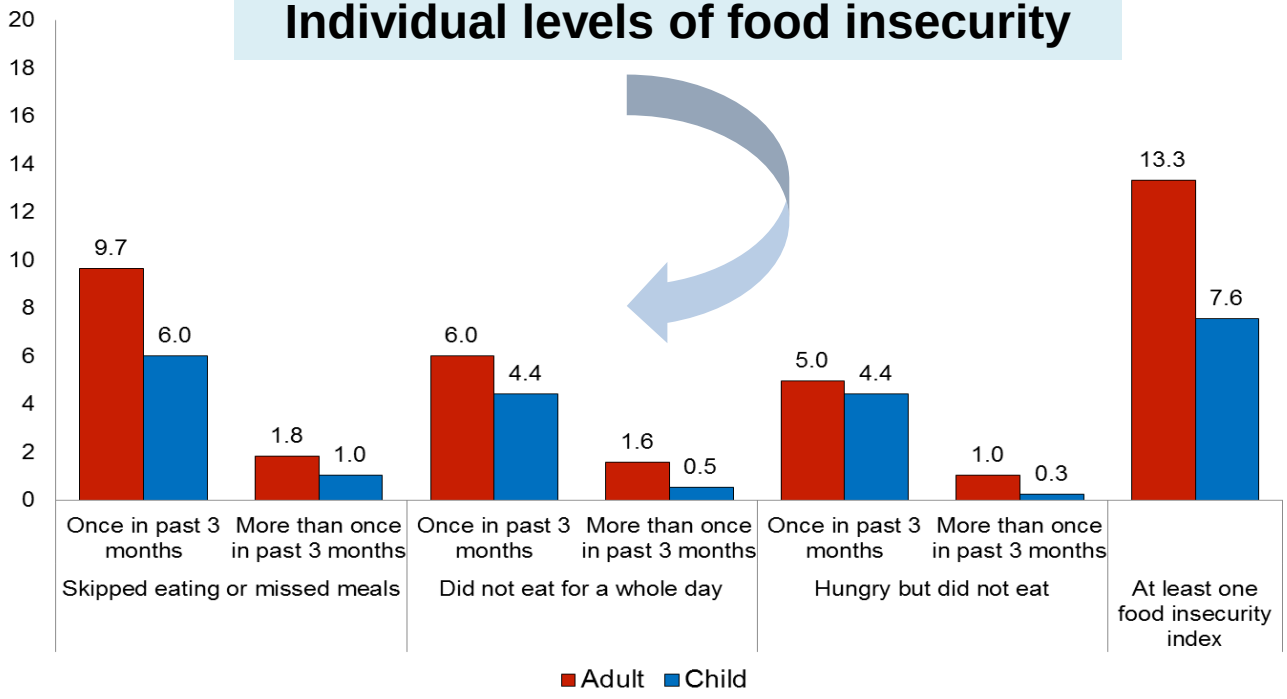
Possible causes of food insecurity according to domain

14 % of Households Experienced Hunger in the past 3 Months

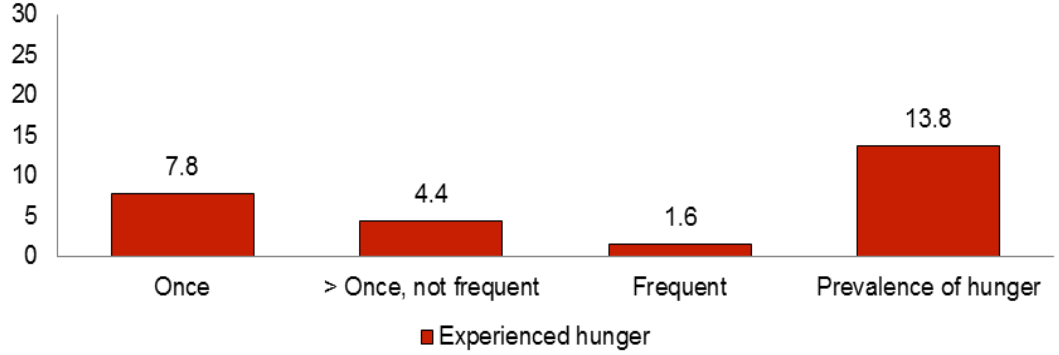
In the preceding three months to survey (October – December 2011)…

- **13.3%** adults were in food insecure
- **7.6%** of children were food insecure
- **13.8%** of households experienced hunger

Individual levels of food insecurity



Hunger in households



Hair and blood examination; IQ test conducted



- With hair and blood samples, involving mother and child participants from four lake-coastal villages, IQ test and other health impacts have been examined. (Aplaya, Caingin, Sto. Domingo)

Chronic LEAD Poisoning in Children: Possible Causes and Effects

Ingestion

Contaminated food (fish, vegetables) and water

Inhalation

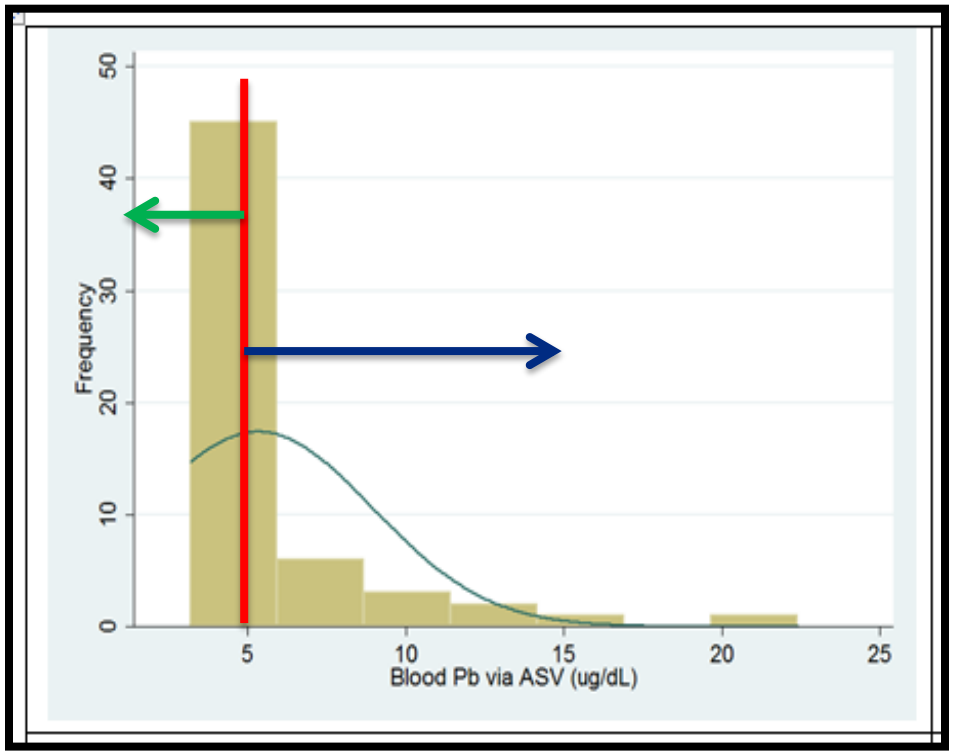
Contaminated air

Dermal

Rare pathway in the general population

Routes of exposure to lead

Blood lead levels among children, 7 – 9 years old



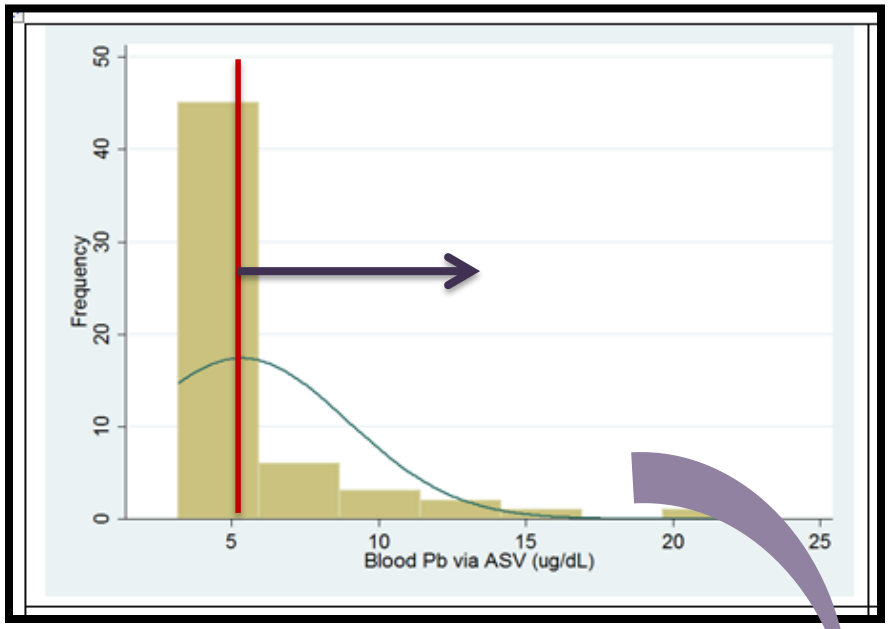
33% of the child-participants had blood lead levels > 5 ug/dL.

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**

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

Chronic LEAD Poisoning in Children: Importance for Risk Communication (Policy)

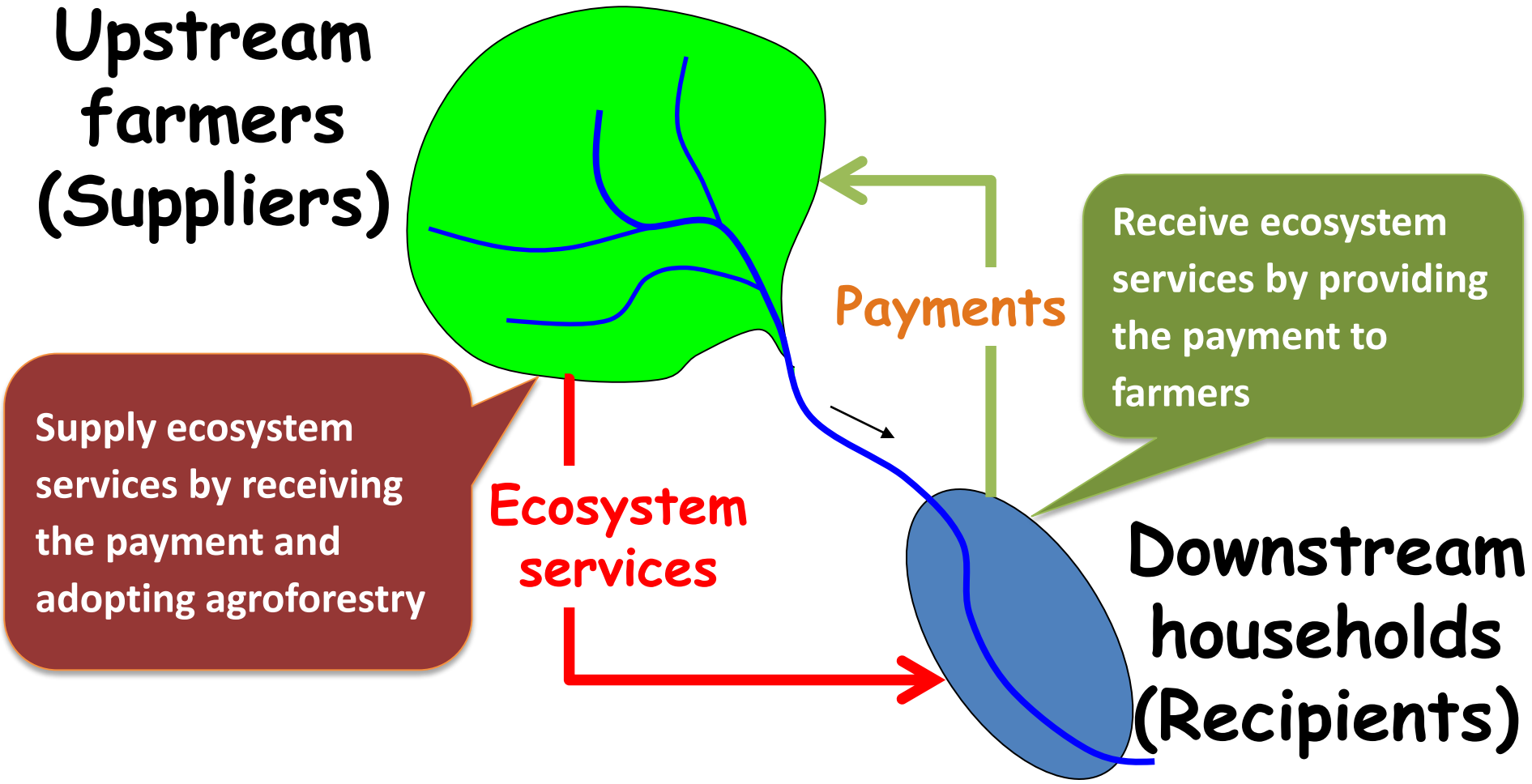
IMPORTANCE OF ADDRESSING CHRONIC LEAD POISONING

- No threshold level for blood lead before clinical manifestations
- **Profound effect on the cognitive development of children**
- Cumulative effect of chronic lead poisoning even with sub-clinical levels

EVIDENCES FROM THE RESEARCH WHICH MAY AID POLICY DIRECTIONS FROM RESEARCH

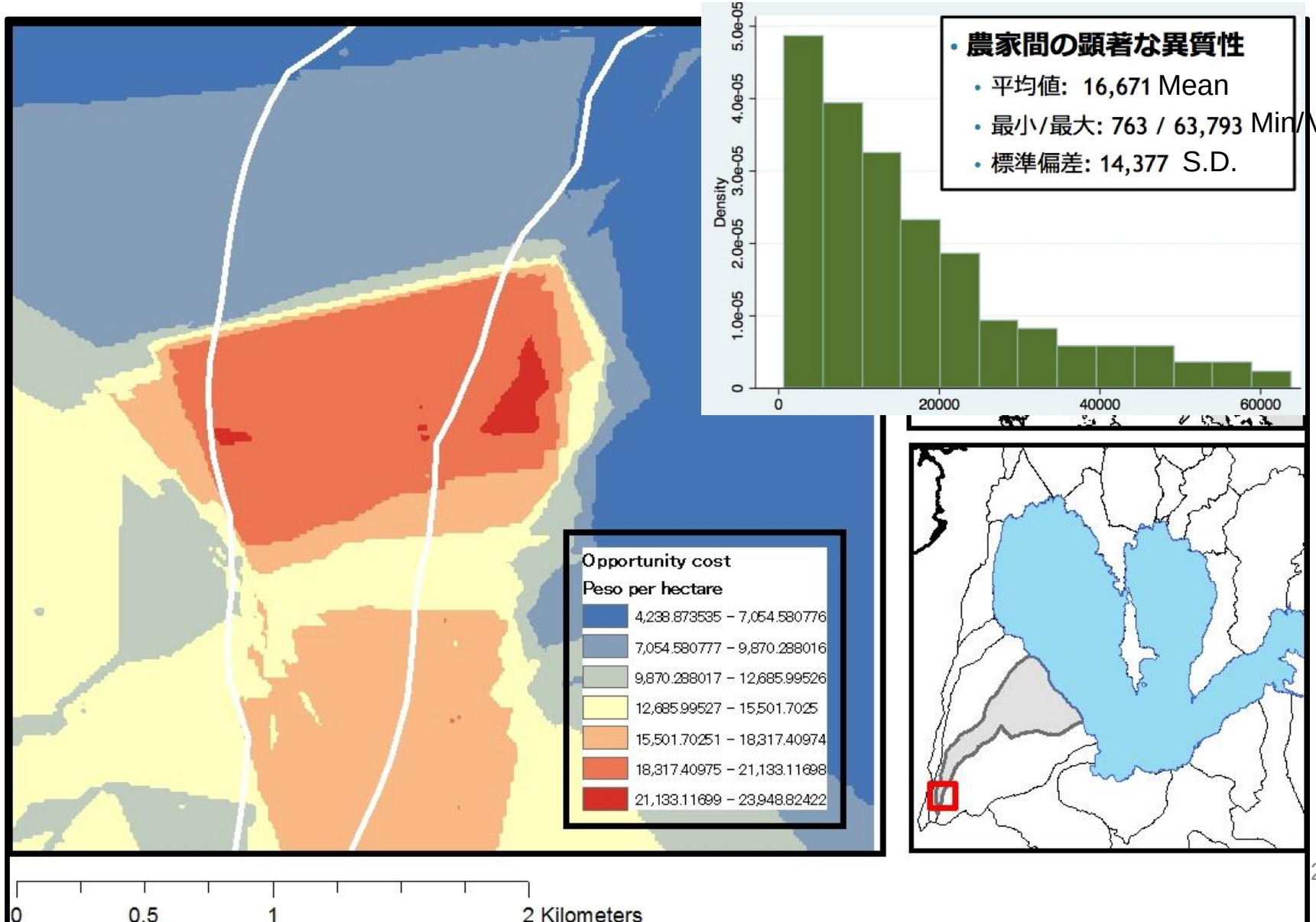
- Increased risk for chronic lead poisoning with ingestion of contaminated fish
- Possible association between blood lead levels and poor cognitive performance
- The cognitive effects of chronic lead poisoning can possibly be influenced (probably through synergism) with other factors such as malnutrition.

Research Result（3）: Paymenmt for Ecosystem Services



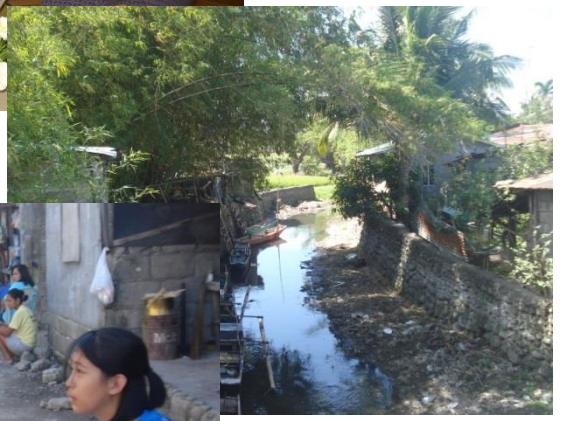
WTA(Willingness to accept) for Maintaining Agroforest in upstream

アグロフォレストリーPESに対する受入意志額（上流域農家）



WTP (*Willingness to Pay*) for Maintaining (Changing to) Agroforestry by Downstream Households

Ecosystem Service	限界支払意志額（ペソ/ 世帯/月） Marginal WTP (Php/HH/Mon)
洪水リスクの減少 Decrease in Flood Risk	3.72
生物多様性の保護 Protection of biodiversity	6.35
水質改善 Water quality improvement	3.89
地下水保全 Ground water conservation	1.45
合計 Total	15.45



Research Result (4): TD Social Experiment

Participatory Approach for Resource Management and Recovery

(資源の保全管理・再生に向けた住民参加型取り組み)

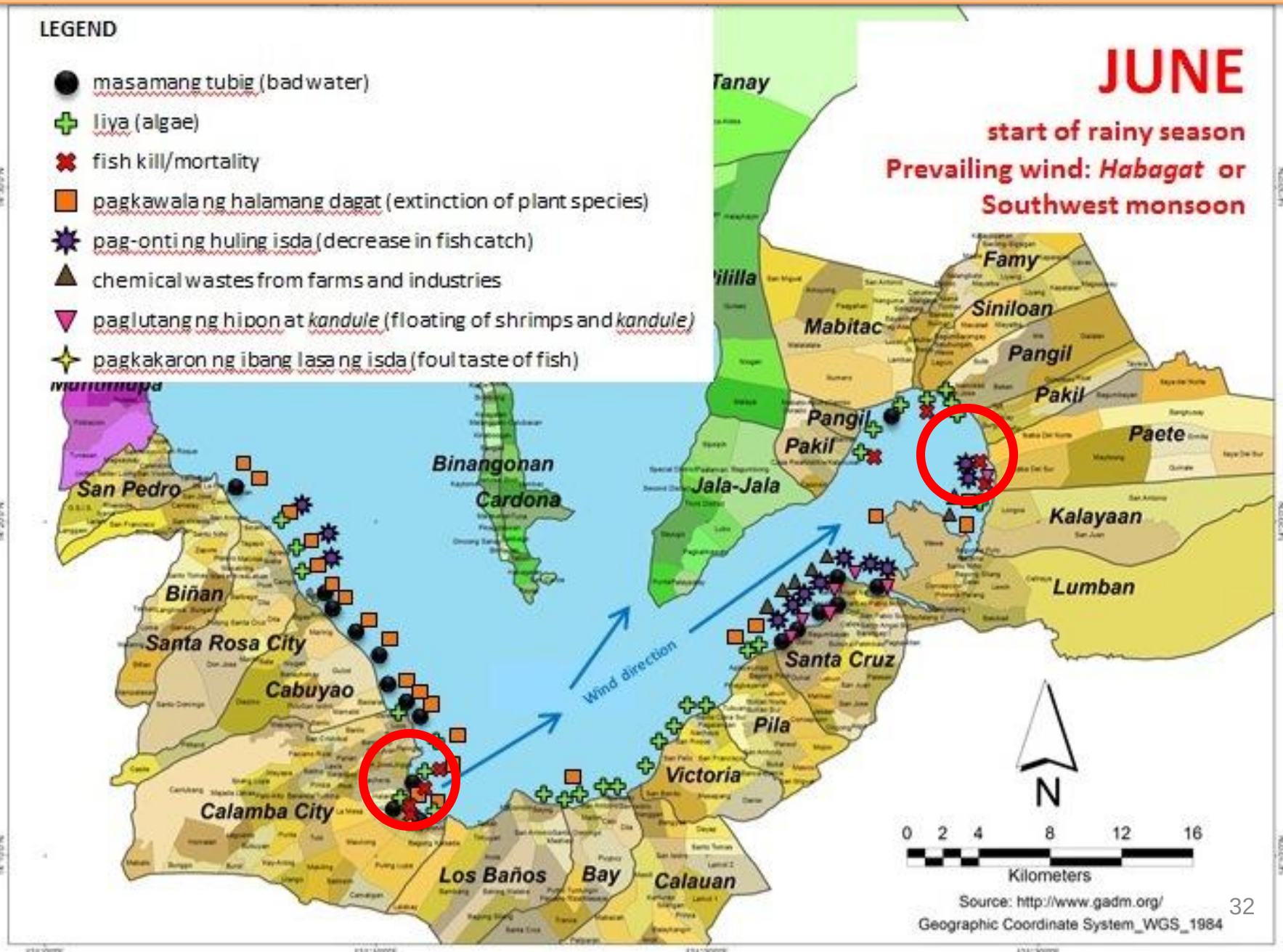
Trans-disciplinary (TD) アプローチ介入実験と検証

TD approach : Interventional Research and Evaluation

Bio-signals of Ecological Risk and Map Symbols

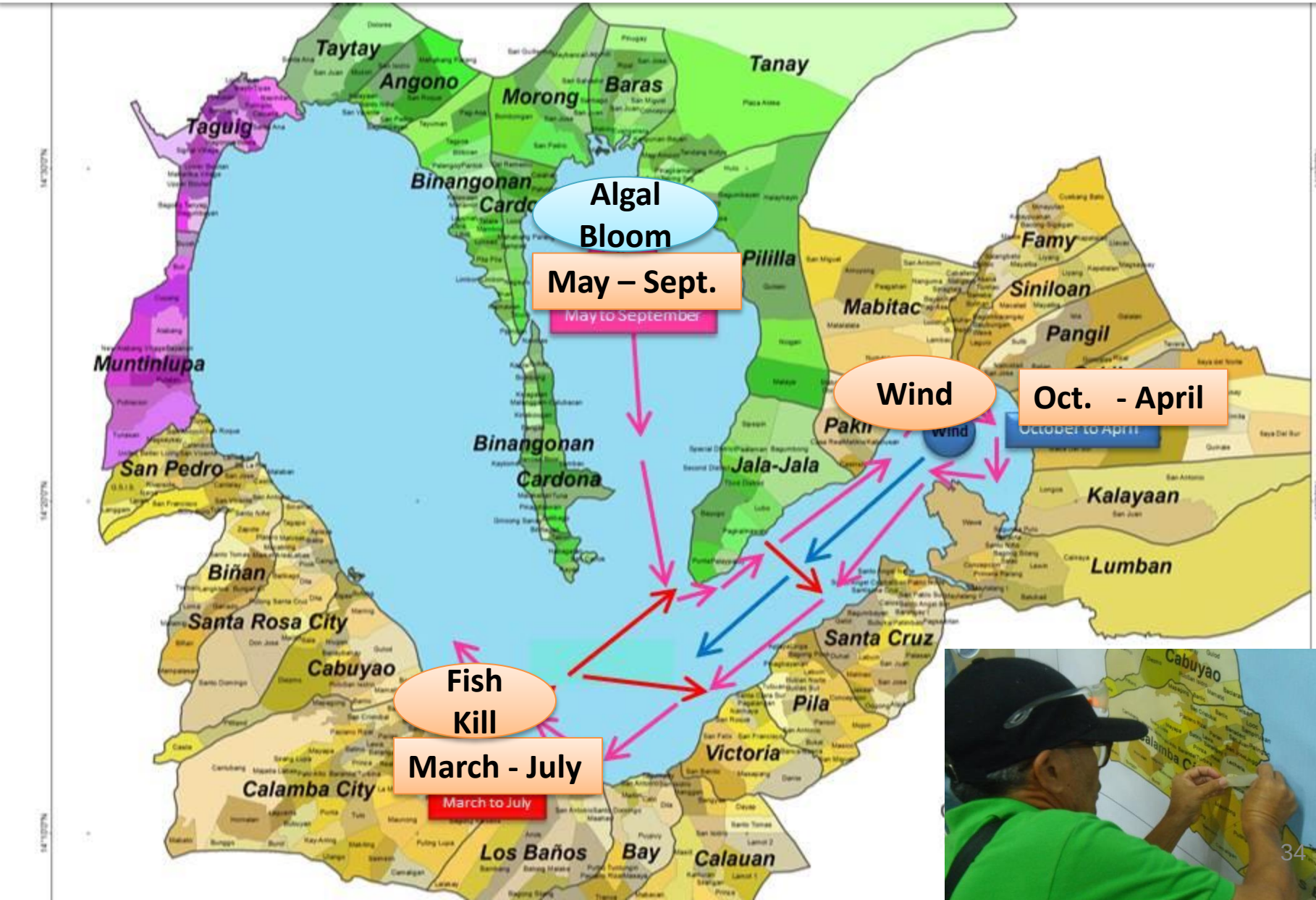
Bio-signals	Messages being conveyed
• Bad water smell (Blackened polluted waters) 	Water pollution, poor fish catch
• Algal Bloom(Green waters) 	Hot weather, signs of forthcoming fish kill
• Loss of Lake Water Plants 	Poor fish reproduction
• Floating shrimps and Catfish and White Cranes 	Benthic organisms/ sediment feeders affected by toxins
• Scum tastes in fishes 	Dry months fish feeding on decaying algae
• High temperature/massive algae 	Fish Kill
• Presence of chemicals in water 	
• Reduction in Fish Catch 	

Ecological Risk Mapping: Monthly data, by bio-signals



Learning with the Community people; local knowledge as key
地域住民(漁業者)から学ぶ:連続対話(検討会)

Bio-Signal Mapping by Fisherfolks ~Algal Bloom, Fishkill and Wind~
～アオコの局地的大発生、魚の大漁斃死と風向きとの関係性～



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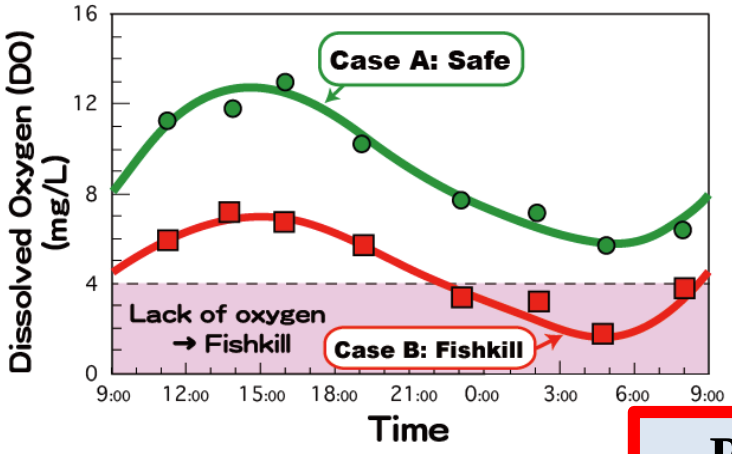
Community Participation for Fishkill Protection and Early Warning System

Data collection by fishermen

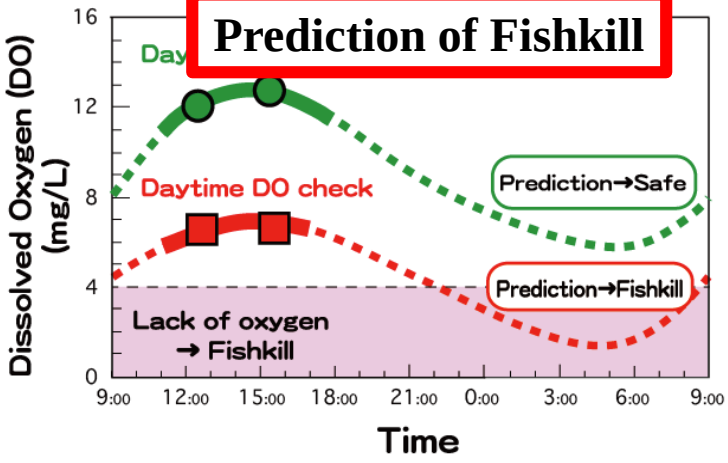
Data collection: One day monitoring of DO



Preventive Measures

Application: Early Warning System

Prediction of Fishkill

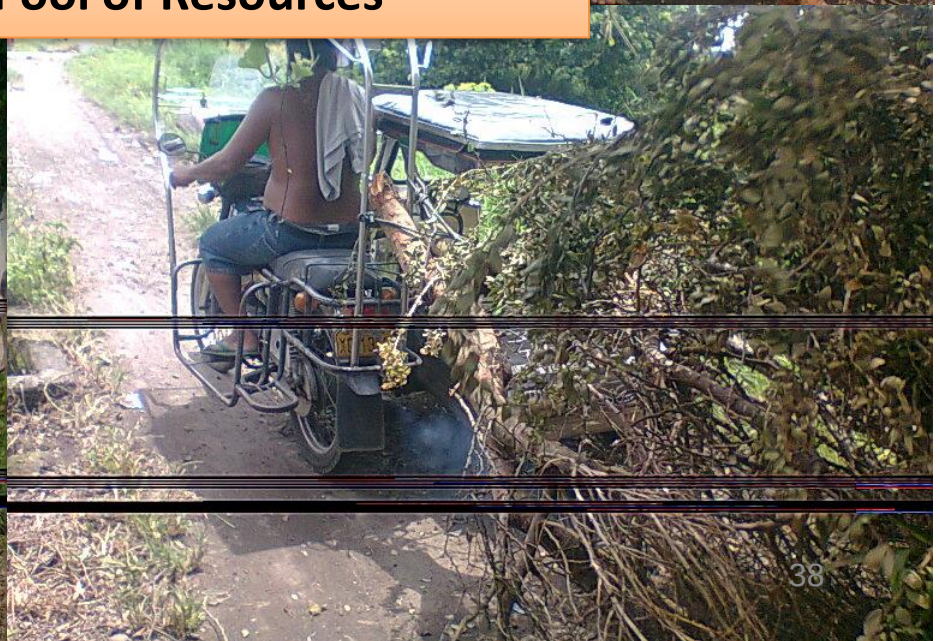


Adoption of Local/traditional Knowledge; “Yankaw” system; for rehabilitation of fish resources and catch (ヒントはエビ漁から)

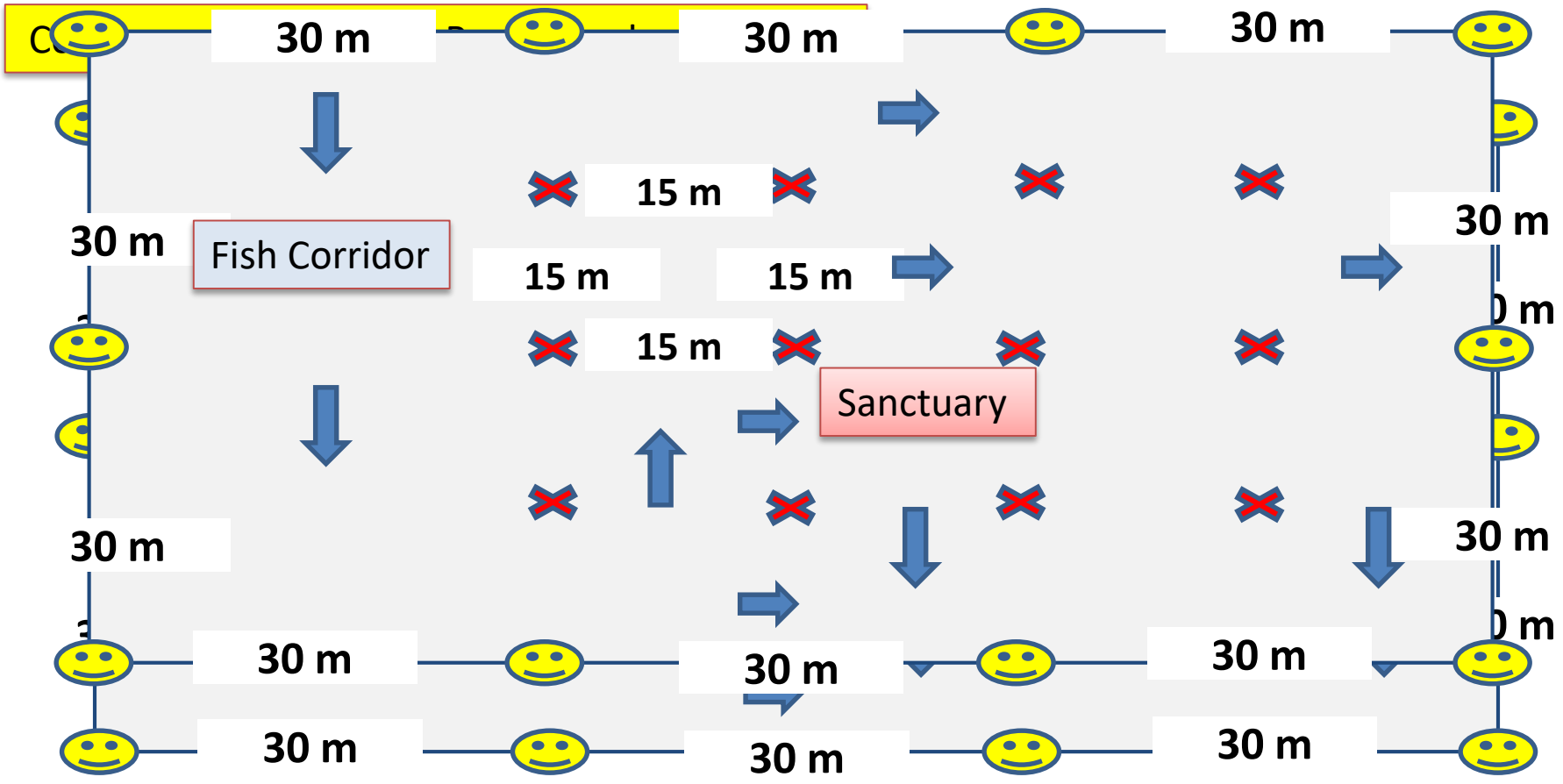
カマチリ枝の伐採・収集・結束 -- Self-Help by Fisheries and Agriculture Management Councils (FARMC) in 10 barangays (villages)

伝統的共助システムの活用（Traditional Bayanihan

--- Helping each Other ; Voluntary Pool of Resources



Designing the Yankaw Fish Sanctuary Zone by Collective Action (Setting a sanctuary Zone and Voluntary Fishing Rules)



LEGEND:

Livelihood , 10 “harvestable” yankaws, sustainability & expansion of Yankaws

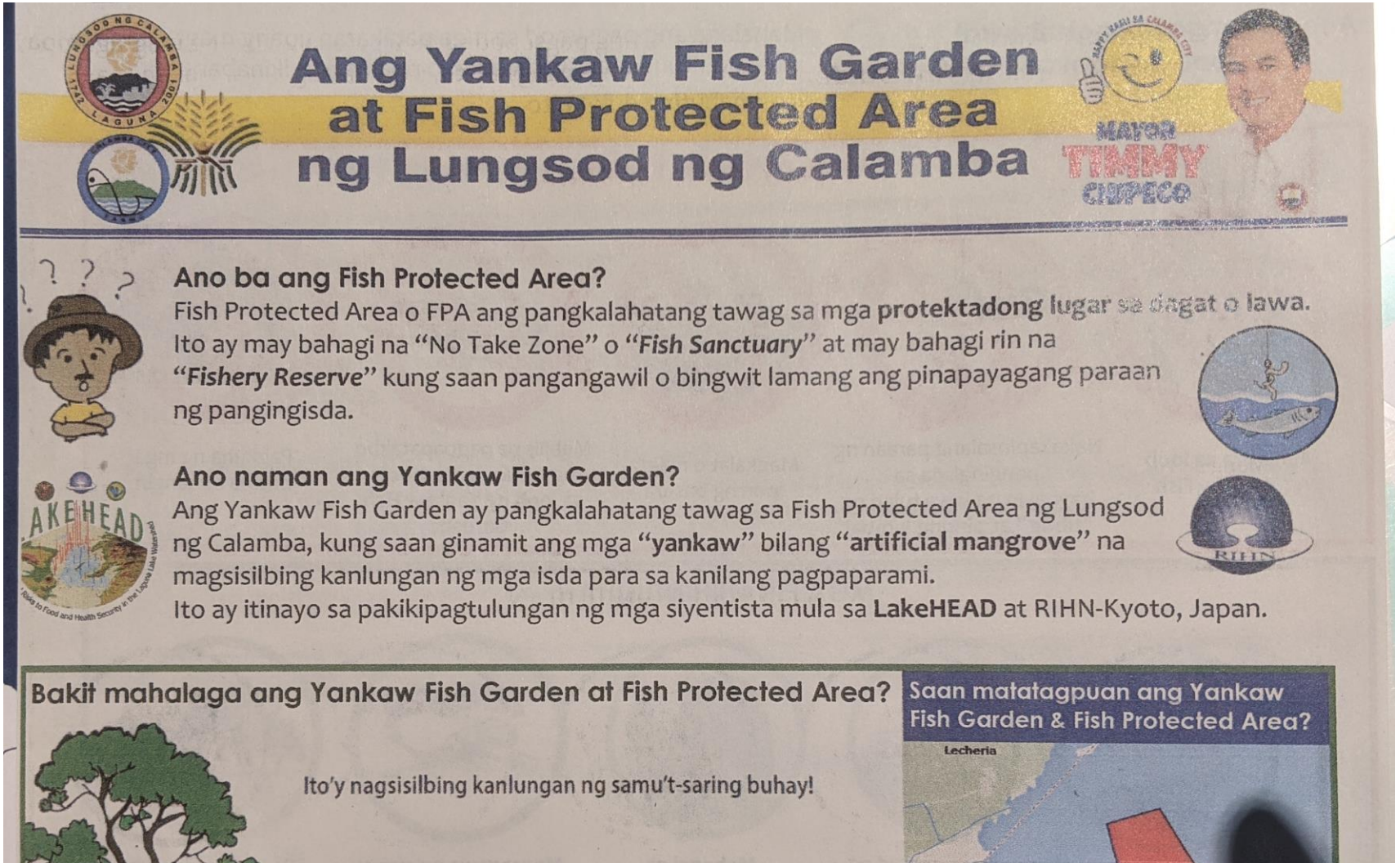
Conservation 12 “restricted” yankaws, for fish breeding and multiplication

Bayanihan (共助), revived !!

= Self Help, Voluntary Community Assistance

大漁の成果に周辺地区から多くの漁民が参加

主な研究成果を現地語（Tagalog）に分かりやすく紹介し、さまざまなステークホルダーに配布・紹介



Ang Yankaw Fish Garden at Fish Protected Area ng Lungsod ng Calamba

MAYOR TIMMY CHIPECO

Ano ba ang Fish Protected Area?

Fish Protected Area o FPA ang pangkalahatang tawag sa mga **protektadong lugar sa dagat o lawa.** Ito ay may bahagi na "No Take Zone" o "***Fish Sanctuary***" at may bahagi rin na "***Fishery Reserve***" kung saan pangangawil o bingwit lamang ang pinapayagang paraan ng pangingisda.

Ano naman ang Yankaw Fish Garden?

Ang Yankaw Fish Garden ay pangkalahatang tawag sa Fish Protected Area ng Lungsod ng Calamba, kung saan ginamit ang mga "**yankaw**" bilang "**artificial mangrove**" na magsisilbing kanlungan ng mga isda para sa kanilang pagpaparami.

Ito ay itinayo sa pakikipagtulungan ng mga siyentista mula sa **LakeHEAD** at RIHN-Kyoto, Japan.

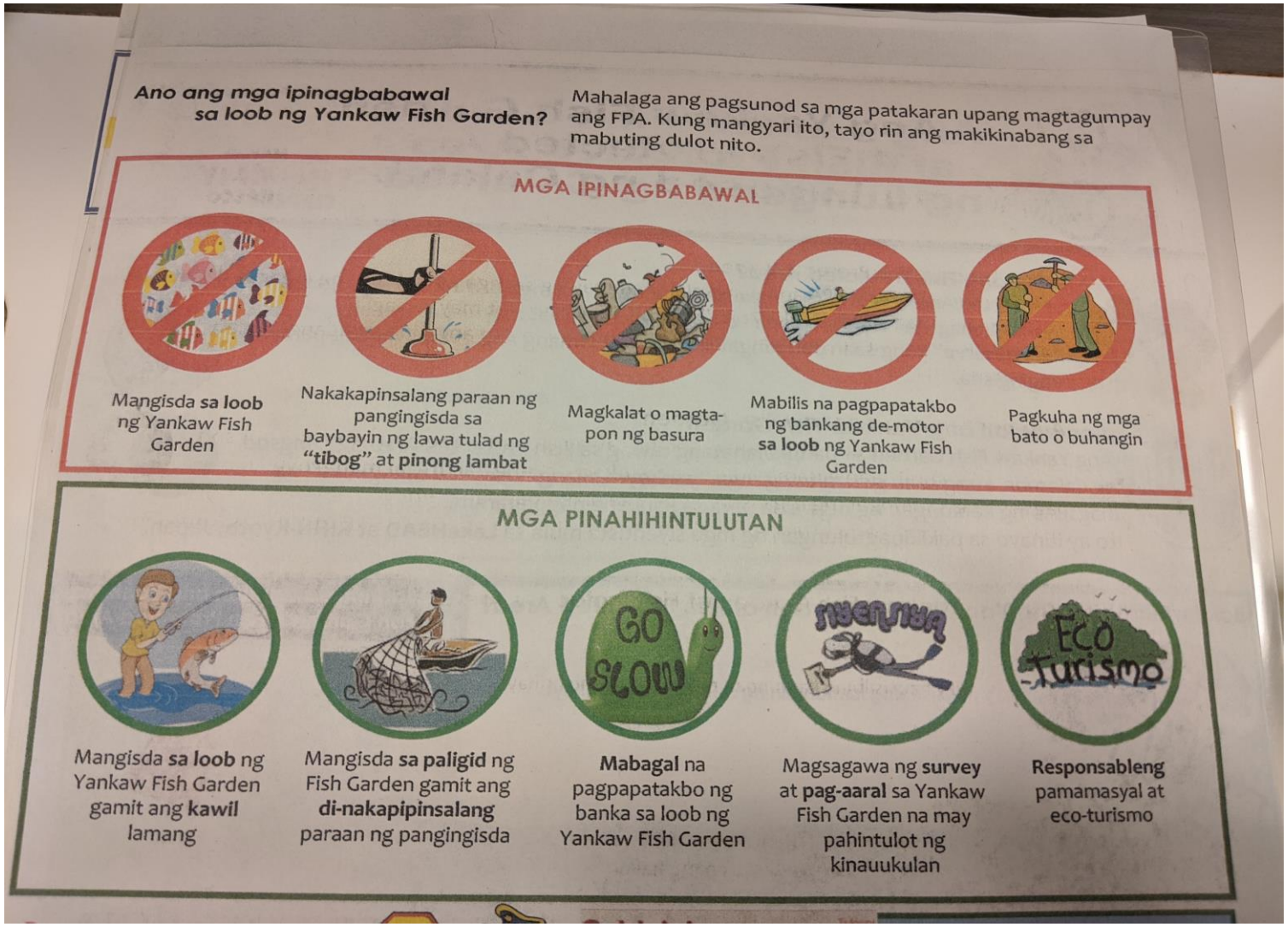
Bakit mahalaga ang Yankaw Fish Garden at Fish Protected Area?

Ito'y nagsisilbing kanlungan ng samu't-saring buhay!

Saan matatagpuan ang Yankaw Fish Garden & Fish Protected Area?

Lecheria

漁民たちが自らの手で「資源の管理と保全のためのルールづくり」を提案し、実行された。



Ano ang mga ipinagbabawal sa loob ng Yankaw Fish Garden?

Mahalaga ang pagsunod sa mga patakaran upang magtagumpay ang FPA. Kung mangyari ito, tayo rin ang makikinabang sa mabuting dulot nito.

MGA IPINAGBABAWAL

Mangisda **sa loob** ng Yankaw Fish Garden

Nakakapinsalang paraan ng pangingisda sa baybayin ng lawa tulad ng **"tibog"** at **pinong lambat**

Magkalat o magtapon ng basura

Mabilis na pagpapatakbo ng bankang de-motor **sa loob** ng Yankaw Fish Garden

Pagkuha ng mga bato o buhangin

MGA PINAHIHINTULUTAN

Mangisda **sa loob** ng Yankaw Fish Garden gamit ang **kawil** lamang

Mangisda **sa paligid** ng Fish Garden gamit ang **di-nakapipinsalang** paraan ng pangingisda

Mabagal na pagpapatakbo ng banka sa loob ng Yankaw Fish Garden

Magsagawa ng **survey** at **pag-aaral** sa Yankaw Fish Garden na may pahintulot ng kinauukulan

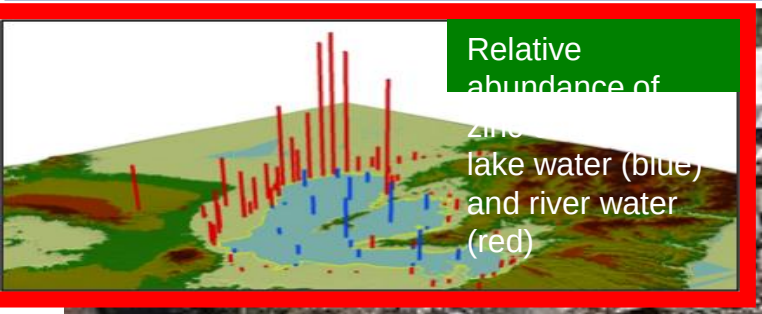
Responsableng pamamasyal at eco-turismo

"Participatory & Community-based" Approach

- **Linkage of Ecological Degradation with Food-Health Security; Complex, diverse, and specific local conditions;**
- **Observation, Data collection and Reporting are crucial (Local People)**
- **Identify Risks; Analyze and Evaluate (Scientists);**
- **Actions & Next Steps;**

⇒ ***Science (Scientists) in Community;***

Partnership: *Working Together* in Saving Laguna de Bay, for our Food-Health Security



1st Diwa ng Lawa Prize Awarded by LLDA (Oct, 2013)

まとめ: Summary and Policy Implications

◆ 課題設定
- 当初の狙い vs. 住民の本音
- 日本の経験 （琵琶湖の取り組み、交流＆視察）
- データ重視 （収集、分析、地域住民の協力）

◆ ステークホルダー(同定、関与)
- プロセス介入 （当初からの参画）
- 漁民、農民、地域住民; 行政; 大学・小中学生、NPO
- Workshop, 意見交換会

◆ 成果の活用、社会実装
- 成果のTagalog語による発信、伝達
- Local knowledge, 在来知 （伝統漁法の見直し）
- PDCAサイクル; 成果の継続と新たな展開