Report of the last PICES-MAFF Project on Building Local Warning Networks for the Detection and Human Dimension of Ciguatera Fish Poisoning in Indonesian Communities (CIGUATERA)

Building Local Warning Networks for the Detection and Human Dimension of Ciguatera Fish Poisoning in Indonesian Communities

Acronym: Ciguatera

Term: April 2020 – March 2023

Project Science Team Co-Chairs:
Mitsutaku Makino (Atmosphere and Ocean Research Institute, The University of Tokyo, Japan)
Mark Wells (University of Maine, USA)

Project Coordinator:
Alexander Bychkov (PICES)

Funding Agency:
Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan (JFA)

Parent PICES Committee:
Human Dimensions Committee (HD)

Mailing list

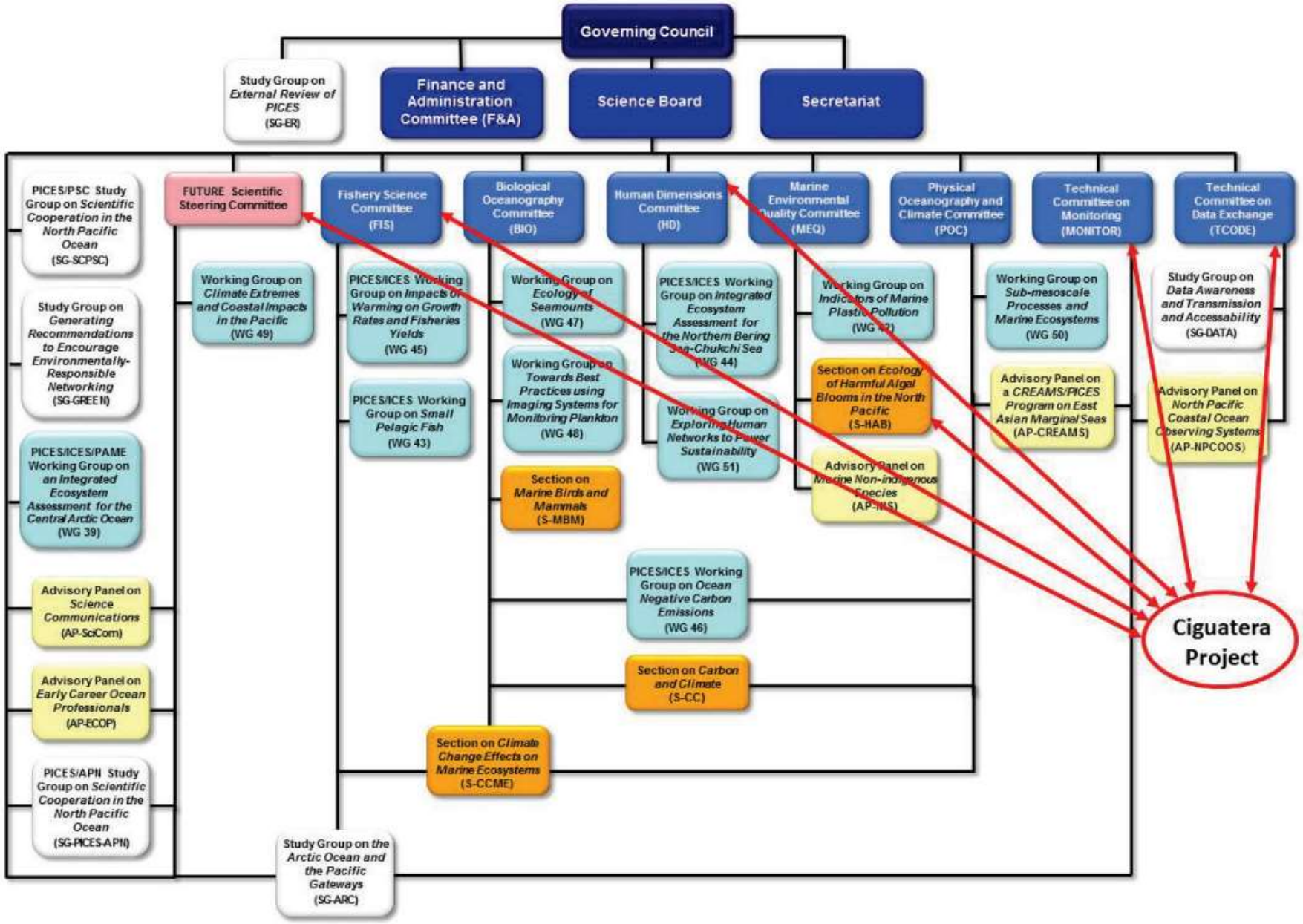
Project background

Benthic harmful algal bloom (HAB) species, such as the causative organism underlying Ciguatera Fish Poisoning (CFP), arguably have the greatest human health and economic impacts of any algal-based poisoning syndromes. CFP stems from the human consumption of fish containing toxins produced by benthic microalgae of the dinoflagellate genera *Gambierdiscus* and *Fukuyoa*, which are the initial sources of ciguatoxin. The effect of CFP on the human dimension extends far beyond the proximate health and economic outcome – chronically impacted communities become fearful of local and other fish sources and transition from their traditional ways of life to one where all protein is

- **Objective**: To build the capacity of local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries
- **Focus**: 1) to develop coastal monitoring activities by local people using smartphone-based technology (FishGIS App), 2) to detect CFP toxin-containing dinoflagellates, 3) to train local people to avoid CFP from their tables.
- **Fund**: MAFF Japan for 3 years (April 2020-March 2023) for $292,653 CAD.
- **PST members**: 6 Member Countries among HD, S-HAB, FIS, TCODE, MONITOR, FUTURE, etc.
- **Indonesian counterpart**: Prof. Suhendar, Mr. Arief and many more (BPPT, ITI)
- **Outputs**: 7 PST meetings, 1 Training WS, 2 PICES presentations, many media coverages, etc.

Name	Affiliation	
Daisuke Ambe	Japan Fisheries Research and Educat	
Seung Ho Baek	South Sea Research Institute, KIOST	
Vladimir Kulik	Pacific Branch of VNIRO ("TINRO"	
Mitsutaku Makino*	Atmosphere and Ocean Research Institute, The University of Tokyo	Japan/HD
Shion Takemura	Japan Fisheries Research and Education Agency	Japan/HD
Naoki Tojo	Hokkaido University	Japan/FIS
Vera Trainer	Northwest Fisheries Science Center, NOAA/Univ. of Washington	USA/S-HAB
Charles Trick	University of Toronto	Canada/S-HAB
Pengbin Wang	Second Institute of Oceanography, Ministry of Natural Resources	China/S-HAB
Mark Wells*	University of Maine	USA/S-HAB

Project Coordinator: Alexander Bychkov (PICES)


Governing Council
Study Group on External Review of PICES (SG-ER)
Finance and Administration Committee (F&A)
Science Board
Secretariat
PICES/PSC Study Group on Scientific Cooperation in the North Pacific Ocean (SG-SCPSC)
FUTURE Scientific Steering Committee
Fishery Science Committee (FIS)
Biological Oceanography Committee (BIO)
Human Dimensions Committee (HD)
Marine Environmental Quality Committee (MEQ)
Physical Oceanography and Climate Committee (POC)
Technical Committee on Monitoring (MONITOR)
Technical Committee on Data Exchange (TCODE)
Study Group on Generating Recommendations to Encourage Environmentally-Responsible Networking (SG-GREEN)
Working Group on Climate Extremes and Coastal Impacts in the Pacific (WG 49)
PICES/ICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (WG 45)
Working Group on Ecology of Seamounts (WG 47)
PICES/ICES Working Group on Integrated Ecosystem Assessment for the Northern Bering Sea-Chukchi Sea (WG 44)
Working Group on Indicators of Marine Plastic Pollution (WG 42)
Working Group on Sub-mesoscale Processes and Marine Ecosystems (WG 50)
Study Group on Data Awareness and Transmission and Accessability (SG-DATA)
PICES/ICES/PAME Working Group on an Integrated Ecosystem Assessment for the Central Arctic Ocean (WG 39)
PICES/ICES Working Group on Small Pelagic Fish (WG 43)
Working Group on Towards Best Practices using Imaging Systems for Monitoring Plankton (WG 48)
Working Group on Exploring Human Networks to Power Sustainability (WG 51)
Section on Ecology of Harmful Algal Blooms in the North Pacific (S-HAB)
Advisory Panel on a CREAMS/PICES Program on East Asian Marginal Seas (AP-CREAMS)
Advisory Panel on North Pacific Coastal Ocean Observing Systems (AP-NPCOOS)
Section on Marine Birds and Mammals (S-MBM)
Advisory Panel on Marine Non-indigenous Species (AP-NIS)
Advisory Panel on Science Communications (AP-SciCom)
PICES/ICES Working Group on Ocean Negative Carbon Emissions (WG 46)
Ciguatera Project
Advisory Panel on Early Career Ocean Professionals (AP-ECOP)
Section on Carbon and Climate (S-CC)
PICES/APN Study Group on Scientific Cooperation in the North Pacific Ocean (SG-PICES-APN)
Section on Climate Change Effects on Marine Ecosystems (S-CCME)
Study Group on the Arctic Ocean and the Pacific Gateways (SG-ARC)

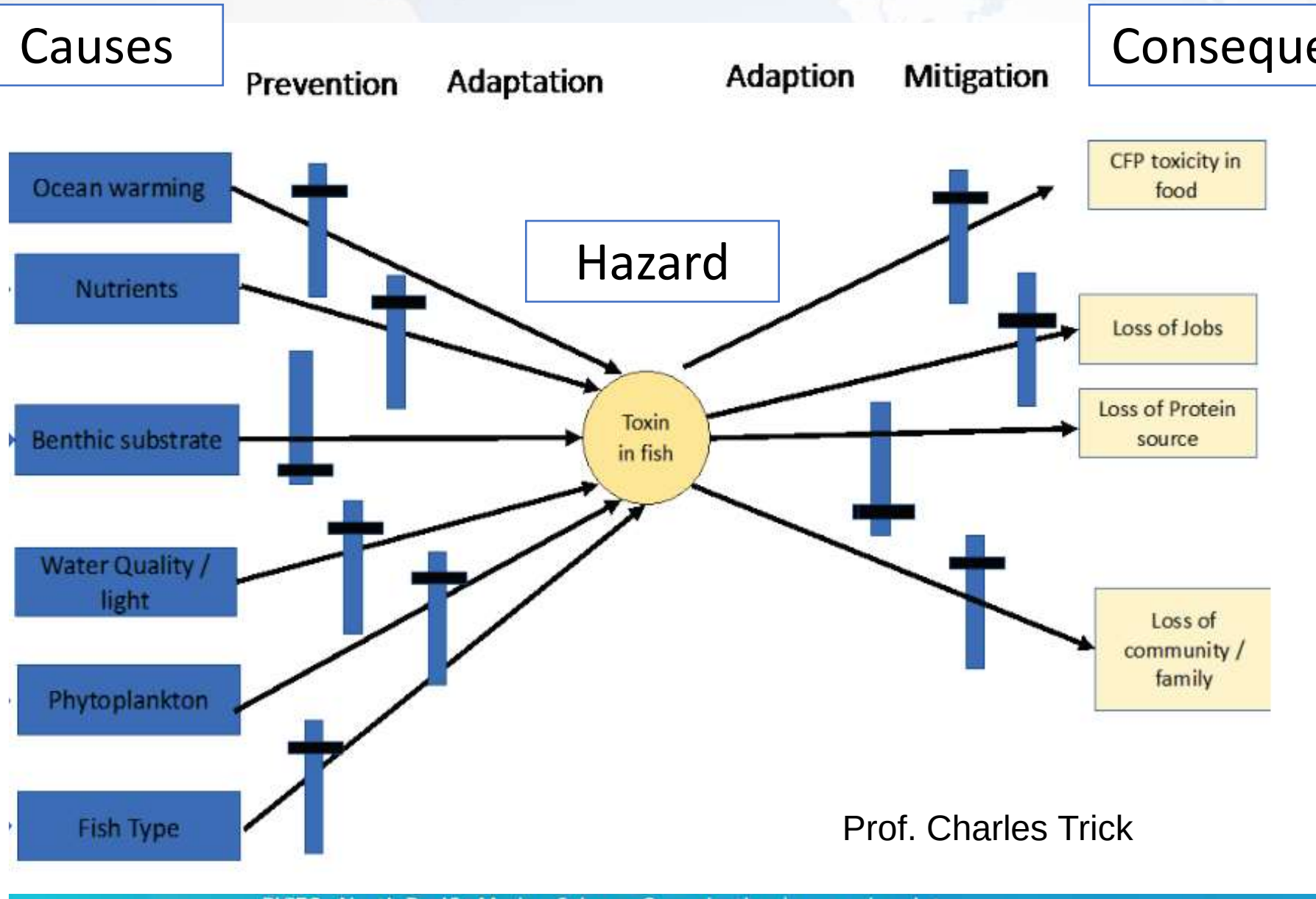
Project support in Indonesia (MOU signed)

IMPLEMENTED AGENDA

MOU AND IA PICES-ITI SIGNING CEREMONY

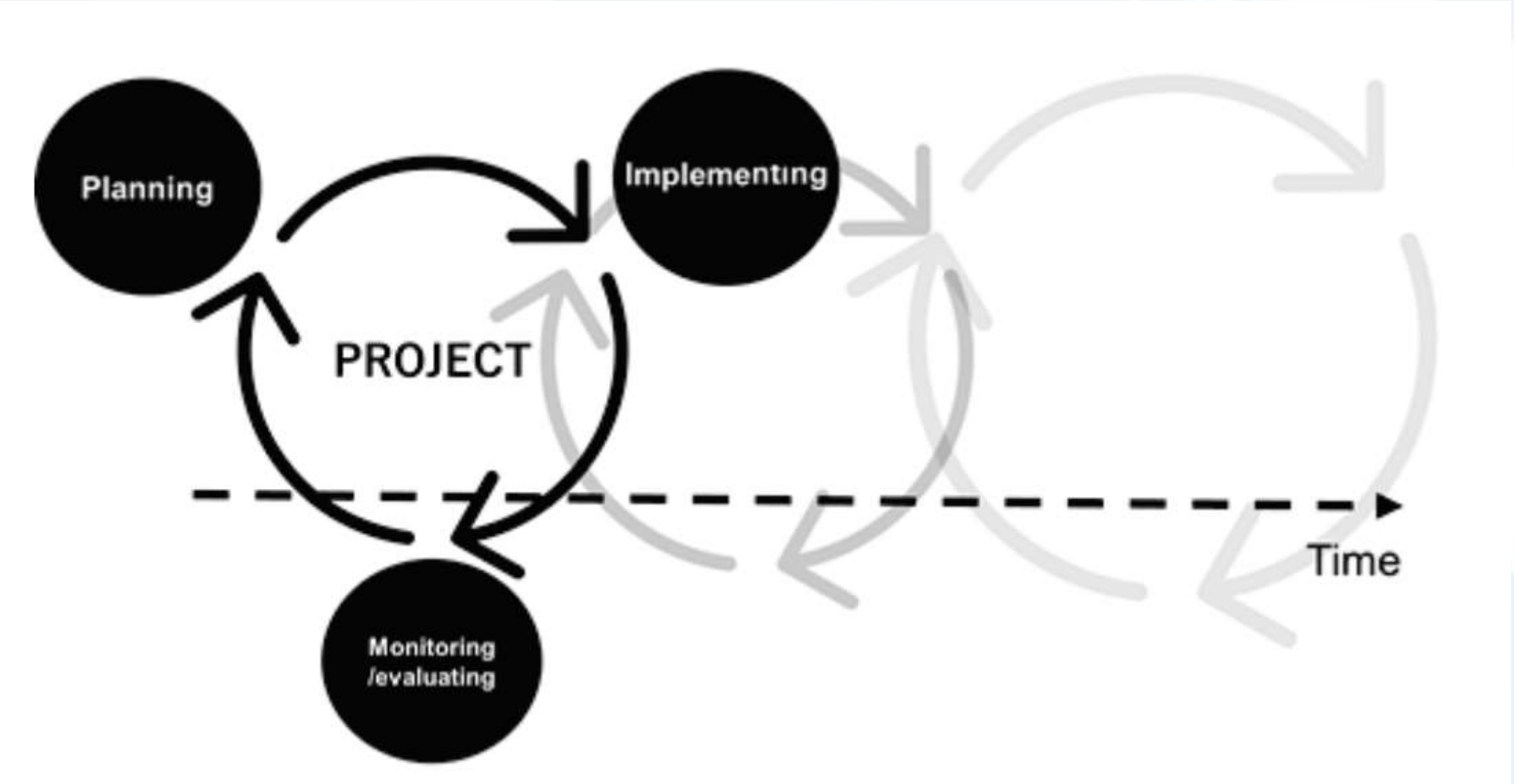
https://youtu.be/8YNKlpXbYGo

The Bow-tie model of the project (big picture)



Prof. Charles Trick

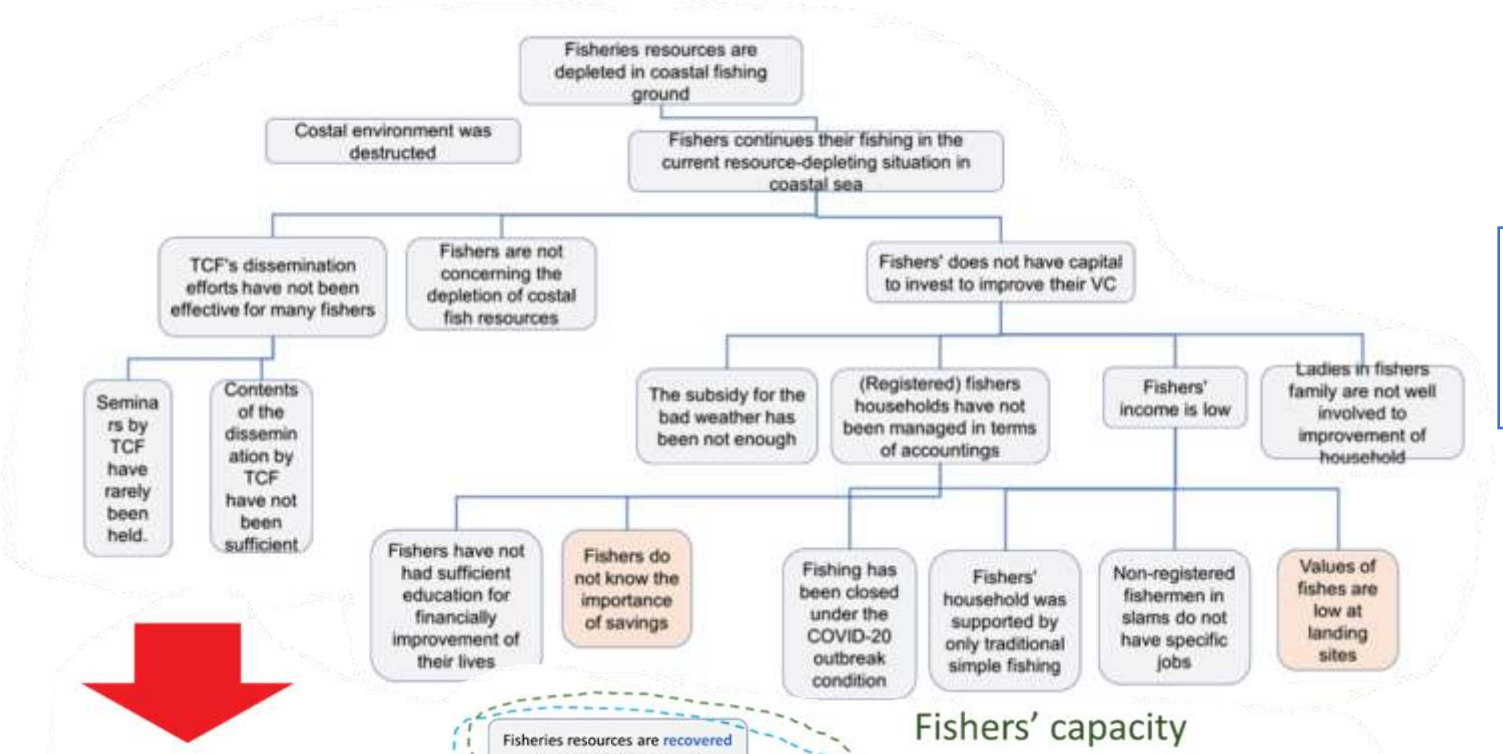
Project cycle management



- A project repeats the cycle of plan-implement-evaluation then improving its quality and increasing its impact

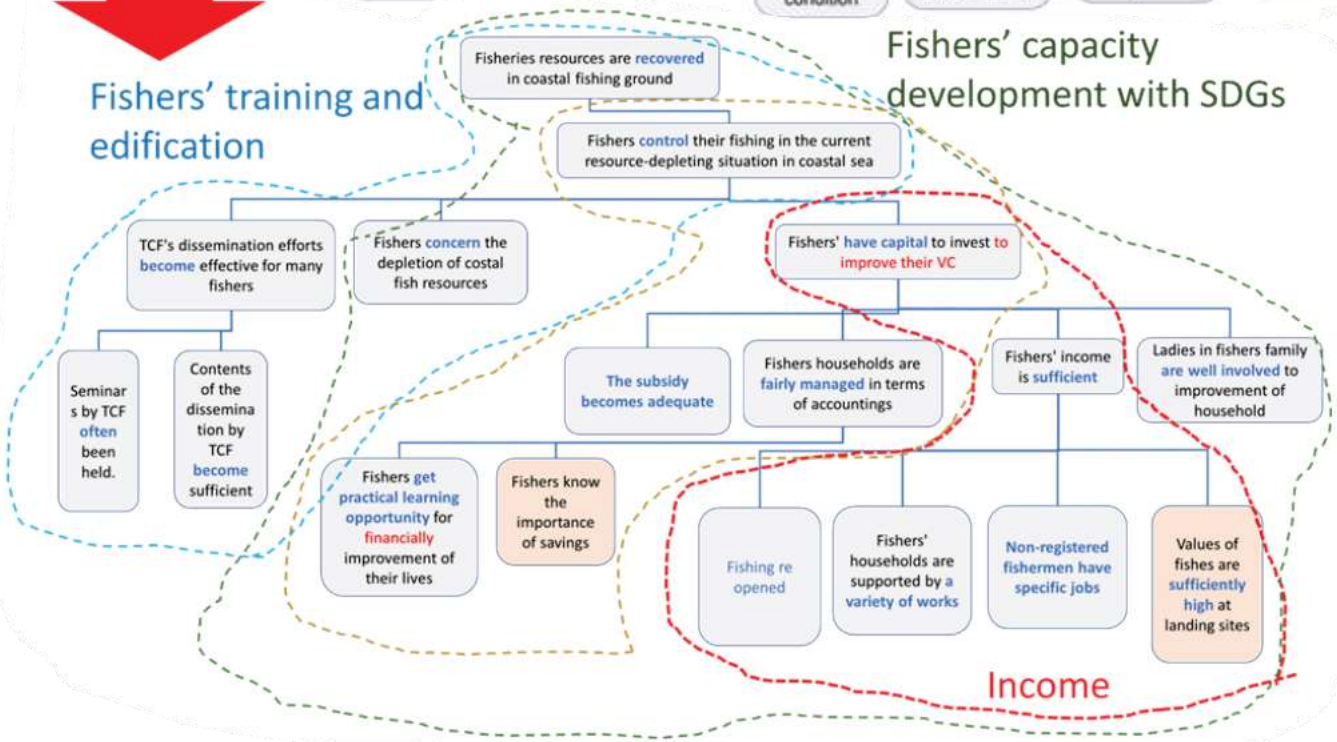
Dr. Tojo

Problem analysis



Fishers' training and edification

Fishers' capacity development with SDGs

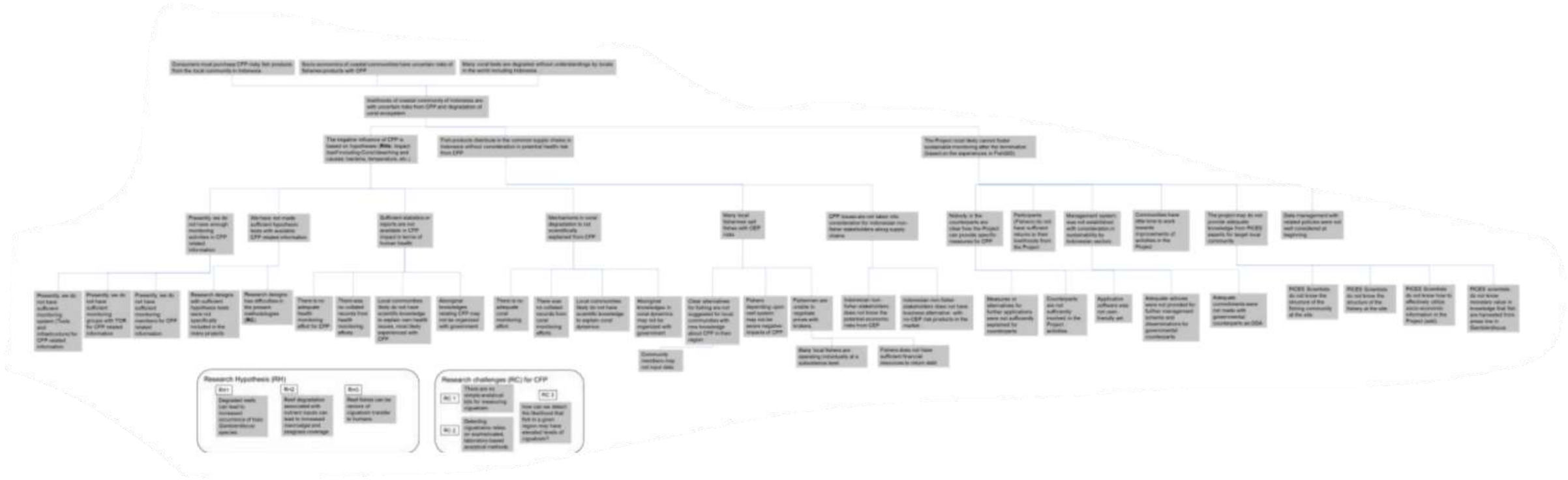


Objective analysis

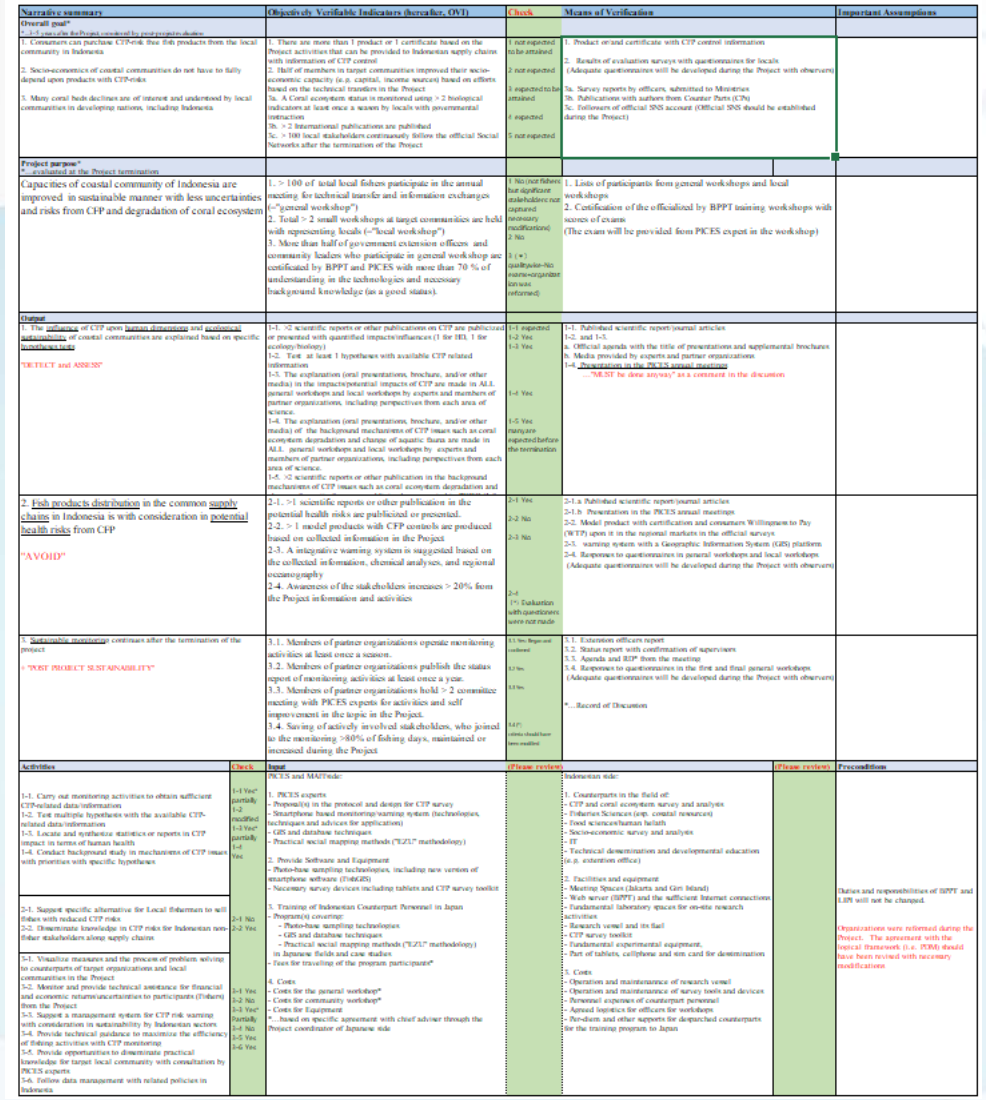
Problem Design Matrix

Date, Version Project title: Completion period: Project Area: Target Group: (Specific group of stakeholders)			
Narrative summary	**Objectively Verifiable Indicators (OVI)**	**Means of Verification (MOV)**	**Important Assumptions**
Overall goal	Specific indicator to evaluate completeness of overall goal	Evidences, sources of information, references for OVI of overall goal	
Project purpose	Specific indicator to evaluate completeness of Project purpose	Evidences, sources of information, references for OVI of Project purpose	Assumptions to complete works for project purpose then reach to overall goal
Output	Specific indicator to evaluate completeness of Output(s)	Evidences, sources of information, references for OVI of Output(s)	Assumptions to complete works for Output(s) then reach to Project purpose
Activity	Inputs		Precondition
	(Specific installations, provided resources for the project etc.)		Condition to do, continue and complete the project overall

Problem Tree (Dr.s Tojo and Takemura)



Final PDM (Tojo and Takemura)

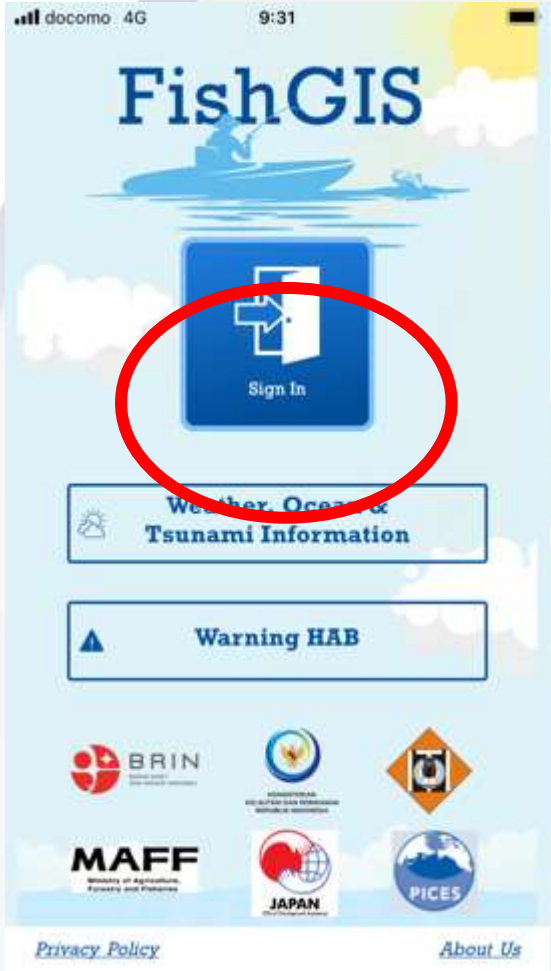


Narrative summary	Objectively Verifiable Indicators (hereafter, OVI)	Check	Means of Verification	Important Assumptions
Overall goal*				
*: 3-5 years after the Project, considered by post-project evaluation 1. Consumers can purchase CFP-risk free fish products from the local community in Indonesia 2. Socio-economics of coastal communities do not have to fully depend upon products with CFP-risks 3. Many coral beds declines are of interest and understood by local communities in developing nations, including Indonesia	1. There are more than 1 product or 1 certificate based on the Project activities that can be provided to Indonesian supply chains with information of CFP control 2. Half of members in target communities improved their socio-economic capacity (e.g. capital, income sources) based on efforts based on the technical transfers in the Project 3a. A Coral ecosystem status in monitored satnp > 2 biological indicators at least once a season by locals with governmental instruction 3b. > 2 International publications are published 3c. > 100 local stakeholders continuously follow the official Social Networks after the termination of the Project	1 not expected to be attained 2 not expected 3 expected to be attained 4 expected 5 not expected	1. Product or/and certificate with CFP control information 2. Results of evaluation surveys with questionnaires for locals (Adequate questionnaires will be developed during the Project with observers) 3a. Survey reports by officers, submitted to Ministries 3b. Publications with authors from Counter Parts (CPs) 3c. Followers of official SNS account (Official SNS should be established during the Project)	
Project purpose*				
*: evaluated at the Project termination				
Capacities of coastal community of Indonesia are improved in sustainable manner with less uncertainties and risks from CFP and degradation of coral ecosystem	1. > 100 of total local fishers participate in the annual meeting for technical transfer and information exchanges (~"general workshop") 2. Total > 2 small workshops at target communities are held with representing locals (~"local workshop") 3. More than half of government extension officers and community leaders who participate in general workshop are certificated by BPPT and PICES with more than 70 % of understanding in the technologies and necessary background knowledge (as a good status).	1 No (not fishers but significant stakeholders) not captured, necessary modification) 2 No 3 (→) qualitative-No exame-organizer ion was reformed)	1. Lists of participants from general workshops and local workshops 2. Certification of the officialized by BPPT training workshops with scores of exams (The exam will be provided from PICES expert in the workshop)	
Output				
1. The influence of CFP upon human dimensions and ecological vulnerability of coastal communities are explained based on specific quantitative tools "DETECT and ASSESS"	1-1. >2 scientific reports or other publications on CFP are publicized or presented with quantified impacts/influences (1 for HD, 1 for ecology/biology) 1-2. Test at least 1 hypotheses with available CFP related information 1-3. The explanation (oral presentations, brochure, and/or other media) in the impacts/potential impacts of CFP are made in ALL general workshops and local workshops by experts and members of partner organizations, including perspectives from each area of science. 1-4. The explanation (oral presentations, brochure, and/or other media) of the background mechanisms of CFP issues such as coral ecosystem degradation and change of aquatic fauna are made in ALL general workshops and local workshops by experts and members of partner organizations, including perspectives from each area of science. 1-5. >2 scientific reports or other publication in the background mechanisms of CFP issues such as coral ecosystem degradation and	1-1 expected 1-2 Yes 1-3 Yes 1-4 Yes 1-5 Yes many,are expected before the termination	1-1. Published scientific report/journal articles 1-2. and 1-3. a. Official agenda with the title of presentations and supplemental brochures b. Media provided by experts and partner organizations 1-4. Presentation in the PICES annual meetings "MUST be done anyway" as a comment in the discussion	
2. Fish products distribution in the common supply chains in Indonesia is with consideration in potential health risks from CFP "AVOID"	2-1. >1 scientific reports or other publication in the potential health risks are publicized or presented. 2-2. > 1 model products with CFP controls are produced based on collected information in the Project 2-3. A integrative warning system is suggested based on the collected information, chemical analyses, and regional oceanography 2-4. Awareness of the stakeholders increases > 20% from the Project information and activities	2-1 Yes 2-2 No 2-3 No 2-4 (*) Evaluation with questionnaires were not made	2-1.a Published scientific report/journal articles 2-1.b Presentation in the PICES annual meetings 2-2. Model product with certification and consumers Willingness to Pay (WTP) upon it in the regional markets in the official surveys 2-3. warning system with a Geographic Information System (GIS) platform 2-4. Responses to questionnaires in general workshops and local workshops (Adequate questionnaires will be developed during the Project with observers)	
3. Sustainable monitoring is continues after the termination of the project = "POST PROJECT SUSTAINABILITY"	3.1. Members of partner organizations operate monitoring activities at least once a season. 3.2. Members of partner organizations publish the status report of monitoring activities at least once a year. 3.3. Members of partner organizations hold > 2 committee meeting with PICES experts for activities and self improvement in the topic in the Project. 3.4. Saving of actively involved stakeholders, who joined to the monitoring >80% of fishing days, maintained or increased during the Project	3.1 Yes: Began and confirmed 3.2 Yes 3.3 Yes 3.4 (*) criteria should have been modified	3.1. Extension officers report 3.2. Status report with confirmation of supervisors 3.3. Agenda and RDP from the meetings 3.4. Responses to questionnaires in the first and final general workshops (Adequate questionnaires will be developed during the Project with observers) *...Record of Discussion	

Activities	Check	Input	(Please review)		(Please review)	Preconditions
1-1. Carry out monitoring activities to obtain sufficient CFP-related data/information 1-2. Test multiple hypotheses with the available CFP-related data/information 1-3. Locate and synthesize statistics or reports in CFP impact in terms of human health 1-4. Conduct background study in mechanisms of CFP issues with priorities with specific hypotheses	1-1 Yes* partially 1-2 modified 1-3 Yes* partially 1-4 Yes	PICES and MAFFside: 1. PICES experts - Proposal(s) in the protocol and design for CFP survey - Smartphone based monitoring/warning system (technologies, techniques and advices for applications) - GIS and database techniques - Practical social mapping methods ("EZU" methodology) 2. Provide Software and Equipment - Photo-base sampling technologies, including new version of smartphone software (FishGIS) - Necessary survey devices including tablets and CFP survey toolkit 3. Trainings of Indonesian Counterpart Personnel in Japan - Program(s) covering: - Photo-base sampling technologies - GIS and database techniques - Practical social mapping methods ("EZU" methodology) in Japanese fields and case studies - Fees for travelling of the program participants* 4. Costs - Costs for the general workshop* - Costs for community workshop* - Costs for Equipment *: ...based on specific agreement with chief adviser through the Project coordinator of Japanese side		Indonesian side: 1. Counterparts in the field of: - CFP and coral ecosystem survey and analysis - Fisheries Sciences (esp. coastal resources) - Food sciences/human helfath - Socio-economic survey and analysis - IT - Technical dessemination and developmental education (e.g. extention office) 2. Facilities and equipment - Meeting Spaces (Jakarta and Giri Island) - Web server (BPPT) and the sufficient Internet connections - Fundamental laboratory spaces for on-site research activities - Research vessel and its fuel - CTF survey toolkit - fundamental experimental equipment, - Part of tablets, cellphone and sim card for dessimination 3. Costs - Operation and maintenance of research vessel - Operation and maintenance of survey tools and devices - Personnel expenses of counterpart personnel - Agreed logistics for officers for workshops - Per-diem and other supports for despatched counterparts for the training program to Japan		Duties and responsibilities of BPPT and LIPI will not be changed. Organizations were reformed during the Project. The agreement with the logical framework (i.e. PDM) should have been revised with necessary modifications
2-1. Support specific alternative for Local fishermen to sell fishes with reduced CFP risks 2-2. Disseminate knowledge in CFP risks for Indonesian non-fisher stakeholders along supply chains	2-1 No 2-2 Yes					
3-1. Visualize measures and the process of problem solving to counterparts of target organizations and local communities in the Project 3-2. Monitor and provide technical assistance for financial and economic returns/uncertainties to participants (Fishers) from the Project 3-3. Support a management system for CFP risk warning with consideration in sustainability by Indonesian sectors 3-4. Provide technical guidance to maximize the efficiency of fishing activities with CFP monitoring 3-5. Provide opportunities to disseminate practical knowledge for target local community with consultation by PICES experts 3-6. Follow data management with related policies in Indonesia	3-1 Yes 3-2 No 3-3 Yes* partially 3-4 No 3-5 Yes 3-6 Yes					

- PDM was also used to evaluate the project results at the 7th PST meeting in Yokohama.

FishGIS App (Takemura and Kogushi)



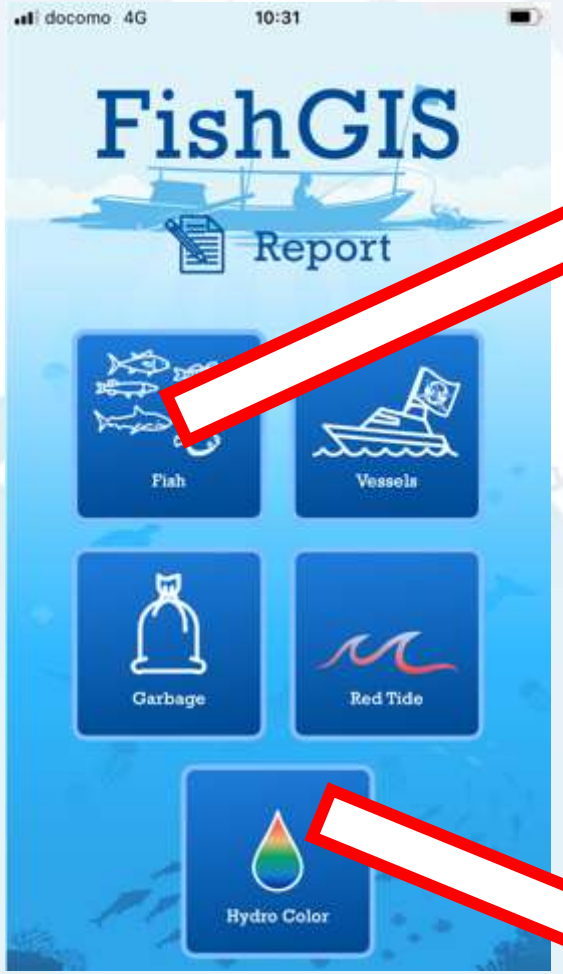
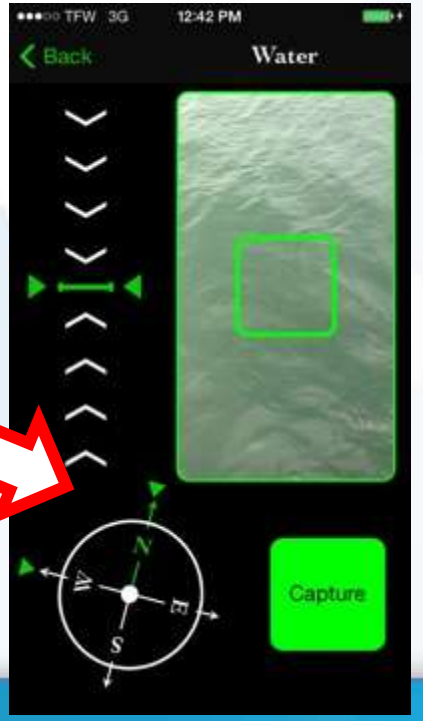


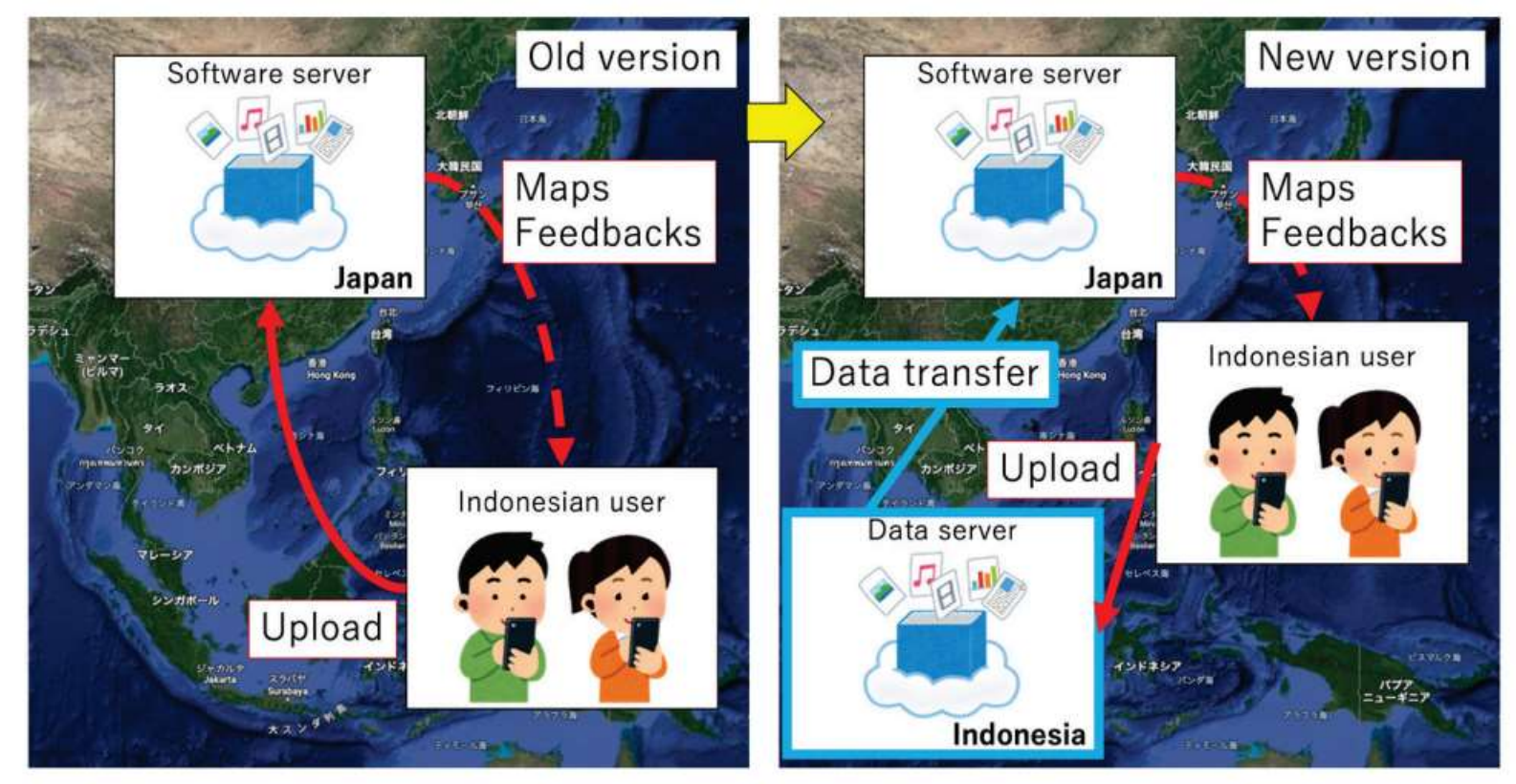
Photo of watercolor



How the ocean is changing?

→ Tools for reporting photos of ocean conditions

ABS-compliant scheme was established
(left: old, right: new)

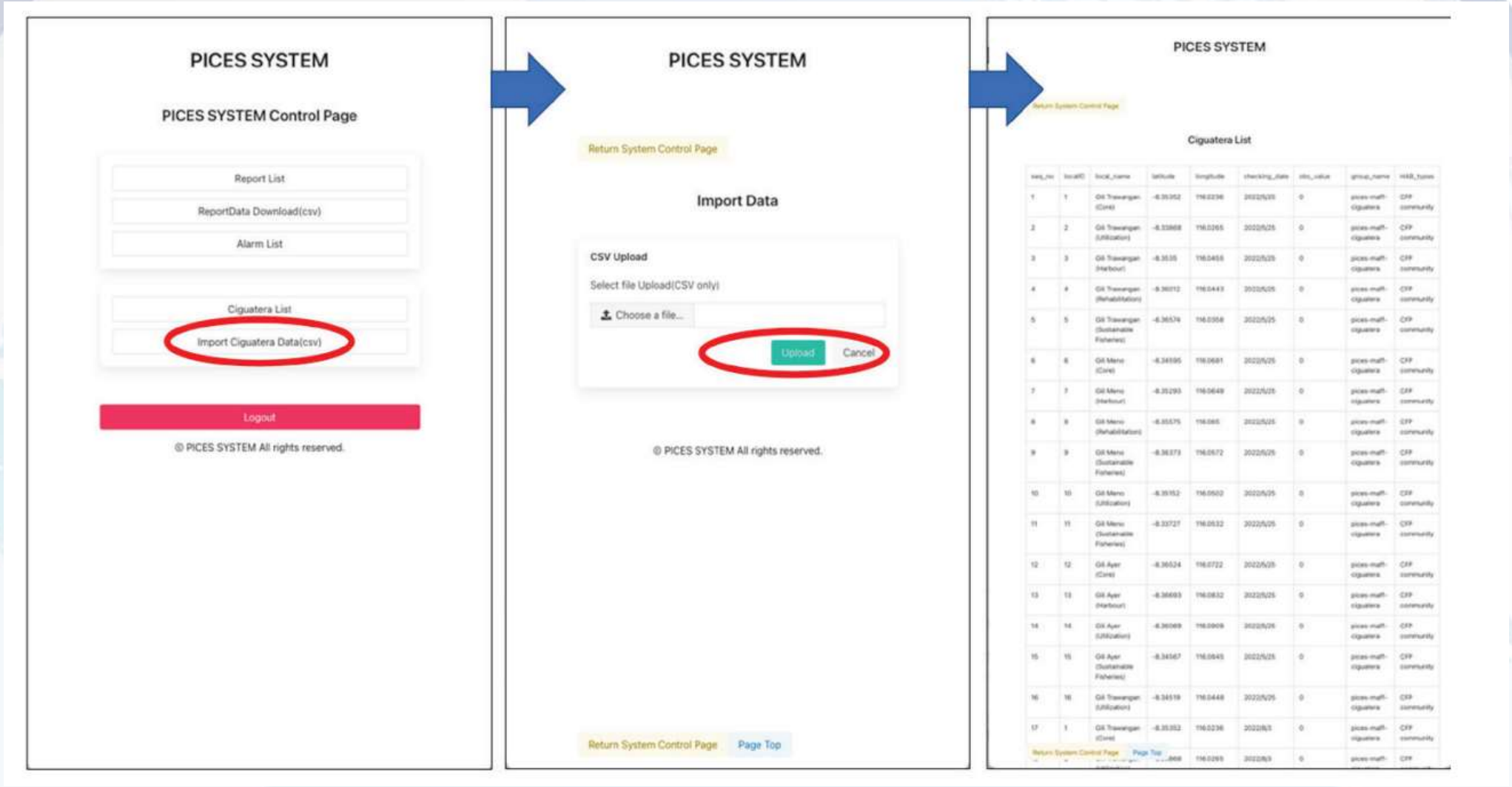


- Article 15 of the Convention on Biological Diversity (CBD) stipulates the basic rules of Access to genetic resources and Benefit Sharing (ABS)

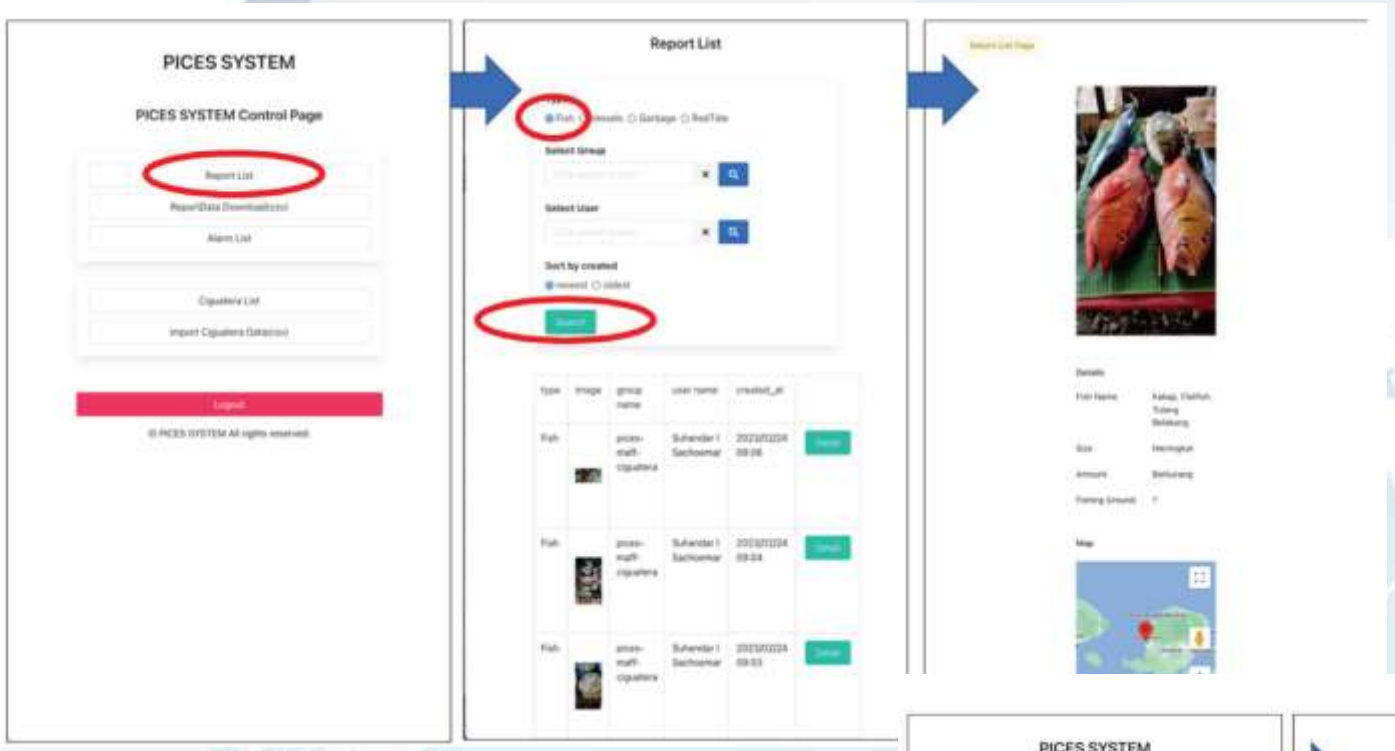
Mapping function
(Hydro colour)

Link to BMKG
(weather, tsunami)

Mapping function
(Ciguatera survey results)

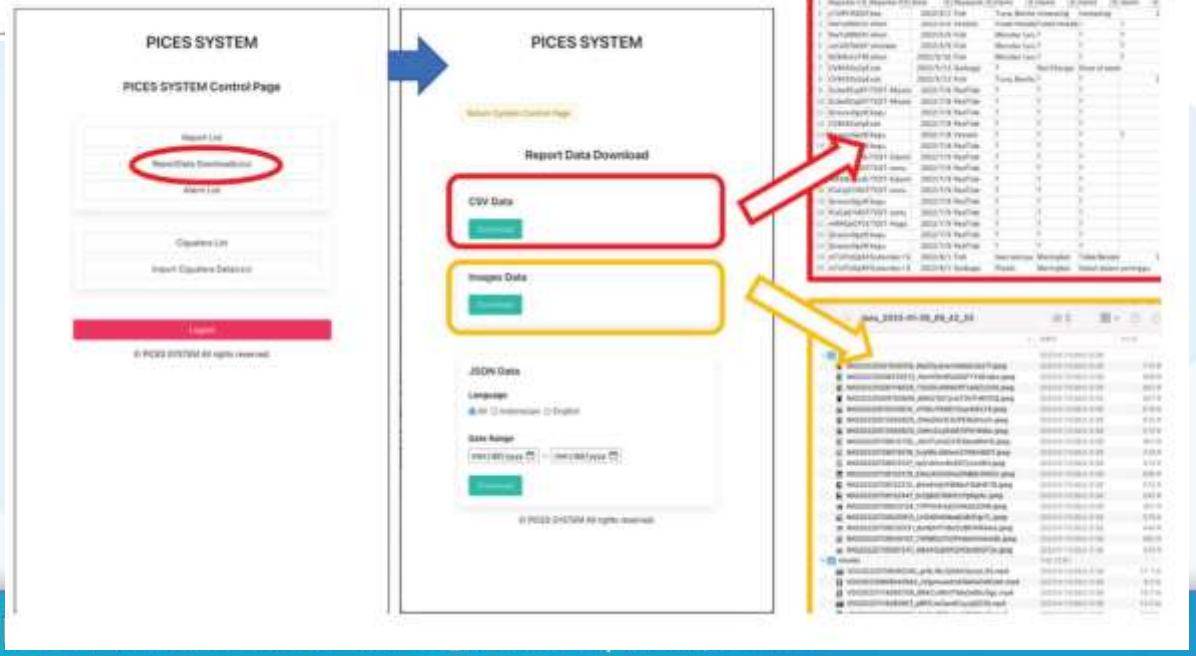


- FishGIS dashboard for uploading the Ciguatera assessment survey results



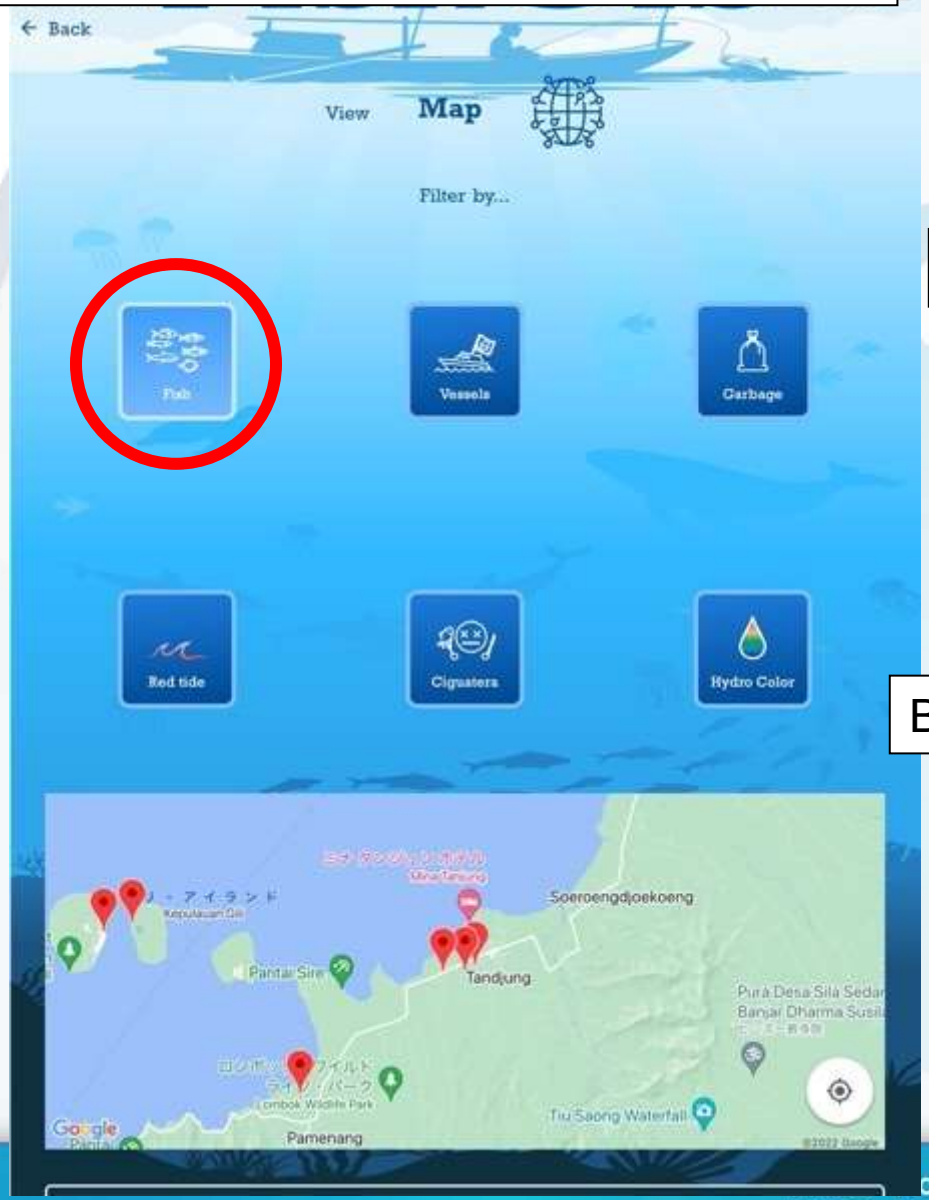
You can search data from the dashboard

And download the data



Examples of **fish photos** collected by the ***FishGIS*** App

Our research teams collected data.



Barracuda?

Horse mackerel?

Bonito?

Horse mackerel?

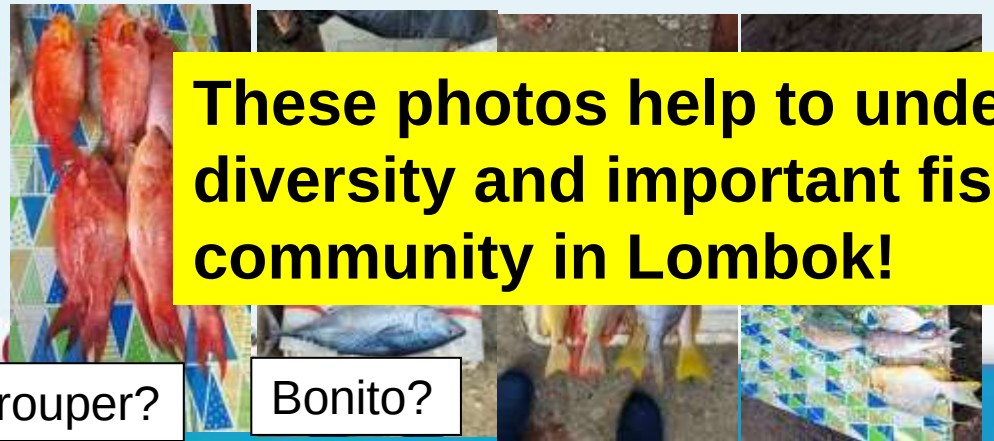
Bonito?

Tuna?

Bonito?

Grouper?

Sardines?



Grouper?

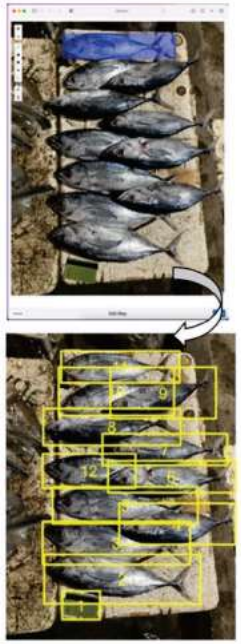
Bonito?

These photos help to understand fish diversity and important fishes for local community in Lombok!

Report images

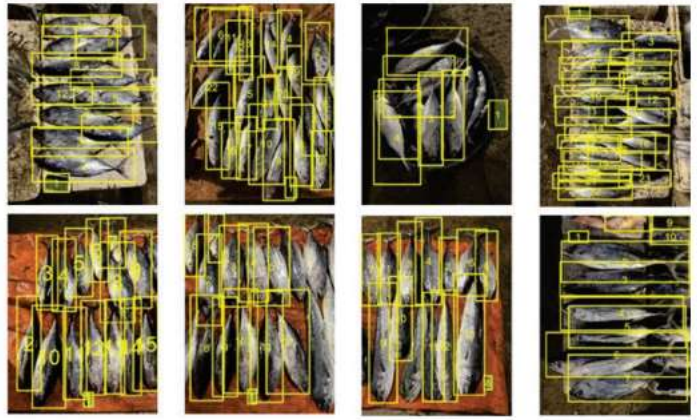
Work time per image:
less than 1 minute

Identify fish species



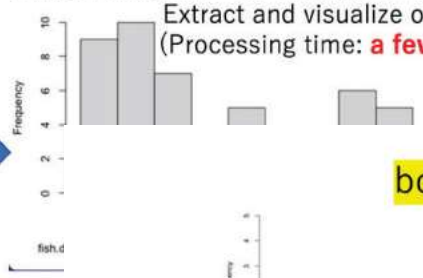
Work time per image:
a few minutes

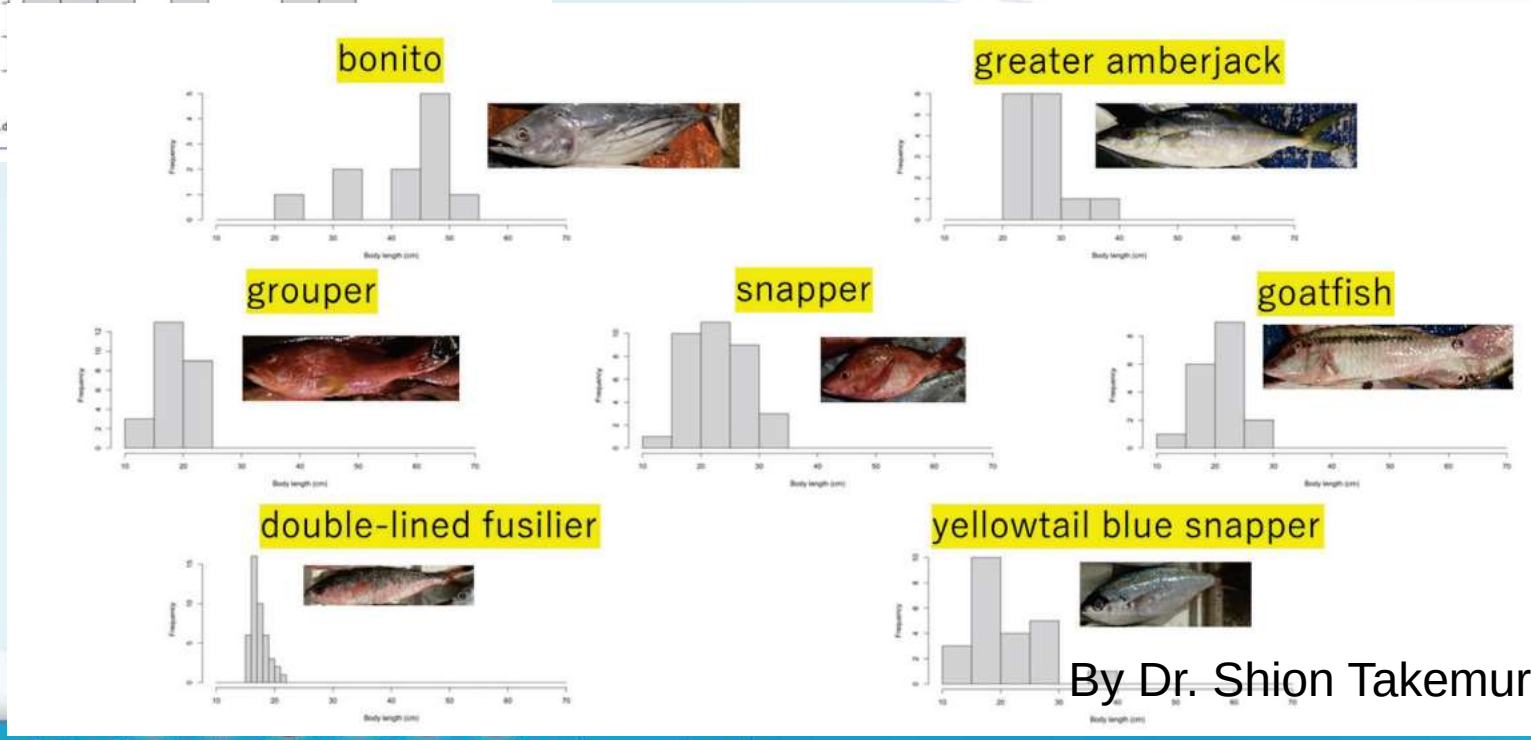
Automatically measure body length from images (by R)



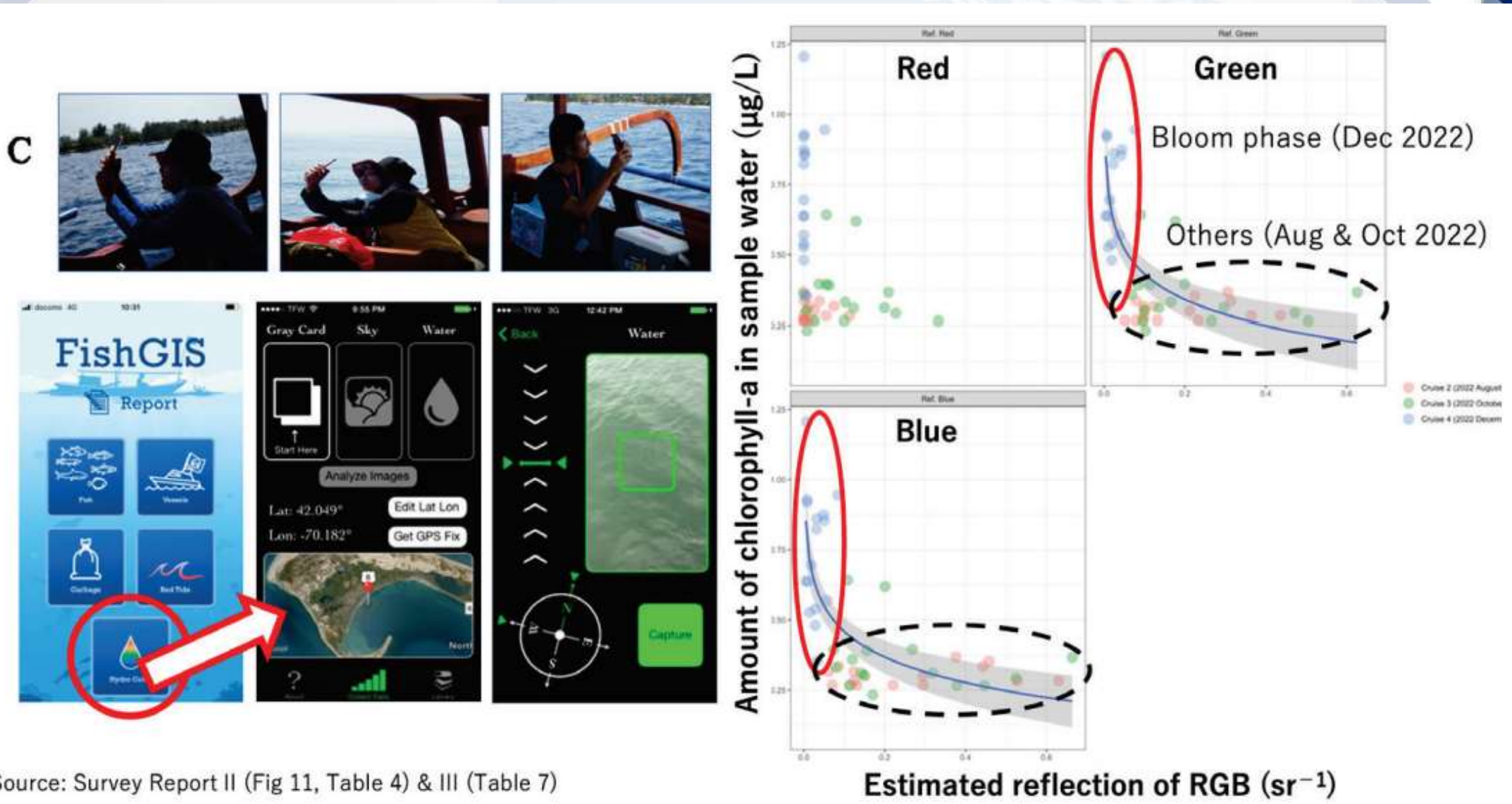
fish.dat[fish.dat$fish_species == "tuna" & fish.dat$photo_conditions == ".

Extract and visualize of tuna data
(Processing time: **a few seconds**)





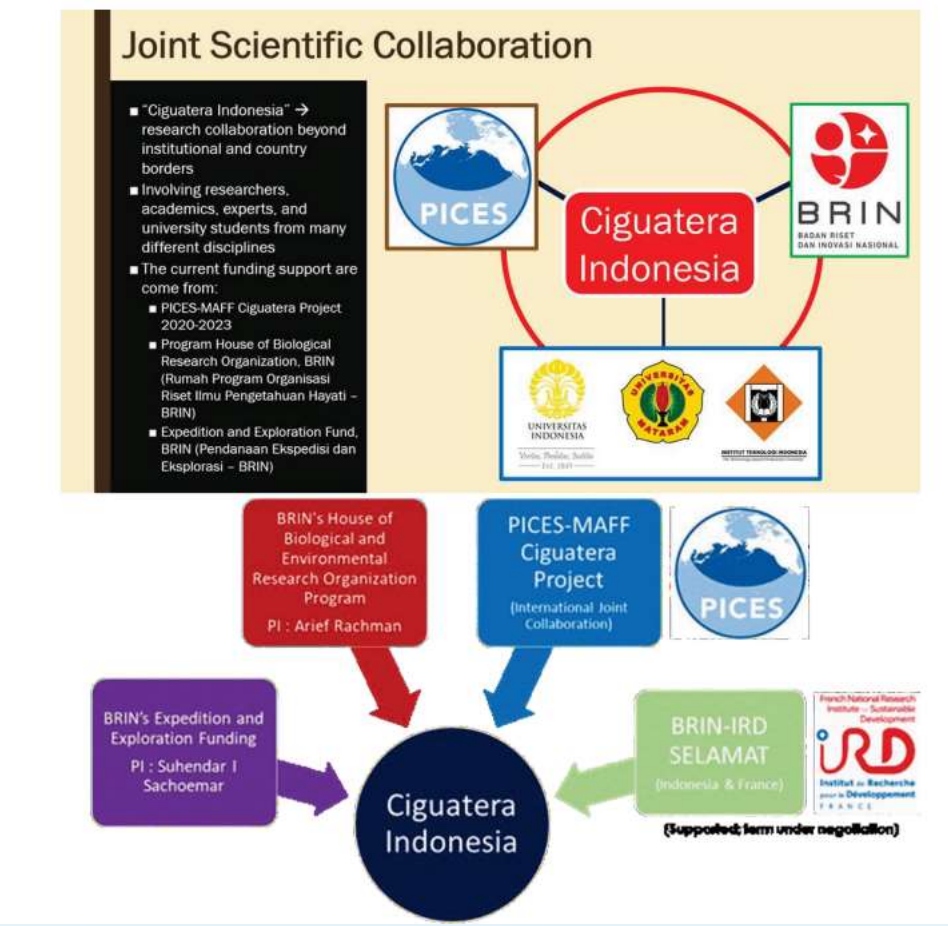
By Dr. Shion Takemura



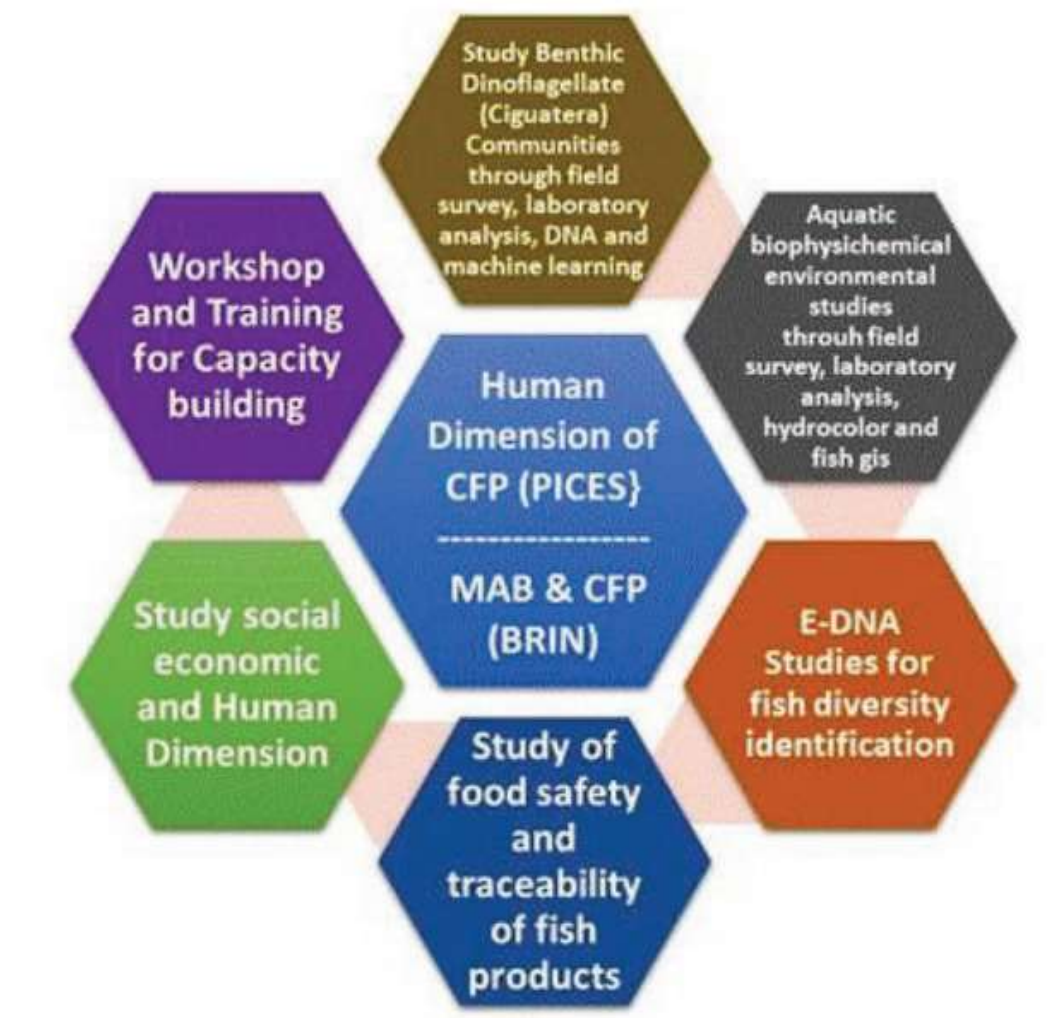
Source: Survey Report II (Fig 11, Table 4) & III (Table 7)

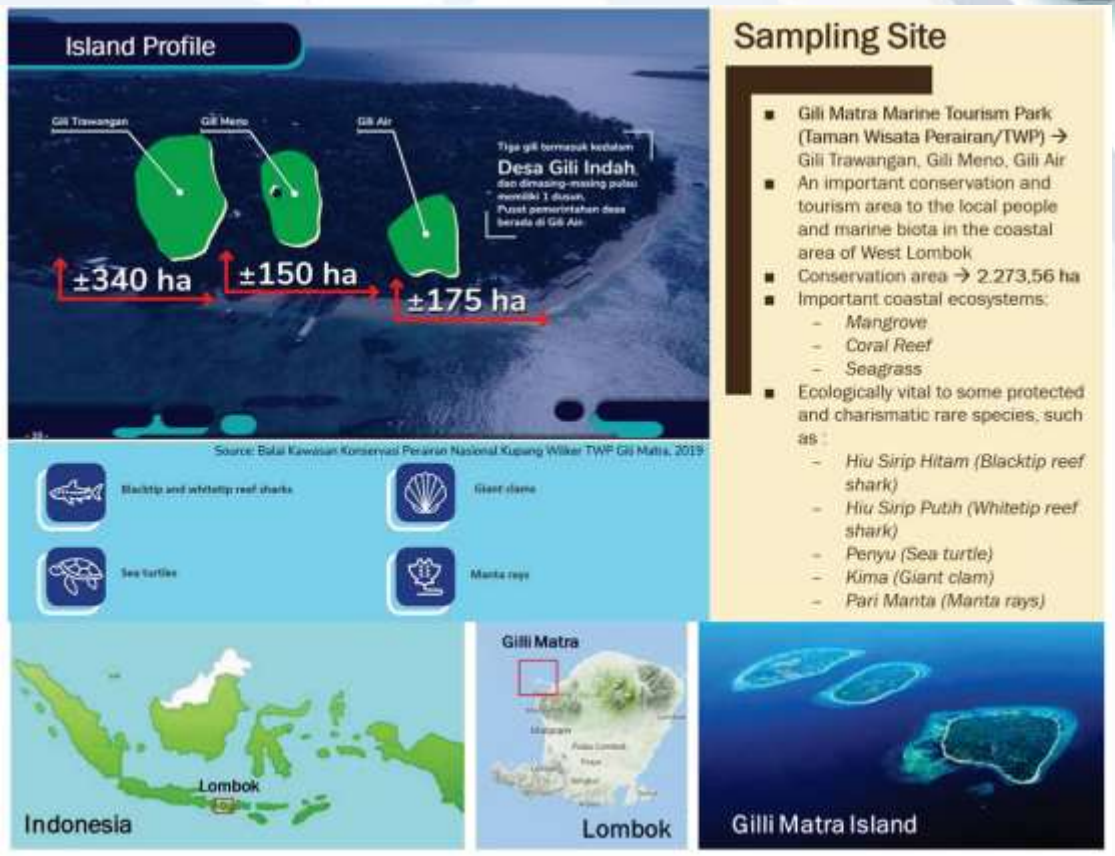
By Dr. Shion Takemura

Field study in Lombok



Scope and field survey

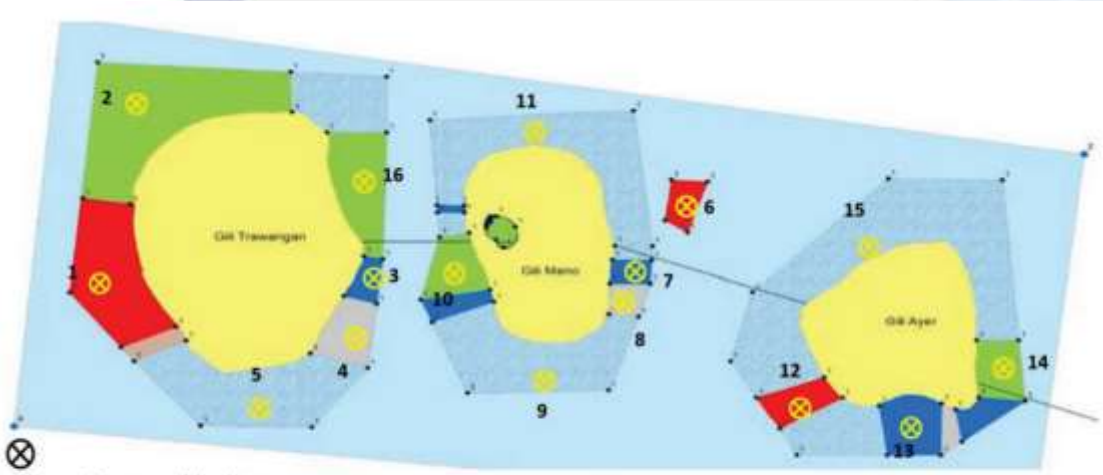




- First survey (Survey I) on May 23–28, 2022
- Second survey (Survey II) on August 1–5, 2022
- Third survey (Survey III) on October 10–16, 2022
- Fourth survey (Survey IV) on December 12–18, 2022
- Fifth survey (Survey V) on February 20–25, 2023

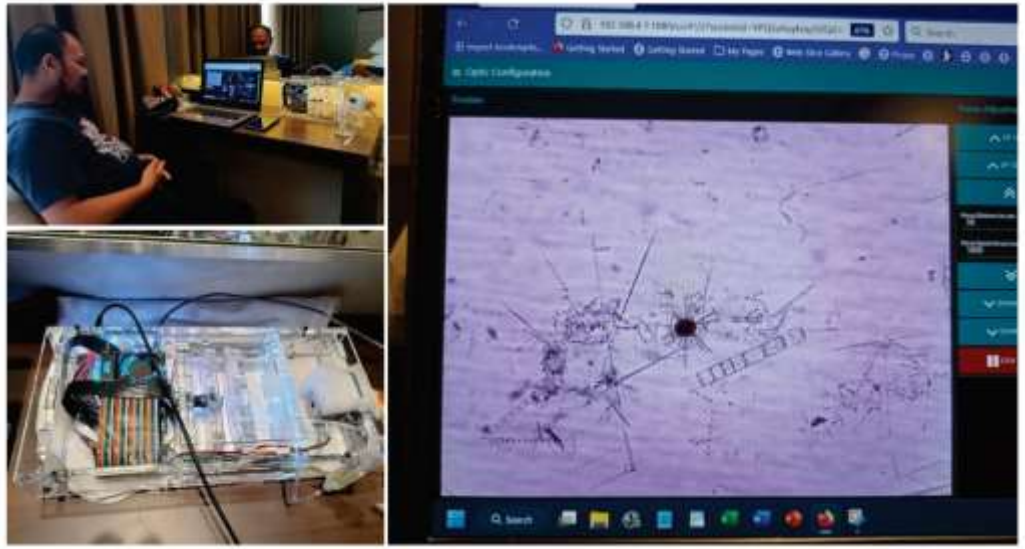
Plankton sampling

(Rachman, 2019)

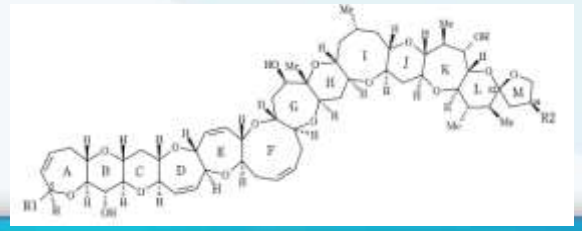


Water column sampling sites
- Plankton (phytoplankton + zooplankton)
- Water quality (Temperature, pH, Salinity, DO, TDS)
- Nutrient concentration
- Chlorophyll-a
- e-DNA

Core Zone
Coral-Sustainable Fisheries Sub Zone
Utilization Zone
Harbor Zone
Protection Zone
Rehabilitation Zone



Hibi et al. (2018)



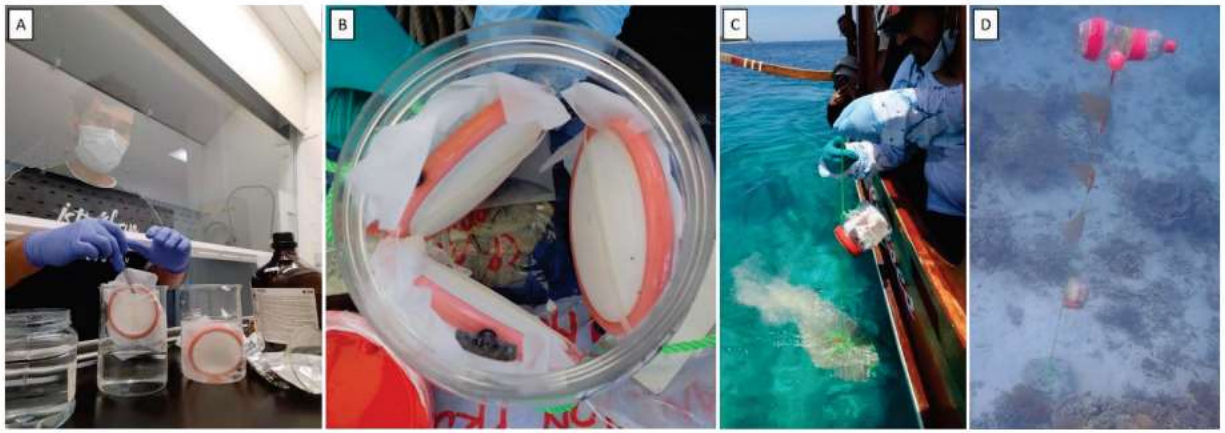
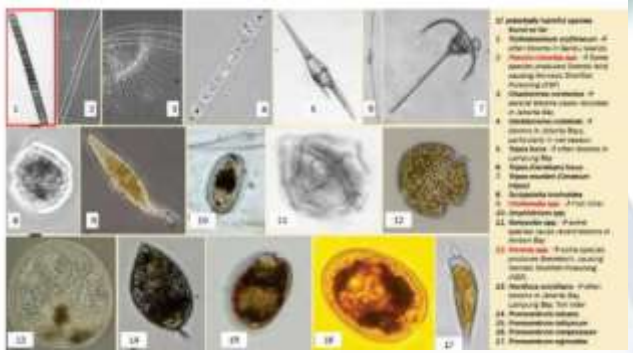


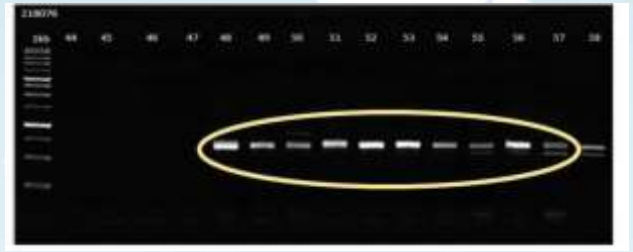
Fig. 5.6 New method to collect ciguatoxin directly from the water column. (A) preparing the SPATT filters in the laboratory, (B) SPATT filters inside the plastic container/cage, (C) deployment of the SPATT rig from the boat, (D) SPATT rig in the water at a depth of 4–5 m.

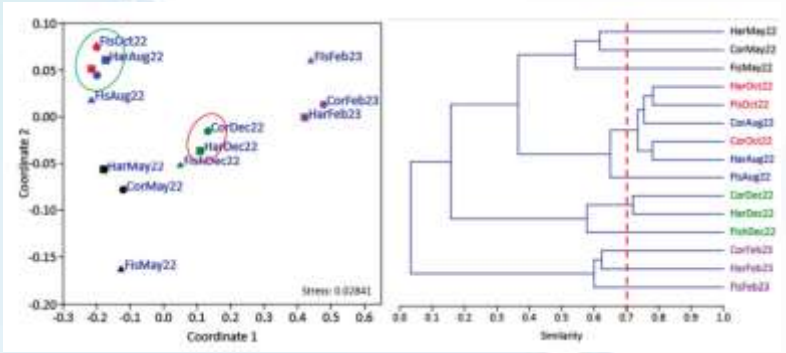
Examples of bHABs habitats (seagrass bed and coral reef)

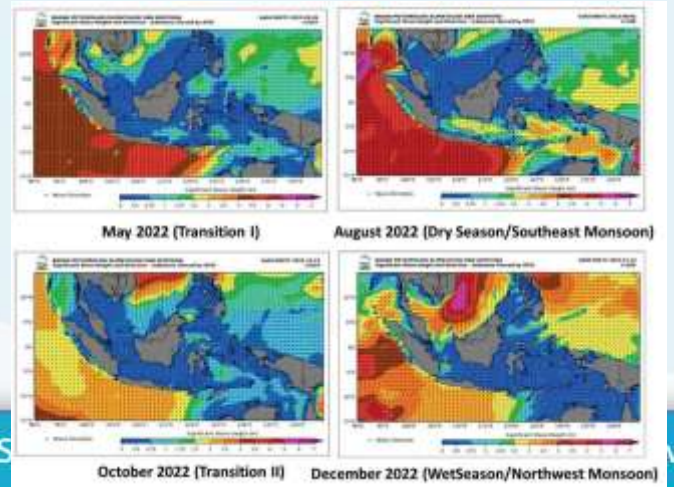
Many analysis (Arief and Suhendar)

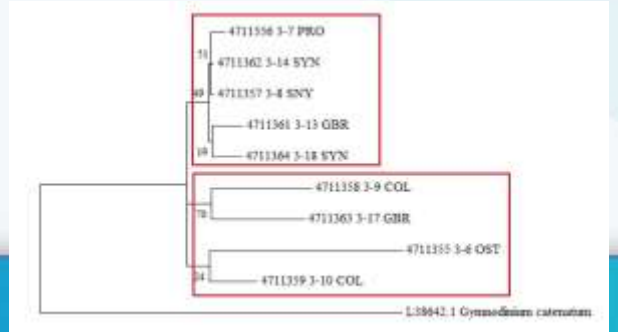
- Plankton community composition, density, species richness, etc.
- SEM images with morphological details
- DNA and eDNA analysis
- Machine learning
- Water quality
- Bioassay
- Traceability analysis
- Questionnaire survey

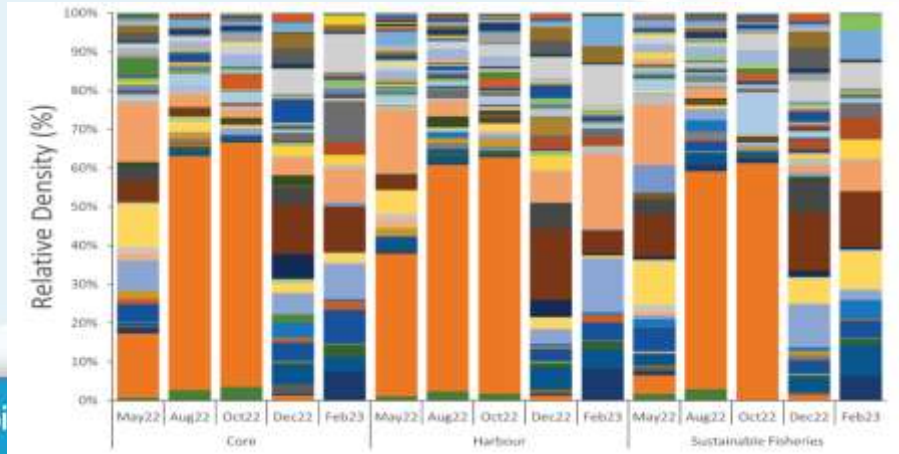












Fish Sampling at Local Fish Landing/Port in Gili Island, Western Lombok, and Northern Lombok

By Prof. Suhendar

Our colleagues in Lombok!

Regional supports are important

- Audience with the West Nusa Tenggara (WNT) Governors' office

- MOU between ITI and WNT Provincial Government (left) and ITI and Mataran Univ (right).

MANDALIKAPOST

ITI and PICES Plan Ciguatera Research in the Waters of the Three Gilis

@MandalikaPost.com Monday, May 23, 2022 | 8:16 p.m.

Governor of NTB Dr. H Zulkieflimansyah and the North Pacific Marine Science C

MANDALIKAPOST.com - the Indo

NASIONAL

wartaJakarta.com

Governor of NTB Supports Synergy of Ciguatera Indonesia and PICES

by Kasiyanto Yasran 03/06/2022

Wartajakarta.com - Governor of NTB, Dr. H... and Innovation Agency (BRIN), Prof. Suhendar Sachoemar said that this research activity is a ...llaborative research between research institutions ...d universities in Indonesia, including ITI, BRIN, ..., UNRAM supported by PICES (The North Pacific ...arine Science Organization).

...CES is an international research institute consisting ... 6 countries in the North Pacific, namely Canada, ...pan, the People's Republic of China, the Republic of ...orea, the Russian Federation and the United States.

NTB May 25, 2022

SUARANTB.com
Jendela NTB untuk Dunia

The Governor of NTB Supports the Research of the ITI Research Team in Gili Matra

The ITI Research Team and related parties took a group photo with the Governor of NTB, H.Zulkieflimansyah, after an audience at the Governor's Hall of NTB, Monday (23/5). (Voice NTB/ist)

GOVERNOR OF NTB, Dr. H. Zulkieflimansyah welcomed the research ... communities that have the potential to cause CFP, with target

Capacity building workshop in January at Lombok Island

WS participants at January WS at Lombok

Finally, Project Data Management Policy

- The data handling considerations for this project are more complex than many other projects because a portion of these data was obtained during surveys funded by the National Research and Innovation Agency of Indonesia (BRIN), through an independent budget.

➔considered to be independent of the PICES Data Management Policy.

- At present, Ciguatera project data are stored either on external cloud-based servers (Google) or in the BRIN Data Repository .

Type of Data	Current Storage Conditions
Data collected by the FishGIS application	External data servers in Indonesia and Japan (raw data) External data server in Japan (data products)
Data collected by the HydroColor application	Importable to external data server in Japan by FishGIS administrator
Data on benthic dinoflagellates	Importable to external data server in Japan by FishGIS administrator
Data from all Indonesian surveys	BRIN Data Repository

Data policy developed by TCODE and BRIN

Ambe-san and Suhendar-san

1. Data gathered as a result of this project activity (hereafter simply termed “data”) are used for the Indonesian government and local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries for conservation and development.
2. Data will be responsibly managed by PICES to guard against loss and to ensure continued accessibility within each community.
3. The quality assurance of data is the responsibility of the data provider and the community to which the data provider belongs.
4. Any data use (publications, reports, etc.) must be acknowledged using a formal citation.
5. PICES will respect the priority rights and any restrictions placed on these data by the data provider and community/organization/government to which the data provider belongs.
6. PICES will respect the terms of use of the applications for data collection used in this project.
7. Any other data will be handled in accordance with the PICES Data Management Policy.

The NEW Project: FishPhytO

- New PICES-MAFF Project “Creating a phytoplankton-fishery observing program for sustaining local communities in Indonesian coastal waters”
- 3 years (April 2023- March 2026)
- Budget for the 1st year: $73,813 CAD
- Continued close collaboration with our Indonesian colleagues (BRIN, ITI, Matran Univ, WNT gov. etc.)
- Expansion of the previous Ciguatera project, including AI analysis of fish catch and application to PICES Member Countries (Japan, Korea, USA, etc.)

Creating a phytoplankton-fishery observing program for sustaining local communities in Indonesian coastal waters

Acronym: FishPhytO

Term: June 2023 – March 2026

Project Science Team Co-Chairs:
Mitsutaku Makino (Atmosphere and Ocean Research Institute, The University of Tokyo, Japan)
Mark Wells (University of Maine, USA)

Project Coordinator:
Alexander Bychkov (PICES)

Funding Agency:
Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan (JFA)

Parent PICES Committee:
Human Dimensions Committee (HD)

Mailing list

Project background, objectives and initiatives

PICES member countries have significant resources for monitoring environmental conditions and fisheries in coastal waters. At the same time developing nations are far more limited in their capacity for collecting data needed to advance their management practices in these waters. Citizen-based monitoring is an approach designed to improve the efficiency and effectiveness of monitoring efforts when technical and financial resources are not sufficient. There are many successful examples of citizen-based monitoring in developed countries. However, this approach has not been widely applied yet to the collection of environmental and fisheries data in developing nations. Based on such