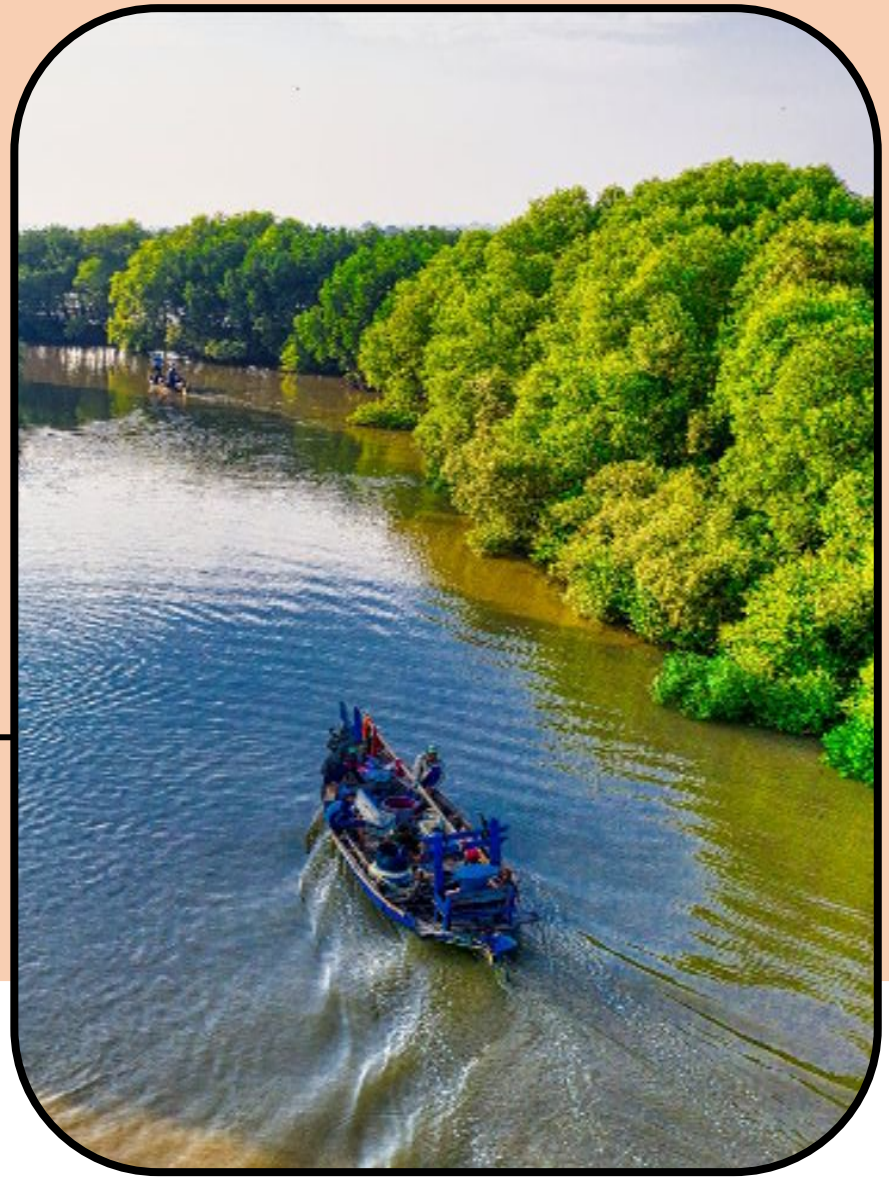
Enabling mangrove ecosystem and aquaculture farmers to thrive: Lesson learned from the Coastal Field School in Indonesia



Ika Zahara Qurani & Ratnawaty Fadilah

TAY JUHANA FOUNDATION

BLUE FORESTS
Yayasan Hutan Biru

TAY JUHANA FOUNDATION

Advocating the land-use and sustainable cultivation of suboptimal lands into productive lands to support food security.

Ika Zahara Qurani

Head of Knowledge Management

BLUE FORESTS
Yayasan Hutan Biru

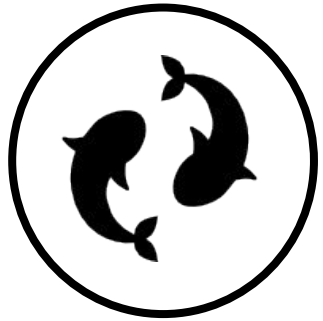
Empowering rural coastal community members to rehabilitate, sustainably utilize and conserve their precious mangrove and coastal resources.

Ratnawaty Fadilah

Socio-economic Technical Advisor

Where does most of our seafood source from?

Sea



Fish Pond

In last decade, the total catches in fisheries are stagnant at **90 million tons**.

Aquaculture production has been growing from 20 to nearly **115 million tons** between 1950 and 2018.

Indonesia is the 2nd largest seafood producer in the world

Global Mangroves Map

Indonesia is home to the world's largest mangrove area (20%). This vast ecosystem reserves one third of global coastal carbon stocks.

Mangrove faces an unprecedented threat from aquaculture sector's extensive development that drives aggressive mangrove conversion into ponds.


Central Java is among the largest domestic producers with nearly 500,000 tons of aquaculture yields in 2017.
© Aji Styawan/ANTARA

Indonesia's Fish Consumption Rate

2011

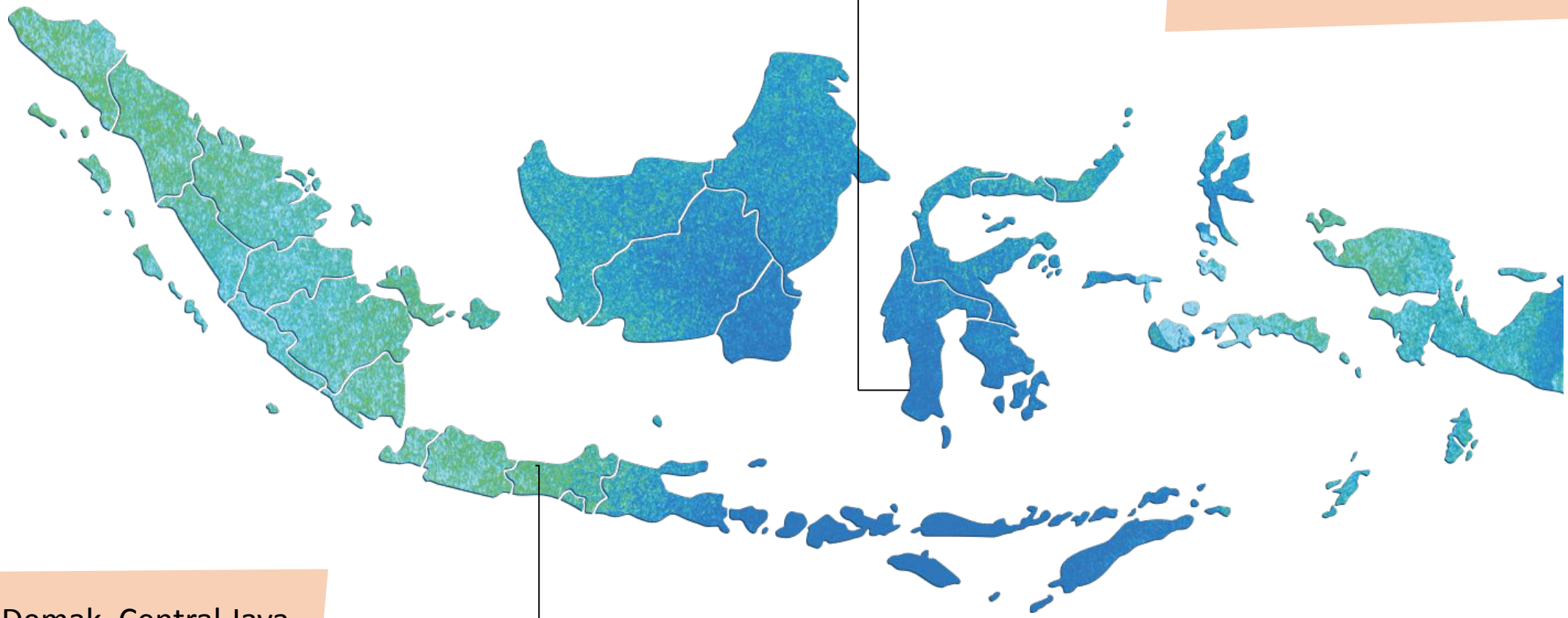
29 kg/year/capita

2019

51 kg/year/capita

Sustainable aquaculture and where to find them?

Map of Indonesia



Pangkep, South Sulawesi

Demak, Central Java

Coastal Field School (CFS)

Weekly meeting on CFS

This approach is adopted from Farmers Field School (FFS) which facilitates farmers to identify the problem they face and how to address them using their own resources.

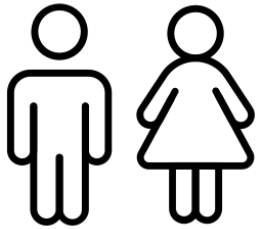
CFS duration lasts for one farming cycle or a year with a total number of meetings that might range from at least 12 up to 16 meetings.

CFS Framework

Location assessment and feasibility studies.

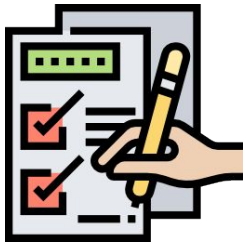
Intensive residential training for the facilitators.

Identify needs, recruit participants, and develop a learning contract.



Equal participation of women and men.

Min. 75% of participants come from poor or vulnerable group.



A pre- and post-test to measure the knowledge improvement.

Farmers present their learnings and findings.

Subjects Delivered in CFS

Sustainable Livelihoods Assessment (SLA)

- Identification and mapping of village ecosystems
- Aquaculture trend analysis
- Seasonal Calendar
- Needs Analysis
- Solution and institutional analysis

Aquaculture Production System

- Farm planning and designing
- Farm preparation
- Organic fertilizer making
- Fish fingerlings and stocking
- Pond monitoring
- Harvesting

Special Topics

- Introduction to soil ecology
- Organic fertilizer
- Fish Feed
- Green mussel culture
- Integrated Multi-Trophic Aquaculture (IMTA)
- Gender understanding
- Mangrove and its rehabilitation measure
- Coastal dynamics and its safety measure

Did the CFS actually work? How can it bring positive impact to fish farmers and mangrove?

CFS in Practice

The Challenge is to increase the sustainability of aquaculture as a livelihood from both socioeconomic and environmental perspectives.

Currently between 660,000 - 1,000,000 ha of mangrove forests have been converted into brackish water aquaculture areas

Kaart van de Hoofdplaats Semarang en Omstreken / Topographisch Bureau 1892


G
KEY
Fill
Grade Up
Inlet
Grade Down
Breach
Culvert (Gorong²)
G
Dike Wall
Channel
Biofilter
© 2012 Tele Atlas
Image © 2012 GeoEye
Guidelines for
Earth Moving
Imagery Date: 7/13/2010
2001
5°01'52.71" S 119°28'22.96" E elev 9 ft

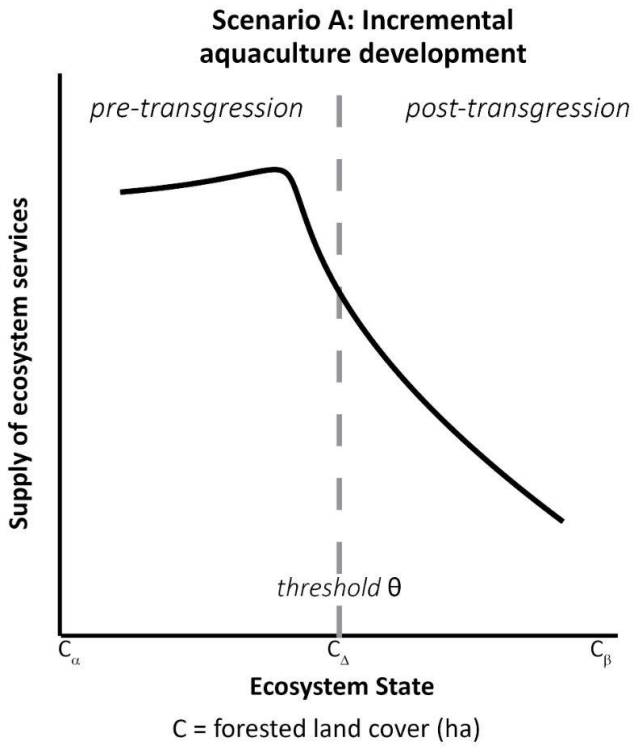
Wetlands Ecol Manage
DOI 10.1007/s11273-008-9101-y

ORIGINAL PAPER

A review of mangrove rehabilitation in the Philippines: successes, failures and future prospects

J. H. Primavera · J. M. A. Esteban

Recommends a 4:1 ratio of mangroves to aquaculture in order to avoid crossing a critical threshold



Limits to aquaculture expansion?

	Landscape (Province)	Mangrove cover loss (%)	Mangrove cover loss over 35 years (1981-2016)	Aquaculture in coastal landscape (%)	Coastal Vulnerability (2009)
1	Demak (Central Java)	92.4		92%	
2	North Luwu (South Sulawesi)	87.3		90%	
3	Majene and Mamuju (West Sulawesi)	66.4		84%	
4	Tanjung Panjang (Gorontalo)	60.0		80%	
5	Mahakam Delta (East Kalimantan)	50.4		49%	
6	Rawa Aopa (SE Sulawesi)	42.4		43%	
7	Batu Ampar (West Kalimantan)	20.8		0%	
8	Indragiri Hilir (Riau)	3.8		0%	
9	Aru (Maluku)	1.7		0%	
10	Sembilang (South Sumatra)	0.5		2%	
11	Teluk Saleh (NTB)	-0.7		57%[2]	
12	Bintuni Bay (West Papua)	-1.3		0%	

Mangrove cover loss (%) index: 81-100 61-80 41-60 21-40 0-20

Coastal vulnerability index: very high high moderate low very low

(Brown, 2015; Brown et al., 2015a, 2016; P3SDLP, 2016)

Increased reliance on external inputs

Fish farmer field school participants in Nisombalia, South Sulawesi noted the 10-fold increase of Urea and inorganic NPK over 10 years in order to maintain original levels of production, and increasing incidence of mortality and disease

Silvofisheries an enigmatic compromise

AEI 9:73-85 (2017) - DOI: https://doi.org/10.3354/aei00213

FEATURE ARTICLE

Sunlight and sediment improve the environment of a litter biofilm-based shrimp culture system

Charles Gatune[1,*], Ann Vanreusel[2], Marleen De Troch[2]

[1]School of Natural Resources and Environmental Studies, Karatina University, PO Box 1957—10101, Karatina, Kenya
[2]Biology Department, Marine Biology, Ghent University, Campus Sterre, Krijgslaan 281-S8, 9000 Ghent, Belgium

*Corresponding author: kgatune@yahoo.com

Empang parit system in Langkat, North Sumatra (left); Mortality of vulnerable impounded mangroves in South Florida (right)

Mixed Mangrove Aquaculture

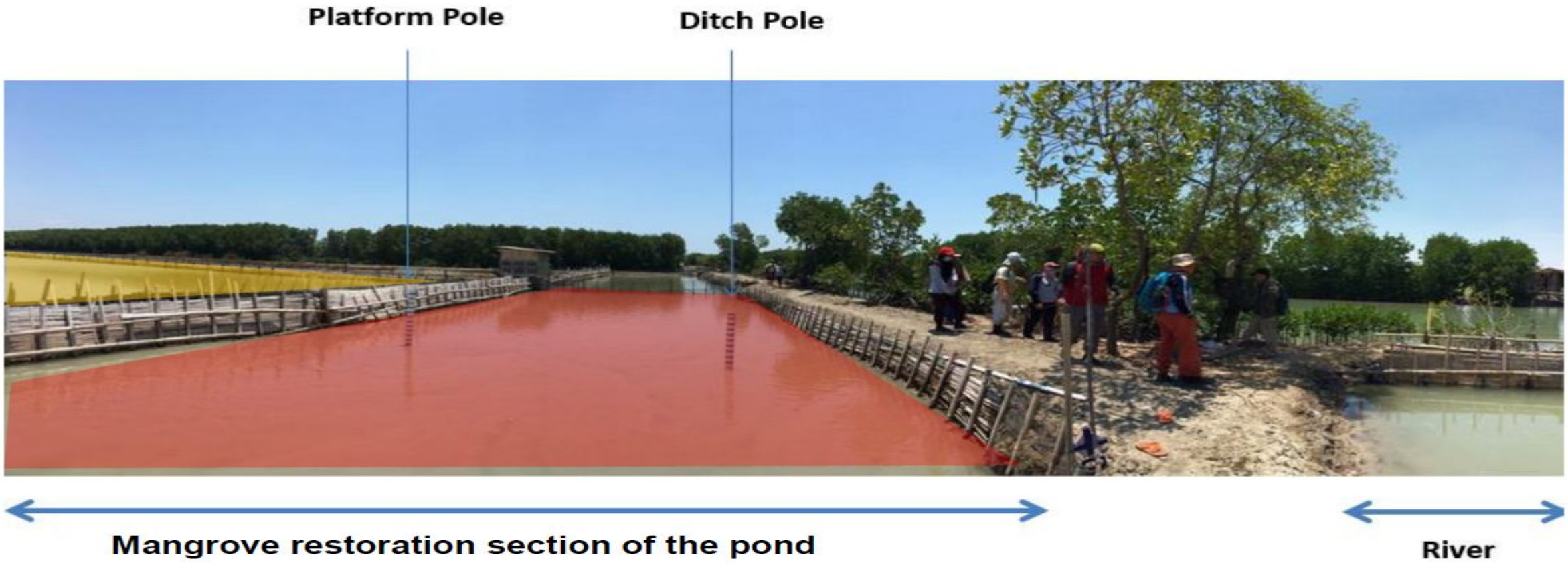
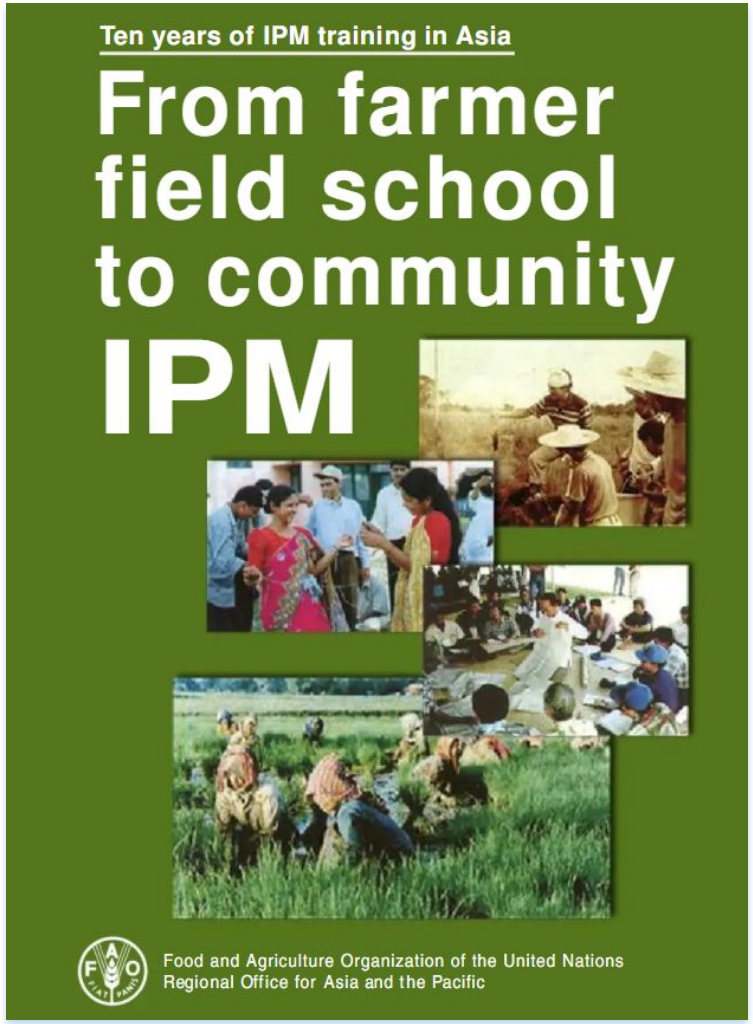


Figure 2.3. Picture of one the aquaculture ponds, depicting the monitoring poles used for the measurements of sediment bed level. One pole is placed in the ditch and one pole on the platform. Mangrove count, water level elevation with respect to MSL were also monitored in this section of the pond. The red section of the pond is where mangroves can come back. The orange section of the pond on the far left, is where aquaculture activities continue to take place. The wood structure is the new dyke that separates the two areas.

Deltares, 2021

Two aspects of a smaller footprint

1. Spatial - reduced aquaculture land cover
2. **Improved management practices**



The farmer field school (FFS) approach combined with the Low External Input Sustainable Agriculture (LEISA) approach

The **Green Revolution**

The **Blue Revolution**

Historical Context

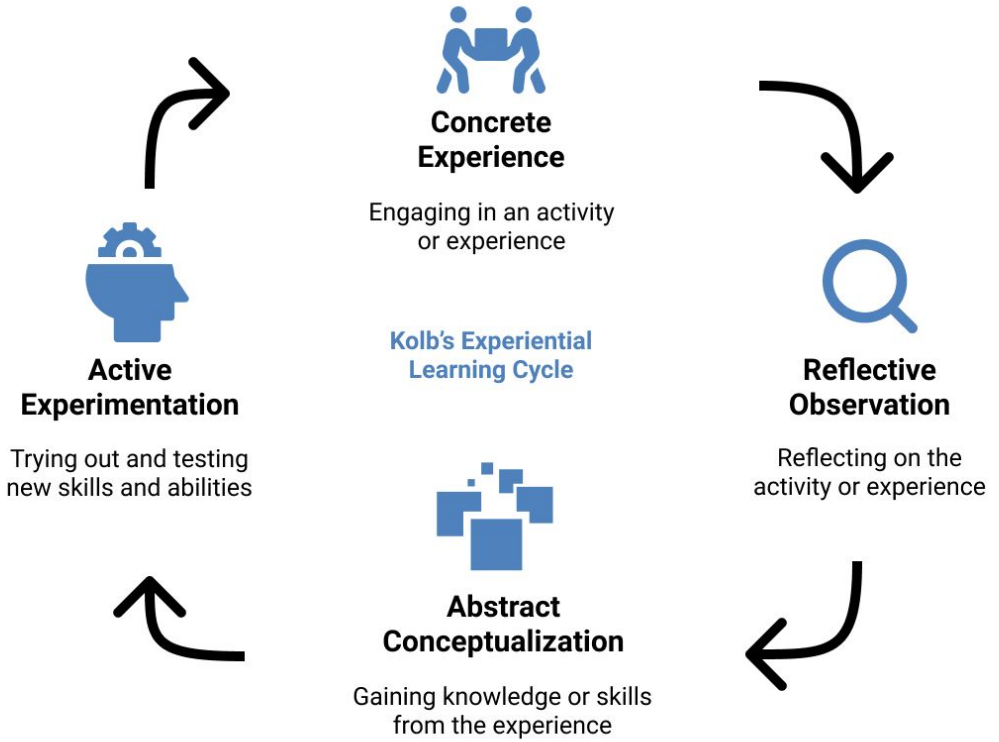
Farmer Field School as a response to the Green Revolution

Fish Farmer Field School as a response to the Blue Revolution

Educational Foundations

All FFFS learning activities apply Kolb's Learning Cycle.
For example:

- Participants collect data in the field ***(concrete experience)*** and return to a meeting place to analyse the data ***(reflection)***
- Agroecosystem analysis emphasizes ***observation*** of the mangrove-aquaculture agroecosystem
- The participants make use of their data to prepare a presentation regarding field conditions and propose decisions for actions (e.g. apply organic fertilizer or don't apply pesticides ***(abstract conceptualization)*** leading to a hypothesis.
- The decision is then implemented over the following week ***(active experimentation)***



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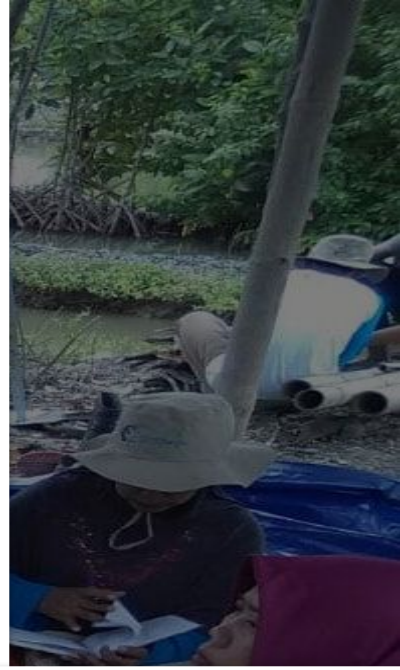
Fish farmers activities in CFS

Sustainable Livelihoods Assessment (SLA)

- Identification and mapping of village ecosystems
- Aquaculture trend analysis
- Seasonal Calendar
- Needs Analysis
- Solution and institutional analysis



Aquaculture Production System

- Farm planning and designing
- Farm preparation
- Organic fertilizer making
- Fish fingerlings and stocking
- Pond monitoring
- Harvesting

Parameter	Shell	Week1	Week 2	Week 3	Notes
Temperature	25-33	28.8	28.8	29	the quality of observation temperature during August is normal
Brightness	25	40	40	30	water brightness is high, the bottom of the pond can be seen, this indicates a lack of plankton so MOL should be given
Salinity	20	30	303	31	Normal
Dissolved oxygen	>4	4.1	5.1	7	Normal
pH	6.5-8.5	7.7	7.8	7.6	Normal
Weight (g)	6.8	7.3	8.3	6.81	
Length (cm)	3.5	2.92	3.15		
Width (cm)	2.1	2.3	2.16	2.2	

Special Topics

- Introduction to soil ecology
- Organic fertilizer
- Fish Feed
- Green mussel culture
- Integrated Multi-Trophic Aquaculture (IMTA)
- Gender understanding
- Mangrove and its rehabilitation measure
- Coastal dynamics and its safety measure

The Comparison of control plot and treatment plot

Parameter	unit	Control plot	Treatment plot
Initial baby shellfish	Kg	100	100
Weight	g/piece	2	2
Harvest	Kg	102	120
Average weight after harvest	g/piece	6.2	10.5
Cost	IDR	872,500	963,300
gross profit	IDR	1,224,000	1,440,000
Nett profit	IDR	724,000	940,000

Impact of CFS

Increased knowledge on improved aquaculture management practices

Table 5. Summary of pre-test and post-test results of increased knowledge					
No	**Studied Criteria**	**Knowledge**			
		Before		**After**	
		Average score	**Category**	**Average score**	**Category**
1	Knowledge on the advantages of pond draining	1.9	Fair	3.7	Good
2	Knowledge on administering organic fertiliser	1.2	Poor	3.9	Good
3	Knowledge on administering water quality maintenance	1.5	Poor	3.7	Good
4	Knowledge on administering proper stocking density	1.8	Fair	3.5	Good
Average score		**1.54**	**Poor**	**3.66**	**Good**

Increased skills on improved aquaculture management practices

Summary of pre-test and post-test results of increased skill

No	Studied Criteria	Skill			
		Before		After	
		Average score	Category	Average score	Category
1	Skill on organic fertiliser making	1.1	Poor	3.7	Good
2	Skill on feed making sourced from locally available ingredients	1.1	Poor	3.3	Good
3	Skill on using measuring devices (pH meter, refractometer, thermometer, sachidisk)	1.0	Poor	3.4	Good
4	Skill on oral presentation/communication	1.7	Fair	3.4	Good
Average score		1.2	Poor	3.5	Good

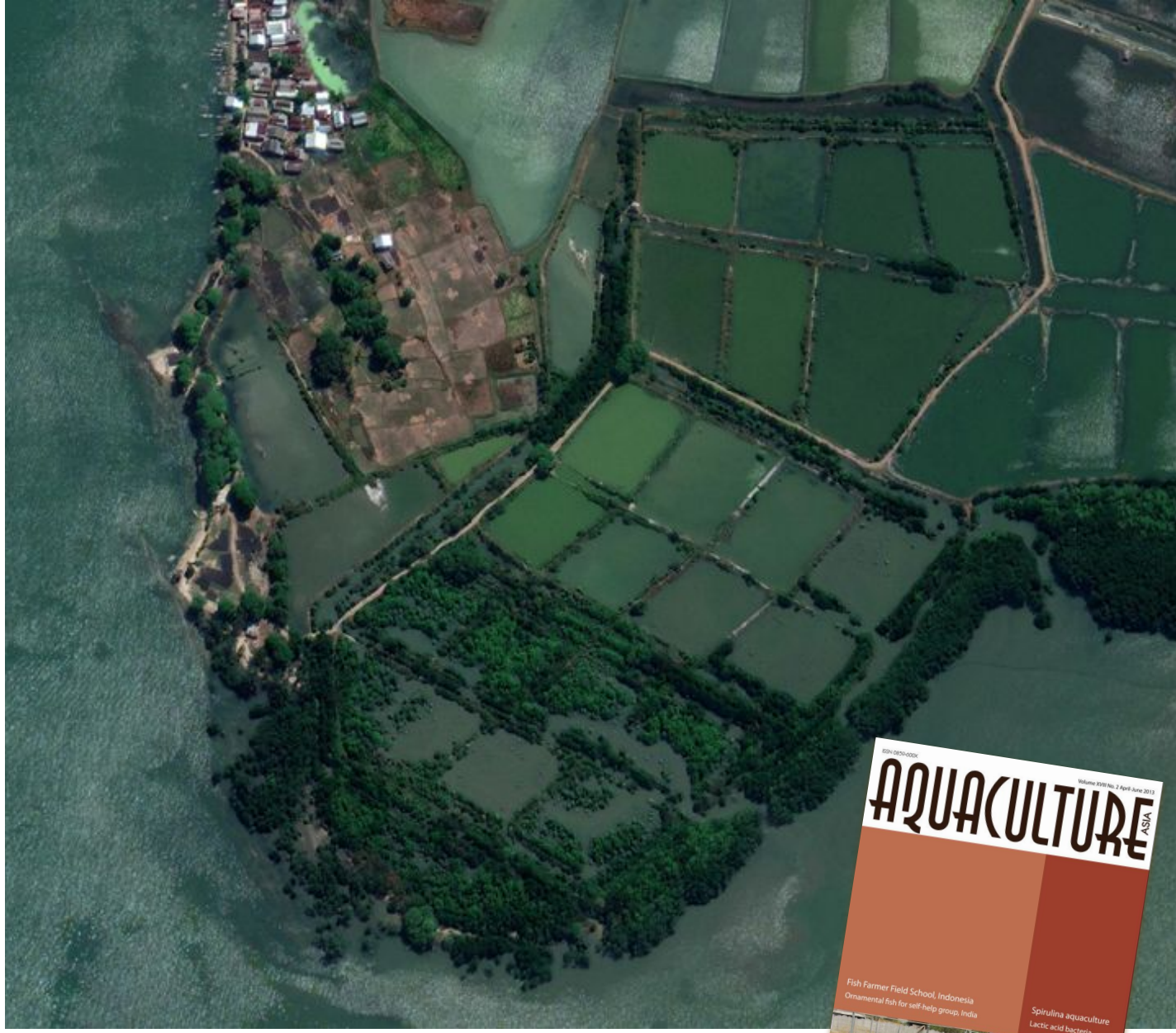
CFS Pre & Post-Test Knowledge Measurement

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	*Pretest - Posttest*	-7.46667	1.76743	.45635	-8.44544	-6.48790	-16.362	14	.000

Conclusion

- Improved sustainable production of aquaculture products
- Reduced reliance on external, industrial inputs
- Increased mangrove aquaculture agro-ecosystem health at the landscape scale
- Landscape mosaic of sustainable aquaculture and healthy mangrove forests



THANK YOU!

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