

Sustainable Sea-Food Security



Special NWO Session at the 12th AFAF

Separate Attachments

Iloilo, 10 April 2019

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10 April, 15:30-17:30: Inclusive Business

How to Make Innovations Contribute to Inclusive Business and Equal Access to Food?

Chair: Marc VERDEGEM

Secretary: Roel H. BOSMA

Two short introductions to present the topic:

Principles of Inclusive Business. BOSMA Roel H., *WUR-ASG-AFI*.

Inclusive Sea-Food Value Chain for Equal Access to Food,
VIVEKANANDAN Vriddagiri, *South Indian Federation of Fishermen Societies, Karamana, Trivandrum, India*.

World Café break-out with Intro on process by CALUMPANG Lorna, and 3 rounds of discussions on propositions in 3 themes:

Theme A: To limit the use of land, fresh water and fish, and increase seafood yields from ponds, priority should be to:

- ✓ Improve the feed use efficiency in ponds to RAS' levels,
- ✓ and Replace fish-meal and fish-oil in rations, by doing

Theme B: Overcoming Constraints to Adoption of Innovations requires that all aquaculture technologies are:

- ✓ Assessed financially through partial budget & CB analysis;
- ✓ Designed further on-farm together with the stakeholders;
- ✓ Taught to smallholder farmers through field schools, or

Theme C: To make Seafood Equally Available to All, the related:

- ✓ Value chains of both fisheries and aquaculture need to be considered in the regional contexts.
- ✓ Business & Trade need to

Plenary: Feedback from the break-out groups and **Discussion** on:

- ✓ How to innovate for better food and nutrient security?

Special Session

Inclusiveness for Sustainable Sea-Food Security

12th AFAF - Asian Forum for Aquaculture & Fisheries.

Wednesday 10 April 2019, Iloilo, Philippines



Goals of three sessions

10:30 - 12:00 Inventory of Challenges and Opportunities of Intensive and Extensive Pond Aquaculture.

13:00 - 15:00: Approaches to Adoption of Innovations in Aquaculture by Smallholder Farmers

15:30 - 17:30: How can Innovations Contribute to Inclusiveness?

We invite Academia, Private sector, NGO and GO to meet

NWO-GCP projects of Wageningen University & Research, Wetlands International; WorldFish, University of Amsterdam, Khulna University, MMFA-Indonesia, IUCN, FishMARC-India, Solidaridad, Aqua-Spark, Diponegoro University, Can Tho University, Blue Forest and others.

10 April, 10:30-12:00, Panel Aquaculture

Challenges and Opportunities of Pond Aquaculture

Chair: Marc VERDEGEM

Secretary: Roel H. BOSMA

1. VERDEGEM Marc C.J.: Challenges for Pond Aquaculture. *Wageningen University & Research, Animal Sciences (ASG), Aquaculture & Fisheries (AFI)*.
2. HERMSEN Devi: Effects of Dioflocs on Seafood Quality. *Wageningen University & Research - ASG-AFI*.
3. TRAN Huu Tinh: Effects of Carbohydrate Sources on a Biofloc Culture System for White Leg Shrimp (*Penaeus vannamei*). *Wageningen University & Research - ASG-AFI*.
4. KABIR Kazi A.: The Effect of Dietary Protein to Energy Ratio and Stocking Densities on Fish Production, Food Web Enhancement and Economic Benefit of GIFT Nile Tilapia Aquaculture In Ponds. *WorldFish - Bangladesh*.
5. HUYNH Thanh Toi: Impact of Feeding High Energy/Protein Ratios on Shrimp Farming. *College of Aquaculture & Fisheries, Can Tho University, Vietnam (CTU)*.
6. Plenary: Dialogue with stakeholders on the innovations.

Lead questions: Aquaculture production is expected to double by 2050, but depends on natural resources for fresh water, fish meal and fish oil, and agricultural (by)products (land, water & energy).

- ✓ How can research support this production increase, while reducing pressure on these resources?
- ✓ Which are priority topics for research?

10 April, 13:00-15:00, Panel Capacity Building

Design & Dissemination of Aquaculture Technology

Chair: Roel H. BOSMA

Secretary: Olivier JOFFRE

1. JOFFRE Olivier: Aquaculture Innovation Research : What (or who) are we missing? *WorldFish - Cambodia*
2. ELFITASARI Tita. Constraints to Aquaculture Innovation in Demak and Brebes, Indonesia. *University Diponegoro, Faculty of Fisheries and Marine Sciences (UNDIP-FPIK)*
3. KHAN Nazneen, Using Service Providers to Include Smallholders in the Value Chain. *WorldFish - Bangladesh*.
4. YUNIATI Woro. Impact of Coastal Farmer Field Schools (CFS) on Farmers in Indonesia. *Blue Forest Indonesia*
5. REJEKI Sri. Impact of Coastal Farmer Field Schools on yields of brackish water ponds in Indonesia. *UNDIP-FPIK*.
6. TRAN Thi Phung Ha: Impact of games on aquaculture innovation. *School of Social Sciences & Humanities, CTU*.
7. JOFFRE Olivier / BOSMA Roel: Agent Based Modelling for Areal Policy Advices. *WorldFish - WUR - CTU*.
8. Dialogue with stakeholders on the proposed innovations.

Lead questions: Classical transfer of technology to farmers had limited outcomes, while multi-stakeholder approaches to design and deploy technology, are perceived as resource consuming.

- ✓ How can research convince governments and donors to invest in multi-stakeholder approaches to innovation?
- ✓ How to mainstream the multi-stakeholder approaches to innovations?

Info sheet for the World-Café session and its panels

This World-Café Session aims to harvest innovative ideas, best practices, and experiences that have significantly changed/improved seafood sustainability and nutrient security. This will also explore new ideas, challenges, concerns and the like, that could fuel further improvements on seafood sustainability and nutrient security.

All participants will be divided into break-out groups of 5 to 7 persons each. Each table will have a host who will stimulate and summarize the discussion on the main question. The groups will be given 20 minutes to discuss one question (1st round); and after 20 minutes, members will be asked to move to the next table to tackle another question (2nd round) and so on, until the 3rd round is done. There will be two bell rings: at the first ring the group starts to summarize, and at the 2nd the participants move to another table. Participants may choose a table they prefer provided the members are not more than seven.

The number of tables will be equally divided to represent the 3 questions. Each table will be provided with writing paper, crayons, pens, etc. At the 2nd and 3rd round, the other groups will build upon the findings of the previous groups and write or draw on the paper.

The summary of the results of the three discussions will be reported to the plenary, where contrasting or complementary insights may be identified and discussed. The central theme of the final part of the plenary session is a **Discussion** on the question:

- ✓ How to innovate for seafood sustainability and nutrient security?

On the following pages we give a short outline and the lead question of each of the topics: sustainable aqua-feeds, sustainable fisheries, technology take-up, inclusive chains and the seafood system.

Table 1: Increase sustainability of aquaculture and feed use in particular.

The list of sustainability issues on aquaculture [10] is long: Land and Water use, Fish in feed, Residues of metals, pesticides & antibiotics, Water pollution, Escapes and genetic contamination, Wild fish for seed, Energy use and Greenhouse gas emissions, Affordability, and Human nutrition (long-chain omega-3 fatty acids). Some of these are related, such as human nutrition and feeds, as well as feed, land and water use, residues and pollution. To limit the use of land, fresh water and fish in feed, and increase seafood yields from ponds, two priorities are considered: to improve the feed use efficiency in ponds to levels reached in RAS, and to replace fish-meal and fish-oil in rations.

- ✓ **What innovative practices in aquaculture and feed use have you come across that may or have significantly change(d)/improve(d) seafood sustainability and nutrient security?**

Table 2: Sustainability of fisheries and small scale fisheries in particular.

Research developed technologies allowing large vessels to increase their efficiency and to fish down the food-chain, which has led to overexploitation, mostly supported by policies. In most cases, policy was unable to protect the fishery grounds of the small boats, that locally may also contribute to overfishing. In any case, big vessels have huge impact on sustainability and food security of smaller fisher' communities. Although at present research supports solutions such as catch quota, monitor and control. tracking and tracing, and marine protected areas, stocks remain overexploited and small fishermen disadvantaged.

- ✓ **What innovative practices in fisheries you have come across that may or have significantly change(d)/improve(d) seafood sustainability and nutrient security?**

Table 3: Co-creation

Co-creation is a process of technology development through collaborative sharing and/or exchange of learnings among and within key actors/stakeholders. In Asia and Africa many smallholders, occupying extensive areas of ponds, remain stuck in low productive systems. Can these farmers be included through knowledge co-creation processes?

The dissemination of aquaculture technologies encounters many barriers, namely: the lack of human and institutional capacity of the participating government institutes [11], lack of support of local authorities, communication problems, lack of trust and farmers' knowledge [12, 13], and not-fit, too costly technologies. In general, the most limiting factor to technology transfer is not technical but social and methodological, and the latter are most often under-addressed [14]. Method-wise, technology innovation and diffusion in aquaculture, hardly include interactions of farmers with researchers, extension services, or NGOs, one aspect of co-creation [15].

Beyond the technology to be promoted/developed through co-creation, other policy ingredients might need to be addressed: genuine agrarian reform, fair prices through protection from dumping of cheap food from abroad, ... breaking dependence on imported inputs in times of economic crisis,... and increasing the resiliency of the economy to climate shocks [14]. Real food system projects are based on a 'research in development' strategy [16] that includes an experimental design of interventions and a built-in impact assessment that informs stakeholders and public authorities on the progress and results [17].

Thus, if governments were to promote change, research could take the lead in co-creation of: "innovations that combine technical and social transformation and thereto, researchers have to engage in and strengthen discourse coalitions to reach the best available policy options" [16]. In *multi-stakeholder cooperation*, researchers can provide facts & figures, identify common ground for interventions and build partnerships to assure that interests of all stakeholders are respected. Central in co-creation processes is clarity about roles and expectations of various actors, and awareness on the beneficiaries and the power-holder dynamics in the processes [18]. In other words: we ask, 'Whose societal relevance is at stake, whose knowledge is taken into account? Who determines which questions are or are not addressed?'

- ✓ **In your experience what are the constraints to adoption of innovations on aquaculture technologies and could they be overcome by a process of co-creation?**

Table 4: Inclusive Aquaculture Business

Support to development started under the paradigm of trickling down: invest in industries and wealth will spread through society. In many developing countries, this strategy, however, did not reduce the number of poor and hungry. Later, community, rural, farming systems, good-governance and value-chain followed suit with accompanying new buzz words, such as co-creation and inclusive business (IB). The definition of IB can, narrowly, include only the resource poor farmers in the development of a value chain. Broadly IB embraces food security and poverty alleviation as goals in the development of a business. Although both definitions are disputed, policymakers consider the private sector as one of the pathways to poverty alleviation. The question now is how to include food security of smallholders and poor consumers in the business development strategies.

IB's narrow definition, in relation to aquaculture is problematic because this enterprise requires financing [19]. However, in Uganda, the more educated people considered aquaculture too risky, while the less educated farmers engaged more in organised fish value chains [20], and in Bangladesh income and food security of resource poor improved through aquaculture [21]. Moreover, IB needs to consider that the focus on one value chain, e.g. shrimp, can increase the income of smallholders, but does not necessarily improve their food security, as multi-species ponds provide essential nutrients to the farm-household [22].

The broader definition of IB, considering food security and poverty alleviation as goals in the development of a business, opens many pathways. However, although IB models may be beneficial for certain groups, these models are not the approach to poverty alleviation [23] because (1) Companies need to focus on efficiency and professionalization to maintain their market share, which may exclude the poor and low educated. (2) In a competitive market, under the pressure of their shareholders and consumers, companies often have no other choice but to pass pressure down the value chain through low prices and wages, unless forced by interest groups and laws on minimum wages and labour conditions, respectively.

Moreover, vertically organised seafood companies having feed-mills, farms and processing facilities, can produce seafood more efficiently than organised smallholders; the resulting low prices increase the accessibility of seafood for the poor [24]. Such companies provide labour and income. But whether these will result in food security and a decent living, will depend on secondary factors, such as permanent contracts, salary' levels vis-à-vis weekly working hours, and negative externalities, such as pollution due to the company's bargaining power.

Hence, improving the livelihoods of resource poor smallholders and making seafood equally available to all, require more than focusing on IB alone. Among others, both value chains of fisheries and aquaculture need to be considered in the regional contexts. Making business inclusive starts by assessing its externalities (cost for nature, biodiversity, air and water) that should be dealt with by other actors such as the government [23].

- ✓ **Which policies are needed for: (a) vulnerable people to increase their food security in the aquaculture and fisheries value chains; (b) companies to avoid externalities and focus on efficiency, to produce more affordable seafood?**

Table 5: The Seafood System

Food systems are broadly conceived as the network of actors and the set of activities ranging from food production to consumption and waste recycling. These interact with one another, and with the surrounding ecological, social, political/cultural and economic environment [1,2]. The food system also comprises structural conditions such as rules, standards and policies; and actors that operate, optimize and innovate the system [2]. The normative goals of a food system are to provide food security and nutrition, environmental security and social welfare [3]. Depending on how a food system is configured, its performance in terms of satisfying food security and nutrition, environmental security and social welfare varies. Food systems may perform well in terms of economic outcomes, but badly in environmental and social welfare; whereas other systems may emphasize environmental security and social welfare at the expense of economic outcomes.

Globally, food systems can be distinguished in two oppositional paradigms: the dominant agro-industrial productivist [2], and the territorial and ecological paradigm [4,5]. Food systems aligned with the agro-industrial paradigm enact an industrial approach to food and farming, with state and industry support primarily geared towards producing large amounts of standardized foods [5,6,7]. Alongside the dominant food systems, many alternative food systems have evolved following a territorial and an ecological logic encompassing new modes of agricultural production, commercialization and consumption. These new modes follow principles of diversification, agro-ecology and alternative food networks. Food systems combining elements of the two paradigms mentioned above are called hybrid [4].

Whatever types of food system, these are affected by climate change, social movements and consumers advocating more healthy food, which are driving forces re-orienting food systems along more ecological, social and environmental lines [8]. However, the gradual shifting is hampered by the subjective concept of sustainability that hinders actors from reaching a consensus on the “best” transition pathways: (1) gradual replacement of agro-industrial conventional production methods by more environment-friendly methods, or, (2) alternative food systems that radically reshape food practices from both technical and social perspective. Although, gradual changes may bring transformation, these changes perpetuate the dominant logic underpinning current industrialized modes of production, distribution and consumption of foods [9].

The alternative food systems, thus, proposes a radical shift from the productivist paradigm towards more localized ecological agricultural production systems and value chains. These alternatives include, among others, agro-ecological and biodiversity-based agriculture; and are supported by alternative food networks, such as community-supported agriculture, food cooperatives, farmers’ markets, and box-schemes.

- ✓ Would co-creation align better with: 1) the “greener” agro-industrial paradigm? or 2) alternative food systems that break the mainstream? Why do you think so?
- ✓ To sustainably innovate, what would be the best route for aquaculture and/or fisheries: 1) the “greener” agro-industrial paradigm? or 2) the alternative food systems? Why?
- ✓ Would Inclusive Business fit best in to: 1) a “greener” agro-industrial paradigm? or 2) an alternative food systems that breaks the mainstream? Why do you think so?

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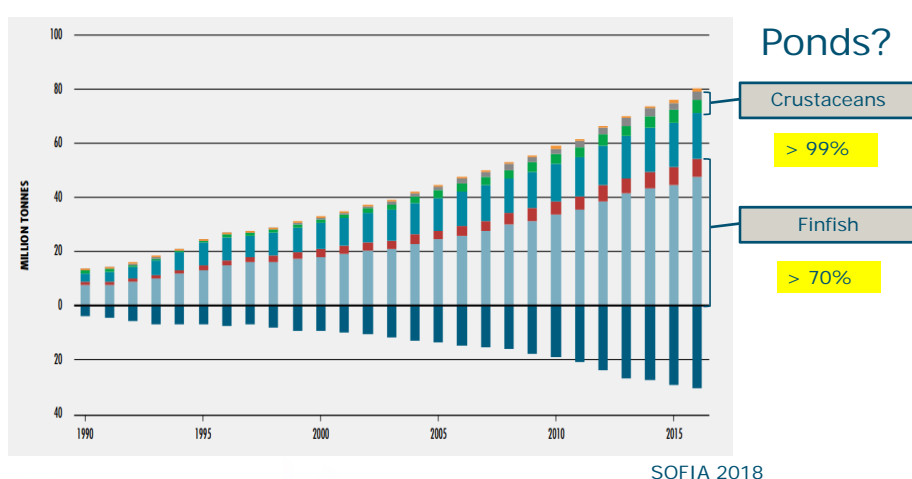
Inclusive innovations for sustainable sea-food security

Challenges for pond aquaculture

10 April, Marc Verdegem



Pond aquaculture is important



Aquaculture products

- Mainly locally consumed
- Small and medium sized farms
- Including poor farmers



→ food security



Ponds

Soil dependent activity (fertility !)



Responsible farming

What drives pond production?

- Nutrient input (amount, quality)
- Oxygen availability



Pond carrying capacity

No aeration: 2 500 – 14 000 kg/ha/crop

Aeration: 30 000 – > 45 000 kg/ha/crop

Future for pond aquaculture

- Doubling aquaculture production: possible in ponds
 - Yield gap = large
 - Minimizing pollution
- Knowledge gap:
 - 2 500 – 14 000 kg/ha/crop ????
 - WQ management - accumulation of sludge?
 - Sludge removal frequency
 - Quality of sludge (natural food, fertilizer)
 - How to minimize sludge accumulation ↔
sludge utilization

Routes to increase pond production

- Make better use of natural food
 - C:N ratio
 - Add CHO
 - Carbon rich faeces
 - Effect of bioflocs on seafood quality
 - Integrating pond technology with recirculation technology
 - Strengthen integrated aquaculture – agriculture systems
- } presentations

Integrating pond technology with recirculation technology

- Lot's of energy input to intensive ponds
 - Paddle wheels not very efficient
 - Air lift technology
 - Degassing towers
 - In-pond biofilter – septic tanks
 - Partitioned ponds (in pond raceways)
 - Controlled pollution systems
- Make better use of crop-waste products in ponds

Aquaculture practice

■ Formulated feeds



20 – 40% fish



60 – 80% waste



- Feed = good for fish
- Feed waste = not good for pond
 - wrong nutrient balance
 - poor food web
 - pollution
 - suffering fish



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9

Dual purpose feed



Good for fish

+

Good for pond

- Feed should stimulate role of food web in maintaining a healthy culture environment
- Feed should be a good fertilizer



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10

Advantages

- Feed company
 - Cheaper feed ingredients
- Farmer
 - Cheaper feed
 - Equal or higher production
 - Easier management, more robust system
- Healthy food and healthy environment



11

Other advantage of food web

- Importance of life vs. dead natural food
- Utilization of plant-based phosphorous
- Nitrogen source?

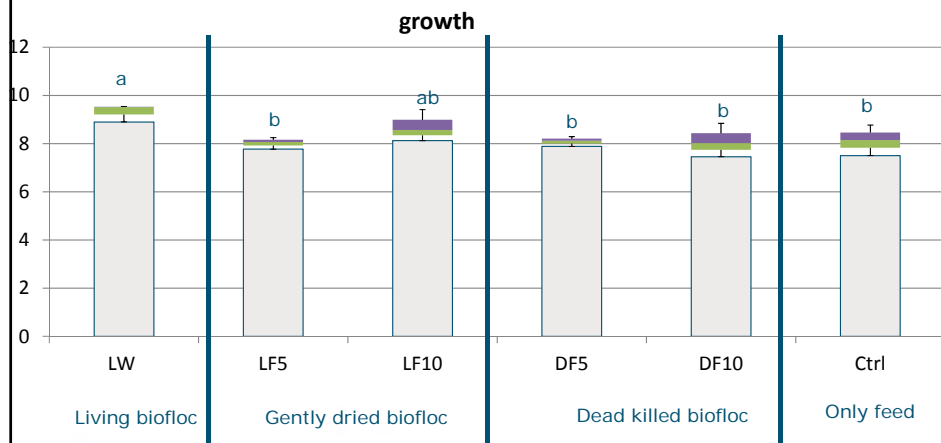


12

Experiment Dead vs. Live BioFlocs

sampling/measurements – growth and proximate

■ Growth – final weight



Effect of live biofloc

- Better growth
- Changes gut microbiota
 - Overlap water- and gut-microbiota
 - Core gut microbiota changed
 - Processing biofloc reduces impact

Circular economy?

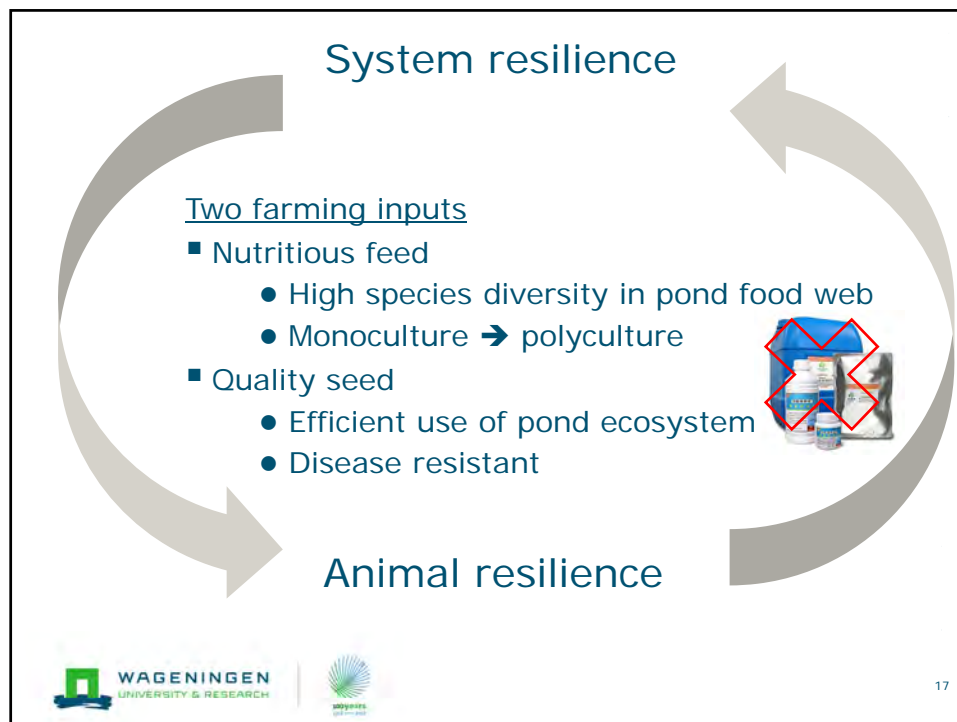
- Use pond to sanitize waste
 - Use low quality ingredients (crop waste) in fish diets
 - While improving nutrient utilization efficiency

N utilization efficiency (%):

- Nutritious pond diet = 72%
- Control feed = 52%

Circular economy

- Convert non-fed ponds into fed ponds
- Increase average production of semi-intensive ponds
- Integrate pond farming in Agri-Aqua circular farming and food systems



"NUTRITIOUS POND" PROJECT

Effects of Carbohydrate Sources on Biofloc Culture System for White Leg Shrimp (*Penaeus vannamei*)

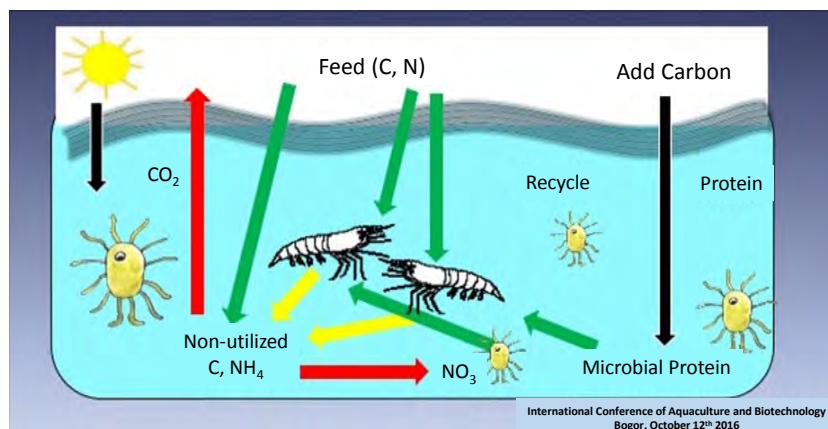
Tran Huu Tinh^a, Tom Koppenol^a, Tran Ngoc Hai^b, and Marc Verdegem^a

^a Wageningen University, the Netherlands

^b Can Tho University, Vietnam



Introduction – biofloc technology



Introduction – carbon sources

- Different types / sources of carbohydrate were tested
 - ➔ C-type has large impact on biofloc system
- Most studies on C-type are experimental, simplifying the pond ecosystem
- Results are difficult to apply at pond level
 - ➔ Need to study whole biofloc pond.
 - ➔ Two, commonly used C-sources were tested in mesocosm:

CORN STARCH vs. MOLASSES

3

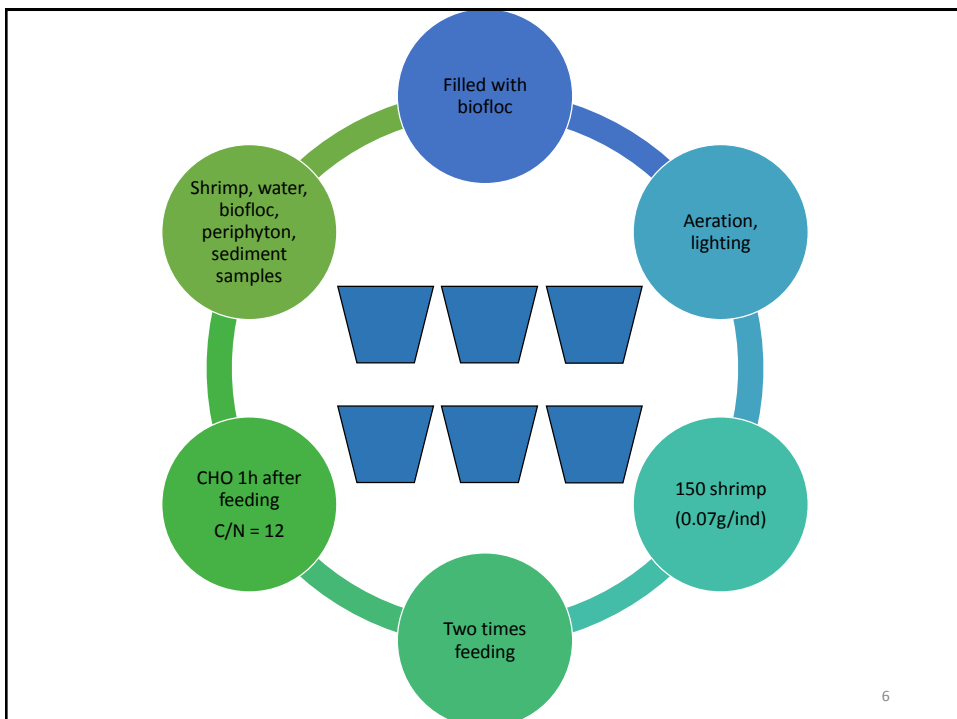
Research questions

1. How do different CHO affect biofloc system?
2. How does C/N vary diurnally?
3. How are C and N distributed in the system?

4

Materials and methods

5

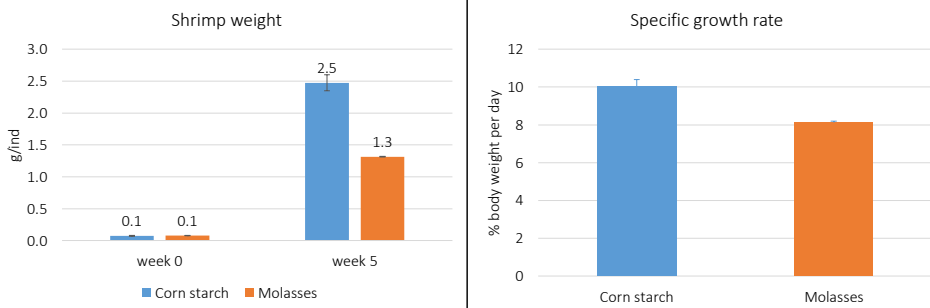


6

Results and discussion

7

Shrimp performance



Treatment	Survival (%)	Growth/35 days (g/shrimp)	FCR (without CHO)
Cornstarch	95.6 ^a ± 1.0	2.40 ^a ± 0.12	1.23 ^a ± 0.05
Molasses	90.0 ^b ± 2.4	1.24 ^b ± 0.01	2.45 ^b ± 0.06

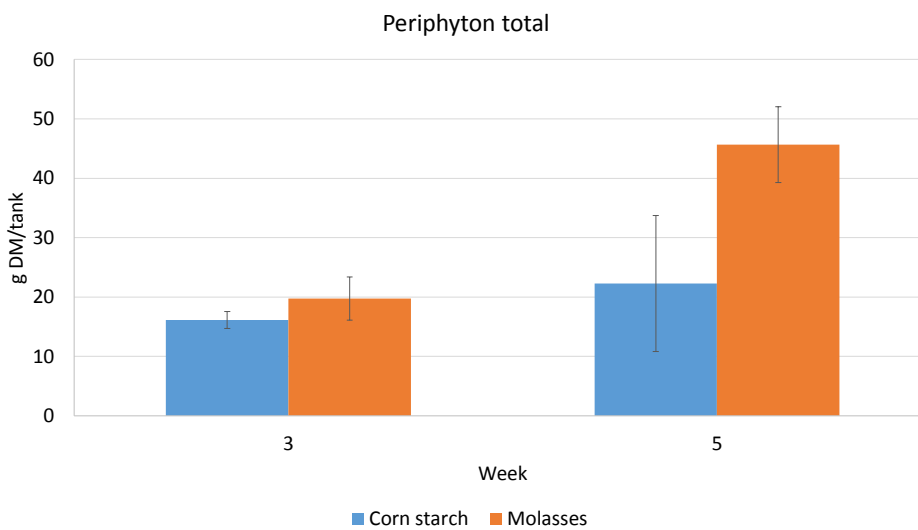
8

Biofloc growth



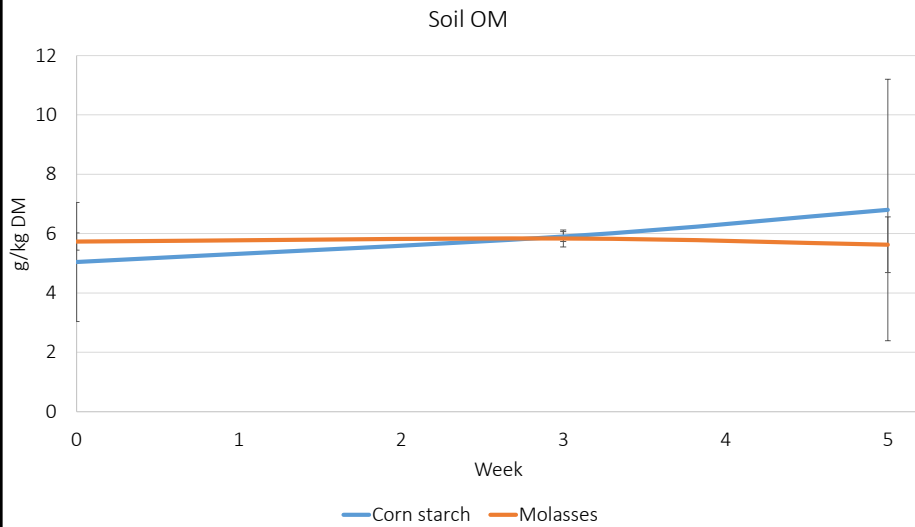
9

Periphyton growth



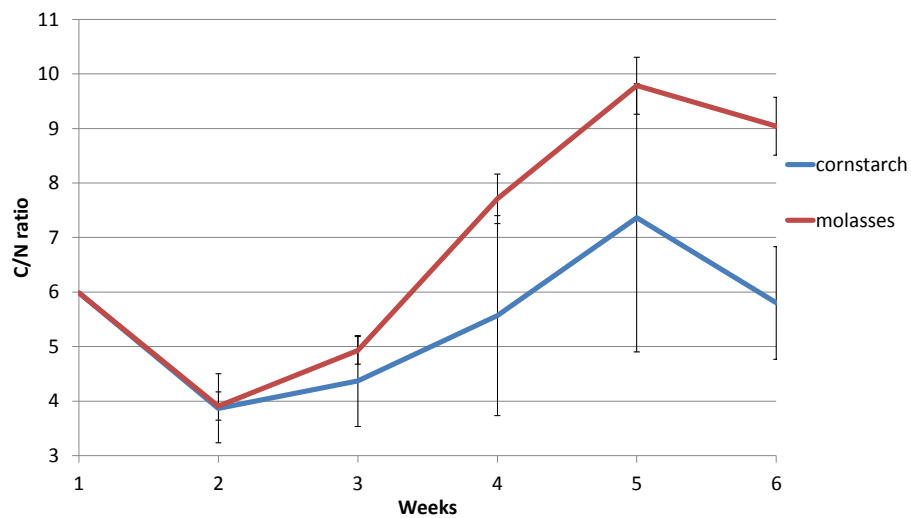
10

Soil organic matter



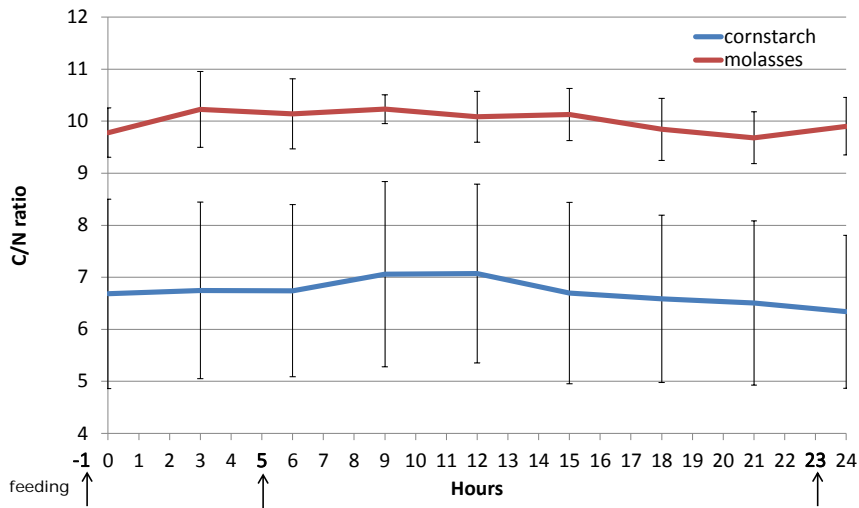
11

C/N ratio in water over the weeks



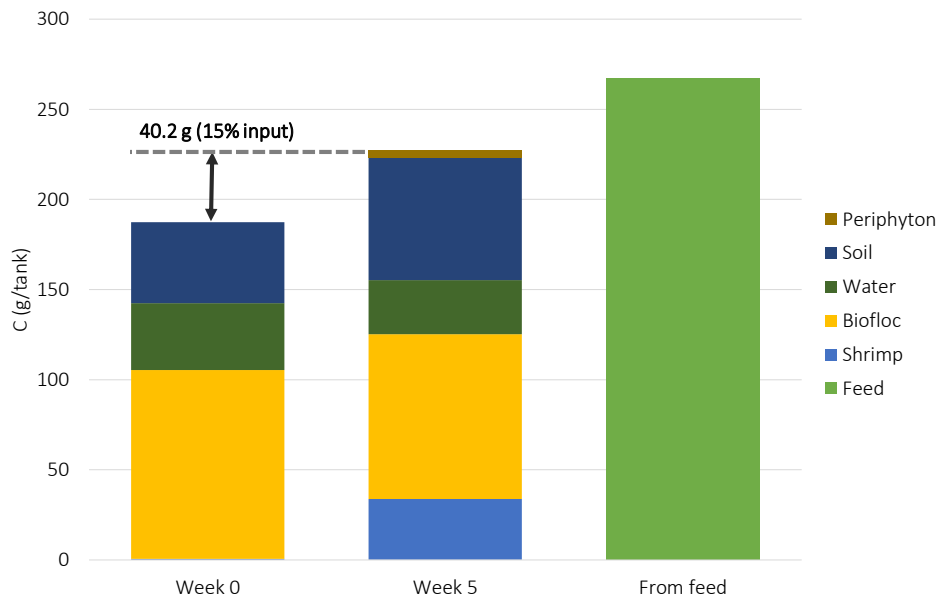
12

C/N ratio in water over 24 hours

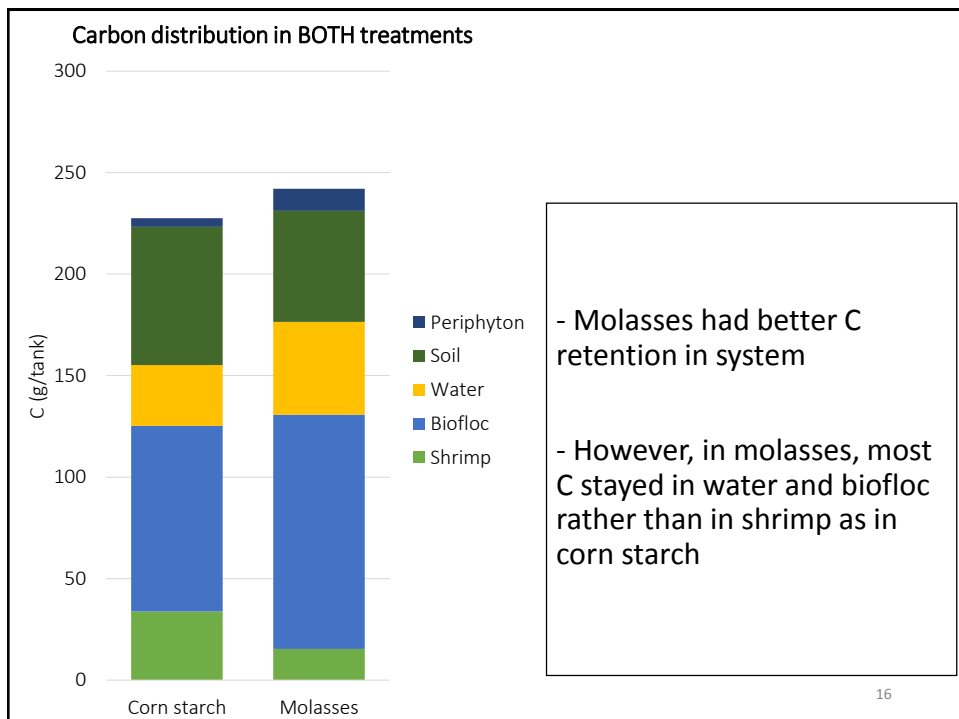
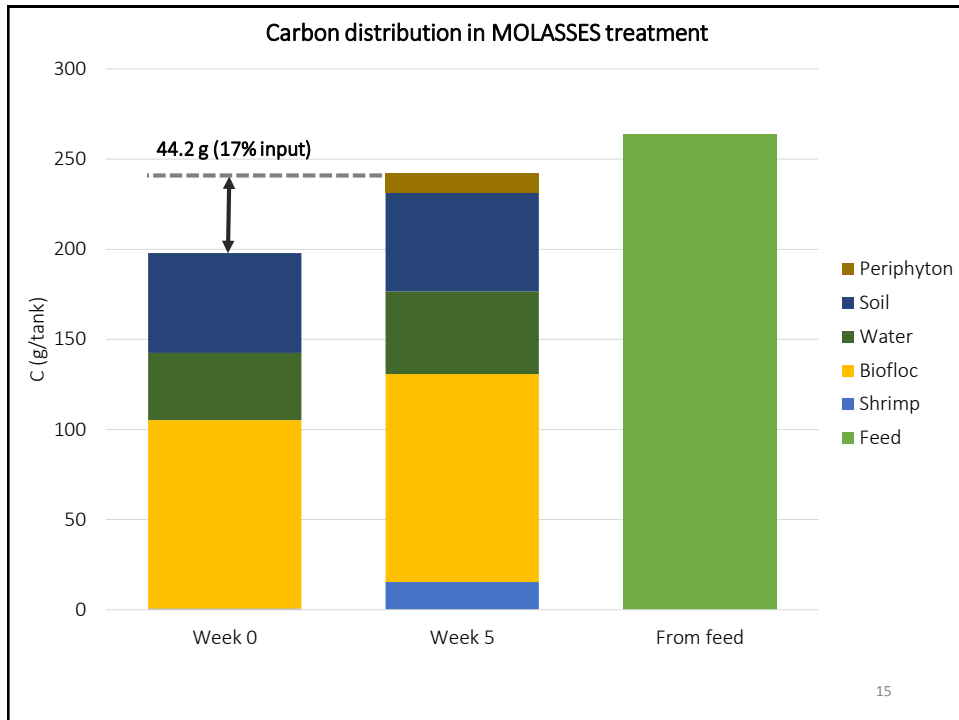


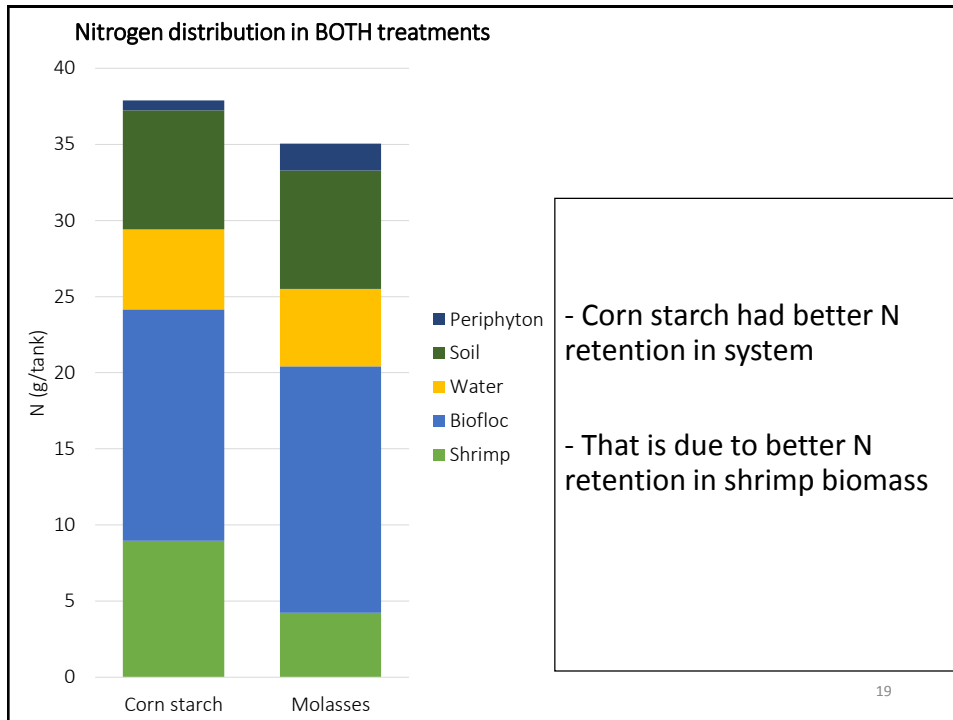
13

Carbon distribution in CORN STARCH treatment



14





Conclusions

1/ How do different CHO affect biofloc system?

→ Corn starch was better than molasses in term of production, growth, and survival enhancement

Conclusions

2/ How are C and N distributed in the system?

→ Corn starch treatment resulted in higher C and N retention in shrimp, while molasses treatment had higher C and N retention in other tank compartments.

21

Conclusions

3/ How does C/N vary diurnally?

→ Diurnal variation of C/N ratio in water is not apparent. Molasses have higher tendency to increase water C/N ratio over culture period

22

Protein to energy ratio for tilapia ?

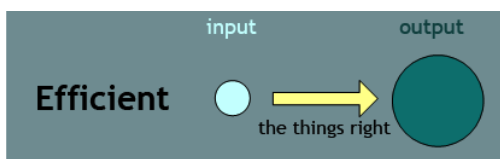
NRC (1993): 18-23 g.MJ⁻¹

Haidar (2018): 16 g.MJ⁻¹ **(lower)**

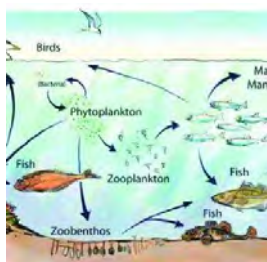


Why protein to energy ratio . . . ?

Not only . . .

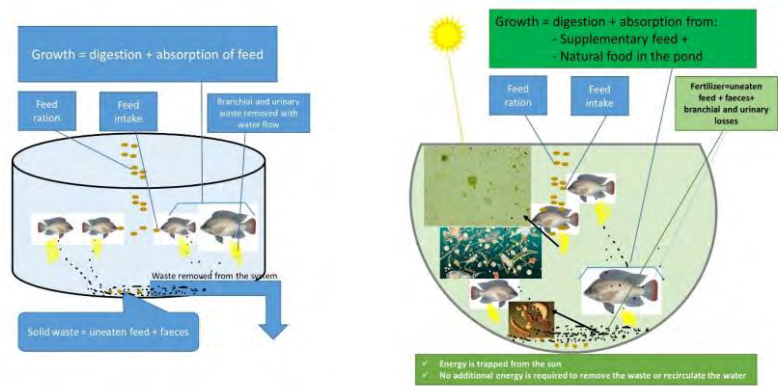


but also . .



Background

- Dietary nutrient requirements are determined in absence of natural food
- ~ 70% of fish produced in pond with natural food



Lowering dietary protein to energy ratio improved performance of tilapia in ponds

K. A. Kabir, M.C.J. Verdegem, J.W. Schrama, J.A.J. Verreth, M. J. Phillips



Tested



Validated



Diets

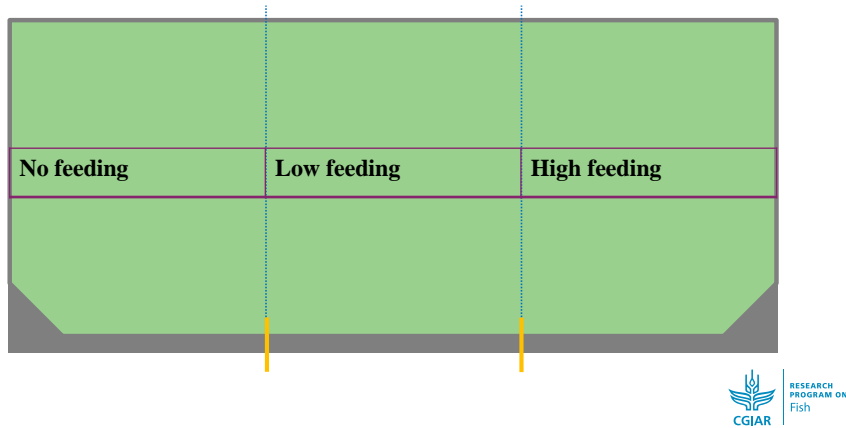
	Diets		
	Units	High P:E ratio	Low P:E ratio
Crude Protein	(g.kg ⁻¹ DM)	313	244
Crude Fat	(g.kg ⁻¹ DM)	55	59
Ash	(g.kg ⁻¹ DM)	113	86
Phosphorus	(g.kg ⁻¹ DM)	15	11
Carbohydrate	(g.kg ⁻¹ DM)	519	611
Gross energy	(kj.g ⁻¹ DM)	19	19
P:E ratio	(g.MJ ⁻¹)	19	14
C:N ratio	(g.g ⁻¹ DM)	8.8	11.8



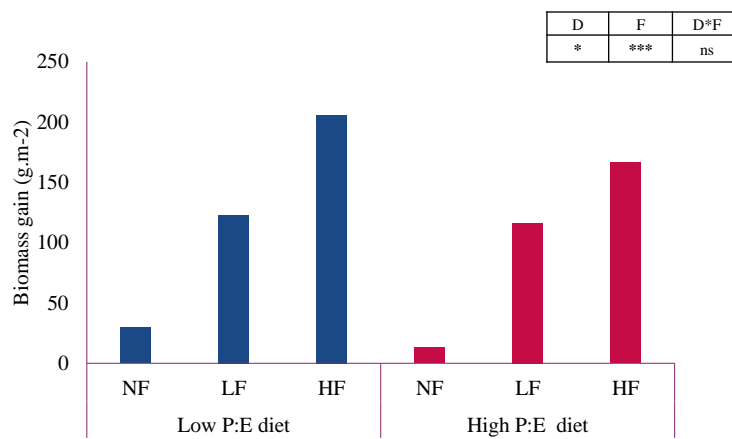
On-station trial

- 2 diets
- Fed equal DM
- 12 outdoor ponds
- 60 days

to understand the contribution of natural food

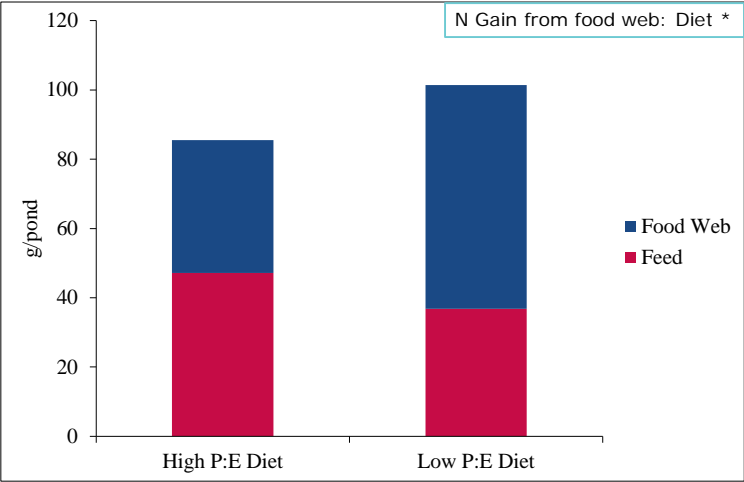


Fish Performance: biomass gain

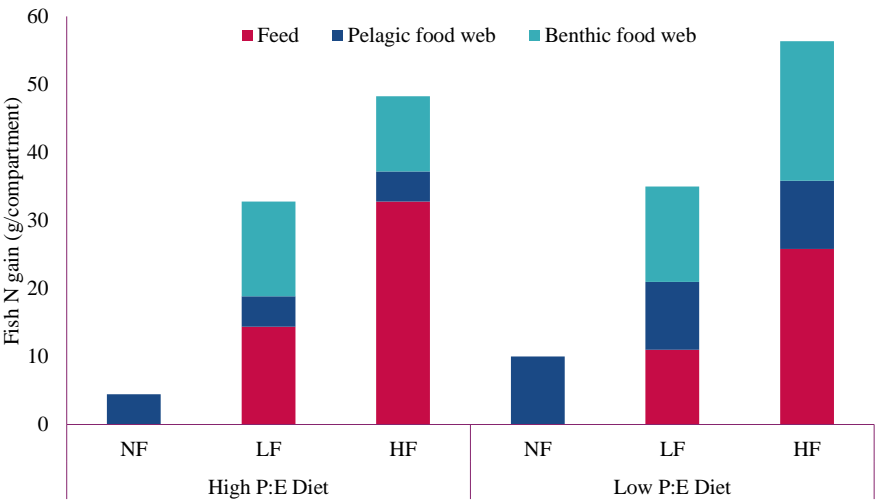


- ☐ No effect of diet on water quality

Nitrogen gain in Fish



Amount of N from different sources contributing to fish N gain

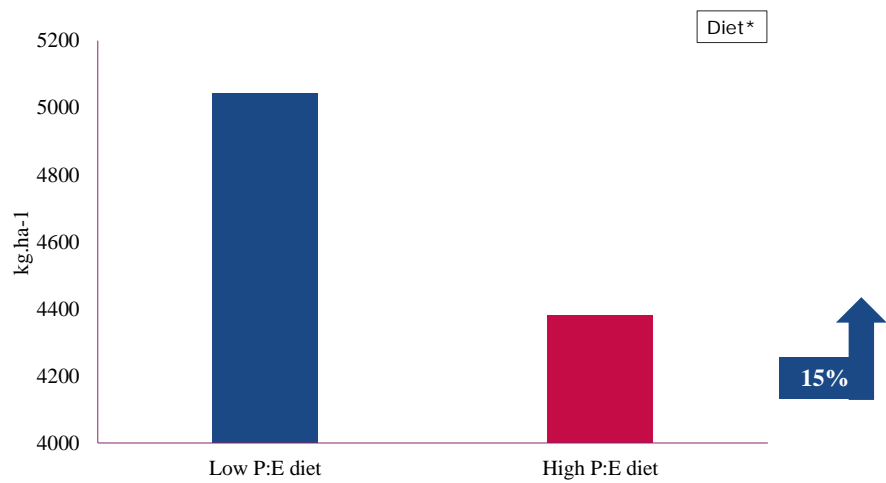


On-farm trial

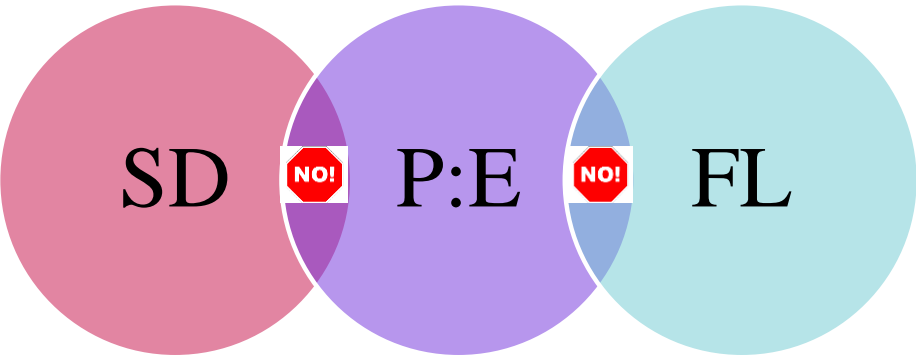
Diets: Same
Feeding level: 2 (14 & 18 g/kg^{0.8})
Stocking density: 2 (2 & 3 fish/m²)
Experimental unit: 40 farmers' pond (~220m²)
Duration: 82 days



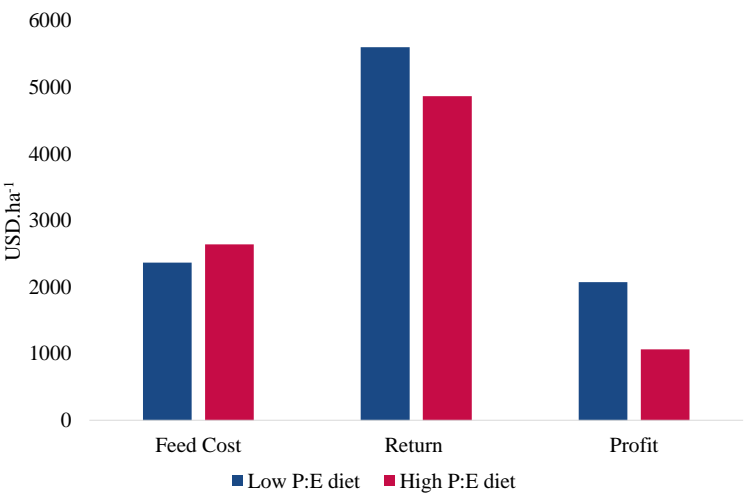
Fish production



* Within the tested level



Economic benefit



Conclusion

❑ Lowering dietary protein content (i.e. P:E ratio):

➤ Improved fish performance

❑ Due to:

➤ Enhanced effect of food web

❑ This concept also worked under field conditions



Thank You



Nutritious Pond Project

New steps in developing sustainable pond farming through diet formulation. A focus on HUFA.

AFAF, 10th April 2019, Devi Hermesen



Nutritious Pond Project

Our wish: produce more with less.

Our aim should be: produce more using sustainable fish oil/meal replacers while **maintaining product quality**. ↔ **HUFA**

Fish/shrimp ponds are ecosystems!

Why not make use of them.



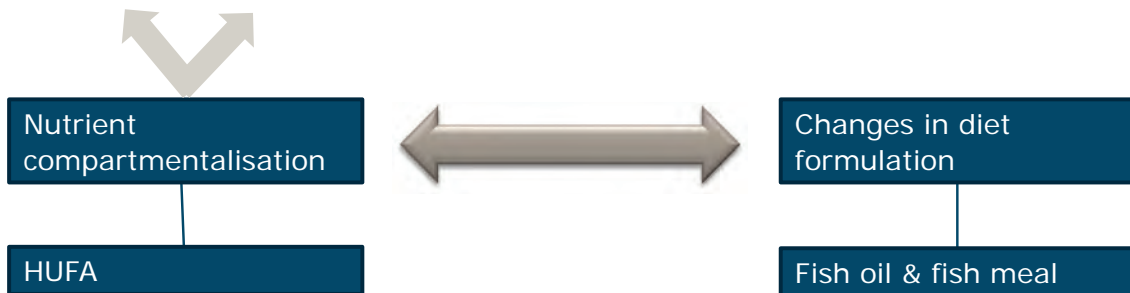
Feed & fertilizer
in 1 product: feed
the whole pond

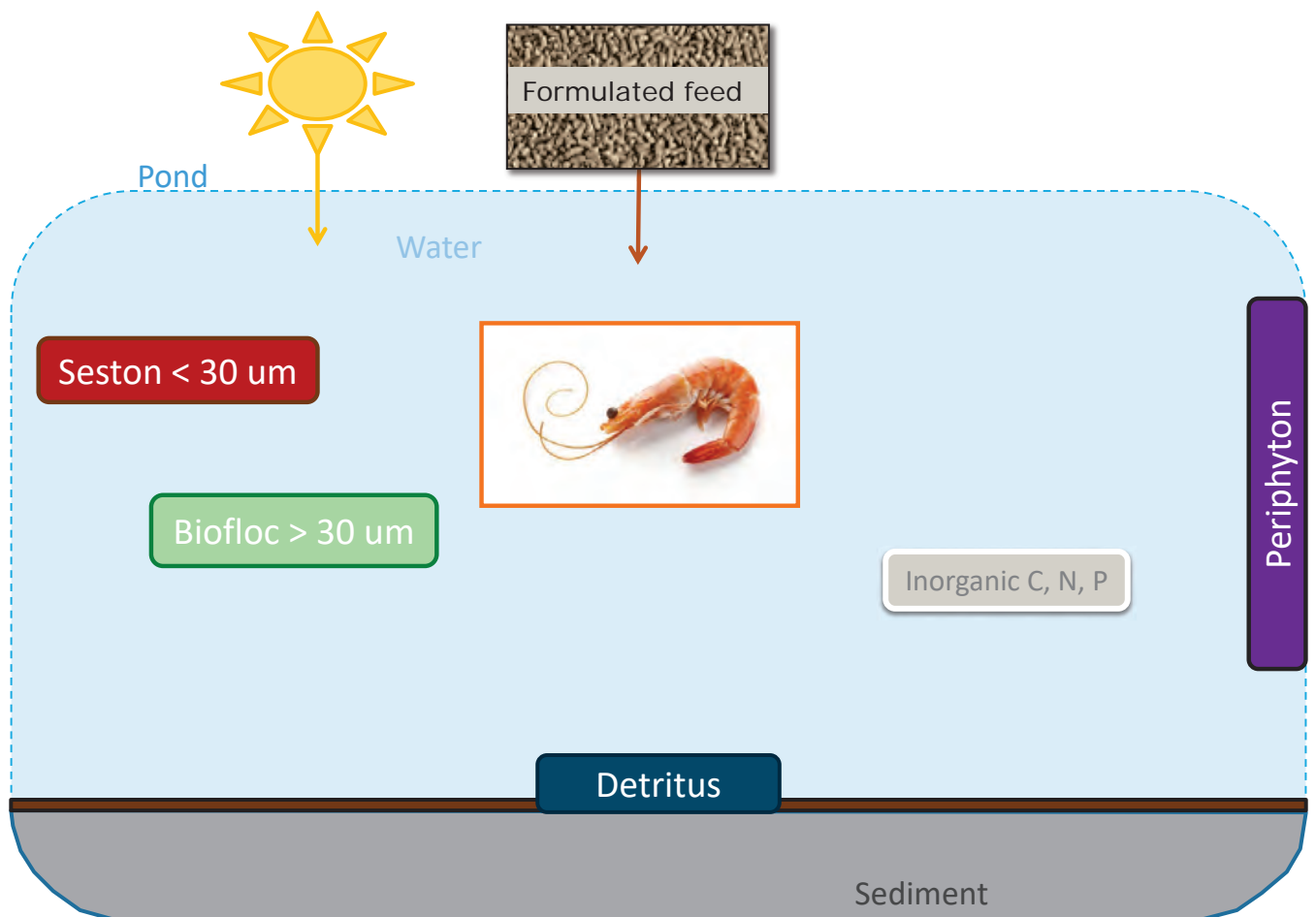
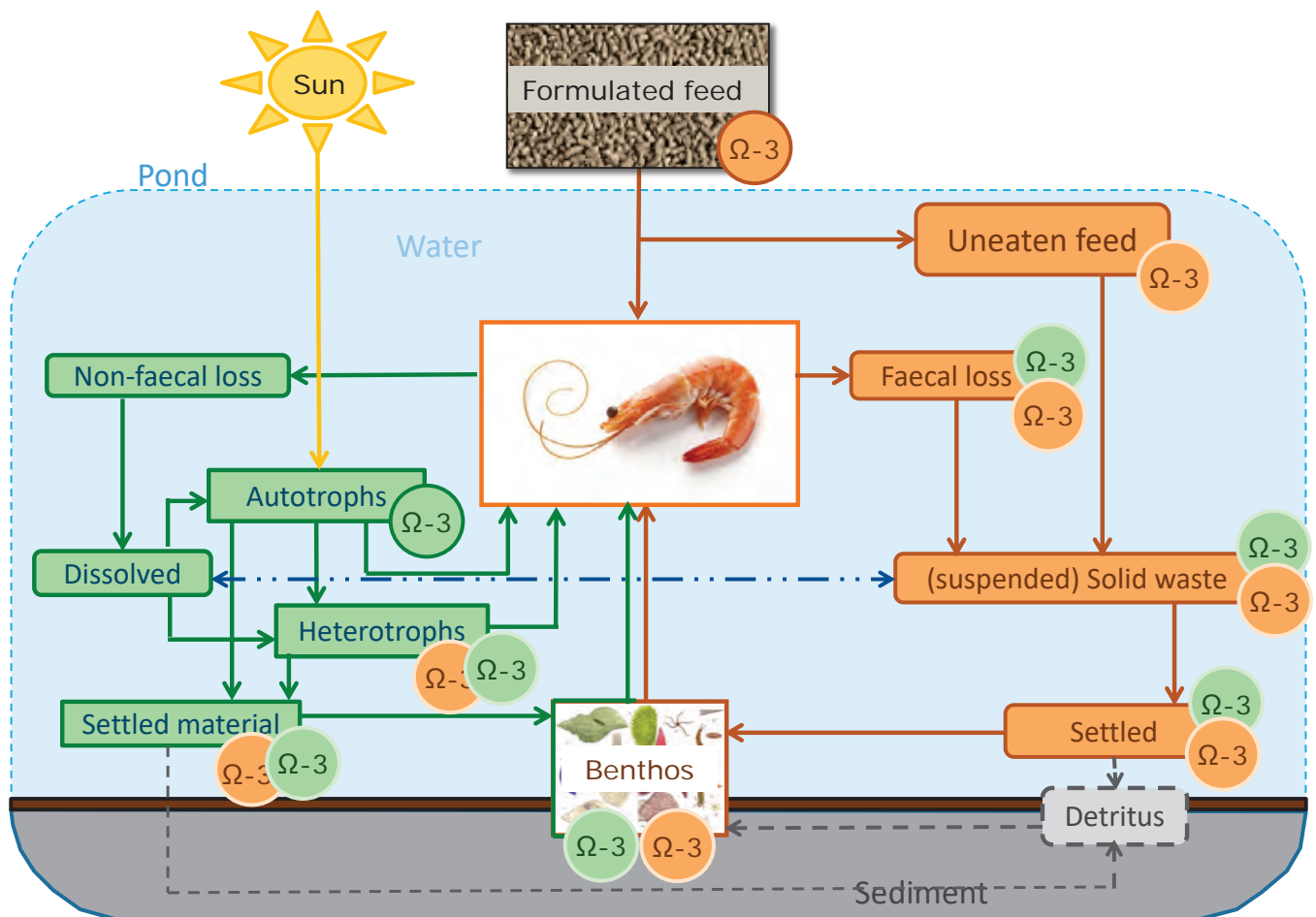


Research aim

Actual **contribution** of **HUFA**
by primary production

How much? Where?



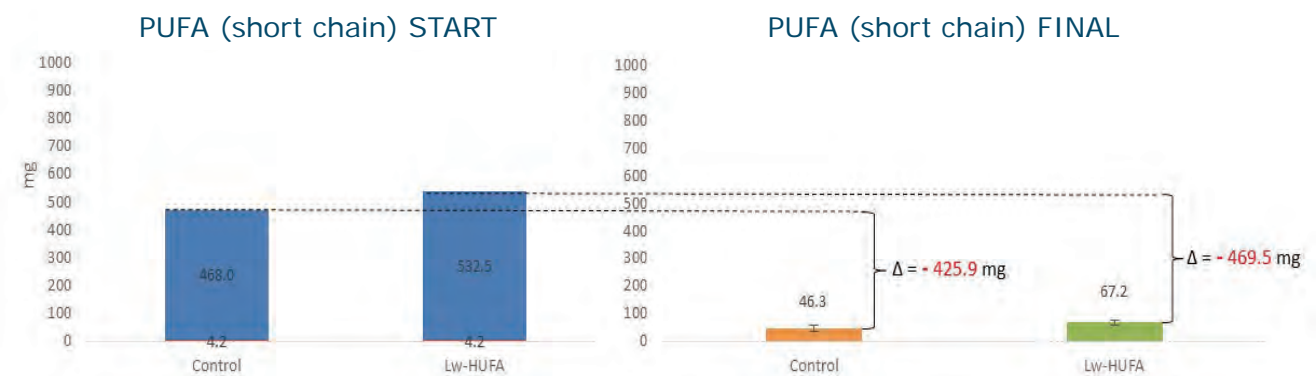
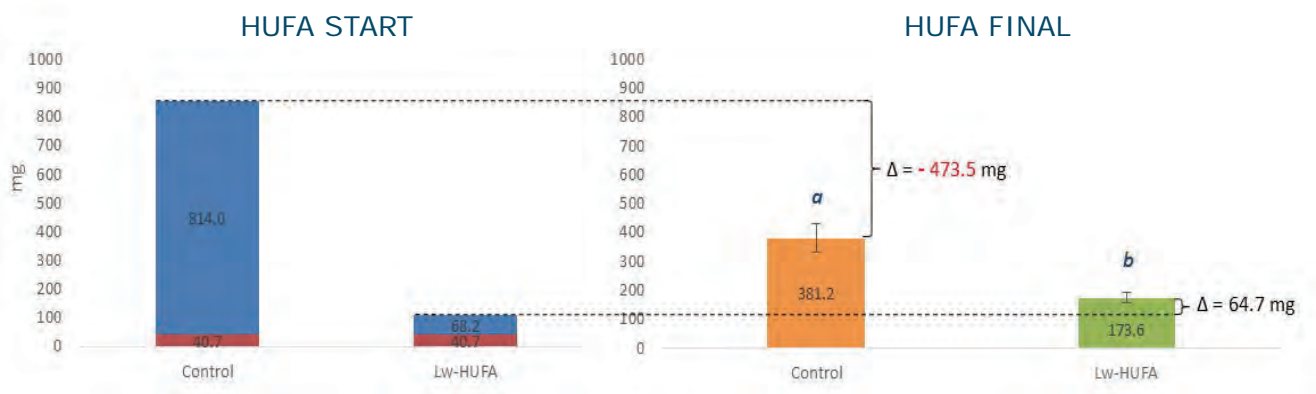


Shrimp HUFA sourcing?

How much?

How much HUFA did the shrimp source from natural food?

- ✓ Difference between standard diet, and a HUFA-poor diet (NO fishmeal, NO fish oil)
- ✓ 58-day experiment, sample start vs final
- ❖ Poorly understood nor been quantified in the past.



Shrimp HUFA sourcing?

Main findings

1. When fed standard commercial diets (containing 16% fishmeal and 1% fish oil), shrimp use 85% of short chain unsaturated fatty acids (ALA) as energy source instead of highly unsaturated fatty acid (HUFA) precursor.
2. Fully replacing fishmeal and fish oil did not affect shrimp biomass production in mesocosms, but resulted in shrimp lower in omega-3 HUFA.
3. When fed fishmeal and fish oil free diets, shrimp source at least 32% of their total HUFA gain from *in-situ* natural producers.

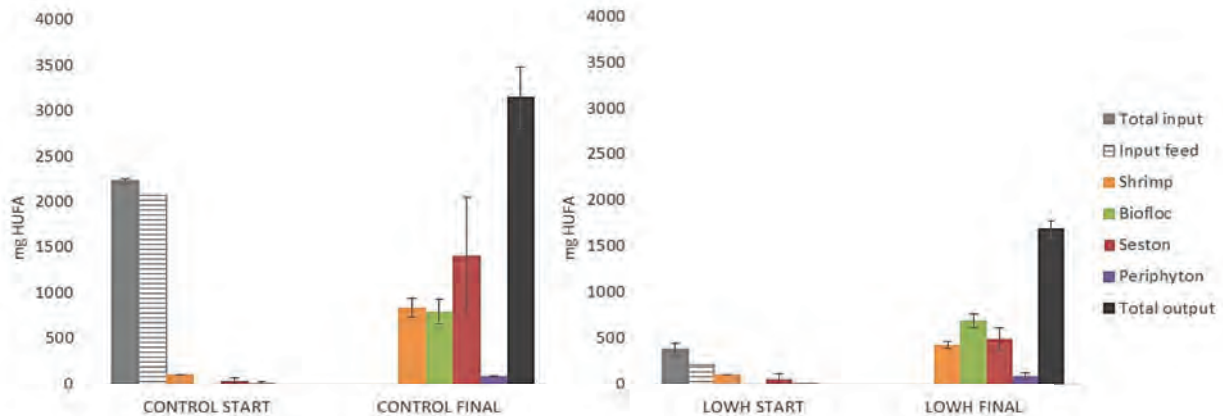


Natural food HUFA accumulation

How much?
Where?

- ✓ Quantification of in situ produced HUFA for each mesocosm compartment.





Natural food HUFA accumulation

Main findings:

1. Total mesocosm HUFA accumulation was >600% increase vs input.
2. More HUFA in compartments than in shrimp → reclaim?

Future study: reclaim nutrients in mesocosm.

How to make shrimp harvest HUFA-rich natural food more?
What is better:

- Biofloc stimulation
- Periphyton stimulation
- Partitioned production systems? (involve more species)
- Other?




Take home message:
**Feed the whole system.
Not just the fish.**



Nutritious Pond Concept, A Pathway to Sustainable Intensification of Aquaculture Systems?

Huynh Thanh Toi; Olivier Joffre; Laurens Klerkx and Marc Verdegem

Asian Forum for Aquaculture & Fisheries; Iloilo, Philippines April 2019



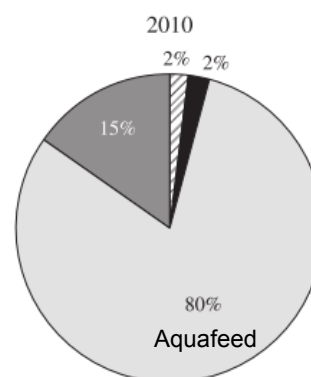
Aquaculture dilemma...

Aquaculture systems rely, for their majority, on fish oil and fish meal

but Fishmeal (FM) & Fish oil (FO) annual production is **finite**

Significant improvement are made in feed formulation and replacement of FM as source of protein

but future needs and prospects are uncertain



World Consumption fish oil

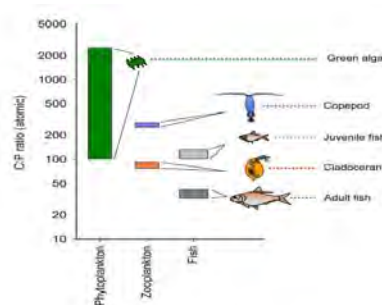
Shepperd et al. 2012



At the pond level...

Food quality is essential but

- Uneaten feed and metabolic waste from still valuable nutrients
- little attention is given to natural food produced in ponds



A portion of feed given in the pond become an expensive and not efficient fertilizer, with low C:N and C:P ratio

→ Waste is not fully decomposed, food web does not function well and misbalances in pond ecosystem make culture species less resilient.

→ Farmers try to correct misbalances, applying prebiotics, probiotics, disinfectants, extra nutrients etc...



Nutritious Pond Project : Paradigm shift “from feeding the animal to feeding the pond”

Objectives

Increase contribution of natural food to the animal diet by stimulating mineralization of wastes in the pond.

How:

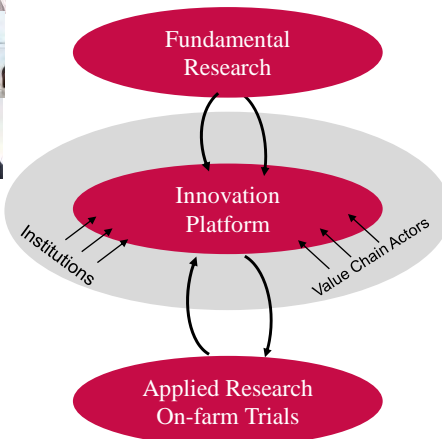
- Understanding pond ecology and nutrient transfer in the pond
- Modifying C:N ratio in the pond by applying (cheap) carbohydrate while reducing the feed amount



“Producing more shrimp using less feed” would result in some of the largest improvements in the environmental performance of most aquaculture systems – (Henriksson et al. 2018)



Multi-stakeholders approach to innovation in aquaculture

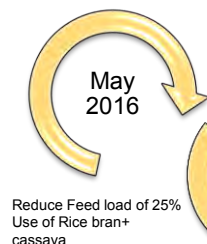


Context

- Mekong Delta, Vietnam & Bangladesh Delta
- Species – *Litopenaeus vannamei*, *Oreochromis niloticus*



Initiation of the Platform
Design of the 1st trials



Reduce Feed load of 25%
Use of Rice bran+ cassava

Reflection on the trials results
Design of the 2nd trial

Reduce Feed load of 15%
Use of cassava only

Reflection on the 2nd trial results
Design of the 3rd trials



3rd Trials Starting

Adaptable feed load during culture
Use of molasses

Reflection on the 3rd trial results
Design of the 4th trials



4th Trials Starting

Adaptable feed load
Rice-bran+ Corn starch
Follow by molasses



Field Trails Set up

Semi –Intensive Systems (30 PL/m2)

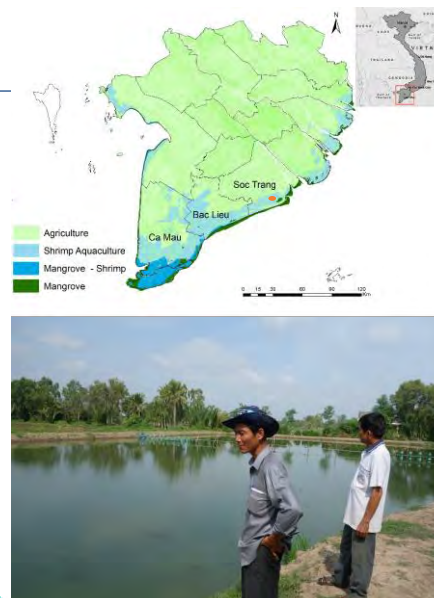
Species : *Litopenaeus vannamei*

4 farmers in Hoa De Cooperative; Soc Trang province

- 3 treatment ponds
- 3 control ponds (conventional feeding)

Skretting – supporting Feed and water analysis

Can Tho Univieristy :set up and monitoring



Evaluation – Trial 1

Only 75% of recommended feed load – Rice Bran+Cassava

Requirements and functions

Technical

- Productivity: 3.6 tons/ ha
- FCR : 1.1
- Survival rate: 85%
- Growth 60 days:100 pce/kg
- No additional significant work load – easiness of use

Economic

- Cost below 100 Mvnd/ha
- Decrease 20% of feed cost

Biology/Ethology

- Hepato-pancreas dark grey
- Body: grey colour
- No diseases

Evaluation of Performances



Storage: pest infestation of rice bran
Preparation work load
Composition : rice bran mineralization

Yield below expectation (3ton/ha)
Slow growth and small shrimp size at harvest with too low FCR (<0.5)





Fast mineralization of waste until 40 days
Good water quality and shrimp health
High survival rate (>90%)
No disease (vs control)
Lower cost (-10%) and higher return return



Evaluation – Trial 2



Only 85% of recommended feed load – Cassava Only

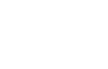
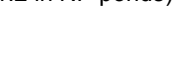
Requirements and functions	Performances
Technical <ul style="list-style-type: none"> Productivity: 3.6 tons/ ha FCR : 1.1 Survival rate: 85% Growth 60 days: 100 pce/kg No additional significant work load – easiness of use 	 <p>Limited growth rate after 60 days Average yield (1.9-2.7 ton/ha) Lower financial return vs Trial 1 Cassava only have less positive effects on pond than cassava-rice bran mix <u>Difficult environmental condition in 2017</u></p>
Economic <ul style="list-style-type: none"> Cost below 100 Mvnd/ha Decrease 20% of feed cost 	 <p>No Storage issue and reduced workload Using Carbohydrate during pond preparation is efficient Lower cost High survival rate Healthy animal vs control</p>
Biology/Ethology <ul style="list-style-type: none"> Hepato-pancreas dark grey Body: grey colour No diseases 	



Evaluation – Trial 3

Only 75 to 95% of recommended feed load – Molasses Only

Requirements and functions	Performances
Technical <ul style="list-style-type: none"> Productivity: 3.6 tons/ ha FCR : 1.1 Survival rate: 85% Growth 60 days: 100 pce/kg No additional significant work load – easiness of use 	 <p>Slow growth and disease in control and treatment ponds Crop: 60-82 days Variable yield (1.3 to 3 tons/ha) and net return</p>
Economic <ul style="list-style-type: none"> Cost below 100 Mvnd/ha Decrease 20% of feed cost 	 <p>Easiness to use Molasses Vibrio concentration low (1-6 X10²) The average individual growth per day was higher in trial (138 mg/day) than control ponds (114 mg/day)</p>
Biology/Ethology <ul style="list-style-type: none"> Hepato-pancreas dark grey Body: grey colour No diseases 	<p>FCR was higher than in Trial 1 and 2 (1 – 1.2 in NP ponds)</p>



A pathway to sustainable intensification

- *Nutritious Pond* concept uses less feed for similar productivity and creates a more resilient pond system
- “Feeding the pond” does not require a RADICAL innovation

Reducing feed load without loss of productivity can be achieved by managing C:N ratio in the pond but more research is needed:

- Influence of bacterial community
- What impact of the environment (methane emission?)



Thank You

Follow us on Research Gate: *The Nutritious Pond Project*

Contact : Olivier Joffre – o.joffre@cgiar.org



Aquaculture Innovation Research : What (or who) are we missing?

Olivier Joffre; Laurens Klerkx

Asian Forum for Aquaculture & Fisheries; Iloilo, Philippines April 2019



Aquaculture, the most dynamic sector of global food system

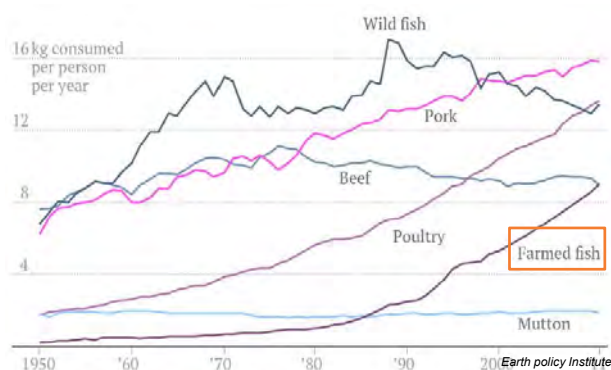
8% annual growth since 1990

Provide 50% of all the fish consumed worldwide.

**Any future expansion of fish supplies must
come from aquaculture**

Driven by Private sector – technical Innovation

Significant contribution of SME in South and SEA



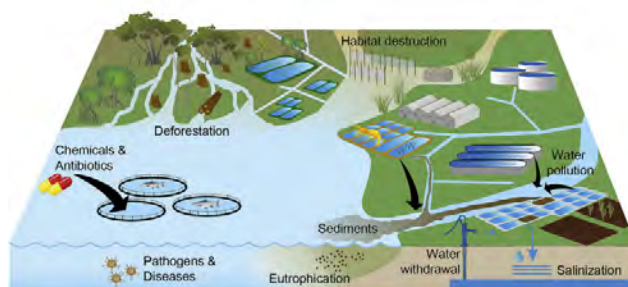
but facing (new) challenges

Social and environmental impact of aquaculture

Prospect in growth require technical and social transformation on the way we raise fish

It requires new type of innovation to tackle new challenges and delivers the desired development outcomes:

- Sustainable
- Equitable
- Inclusiveness



Source: Ottinger et al. 2016



Innovation Research in Aquaculture?

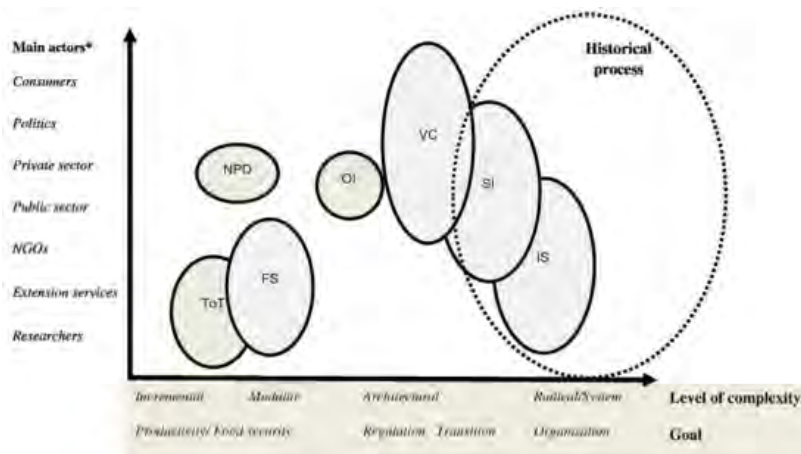
Innovation can be technical but also non- technical (social, organizational, institutional)

Innovation research in agriculture sector is approach by different angles, focus and scope.

What about in the Aquaculture sector?



Open Innovation (OI), New Product Development (NPD)



Systematic review

Screening by types of Approaches & Inclusion Criteria

100 articles selected



Where is the focus?

Transfer of Technology

Pond & Cage Management

Breeding

System Approaches

National sector transformation

Legal and institutional changes

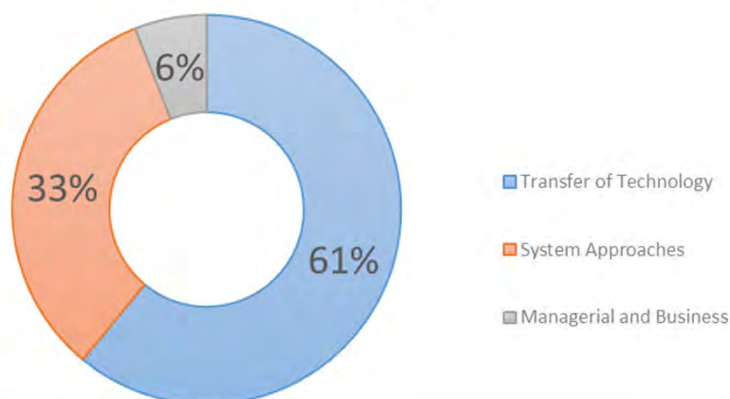
Certification and Standards

Managerial and Business

Breeding

Value Chain Innovation

Innovation Research Publication in Aquaculture
1960-2016

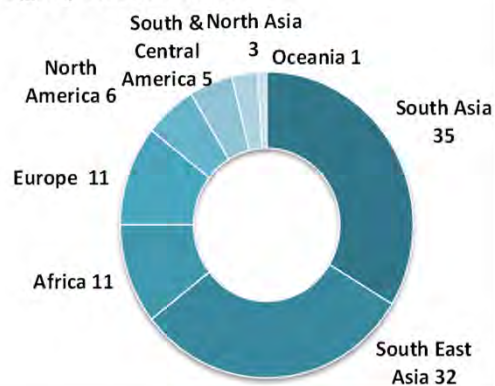


Where is the focus (ii) ?

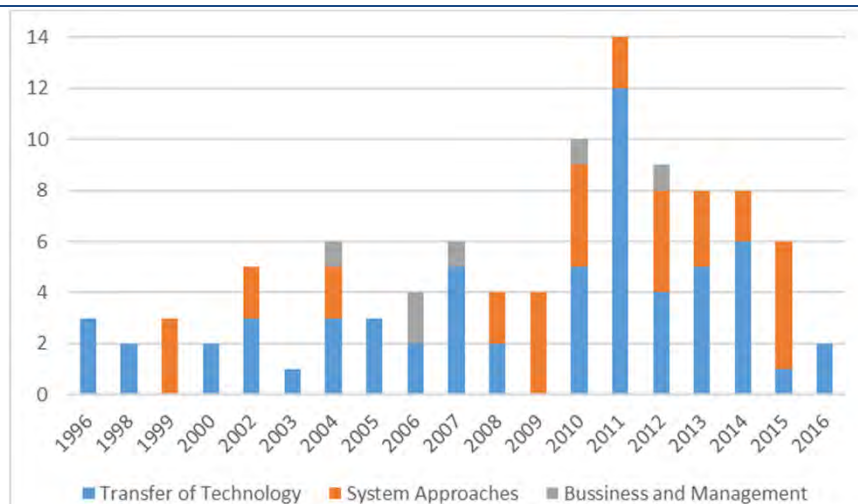
Habitat



Geographical focus



A new trend in Aquaculture Innovation research?



Already some changes in aquaculture innovation literature

Gender

Gender and aquaculture value chains: A review of key issues and implications for research

Froukje Kruijsen^{a,*}, Cynthia L. McDougall^b, Imke J.M. van Asseldonk^c

Smallholder Nutrition

Fish consumption in urban Lusaka: The need for aquaculture to improve targeting of the poor

Sven Genschick^{a,*}, Pamela Marinda^b, Gelson Tembo^c, Alexander M. Kaminski^a, Shakuntala H. Thilsted^d

Income & poverty

Give a Man a Fishpond: Modeling the Impacts of Aquaculture in the Rural Economy

Mateusz Filipiński^{a,*}, Ben Belton^b

Technological changes

The “quiet revolution” in the aquaculture value chain in Bangladesh

Ricardo Hernandez^{a,*}, Ben Belton^b, Thomas Reardon^b, Chaoran Hu^b, Xiaobo Zhang^c, Akhter Ahmed^a



Co-design to tackle complex problems

- Push by donors (EU; WOTRO) for “Knowledge platform”, PPP
- Need to involve Private Sector in development (policies, agenda)
- Multi-stakeholder approach & Platform



Knowledge more relevant to different stakeholders & specific target groups - Inclusiveness

Adapted to local needs and context to facilitate adoption

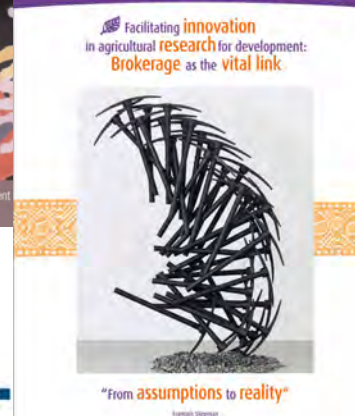
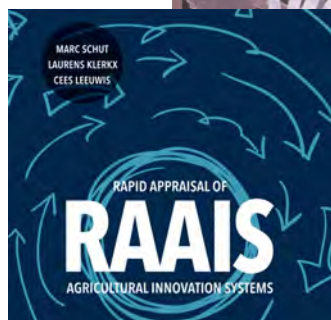
Not only technology driven

Private sector to achieve impact



Multi-stakeholder approach Tools and Method for agriculture

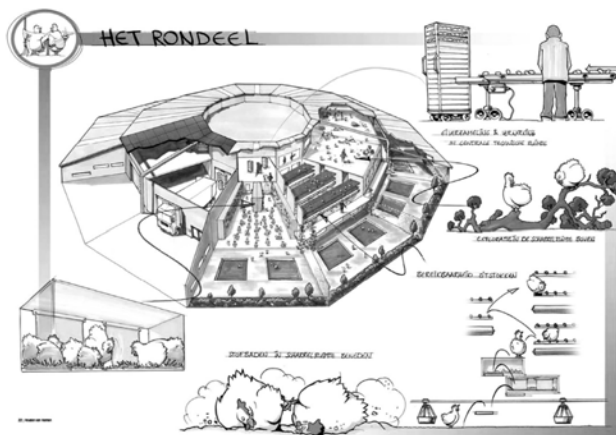
- Numerous guidebooks and material originating from agriculture sector
- Usually to solve governance/ Institutional problem along Value Chain
- Limited influence of Aquaculture experience (i.e. round table for international standards)



Co-designin aquaculture?

Dominance of livestock and poultry sector

- Methods and practices from agriculture and livestock sector
- No “Aquaculture example” documented



some emerging cases...



Interest of private sector to reach SME fish farmers
Contextualized technology for users with limited capacity
and facing multiple constraints



Easy to implement?



- Not research centered but private sector and users influence...need to compromise
- Convince stakeholders
- Need proof of concept –often timeframe of project does not allow
- Accept culture and norms....



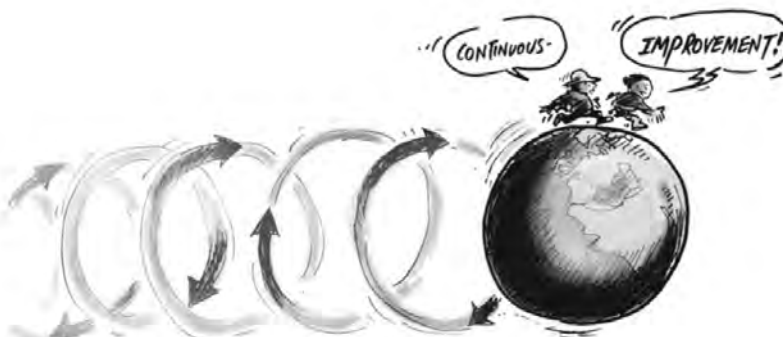
- Better insight in user need and requirement
- Exchange between fundamental and applied research
- Private sector expertise
- Insight in adoption process



Multi-stakeholder approach to take into consideration complexity

Complementarity with *Technology driven approaches*

- Multi levels perspective – going beyond the farm
- Add institutional and social dimension with : regulatory framework and organization of farmer
- Inclusive and tailored innovation
- Ultimately facilitate uptake





WAGENINGEN UNIVERSITY
WAGENINGENUR



Constraints to Aquaculture Innovations in Demak and Brebes, Indonesia

Tita Elfitasari, Laurens Klerx, Olivier Joffrey, Roel H. Bosma
Sri Rejeki, Lestari Lhaksmi W, Restiana Wisnu A,

1

Background



- Northern coast of Java,
 - mangrove forest converted to brackish water ponds
 - ground-water extraction, land subsidence,
 - sea water rise and tidal floods

Resulting in loss of land, aquaculture ponds became submerged and disappeared affecting local livelihood

2

Background

Integrated Multi-trophic Aquaculture (IMTA) concept the utilization of waste from higher trophic to be used as feed for species of the lower trophic

The concept of Integrated Multi Trophic aquaculture (IMTA) was suggested as a promising strategy to recover aquaculture in areas impacted by coastal abrasion.

Environmental technology for increasing the shrimp production, as well as the product diversification



3

Question & Approach

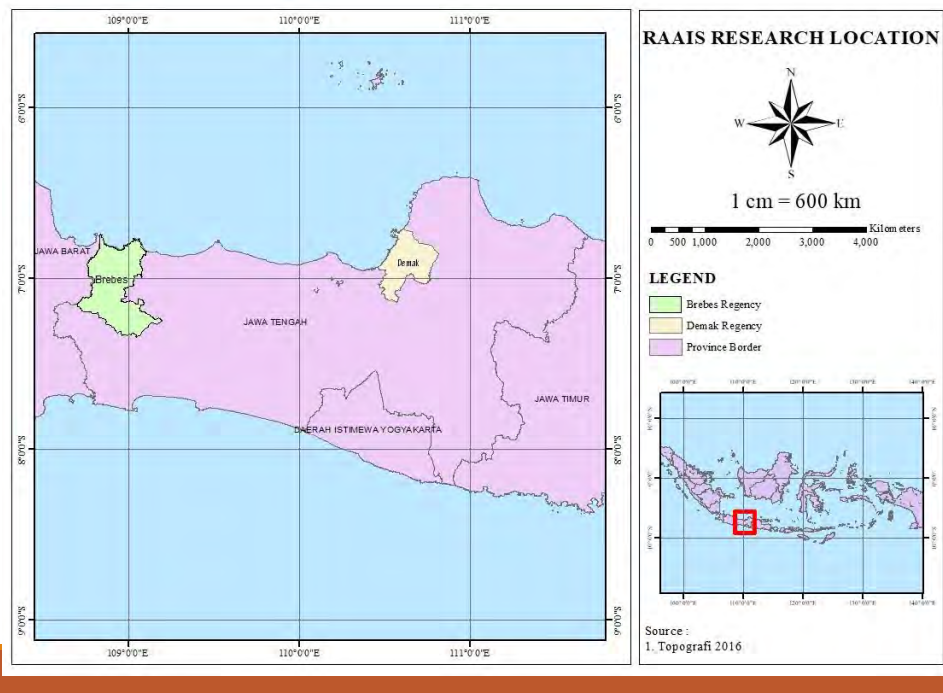
What are the constraints to adopt IMTA system in area with high coastal erosion?

System Approach :

- Multi- dimensions (technical, institutional , biophysical, political, socio-cultural)
- Multi-stakeholder involvement
- Multi level – understanding if the constraints are operating at local level (pond farm village) or at higher level



4



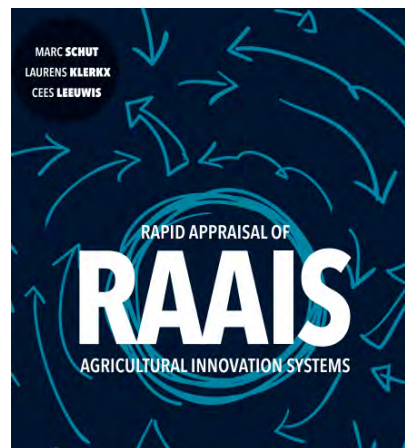
5

Methodology

Rapid Appraisal of Aquaculture Innovation System (RAAIS) – in two location : Demak and Brebes

RAAIS :

- Multi-stakeholder process to identify constraints to innovation and entry point for action
- Used in agriculture (and aquaculture)



6

Stakeholder

- Farmers
- Government & Extension services
- NGO
- Academic
- Private Sector



7



8

DEMAK

Top 5 constraints identified by

FISH FARMERS	NGOS
➤ Low water quality	➤ Regional policy depend on political party and keeps changing
➤ Low pond soil quality	
➤ High price of commercial feed	➤ Lack of farmers' knowledge and motivation to implement new technology without proof of success
➤ Low quality of seed	
➤ Marketing problems	➤ Lack of technology transfer
	➤ Lack of farmers' skills in adopting new innovation
	➤ Lack of access to market and credit

9

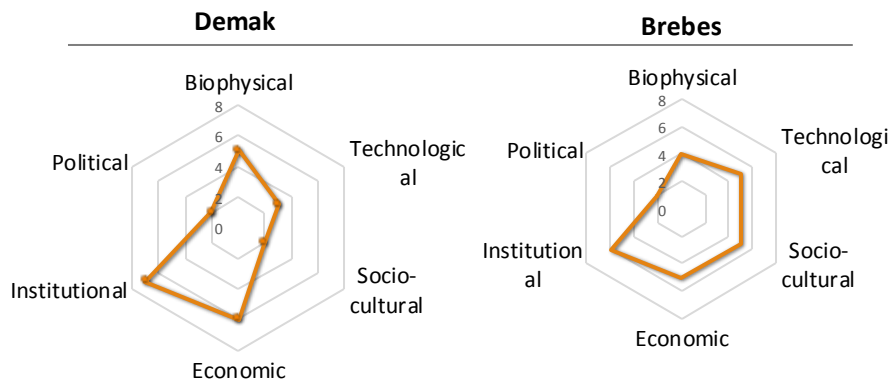
BREBES

Top 5 constraints identified by

FARMERS	NGO
➤ Low quality of seed	➤ Unpredictable condition of weather and climate
➤ Low selling price	➤ Limited knowledge of aquaculture technology and only adopt from parents
➤ Unsupportive infrastructure (roads and bridges)	
➤ Disease and parasite problems	➤ Unstable market
➤ Heavy abrasion problems	➤ Lack of capital
	➤ Lack of good infrastructure to support aquaculture process

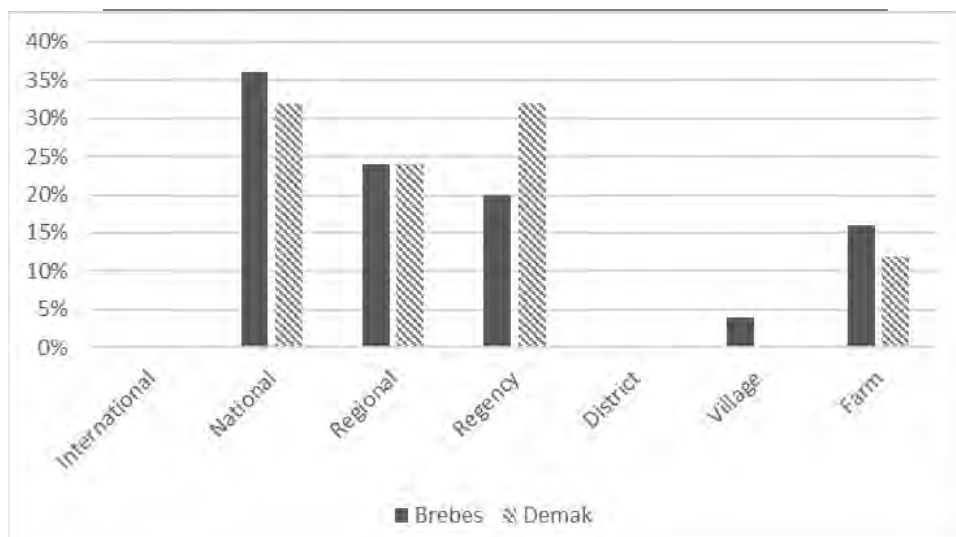
10

Type of Constraints



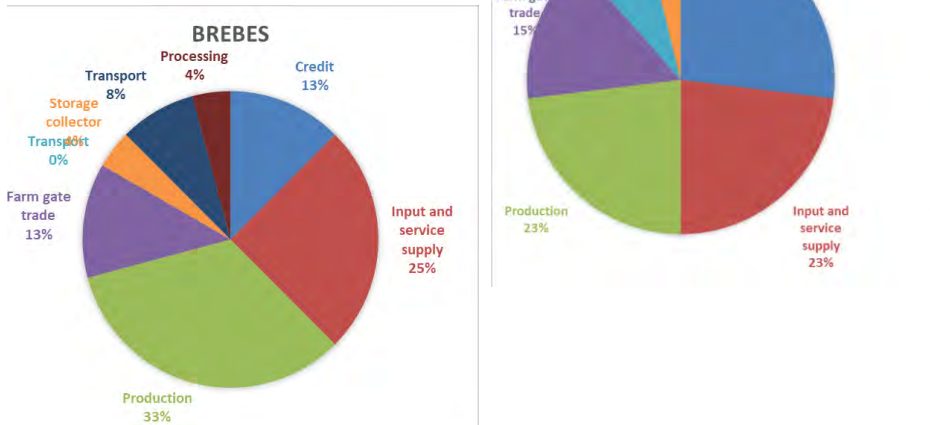
11

Percentage of constraints and challenges across different administrative levels



12

Constraints along value chain



13

Conclusion

- Most constraints were institutional, rooted in laws and regulations at the national level
- Supporting IMTA development and sustainable coastal aquaculture will be dependent on improving infrastructure
- Lack of extension services and their capacity to support farmers was key to both locations
- Adoption of IMTA and other innovations in the mangrove restoration areas of Brebes and Demak regency face mostly similar challenges along their value chains

14

Acknowledgement

Thank you to:

NWO Netherlands for funding the project

Staffs from Wageningen University and Worldfish for assistance in RAAIS training

Brebes and Demak Region Fisheries and Marine Government Office for coordinating the stakeholders

Staff and students of Aquaculture Department, Faculty of Fisheries and Marine Sciences Diponegoro University for assisting the workshop.



Effect of a service provision model to include Bangladesh's small holder and landless farmers in the agricultural value chain

Nazneen Khan, Qazi Azaz-Uz-zamaz, Shamim Hossain, Kate Hartley & Malcolm Dickson

NWO
Netherlands Organisation for Scientific Research
WOTRO Science for Global Development

Food & Business
Knowledge Platform

WorldFish

WAGENINGEN
UNIVERSITY & RESEARCH

Background

- ❑ 15 million smallholders
- ❑ Productivity didn't change in last decade
- ❑ Conventional extension focused on commercial producer
- ❑ Small producers contribute majority of the aquaculture production
- ❑ Local traders can help smallholders

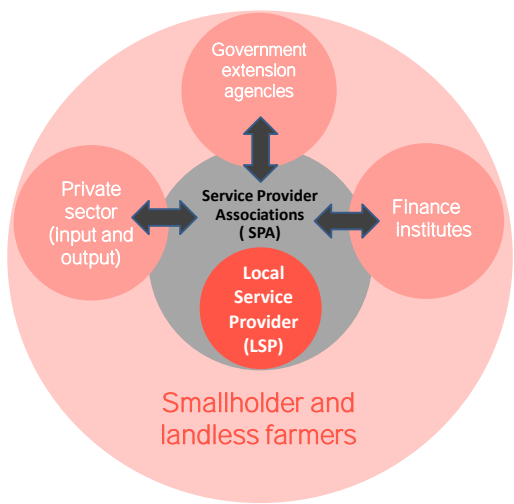


Goal

The project aims to support 180,000 smallholder farmers in Bangladesh through improved access to appropriate technical advice, affordable inputs, business and market support.



What is LSP model?



Local Service Provision model

Core stakeholders

- ❖ Producer groups
- ❖ Input market actors
- ❖ Output market actors
- ❖ LSPs and SPA

Supporting stakeholders

- ❖ MFIs
- ❖ Government line department
- ❖ Private company

Enabling environment stakeholders

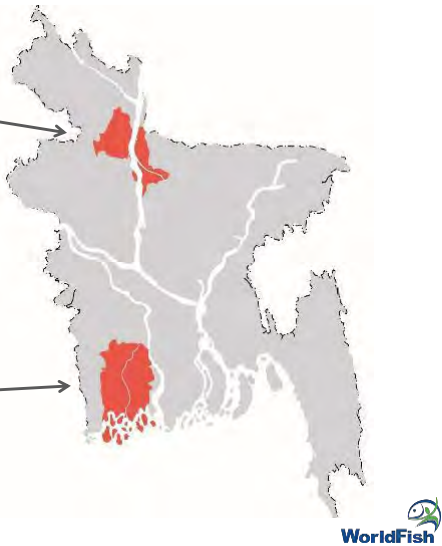
- ❖ Labor association
- ❖ Transporter
- ❖ Local administration



Where the model has tested?

Gaibandha and Jamalpur
12 upazilla frequently hit by monsoon floods

Khulna and Bagerhat
6 upazilla where frequent cyclones, storms & waterlogging crisis



Model inclusiveness

- ✓ 40 Women's Business Centres (WBC) were established to support female LSPs who have more difficulty in accessing markets, this also was designed to increase earning potential of female LSPs
- ✓ 200 women LSP selected & trained through which 40,000 rural women in order to effectively reach female farmers



How LSP provide services



Income & Employment:

86% of the households experienced a 31% rise in annual income.



Gender : Values & rights

Most of the women are making house hold decisions, market own produces and make household decisions



WorldFish

Food Security and Nutrition

- Up to 96% of the households consume three meals per day
- 98.5% of these consume 5 out of the 8 World Health Organization (WHO) recommended food groups
- Yields increased by 32% in fish, 94% in poultry and 101% in tomato



WorldFish

Major learning : What worked?

- ✓ The assumption that “Farmers pay if services are accessible, affordable, holistic, and thus adding a value to the agricultural produce” has been proofed as realistic
- ✓ Working as agents for financial services, inputs and output markets, LSPs are able to offer holistic services
- ✓ The complementation of public extension services with LSPs increases the outreach and efficiency of the public extension system



Major learning :What needs to be changed?

- ✓ Pool of LSPs can be formed jointly by line department, market and project representatives. Cumulative support from multiple organizations will increase skill as well as their acceptance to the community



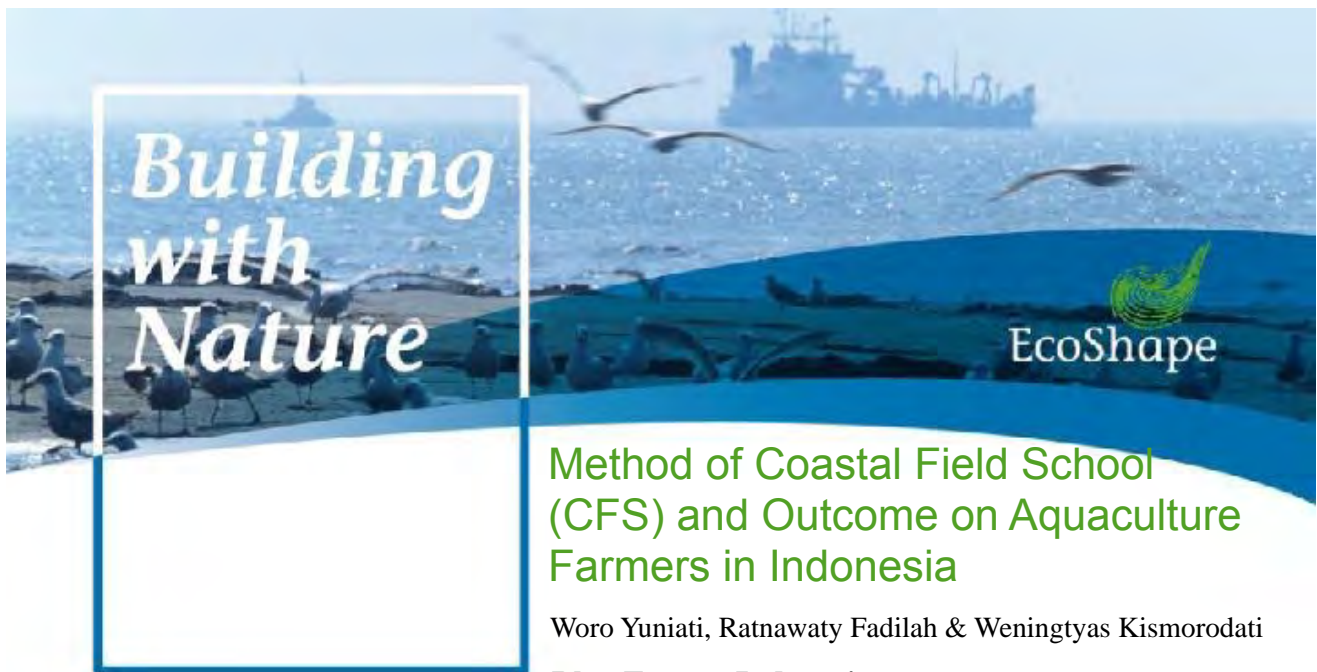
Major learning :What are still unclear?

- ✓ Financial capacity of SPA can be increased involving producer group members with SPA. It can be done through monthly deposit of the farmers , lending deposited money among members, supporting project implementation of NGOs, doing small business, developing market place for the farmers



Thank You





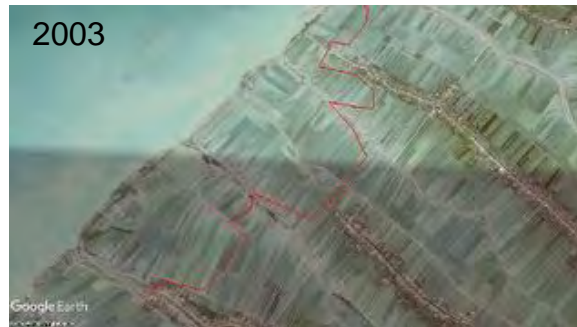
Outline

- A brief introduction to Coastal Field School (CFS) program within the BwN project
- What is CFS Approach?
- CFS Principles
- CFS learning process
- Achievement of CFS program
- Conclusion



Overview of Building with Nature (BwN) Project

- BwN is Dutch-Indonesia cooperation program which aims at securing the severely eroding Northern Java's delta coastlines, which is driven by loss of mangrove and land subsidence, from 2015-2020.
- This project provides a combined sustainable solution of mangroves and aquaculture to restore the degraded ecology and economy.



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2018



BwN Socio-economic Target

- The majority of coastal Demak livelihoods are capture fisheries and aquaculture.
- Those who mainly affected by the coastal erosion and floods are brackishwater aquaculture farmers.
- In addition to the aforementioned problem, poor management capacity of the farmers causes low aquaculture productivity
- The BwN project is targeting to revitalise the aquaculture productivity by **50 % by 2020**
- To achieve the successful aquaculture revitalisation and ensure the long term success, the project provides capacity building for the farmers in sustainable aquaculture management using **coastal field school** (CFS) approach.

What is Coastal Field School ?



Concept:

- experiential
- participatory
- problem solving based
- discovery based
- One production cycle

Objective:

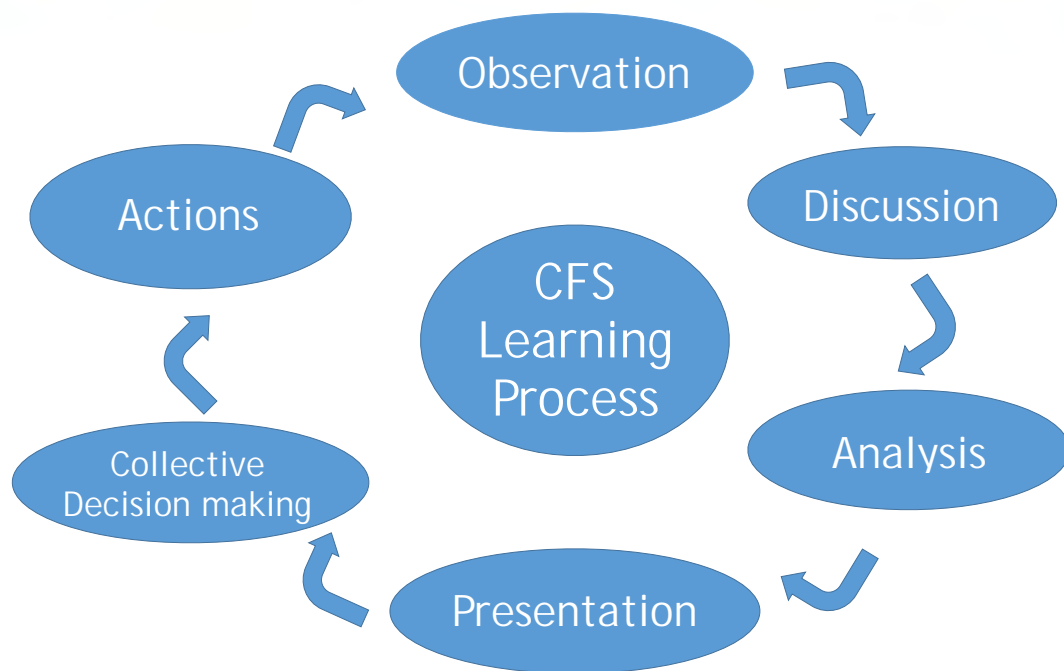
- To build farmers' capacity to critically analyse their production system, identify problems, test possible solutions that most suitable to the local condition and farming system (FAO, 2003)
- To provide small farmers with practical experiences in ecology and agroecosystem analysis to enable them to grow a healthy produce sustainably and in sovereignty in the context of integrated coastal resource management

CFS principles:

- The CFS activity covers **one production cycle**
- The primary learning place is **the field (pond)**
- **Equity**, no hierarchy
- **Facilitating** instead of teaching
- The farmer as **expert**
- **Hands-on** and **discovery-based** learning
- **Comparative experiment** (low external input sustainable aquaculture (LEISA) vs traditionally managed pond)
- Typical activities: the 1) **agroecosystems analysis**, 2) **special topic**, and a 3) **group dynamics**
- **Integrated and learner-defined** curriculum



CFS Learning Process



CFS Learning Process



CFS monitoring and evaluation method

- Participants were given a questionnaire eliciting a list of knowledge and skills that they already have before the CFS activity and the same questionnaire at the end of the CFS cycle
- Focussed Group Discussion (FGD) on the participants change
- Pond management logbook recording

Outputs:

No	Increased Knowledge	Pre test	Post test	%
1	Low External Input Sustainable Aquaculture system	0	14	70
2	Diseases and its prevention measures	1	10	50
3	Economic analysis of pond production	5	12	60
	Increased Skill			
1	MOL and Compost making	0	14	70
2	Feed making from locally available ingredients	0	12	60
3	Conducting agroecosystem analysis	0	13	65
	Increased Confidence			
1	Public speaking	9	10	50
2	Problem solving	0	6	30
3	Decision making	0	10	50

Outcome:

1. 50% participants adopt LEISA system in their own farms
2. 2 local champion use their improved knowledge and skill to provide technical assistant on pond management for their farmer colleagues
3. 50% participants are capable of making local microorganism (to degrade the remaining organic matters in the pond) from locally available ingredients
4. The participants (in group) are capable of producing fish/shrimp feed from locally available ingredients
5. The CFS alumni are inspired and has their independent comparative experiment to improve pond management with their group
6. The participants are more critical and confident in negotiation (having a voice) with other party or new technology intervention

Achievement

1. Adoption of Coastal Field School approach by the local government (in the Mid-term District Development plan)

Conclusion

1. Strengthening observation capability and increasing knowledge ownership through discovery based learning
2. Building self-confidence and enhancing decision-making capacity
3. Minimizing risks in experimenting with new practices
4. Changing deep-rooted beliefs and practices
5. Developing problem-solving capabilities

Reference

- Brown, Benjamin. 2015. Coastal Field School Prospectus. Blue Forests. Unpublished document
- Hagiwara, T., Ogawa, S., Kariuki, P. M., Ndeti, J. N., and Kimondo, J. M. 2011. Farmer Field School Implementation Guide. Farm Forestry and Livelihood Development. FAO, JICA and Kenya Forest Service.

Thank You



Building with Nature - Indonesia



Kementerian Pekerjaan Umum
dan Perumahan Rakyat



Wetlands
INTERNATIONAL



IMARES

WAGENINGEN UR



Kolaborasi Perikanan dan
Baku Kelautan

UNESCO-IHE
Institute for Water Education





The Impact of Coastal Field School (CFS) on Pond Production in Demak Central Java, Indonesia

Sri Rejeki
Roel Bosma
Restiana Wisnu Ariyati
Lestari Laksmi Widowati

Introduction

- Coastal Abrasion
- Destruction of mangrove forest for brackish water ponds
- Ground-water extraction
- Climate change

- Degradation
- Physically
- Chemically &
- Biologically

Loss of land and livelihoods.

Demak District, Central Java, is one of the areas where brackish water pond production, i.e. shrimp and milk fish, provided a source of wealth for the local community

Yield decreasing: 2015

- 200 kg/ha/year milk fish
- 43 kg/ha/year of white leg, tiger and local shrimps



PROBLEMS IN AQUACULTURE

Degradation of brackishwater pond environments:

- Extreme degradation: loss of the pond → broken dykes
- Mild degradation: decrease in the pond environmental quality of physical, chemical and biology:
 - Pond management problems,
 - Decrease in pond carrying capacity,
 - Decrease in pond production,
 - High operational costs

PROBLEMS SOLVING

Modified-Low External Input Sustainable Aquaculture (LEISA) Application

Can maintain
the balance
of the pond
ecosystem

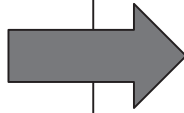
Increase
pond
production

Alleviate
poverty

Increase
farmer
income

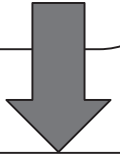
Open jobs
opportunity

Modified-Low External Input Sustainable Aquaculture (LEISA) Application



Coastal Field Schools (CFS)

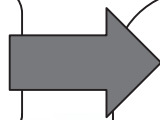
- Trains farmers on good management practice in aquaculture: Improving pond management
- Application of the home-made fermented organic fertiliser, called MOL



The achievements in three of the villages that applied LEISA were monitored monthly



Objectives



1. Increase pond production
2. Improve the quality of safe and healthy aquaculture products
3. Maintains the balance of ecosystems by organic materials application in the system



Methods

1. Case study
2. A purposive random sampling in 3 villages: Tambakbulusan, Purworejo, Morodemak
3. March 2016 – December 2018

LOKAS

MATERIALS

Monitored ponds from 3 villages

Where the farmers implemented the learning from CFS in their ponds during the same season as the training was given, no individual baselines were measured.

1. Tambakbulusan: 5 ponds
2. Purworejo: 5 ponds
3. Morodemak: 6 pond farmers,



1. Local made Probiotic: Local Micro Organisms (LMO)
2. WQC
3. Shrimp Juveniles
4. Milk fish fry

Data Collection

Water Quality Parameters

- Chemis: DO, TAN-NH3, Nitrit, Salinity
- Physics: temperature, Transparency; Colour
- Biology: Plankton

Shrimp and Milkfish Yield

- Revenue
- Benefid Cost Ratio



RESULTS



Water quality monitoring



The higher shrimp yielded in volume and size from the pond with M-LEISA concept

Water Quality

- Mostly acceptable
- Nitrate and phosphate levels were good for plankton growth
- The ammonia levels in these ponds mostly stayed within the safe range
- In some ponds the pH was beyond the optimum range
- At the turn of the seasons the salinity & water temperature changed drastically
- At most sampling days the observed ponds had sufficient plankton abundance.

The water quality parameters of Monitored Pond M-F

Date	Physical			Biological	Chemical					
2018	Clarity (cm)	T (°C)	Water Color	Plankton (*10 ³ ind/L)	DO (ppm)	pH	Salinity (ppt)	N (ppm)	P (ppm)	Ammonia (ppm)
25/7	50	29,3	Greenish Yellow	8,36	5,81	8,7	32	1,63	0,20	0,04
14/8	40	34,2	Greenish Yellow	15,2	5,9	8,6	30	2,02	0,09	0,01
14/9	35	31	Green	16,1	4,8	8,6	35	2,82	0,17	0,01
26/10	30	33,4	Brown	20,2	5,8	8,3	30	3,6	0,02	0,18

Shrimp and Milkfish Yield; The pond's average areas and the average operational cost (OC), yield, revenues and benefit per ha , and the Benefit/Cost ratios, for farmers applying MOL or not.

	Pond	Area (Ha)	OC (*1,000 IDR)	Yield (kg)		Income (*1,000 IDR)		Total Revenue (*1,000 IDR)	Benefit (*1,000 IDR)	Benefit / Cost ratio
				Milkfish	Shrimp	Milkfish	Shrimp			
No MOL applied	TF	4	1,700	75	190	900	15,200	16,100	14,400	8.5
	TH	0.75	3,037	900	261	10,800	20,907	31,707	28,670	9.4
	M-B	1	1,891	750	-	9,000	-	9,000	7,109	3.8
	M-C	4	974	600	-	7,200	-	7,200	6,226	6.4
	M-D	3	1,369	500	-	7,000	-	7,000	5,631	4.1
	M-E	3	1,692	750	-	9,000	-	9,000	7,308	4.3
	M-F	3.5	866	857	-	10,286	-	10,286	9,420	10.9
	Average	2.75	1,647	633	226	7,741	18,053	12,899	11,252	6.8
Farmers applied MOL	TB	2.5	2,850	900	338	10,800	27,008	39,008	36,158	12.7
	TD	2	2,140	1,050	291	12,600	23,240	35,840	33,700	15.7
	TG	4	907	825	-	9,900	-	9,900	8,994	9.9
	P-A	0.5	8,440	1,000	300	14,000	25,500	39,500	31,060	3.7
	P-B	0.25	15,180	840	480	11,760	33,600	45,360	30,180	2.0
	P-C	3	1,539	600	220	7,200	17,600	25,133	23,594	15.3
	P-D	0.75	5,967	500	220	6,000	17,600	23,600	17,633	3.0
	P-E	1.5	1,637	67	55	800	4,427	5,227	3,589	2.2
	P-F	1	4,250	900	240	10,800	19,200	30,000	25,750	6.1
	M-A	0.6	3,200	1,000	-	12,000	-	12,000	8,800	2.8
	Average	1.61	4,611	768	268	9,586	21,022	26,557	21,946	7.3



Most farmers in Morodemak pursued using an-organic chemicals

Most farmers of Tambakbulusan and Purworejo implemented the LEISA they learned at the CFS:

1. Application of the home-made fermented organic fertiliser, called MOL.
2. Water quality improvement through
 - drying of the ponds for at least 5 days,
 - mixing composted goat manure to the sediment,
 - adding MOL before stocking.
 - Applying smaller dose of MOL weekly during the culture period

- All 17 farmers stocked milkfish and
- more than half did 1, 2 or 3 cultivation cycles of shrimp.
- The production of milkfish 1 cycle of 5-6 months
- the tiger or whiteleg shrimp were cultured in cycles of 2-3 months.

Tambakbulusan & Purworejo,

- Cultivated both milkfish and shrimp, and applied MOL,
 - the average shrimp yield ± 260 kg/ha (6x the baseline).
 - The average milkfish yield was around ± 712 kg/ha (3x the baseline).

Morodemak

- Farmers cultivate milkfish only
- Not applying MOL,
- harvested 743 kg/ha (slightly higher than in the two other villages.)



The pond's average area, the operational cost (OC), yield, revenues and benefit per ha, and the Benefit/Cost ratio.

	Area (ha)	OC (*10 ⁶ IDR / ha)	Yield (kg/ha)		Income (*10 ⁶ IDR/ha)		Total Revenue (*10 ⁶ IDR/ ha)	Benefit (*10 ⁶ IDR/ha)	Benefit / Cost ratio
			Milkfish	Shrimp	Milkfish	Shrimp			
Tambakbulusan	2,65	2,1	750	216	9,0	17,3	26,5	24,4	11.3
Purworejo	1,17	6,2	651	253	8,4	19,7	28,1	22,0	5.4
Morodemak	2,52	1.7	743		9.1		9.1	7.4	5.4

The farmers in Purworejo invested more in an attempt to make a decent income from the smaller area

In Tambakbulusan and Purworejo, where most farmers cultivated both milkfish and shrimp, and applied MOL:

- The average shrimp yield was about 260 kg/ha which is more than six times the baseline.
- The average milkfish yield was around 712 kg/ha (> 3X the baseline)
- The operational cost
in Tambakbulusan : 30% > in Morodemak
1/3 > in Purworejo
- The gross margin
in Purworejo < in Tambakbulusan
in Purworejo and Tambakbulusan 3X > in Morodemak
- B/C Ratio
in Purworejo and Morodemak 0,5X < in Tambakbulusan

SUM-UP

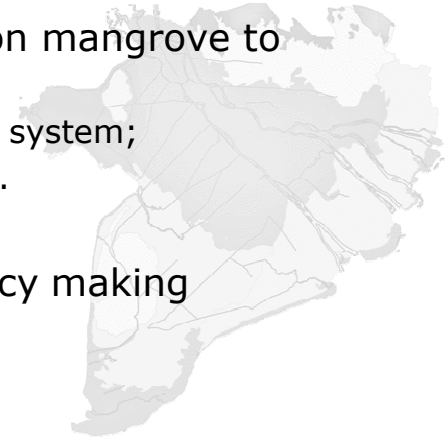
1. After Coastal Field School most Farmers apply pond management following LEISA concept
2. Some farmers continue semi-intensive system.
3. Average gross income:
 - Baseline (2015): about 10 million IDR per year.
 - For one cycle after CFS: 20 million IDR.
4. Farmers can do at least two cycles per year and thus can double their income when implementing the LEISA system learned during the CFS.



Overall Goal ALEGAMS Project

ALEGAMS: *Assess the Learning Effects of Games on Attitude of Stakeholders on Sustainable Shrimp Farming.*

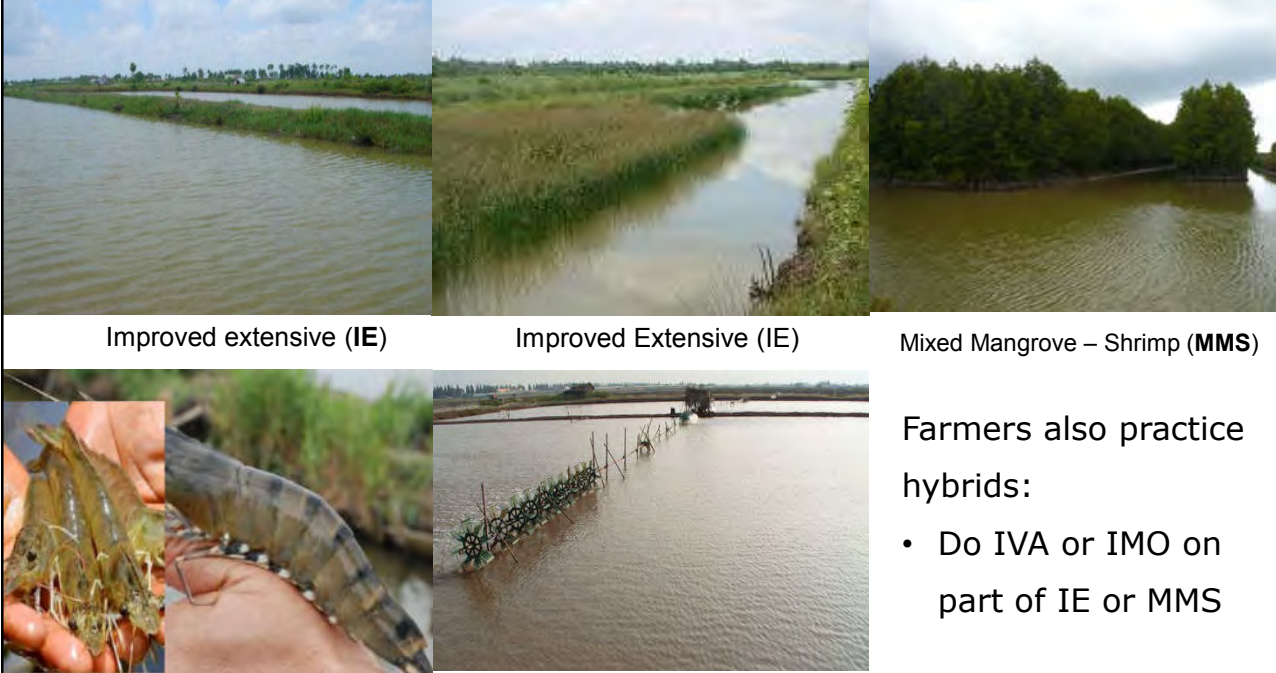
- ❖ Raise knowledge and awareness on mangrove to influence:
 - Farmer's decisions on the production system;
 - Policies and plans in the coastal area.
- ❖ Connect local knowledge with policy making
 - Insight in feasibility;
 - Improve decision making.



Shrimp Farming Board Game

- ❖ Challenging: % of risk every round determined by two 10-sided dices.
- ❖ Farmers' perceptions (opinion, attitude)
 - % of loss (risks) in different systems;
 - skill to escape the loss;
 - role of technology;
 - importance of mangroves.
- ❖ Realistic
 - The economic characteristics;
 - General event cards;
 - Personal event cards;
 - Technology options;
 - The option to buy or sell farms;
 - Invest in either IE, MMS, IMO, IVA on (part of) their farms.





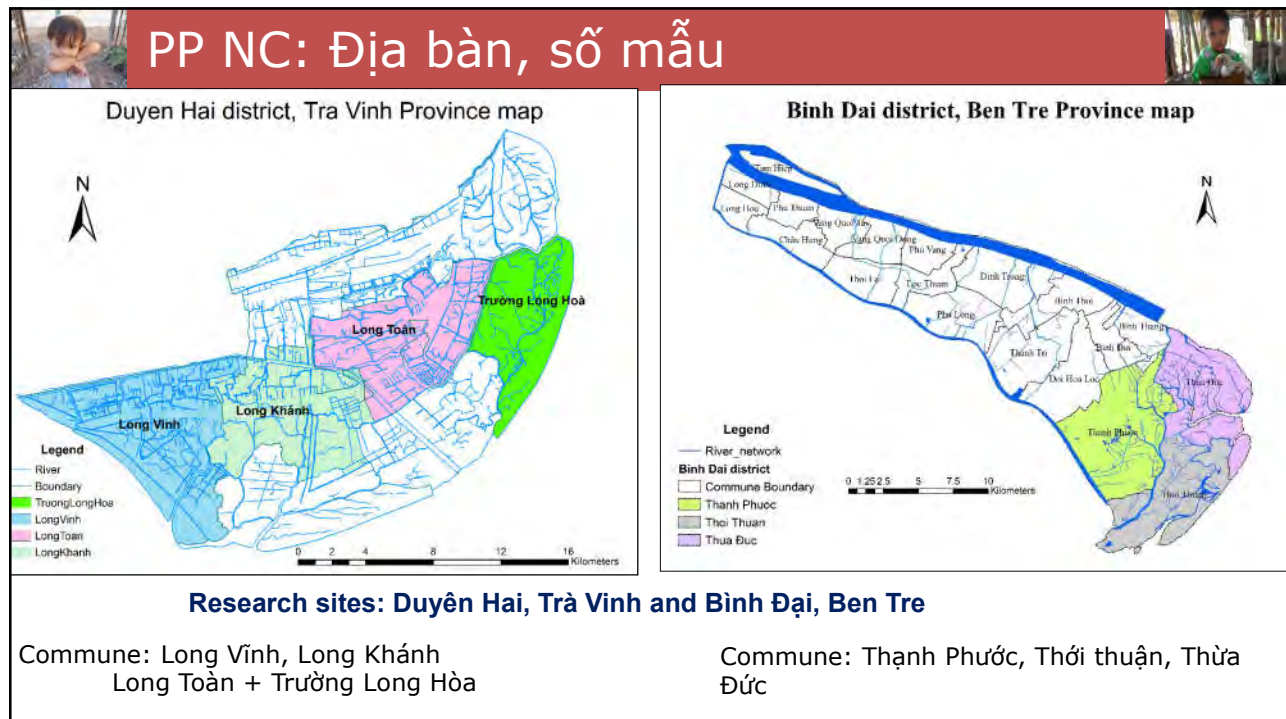
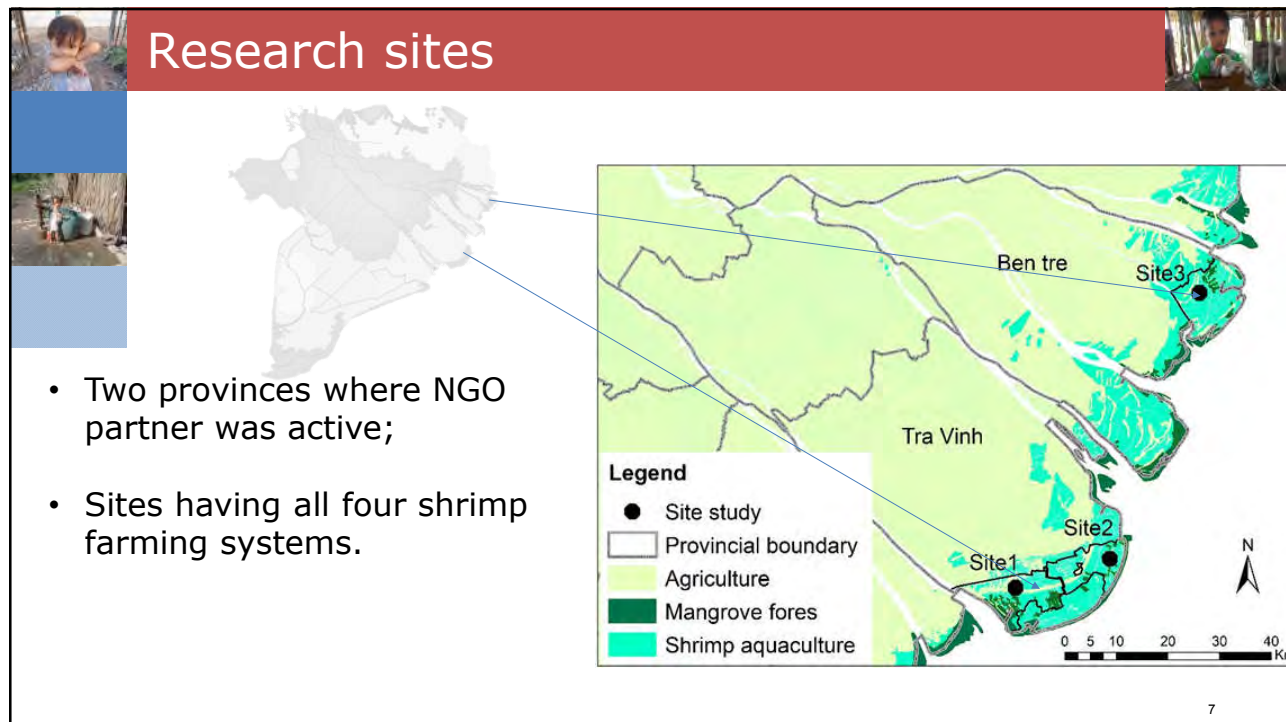
Improved extensive (**IE**) Improved Extensive (IE) Mixed Mangrove – Shrimp (**MMS**)

Vannamei - Monodon Intensive (**IVA** or **IMO**)

Farmers also practice hybrids:

- Do IVA or IMO on part of IE or MMS

Realistic Game: Cost – benefit parameters				
	MMS	Improved Extensive	Monodon (IMO)	Vannamei (IVA)
Investment cost	90	100	150	150
Operational cost	90	20	250	400
Minimum & maximum gross margin for the dice-scores.	+20 / +130	-50 / +150	-250 / + 400	-400 / +450



Methods, Variables, size & data collection

- 1st survey for farm characteristics;
- Design and test the game.

❖ Longitudinal survey

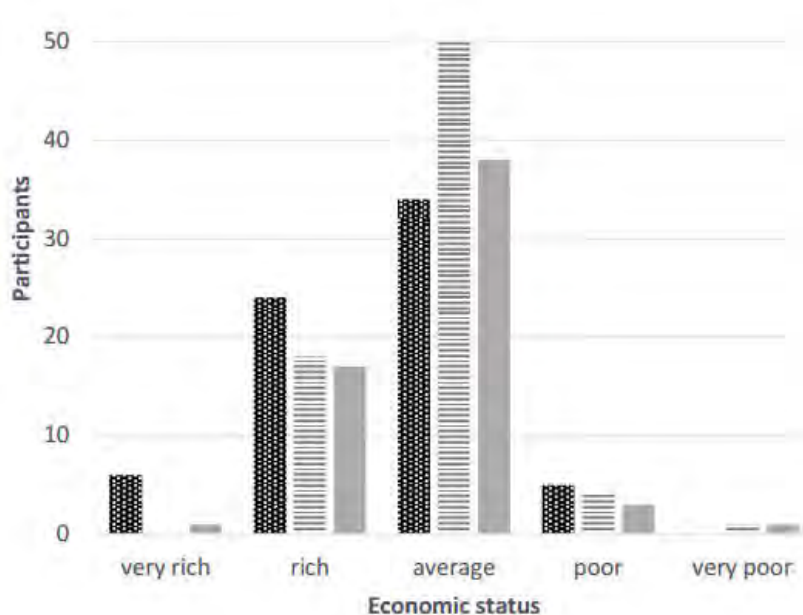
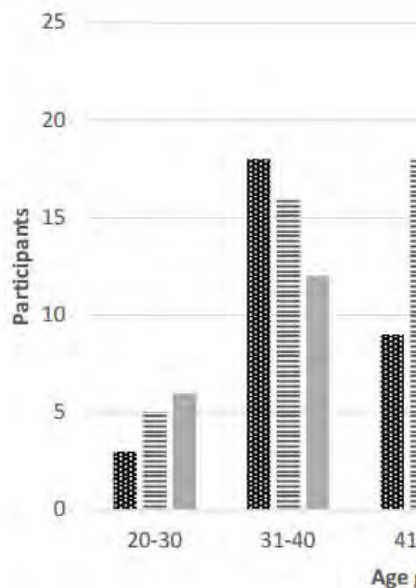
- Inventory of opinions on shrimp farming, mangrove and environment of 2 groups (23 questions):
 1. players of the board game (1 or 2 times)
 2. non players of the game).
- Sample sizes:
 - 219 HHs for the 1st interview
 - 110, 42 & 5 farmers played the game, 1x, 2x or 3x, resp..
 - 62 didn't play game => control group

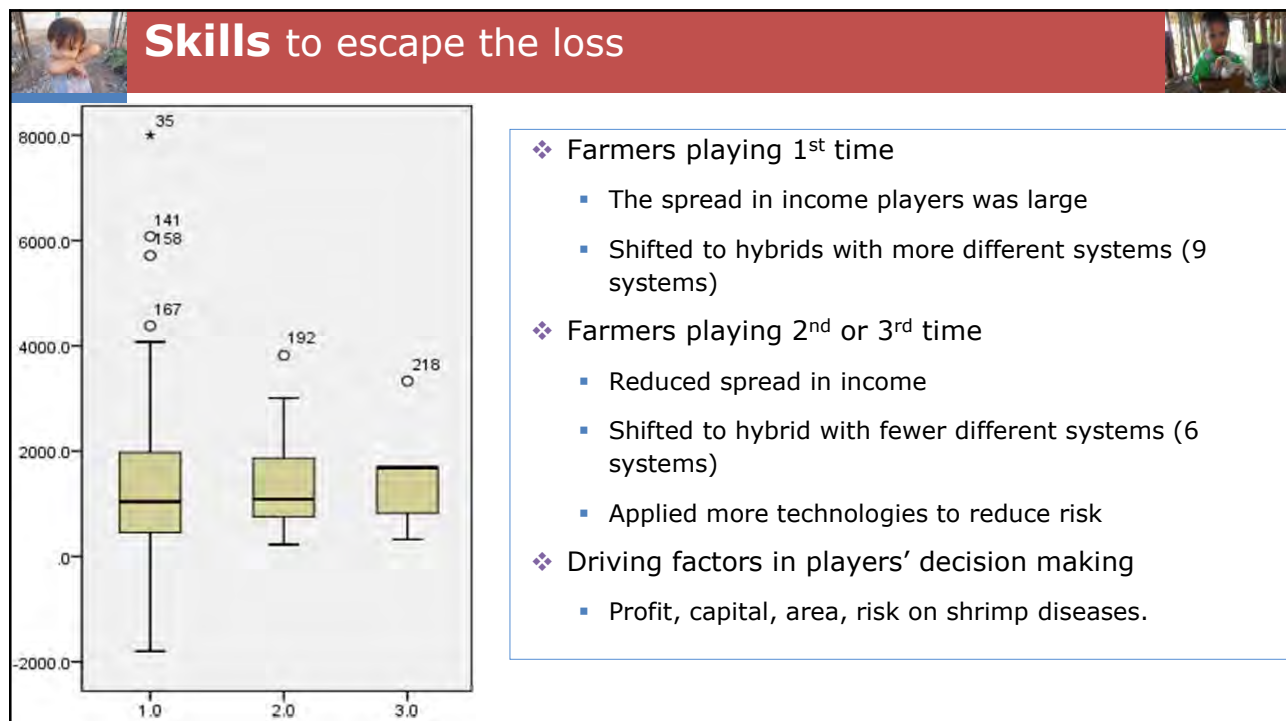
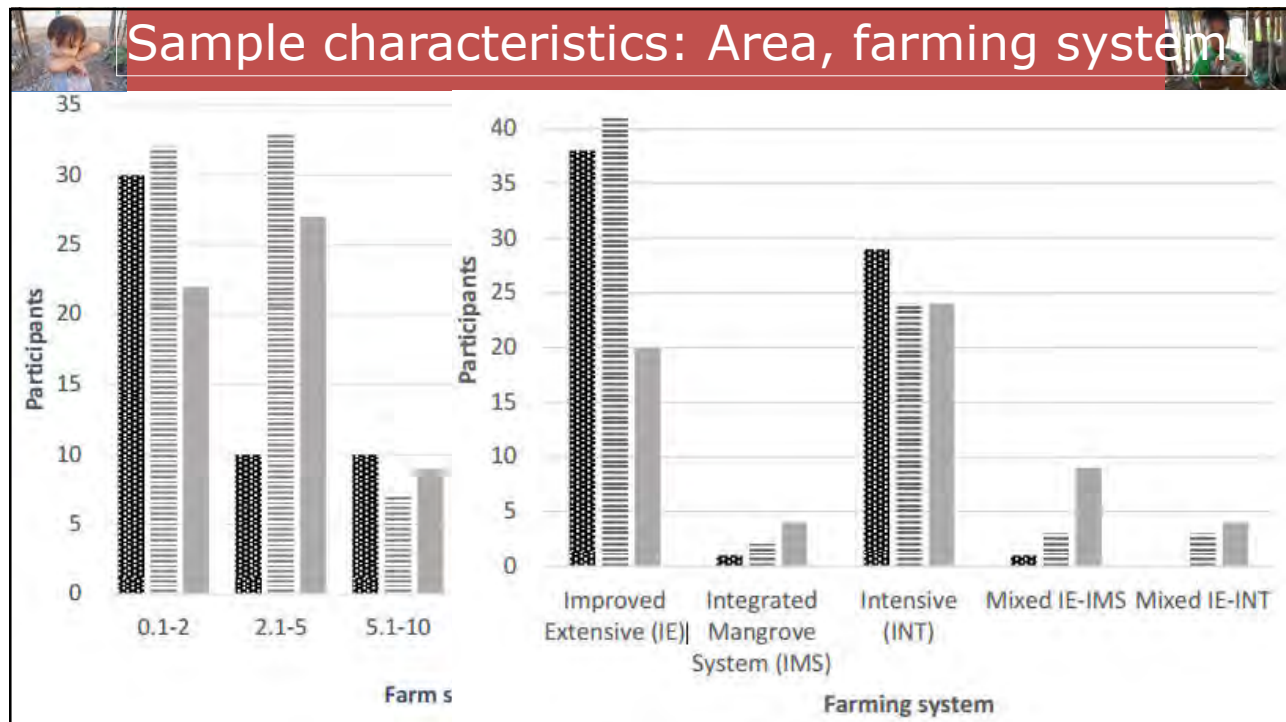
❖ Recording of **Game play results**;

- ❖ After playing some Qs about the process.

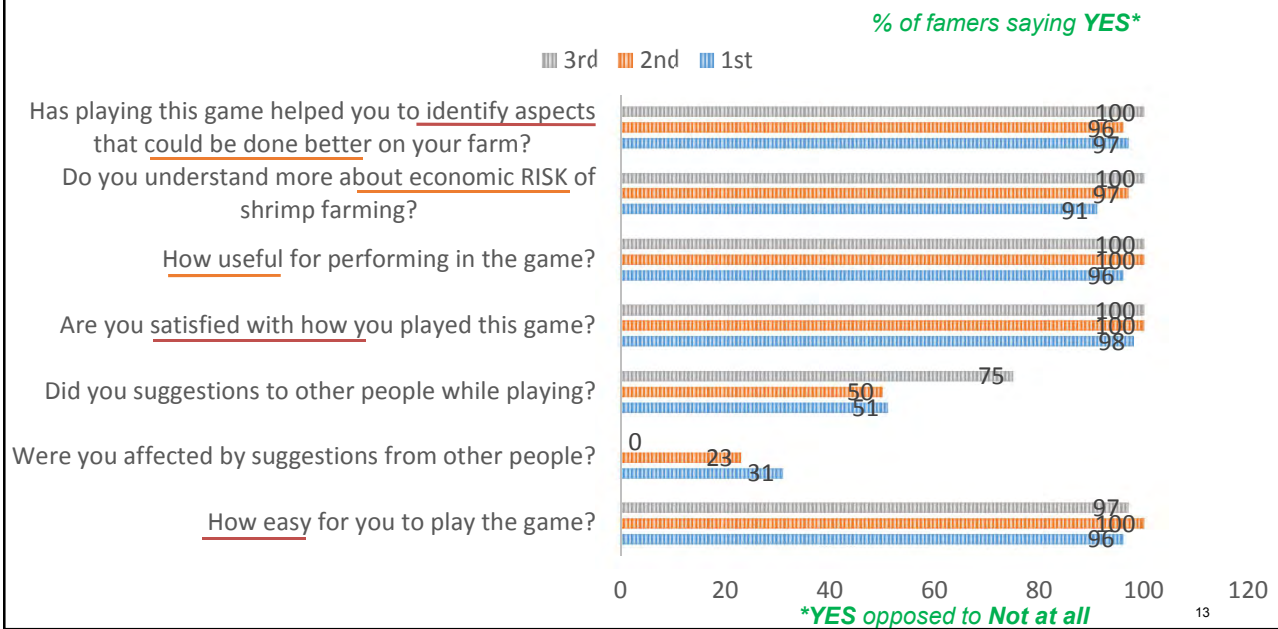
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Sample characteristics: age, economic status



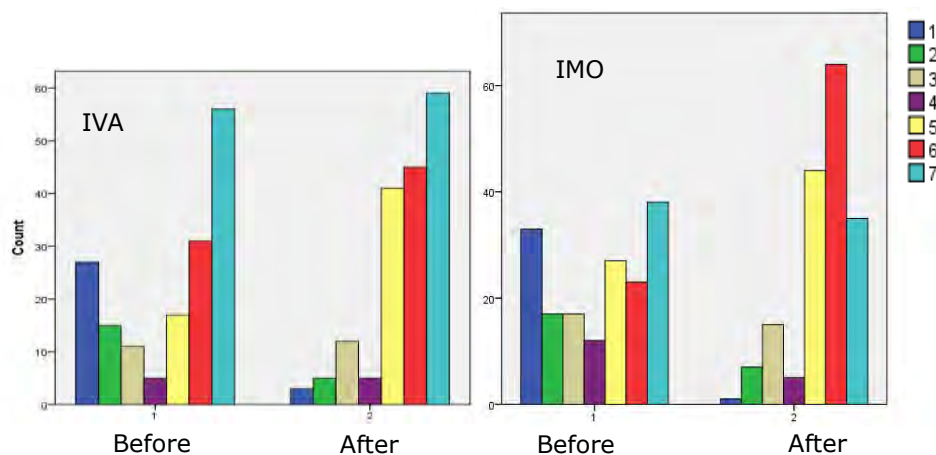


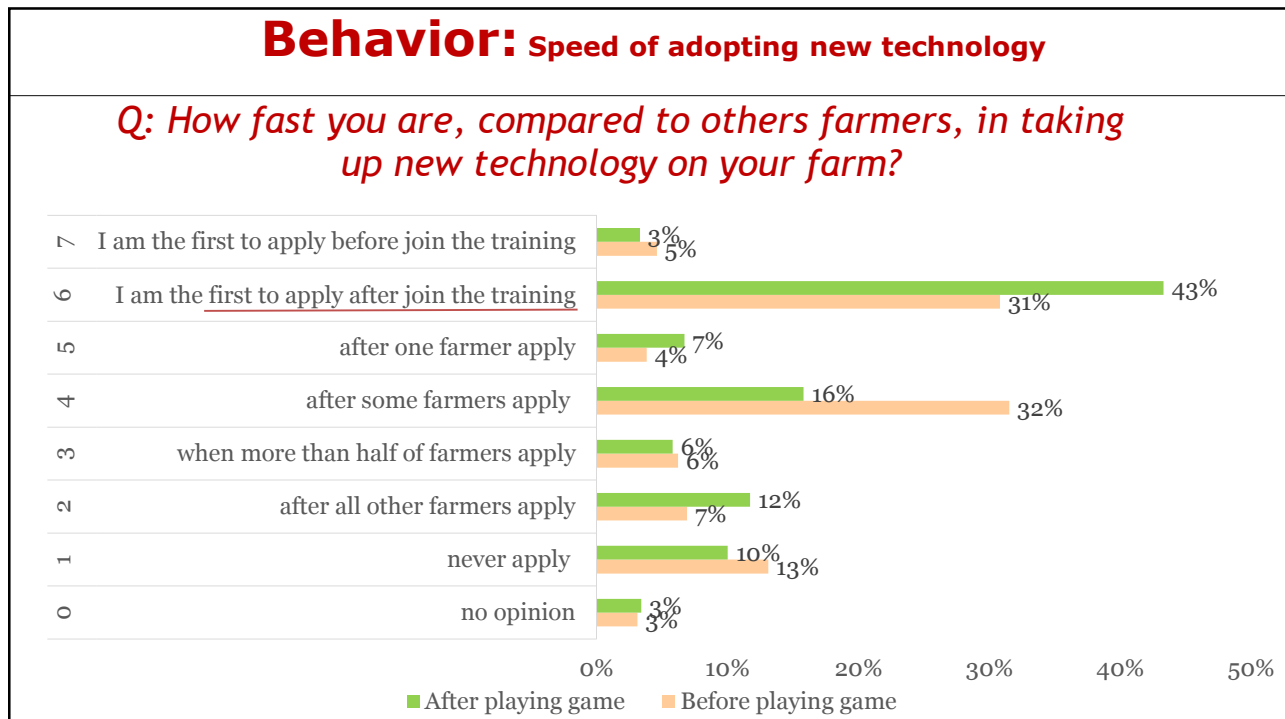
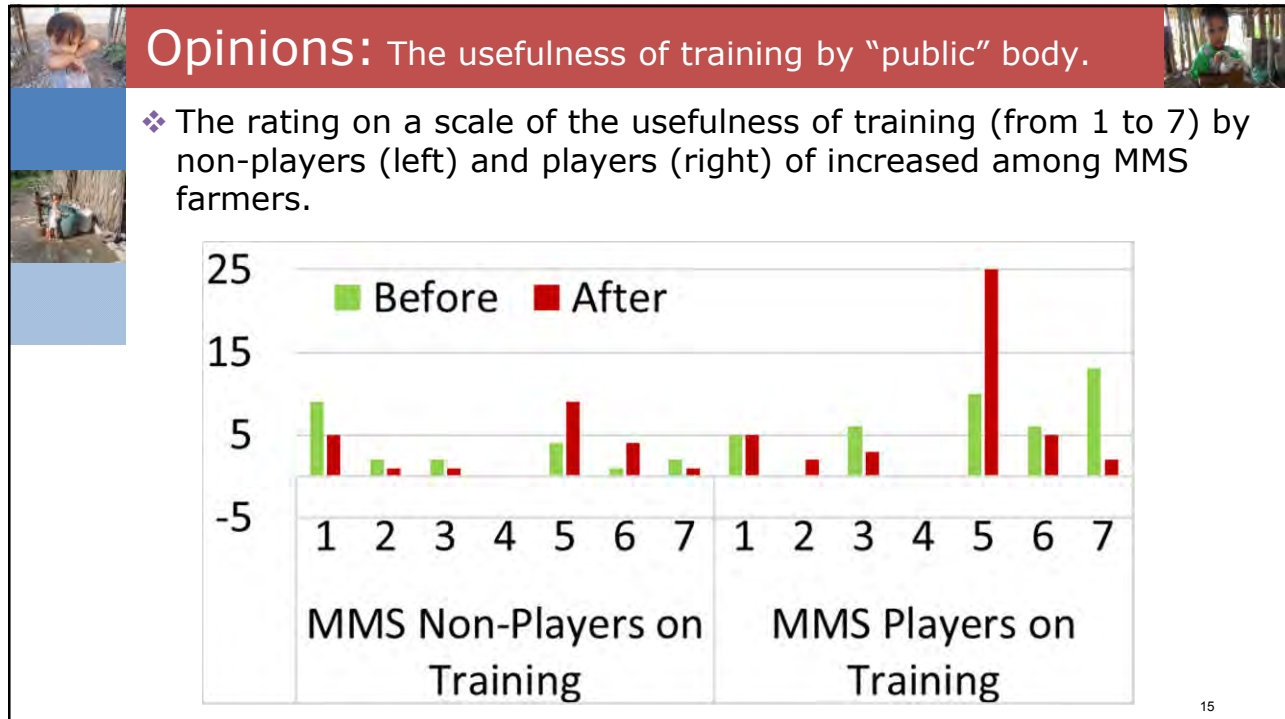
Opinions about the game after playing 1st, 2nd or 3rd times



Opinions: Impact of disease risk on income

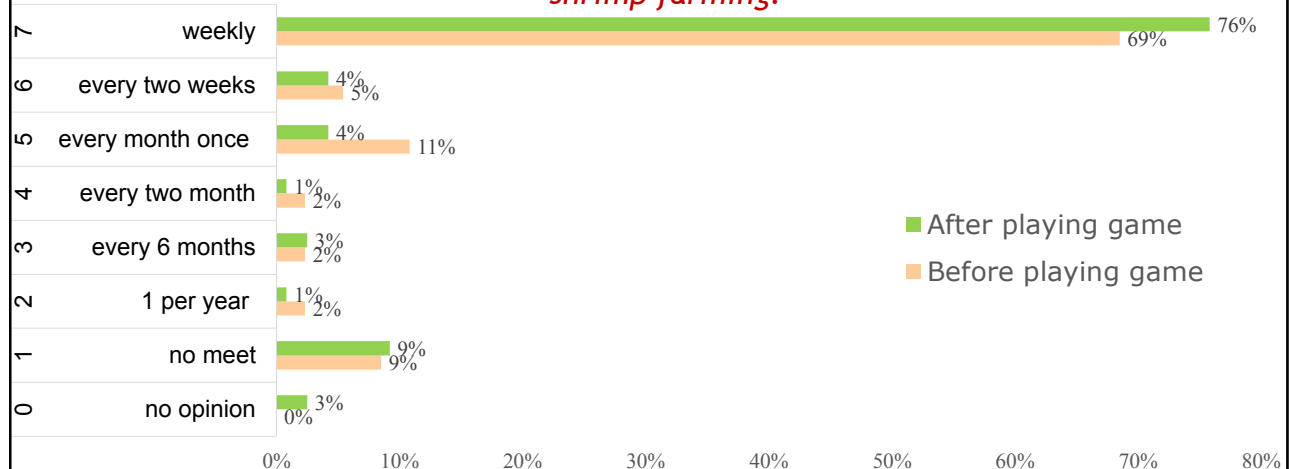
Rating of the impact of disease risk on the income of IVA (left) and IMO (right) before and after playing the game





Behavior: Consultancy with others

Do you meet with other farmers informally in your hamlet to discuss shrimp farming?



In case of shrimp disease the players consulted salesmen of veterinary products less

Conclusion:

(skill, knowledge, ability) + (opinions, motivation, attitude) => (behavior)

❖ Playing the game

- They developed skills to escape the losses (*knowledge, skill*).

❖ After the game, they confirmed that:

- They understand more about risks of 4 shrimp farming systems (*awareness, knowledge*)
- They can identify farming aspects that could be apply on their farm (*skill, knowledge*)
- They increase information exchange among people (*attitude, behavior*)
- They swiftly adopt new technology to produce less medical (safe) products (*attitude, awareness, behavior*)



Message => realistic and challenging games can improve extension

Acknowledgments

- NWO/WOTRO
- Wageningen University
- ALEGAMS project
- IUCN
- Local government & farmers in Tra Vinh & Ben Tre



**Thank you for your
kind attention**





Agent-based Modelling to Support Policies on Shrimp Farming and Mangrove

Ben Tre and Tra Vinh Province,
Mekong Delta, Vietnam

Tong Q. Hiep, Van P.D. Tri, Arend Ligtenberg, **Roel H. Bosma**, Tran T.P. Ha, Arnold K. Bregt

Introduction

- Coastal zones (CZ), such as that from the Mekong Delta:
 - Opportunities for livelihood and recreation,
 - But industrialisation & urbanisation increase vulnerability for changes in Upstream water sources, Sea level and Ecology.
- Shrimp culture in CZ:
 - Uses ecosystem services & contributes to socio-economy;
 - GO push shift to intensive (INT) farming for high yields and profits;
 - Most farmers lack capacities for a radical shift, => hybrid systems;
 - Production increase => space for mangrove recovery, but policies are inadequate, and neglect risks.
- Environmental NGO's advocate balance ecology = economy.
- Designing policy that considers all aspects is challenging:
 - Gap between plans of GO, NGO and farmers' practices.

Opportunity for Agent-based Models

- Agent-based models
 - GIS based
 - Multiple, interacting agents,
 - Within a model or simulation environment.
- Relationship between agents is specified:
 - linking agents to other agents
 - and / or other entities within a system.



ABM to support coastal zone planning

ALEGAMS' ABM aims to support CZ planning in 3 ways:

Explanatory: How do farmer's activities and decisions modify the shrimp farming systems?

Explorative: Scenarios to study the effects of policies and CC on the future shrimp farming landscape.

Informative: Provide information on past and current systems through spatial information.

Developing the model

Narratives about behavior and impact of the drivers:

- virus outbreak,
- value chain, access to inputs etc....
- infrastructure, salinity, flooding.

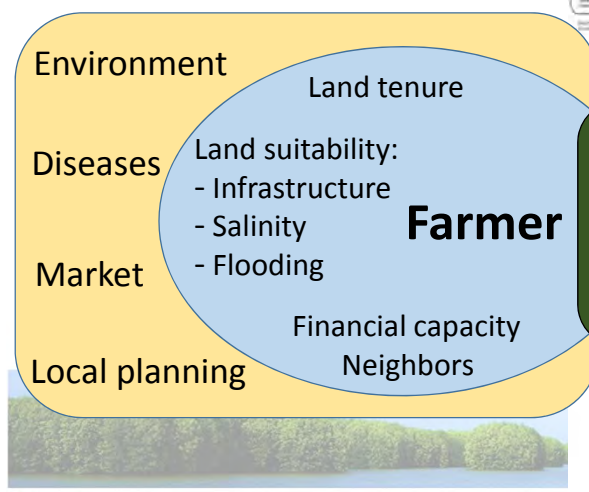
Update and assess certain parameters:

- virus risk, costs, prices, copy-cat behavior, etc....

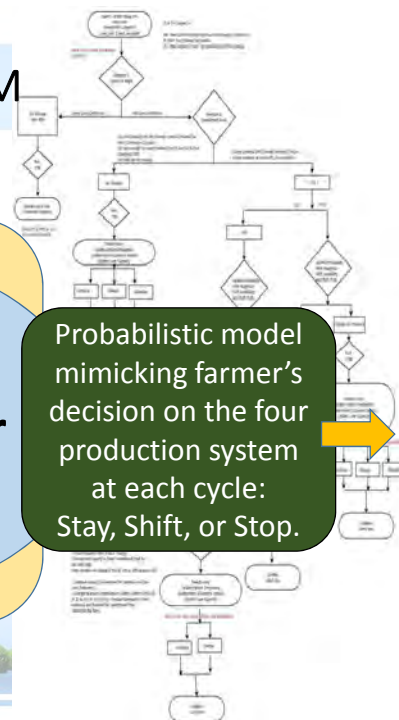


Decision pathway of this ABM

Agent's decision-making:



Probabilistic model mimicking farmer's decision on the four production system at each cycle: Stay, Shift, or Stop.



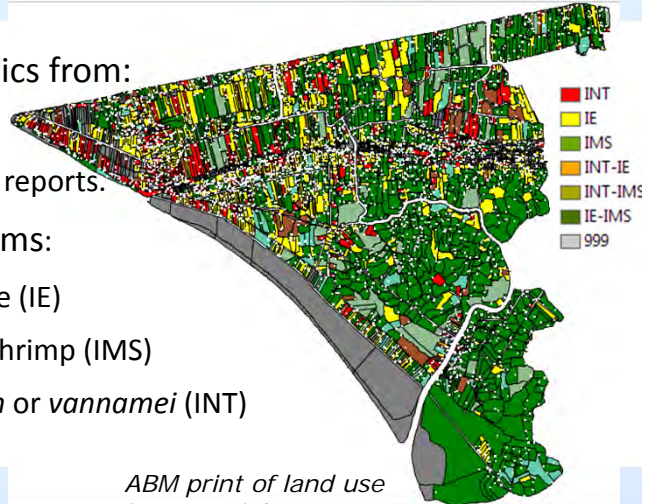
Data for Agents = Shrimp farmers

Agent's characteristics from:

- Field surveys,
- Official government reports.

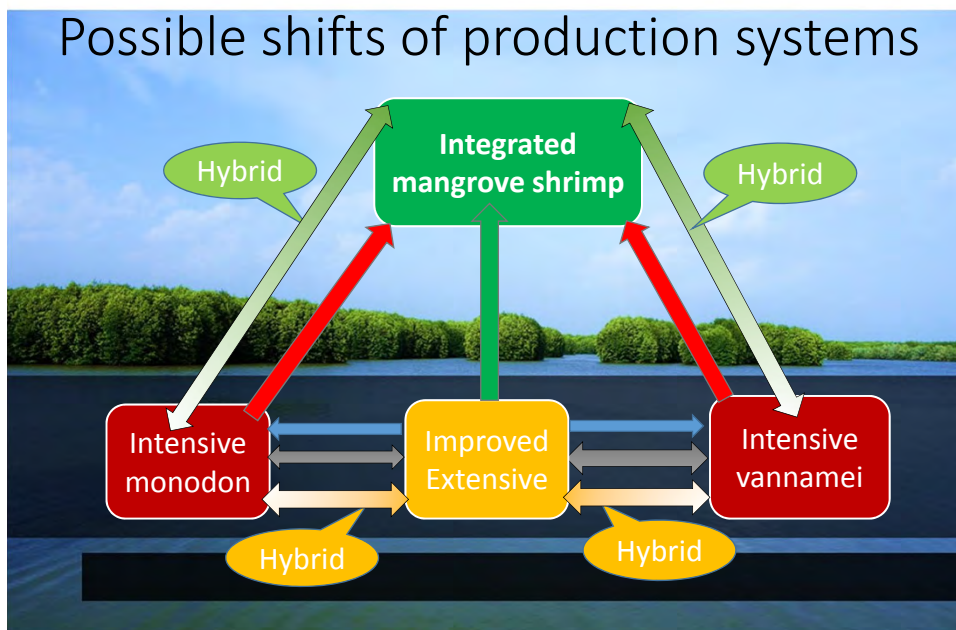
⇒ Four main systems:

- Improved Extensive (IE)
- Mixed Mangrove Shrimp (IMS)
- Intensive *monodon* or *vannamei* (INT)
- and their Hybrids



ABM print of land use
in Long Vinh commune,
Duyen Hai, Tra Vinh province (Site 1)

Possible shifts of production systems



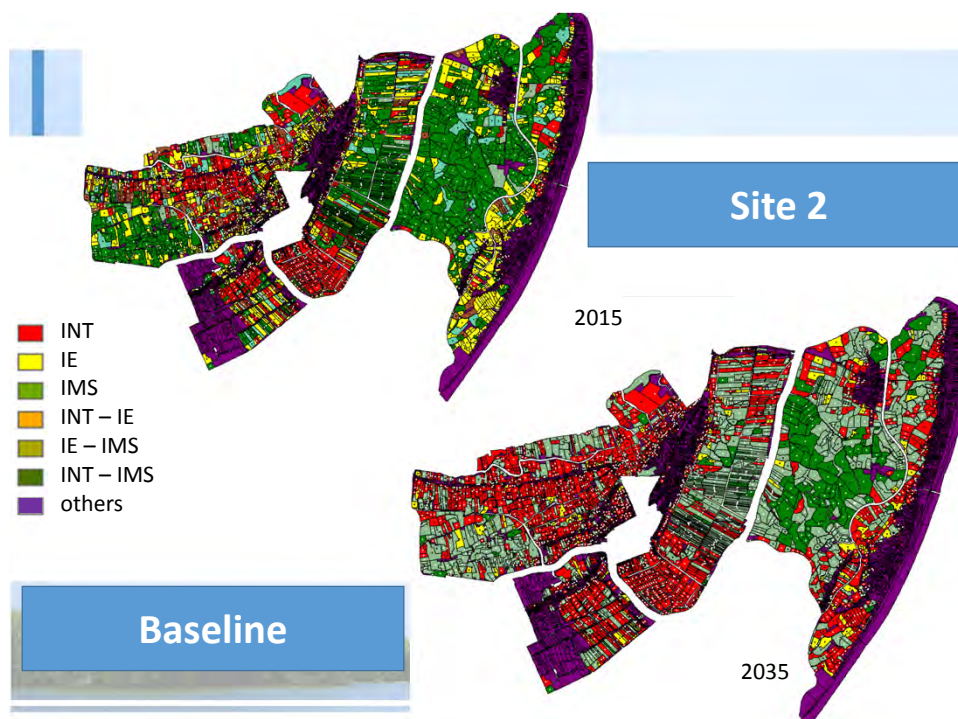
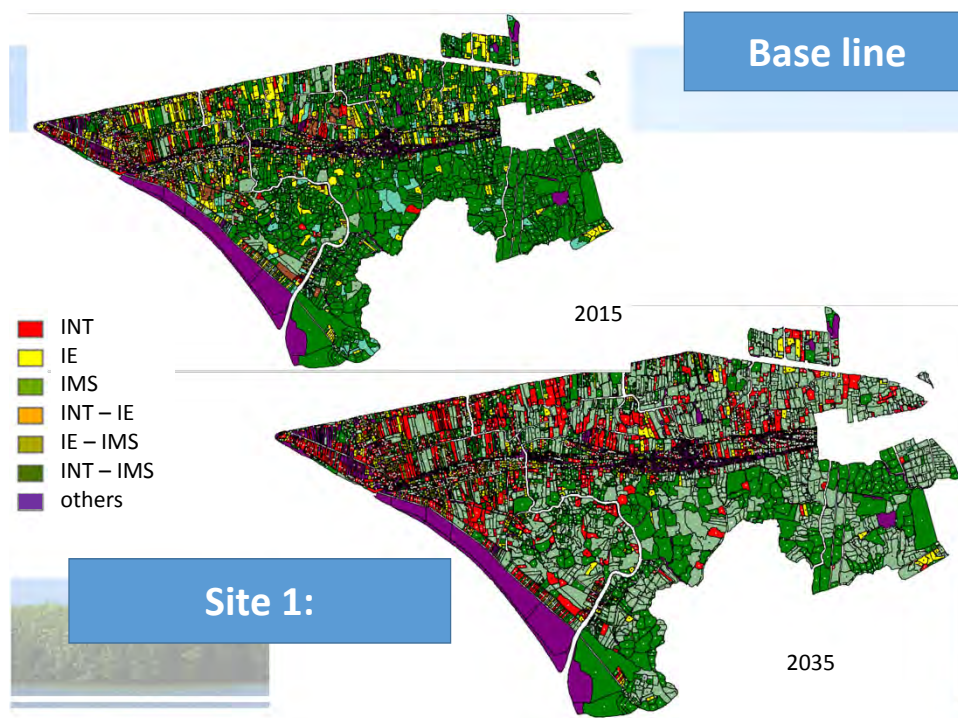
Factors in agent's decision on farm system

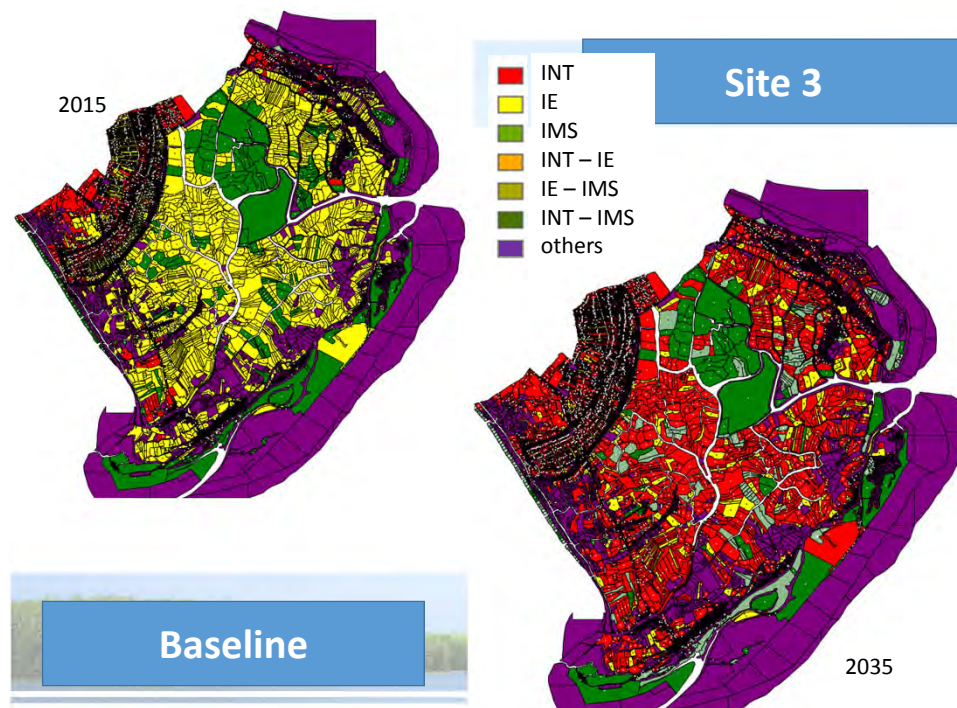
Farm type	Reduce	Shift	Abandon	Continue
INT	Don't have enough money for whole area	To IE: Fail many times To IMS: INT area <0.3, fail many times, IMS area >0	Lack of money Fail many times	Success Enough money for next crop
IE		To INT: Enough money for INT investment and operation. To IMS: IMS area >% IE area	Lack of money	Success Lack money to move to INT
IMS	No	To INT hybrid: Enough money for INT investment and operation (not in protection forest area). To IE: normally not	No	Farm whole area with IMS

Results baseline simulation after 20 yr

Studied area	1	2	3
Intensive farming	+ 780%	+ 225%	+ 2147%
Improved extensive	- 80%	- 95%	- 80%
Integrated mangrove shrimp	- 11%	- 0.5%	- 97%







Two other scenarios

1. Thus, baseline confirmed effect of GO policy:
 - Increase of INT, with high yield,
 - but high risk and numerous drop-outs,
 - Many stay in discontinuous hybrid IE-INT.
2. Organic, with policy favouring IMS:
 - increase INT and hybrids continues,
 - while IMS remains stable.
3. Climate Change = higher salinity, long droughts:
 - => more diseases and lower incomes.



Conclusion:

- Intensive shrimp farming develops if:
 - infrastructure (electricity) is available
 - and neighbours are successful.
- Intensive shrimp farming expands in all 3 scenarios
 - Other policies needed to increase mangrove cover.
- Number of involved households decreases gradually,
 - Number of marginalised increases, unless



Thank you for your attention!



Inclusive Business & Food Systems

Poverty Alleviation & Improved Food Security

Roel H. Bosma,



Research for Development

During my career I lived a list of Paradigms to Development, e.g.:

- Trickle down: invest in industries, and wealth will spread through society;
- Community -, rural -, and farming-systems development;
- Good-governance
- Value-chain (VC) development.

✓ In many DCs, no reduction in numbers of poor & hungry.

Now: Co-Creation,
Inclusive Business (IB)
Food Systems.



Inclusive (Aquaculture) Business

IB aims to make VCs contribute to food security (FS)
& poverty alleviation (PA)

Two main definitions of IB: narrow and broad.

Narrow: include resource poor farmers in VC development

- Aquaculture requires finances, but successful cases published,
- But, focus on one VC might not improve FS like a multispecies pond.

A vertical production chain mostly more effective than
value chain of many small holders



Inclusive (Aquaculture) Business

Broad: embrace food security & poverty alleviation in
business development goals.

- Some IB models beneficial for certain groups,
- but **not the** approach to poverty alleviation because:
 1. Companies focus on efficiency and professionalization to maintain market share, which excludes poor and low educated.
 2. Competitive market = Pressure of shareholders and consumers.
Demand for high profit ⇔ low consumer prices
Goes at expense of: Environment,
Low farm gate prices,
Low wages

unless



(Sea) Food Systems

Food systems:

- network of actors and the set of activities from production to consumption and waste recycling, including innovation.
- structural conditions such as rules, standards and policies;

Food systems **interact** with one another, and **environment**:

- Ecological, Social, Political/cultural and Economic.

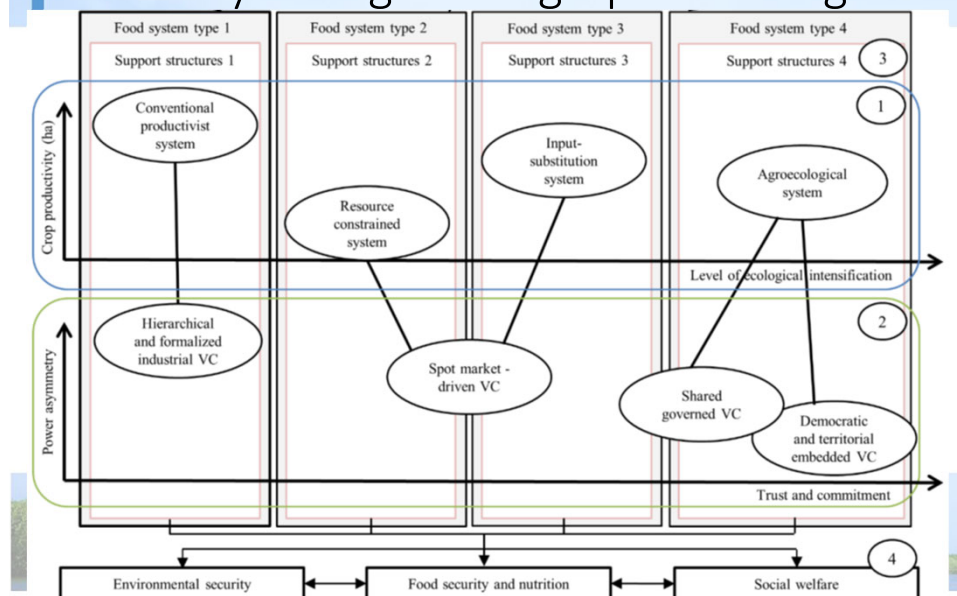
Goals: Provide food security and nutrition, environmental security and social welfare.

Food system's **performance** on these 4 differs & may contrast:

- ❖ Dominant Agro-industrial productivist paradigm (AIP);
- ❖ Territorial and ecological paradigm (TEP)
- ❖ Hybrids with principles of diversification, agro-ecology.



Food System generic graphical image



(Sea) Food Systems

Various driving forces to re-orient systems along more ecological, social and environmental lines.

Can the dominant AIP make a transition?

Gradual 'greening' to making AIP environment-friendly:

- ✓ may bring transformation,
- ✓ but perpetuates dominant logic of the business model.

Alternatives propose to radically reshape food practices from both technical and social perspective:

- Local ecological production systems and value chains;
- Incl. agro-ecological and biodiversity-based culture;
- Supported by alternative food networks.



Strengthening Economic Agency of Women Fish Vendors in select coastal cities of India

FishMARC

Women Fish Vendors in India

- Fish vending by women belonging to the marine fishing communities is an important livelihood
- If 1 million fishermen go to sea, around 200,000 fisherwomen are in fish vending across the Indian coast, both in rural and urban areas
- There is a high concentration of women fish vendors in coastal cities in view of larger market potential for fish vending
- Maharashtra tops in number of women fish vendors, followed by Andhra Pradesh and Tamil Nadu. However, Kerala has a very high concentration of women fish vendors in Trivandrum district
- As far as urban areas are concerned, Bombay (25,000), Chennai (10,000) and Trivandrum (10,000) are top 3 locations. The project intends to work in these three locations

Profile of women fish vendors

- Widows
- Wives whose husbands unable to earn an income due to illness or alcoholism
- Wives of fishermen working on and/or owning small boats. Wives of crew members on board mechanised vessels
- In general, fish vendors are from the relatively poorer households in the fishing community and play an important role in preventing their families from slipping into destitution and improve their fortunes and achieve some of their aspirations.

Issues faced by women fish vendors

1. *Lack of facilities at landing centres and wholesale markets*
2. *Lack of facilities in retail markets*
3. *Discrimination in markets, lack of rights including tenure*
4. *Issues related to fish quality and value addition*
5. *Transportation problems*
6. *Gaps in credit and financial services*
7. *Occupational hazards*
8. *Weakness of fish vendor organisations*

Fish vending women: Emerging livelihood threats

- *The new supermarket culture; online fish sales*
- *Changing consumer profile due to influx of non-coastal people to the coast, emergence of new professional class that prefers alternative channels to buy fish*
- *Growth of institutional customers (who buy from wholesalers)*
- *Negative image of fisherwomen*
- *Growth of education in fishing community, growing unwillingness to take up fish vending*

Overall Project Goal

Women Fish Vendors have a Dignified,
Remunerative and Sustainable Livelihood

Medium term outcomes

Empowered Fish Vending Women with an increased voice and power in the fisheries value chain in coastal cities of India

Some Specific outcomes

1. Improved returns from fisheries enterprises and control of income by women
2. Reduced drudgery and hardship for women
3. Strong fisherwomen institutions addressing and solving livelihoods challenges of its members by engaging with market, public and local governance systems
4. Fisherwomen having a higher voice and control in running their existing value chains and realising better access to facilities, services and terms of trade.
5. Few groups of fisherwomen moving up from being a mere production-end actors in the value chain to a co-owners of businesses in the consumption end of the value chain (only at pilot level)
6. New, viable and scalable models of value chain engagement of fisherwomen and their institutions demonstrated and disseminated

Activities to achieve objectives

1. Improving returns from fish vending

(a) Enhancing credit access through bank linkages and capacity building of fish vendor organisations;

(b) Improving fish quality through training and use of ice boxes and other individual equipment, storage facility

2. Reducing drudgery and hardship

- a) Support to ensure better facilities for fish vendors in markets
- b) Tackling occupational health and safety issues

3. Establish rights of fish vendors

- a) Research & Documentation; policy advisories;
- b) Capacity building for women to take up negotiations with local market authorities and relevant Govt agencies

4. Establish new modes of fish marketing by fisherwomen

- a) Market studies and value chain analysis
- b) Capacity building for new types of marketing
- c) Seed capital for pilot projects

5. Establish/strengthen fish vendor organisations

- a) Support to coastal women fish vendor organisations

Project INDICATORS

- At least 2,000 fish vendors will have regular access to credit and financial services and systems in place for many more to do so.
- At least 1000 fish vendors will improve fish handling practices and use ice boxes
- Municipal Corporations in two cities will have taken on board fish vendor suggestions to improve facilities for them in fish markets.
- Fish vendor organisations representing and providing services to over 5000 fish vendors will be active in the three project locations.

Project Approach

- Work closely with existing organisations of fish vendors
- Attempt fresh organisation only when unavoidable
- Create platforms with both fish vendor organisations and NGOs to identify and take up advocacy work
- **Bombay:** Strong fishing community trade union; good women leaders aware of issues and having a clear agenda for change
- **Chennai:** Fish vending women largely unorganised; SIFFS women's thrift & credit groups on the two extremities of the Chennai coast provide some base for organisation
- **Trivandrum:** Three strong organisations working for fish vendors, one specialising in economic interventions while the other two on advocacy and struggles for rights.

SPECIAL SESSION 1: INCLUSIVE INNOVATIONS FOR SUSTAINABLE SEA-FOOD SECURITY

12AFAP Session Theme: Aquaculture

This special session, occupying three panels, has three goals: (1) knowledge exchange between the NWO-GCP-F&B funded projects working on seafood, (2) exchange with unrelated stakeholders, and (3) identification of constraints to inclusion of small farmers and fishers in development. Support to development started under the paradigm of trickling down: invest in industries then wealth will spread through society. As this hardly reduced the number of poor, strategies with focus on communities, agriculture, good-governance and value chain followed. Most investments had some impact but lead also to the accumulation of capital of the wealthy without improving reducing poverty. Can aquaculture do better?

The three panels will discuss:

1. Challenges of Pond Aquaculture and Benefits of Bioflocs and Related Technologies.
2. Approaches to Design and Adoption of Innovations and Capacity Building in Aquaculture?
3. How can Innovations in Aquaculture Contribute to Inclusive Business and Food-Security?

The first two focus on knowledge updates and the last on inventories and discussions.

Organizer:

NOW-GCP projects of WorldFish, Wetlands International Indonesia, Wageningen University & Research, University of Amsterdam, Skretting, FishMARC India, Ecoshape, Diponegoro University, Can Tho University, and Blue Forest.

Sub-Themes:

1. Technologies for Sustainable Intensification of Aquaculture
2. Approaches to Design & Disseminate Aquaculture Technology
3. Inclusive Value Chain Innovations for Sustainable Seafood Security

SUB-THEME 1: TECHNOLOGIES FOR SUSTAINABLE INTENSIFICATION OF AQUACULTURE

CHALLENGES FOR POND AQUACULTURE

Marc Verdegem^{1,2}, Roel Bosma¹, Kabir Kazi^{1,2}, Devi Hermesen¹, and Tran Huu Tinh¹

¹*Aquaculture and Fisheries, Animal Sciences, Wageningen University & Research*; ²*WorldFish, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia (marc.verdegem@wur.nl)*

The majority of aquaculture production comes from ponds that pollute or occupy large areas. In spite the overwhelming importance of ponds for aquaculture production, our basic understanding of the pond ecosystem is limited while resources to expand the sector are limited. Thus, increases in global production will mainly have to be realized by raising pond productivity. The challenge is to increase yields while mitigating the environmental impacts from pond culture through e.g.: (1) improving the conversion of primary and microbial production into fish and shrimp production, (2) integrating pond technology with recirculation technology and (3) developing integrated aquaculture-agriculture systems. Irrespective of the route chosen, a better understanding of the underlying processes explaining nutrient dynamics in ponds will be instrumental. Focusing on the carbon:nitrogen balance, the nutritious pond concept provides ways to make better use of the pond's food web to feed fish or shrimp and contributes to increased production.

EFFECT OF BIOFLOCS ON SEAFOOD QUALITY

Devi Hermesen¹, D.B. van de Waal², S.A.J. Declerck², and M.C.J. Verdegem¹

¹Aquaculture and Fisheries, Animal Sciences, Wageningen University & Research; ²Netherlands Institute of Ecology, Wageningen, The Netherlands (marc.verdegem@wur.nl)

In a “nutritious pond” system, the incorporation of natural food elements into shrimp biomass may increase. This mesocosm study compared a Control diet containing fish oil and fishmeal, and a diet without these (low-H treatment). After 57 days, 12% of the feed input was metabolized into shrimp biomass, which did not differ between treatments. Control shrimp's, and total food web, HUFA content in the control tanks was twice as high than low-H. HUFA retention in the control was over ten-fold higher than Low-H tanks, pinpointing in situ de novo production of EPA, DHA and ARA. Among six food web compartments, the highest HUFA accumulation was observed in seston. Whether Low-H shrimp experienced a HUFA-deficient environment is not confirmed. Based on above, reducing fish oil and fishmeal in shrimp diets seems possible, but depends on the potential to canalize HUFA-containing algae in the seston into better accessible food web compartments.

EFFECTS OF CARBOHYDRATE SOURCES ON A BIOFLOC CULTURE SYSTEM FOR WHITE LEG SHRIMP (*Penaeus vannamei*)

Tran Huu Tinh¹, Tom Koppenol¹, Tran Ngoc Hai², and M.C.J. Verdegem³

¹Aquaculture and Fisheries, Animal Sciences, Wageningen University & Research; ²College of Aquaculture & Fisheries, Can Tho University, Vietnam; ³WorldFish, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia (thtinh@outlook.com)

The addition of carbohydrate stimulates biofloc growth and the latter improves water quality and reduces the need for water exchange, while the flocculated materials serve as natural shrimp feed. This research aimed at comparing effects of corn starch and molasses addition on the white leg shrimp (0.07 g/individual) stocked indoor at 250 individual/m³, with aeration and lighting, and fed with 37% protein and C/N ratio of 12. Both corn starch and molasses additions resulted in low Total Ammonia Nitrogen levels. The amount of bioflocs in both treatments increased over time. In the molasses treatment the periphyton growth was higher at the end of the experiment and had higher crude protein content compared to corn starch. But the latter resulted in significantly higher growth rate, production, average weight of the shrimp, and lower FCR. Nitrogen retention in the corn starch treatment was greater than that in the molasses treatment.

THE EFFECT OF DIETARY PROTEIN TO ENERGY RATIO AND STOCKING DENSITIES ON FISH PRODUCTION, FOOD WEB ENHANCEMENT AND ECONOMIC BENEFIT OF GIFT NILE TILAPIA AQUACULTURE IN PONDS

Kabir Kazi. A^{1,2}, M.C.J. Verdegem¹, J.W. Schrama¹, J.A.J. Verreth¹, and M. J. Phillips³

¹Aquaculture and Fisheries Group, Animal Sciences, Wageningen University & Research, PO Box 338, 6700 AH, Wageningen, Netherlands; ²Sustainable Aquaculture Program, WorldFish Bangladesh, House # 22B, Road #7, Block # F, Banani, Dhaka-1213; ³WorldFish, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia (kazi.kabir@wur.nl)

In non-lined ponds, natural food complements dietary P/E. We assessed the effect of lowering dietary P/E ratio with an increasing stocking density on performance of tilapia, food web enhancement and impact on pond nutrients. The experiment was conducted in a 2x2x2 factorial design: diet (CP:CE ratio 19 vs. 14 g.MJ⁻¹); feeding level; and stocking density (2 vs 3 m⁻²) in 40 farmers' ponds. Biomass gain increased with a decreasing dietary P/E ratio and increasing stocking density). A negative accumulation of N and P in pond water was noticed for low stocking density ponds. Nitrogen gain in fish was higher for low P/E diet and also influenced by feed per square meter. At low P/E diet, the contribution of natural food to fish production was higher than for the high P/E diet. Net profit increased by lowering the dietary P/E ratio of the diet (2070 vs 1072 US\$ ha⁻¹ 83 day⁻¹).

SUB-THEME 2: APPROACHES TO DESIGN & DISSEMINATE AQUACULTURE TECHNOLOGY

AQUACULTURE INNOVATION: WHAT (OR WHO) ARE WE MISSING?

Olivier M. Joffre¹ and Laurens Klerkx²

¹WorldFish, Phnom Penh, Cambodia; ²Knowledge, Technology and Innovation Group, Wageningen University, The Netherlands (o.joffre@cgiar.org)

Present aquaculture growth is driven by a dynamic industrial sector, while the resource poor farmers hardly evolved. However, aquaculture needs to adapt to new constraints, such as, resource limitations, environmental impact and climate change. Across the various approaches to innovation, inclusiveness is often lacking or weak. Often, innovation research is limited to donor led projects and a focus on small-scale farmers. Because of this focus, the inclusion of small and medium scale business type of producers has been limited. The agriculture sector uses multi-stakeholder platforms and approaches to design innovations, tackle complex problems and support more inclusive growth. In analogy, aquaculture should deploy multi-stakeholder platforms for action-driven innovation to stimulate joint technology and practice development. Such approaches will require changes in the planning of innovation processes and the integration of small and medium scale enterprises and poor households. The latter three constitute the core of the beneficiaries of aquaculture innovation.

ASSESSING CONSTRAINTS TO INNOVATIONS IN THE INDONESIAN AQUACULTURE VALUE CHAIN

Tita Elfitasari¹, Laurens Klerkx², Olivier Joffre³, Sri Rejeki¹, Lestari Lhaksmi W¹, Restiana Wisnu A¹, and Roel H. Bosma⁴.

¹Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Diponegoro University, Semarang, Indonesia; ²Communication & Innovation Group, Wageningen University & Research, The Netherlands; ³WorldFish, Phnom Penh, Cambodia; ⁴Aquaculture & Fisheries, Wageningen University & Research, The Netherlands (t.elfitasari@undip.ac.id)

In Indonesia, destruction of mangroves for ponds, ground-water extraction and climate change result in loss of land and livelihoods since 2008. In Demak (Central Java) and Brebes (West Java) most farmers stopped stocking shrimp, also as water quality had reduced due to industrial and urban waste. Integrated Multi Trophic aquaculture (IMTA) might recover shrimp aquaculture. Data on the innovations in the value chain of shrimp were collected and analysed using the RAAIS tool (Schut et al. 2015; Agricultural Systems 132: 1–112). Stakeholders from different background participated. Participants agreed that most constraints were institutional, often related to infrastructure and assets, and rooted in laws and regulations at the national level. Among the top three constraints one constraint was similar: the lack of extension services. The adoption of IMTA and other innovations in the mangrove restoration areas of Brebes and Demak regency thus face mostly similar challenges.

EFFECT OF A SERVICE PROVISION MODEL ON INCLUDING BANGLADESH'S SMALL HOLDER AND LANDLESS FARMERS IN THE AQUACULTURE VALUE CHAIN

Nazneen Khan, Qazi Azad-uz-zaman, Shamim Hossain, Kate Hartley, and Malcolm Dickson

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(Nazneen.Khan@cgiar.org)*

In Bangladesh, agriculture supports more than 75% of the population; 19% of them remain food-insecure and 31% live below the poverty line. From April 2015 to March 2018, through a Local Service Providers model (LSP), the project Improving Food Security and Livelihoods aimed to develop value chains, improve agricultural productivity, enhance nutritional status, and increase women's decision-making capacity. The LSP was linked to the coordination of development, extension and research (Figure). Strengthened LSP and its associations helped the poor to enter markets and supported producers to organize into Enterprises. At project's end, 86% of the households experienced 31% rise in income, the area of land cultivated increased for landless, smallholders and LSPs, up to 96% of the households consumed three meals per day, yields increased by 32% in fish, 94% in poultry and 101% in tomato, and most of the women were engaged in household decision-making and marketing their products.

AQUACULTURE FIELD SCHOOLS AND FARMER'S SKILLS IN INDONESIA

Woro Yuniatia¹ and Ratnawaty Fadilah²

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To train farmers on sustainable aquaculture Blue Forest developed a curriculum for Aquaculture Field-schools (AFS) using group observations, presentations, discussions and collective decision making on a demonstration plot. AFS last at least one aquaculture cycle. AFS in Demak's Building with Nature project has 16 sessions and includes improved practices following a Low External Input and Sustainable Aquaculture (LEISA) concept applying home-made fermented organic fertilizer called MOL, and sessions on understanding the coastal dynamics and mangrove recovery. The project monitors the general achievements in all ten villages. Participatory evaluation indicated that the participants improved know-how on sustainable aquaculture management, agro-ecosystem observation and analysis, and enhanced self-confidence on aquaculture decision-making. Moreover, they built confidence and skills in public speaking. The changes in yield were not well monitored by the farmers. A related study of a sample in three villages showed that LEISA increased cost, but harvested stocked shrimp doubled farmer's income.

IMPACT OF A LOW EXTERNAL INPUT APPROACH ON YIELDS OF BRACKISH WATER SHRIMP PONDS IN INDONESIA

Sri Rejeki¹, Restiana Wisnu Ariyati¹, Lestari Laksmi Widowati¹, and Roel H. Bosma²

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In Indonesia, destruction of mangrove forest for ponds, ground-water extraction and climate change resulted in loss of land and yield¹ reductions. Farmers in Demak harvested 200 and 43 kg/ha/year of milkfish and shrimp, respectively. Demak's Building with Nature project uses Aquaculture Field Schools to train farmers in Low External Input and Sustainable Aquaculture (LEISA) that applies compost and a home-made organic fertilizer called MOL. Our team monitored the yield and others factors in three of the ten villages. Average yields of farmers applying MOL and cultivating both milkfish and shrimp increased to about 700 kg/ha and 260 kg/ha, respectively. Farmers having small multi-species ponds made 3 times higher operational cost and reached slightly lower gross margins than those with larger. LEISA increased cost and lead to slightly higher yields, but because most farmers applying MOL successfully stocked shrimp their income was almost double: 11.3 compared to 22 million IDR/ha/yr.

USING BOARD GAMES TO RAISE AWARENESS AND SKILLS FOR SUSTAINABLE SHRIMP FARMING IN VIETNAM

Tran Thi Phung Ha¹, Nguyen Thi Huynh Phuong¹, Tong Quoc Hiep², Roel H. Bosma³, Arend Ligtenberg⁴, Romina Rodela⁵, Arnold K. Bregt⁴

¹School of Humanities and Social Sciences, Can Tho University (CTU), Vietnam; ²College of Environment and Natural Resources, Can Tho University, Vietnam; ³Wageningen University & Research (WUR), Aquaculture & Fisheries group; ⁴WUR, Laboratory of Geo-Information Systems and Remote Sensing, Netherlands; ⁵Södertörn University, School of Natural Sciences, Technology & Environmental Studies, Sweden (arend.ligtenberg@wur.nl)

Along its coast, the Vietnamese Mekong Delta has protected mangrove forests and behind this a buffer zone of Integrated Mangrove Shrimp farms (IMS). Voluntary adoption of IMS beyond the buffer zone is hampered by assumptions of farmers and policy-makers about profits compared to intensive shrimp monoculture. ALEGAMS developed a board-game allowing farmers to experience the financial consequences of their decisions in shrimp farming, and assessed the effect of playing the board-game on farmer's learning and willingness to adopt IMS. The players stated to have learned about Investment & operation costs, Management & technologies, IMS' profits, and risks of Intensive shrimp farming. Several month after having played 1-3 sessions, farmer's behavior had changed: slightly higher frequency of weekly consultations and more persons consulted on practices & diseases, but increased suspicion about veterinary salesman, and technology take-up after one training increased from 30 to 43%

AGENT BASED MODELLING TO SUPPORT POLICIES ON SHRIMP FARMING AND MANGROVE IN THE VIETNAMESE MEKONG DELTA

Tong Quoc Hiep¹; Van Pham Dang Tri¹, Arend Ligtenberg², Roel H Bosma², Tran Thi Phung Ha¹, Arnold Bregt²

¹Can Tho university, Can Tho, Viet Nam; ²Wageningen University, Wageningen, The Netherlands (vpdtri@ctu.edu.vn)

Coastal zones are vulnerable to changes in ecology due to industries and urbanization, and in upstream water sources and sea level. Designing policies considering all aspects is challenging. NGO's advocate balancing ecology and economy, while GO stimulates farmers to shift to intensive (INT) shrimp farming. Most farmers intensify only part of their improved-extensive (IE) or integrated mangrove shrimp (IMS) farms into so-called hybrid systems. Using an agent-based model a spatially explicit assessment of farmers' choices and local orientation was simulated for three areas and three scenarios. The baseline scenario, assuming the increase of INT due to GO policies, shows that planning fails due to a gap between the ambitions of local authorities and the outcomes for farmers. The Organic scenario confirmed the trend towards more INT while just maintaining IMS, despite financial support. In the Climate Change scenario, the income of shrimp farming decreased due to the increased risks.

SUB-THEME 3: INCLUSIVE VALUE CHAIN INNOVATIONS FOR SUSTAINABLE SEAFOOD SECURITY

Support to development started under the paradigm of trickling down: invest in industries and wealth will spread through the society. This didn't bring down the numbers of hungry humans. Strategies like community, rural, agricultural, governance and value chain followed. Most investments had some impact but mainly lead to the accumulation of capital in value chains and industries and at the level of the investors without improving food security and wellbeing for the resource poor. The latter seems the consequence of the focus on capital and its protection by the network of wealthy owners.

The paradigm of Inclusive Business aims to use / develop approaches that improve the inclusion of (resource) poor in the value chains, and thus improve their access to food, clean water, health care, education, and etcetera. Thereto we ask the question: How Can Innovations in Aquaculture and Fisheries Contribute to Inclusive Business and Equal Access to Food? We proposes the following interactive program:

1. BOSMA Roel H.: Principles of Inclusive Business and Negative Impacts of Industrial Aquaculture. Aquaculture & Fisheries, Wageningen University & Research
2. SCHOLTENS Joeri: Inclusive Sea-food Value Chains to improve food- and nutritional security for the poor. University of Amsterdam - Amsterdam Institute of Social Sciences.
3. World Café break-out sessions, including an introduction on the process and three rounds of break-out discussions on the three points mentioned below (45').
4. Plenary: Break-out group's conclusions (3 to 6 * <3'), followed by a discussion on policy recommendations (20' to 25').

Through specific questions/propositions related to three topics, we will stimulate debates in the break-out groups. The latter will be composed of 7 to 12 persons from different back-grounds. The topics / titles of the three themes are:

- ☐ Future of Bioflocs and Related Technologies in Extensive and Intensive Aquaculture;
- ☐ Overcoming Constraints to Innovations in Seafood Production by Smallholders;
- ☐ Inclusive Seafood Business, Sustainable Seafood Trade & Seafood Security.