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RECENT DEVELOPMENTS OF BIOSECURITY AND BIOFLOC TECHNOLOGY

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i-SHARP FARM PROJECT, Malaysia – Phase 1

RECENT DEVELOPMENTS OF BIOSECURITY AND BIOFLOC TECHNOLOGY

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1. INTRODUCTION

Farm biosecurity begins with design and construction of farm. Development of shrimp farm layouts from simple pond base flow through system during 1980s. At present with modular system by using reservoirs to treat incoming water provide biosecurity required to control the emerging viral issues (Nyan Taw, 2005, 2008 & 2011). With biosecure farm design and construction, biosecure operation system need to be implemented (Nyan Taw 2010, 2012 & 2013).

Biofloc, a very recent technology seem a very promising for stable and sustainable production as the system has self nitrification process within culture ponds with zero water exchange (Yoram, 2000, 2005a&b & Yoram, et at 2012). The technology has been successfully applied commercially in Belize by Belize aquaculture (McIntosh, 2000a, b & c, 2001). It also has been applied with success in shrimp farming in Indonesia, Malaysia (Nyan Taw 2004, 2005, 2008, 2010, 2011 &, 2012) and recently successfully commercialized in Malaysia (Nyan Taw, et.at 2013). The combination of two technologies, partial harvesting and biofloc, has been studied in northern Sumatra, Indonesia (Nyan Taw 2008 *et. al*).

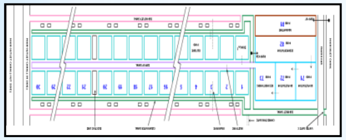
Presently, a number of studies by major universities and private companies are using biofloc as a single cell protein source in aquafeeds.

With emerging viral problems and rising costs for energy, biosecure with biofloc technology appears to be an answer for sustainable production.

1999

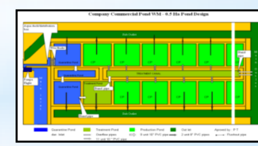
2. BIOSECURITY BEGINS WITH FARM DESIGN & CONSTRUCTION

Module



Module

2009

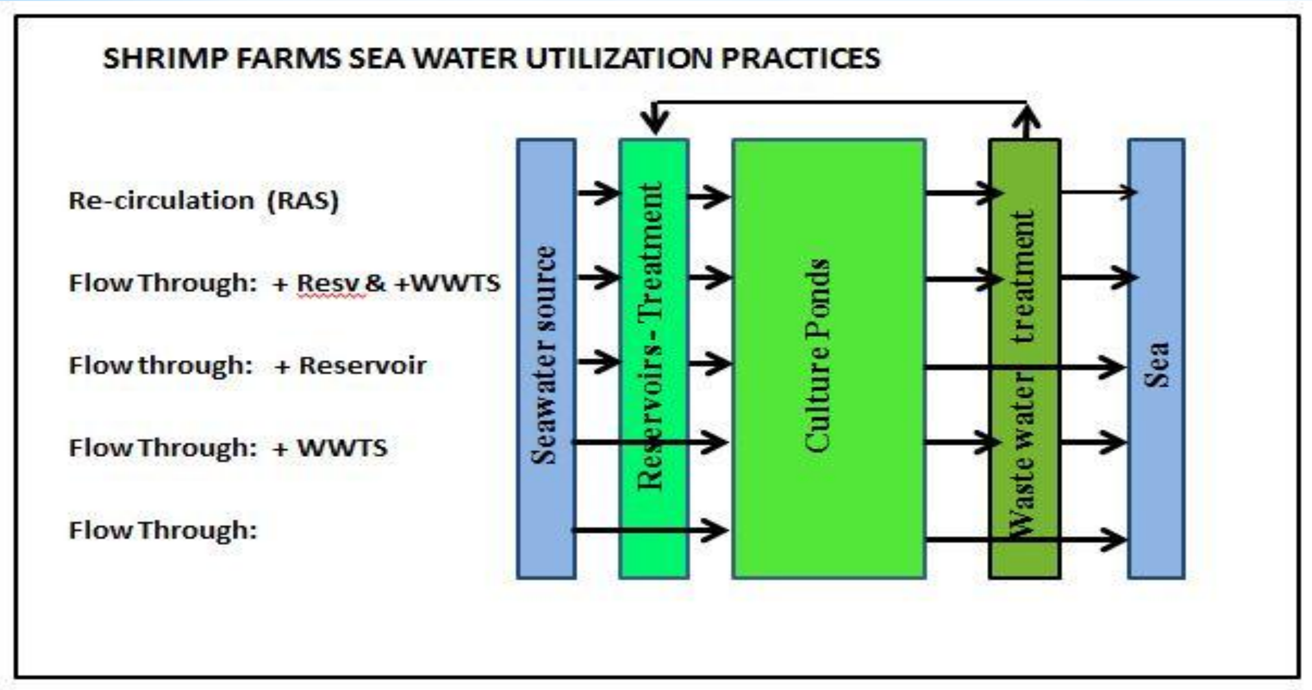


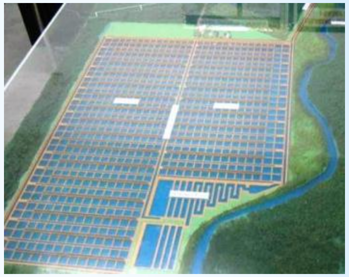
Module

Nyan Taw ,WAS 2005 Bali Farmer session 2005
Nyan Taw, Shrimp Farm Indonesia GAA 2005
Nyan Taw ,et.at Reengineering Dipasena GAA 2008
Nyan Taw , et al Malaysian shrimp farm redesign GAA 2011

SHRIMP FARMS SEA WATER UTILIZATION

RAS iSHARP modules, Malaysia



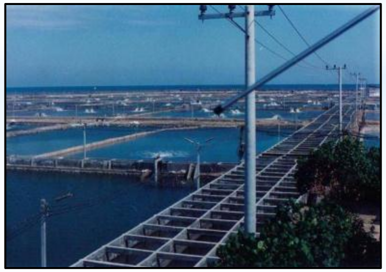


RAS iSHARP Project, Malaysia

RAS – Recirculation system, Lampung, Indonesia

Flow Through - Lampung, Indonesia

Flow through + WWST, Sumbawa, Indonesia



Flow through + Reservoirs, East Java, Indonesia

Flow through - + reservoirs & WWTS, Malaysia

i-SHARP BIOSECURITY
FARM DESIGN & CONSTRUCTION

1. **Reservoirs** 2 units for water treatment to prevent raw water entering culture ponds
2. **Secured inlet & outlets** to prevent disease spreading during outbreaks
3. **Water levels** - prevent cross contaminations
4. **Central drains** at each ponds to increase pond carrying capacity
5. **Spill ways** at main and sub supply canal to prevent flooding and overflow which could contaminate culture ponds
6. **Road for each row** to reduce contamination by human – maintenance, supply and harvest teams
7. **Wastewater treatment system** – disease control

MODULE OPERATION

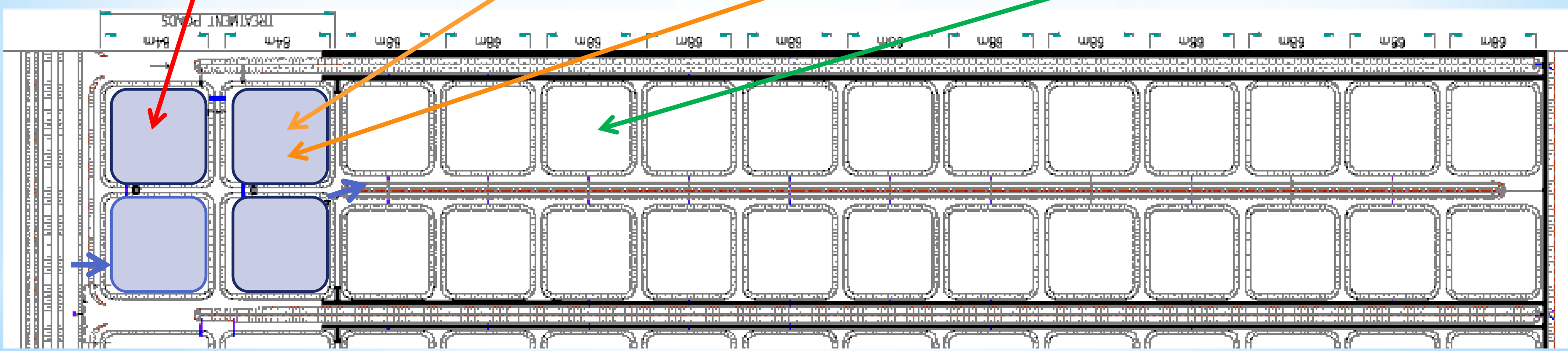
Water treatment system (Control WSSV)

Physical barrier for viral carriers – use 250 micron screen net

Chemical application – kill viral carriers. Apply crusticides

Kill free water bore virus (aging) - dies in 72 hrs without host

Treated water ready for use for culture (apply same procedure)



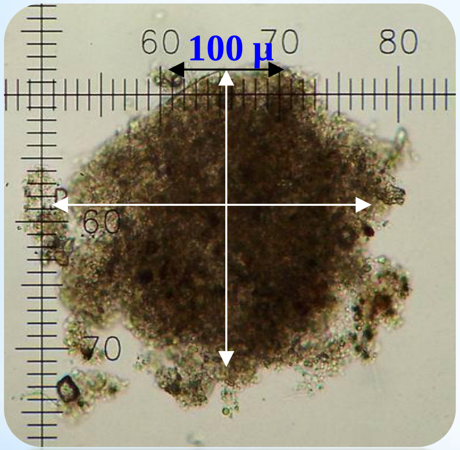
Treatment Reservoirs ponds

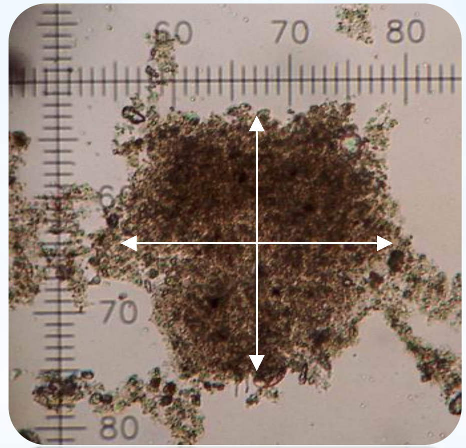
Culture ponds

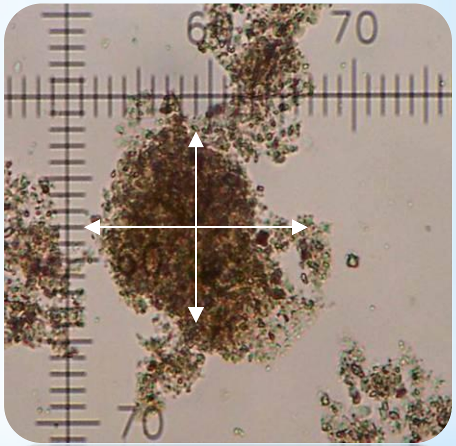
Clean animals – SPF or SPR or PCR check
Clean Ponds-clean or oxidized pond bottom
Clean Water– treated water & nets (250 micron)
Prevent carriers (fence)
Strict security to avoid biosecurity breaches

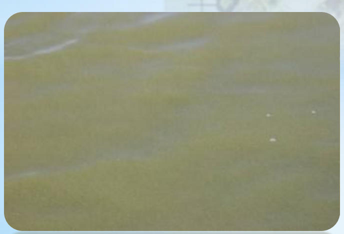
3. BIOFLOC

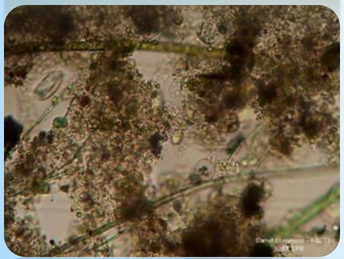
FLOC COMMUNITIES AND SIZE

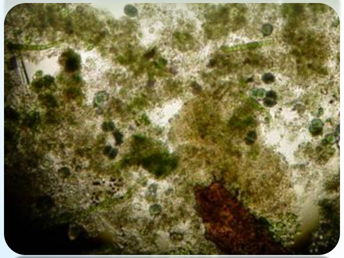












Brown **Green**

The biofloc

Defined as macroaggregates – diatoms, macroalgae, fecal pellets, exoskeleton, remains of dead organisms, bacteria, protest and invertebrates.
(Decamp, O., *et al* 2002)

As Natural Feed (filter feeders – *L. vannamie* & Tilapia) : *It is possible that microbial protein has a higher availability than feed protein (Yoram, 2005)*

BIOFLOC TECHNOLOGY CONCEPT

Figure 2.3: Scheme of recirculating aquaculture system (RAS)

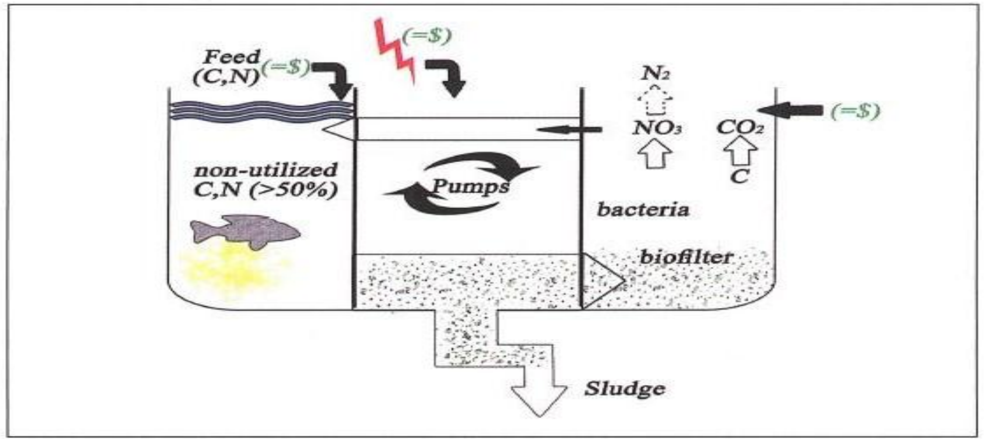
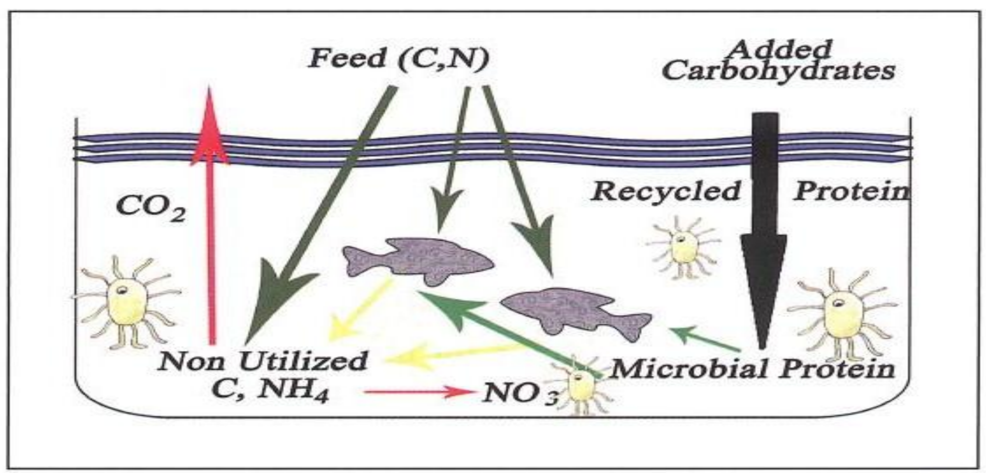


Figure 2.4: Scheme of Biofloc technology (BFT) system

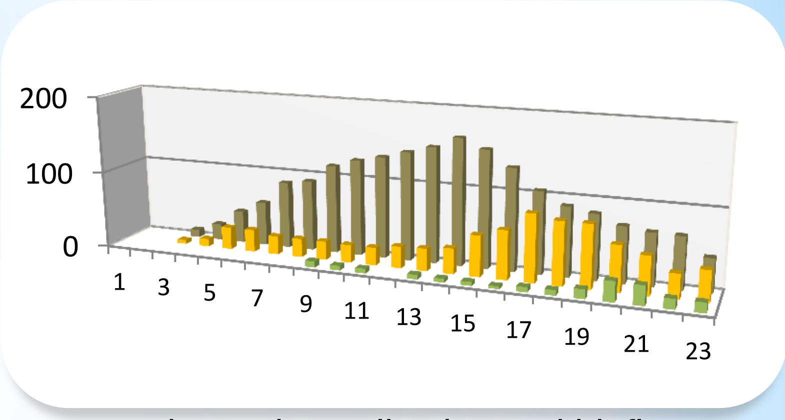


Biofloc technology is a system that has a self-nutrification process within culture pond water with zero water exchange (Yoram, 2012)

4. SHRIMP FARMING IN BIOFLOC

Basics

1. High stocking density - over 130 – 150 PL10/m2
2. High aeration – 28 to 32 HP/ha PWAs
3. Paddle wheel position in ponds (control biofloc & sludge by siphoning)
4. Biofloc control at <15 ml/L
5. HDPE / Concrete lined ponds
6. Grain (pellet)
7. Molasses
8. C&N ratio >15
9. Expected production 20–25 MT/ha/crop with 18-20 gm shrimp
10. Extra out put – biofloc as protein source
11. Red color shrimps after cooking

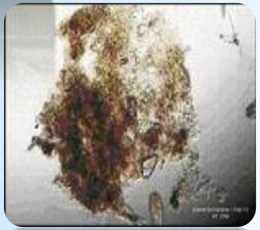


Feed & grain application and biofloc

High density

High aeration & PWAs position

Grain pellet



Bioflocs

Biofloc

Dark Vannamei

Red Vannamei

BIOSECURE MODULES

Arca Biru Farm, Blue Archipelago, Malaysia

HDPE lined ponds with center drain, secured outlet gates & Main supply canal

Biosecurity – crab fence & bird scare

Pond out let gate

Sub inlet

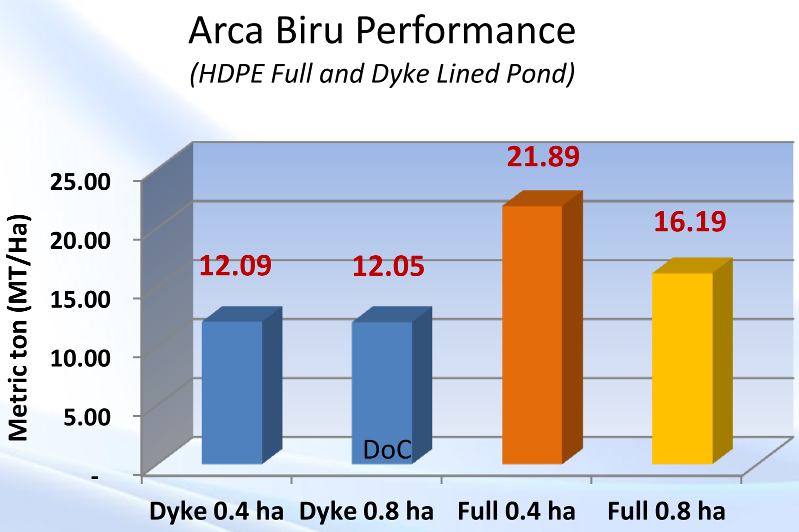
250 & 1000 micron screen net

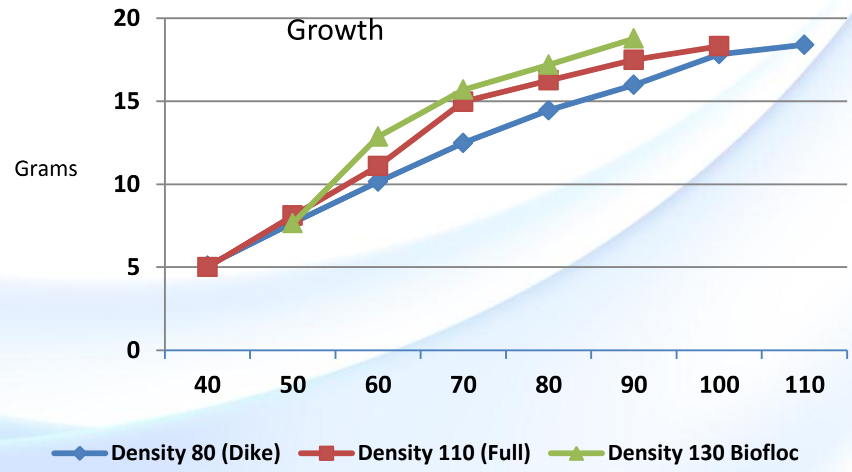
HDPE Lined secondary supply canal

Nyan Taw, Biosesurity….GAA Nov/Dec 2010
Nyan Taw, *et.al.* Malaysian ….GAA March/April 2011

PERFORMANCE

Blue Archipelago, Malaysia





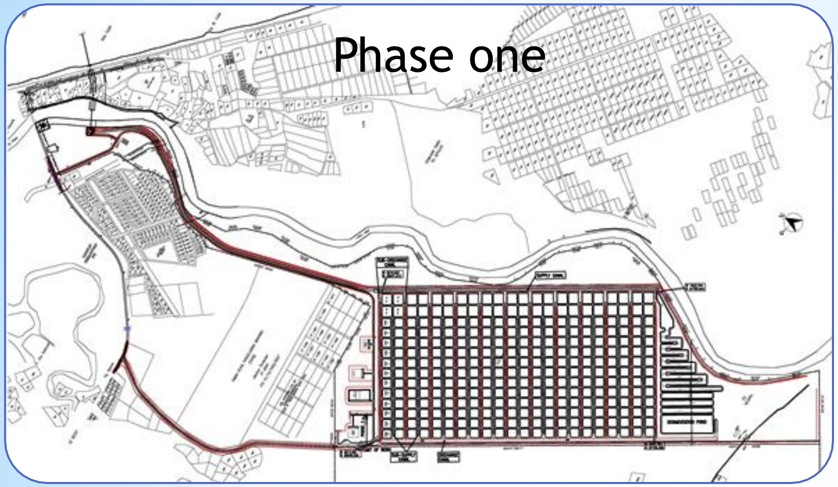
PRODUCTION PERFORMANCE OF ARCA BIRU FARM

Production Parameter	System/size/type		
	Biofloc 0.4 ha HDPE	Semi-Biofloc 0.8 ha HDPE	Conven 0.8 ha HDPE Dyke
No of Ponds	2	19	119
PWA Energy (Hp)	14	24	20
Stocking Density	130	110	83
DOC (days)	90	101	111
SR (%)	89.16	81.35	83.19
MBW (gr)	18.78	18.31	17.80
FCR (x)	1.39	1.58	1.77
ADG (gr/day)	0.21	0.18	0.16
Avg Harvest tonnage (kg)	9,006	12,950	9,616
Production (Kg/Ha)	22,514	16,188	12,019
Prod per power input (Kg/Hp)	**643**	**540**	**481**

Nyan Taw, *et.al.* GAA March/April 2011

i-SHARP SHRIMP FARM PROJECT Malaysia

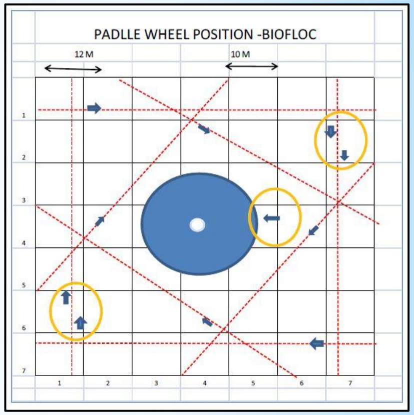
Blue Archipelago
Quality | Safety | Ecology



Phase one

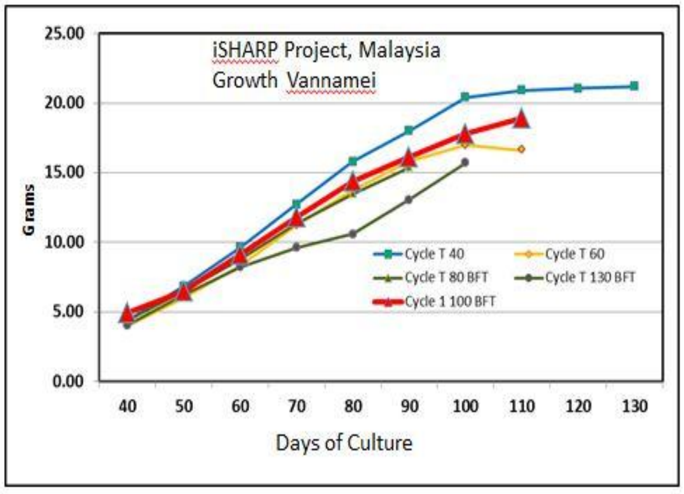
Modules in operation

Paddle wheel aerators position



HDPE Lined modules

iSHARP Biofloc System Performance – Cycles -Trial and Commercial 1, Malaysia

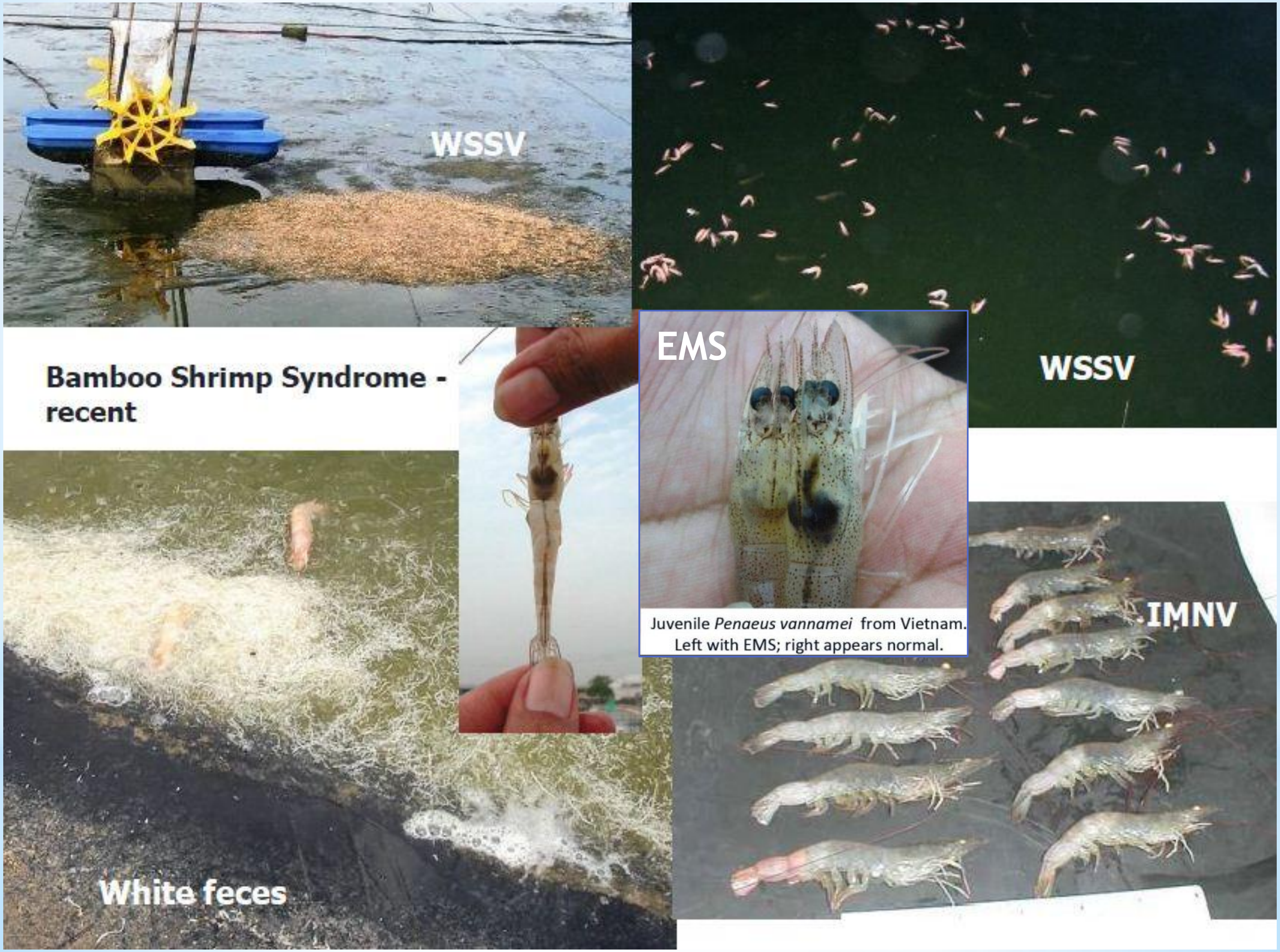


Nyan Taw *et. al. GAA Jan/Feb* 2013

Production Performance CYCLE Trial & 1 for Modules 1 & 2

Production Parameter	CYCLE Trial - Modules 1 & 2				CYCLE 1 -Modules 1 & 2	
	Density 40/m2	Density 60/m2	Density 80/m2	Density 130/m2	Density 100/m2	Density 100/m2
No of ponds	20	16	8 BFT	4 BFT*	24 BFT	24 BFT
Paddle Wheels Aerators (HP)	12	12	12	16	12	12
Days of Culture (DoC)	113	108	94	88	100	99
Survival Rate (%)	112.23	101.22	106.05	69.56	97.30	104.92
MBW (grams)	21.65	17.41	13.86	12.56	16.05	16.31
FCR	1.34	1.47	1.32	1.74	1.39	1.26
Average Production (kg/pond)	4,875	5,294	5,828	5,677	7,714	8,547
Average Production (kg/ha)	9,749	10,587	11,655	11,354	15,428	17,093
Prod per power Input (Kg/Hp)	406	441	486	355	643	712

7. SHRIMP DISEASES & BIOFLOC



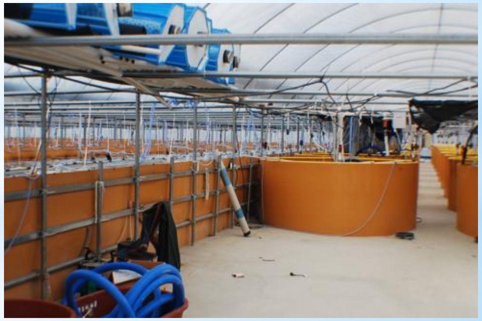
EMS/AHPNS Spreading in Asia & SE Asia

BIOFLOC MAY ENHANCE IMMUNE ACTIVITY

More than 2,000 bacterial species were found in well-developed biofloc water

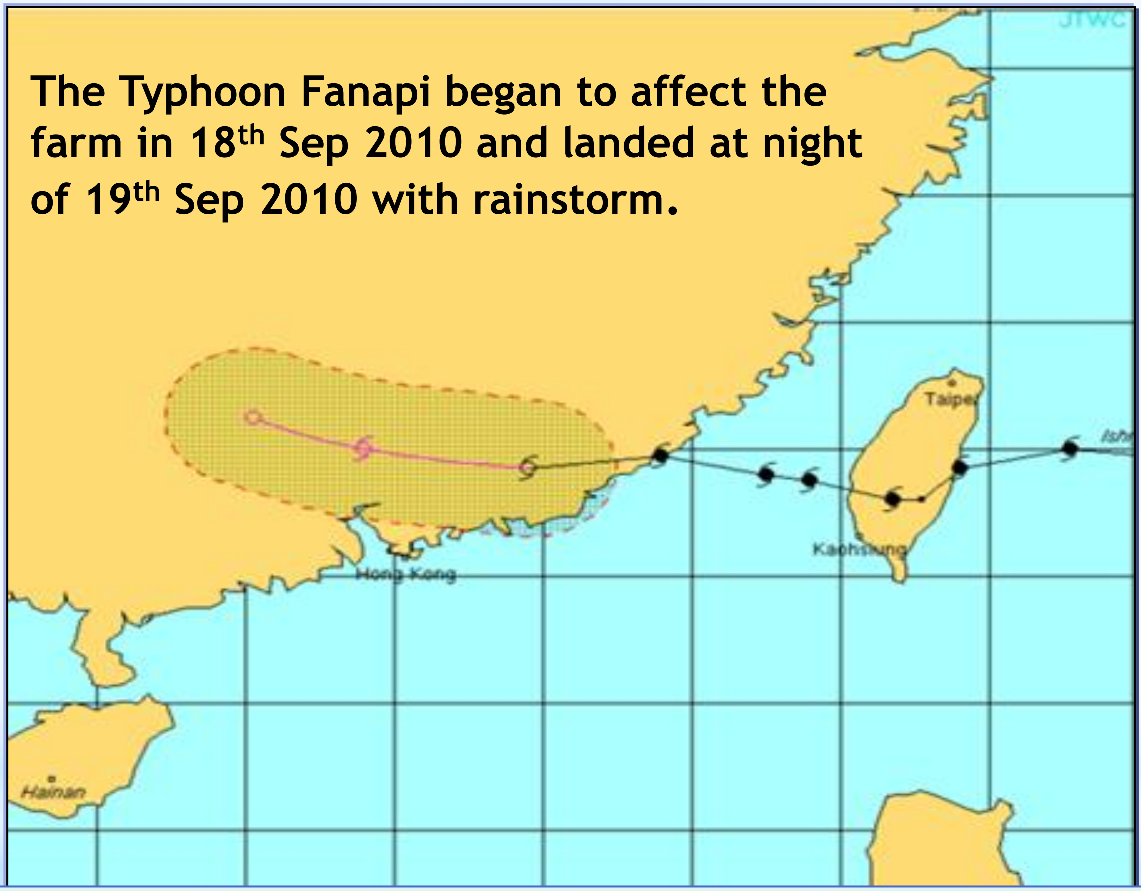
Biolfocs may enhance immune activity, based on mRNA expression of six immune-related genes.

ProPO1, proPO2, PPAE, ran, mas and SP1



From – In-Kwon Jang, IWA International Water Congress, 2012, Busan, Korea

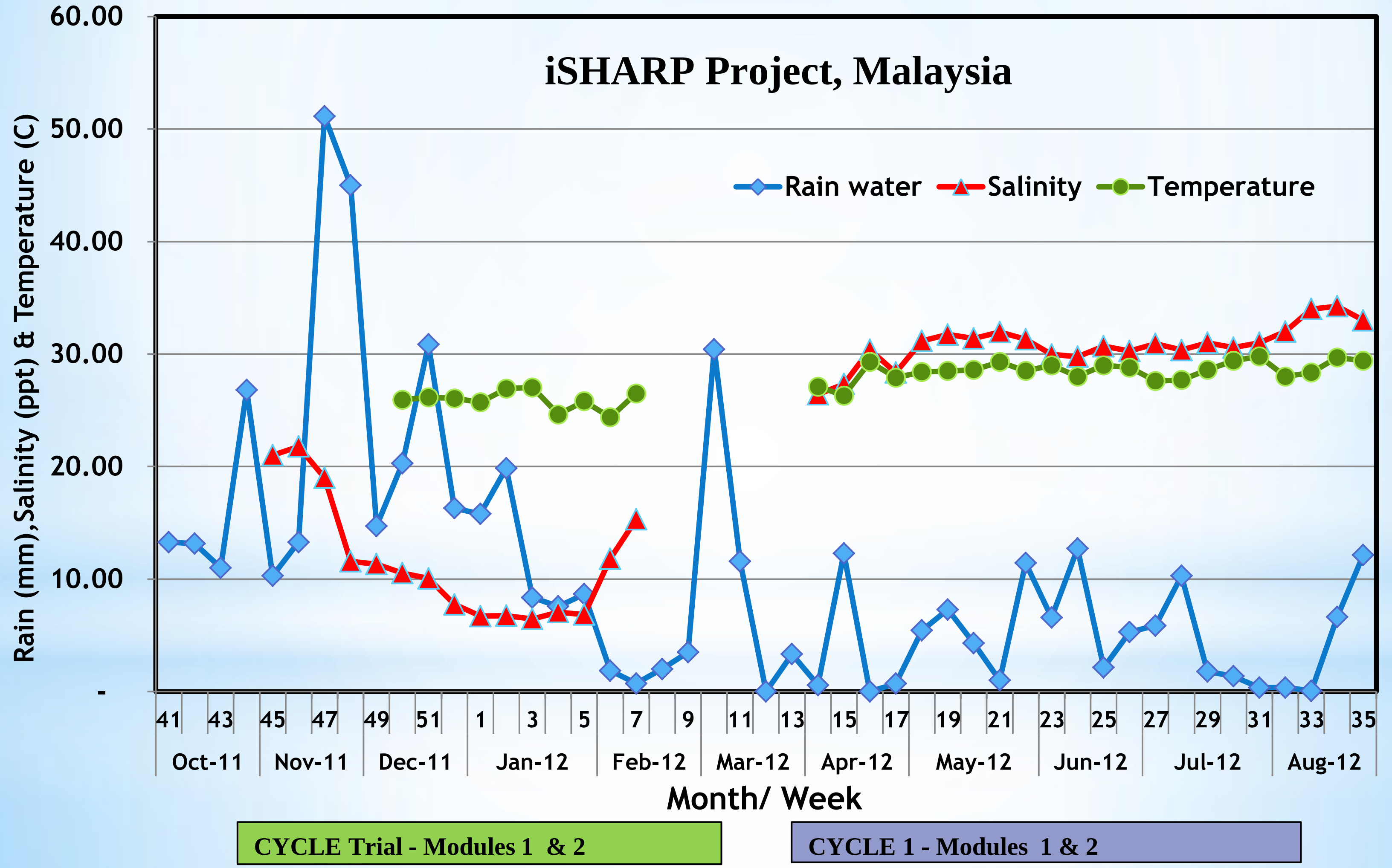
Heterotrophic bacteria (in Biofloc) control viral diseases ?



The Typhoon Fanapi began to affect the farm in 18th Sep 2010 and landed at night of 19th Sep 2010 with rainstorm.

According to Dr. Jiasong, South China Sea Fisheries Research Institute (personal communication) - **Keeping high level oxygen concentration, and promoting heterotrophic bacteria growth are two important methods to prevent the diseases outbreak after tropical storm.**

BIOSECURITY & BIOFLOC MANAGED TO PASS THROUGH MONSOON ?



Nyan Taw *et. al. GAA Jan/Feb* 2013

6. BIOFLOC AS AQUAFEED PROTEIN SOURCE

Crude Protein – range 35-50%

(Slightly deficient in arginine, lysine & methionine)

Crude Lipid – range 0.6-12%

High Ash – range 21-32 %

(Conquest & Tacon, 2006)

Tabela 2 – Composição Bromatológica com base na matéria seca de agregados microbianos formados em diferentes experimentos

Fonte	PB (%)	Carb (%)	EE (%)	FB (%)	Cinzas (%)
McIntosh et al (2000)	43,00	-	12,5	-	26,5
Tacon *et al* (2002)	31,20	-	2,6	-	28,2
Soares (2004)	12,0-42,0	-	2,0-8,0	-	22,0-46,0
Emerenciano *et al* (2006)	30,40	29,10*	0,47	0,83	39,20
Wasielesky *et al* (2006)	31,07	23,59	0,49	-	44,85

PB - proteína bruta; Carb. - carboidratos; EE - extrato etéreo ou lipídios; FB - fibra bruta

(Emerenciano et. al, 2012)

Composition of microbial flocs on dry matter basis, mean values with standard errors, as determined by laboratory analysis ($n = 2$).

Parameter	Microbial flocs
	[g/100 g]
Crude protein	49.0 ± 1.5
Carbohydrate[a]	36.4 ± 0.9
Total ash	13.4 ± 0.6
Crude fat	1.13 ± 0.09
Crude fiber	12.6 ± 0.1
Calcium	1.28 ± 0.07
Phosphorus	1.29 ± 0.08
Sodium	1.27 ± 0.03
Potassium	0.75 ± 0.13
Magnesium	0.41 ± 0.05
	[mg/kg]
Zinc	181 ± 1
Copper	92.5 ± 3.0
Manganese	35.0 ± 0.5

[a] Calculated value (Merrill and Watt, 1973): carbohydrate = 100 − (ash + crude protein + moisture + total fat).

(Kuhn, et. al, 2009)

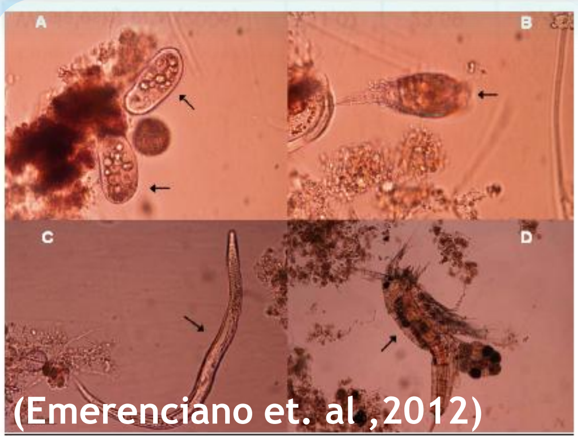
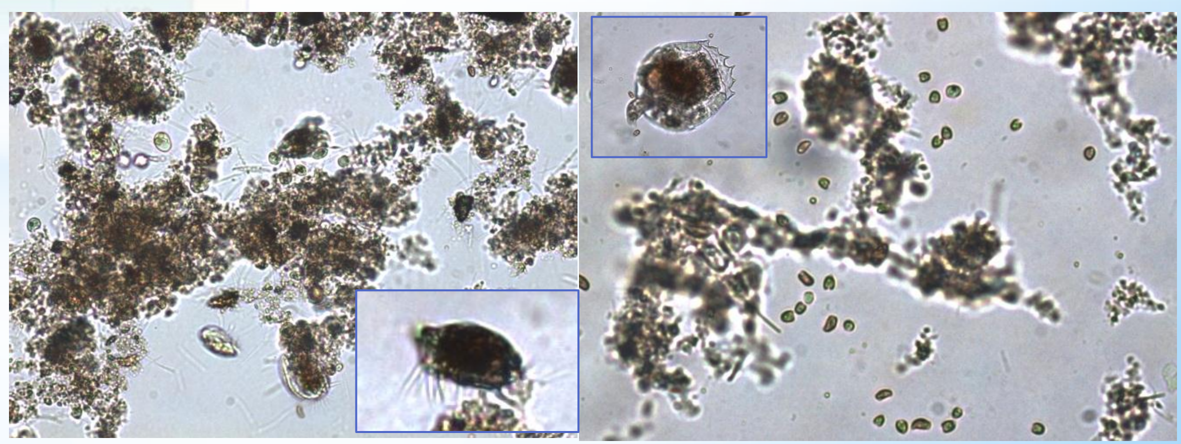


Figure 2 – Grazers often observed in BFT system such as ciliates protozoa (A), flagellates protozoa (B); nematodes (C) and copepods (D) (10x magnification) (Source: Emerenciano et al., 2012)

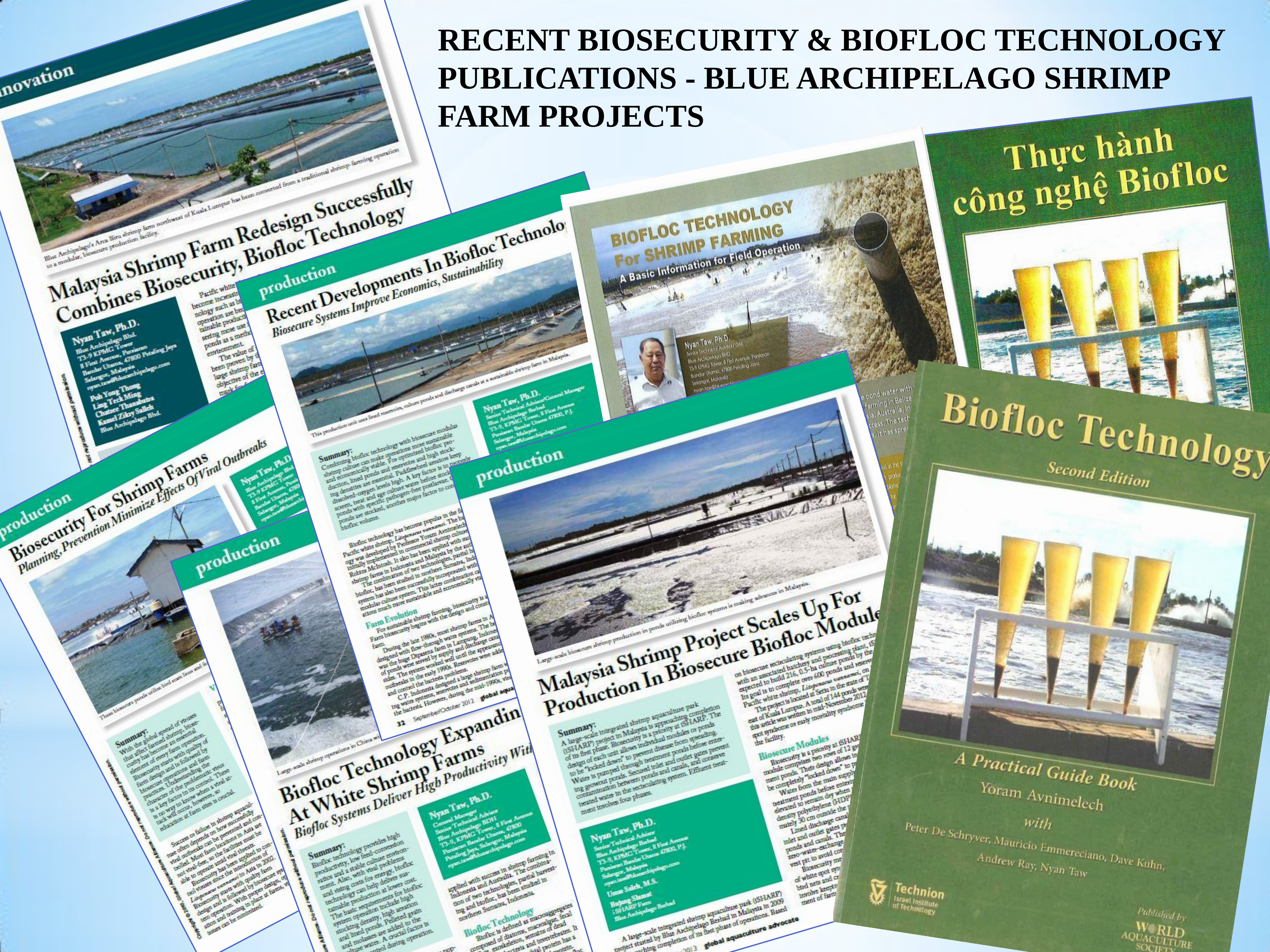


iSHARP ponds biofloc, Malaysia

7. ECOMOMICS OF BIOFLOC TECHNOLOGY

	BIOFLOC	AUTOTROPHIC	REMARKS
Production (MT)	22 MT/ Ha	21 MT/ha	Increase in production = more profit
Growth (gms/day)	0.16 to 2.1	0.13 to 0.16	Larger shrimp size = better price
FCR	1.1 to 1.3	1.5 to 1.7	Lower FCR = lesser feed cost. FCR 0.1 = 3-4% of feed cost.
Biofloc as Protein source	Crude Protein - 35-50%	none	Shrimp/fish consume biofloc. Biofloc can be harvested to replace protein in aqua feed.
DoC (Days of Culture)	90 -100 days	110-120 days	Less DoC = increase production cycles (eg from 2 to 2.5 cycles/ year. More revenue.
Energy Efficiency (HP)	650 – 1,100 Kg/HP	400 - 600 Kg/HP	More efficiency = less energy cost
Shrimp color (red)	Salmon scale > 28	Salmon scale < 24	Strong red = Better price
Stability	CV < 25 %	CV > 25 %	Lower CV = More productivity
Sustainability	Flush out < 1.5%	Flush out > 10 %	More sustainability = Higher production
Water exchange	Zero water exchange	Minimum or flow through	Energy saving in water pumping
Gross profit	> 35 %	< 30 %	The more the profit the better
Production Cost	< 15-20 % than Autotrophic	Standard Autotrophic	Less production cost = more profit
Feed Mill - production	Less sale but more sustainable sale	Normal sale	Feed mill should include grain pellet for biofloc with which sustainable sales could be secured.

RECENT BIOSECURITY & BIOFLOC TECHNOLOGY PUBLICATIONS - BLUE ARCHIPELAGO SHRIMP FARM PROJECTS



8. ACKNOWLEDGEMENTS

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Mr. Abu Bakar Ibrahim (CEO) and Mr. Christopher Lim (COO), Blue Archipelago for their interest and support. The staff and members of Blue Archipelago, Malaysia for their support.

Thank You


Aquaculture America 2006 Las Vegas
EXIT
Shaun M. Moss, George Chamberlian, Rod Mcneil, Joe , -----, ------, Daniel F. Fegan,
Yoram Avnimelech, Tim Hering, ----, ----
------, Tzachi M. Samocha, Bob Rosenberry, J. Michael Mogollon Nyan Taw