

Nashville, Tennessee USA
February 21-25, 2013



RECENT DEVELOPMENTS OF BIOSECURITY AND BIOFLOC TECHNOLOGY

Nyan Taw, Ph.D.

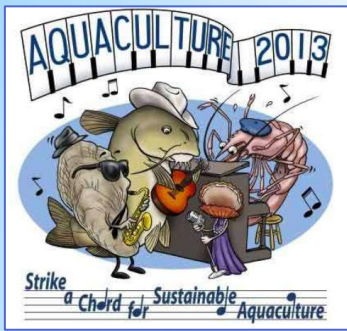
Blue Archipelago Berhad

nyan.taw@bluearchipelago.com

nyan.taw@gmail.com



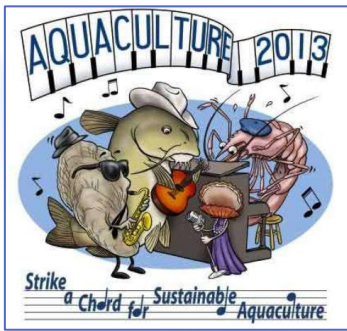
i-SHARP FARM PROJECT, Malaysia – Phase 1



RECENT DEVELOPMENTS OF BIOSECURITY AND BIOFLOC TECHNOLOGY

1. INTRODUCTION
2. BIOSECURITY
3. BIOFLOC
4. BIOFLOC IN SHRIMP FARMING
5. SHRIMP DISEASES & BIOFLOC
6. BIOFLOC AS PROTEIN SOURCE
7. ECONOMICS
8. ACKNOWLEDGEMENTS





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).

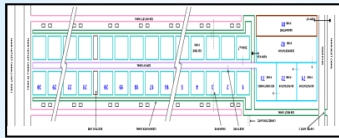
Biofloc, a very recent technology seem a very promising for stable and sustainable production as the system has self nitrification process within culture ponds with zero water exchange (Yoram, 2000, 2005a&b & Yoram, et at 2012). The technology has been successfully applied commercially in Belize by Belize 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. a/*).

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.

2. BIOSECURITY BEGINS WITH FARM DESIGN & CONSTRUCTION

Module



Module base system CPB, Indonesia



Modules Earthen & HDPE lined ponds (0.5ha). Recirculation system

2000

Module base system – iSHARP Project
Blue Archipelago, Malaysia



2011

Pond base to module base system
Arca Biru, Blue Archipelago, Malaysia



2010



Module

2009

Pond base in rows

1990



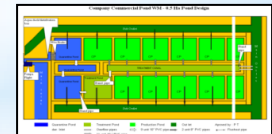
p.t. dipasena citra darmaja™
Integrated Shrimp Farming

Module base system
Dipasena WM, Indonesia



Pond base in rows changed to Module base operation system in 2006 – reservoirs and culture ponds

2006



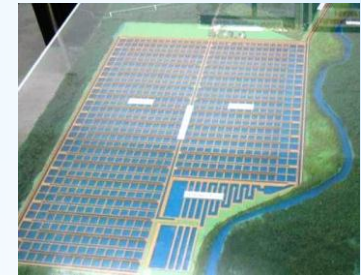
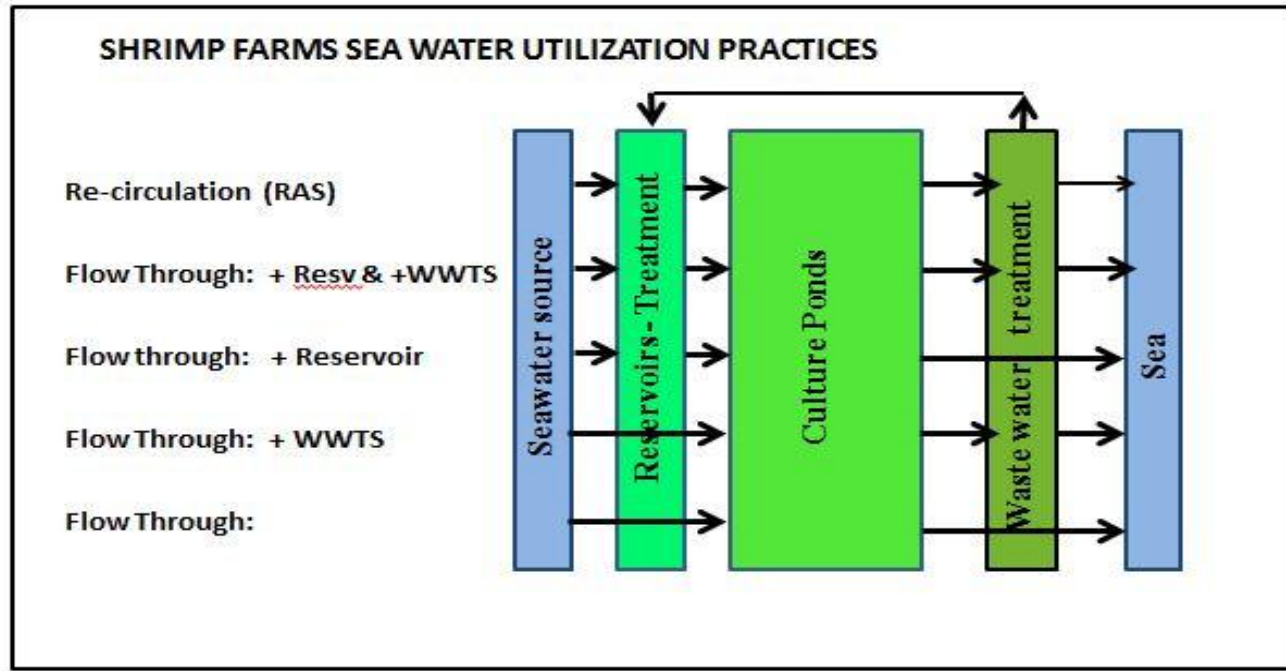
Module

- 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 PRACTICES



RAS iSHARP modules, Malaysia



RAS iSHARP Project, Malaysia



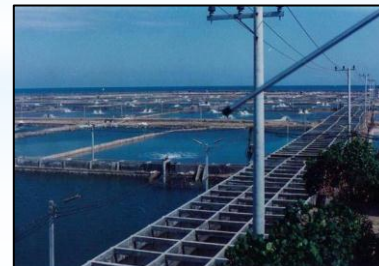
RAS - Recirculation system, Lampung, Indonesia



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

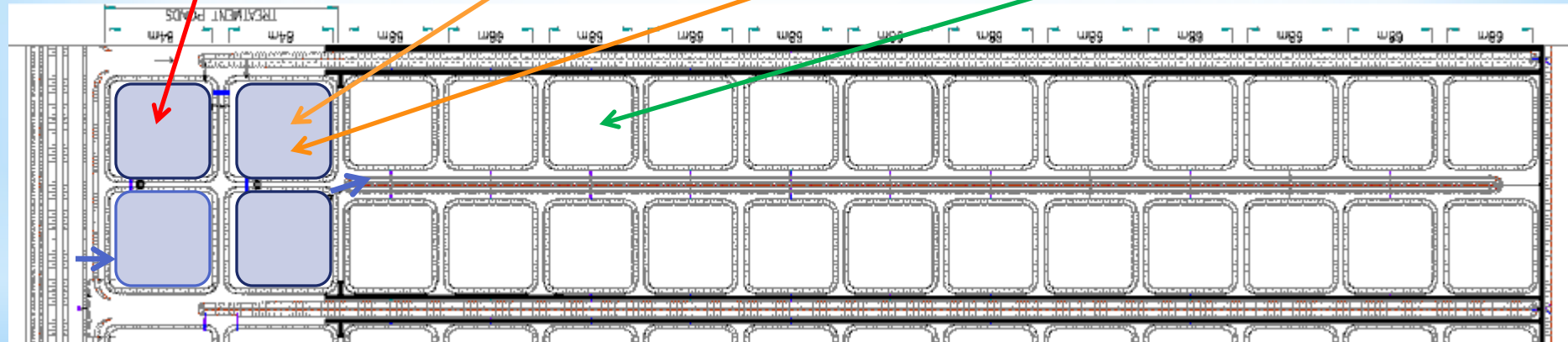
Water treatment system (Control WSSV)

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)



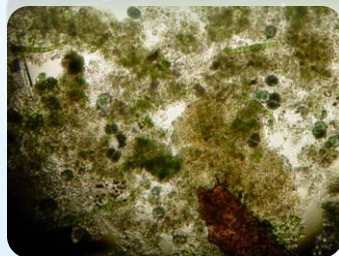
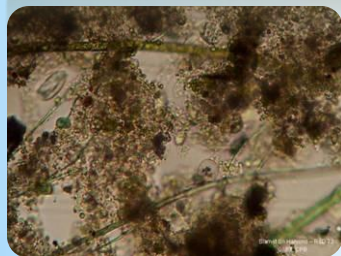
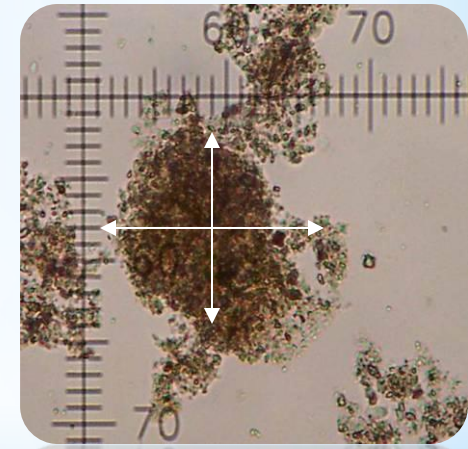
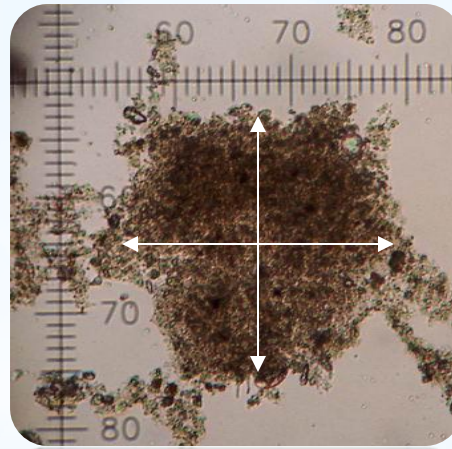
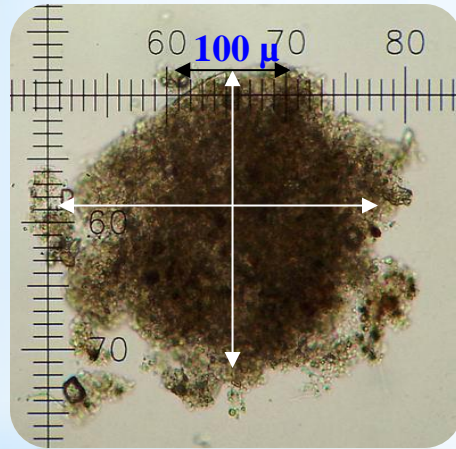
 Treatment Reservoirs ponds

 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, protist and invertebrates.

(Decamp, O., et al 2002)

As Natural Feed (filter feeders – *L. vannamei* & 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)

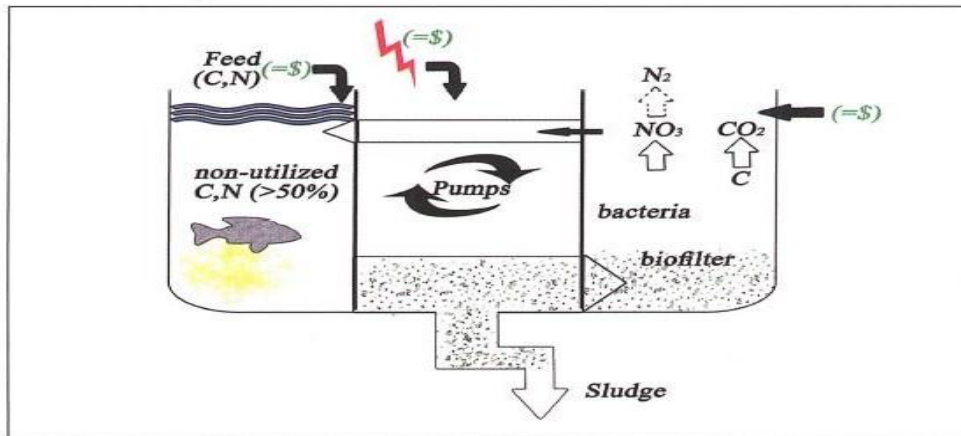
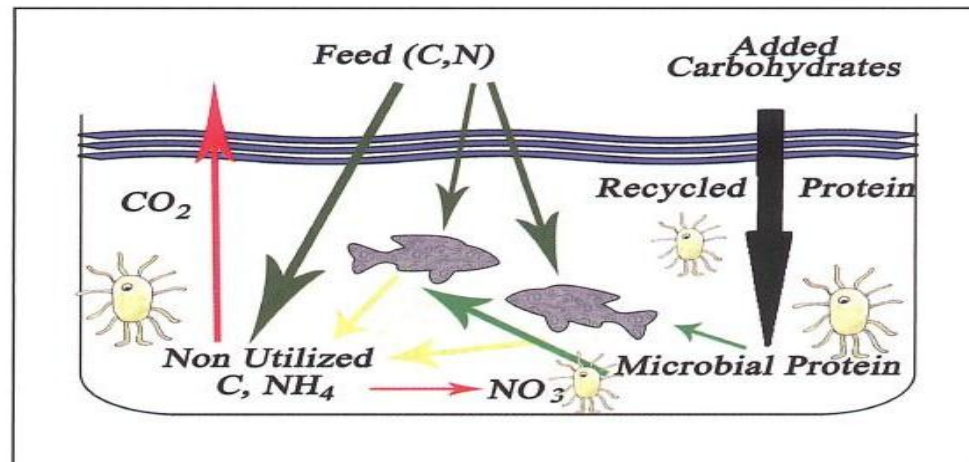


Figure 2.4: Scheme of Biofloc technology (BFT) system

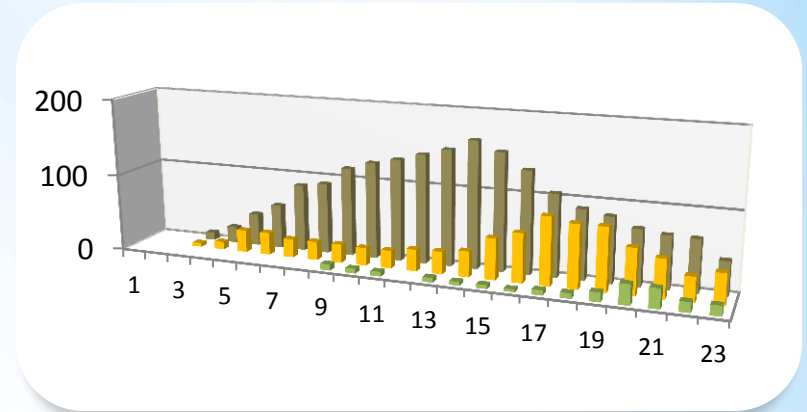


Biofloc technology is a system that has a self-nitrification process within culture pond water with zero water exchange (Yoram, 2012)

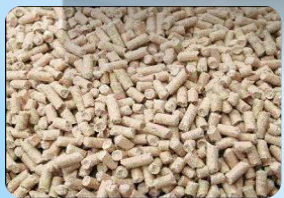
4. SHRIMP FARMING IN BIOFLOC

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



Grain pellet



Bioflocs



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 outlet gate



Sub inlet



250 & 1000 micron screen net



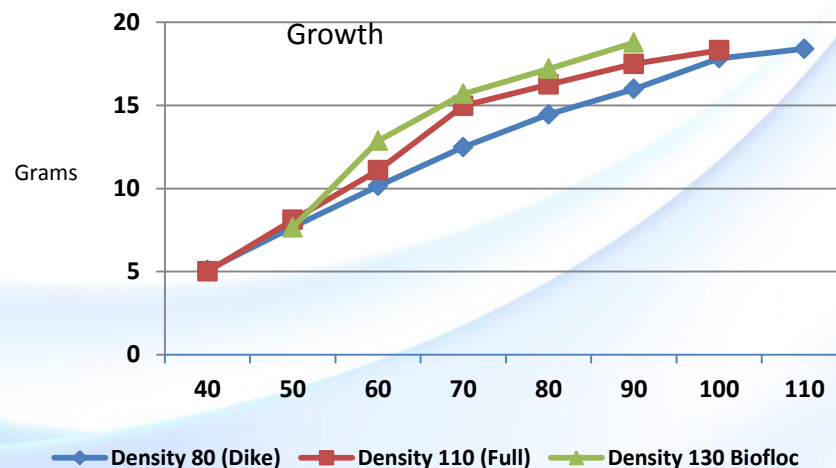
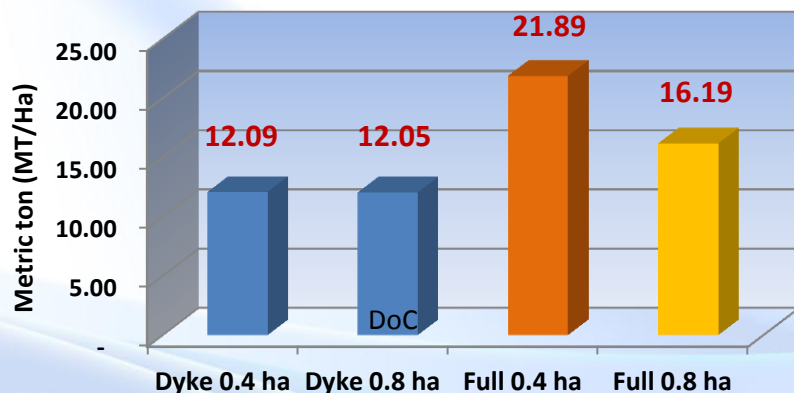
HDPE Lined secondary supply canal

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

PERFORMANCE

Blue Archipelago, Malaysia

Arca Biru Performance
(HDPE Full and Dyke Lined Pond)

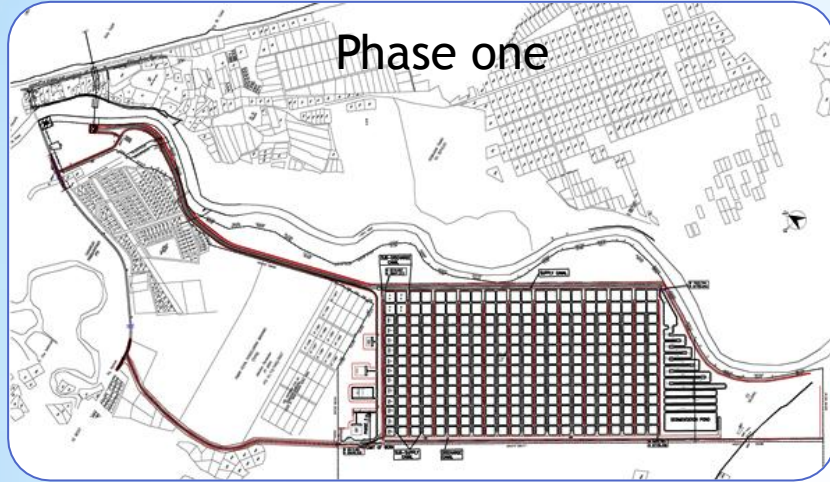


PRODUCTION PERFORMANCE OF ARCA BIRU FARM

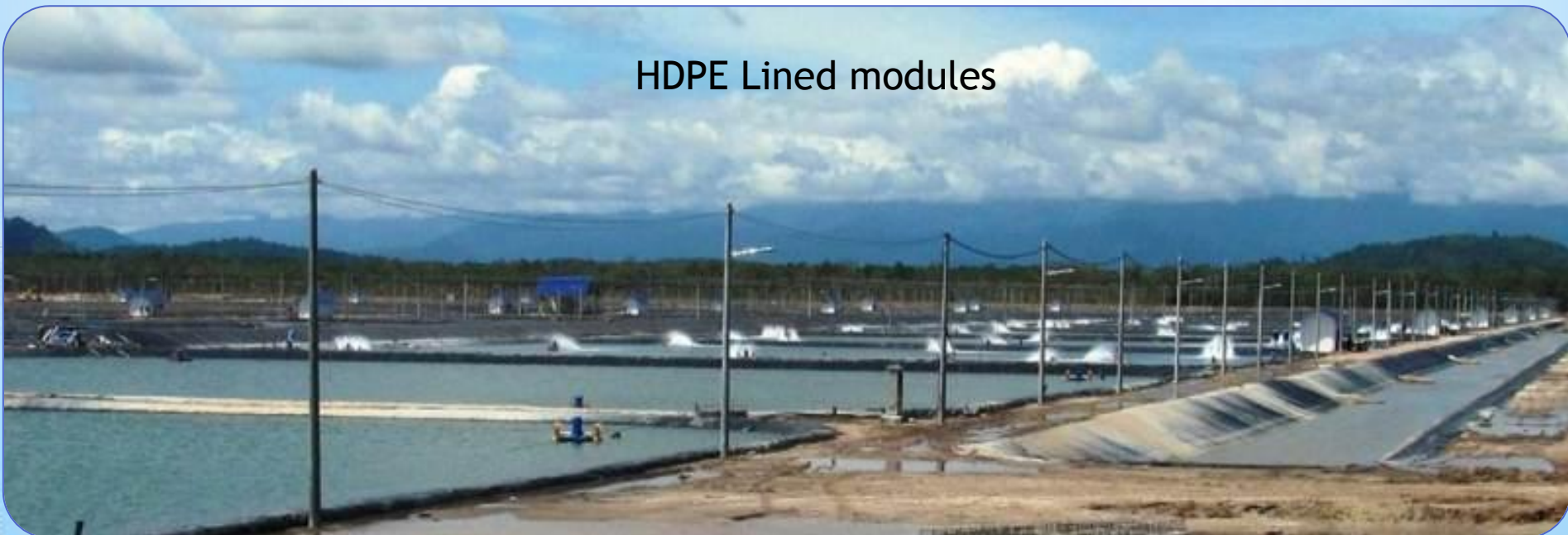
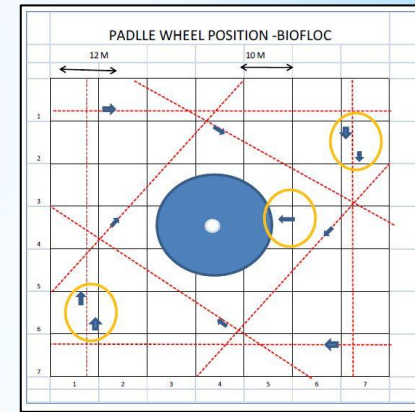
Production Parameter	System/size/type		
	Biofloc 0.4 ha HDPE	Semi-Biofloc 0.8 ha HDPE	Conven 0.8 ha HDPE Dyke
No of Ponds	2	19	119
PWA Energy (Hp)	14	24	20
Stocking Density	130	110	83
DOC (days)	90	101	111
SR (%)	89.16	81.35	83.19
MBW (gr)	18.78	18.31	17.80
FCR (x)	1.39	1.58	1.77
ADG (gr/day)	0.21	0.18	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

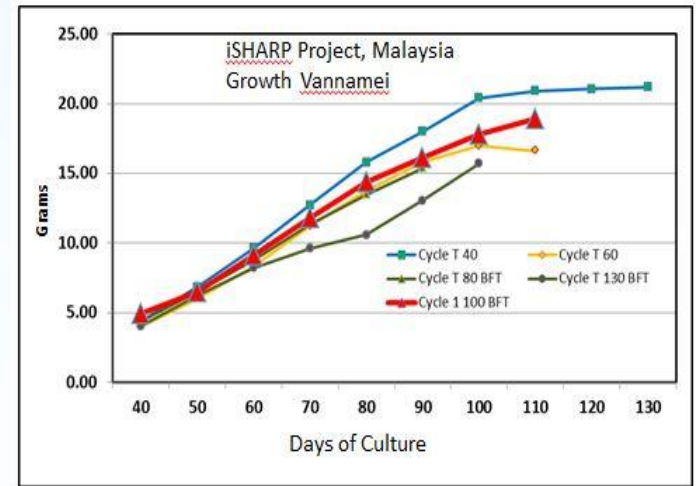
i-SHARP SHRIMP FARM PROJECT Malaysia



Paddle wheel aerators position



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



Production Performance CYCLE Trial & 1 for Modules 1 & 2

Production Parameter	CYCLE Trial - Modules 1 & 2				CYCLE 1 - Modules 1 & 2	
	Density 40/m ²	Density 60/m ²	Density 80/m ²	Density 130/m ²	Density 100/m ²	Density 100/m ²
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

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



7. SHRIMP DISEASES & BIOFLOC



Bamboo Shrimp Syndrome - recent



Juvenile *Penaeus vannamei* from Vietnam. Left with EMS; right appears normal.



EMS/AHPNS Spreading in Asia & SE Asia



Dr. Lim, GOAL 2012

BIOFLOC MAY ENHANCE IMMUNE ACTIVITY

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

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

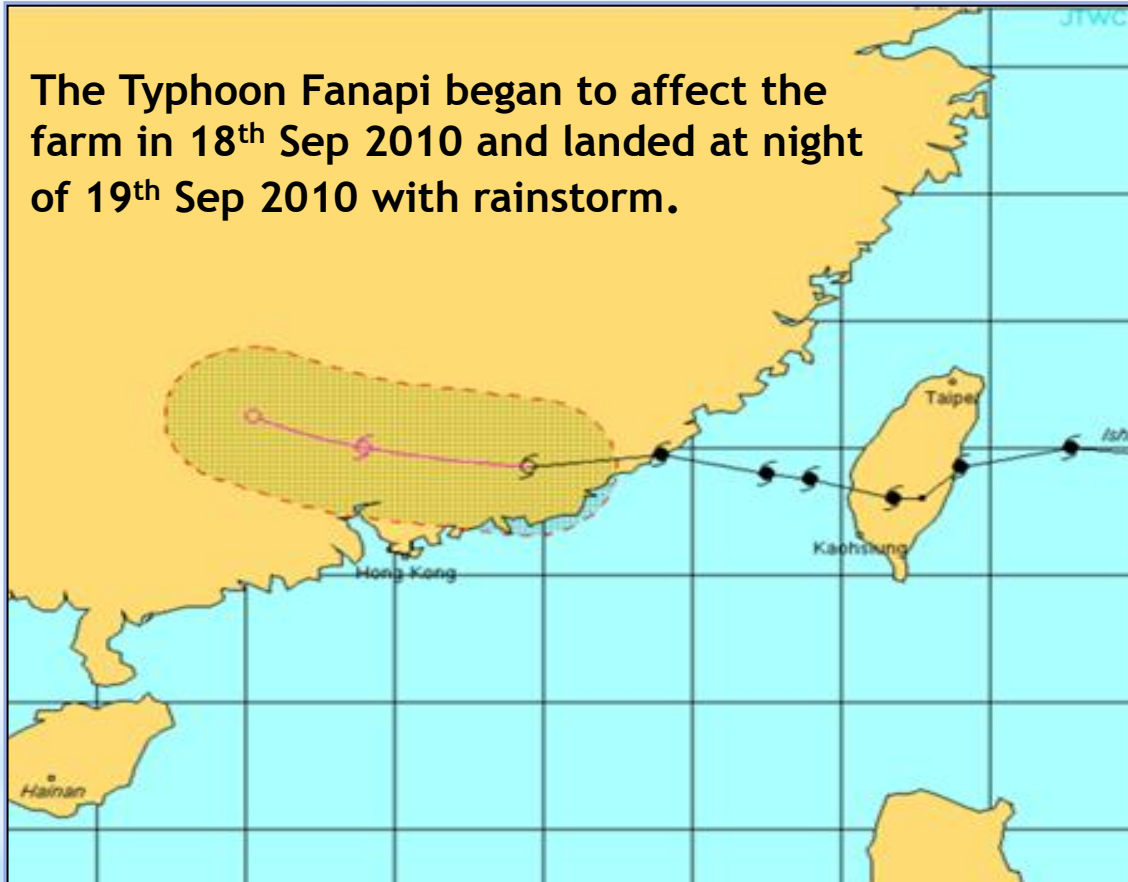
ProPO1, proPO2, PPAE, ran, mas and SP1



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

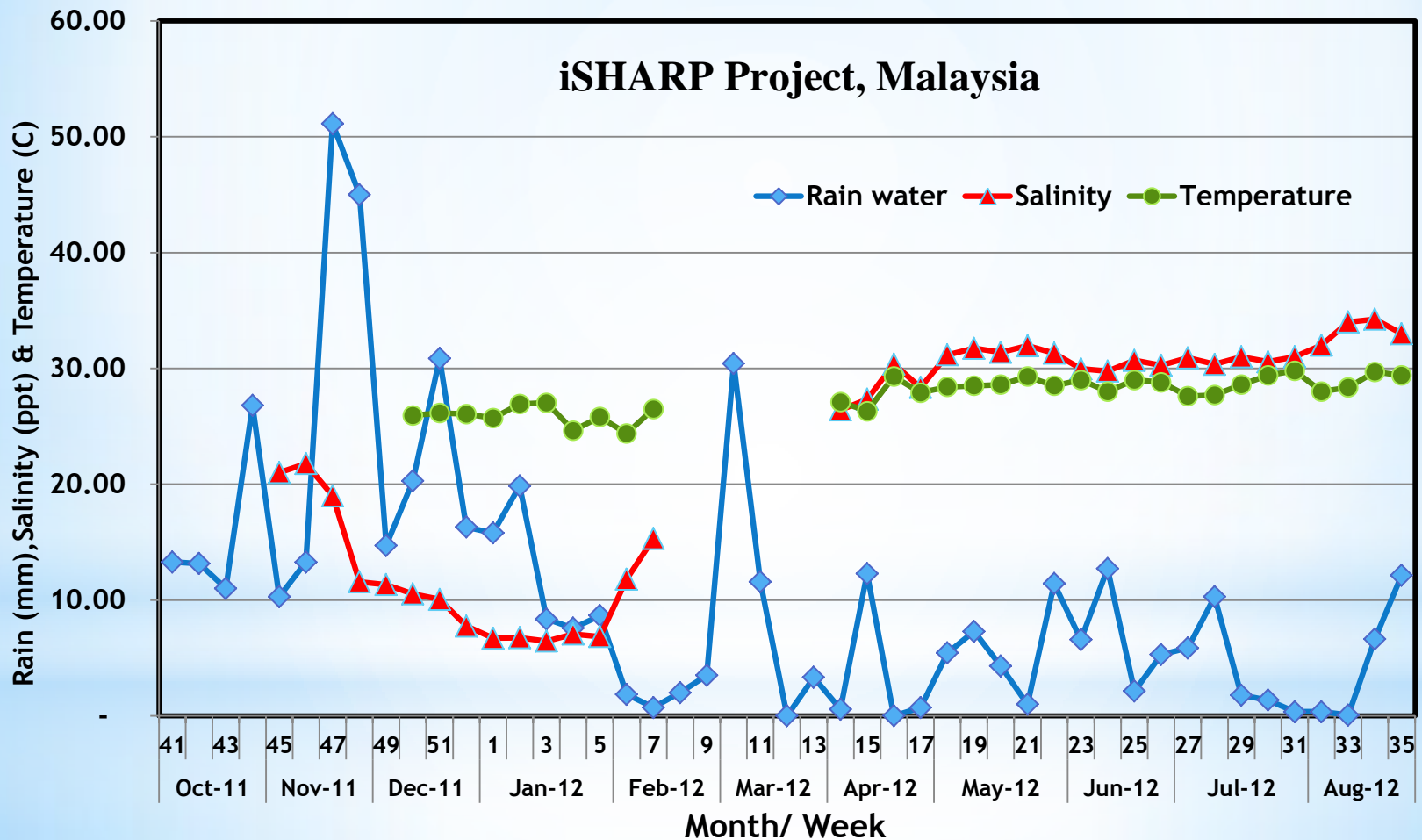
Heterotrophic bacteria (in Biofloc) control viral diseases ?

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 ?



CYCLE Trial - Modules 1 & 2

CYCLE 1 - Modules 1 & 2

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

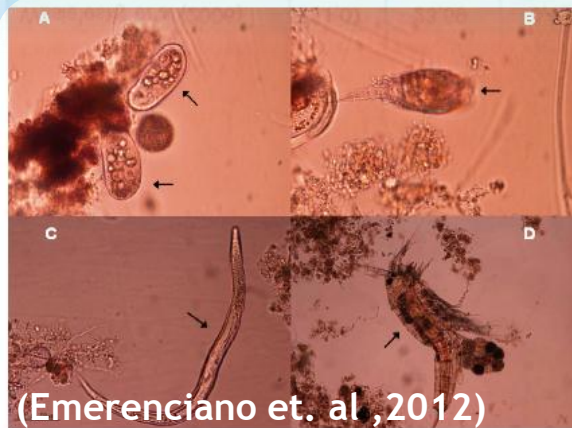
PB - proteína bruta; Carb. - carboidratos; EE - extrato etéreo ou lipídios; FB - fibra bruta

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).

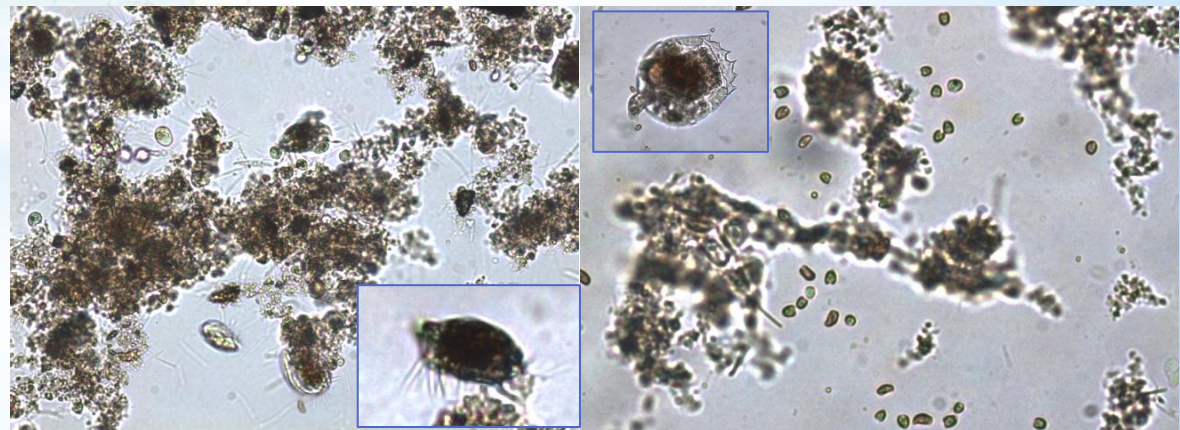
(Emerenciano et. al, 2012)



(Emerenciano et. al, 2012)

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

(Kuhn, et. al, 2009)



iSHARP ponds biofloc, Malaysia

7. ECONOMICS 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



Malaysia Shrimp Farm Redesign Successfully Combines Biosecurity, Biofloc Technology

Nyan Taw, Ph.D.
 Blue Archipelago Biol.
 73-9 KIPPEC Tower
 8th Floor, Avenue 8
 Bandar Utama, 47800 Petaling Jaya
 Selangor, Malaysia
 nyantaw@bluearchipelago.com
 nyantaw@bluearchipelago.com

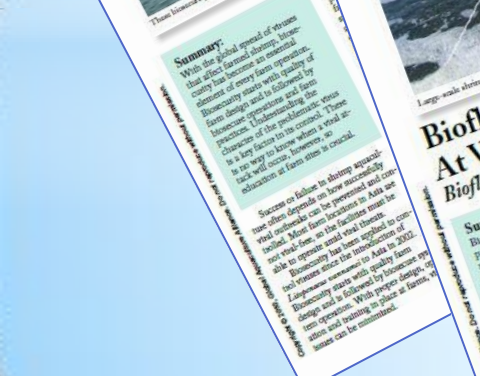
Pacific white shrimp become increasingly scarce as biosecurity technology such as biofloc production systems are used to create more sustainable production systems. The value of biofloc technology has been proven by a large shrimp farm project in Malaysia.



Biosecurity For Shrimp Farms Planning, Prevention Minimize Effects Of Viral Outbreaks

Nyan Taw, Ph.D.
 Blue Archipelago Biol.
 73-9 KIPPEC Tower
 8th Floor, Avenue 8
 Bandar Utama, 47800 Petaling Jaya
 Selangor, Malaysia
 nyantaw@bluearchipelago.com

production



Biofloc Technology Expanding At White Shrimp Farms Biofloc Systems Deliver High Productivity With

Nyan Taw, Ph.D.
 General Manager
 Technical Institute
 International Institute
 Blue Archipelago Biol.
 73-9 KIPPEC Tower, 8th Floor
 Petaling Jaya, Selangor, Malaysia
 nyantaw@bluearchipelago.com

Summary:
 Biofloc technology provides high productivity, low feed conversion ratios and a stable culture environment. Along with costs for energy, biofloc technology can help achieve sustainable production at lower cost. The basic requirements for biofloc systems include high aeration systems, frequent water changes, and the addition of a carbon source. A crucial factor is the control of the system during operation.

Biofloc Technology
 Biofloc is defined as macroorganisms composed of diverse, multicellular, local bacteria and microorganisms. It is a natural process that occurs in ponds and tanks. Biofloc provides a natural control during operation.



BIOFLOC TECHNOLOGY For SHRIMP FARMING

A Basic Information for Field Operation



Nyan Taw, Ph.D.
 Senior Technical Advisor/General Manager
 Blue Archipelago Biol.
 73-9 KIPPEC Tower, 8th Floor
 Petaling Jaya, Selangor, Malaysia
 nyantaw@bluearchipelago.com

Summary:
 Combining biofloc technology with biosecure mobile shrimp culture can make operations more sustainable and economically viable. For optimum biofloc production, local ponds and reservoirs and large stockpiling reservoirs are essential. Pathogens are kept from the system by using a large stockpiling reservoir. The value of biofloc technology has been proven by a large shrimp farm project in Malaysia.

production



Malaysia Shrimp Project Scales Up For Production In Biosecure Biofloc Modules

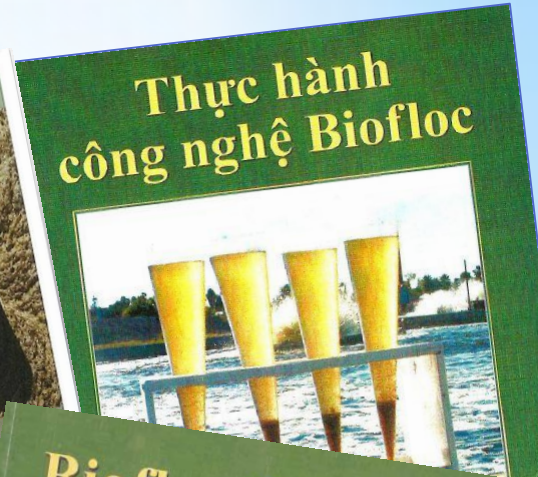
Summary:
 A large-scale integrated shrimp aquaculture park (ISHARP) project in Malaysia is approaching completion of its first phase. Biosecurity is a primary at ISHARP. The design of each unit allows individual modules or ponds to be "locked down" to prevent disease from spreading. Water is purged through treatment ponds before entering grower ponds. Second trial and control ponds prevent contamination between ponds and canals, and conserve treated water in the recirculating system. Efficient treatment involves four phases.

Biosecure Modules
 Biosecurity is a priority at ISHARP. Each module consists of two rows of 12 grower ponds. These design allows for treatment ponds to be completely "locked down" to prevent disease from spreading. Water from the main supply treatment ponds before entering grower ponds. Second trial and control ponds prevent contamination between ponds and canals, and conserve treated water in the recirculating system. Efficient treatment involves four phases.

Nyan Taw, Ph.D.
 Senior Technical Advisor
 Blue Archipelago Biol.
 73-9 KIPPEC Tower, 8th Floor
 Petaling Jaya, Selangor, Malaysia
 nyantaw@bluearchipelago.com

Uzun Rohat, M.S.
 Rajang Shrimp
 101100919
 Blue Archipelago Biol.

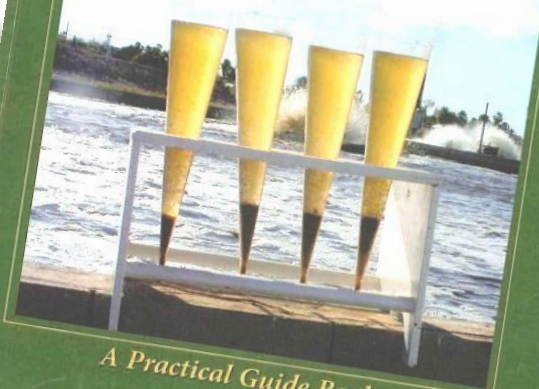
A large-scale integrated shrimp aquaculture park (ISHARP) project started by Blue Archipelago Biol. in Malaysia in 2009 is approaching completion of its first phase of operations. Based on biosecure modules, the project is making advances in Malaysia.



Thực hành công nghệ Biofloc

Biofloc Technology

Second Edition

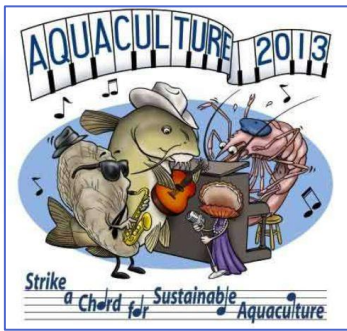


A Practical Guide Book

Yoram Avnimelech
 with
 Peter De Schryver, Mauricio Emmerciano, Dave Kuhn,
 Andrew Ray, Nyan Taw

Technion
 Israel Institute of Technology

Published by
WORLD
 AQUACULTURE
 SOCIETY



8. ACKNOWLEDGEMENTS

The author would like to sincerely thank the following:

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

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