ASIAN PACIFIC AQUACULTURE 2009

POTENTIAL FOR DEVELOPMENT OF BIO-FLOC TECHNOLOGY FOR PACIFIC WHITE SHRIMP (*Litopenaeus vannamei*) FARMING

Nyan Taw

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Acknowledgements

The presentation is based on studies and surveys experienced by the author on Biofloc (BFT) in Indonesia, South & Central America, China and Malaysia.

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Introduction

Shrimp farming has become competitive and as such the technology utilized needs to be efficient in all aspects – productivity, quality, sustainability, bio-security and to be in line with market demand.

BFT (Biofloc) system is at present highly sought technology for Pacific white shrimp culture due to high efficiency, productivity, sustainability and with lower FCR. The basic system of bio-floc technology was given by Avnimelech (2000, 2005a&b). The system was successfully applied in commercial culture of shrimps by McIntosh (2000a,b & c, 2001), McNeil (2000), Nyan Taw (2005, 2006, 2009), Nyan Taw & Saenphon Ch. (2005); Saenphon Ch. et.al. (2005). BFT in combination with partial harvest was presented at WA 2009 in Veracruz, Mexico by Nyan Taw (2009). Recently, Avnimelech (2009) published a book entitled "Biofloc Technology: A Practical Guide Book" .

Basic Concept of Biofloc Technology

Yoram Avnimelech, 2000, 2005

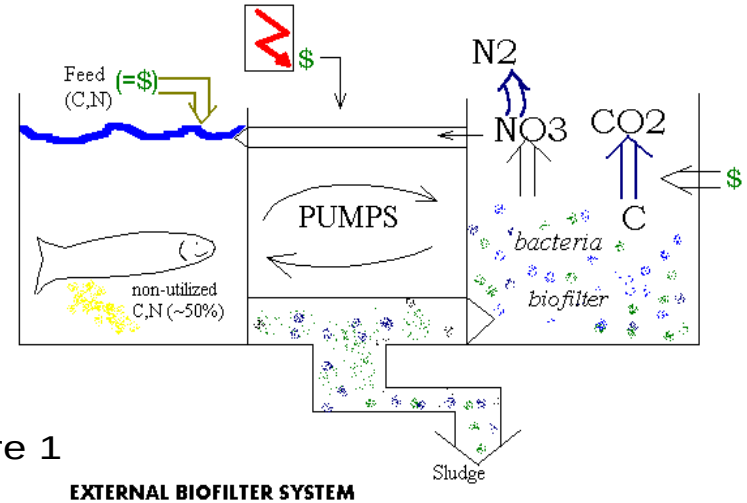


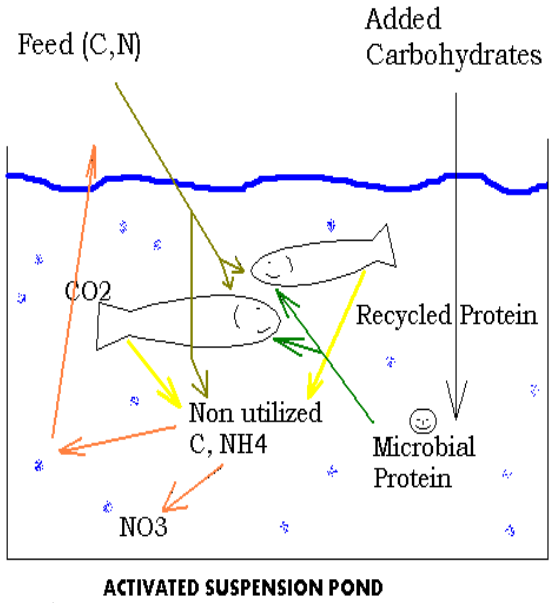
Figure 1

EXTERNAL BIOFILTER SYSTEM

Data on feed protein utilization

- ASP Tilapia ponds (Avnimelech) 45%
- ASP ShConventional fish, shrimp ponds 20-25%
- Srimp ponds (McIntosh) 45%
- Closed shrimp tanks (Velasco) 63%

- ASP shrimp ponds, ^{15}N study
  Michele Burford et al. 18-29% of total N consumption

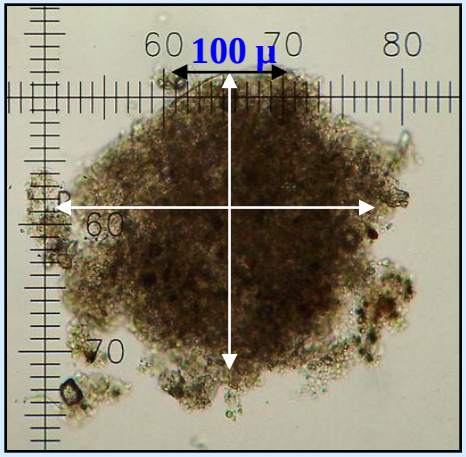


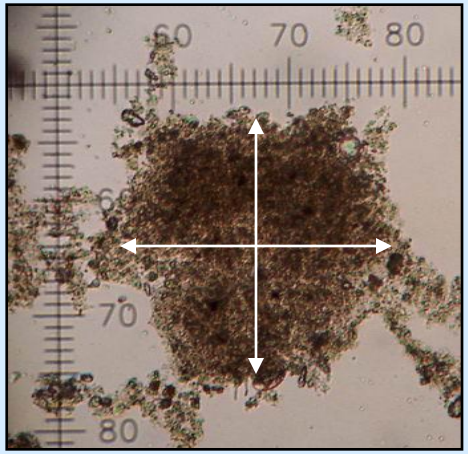
ACTIVATED SUSPENSION POND

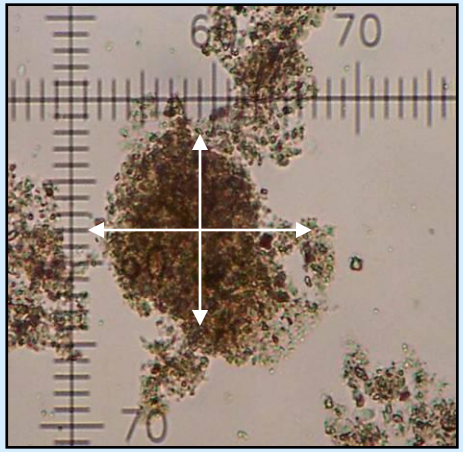
Figure 2

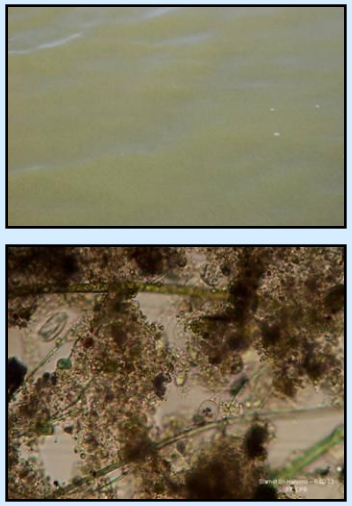
The ‘Biofloc (Floc)’

FLOC COMMUNITIES AND SIZE

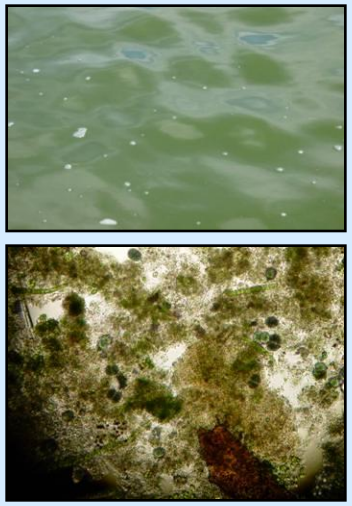








Brown



Green

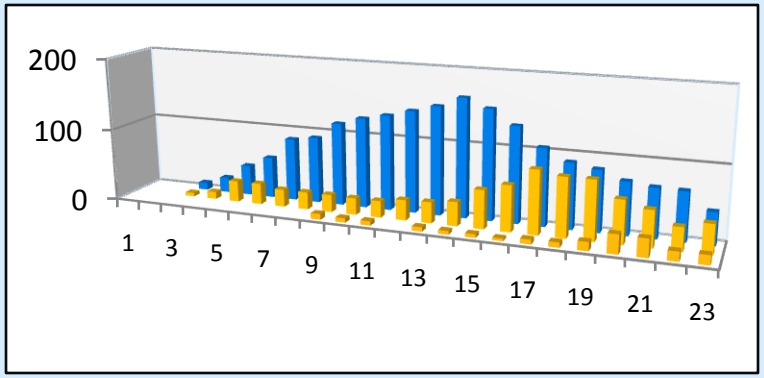
The biofloc

Defined as macroaggregates – diatoms, macroalgae, facial 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)*

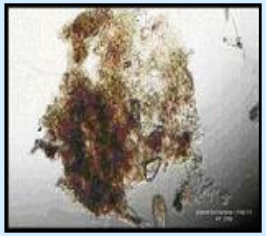
Basic of BFT in Shrimp Farming

1. **High stocking density - over 130 – 150 PL10/m2**
2. **High aeration – 28 to 32 HP/ha PWAs**
3. **Paddle wheel position in ponds**
4. **HDPE lined ponds**
5. **Grain (pellet)**
6 **Molasses**
7. **Expected production 20–25 MT/ha/crop**



Feed & grain application and biofloc

Grain pellet



Bioflocs

Dark Vannamei

Red Vannamei

Belize, Central America

Biofloc system culture

Belize Aqua Ltd – A view

Belize Aqua Ltd - ponds

BELIZE SHRIMP FARM (McIntosh, 2000b&c)

L. vannamei Mexican strain
Pond size 1.6 hectare
Pond type Fully HDPE lined
Aeration input 48 HP of PWA
System Heterotrophic zero water exchange
Production 13,500 kg/ha/crop
Carrying capacity 550 kg shrimp/HP of PWAs

Farms Using Bio-floc Technology in Indonesia

First Biofloc Commercial Trial

Central Pertiwi Bahari (CP, Indonesia)

Description	Average Per Code					
Fry Code	(12) A416	(12) A417	(12) A418	(11)A420	(12) A539,A416	Avg
Tot pond	5	6	7	5	3	26
STD(pcs/m^2)	131	131	130	131	131	131
DOC (day)	148	146	150	146	146	147
Biomass(kg)	11,337	10,587	10,650	10,886	11,256	10,883
MBW (g)	16.78	17.66	17.61	17.89	16.38	17.4
CV (%)	24.2	21.2	26.8	21.4	21.3	23.0
FCR (- GP)	1.01	1.09	1.08	1.03	0.98	1.04
FCR (+ GP)	1.69	1.83	1.82	1.70	1.64	1.73
SR (%)	100.0	91.6	92.8	92.8	105.0	95.9
ADG (g/day)	0.11	0.12	0.12	0.12	0.11	0.12
Prod (g/m^2/crop)	2,267	2,118	2,130	2,177	2,251	2,176

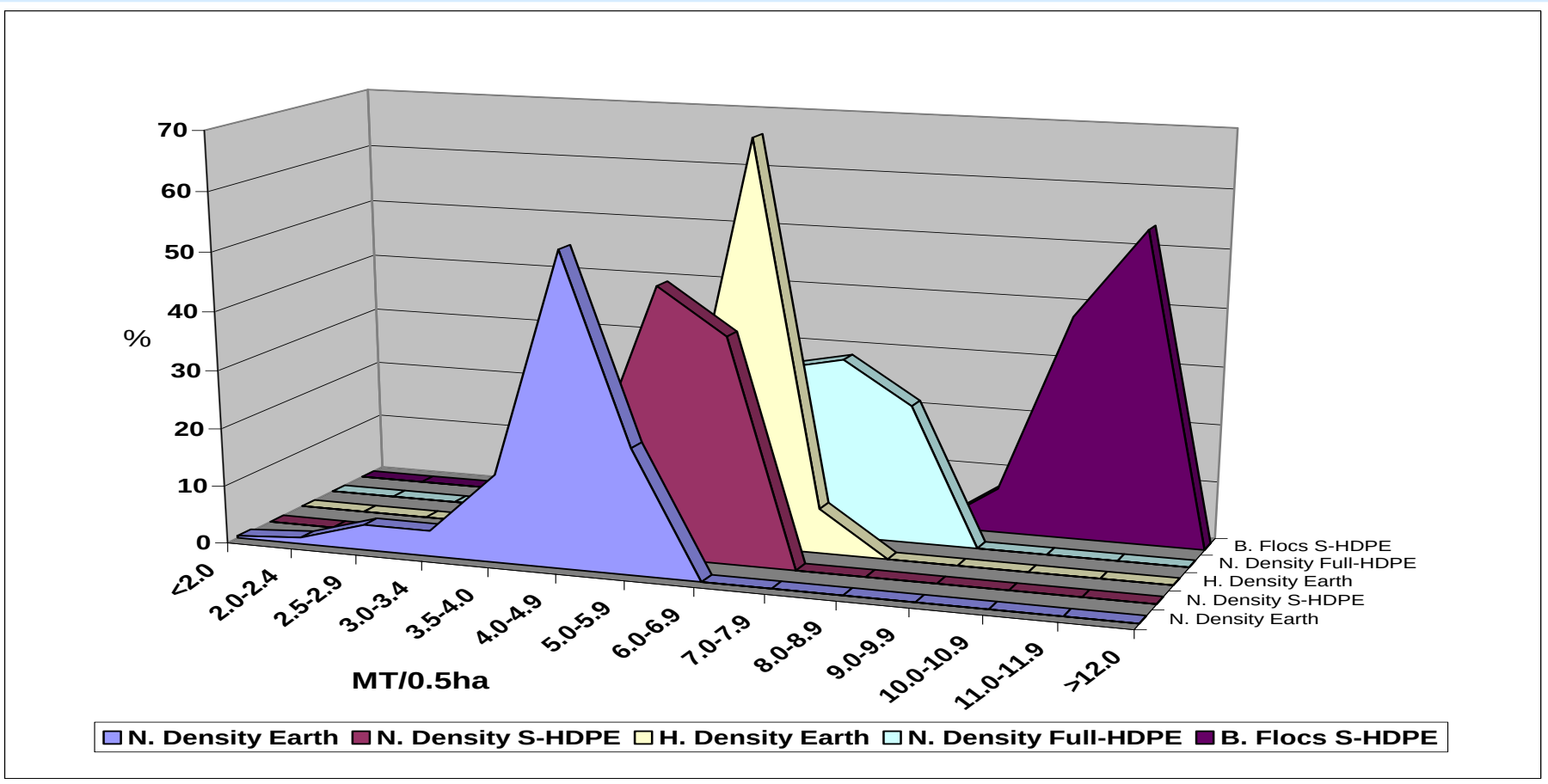
Semi-lined 0.5 ha ponds

Nyan Taw (2005, 2006)

Production Efficiency (CPB)

Efficiency: **Increased from 9.0 MT to 21.8 MT/ ha pond.**

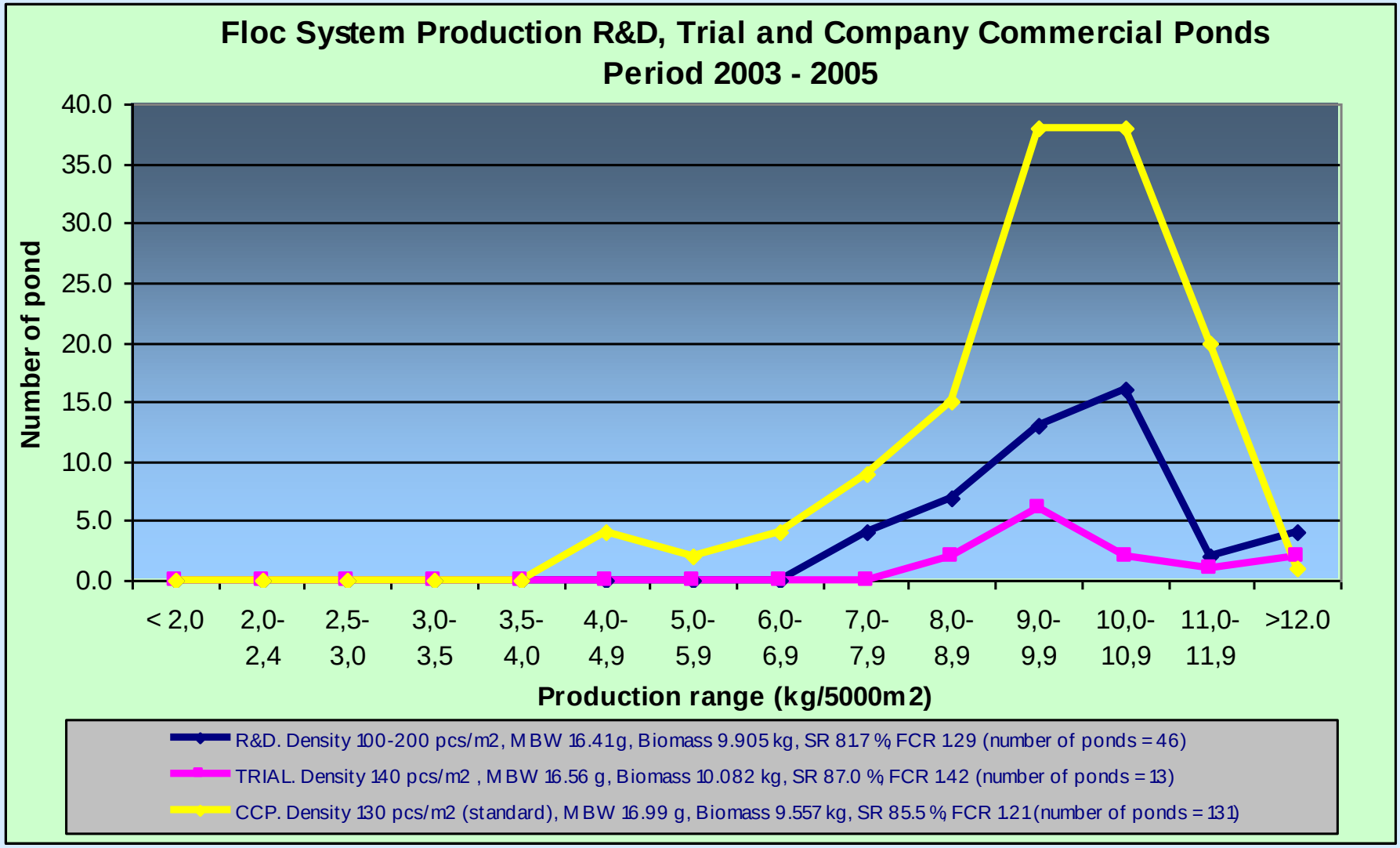
Carrying capacity: Increased from 430 kgs to 680 kgs/HP (PWA)



Rudyan Kopot & Nyan Taw (2004)

Biofloc Production Performance

TD - R&D, Trail & Commercial (CPB)



Nyan Taw (2006)

Partial harvest/Biofloc

Global Group, Medan

Partial harvesting by cast nets

Global Group Medan

Harvest/Biofloc Performance

Partial Harvest Performance with Bio Floc Technology (February - July 2008)

Pond/size	System	Energy Input		Density	Partial	Harvest				Production		FCR		SR	Energy Efficiency -kg/HP	
		(Pond)	(Ha)	(M2)		DoC	Biomas (Kg)	Size No/kg	MBW (gr)	Kg/Pd	Kg/Ha	GP	Feed	(%)	Std Capacity	Efficiency
1 5896 m2	Phyto	16 (PW)	27 (PW)	100	1	118	434	47	21.28							
					Final	127	11,027	43	23.26	11,461	**19,439**	0	**1.60**	75.72	560*	**720**
2 5896 m2	Bio Floc	18 (PW)	31 (PW)	145	1	108	2,092	59	16.95							
					2	121	1,016	55	18.18	13,508	**22,910**	0.59	**1.20**	84.07	680*	**739**
					Final	131	10,400	52	19.23							
3 5940 m2	Bio Floc	18 (PW)	30 (PW)	146	1	109	2,108	56	17.86							
					2	122	999	50	20.00	14,386	**24,219**	0.56	**1.14**	80.95	680*	**807**
					Final	130	11,279	47	21.28							
4 4704 m2	Bio Floc	16 (PW)	34 (PW)	257	1	85	1,962	93	10.75							
					2	99	1,896	75	13.33							
					3	113	1,871	62	16.13							
					4	127	2,587	56	17.86	17,963	**38,229**	0.58	**1.12**	86.54	680*	**1,124**
					5	134	2,475	53	18.87							
					Final	155	7,192	47	21.28							
5 2,500 m2	Bio Floc	9 (PW) 3 (BL)	36 (PW) 12 (BL)	280	1	84	924	86	11.63							
					2	99	1,455	74	13.51							
					3	113	1,324	61	16.39							
					4	127	1,448	57	17.54	12,371	**49,484**	0.48	**1.11**	102.35	680*	**1,031**
					5	134	1,043	54	18.52							
					Final	155	6,177	50	20.00							
6 2500 m2	Bio Floc	7 (PW) 3 (BL)	28 (PW) 12 (BL)	145	1	110	1,166	51	19.61							
					2	124	367	49	20.41	6,545	**26,180**	0.50	**1.10**	86.35	680*	**655**
					Final	127	5,012	47	21.28							
7 2500 m2	Bio Floc	9 (PW) 3 (BL)	36 (PW) 12 (BL)	145	1	110	892	61	16.39							
					2	124	323	57	17.54	6,615	**26,460**	0.50	**1.10**	100.8	680*	**551**
					Final	130	5,400	54	18.52							
										82,849	**29,560**	0.53	**1.13**	88.1		

Nyan Taw, et al, 2008

Global Group Demo Farm
Karang Asem, Bali, Indonesia


Full concrete pond - 2,600 m2

Biofloc system culture
High aeration


Full concrete pond - 2,000 m2

Shrimp farms using BFT

Performance - Shrimp Farms at Java & Bali, Indonesia using Biofloc Technology

Karang Asem, Bali, Indonesia

Pond	A2	A3	B1	B2	B3	C1	C2	C3
Pond size	2,600m2	2,500m2	2,000m2	2,000m2	2,000m2	600m2	600m2	600m2
PL tebar	129/m2	134/m2	167/m2	167/m2	167/m2	152/m2	152/m2	152/m2
DoC	125	125	126	91*	125	147	135	147
SR %	91	84	93	62	85	92	89	91
ABW	20.57	20.12	18.18	12.19	18.55	24.15	21.14	24.27
FCR	1.3	1.42	1.36	1.45	1.44	1.61	1.52	1.58
Harvest/pond	6,232 kg	5,695 kg	5,645 kg	2,493 kg	5,248 kg	2,018 kg	1,725 kg	1,943 kg
Harvest /ha	23,969 kg	22,781 kg	28,225 kg	12,464 kg	26,235 kg	33,645 kg	28,750 kg	32,361 kg

Singaraja, Bali, Indonesia

Pond	B3	B4
Pond size	2,500m2	2,500m2
PL tebar	152/m2	152/m2
DoC	147	147
SR %	85	81
ABW	24.39	24.39
FCR	1.63	1.59
Harvest/pond	6,304 kg	6,005 kg
Harvest/ha	25,212 kg	24,020 kg

Global group demo ponds in Bali on BFT

Courtesy of Mr. Suritjo Setio, 8 September 2009

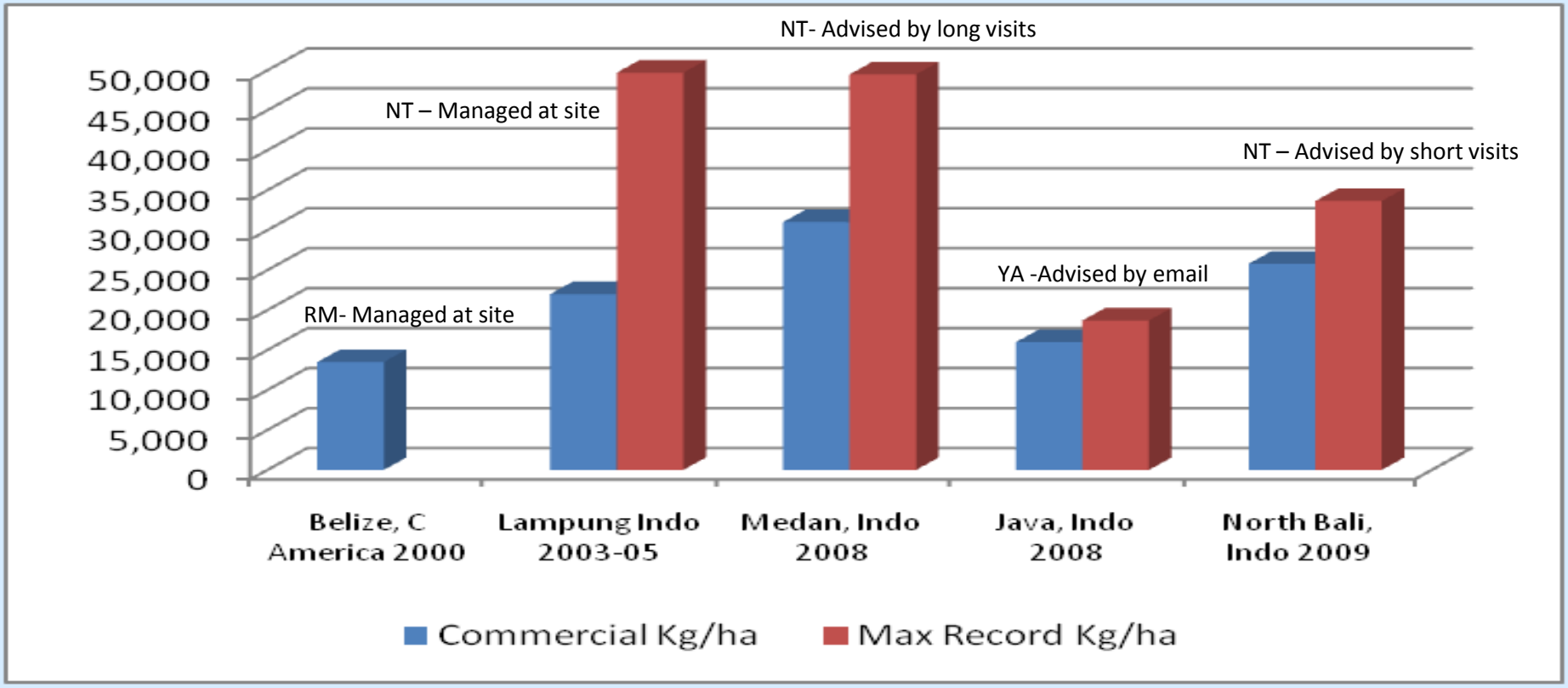
Java, Indonesia (Avnimelech 2009)

Pond	D6	D5	D8	D7	D9	D4
Pond size						
PL tebar	115/m2	115/m2	141/m2	172/m2	176/m2	139/m2
DoC	113	121	118	121	121	108
SR %	85	106	77	79	53	75
ABW	16.7	15.36	17.3	17.89	20.08	15.5
FCR	1.37	1.6	1.51	1.75	2	1.65
Harvest/pond	8,214 kg	7,374 kg	8,566 kg	6,739 kg	5,256 kg	7,533 kg
Harvest/ha	16,300 kg	18,700 kg	18,500 kg	14,600 kg	11,400 kg	16,400/kg

Based on report from Suri Tani Pemuka, Indonesia

SUMMARY

Development of BFT (Productivity)



According to Shrimp News International (2006) No one knows how many shrimp farms are employing the bio-floc technology. The best examples of the of farms that have implemented the new technology are: 1. Belize Aquaculture, Ltd., in Belize. 2. OceanBoy Farms in Florida, USA, and 3. PT Central Pertiwi Bahari in Indonesia.

Bio-floc in Raceways/Wet Lab
Experiments, Trials & Growout

1. Nursery–nursed for 1 to 2 weeks then to GO
2. Grow-out culture to market size (15-20 gm)
3. Broodstock production – culture to broodstock size (45 – 50 gm).
4. Broodstock testing– trials for quality of broodstock family lines (two to four months).
5. First phase of the three phase culture system.

Raceway Technology

Biofloc Trials - Nursery & GO

Description	Stocking Density (pcs/m²)	
	550	130
Pond	2	2
Initial MBW (g)	4.9	1.7
Period (days)	57	90
Harvest Biomass (kg)	374	151
Final MBW (g)	13.8	18.4
FCR	1.2	1.0
Survival rate (%)	66	88
ADG (g/day)	0.16	0.19
Productivity (kg/m²)	5.2	2.1
Productivity (kg/ha)	51,893	21,001

Nyan Taw, et.al Role of R&D ...

World Aquaculture 2005 Bali

Raceway trials in BFT

Global Group Raceways at Anyer, Indonesia

The raceway system with biofloc is being applied for trials for *L. vannamei* broodstock family selection.

Wet Laboratory – Trial Tanks

Global Group facility at Anyer, Indonesia

1. Shrimp feed trials using transferred Biofloc
2. Small scale experiments at request
3. Freshwater tolerance experiments
4. Nursery stage experiments

Tilapia trials in freshwater BFT

Global Group facility at Anyer, Indonesia

BFT Farms with difficulties

Medan

Uncoordinated paddle wheel positions

Number of PWAs not correlated to stocking density or carrying capacity

Can develop biofloc but cannot control

Medan & Bangka

PWAs – direction one way only

Number of PWAs not correlated to stocking density or carrying capacity

Can develop biofloc but cannot control

BFT farms with difficulties

Lampung

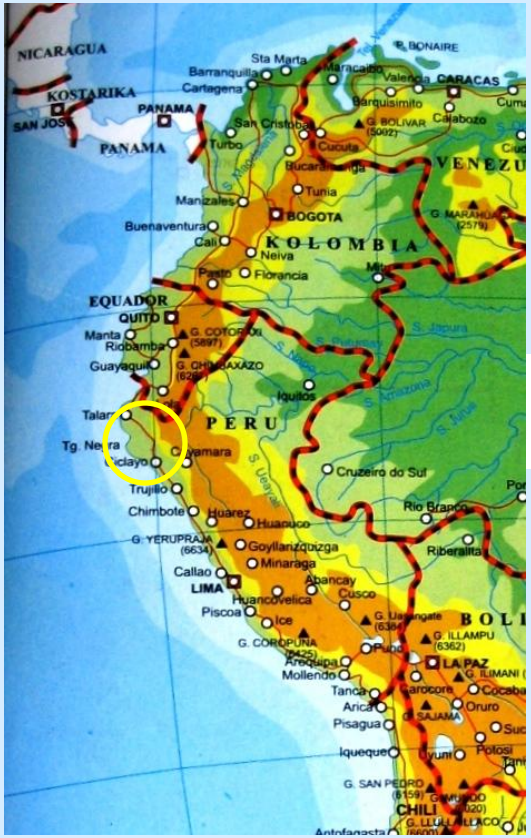
Excess aeration

PWA and air diffusers number & position not control or in wrong position

Potential of BFT – PERU

Lined and covered

Piura - Intensive with freshwater covered



Piura -Inside covered pond

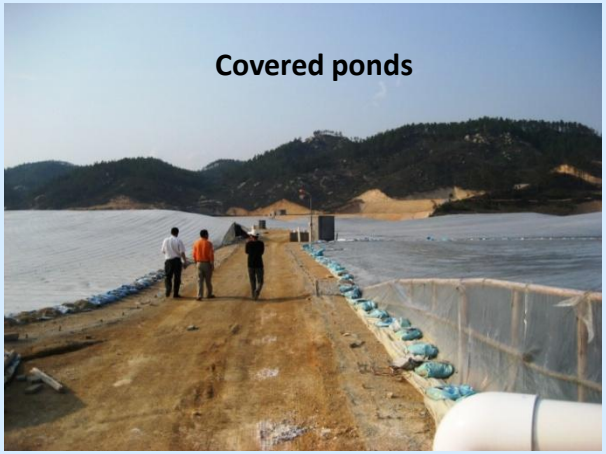
Piura Intensive FW Nursery

Tumbes-Extensive with SW

Grain

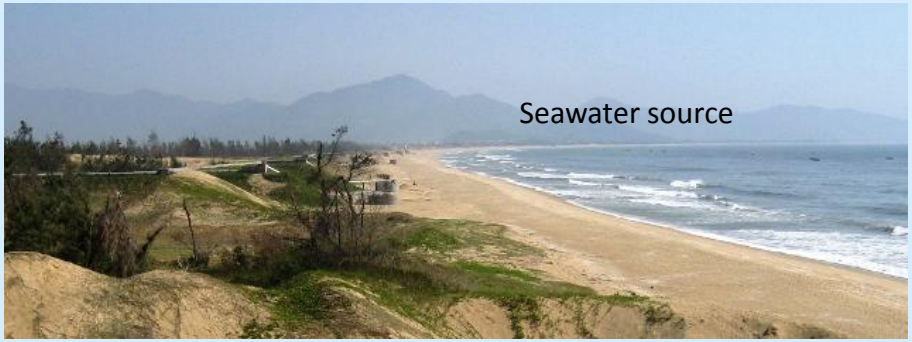
Potential for BFT – GUATEMALA
Lined with high energy input

Potential for BFT – CHINA
Lined, covered & high energy input

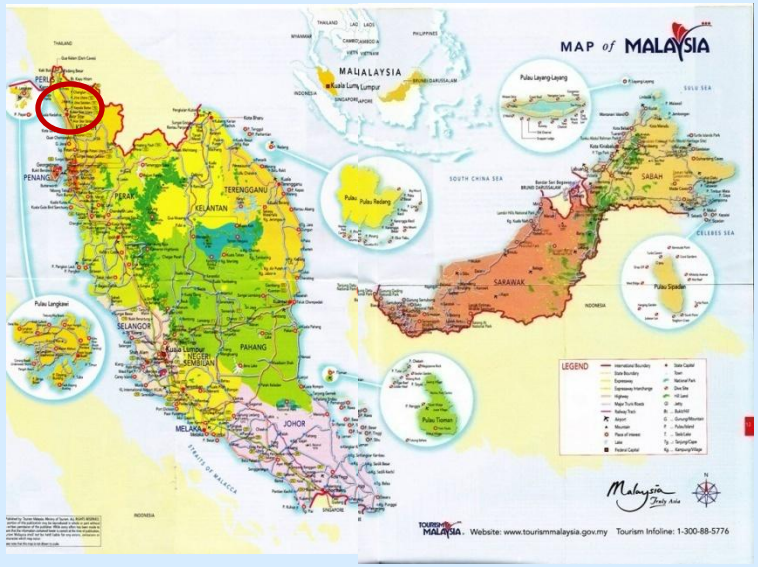


Potential for BFT – CHINA

Lined, covered & high energy input



Potential for BFT – Malaysia
Ideal layout and bio-securied



Seawater Intake – 2.6 km offshore

Advantages/ Disadvantages

Advantages

1. *Bio-security very good (from water) – to date WSSV negative using the system.*
2. *Zero water exchange – less than 100% exchange for whole culture period.*
3. *Production (Carrying capacity): 5-10% better than normal system*
4. *Shrimp size bigger by about 2.0 g than normal system*
5. *FCR low – between 1.0 to 1.3 (without GP)*
6. *Production cost lower by around 15-20 %.*

Disadvantages

1. *High energy input – paddlewheels 28HP/ha.*
2. *Power failure critical – maximum one hour at any time (better zero hour failure)*
3. *Full HDPE lined ponds – minimum semi-HDPE lined*
4. *Technology similar but more advance – need to train technicians*


Thank You
Nyan Taw
BlueArchipelago
Quality | Safety | Ecology

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POTENTIAL FOR DEVELOPMENT OF BIOFLOC TECHNOLOGY FOR PACIFIC WHITE SHRIMP (*Litopenaeus vannamei*) FARMING

Nyan Taw*

Blue Archipelago
T3-9, KPMG Tower, 8 First Avenue
Persiaran Bandar Utama
47800 Petaling Jaya, Selangor
Malaysia
nyantaw@hotmail.com
nyan.taw@bluearchipelago.com

Biofloc technology (BFT) has become a highly sought technology in Pacific white shrimp farming. The technology was initially started successfully in Belize (Chamberlain, et.at, 2001a & b; McIntosh, 2000 & 2001). The technology has been also applied with success in Indonesia (Kopot & Taw, 2004; Chandaeng, et.al, 2005; Taw, 2005 & 2006), and black tiger shrimp in Australia Smith (2008). The most recent study was by combination of two technologies, partial harvest and biofloc, in northern Sumatra, Indonesia (Taw, et.at, 2008; Taw, 2009).

Since then there have been many commercial trials especially in Indonesia from North, Middle to South Eastern Sumatra, from West to East Java and to Bali with successes and failures. Similarly, China and Malaysia shows interest in the technology. South and Central American countries are also interested in their intensive culture systems to adopt the technology. The success or failure of the technology was mainly due to lack of understanding on the basic concept of the technology in commercial application. Present presentation evaluates the technology applied in commercial farms and its development potentials.