Blue Archipelago

ASIAN - PACIFIC AQUACULTURE 2011

Expending Pacific White Shrimp (*Litopenaeus vannamei*) Farming in Biofloc System

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Kochi, India
17-20 January 2011

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 and on Potential of BTF at Asia Pacific Aquaculture 2009 in KL by Nyan Taw (2009). Recently, Avnimelech (2009) published a book entitled "Biofloc Technology: A Practical Guide Book" . Very recently Nyan Taw (2010) published an article in GAA on expansion of biofloc technology in white shrimp farms. Studies on raceway nursery and super intensive zero water exchange systems were carried out by Somacha (2002 & 2009).

Basic Concept of Biofloc Technology

Yoram Avnimelech, 2000, 2005

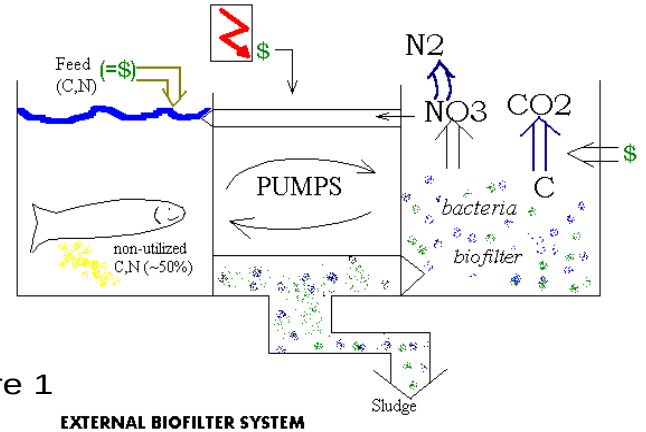

Figure 1

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

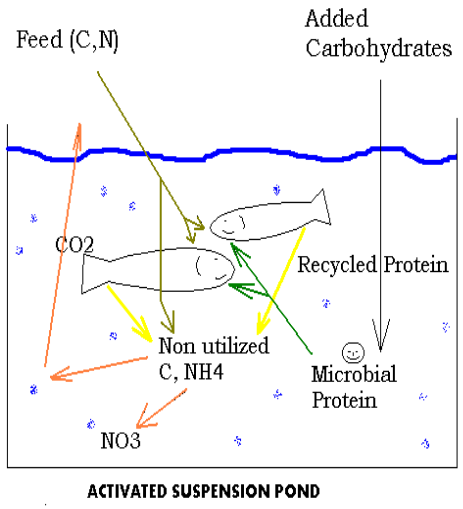

Figure 2

The ‘Biofloc (Floc)

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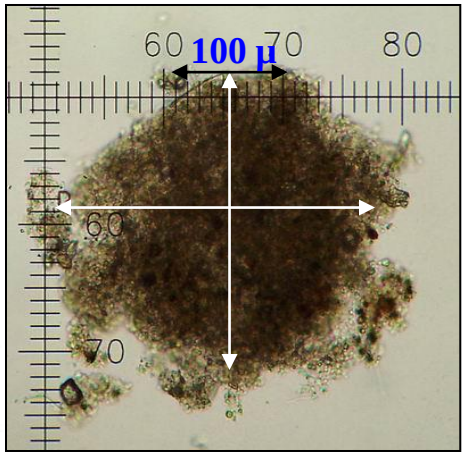
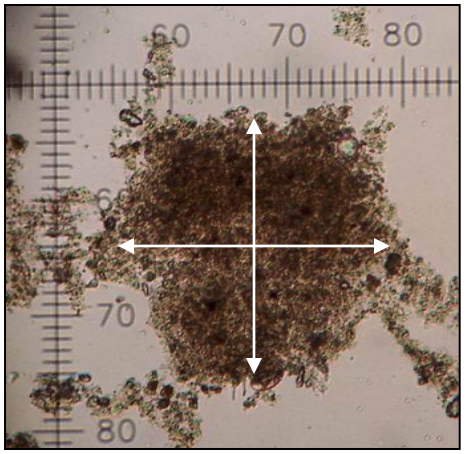
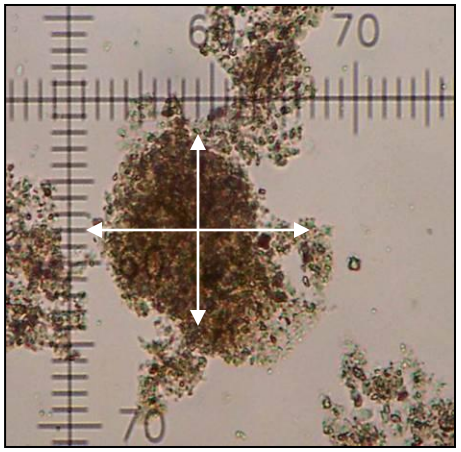
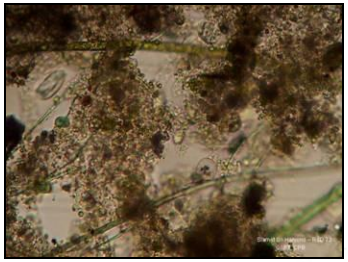
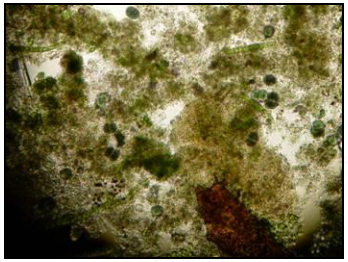
FLOC COMMUNITIES AND SIZE











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)*

Basic of BFT in Shrimp Farming

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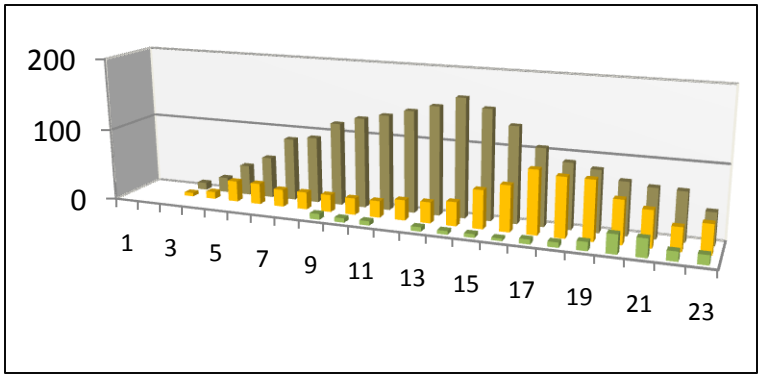
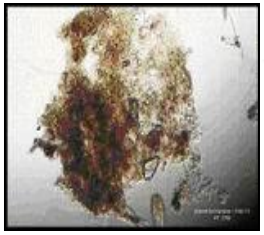
1. **High stocking density - over 130 – 150 PL10/m2**
2. **High aeration – 28 to 32 HP/ha PWAs**
3. **Paddle wheel position in ponds**
4. **HDPE / Concrete lined ponds**
5. **Grain (pellet)**
6 **Molasses**
7. **Expected production 20–25 MT/ha/crop**



Feed & grain application and biofloc

Grain pellet



Bioflocs

Dark Vannamei

Red Vannamei

Pond Operation

High Aeration

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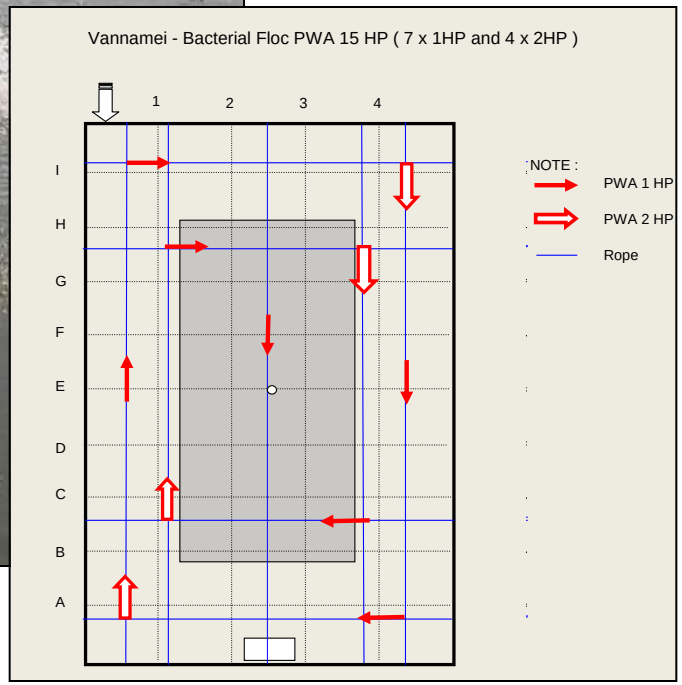
Feeding

Siphoning



Paddle Wheels position

Sampling Method

Measuring procedure

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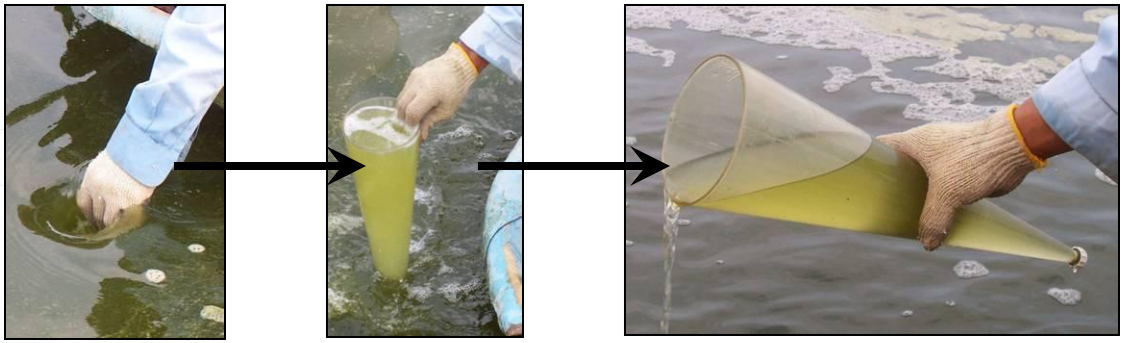
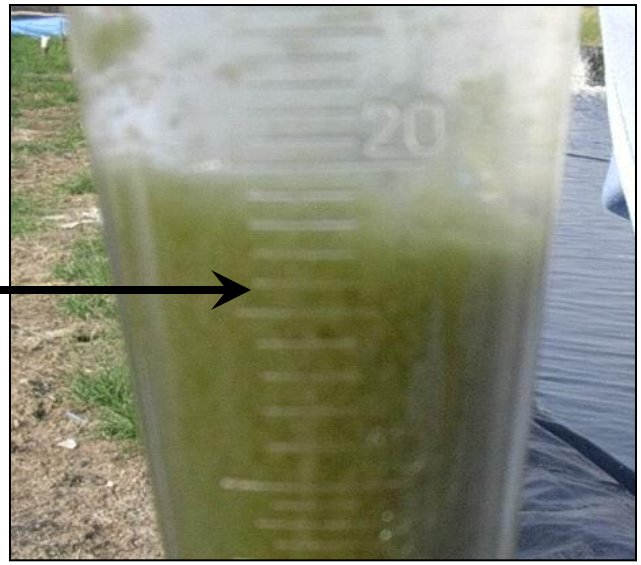
1 liter / 2 places/ 15 cm deep/ between 10-12 am



Let it settled for 15-20 minutes



Read density of flocs in cone (ml/l)

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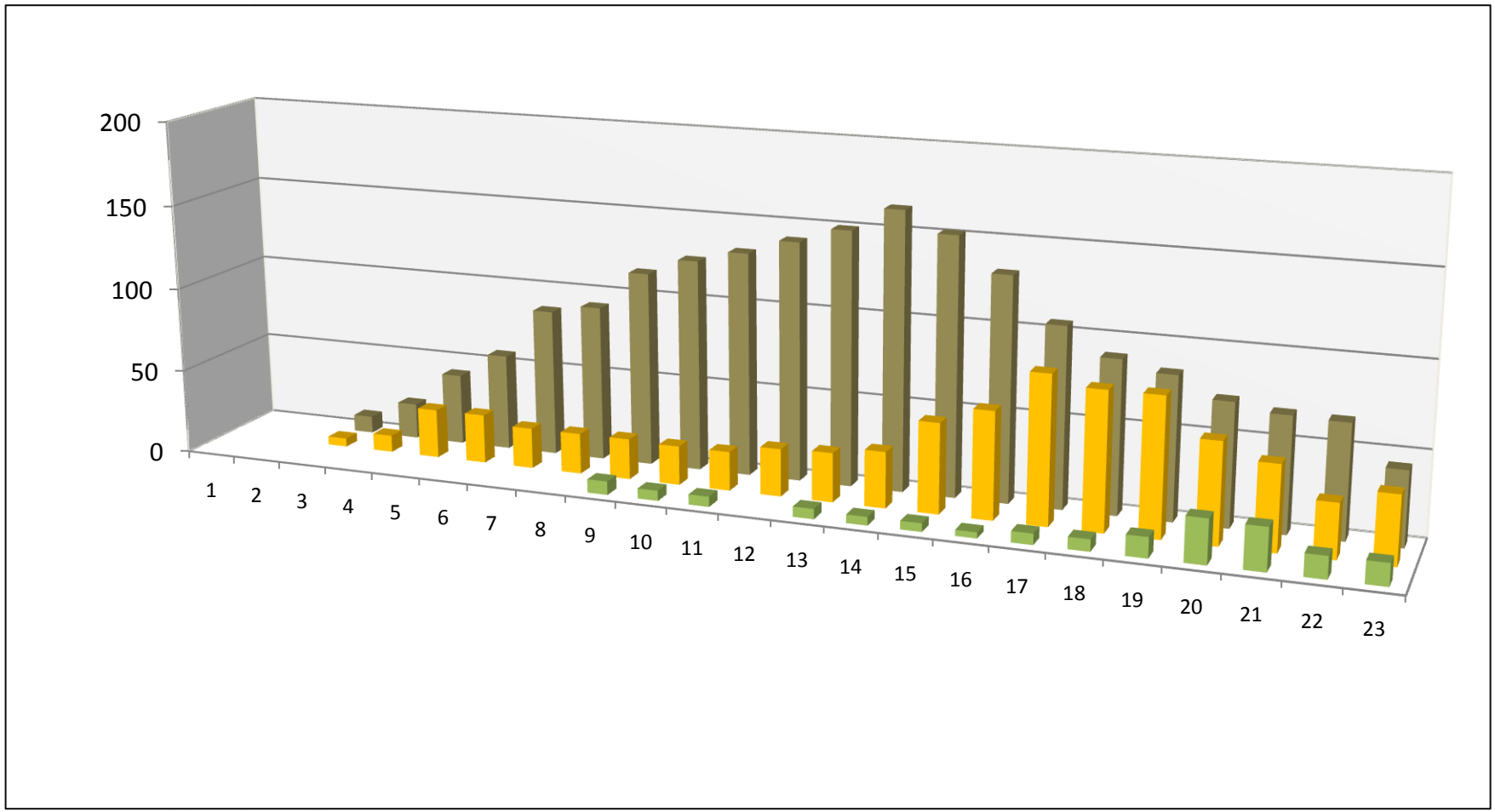
Feed , Grain Pellet and Biofloc



Control Biofloc

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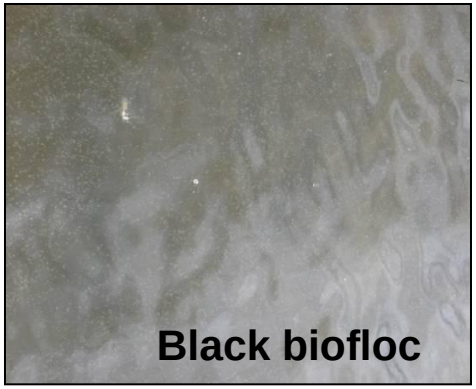
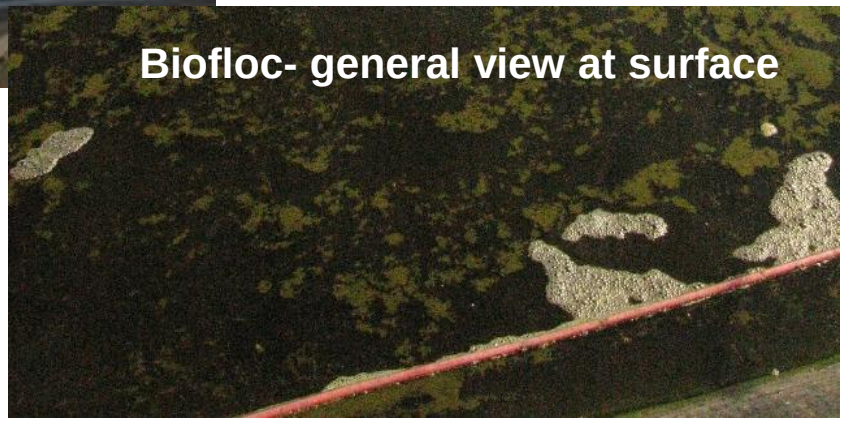
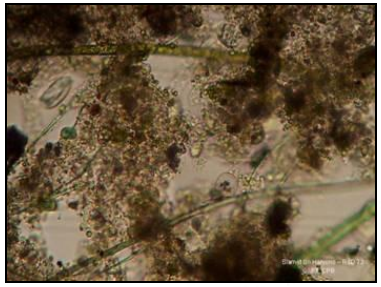
Black gill



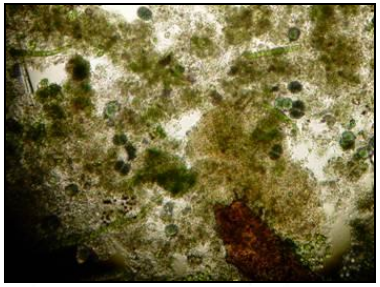
Black biofloc



Biofloc- general view at surface



Brown biofloc



Green biofloc

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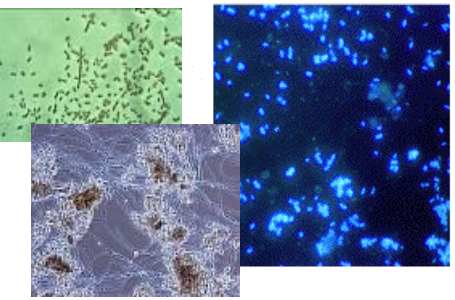
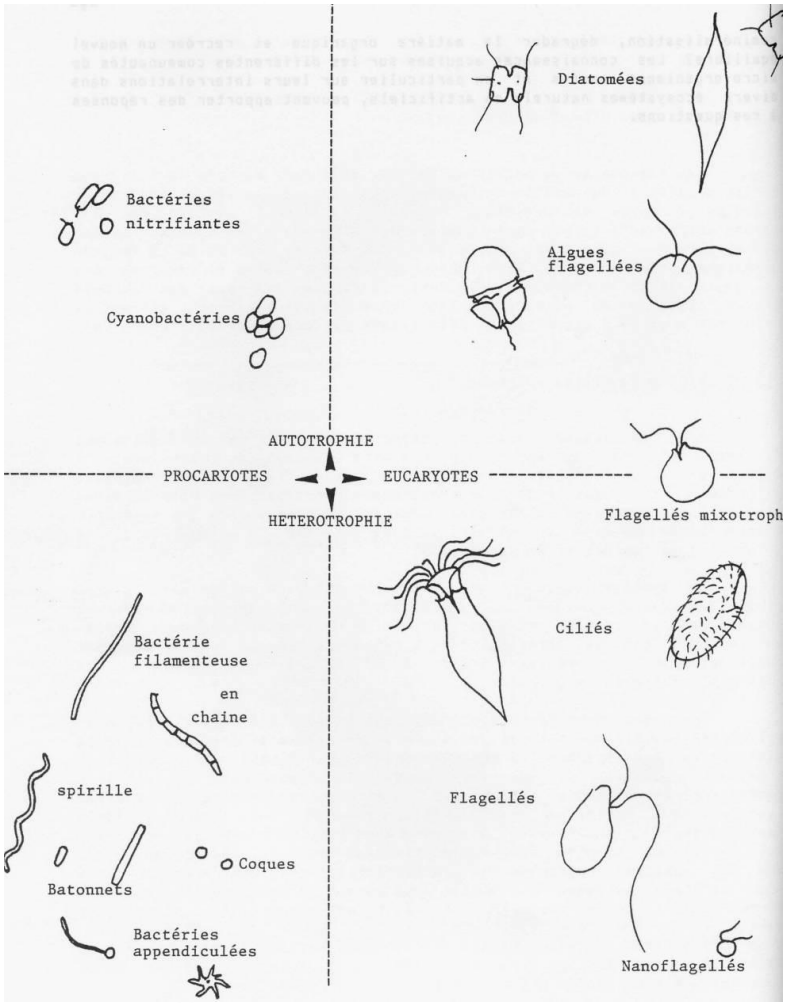
Los "microorganismos"...

bacteria



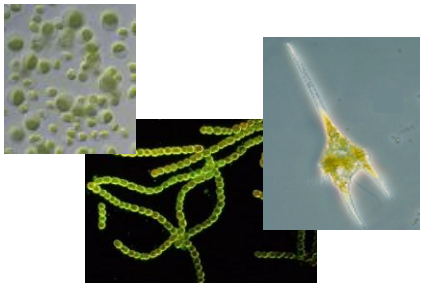
Heterotróficas, nitrificantes...

Fuentes y exigencias de C, N, etc...



Diatomeas, "nativas"... etc

Microalgas



Dinámica y intereracción...

Bottom-up/top-down...

Cadena alimentaria/ M.O. disuelta

Fotos: Yoram Avnimelech

Kind courtesy of Mr. Mauricio Emerenciano

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

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Shrimp Farms in Indonesia where BFT was applied

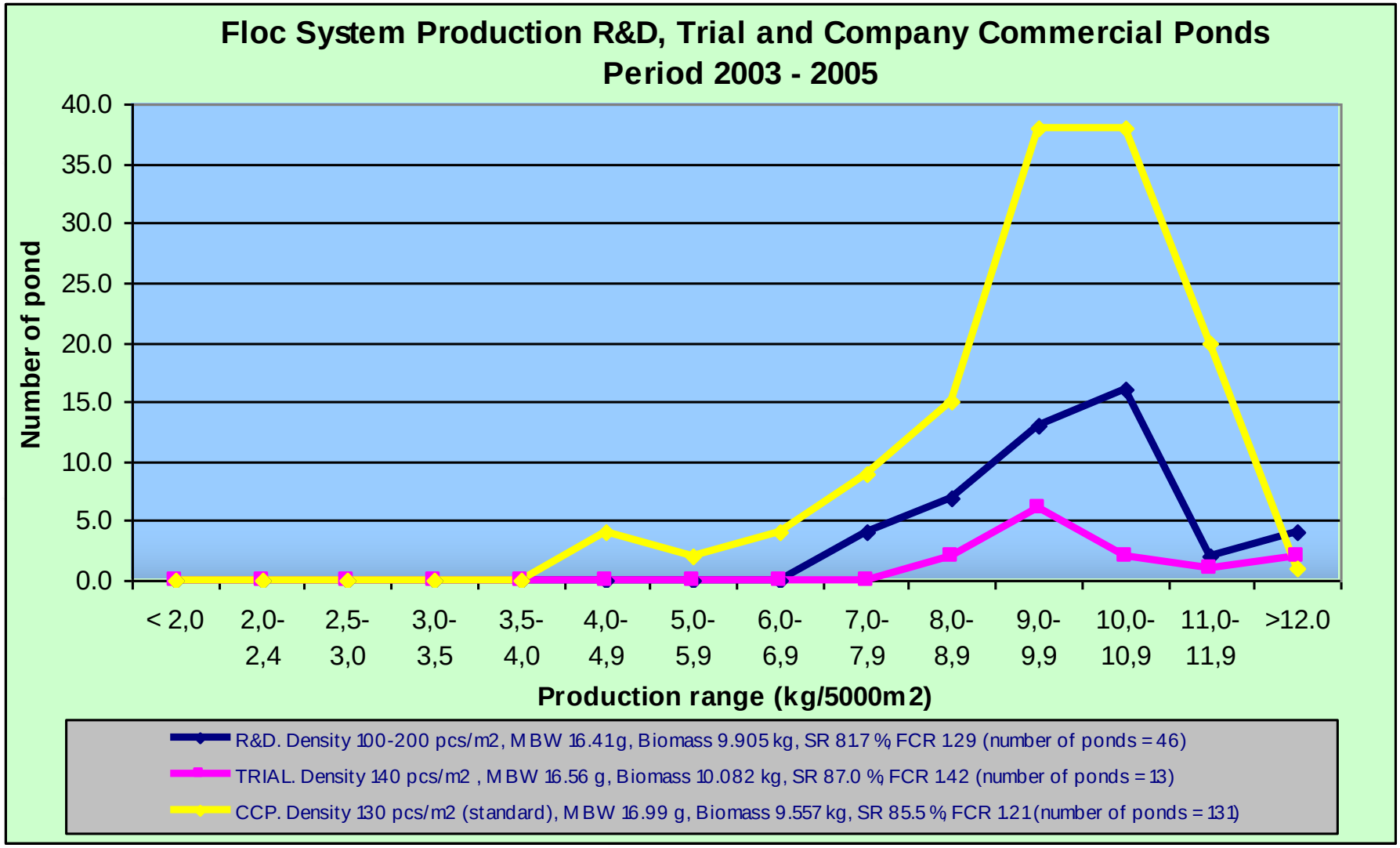
Global Medan

Global Medan

Bali

Production Performance

TD - R&D, Trail & Commercial



Global Medan

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Partial 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	Phyto	16 (PW)	27 (PW)	100	1	118	434	47	21.28							
5896 m2					Final	127	11,027	43	23.26	11,461	**19,439**	0	**1.60**	75.72	560*	**720**
2	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**
5896 m2					Final	131	10,400	52	19.23							
3	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**
5940 m2					Final	130	11,279	47	21.28							
4	Bio Floc	16 (PW)	34 (PW)	257	1	85	1,962	93	10.75							
4704 m2					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	Bio Floc	9 (PW)	36 (PW)	280	1	84	924	86	11.63							
		3 (BL)	12 (BL)		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**
2,500 m2					5	134	1,043	54	18.52							
					Final	155	6,177	50	20.00							
6	Bio Floc	7 (PW)	28 (PW)	145	1	110	1,166	51	19.61							
		3 (BL)	12 (BL)		2	124	367	49	20.41	6,545	**26,180**	0.50	**1.10**	86.35	680*	**655**
2500 m2					Final	127	5,012	47	21.28							
7	Bio Floc	9 (PW)	36 (PW)	145	1	110	892	61	16.39							
		3 (BL)	12 (BL)		2	124	323	57	17.54	6,615	**26,460**	0.50	**1.10**	100.8	680*	**551**
2500 m2					Final	130	5,400	54	18.52							
										82,849	**29,560**	0.53	**1.13**	88.1		

Nyan Taw, et al, 2008

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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

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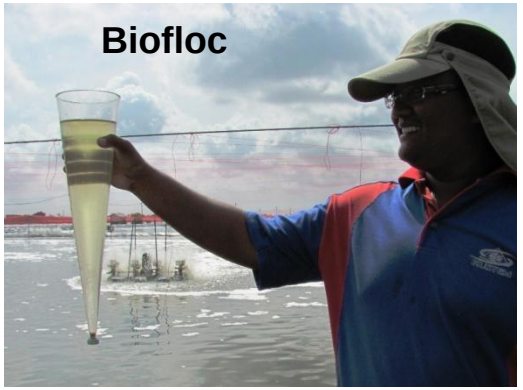
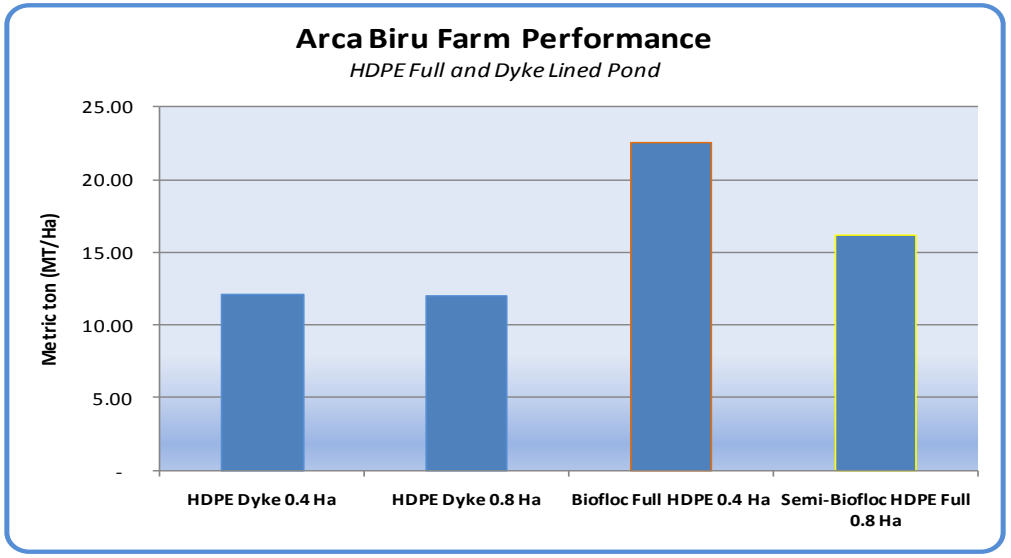
Biosecure modular system with BFT

250 & 1000 micron screen net

Seawater Intake – 2.4 km offshore

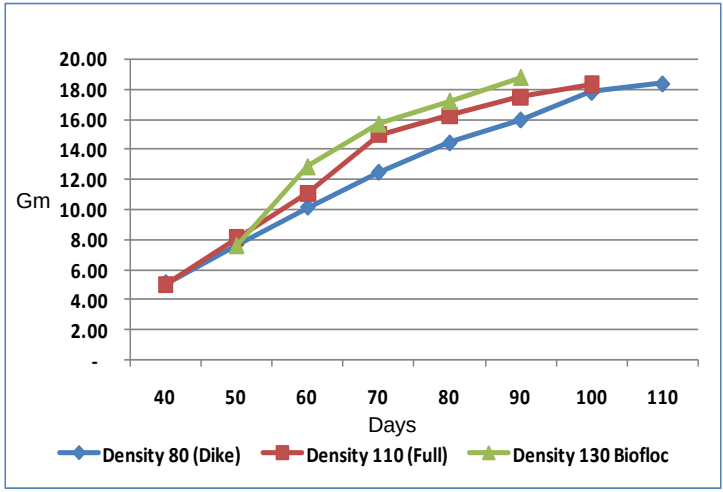


Blue Archipelago, Malaysia
Arca Biru Sdn Bhd Shrimp Farm



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**



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Bio-floc in Raceways/Wet Lab

Experiments, Trials & Growout

1. Nursery–nursed for 1 to 2 weeks then to GO
2. Super-intensive /intensive culture (to market size)
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

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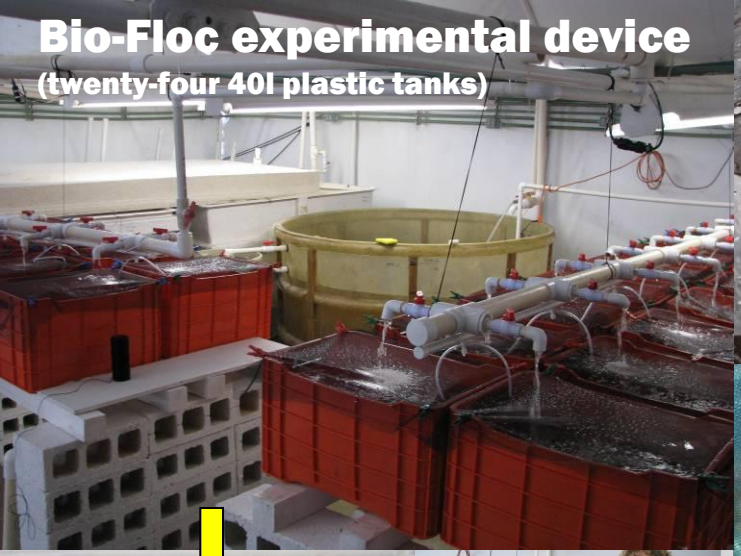
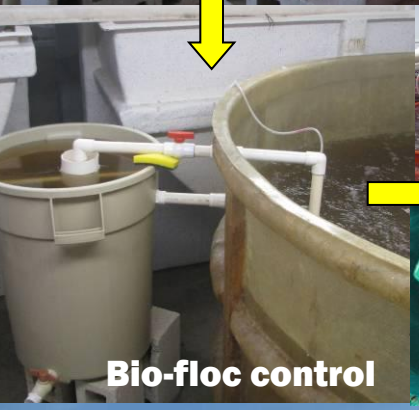
Global Group facility at Anyer, Indonesia

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





UMDI, Sisal
UNAM-México

Kind courtesy of Mr. Mauricio Emerenciano

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

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

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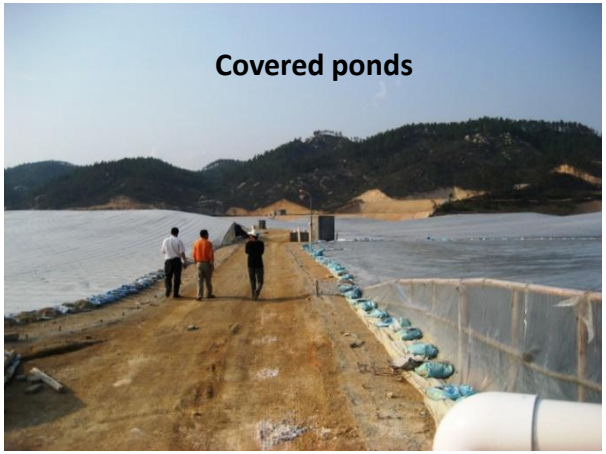
Southern China



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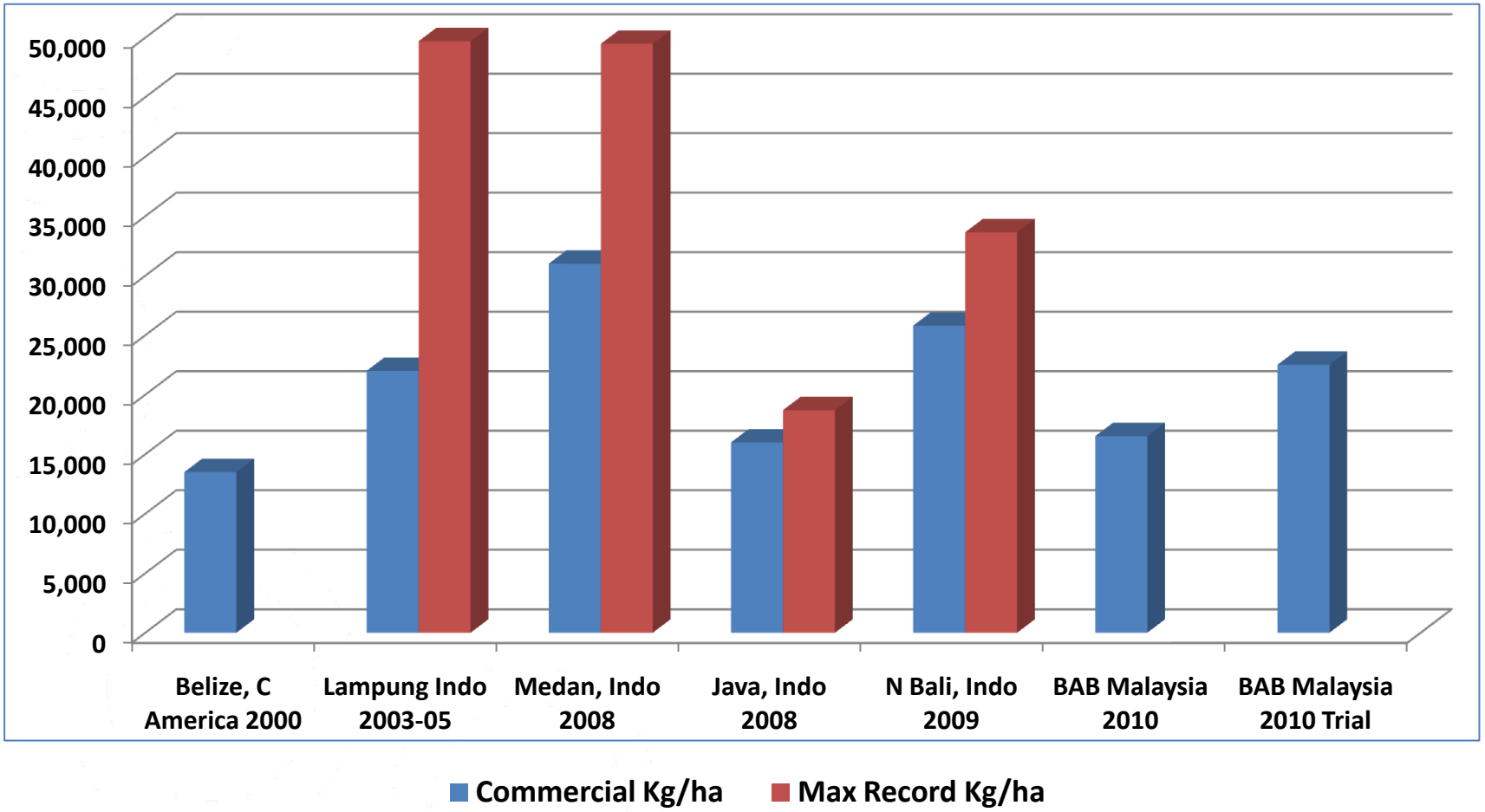
Development of BFT (Productivity)



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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*

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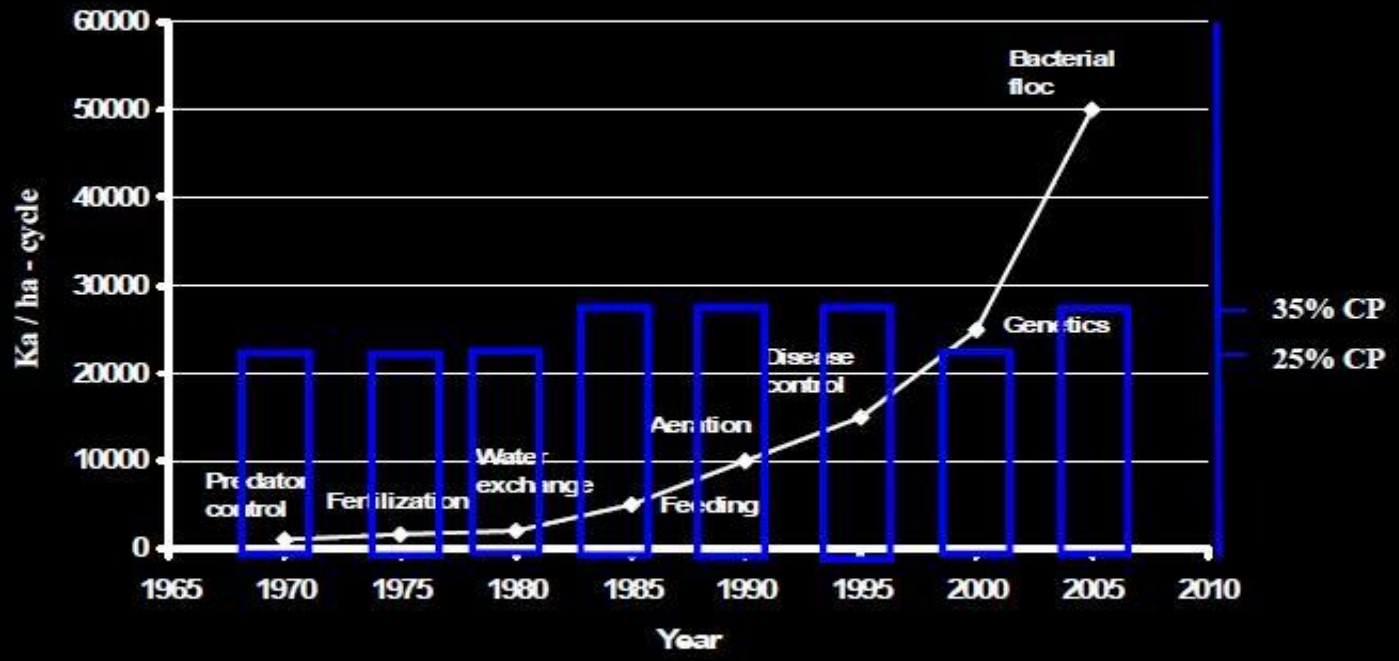
SHRIMP PRODUCTION IMPROVEMENT



Sergio Nates Dec 2006

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