Aquaculture America 2012

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RECENT DEVELOPMENTS IN BIOFLOC TECHNOLOGY IN SHRIMP CULTURE AND ITS ECONOMICS

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Paris Hotel and Casino
Las Vegas, Nevada USA

INTRODUCTION

Biofloc technology has become a popular technology in the farming of Pacific white shrimp, *Litopenaeus vannamei*. The basic technology was developed by Professor Yoram (2000, 2005a&b) in Israel and initially implemented 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). The combination of two technologies, partial harvesting and biofloc, has been studied in northern Sumatra, Indonesia (Nyan Taw 2008 et. al). The system has been successfully incorporated in biosecure modular culture system (Nyan Taw, 2011 et. at).

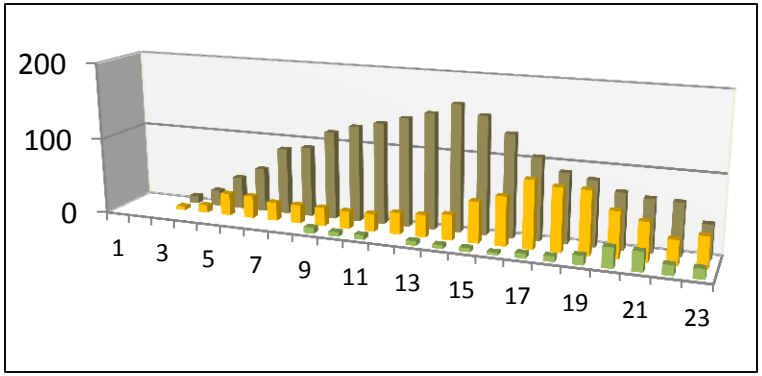
With emerging viral problems and rising costs for energy, biofloc technology appears to be an answer for sustainable production at lower cost. The technology has applied also in super-intensive raceways to produce more than 9 kg shrimp/ m3. The raceway applications have supported nursery and growout to shrimp broodstock rearing and selection of family lines. Presently, a number of studies by major universities and private companies are using biofloc as a single cell protein source in aquafeeds.

In any aquaculture business as defined by economics - savings are also considered as profit. Savings such as from feed, time, energy, stability and sustainability can be calculated as profit. It seems biofloc technology has these properties.

SHRIMP FARMING IN BIOFLOC

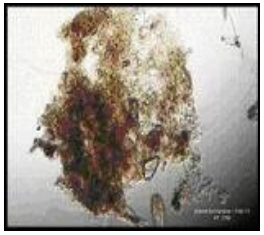
SUMMARY

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 gms shrimp**



Feed & grain application and biofloc

Grain pellet



Bioflocs

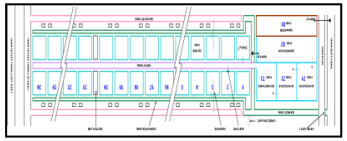
Dark Vannamei

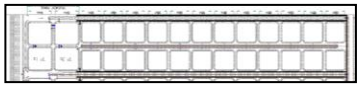
Red Vannamei

TECHNOLOGY DEVELOPMENT

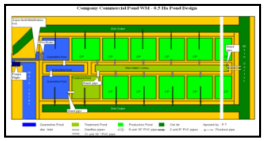
Farm Construction & Design

Module





Module



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

MODULE OPERATION

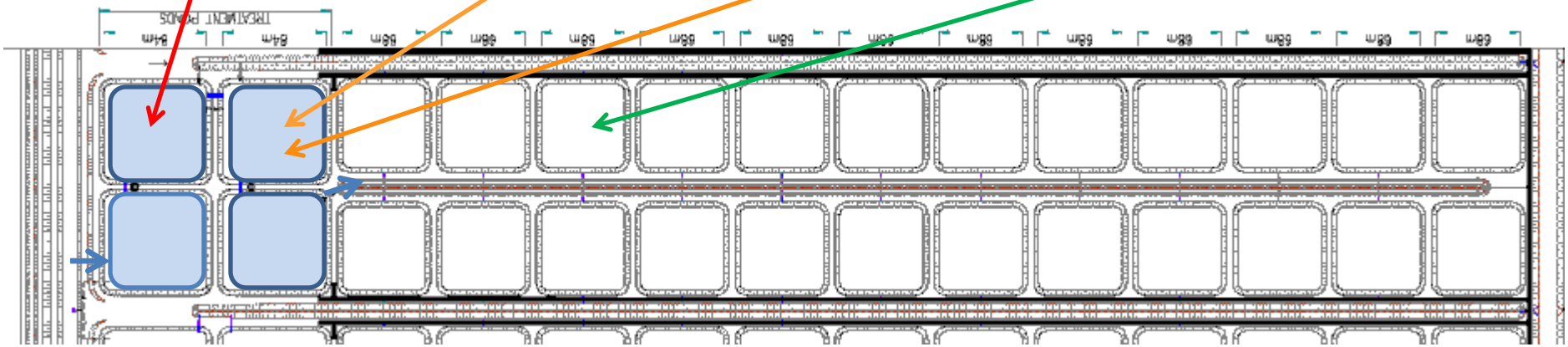
Water treatment system (Control WSSV)

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

FIRST BIOFLOC COMMERCIAL TRAIL

Indonesia

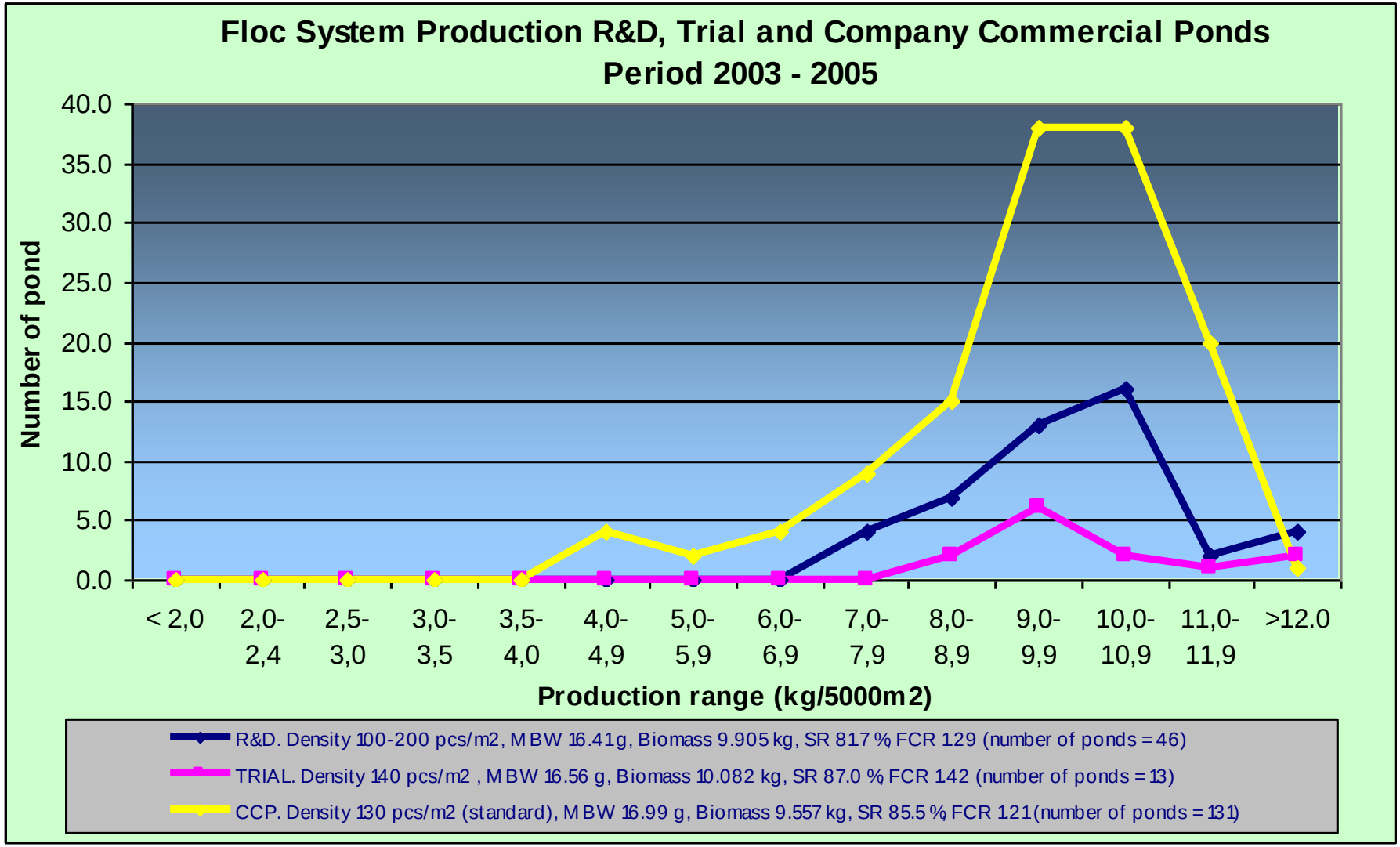
Description	Average Per Code					
Fry Code	(12) A416	(12) A417	(12) A418	(11) A420	(12) A539,A416	Average
Total No ponds	5	6	7	5	3	26
STD(pcs/m^2)	131	131	130	131	131	131
DOC (day)	148	146	150	146	146	147
Biomass(kg)	11,337	10,587	10,650	10,886	11,256	10,883
MBW (g)	16.78	17.66	17.61	17.89	16.38	17.4
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
Production (kg/ha/crop)	2,267	2,118	2,130	2,177	2,251	2,176

Semi-lined 0.5 ha ponds

Nyan Taw (2005, 2006)

PRODUCTION PERFORMANCE

Indonesia

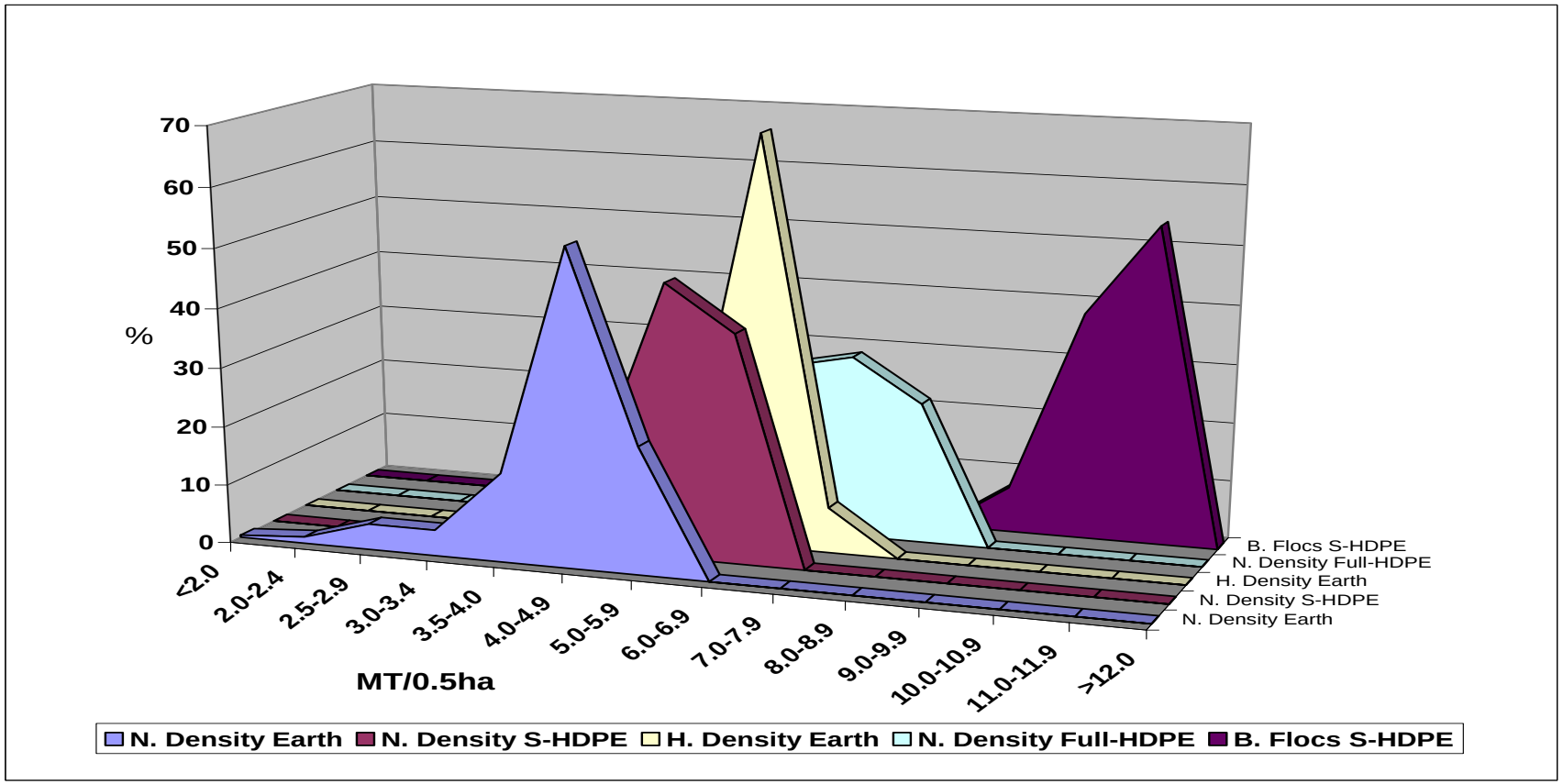


Nyan Taw (2005, 2006)

PRODUCTION EFFICIENCY

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

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

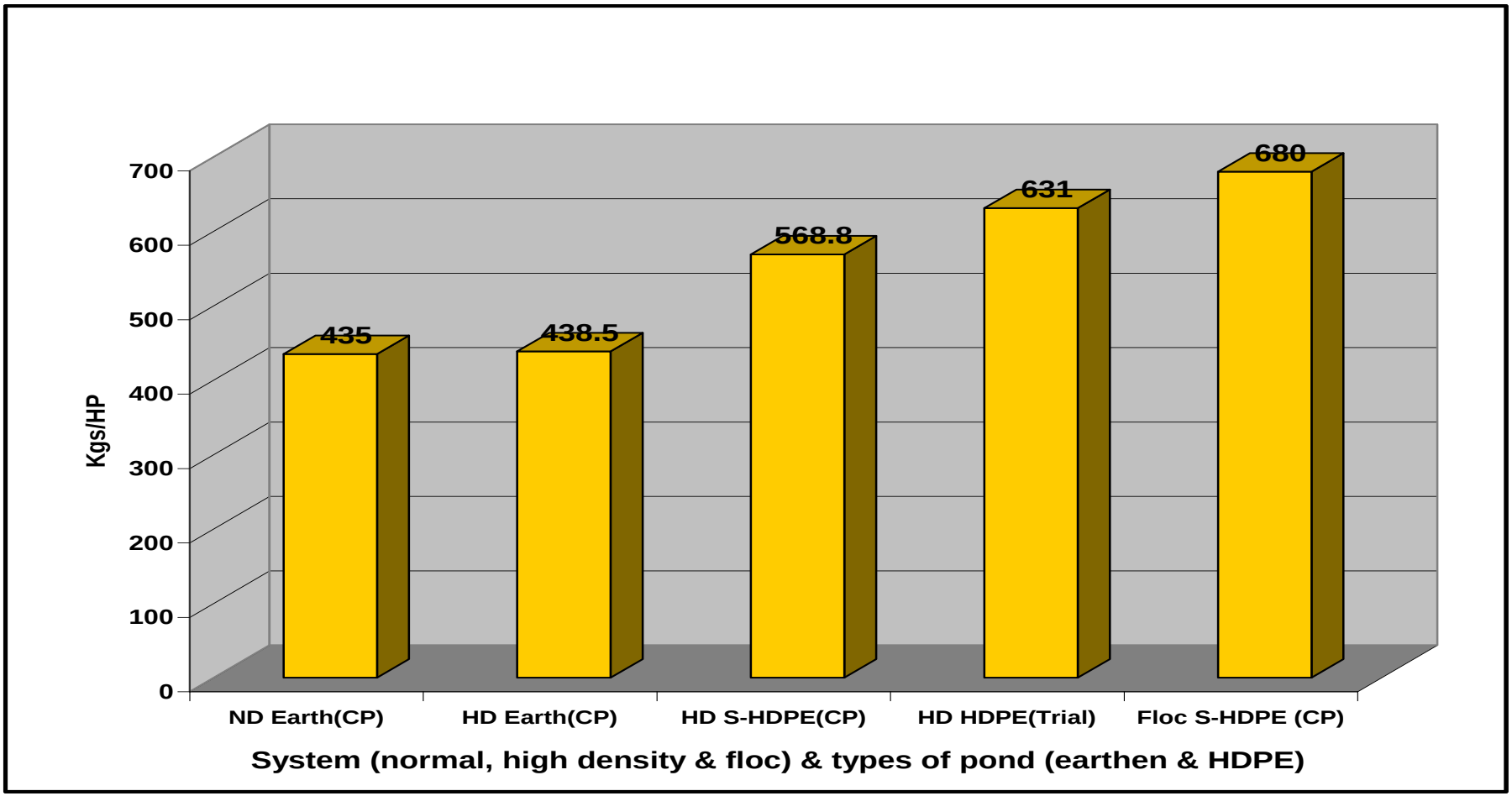


Rudyan Kopot & Nyan Taw (2004)

CARRYING CAPACITY

Pond type & system (*L. vannamei*)

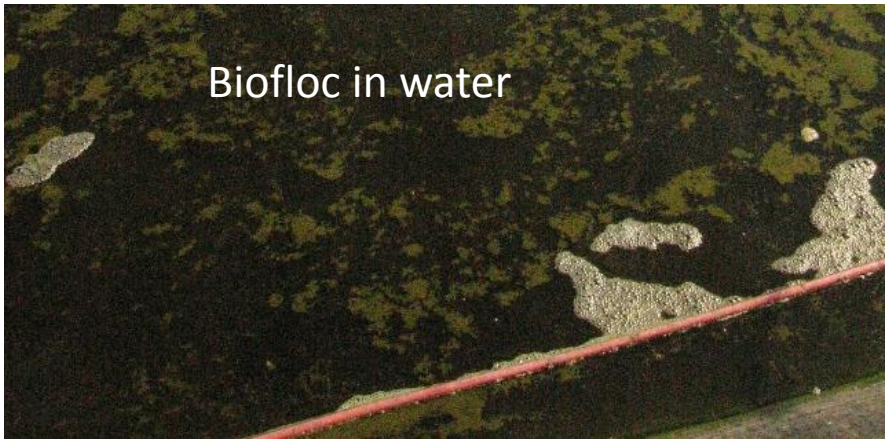
Increased from 430 to 680 shrimp kgs/HP (PWA)



Rudyan Kopot & Nyan Taw (2004)

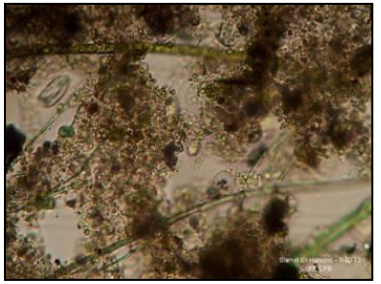
BIOFLOC & PARTIAL HARVEST

Indonesia

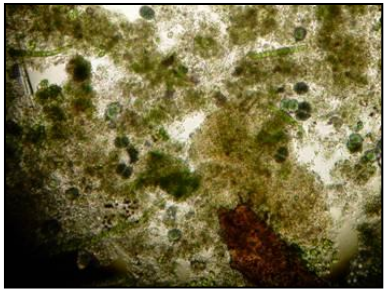


Nyan Taw, et al, GAA Sep/Oct 2008

Brown biofloc



Green biofloc



Nyan Taw. et al WAS 2009 Mexico

BIOFLOC & PARTIAL HARVEST
PERFORMANCE, Indonesia

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				**1.60**	75.72	560*	**720**
5896 m2					Final	127	11,027	43	23.26	11,461	**19,439**	0				
2	Bio Floc	18 (PW)	31 (PW)	145	1	108	2,092	59	16.95					84.07		
					2	121	1,016	55	18.18	13,508	**22,910**	0.59	**1.20**		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					80.95		
					2	122	999	50	20.00	14,386	**24,219**	0.56	**1.14**		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					86.35		
		3 (BL)	12 (BL)		2	124	367	49	20.41	6,545	**26,180**	0.50	**1.10**		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, GAA Sep/Oct2008
Nyan Taw et al, WAS 2009 Mexico

BIOSEURE MODULES

Arca Biru, Blue Archipelago

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

Biosecurity – crab fence & bird scare lines

Pond out let gate

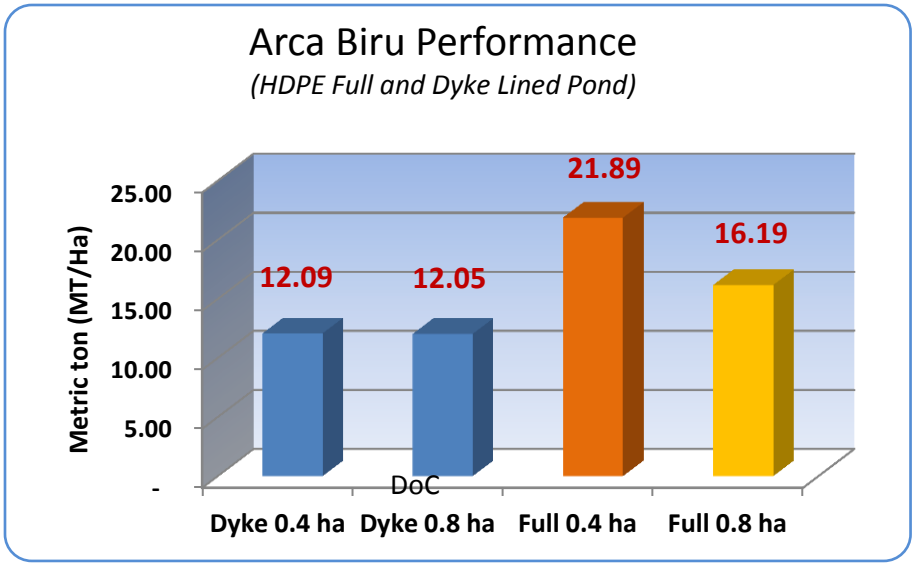
Sub inlet

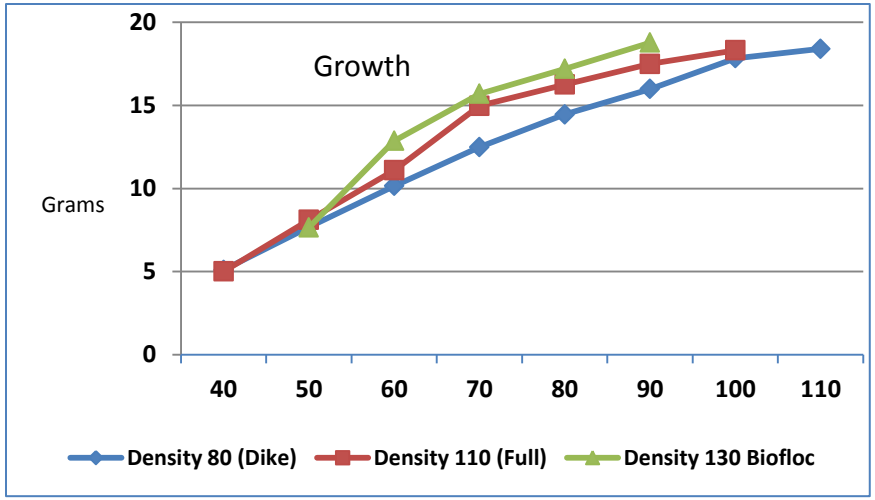
250 & 1000 micron screen net

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





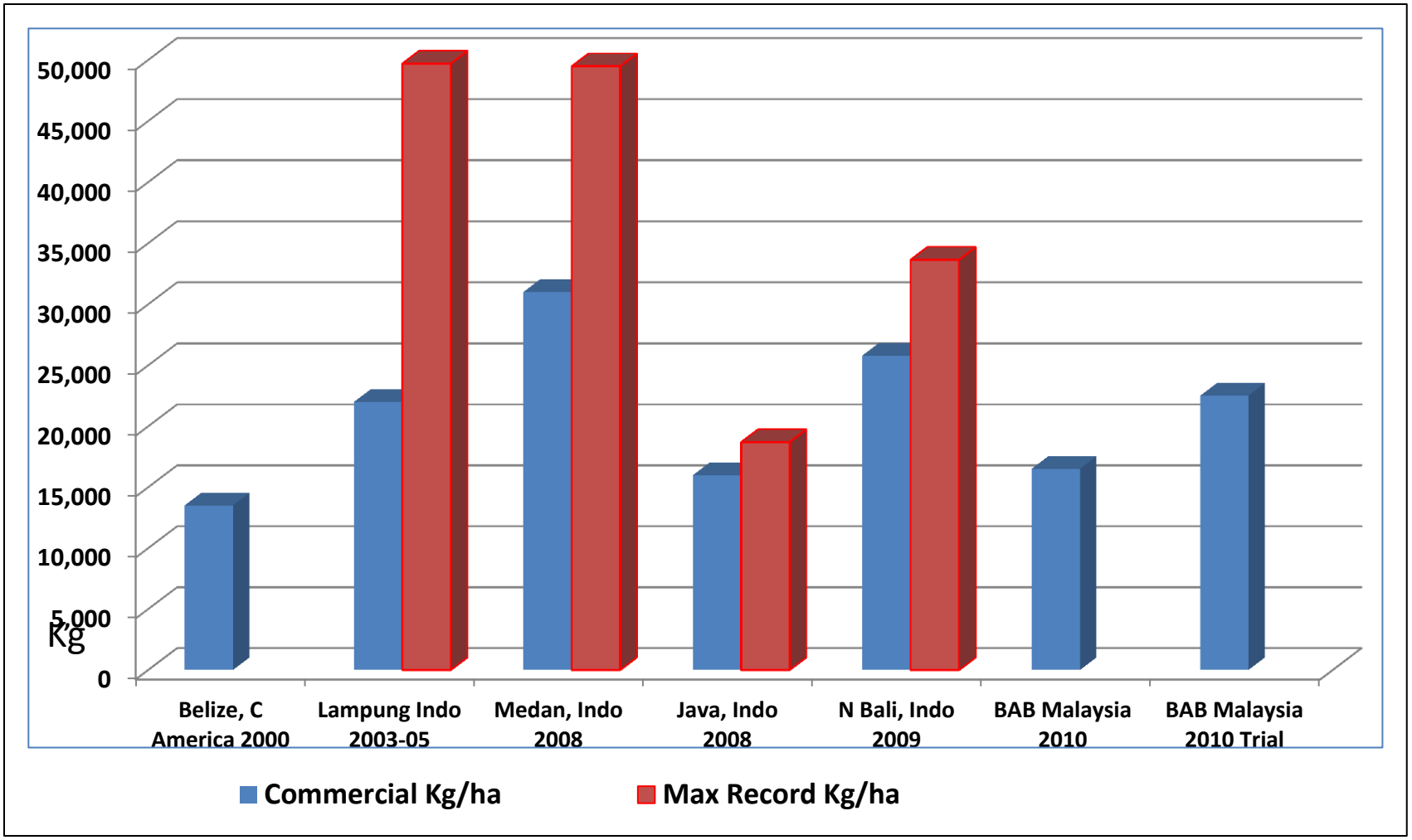
PRODUCTION PERFORMANCE OF ARCA BIRU FARM

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

BIOFLOC IN SHRIMP FARMING

Production Performance



PERFORMANCE

Nursery/ GO, CPB Indonesia

Description	Stock Density (pcs/m^2)			
	550	130	200*	130*
Tank (72 m^2)	2	2	3	3
Initial MBW (g)	4.9	1.7	0.16	0.16
Period (day)	57	90	125	125
Harvest Biomass (kg)	374.0	151.0	183	137
Final MBW (g)	13.8	18.4	14.3	14.3
FCR (exclude GP)	1.2	1.0	1.8*	1.6*
Survival rate (%)	66	88	89	102
ADG (g/day)	0.16	0.19	0.11	0.11
Productivity (kg/m^2)	5.2	2.1	2.5	1.9
Productivity (kg/Ha)	51,893	21,001	25,432	18,993

* trial to develop floc without GP

Shrimp harvested

Raceway

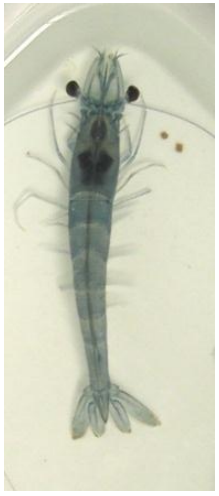
Culture performance in HDPE lined nursery tanks (Floc system)

Nyan Taw, 2004

APPLICATION OF BIOFLOC TECHNOLOGY

Indoor facility, Indonesia

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



SUPER-INTENSIVE (RAS)

Ocean Institute, Hawaii
Moss (2006)

Stocking Density	300 /m3
FCR	1.49
Size	24.7 g
Production	7.5 kg/m3

Texas A & M University
Samocha (2009)

Stocking Density	450 /m3
FCR	1.52
Size	22.36 g
Production	9.37 kg/m3

P. monodon CULTURED IN BIOFLOC

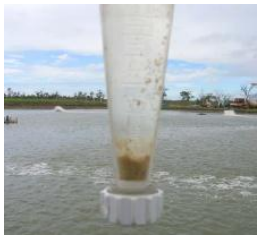
Can *P. monodon* be cultured in biofloc systems?

- Typical production in ponds with a stable floc and stocked with about 45 PL/m² was 10 to 12 t per hectare
- Target harvest weight 35 g
- FCRs when shrimp were 30 g was 1.3:1 (excluding molasses added to pond)

From:

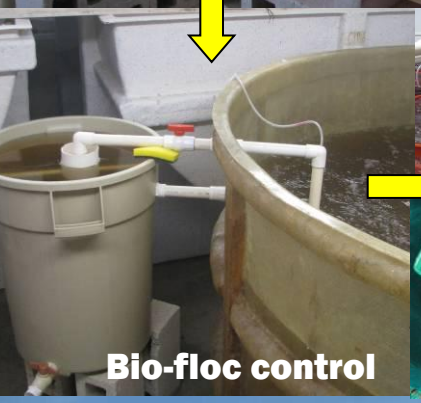
David M. Smith, et al, 2008

Development of protocols for the culture of black tiger shrimp, *Penaeus monodon,*in "zero"water exchange production ponds



BIOFLOC STUDIES IN MEXICO & BRAZIL.

Bio-Floc experimental device
(twenty-four 40l plastic tanks)



Bio-floc control

Kind courtesy of Dr. Mauricio Emerenciano

Indoor
(Six 12,000l indoor bio-floc lined tanks)

Outdoor
(six-teen 20,000l outdoor bio-floc lined tanks)

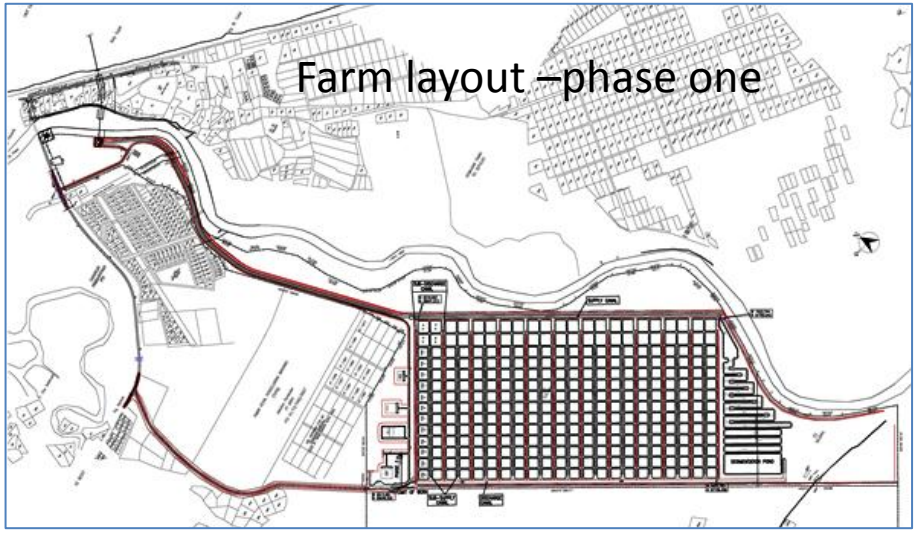
UMDI, Sisal
UNAM-México

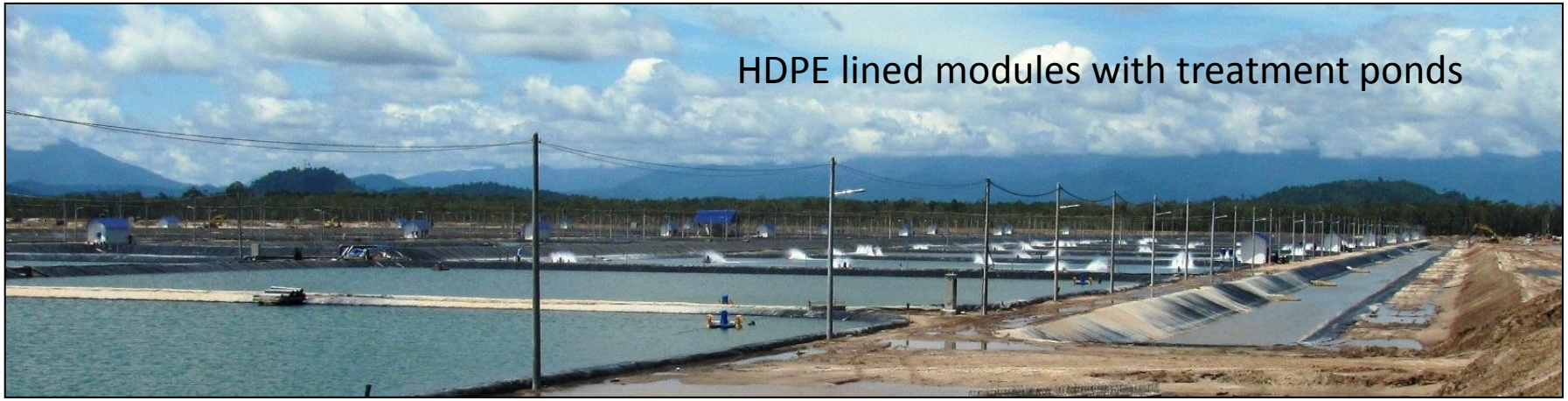
ECONOMICS

Shrimp farmers' view - Saving is profit also

	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 = 4% of feed cost (approximately).
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)	680 – 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.

iSHARP INTEGRATED SHRIMP FARMING PROJECT, Malaysia (Potential for Biofloc Technology)



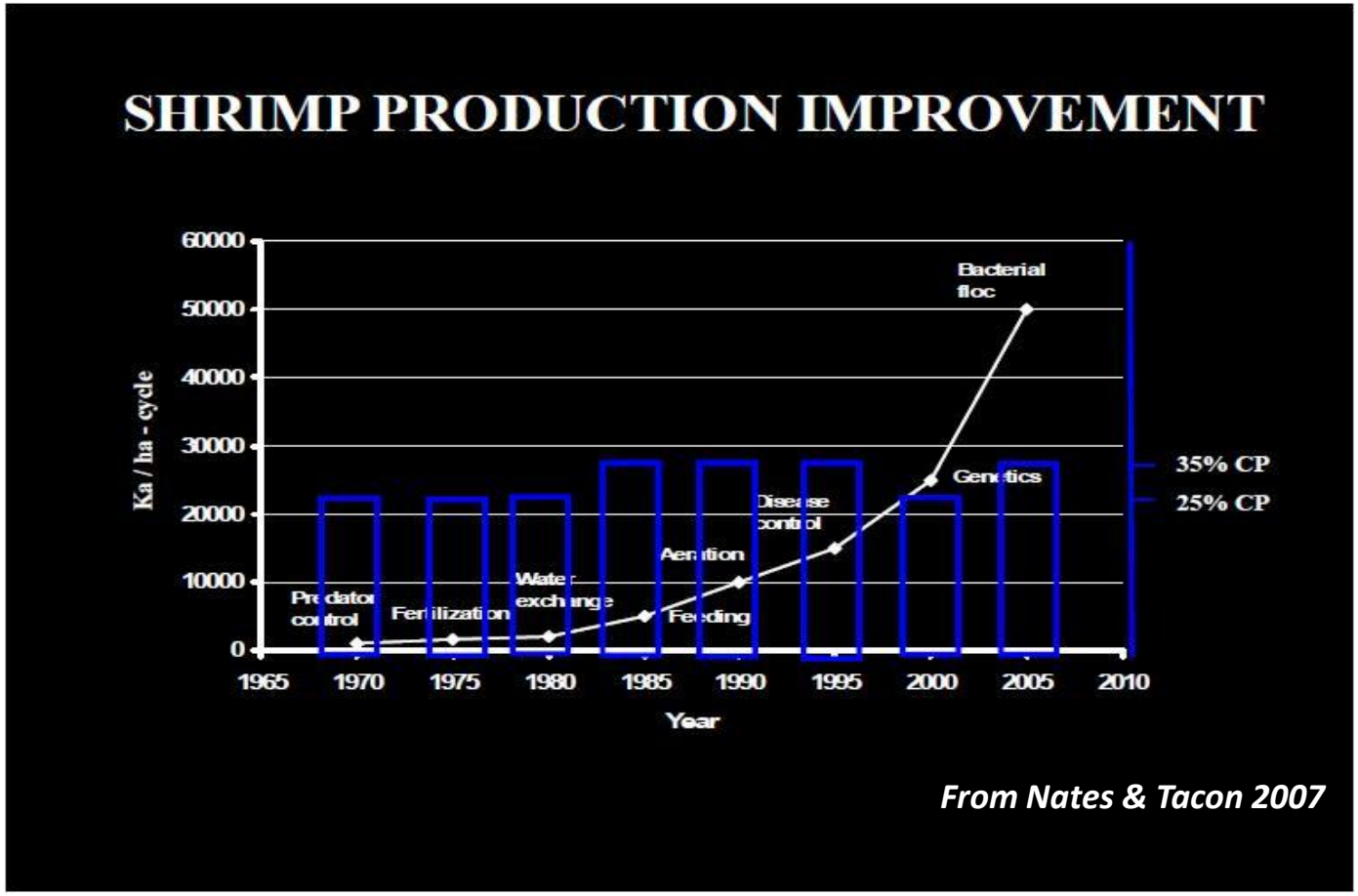


ACKNOWLEDGEMENTS

The author would like to give sincere thanks to 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 to make this presentation possible.

Thank You



From Nates & Tacon 2007

Nyan Taw

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Presentation Title: RECENT DEVELOPMENTS IN BIOFLOC TECHNOLOGY IN SHRIMP CULTURE AND ITS ECONOMICS

Nyan Taw
Abstract: #27
Session Name: Biofloc Culture Systems (Session #_ 7)
Session Date: Thursday, March 1
Time Assignment: 9:00 AM