New Paradigm for Controlling EMS / APHNS in Intensive Culture Ponds

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Vannamei 101

"Crisis drives technology…Change!"

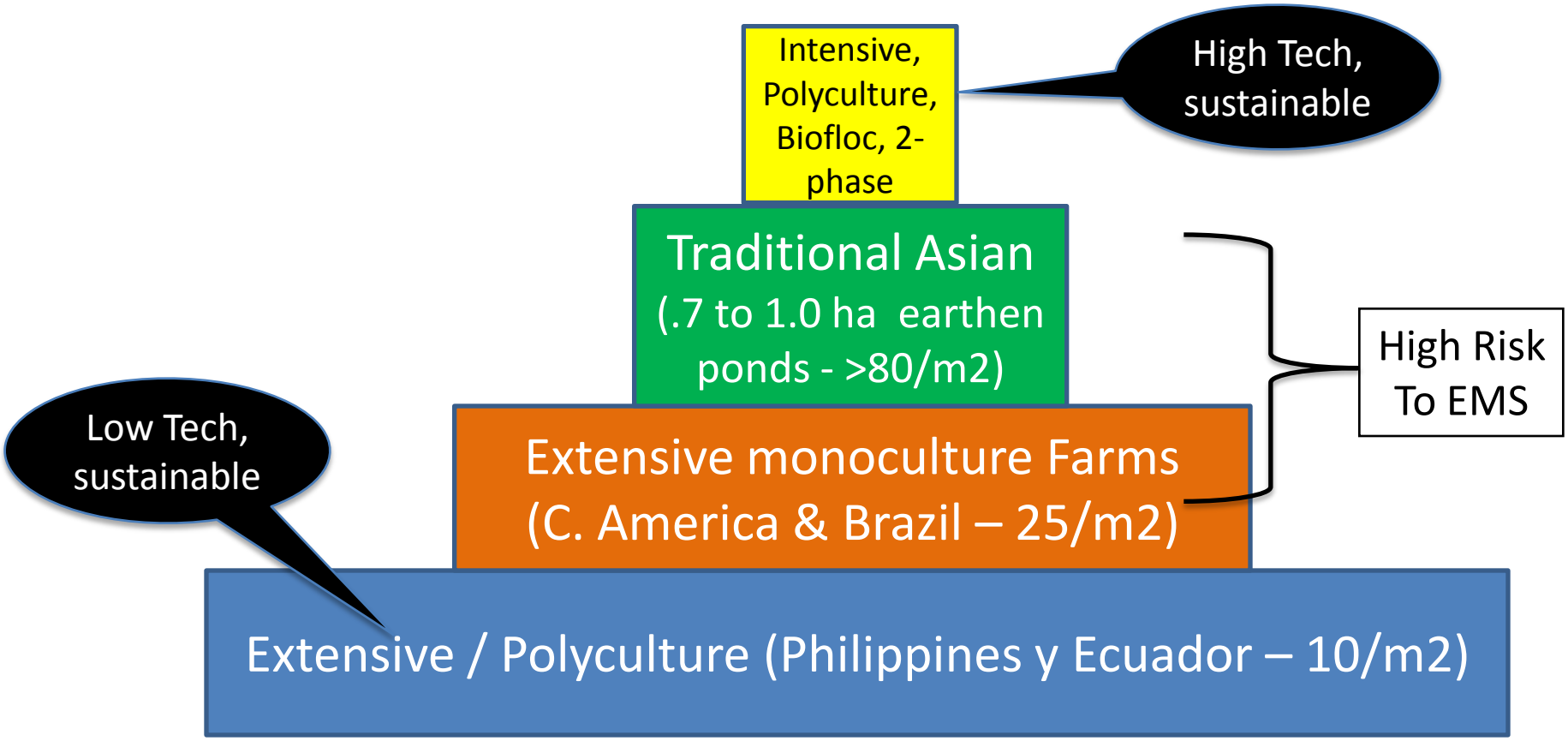
New Era of Crisis and Change

- Climate change - drought, flooding, typhoons, red tide
- Pollution – water resources, coastal areas, pesticides
- New Diseases – bacterial/fungal, not viral
- Economic crisis – increasing cost of production; unfavorable currency exchange rates

Estatus de Produccion por Pais 2016

Pais	Mejorando o Bajando?	Target Market (majority)	Razon
Mexico		Domestic	Vibrio, EMS, WSSV
Brazil		Domestic	WSSV
China		Domestic	EMS, EHP
Indonesia		Export	EHP
India		Export	EHP
Thailand		Export	Sistemas y geneticas
Vietnam		Export	EMS, EHP
Ecuador		Export	Vibrio in hatcheries

Modelos de Cultivo Camaron



APHNS/EMS is "*natures insecticide*"

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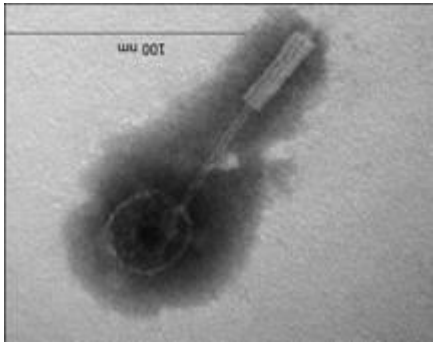

Internal: 10^5 Vibrio concentration in stomach of shrimp => release toxin => damages HP => mortality

External: 10^2 Vibrio concentration in deteriorating pond bottom conditions => release toxin => mortality

Problem is that instead of killing the pest, APHNS is killing the crop!

Criteria for Controlling EMS in ***Intensive*** Culture Systems

1. **Pond design – square, center drain, smaller ponds, liner**
2. **Water management – exchange and requirement**
3. **Solids removal => central drain or "shrimp toilet"**
4. **Polyculture (Tilapia) and/or recirculation**
5. **Shading ponds – reduce Blue-Green algae**

1. Aeration requirement
7. Feed management – automatic feeders
8. Clean, good quality seedstock
9. Nursery systems – 2-phase grow-out
10. Genetics – maximize genetic potential

Traditional versus New

Pond Description	Traditional	New
Size (area)	1+ hectare	1,000 to 3,000 m2
Shape	Rectangular	Square or round
Depth	1.0 to 1.5 meters	1.5 to 2.5 meters
Bottom	Earthen	Lined (HDPE)
Aeration	20-40 hp/hectare	55 to 75 hp/hectare
Discharge location	Side gate	Center drain
Water exchange	<50% over cycle	1,000%+ over cycle
Polyculture (reservoirs)	none	Tilapia
Feeding	4-5 times - daytime	300+ times/12-24 hrs
Kilos/m2/crop	1-2 kilos/m2 (before EMS)	3-4 kilos/m2

Prioridades de Manejo Preventativo

Prioridade 1 – Tenha os fundos dos viveiros limpos
Prioridade 2 - Mantenha os fundos dos viveiros limpos
Prioridade 3 – Tenha certeza que os fundos dos viveiros estão limpos!

- Remover as partículas de bioflocos sedimentadas, alga morta e restos de resíduos orgânicos
- Remover as carapaças e ração não ingerida
- Manter o nível de bioflocos menor que 2 cm no Cone Inhoff
- Eliminar o excesso de material que possa servir de substrato para colonização de Vibrio

Trending: Making smaller ponds from larger ponds

Before…8,000 m2 pond in Thailand

Smaller 2,000 m2 ponds with shrimp toilet

- 5,000 m2 ponds; from 2.5 ha
- 250 PL/m2; direct stocking
- 13 grams in 110 days
- 2.5 to 3.0 kg/m2 harvested
- 25 to 30 MT per hectare
- 2 cycles in 2016; 80-90% survival

- 5,000 m2 ponds; from 2.5 ha
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0.5 hectare x 2.0 m deep
= 10,000 m3 x 2.0 kg/m2 shrimp
= 20,000 kg x 1.5 FCR
= 30,000 kg shrimp feed x 25% undigested
= 7,500 kg shrimp waste/cycle

Not counting:

- Organics from uneaten feed
- Settled phytoplankton and biofloc
- Molts and dead shrimp

Semi-biofloc protocol with no shrimp toilet

Probiotics:
Enzymes
Prebiotics
Organic acids

10 cm/liter of floc x 10,000 m2 = 100 metric tons of sludge!

Minerals:
Magnesium
Calcium
Potassium
Alkalinity
pH
Trace elements

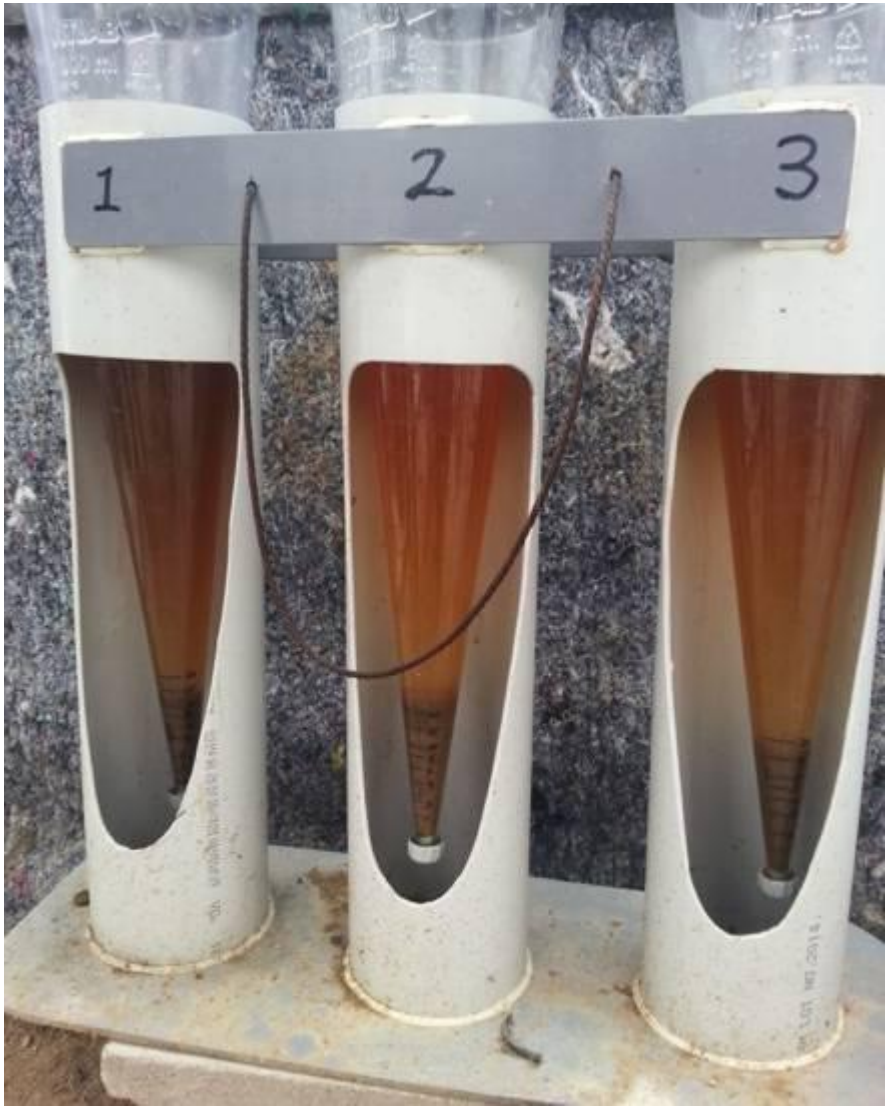
Heavy Aeration:
Paddlewheels
Injectors
Diffusers/blowers

Zero to low water exchange

Carbon sources:
Molasses or sugar,
Feed

Build-up of organic waste => APHNS mortality

Heavy Biofloc = Recipe for Disaster



10 cm/liter of biofloc
In a 1.0 ha pond

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Power goes off

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100 cubic meters sediment on the pond bottom

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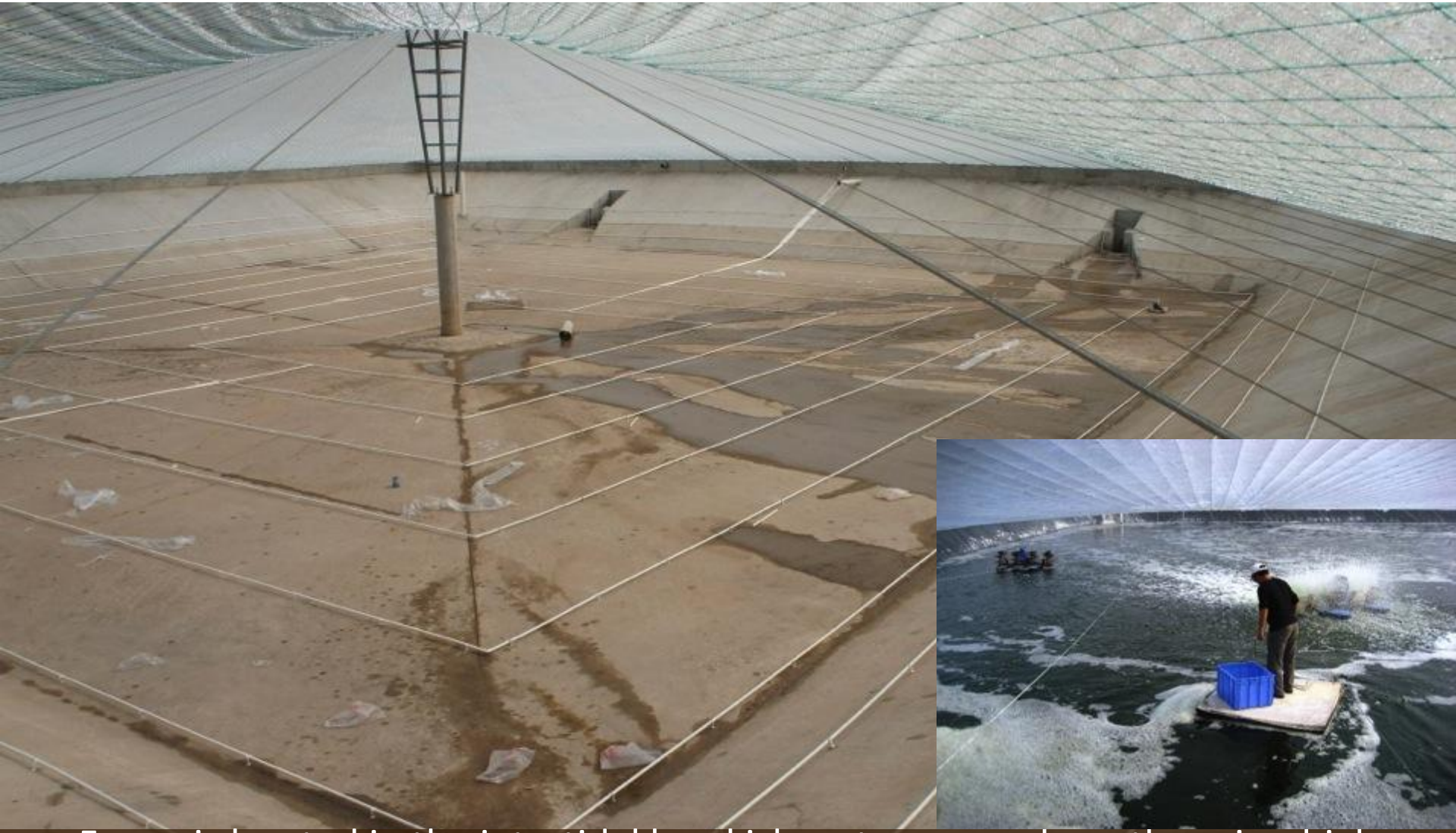
Shrimp farm in China

No center drain – EMS/APHNS mortality in 2015



Farms is located in the intertidal brackish water zone where there is a high concentration of shrimp farms having higher EMS/APHNS related outbreaks.

“Shrimp Toilet”….

Efficient removal of sediments

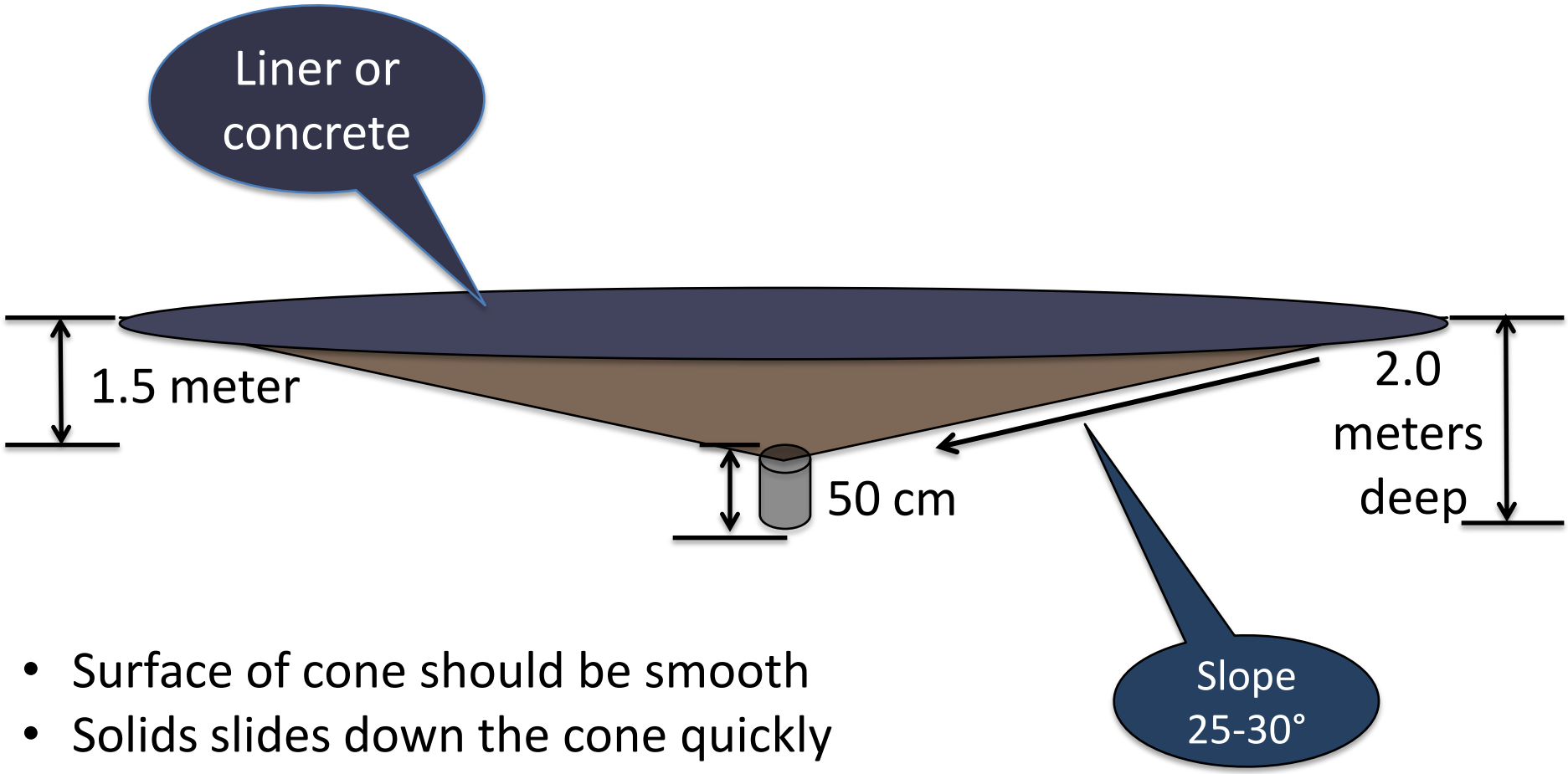
- Toilet is 5-7% of pond surface area
- No drain line!
- Submersible or floating pump (2 hp)

Shrimp Toilet

Shrimp Toilet Design and Efficiency

- Smooth shrimp toilet surface moves solids to center faster
- Steep slope moves solids to center faster
- Less water needed to remove solids

Shrimp Toilet Design



- Surface of cone should be smooth
- Solids slides down the cone quickly
- Larger and steeper the cone, less water exchange
- Square or round ponds

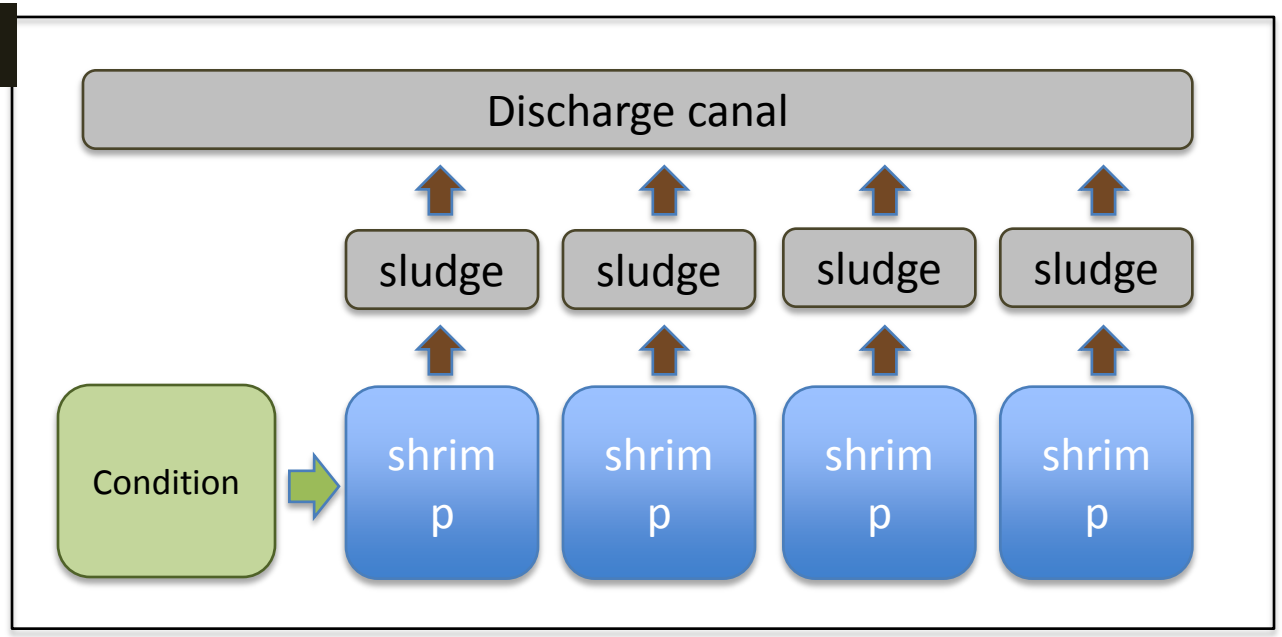
Center Pipe

- 60 cm wide x 60 cm deep

Thailand 2014

Before EMS

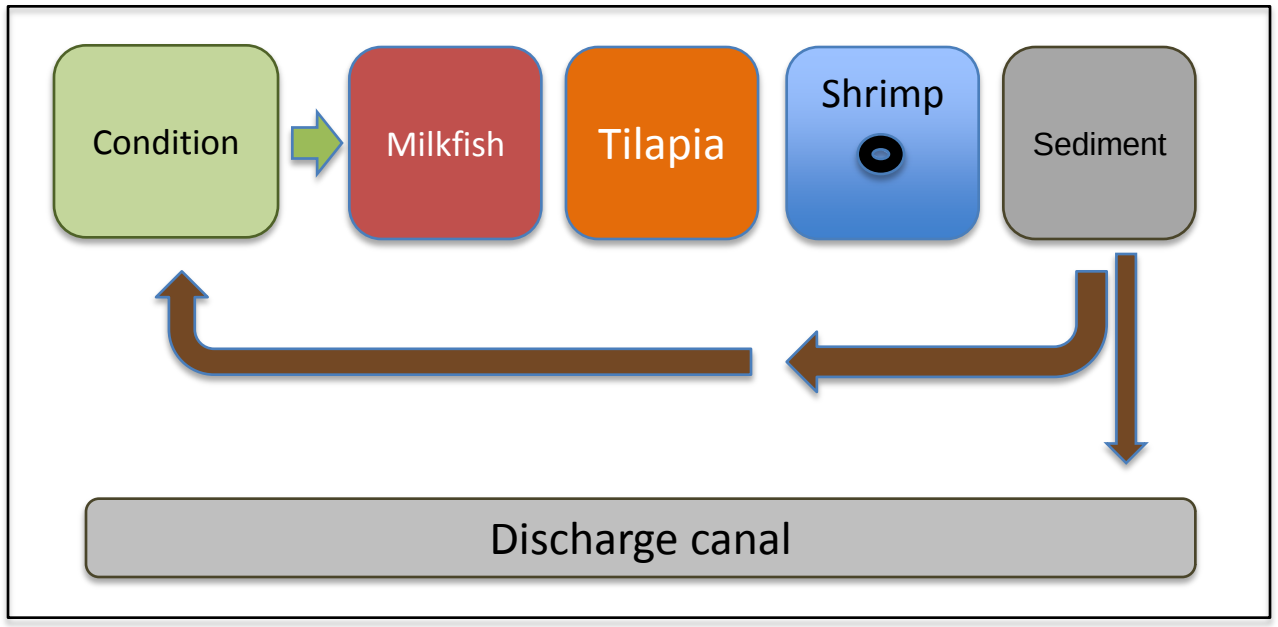
(sludge removed after harvest)



20% Reservoir; 80% Grow-out

After EMS

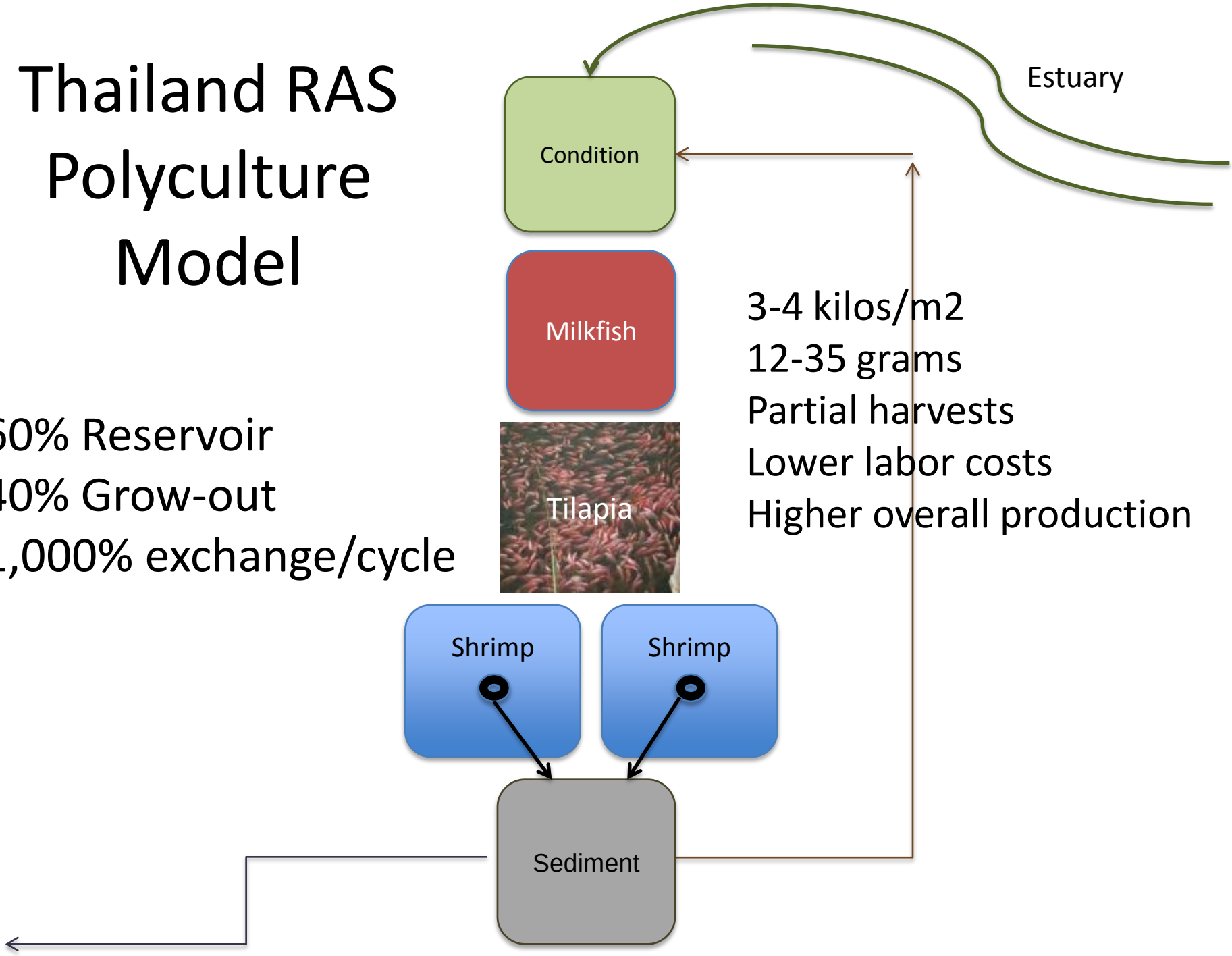
(waste, uneaten feed, and molts removed immediately)



60% Reservoir; 40% Grow-out

Thailand RAS Polyculture Model

60% Reservoir
40% Grow-out
1,000% exchange/cycle



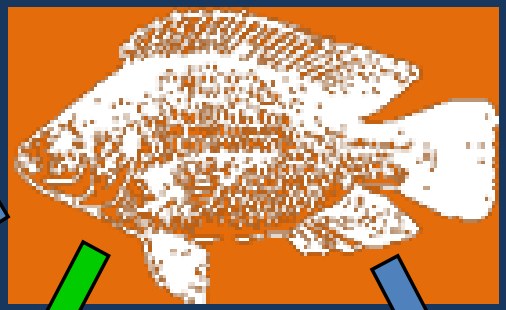
3-4 kilos/m2
12-35 grams
Partial harvests
Lower labor costs
Higher overall production


Surat Thani, Thailand
Farmers in Thailand are modifying their farms to use the “Luem Takan” technique.
Producing 30 to 40 metric tons per hectare.

Samran farm	Criteria
Pond area	3,000 m2
Pond depth	2.5 meters
Water preparation	10 days (probiotics, minerals)
Minerals (x 1 ppm)	K = 15, Ca = 15, Mg = 40
Stocking density	250-300/m2 juveniles
Salinity range	15 to 26 ppt
Alkalinity and pH	>130 ppm and 7.6-7.7
Partial harvest	50 days/14 g
Final harvest	Until 120 days/20-25 g
Biomass harvested	4.3 to 7.5 kg/m2
% Survival	70-90%
FCR	1.2
Cost and sales price per kilo	Cost: $3.50/kg; Sales: $5.00/kg ave.
Tilapia and milkfish in reservoir	20,000 each per reservoir

Tilapia Recirculation Reservoirs…Tilapia is apart of the solution
Tilapia consumes excess sediments (fish are not fed)
Surface water overflows to a series of Tilapia reservoirs

Tilapia as a Biomanipulator



Feeding on organic waste and conversion to feces

Selective foraging resulting to dominance of beneficial green algae

Bioturbation resulting to enhanced breakdown of OM

Release in the water column of anti-microbials from mucous

IMPROVED SEDIMENT QUALITY

STABLE/GOOD WATER QUALITY

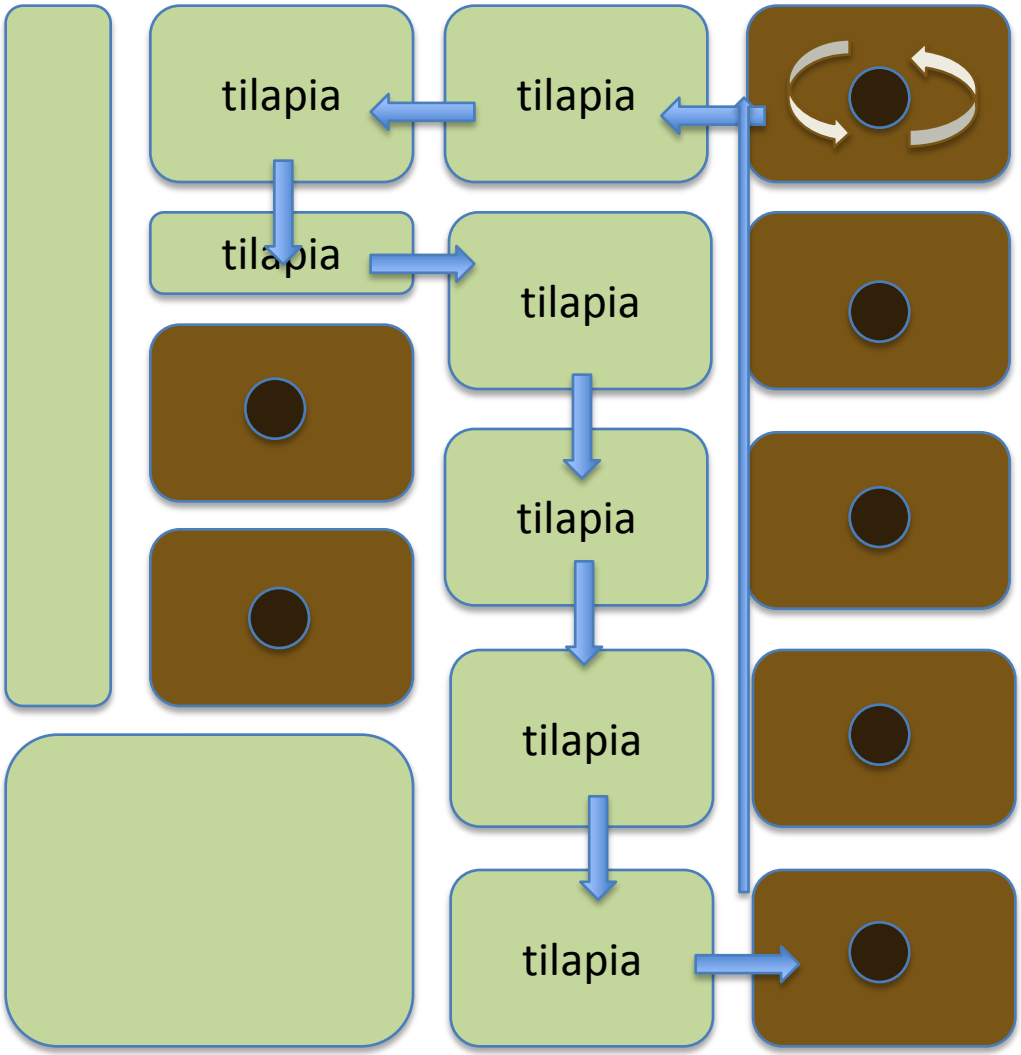
SUPRESSION OF GROWTH OF *VIBRIO*

Criteria	Reservoir
Stocking size	50 to 70 grams
Stocking density	10 fish / m2
Stocking biomass	1-2 kilos / m2
Harvest size	400 to 500 grams per fish
Harvest biomass	5 kilos / m2
Aeration	Yes; 1-2 paddlewheels/reservoir
Feeding	none

Lysozymes in Tilapia Mucus

- Lysozyme - enzyme that is destructive of bacteria; functions as an antiseptic, found mucus (fish slime), egg albumin, and certain plants.
- Lysozymes are apart of the innate immune system in living organisms.
- Tilapia has more slime or mucus than other fish species.

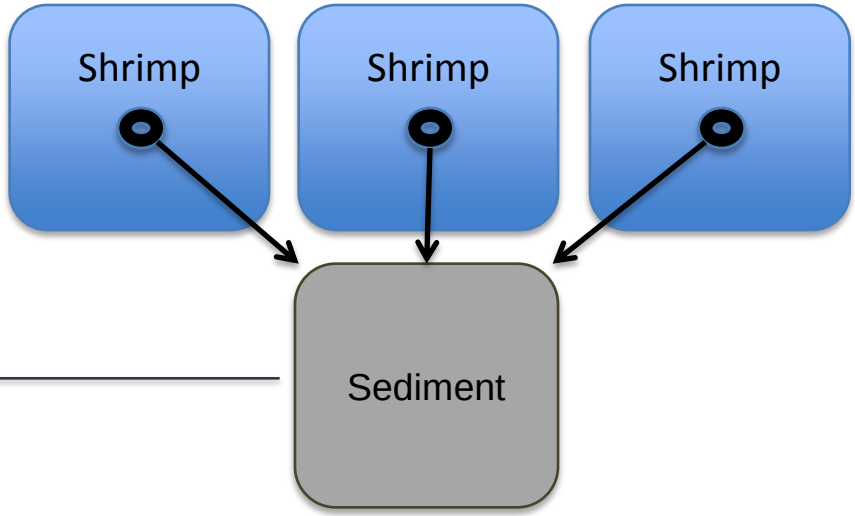
Samran Farm produces more than double the shrimp production shrimp in less than 50% of the pond capacity.



Thailand Flow-Through Model

Gracilaria sp

3-4 kilos/m2
12-35 grams
Partial harvests
Lower labor costs
Higher overall production



60-70% Reservoir
30-40% Grow-out

Central Vietnam

- Water from beach well points
- Pre-filtered clean water
- 5-10% exchange from DOC 30-60
- 10-20% exchange after DOC 60
- No EMS/APHNS related mortalities in 2 years

Secondary reservoir stocked with macro algae (Gracilaria sp.)

Macro Algae Conditioning of Reservoir Water (Low nutrients, low organics, no disinfection)

7 metric tons / 1,600 m2 = 4.37 kg/m2

1,600 m2 x 3 meters deep

Return water passes through a large filter bag before filling the pond

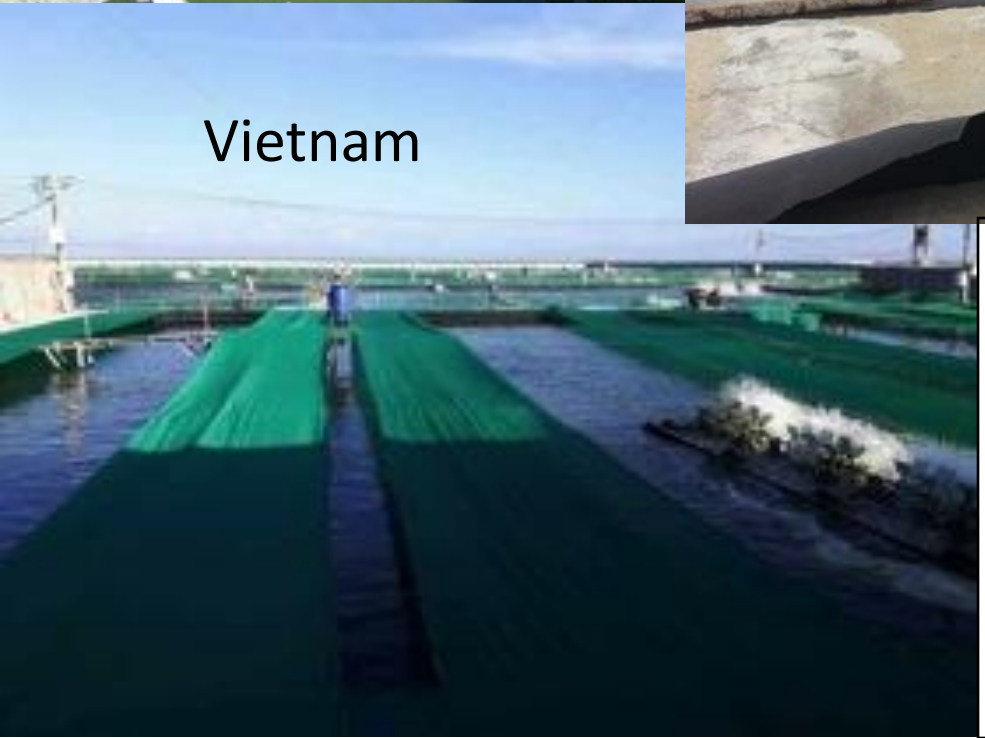
Energy requirement	**50 to 70 HP/Ha (depending on pond depth)**
Water exchange period	Starting at DOC 30 to harvest
Exchange rate per day	5 to 25%, depending on biomass
Continuous pumping (2 hp)	24/7; two pumps in evenings after DOC 60
Intermittent pumping	3 minutes on/ 10 minutes off; 24/7
Reservoir capacity	Approximately same area as grow-out

Pumps continuously remove sediments from the shrimp toilet

Blue-green algae bloom is usually followed by Vibriosis

Philippines

Vietnam



- Reduces phytoplankton blooms (especially blue-green)
- Stabilizes water quality (less pH and DO fluctuation)
- Favors beneficial bacteria
- Reduced water temperatures

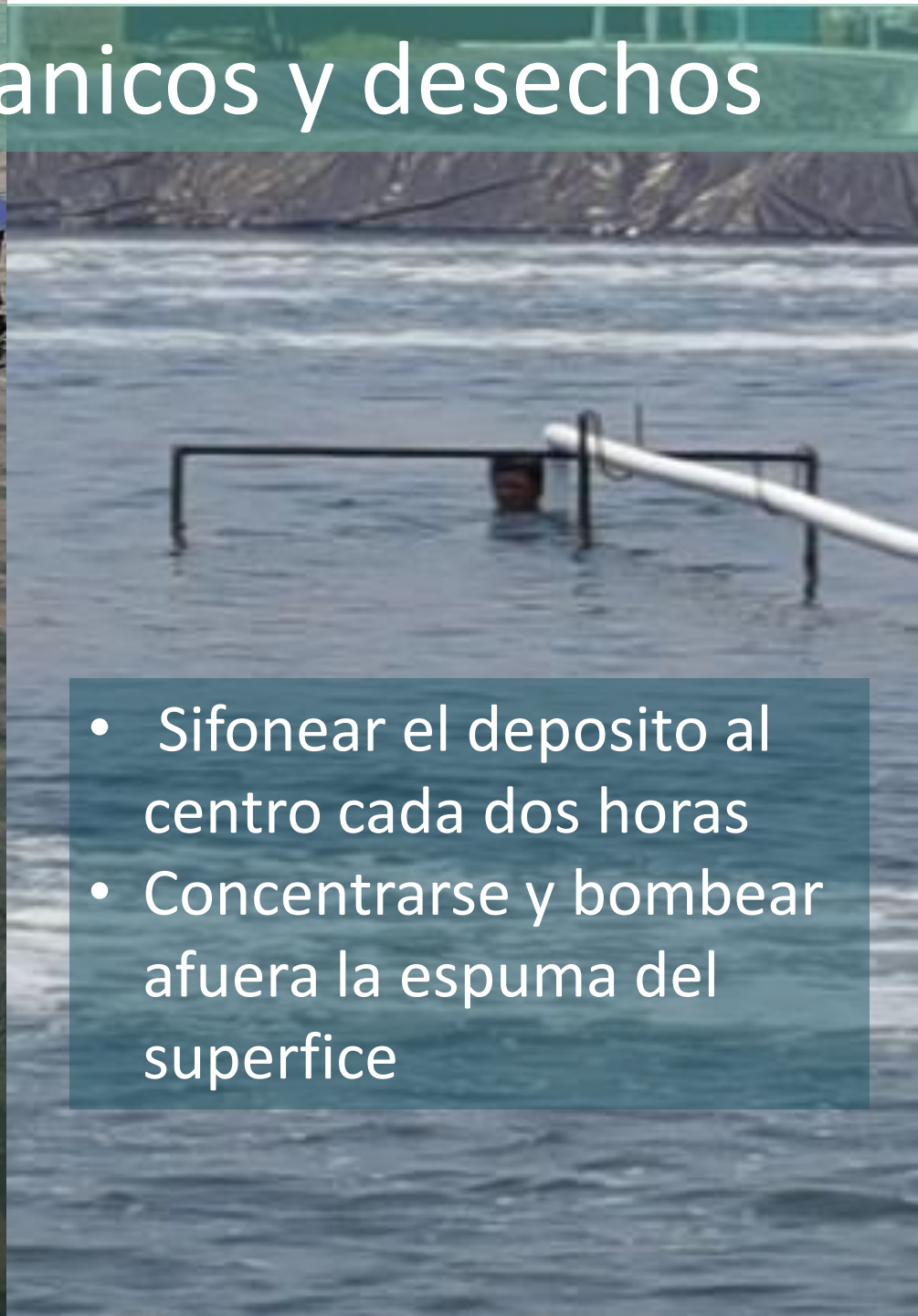
Pond Dye or Colorant

Vietnam

Concrete + Sand Pond Bottom

- Compacted feeding area
- Less turbidity in water column
- Healthier biofloc

Eliminar los organicos y desechos



- Sifonear el deposito al centro cada dos horas
- Concentrarse y bombear afuera la espuma del superfice

Thailand

Cost Breakdown	Thai Baht	USD
Feed	65	$1.86
Electricity	40	$1.14
Probiotics, treatments	20	$0.57
Seedstock (juveniles)	15	$0.43
Misc	5	$0.14
Total	**145**	**$4.14**

Harvest size	Grams	% of Harvest	Baht	USD
60 per kilo	17	25%	150	$4.29
40 per kilo	25	25%	180	$5.14
30 per kilo	33	50%	220	$6.29
Total			**192.5**	**$5.50**

Cost per kilo	Farm Gate Value	Net Profit	% Profit
$4.14	$5.50	$1.36	33%

Super Intensive Culture Systems
Sulawesi, Indonesia

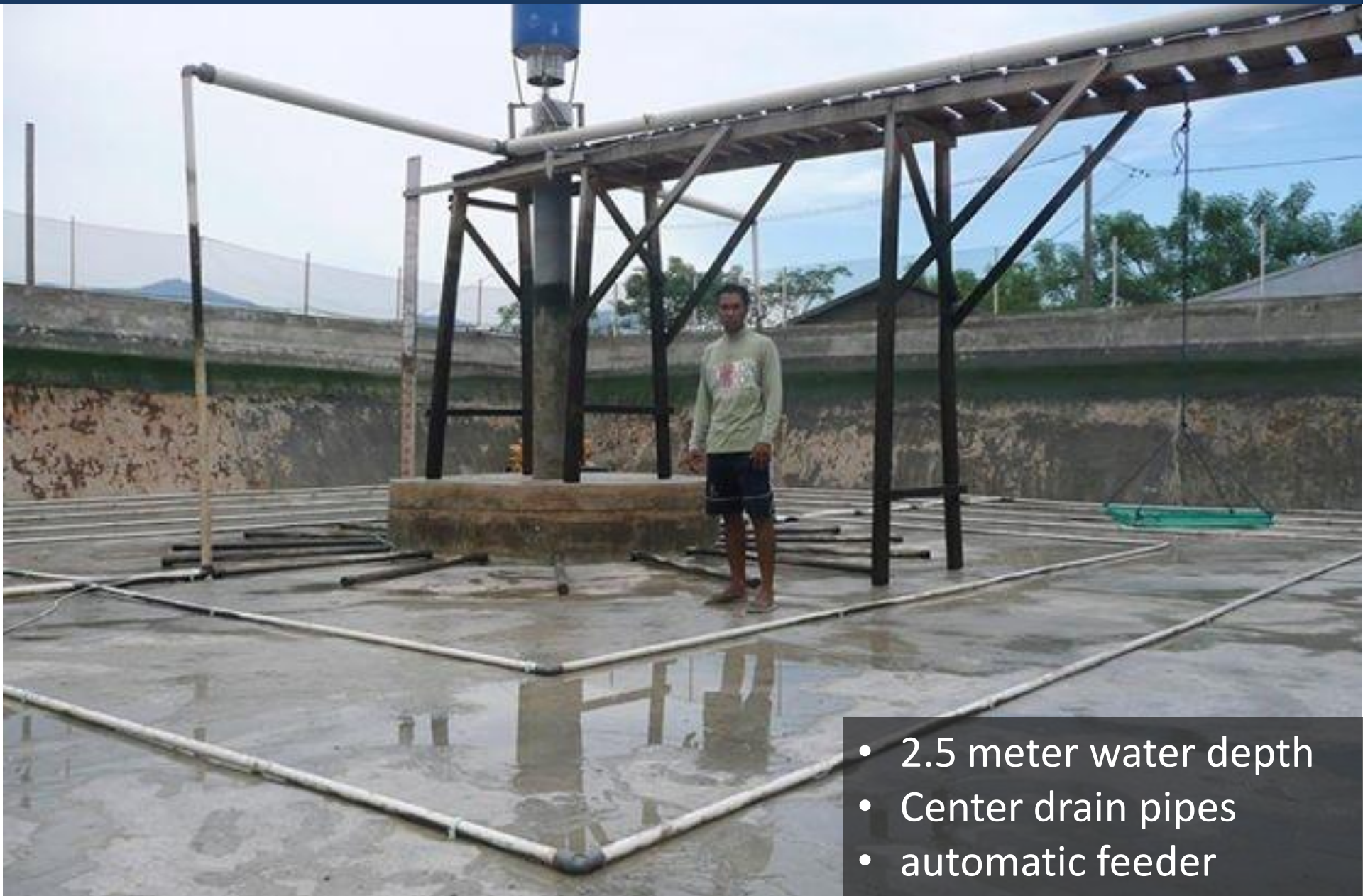
Total hp = 14 hp (140 hp/hectare)

Pond area: 1,000 m2

Super Intensive Systems (outdoor)

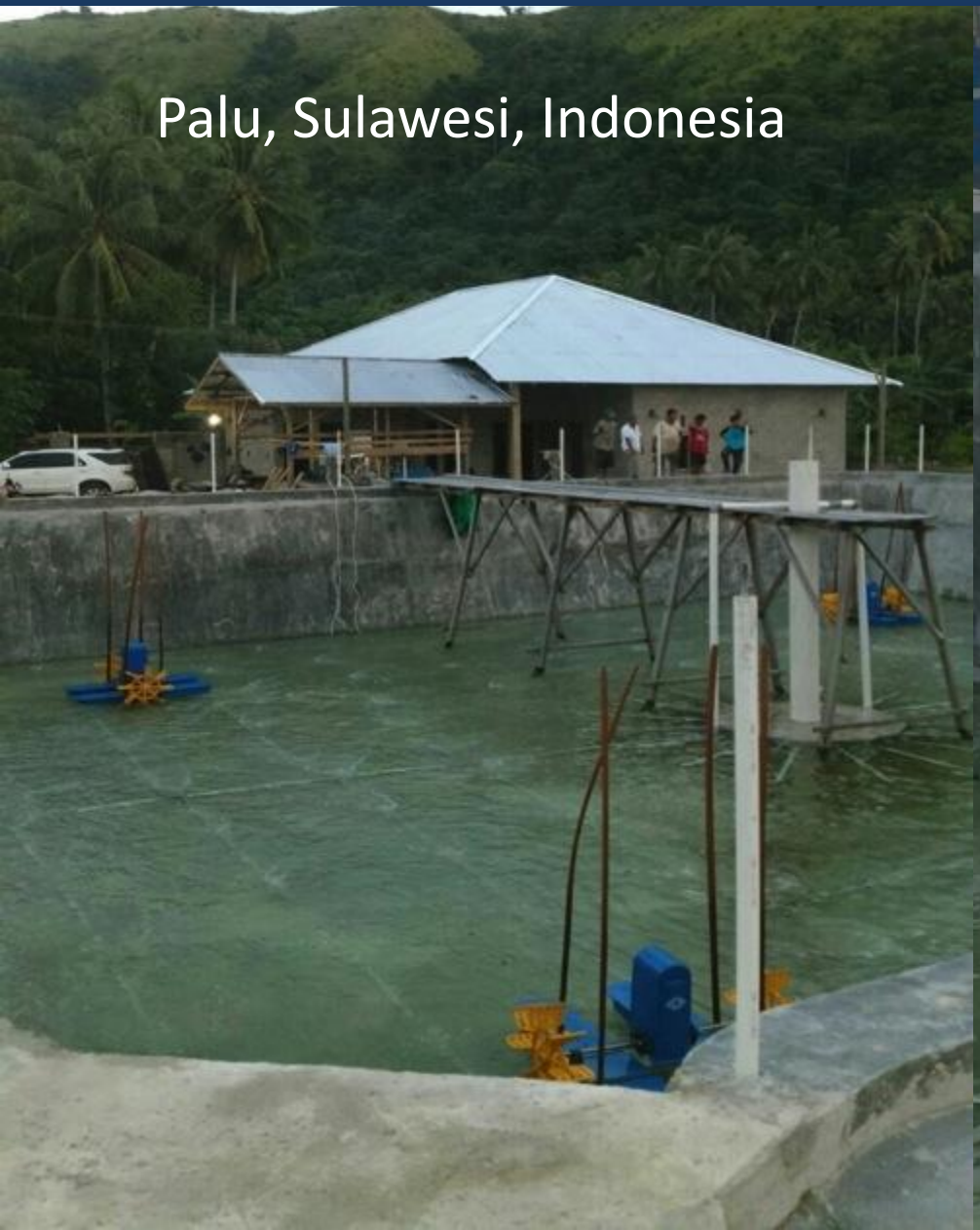
Pond Dimensions	20m x 20m x 3m deep (400 m2)
Direct stocking density (PL12)	1,000 PL's per m2 (333 PL's per m3)
Total harvest	80-120 metric tons/hectare/cycle
Kilos per m2 / m3	8-12 kilos/m2 or 2-4 kilos per m3
% Survival	90% on average
Water exchange	Up to 30% daily (after DOC 30)
FCR	1.4-1.6
Sizes harvested	10-35 grams (4 partial harvests)
Aeration	120-150 hp per hectare
DOC	110+

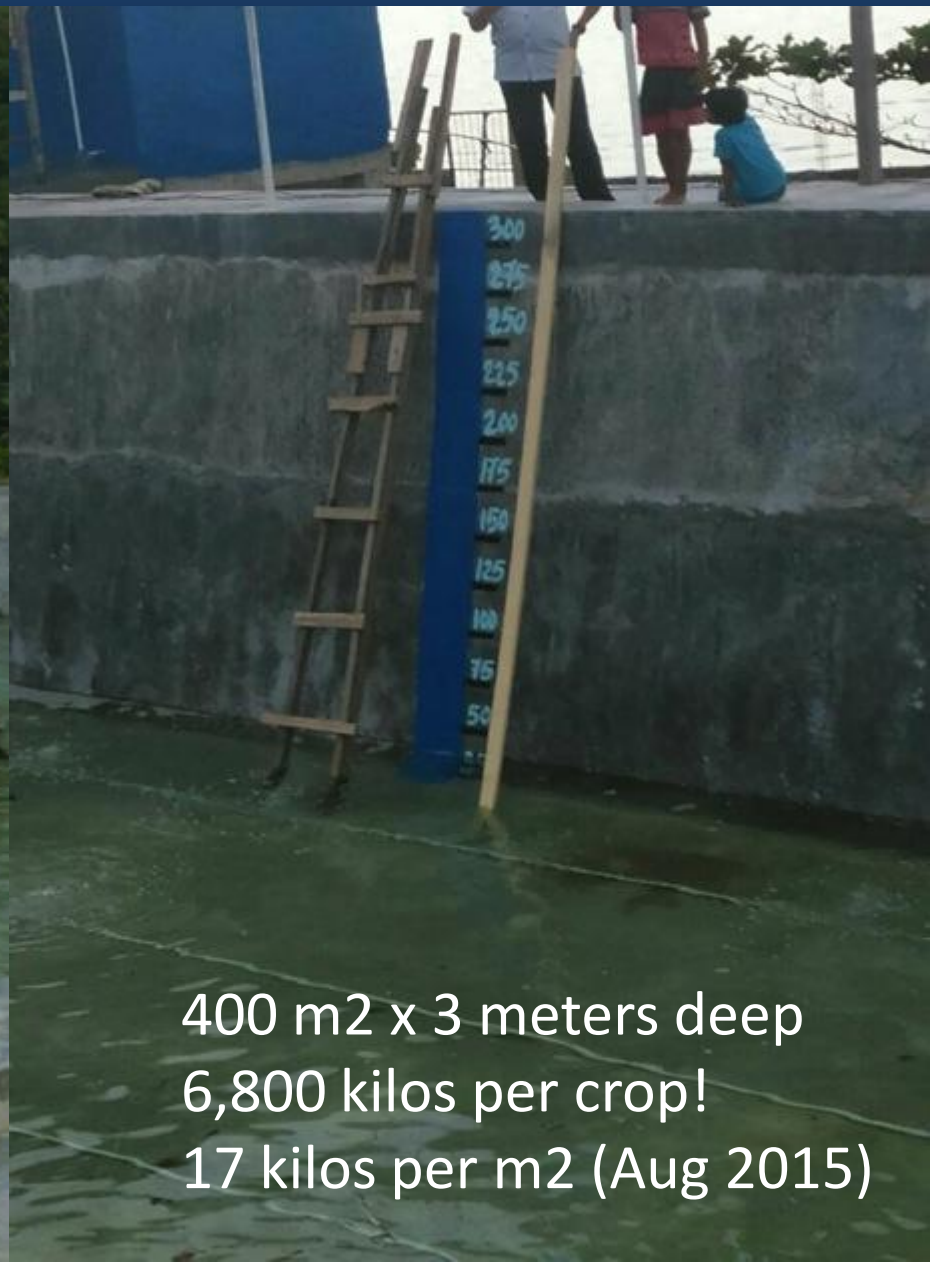
“The solution to pollution is dilution.”



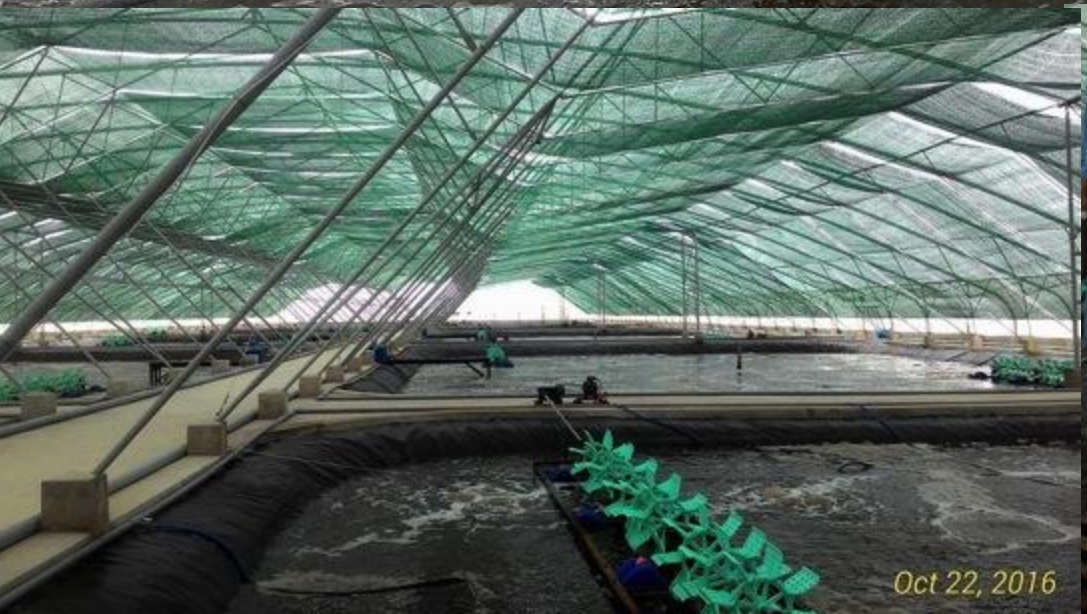
- 2.5 meter water depth
- Center drain pipes
- automatic feeder

“The solution to pollution is dilution.”





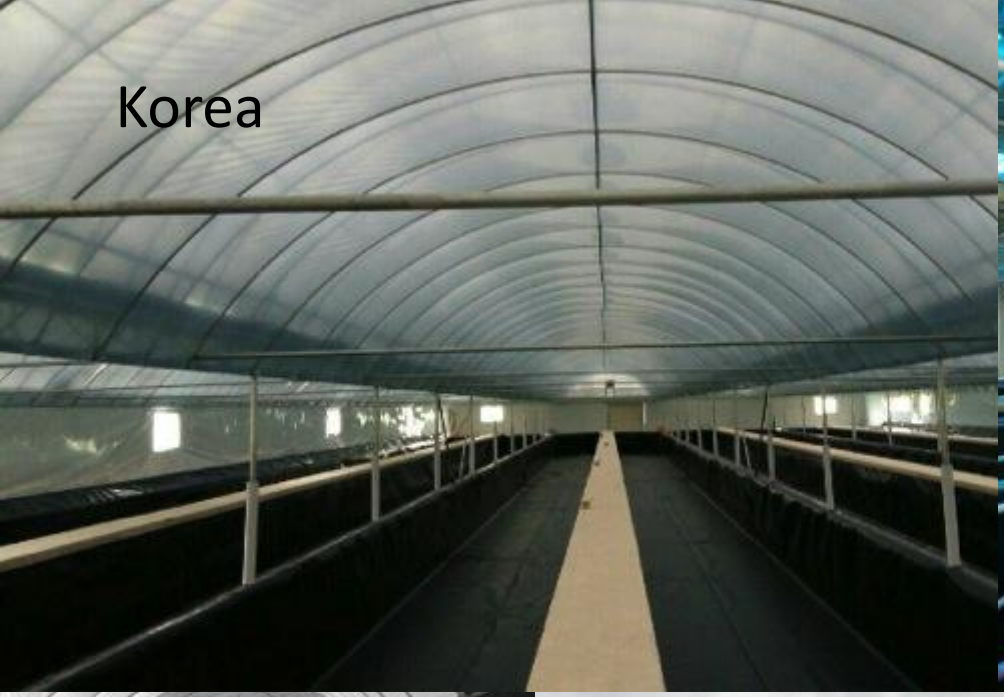

Vietnam
Discharge pipes


Oct 22, 2016

“Brown Water (biofloc) Technique”

Korea

- The most advanced country for indoor biofloc technology
- 35 indoor farms and growing
- 100 hp/ha energy requirement; aspirators + airlifts
- Raceways area 200 m2; 1.2 meters deep; 2-phases
- 250-300/m2 density; 4 kg per m2 target
- Market price: $30 USD/kilo (live)


Korea

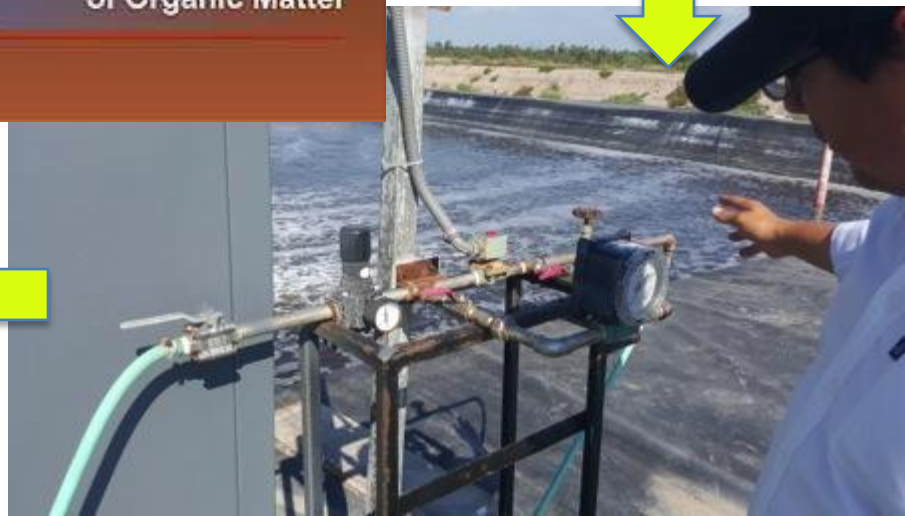

Algeria


Mazatlan, Mexico


Zacatecas, Mexico

DISSOLVED OXYGEN (D.O.) CONSUMPTION

15% of D.O.	Prawns
15% of D.O.	Plankton
70% of D.O.	Microbial Decomposition of Organic Matter



Trial Using Liquid Oxygen	No Oxygen (average)	With Oxygen (one trial)
Pond vol. (.5 ha x 2 m deep)	10,000 m3	10,000 m3
Stocking density (.5 grams)	300/m2	600/m2
Aeration (PDW and blower)	68 hp/hectare	68 hp/hectare
Days of culture	90 days	90 days
Harvested (partial + final)	7 metric tons	21 metric tons
Size range	12-22 grams	12-19 grams
Survival rate	50% average	50% (actual)

- Oxygen injected into air line when DO goes below 4.0 ppm
- 1 m3 liquid O2 = 800 m3 gas O2
- 1 m3 liquid O2 = $200 USD
- Used 20 m3 of liquid O2 x $200 = $4,000 USD
- Profit margin: 44% ($58,000 net profit)

Drivers for Shrimp Production

1. Genetic improvement (50%)
2. Technical Management (50%)

SPF Certified Broodstock (primary suppliers to Asia)	ADG	Grams per week (80+/m2)
CP (Thailand)	.34	2.4 +/- .3 grams
Shrimp Improvement Systems (Hawaii-Florida)	.28	2.0 +/- .3 grams
Kona Bay (Hawaii)	.28	2.0 +/- .3 grams

SPR Broodstock (local breeding companies)	ADG	Grams per week (10-15/m2)
Mexico (pure line)	.21	1.5 grams
Ecuador	.18	1.3 grams
Brazil	.14	1.0 grams
Central America (Guatemala, Belize, Honduras, Nicaragua)	.14	1.0 grams

Performance Comparisons from Different Genetic Stocks of *P. vannamei*

Traits	Ecuador (SPR)	Mexico (SPR)	Brazil (SPF)	Hawaii (SPF)
Survival	***	*	*	*
Growth per week	1.0 g/week	1.0/ week	1.0 g/ week	2.0/ week
High Density	*	*	*	***
Uniformity	*	*	*	***

- For densities of more than 80 animals per m2

Brazil Needs Two Broodstock Lines

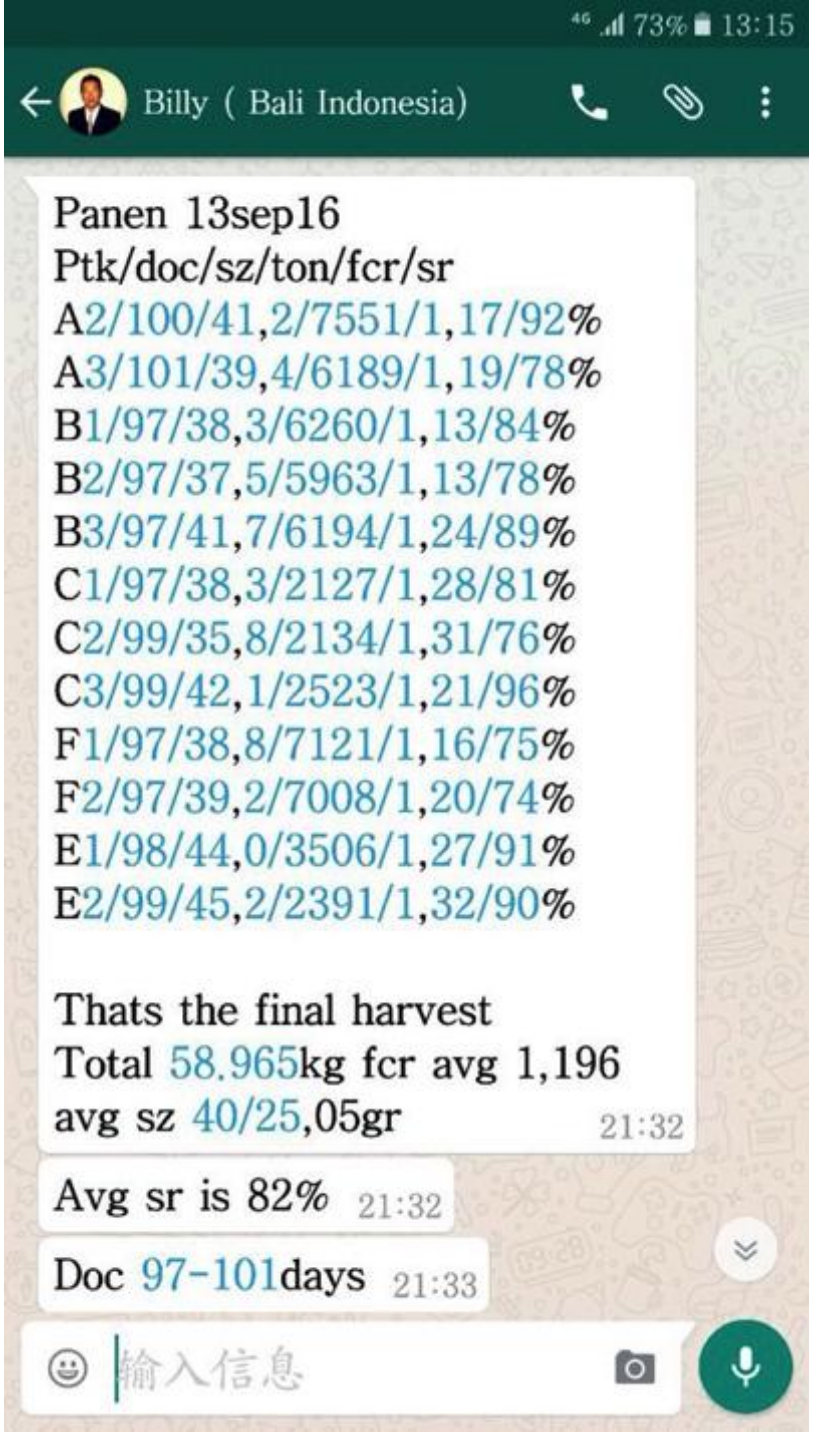
1. SPF certified, Fast Growth, High Density
   - Certified SPF Broodstock
   - For farms that can control EMS
   - Indoor, intensive semi-biofloc farms

2. SPR, Slower Growth, More Disease Tolerant
   - Brazil line is robust; selected over 20+ generations
   - For traditional farms with large ponds
   - Trade-off…slow growth, high size variation

Record size for cultured P. vannamei!

- 150 gramos en 5.5 meses del cultivo (hembra)
- 135 gramos para machos
- cosecha final: 5 toneladas (en Malaysia)

- 105 dias del cultivo; siembra directa
- 40 gramos promedio
- 80 animales por m2 siembra
- Sistema de “shrimp toilet”



Indonesia (Bali) Intensive Farm

- Culture period: 100 days
- Direct stocking: PL12 (SPF)
- Survival average: 82%
- Harvest size: 25 grams
- Average daily growth: .25 ADG

Two or three grow-out phases are not necessary when stocking shrimp selected for fast-growth!

Muito Obrigado