



Why is Brazil not a Shrimp Superpower

And ideas to make the shrimp industry reach it greatest potential

Robins McIntosh
Charoen Pokphand Foods
Bangkok Thailand

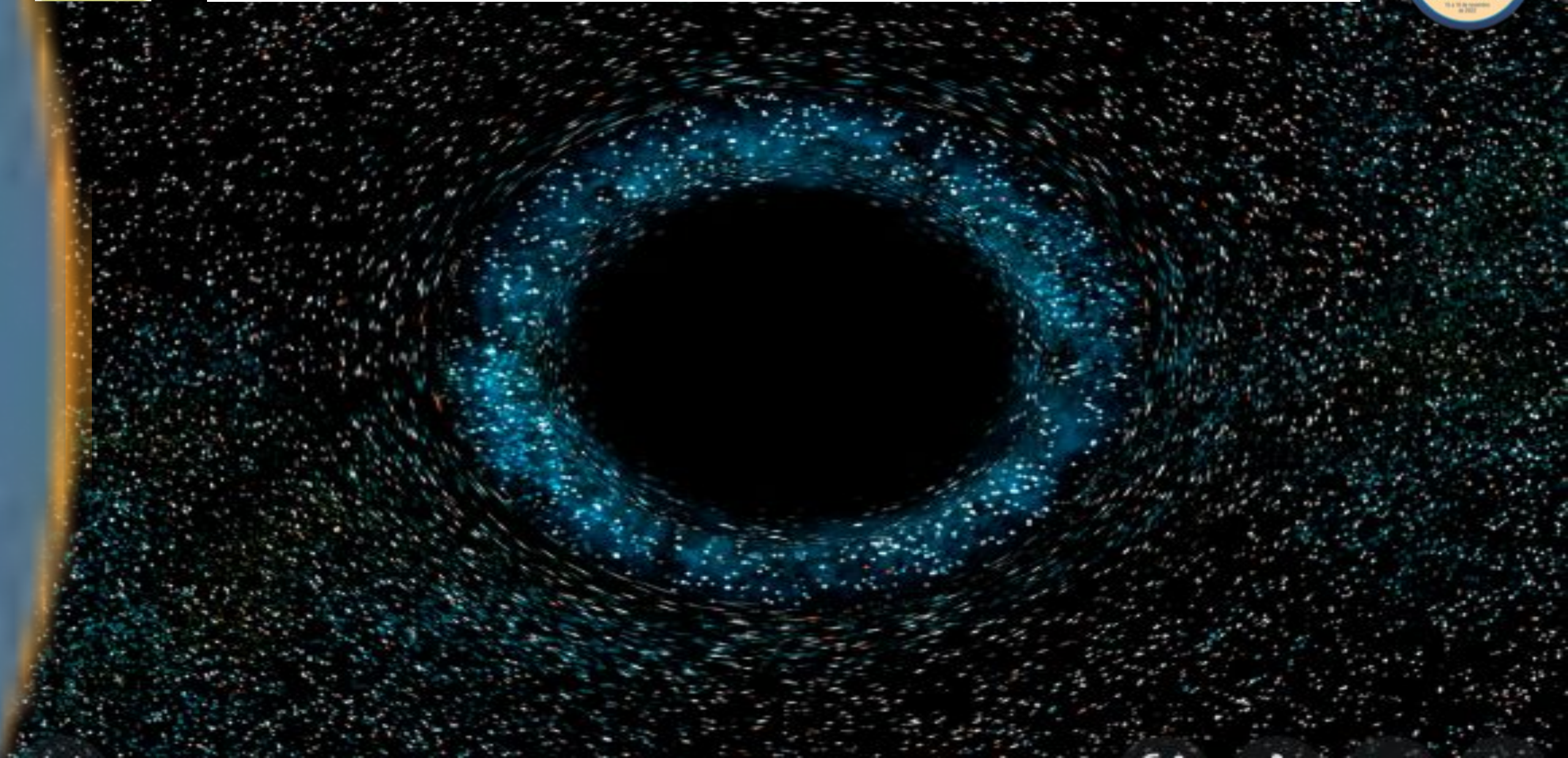


2005 : I SAW a **BRIGHT FUTURE** for Brazilian Shrimp





2022: I See a possible **BLACK HOLE**





This is what I saw in Brazil 2005: Report to CPF Thailand



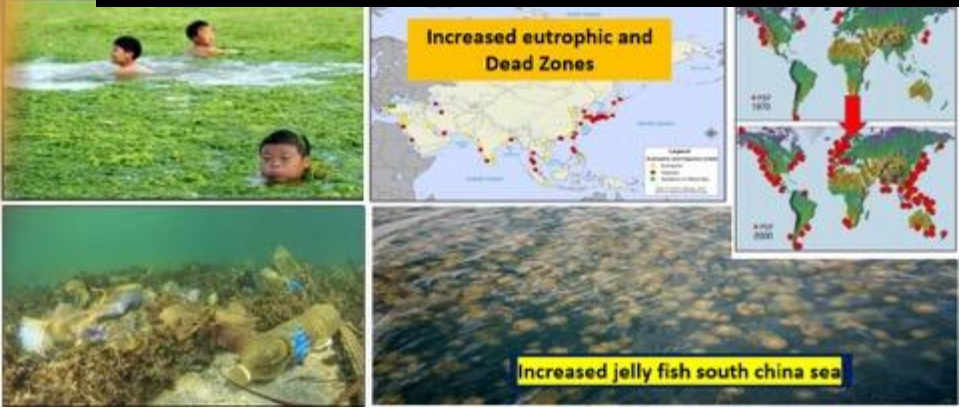
- **Competitive cost of production potential**
- **Available suitable resources for C.P. shrimp technology**
- **Competitive access to multiple world markets**
- **Complementation with Thailand shrimp production (large shrimp in Thai winter months)**

The World of Shrimp is always changing: Environment, Genetics, Health Challenges, Markets, Financial Challenge

Dense Monoculture Farms



Deteriorating Environments

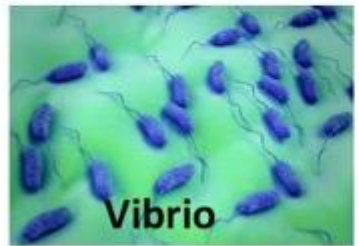


Increasing Vibrio Numbers

Another Report Links
Deadly Vibrio Infections To
Climate Change



Judy Stone Senior Contributor @healthcare
I am an infectious disease specialist and editor of *Business: the Family Store of Power and Wealth* over *Real and of Civilization Capital* *Research*, the essential guide to the world.



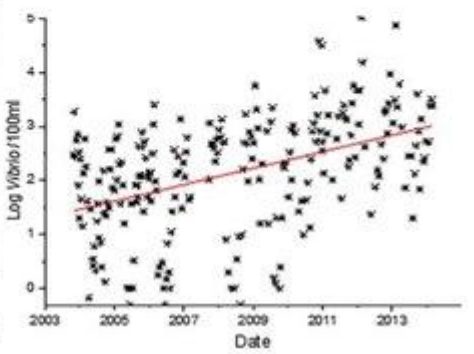
Vibrio

The New York Times
*The World's Oceans Are in Danger,
Major Climate Change Report Warns*



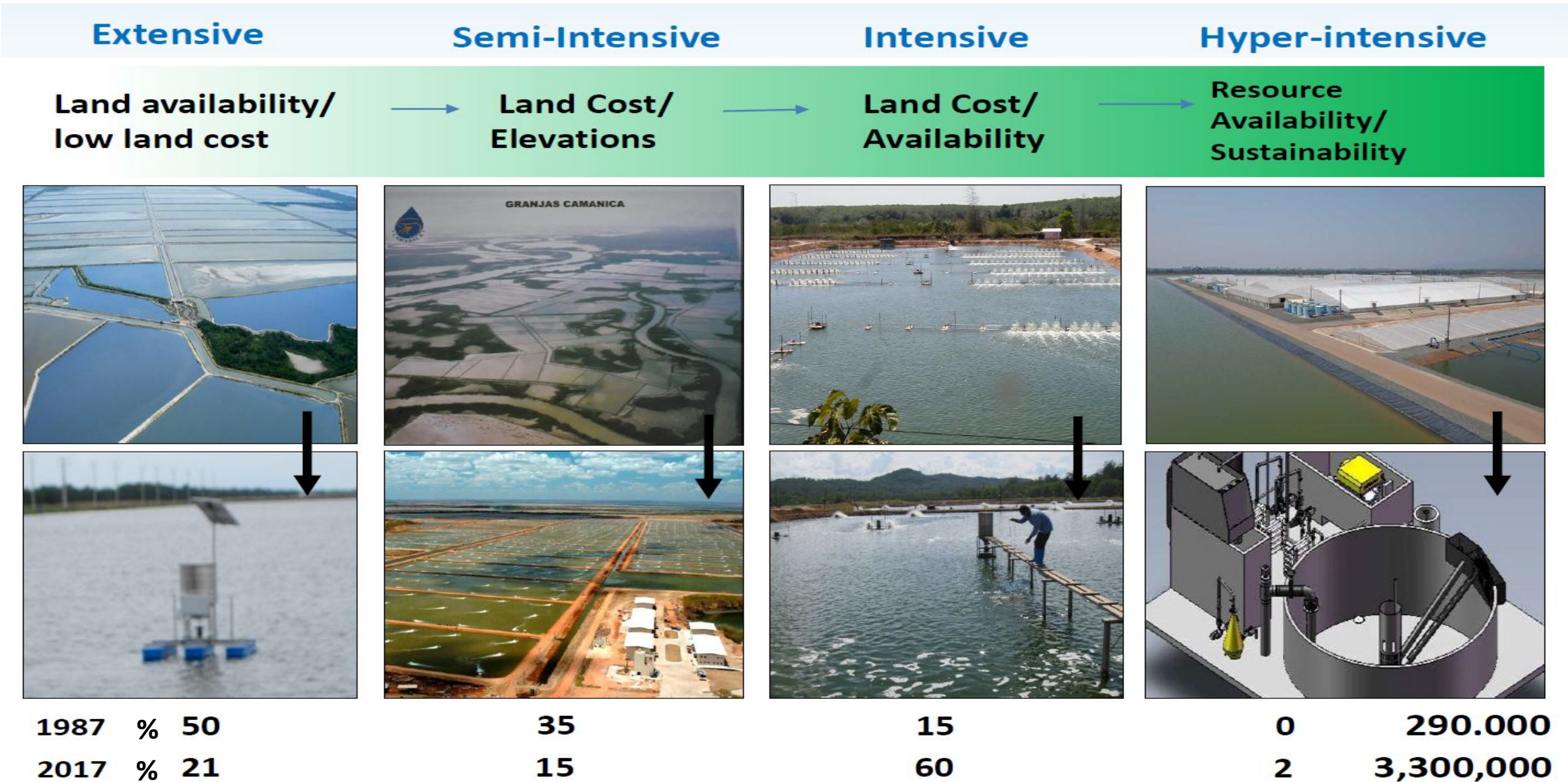
The New York Times

Vibrio Levels Neuse Estuary; NC USA



**EHP WSSV APHNS
RUNNING MORTALITY?
Decrease in World Transparency**

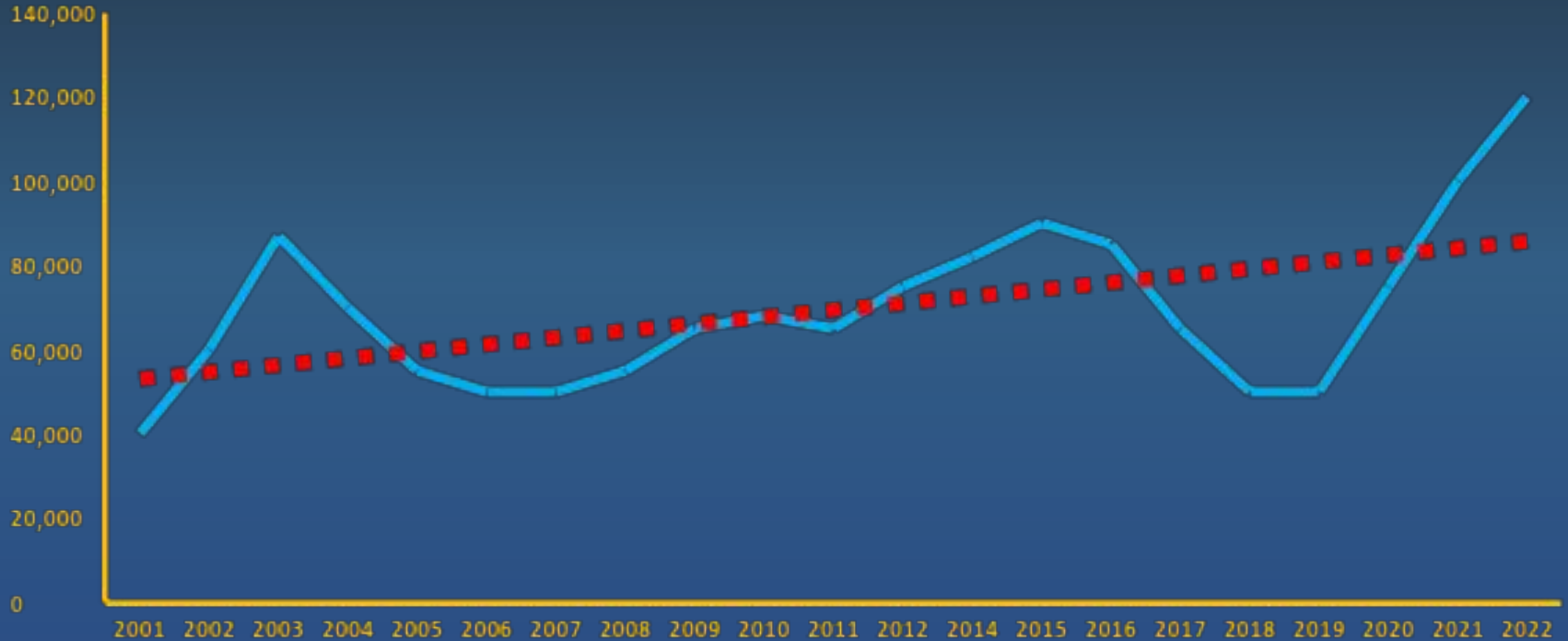
And we must continually Adapt to those Changes



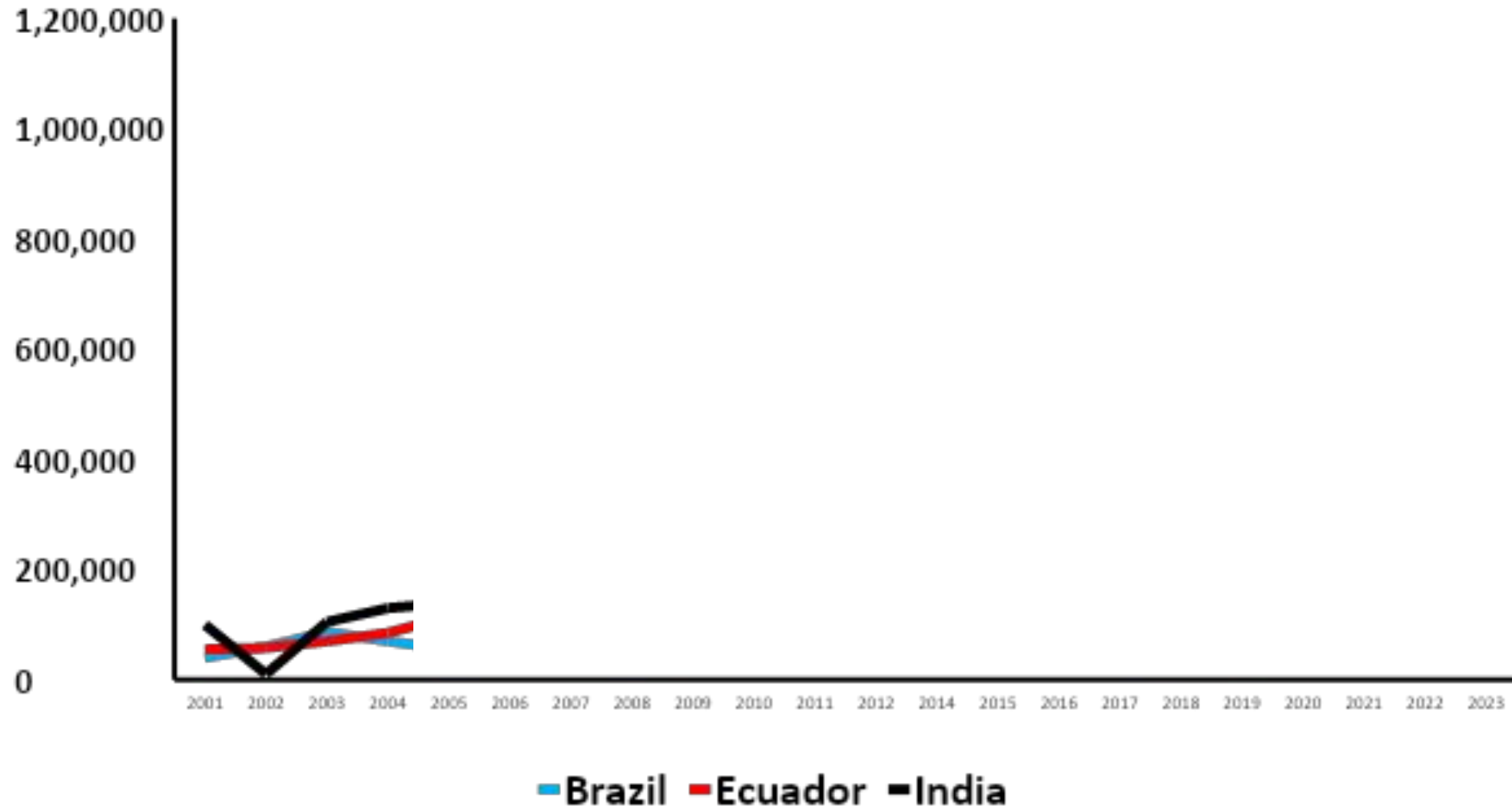


Brazil shrimp production 2001-2022

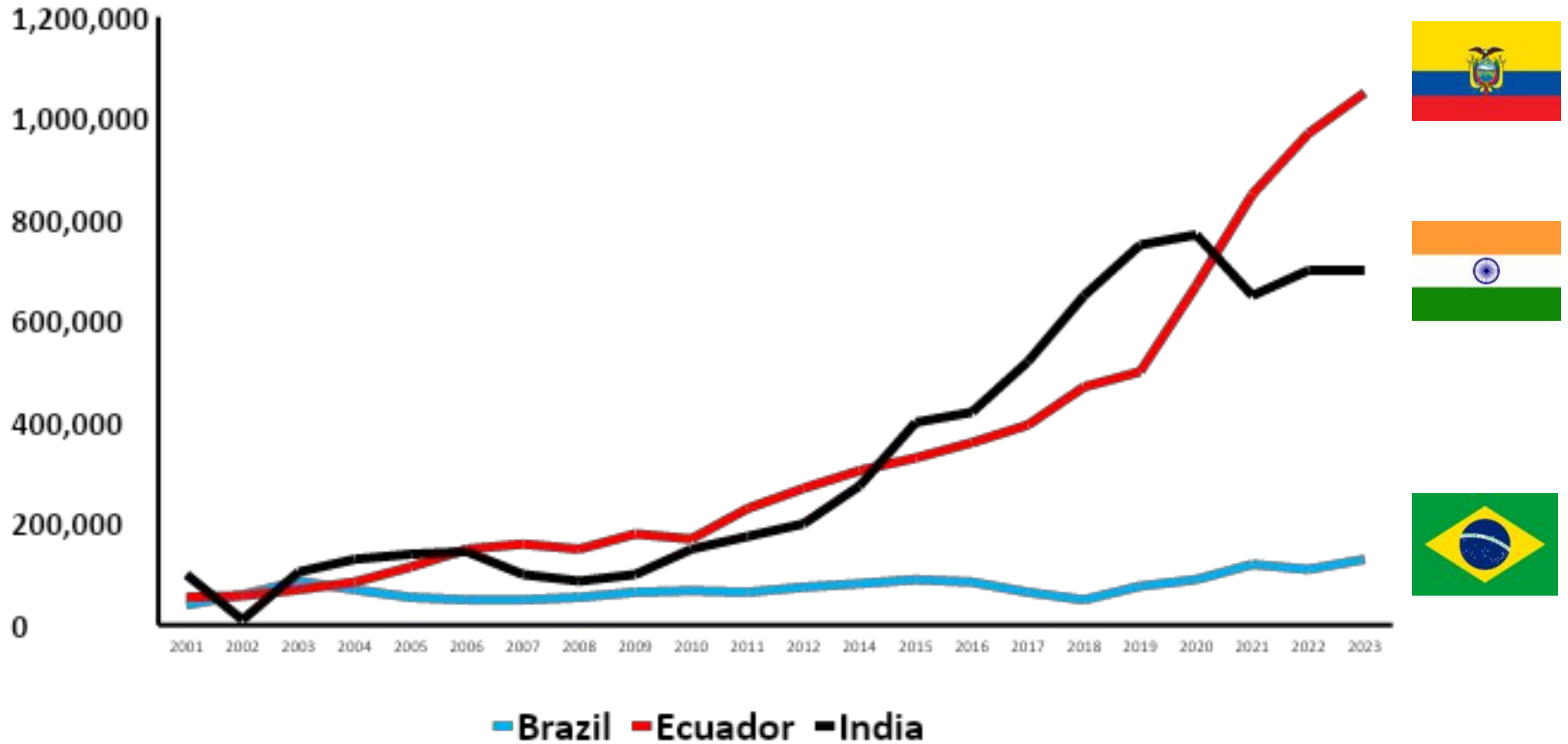
Growth; but with low predictability



Brazil has not maintained competitiveness



Brazil has not maintained competitiveness



Early Years Brazil was a leading innovator in South America



Advanced Hatcheries



Large 10 Ha ponds with Electrification



Electric Paddlewheels



Feeding Trays from Kayaks

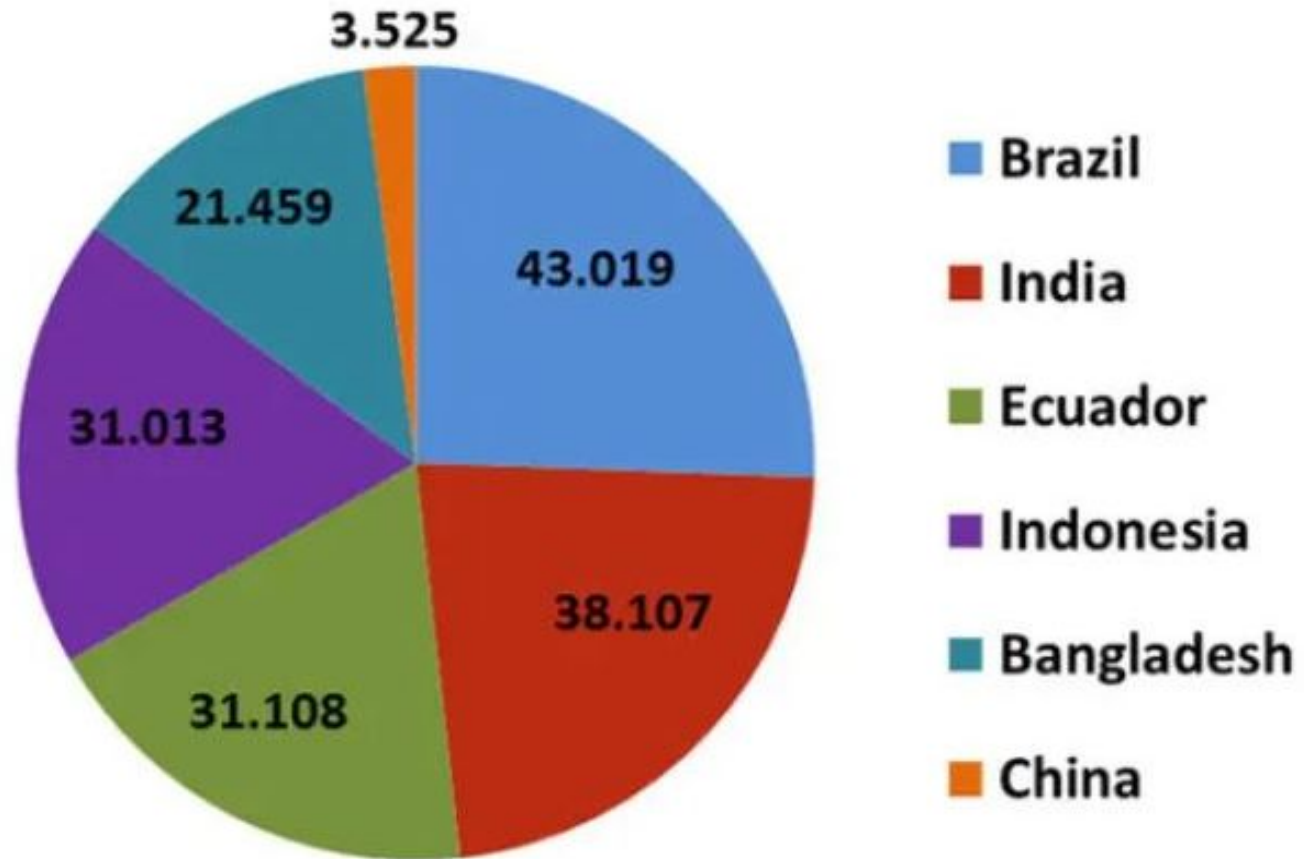
Early Adoptions and Innovations in Harvesting and Processing



BRAZIL: LEADER IN 2004 AND 62nd PLACE IN 2015



IN 2004, BRAZILIAN SHRIMP LOST GSP (GENERAL SYSTEM OF PREFERENCES) BENEFITS TO THE EU, PAYING IMPORT TARIFFS OF 12% (RAW FROZEN SHRIMP) AND 20% (PROCESSED PRODUCT), THUS LOSING MARKET COMPETITIVENESS.



Source: EUROSTAT, May 2013.

In 2014-2015 there was Reason to Believe:

MAPA 2014 An SPF future

Dealing with shrimp diseases – Private Sector

➤ Strategies:

- Replacement and maintenance of high health domesticated stocks of *L. vannamei* as broodstocks;
- Investments to develop genetically improved stocks;

2015: a fledgling but optimistic intensive culture sector developing

A tariff-free return to international markets means intensification and increased production

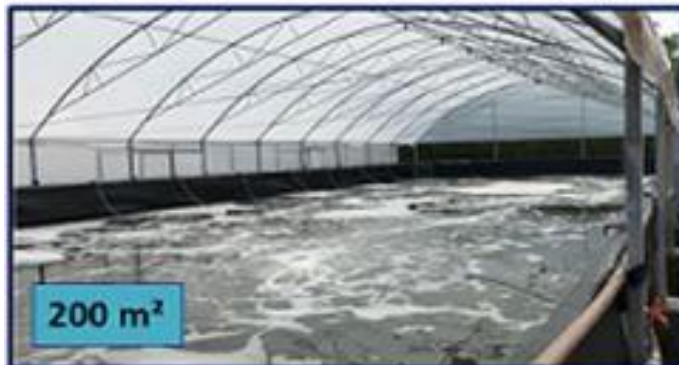
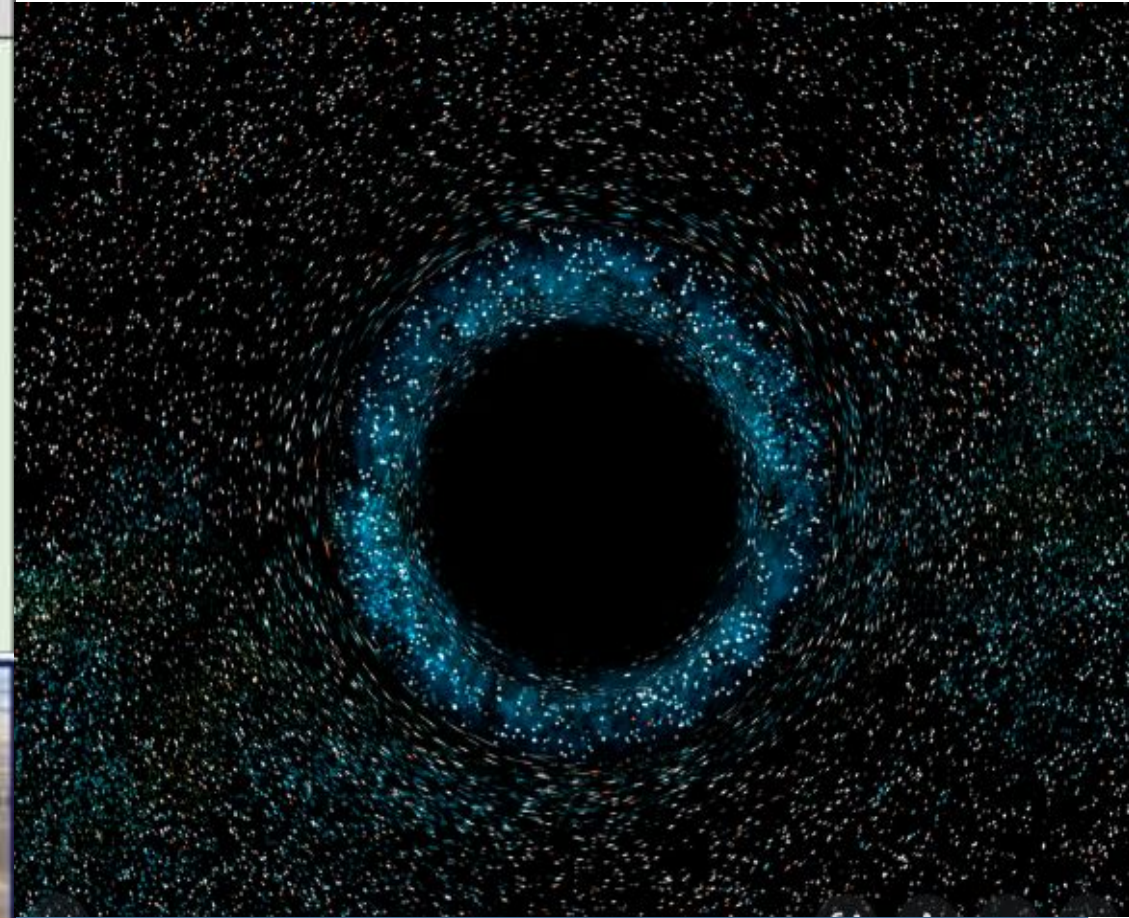


Categorias	N° Produtores	N° Respostas (98%)	Densidade de Estocagem por Categoria de Produtores em 2011							
			< 10 cam/m ²		Entre 10 e 30 cam/m ²		30-50 cam/m ²		> 50 cam/m ²	
				%		%		%		%
Micro	717	702	342	48,6%	315	44,9%	35	5,0%	11	1,6%
Pequeno	184	184	78	42,4%	72	39,1%	29	15,8%	5	2,7%
Médio	245	241	80	33,2%	130	53,9%	28	11,6%	3	1,2%
Grande	76	75	14	18,7%	47	62,7%	12	16,0%	2	2,7%
TOTAL	1.222	1.202	513	42,7%	564	46,9%	104	10	21	1,7%

2018: The Plan

2022: The Reality

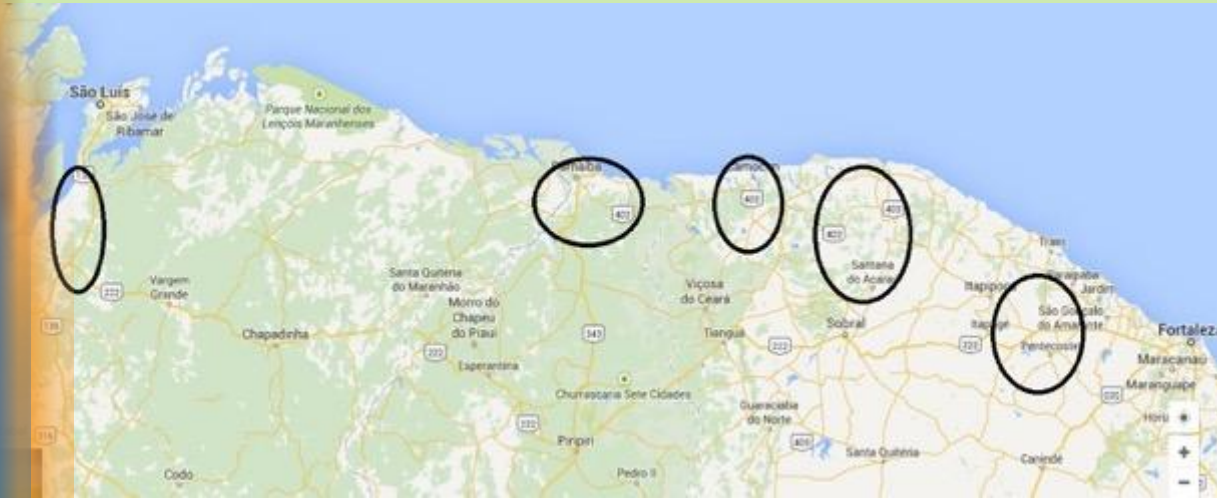
Parameter	Intensive	Super-Intensive
Area	200 m ²	4000 m ²
Density	750 PL/m ²	200 juveniles/m ²
Days of culture	60	90
Average weight (g)	10	20
Survival (percent)	75	90
Production (kg)	1,125	14,400
FCR	1:01	1.5:1
Productivity/ha/cycle (kg)	56,250	36,000
Productivity/ha/year (kg)	281,250	108,000
No. cycles per year	5	3



Most if not all intensive farms have failed

Abundant Untapped Resources

Identified areas for future development

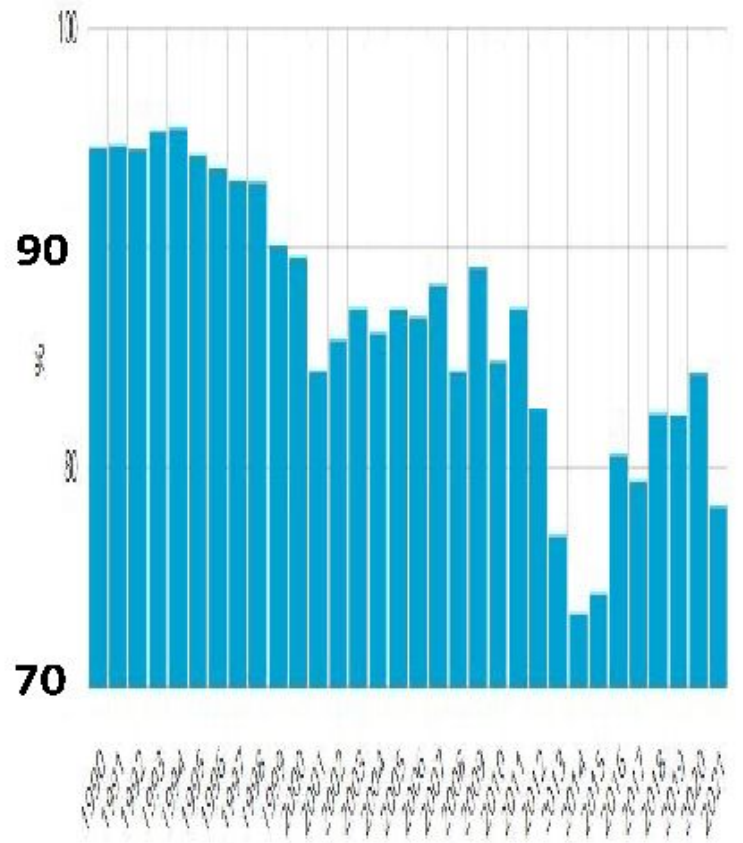


Ecuador much less undeveloped resources



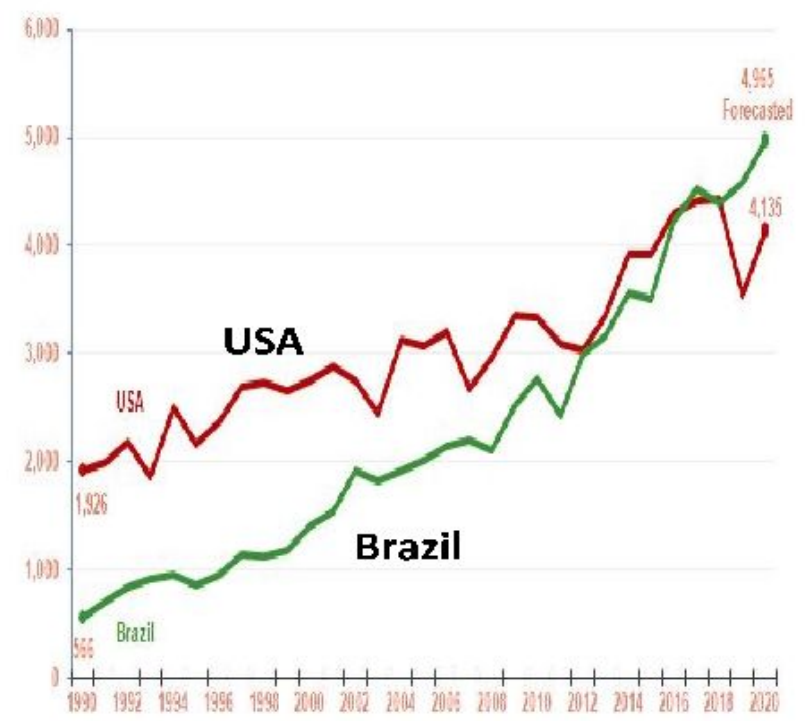
Essential Inputs : World Class

Brazil Renewable Energy

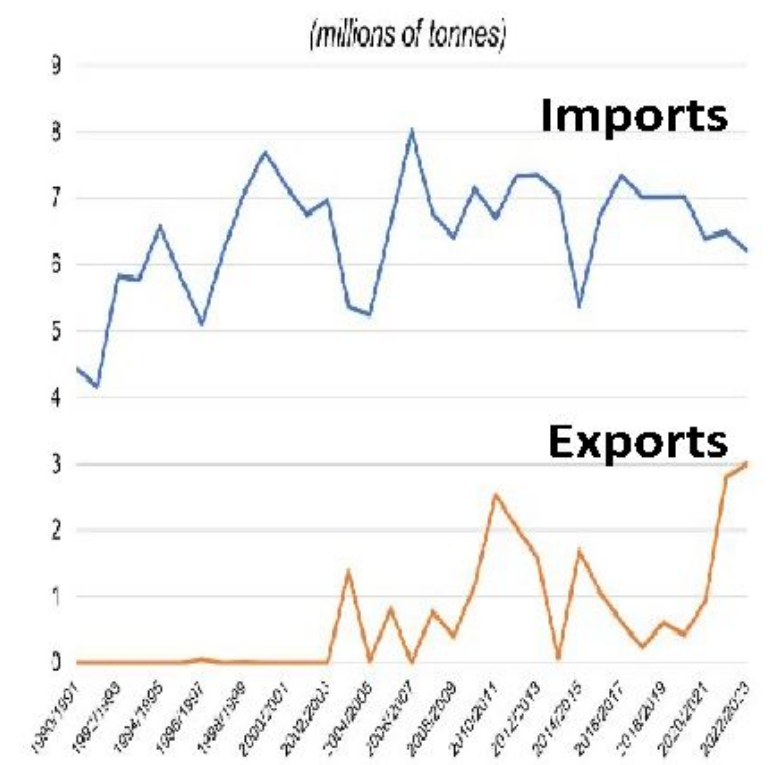


% of Electricity from Renewables

Brazil Soybean Production



Brazil Wheat Export & Import



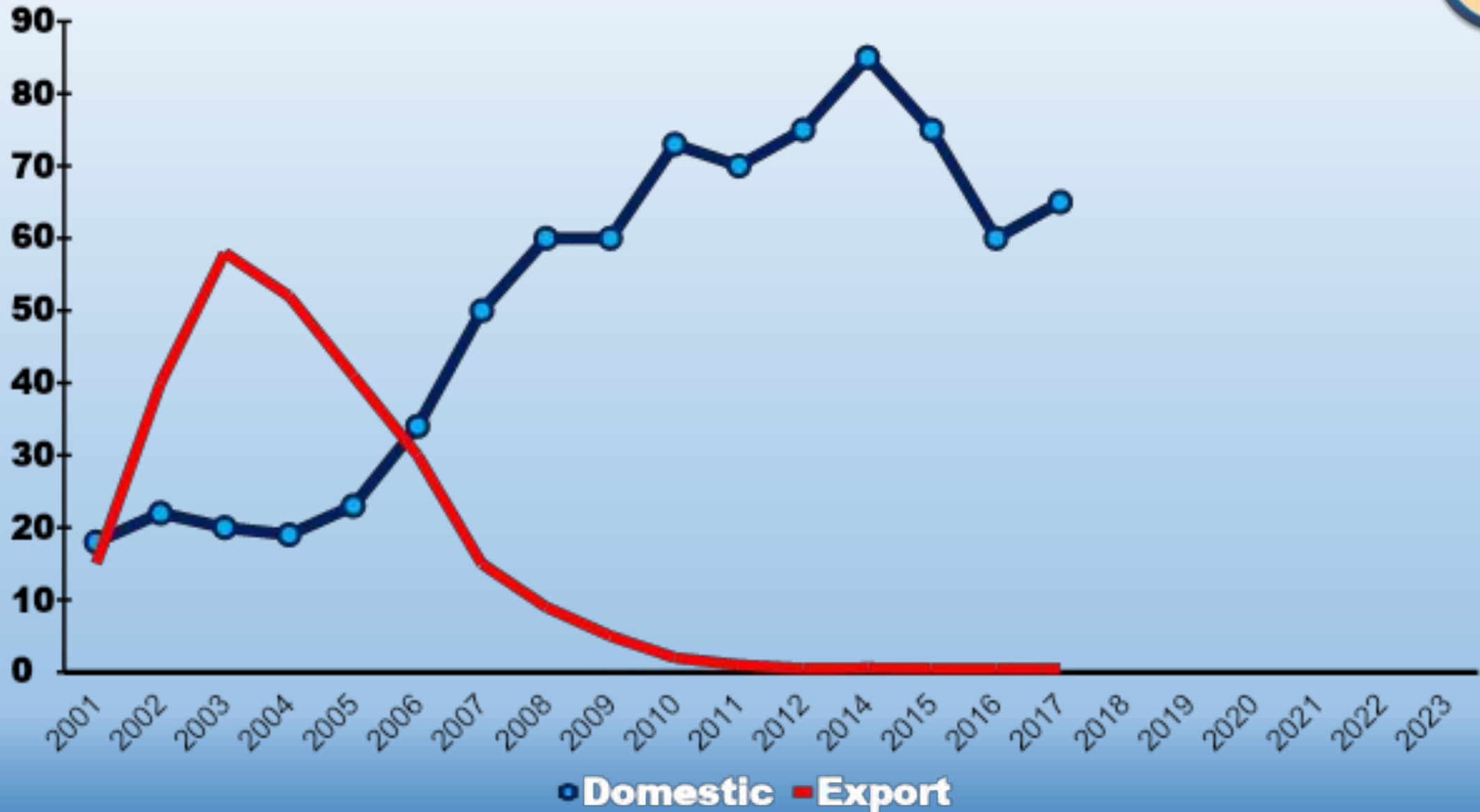
What Happened to the “Brazil Story”

Brazil Real strengthened; Exports not competitive









Brazilian Domestic Trade replaces Exports





Brazil Meat and Seafood Consumption (Per capita kg)

	2005	2014	Growth(%)
 Chicken	36	56	55
 Beef	38	50	31
 Fish	5.5	13.5	145
 Shrimp	0.2	0.8	300

Domestic Market Created for Brazilian Shrimp to replace the Export Market



Selling shrimp for domestic consumption always higher prices than selling to export markets

	2020	2021	2022
 Brazil	6.80	-	5.00
 China	7.80	7.70	8.50
 Ecuador	3.20	4.50	3.80

60 count HOSO in USD

Results in lower incentive to improve culture efficiencies

Comparison of Cost Inputs and Culture Performance

Brazil is competitive inputs; Lags in Performance efficiency, Technology

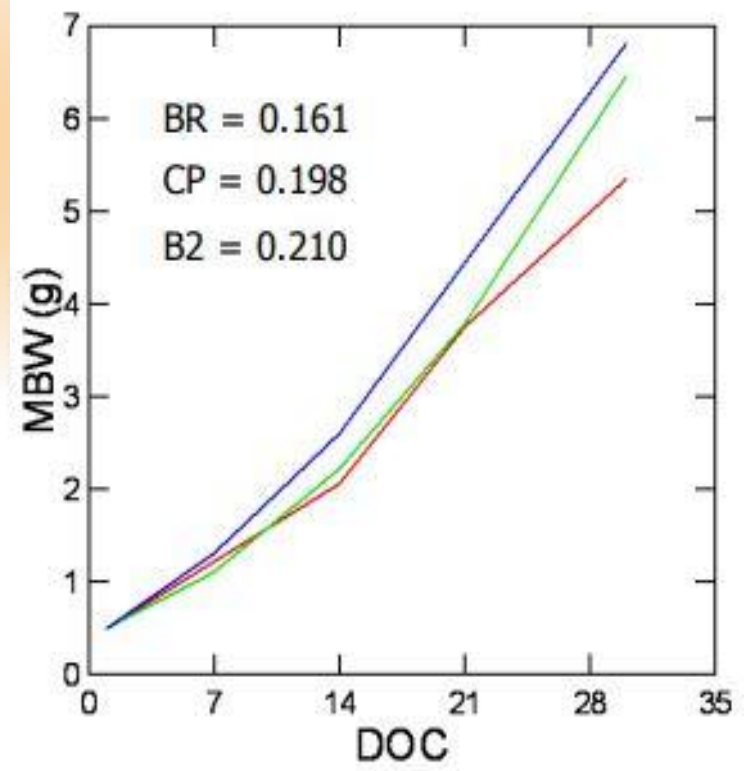


	 Brazil	 Ecuador	 India		 Brazil	 Ecuador	 India
Feed Cost (USD / kg)	0.75-1.40	1.40	1.35	Yield	1,500	2,000-6,000	10,000
Seed Cost (1,000 PLs)	2.20	2.00	4.00	Stocking (pcs/m²)	15	12-35	60-120
Energy (USD / kwh)	0.08	0.065-.07	0.05	Survival (%)	70	70	70-non failed
Failure Rate	moderate	Low?	moderate	ADG (g/day)	0.12	0.26	0.28
				FCR	1.3	1.5	1.3-1.5
				Harvest Size (gram)	12-18	18-40	18-25

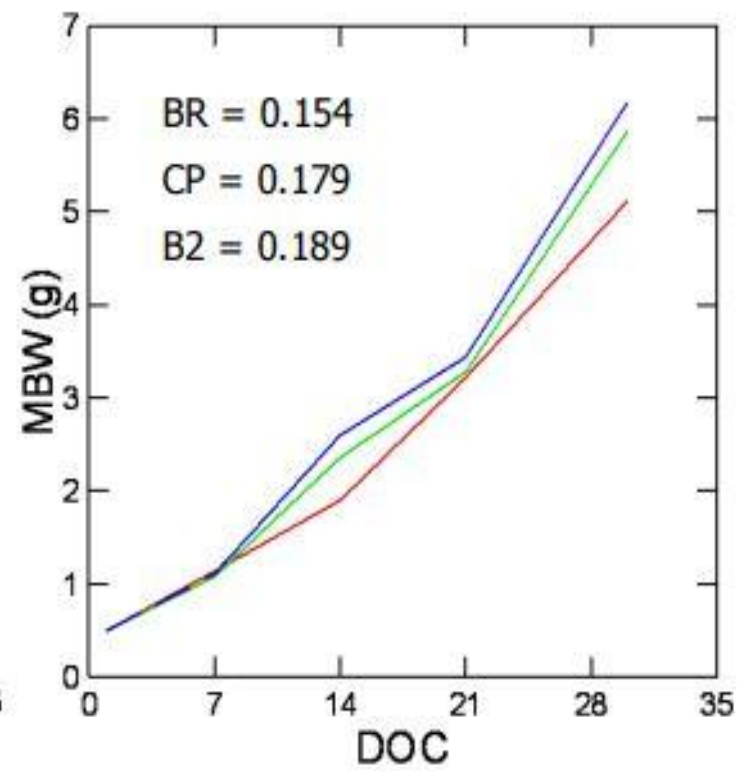
Feeds are Important:

2018 feed performance: Brazilian vs Asian

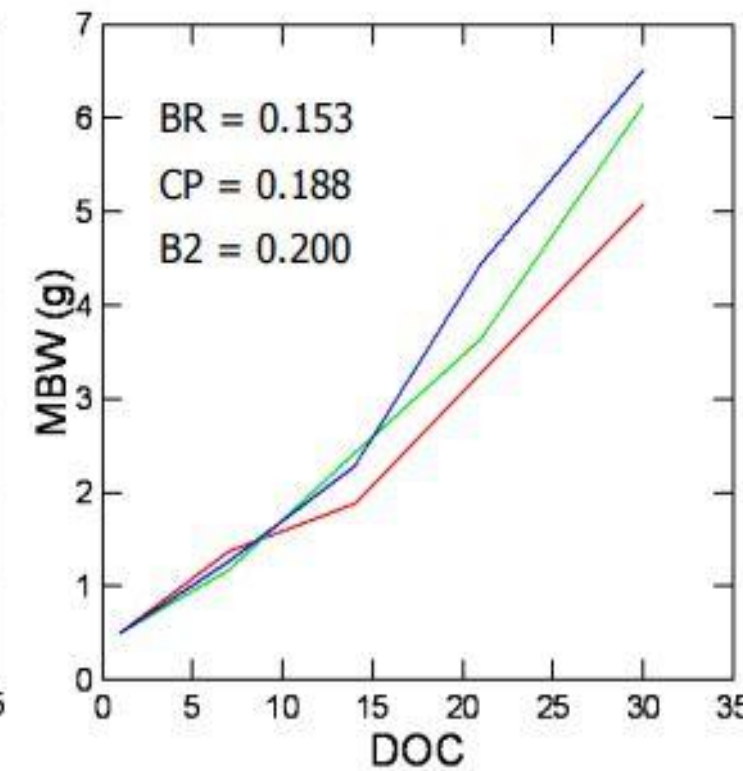
Den 30 pcs./m³



Den 60 pcs./m³

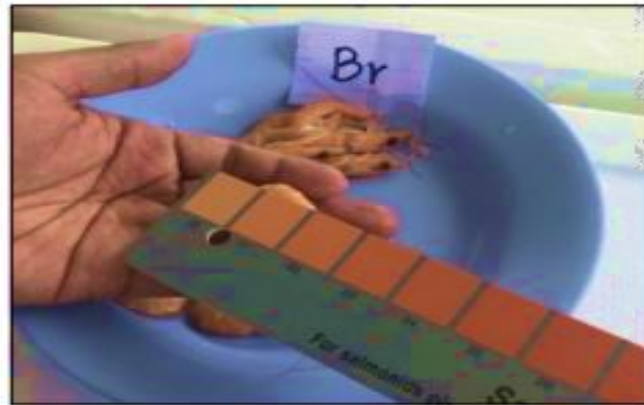


Den 90 pcs./m³



BR
CP
B2

Shrimp Diet effect on Cooked Color Presentation



Color No	%		B2
	Br	CP	
20	16.7		
21	20.0		
22	40.0	13.3	
23	23.3	23.3	
24		16.7	13.3
25		26.7	50.0
26		13.3	20.0
27		6.7	13.3
28			3.3

The Industry will evolve towards “Sustainable Intensification”



“...Producing more from Less...”

- Less Land, more shrimp;
- Less Water, more shrimp
- Less Feed, more shrimp
- Less Energy, more shrimp



CAMANOR

55 tons/hectare crop/ 165 tons/hectare year

Ecuador has Evolved

Intensification Ecuadorean Style- Using Asian Technologies

Closed Systems

Autofeed; 1 unit/ha

Aerators: 6-10 HP/Ha

Improved Feeds



Genetics of fast growth, large size
in Robust bodies

América
economía

Edición Ecuador www.americaeconomia.com

NEGOCIOS
PayPhone, el aliado clave de los usuarios, emprendedores y de la banca.

ESPECIAL UNIVERSIDADES

POR SU GENÉTICA LOS CONOCEREIS

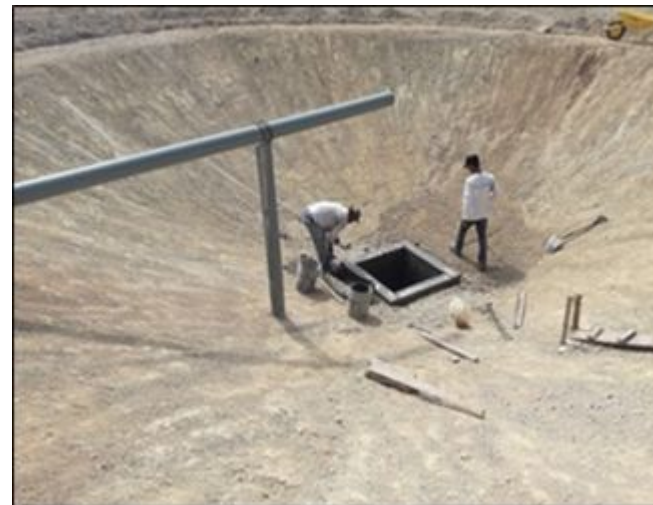
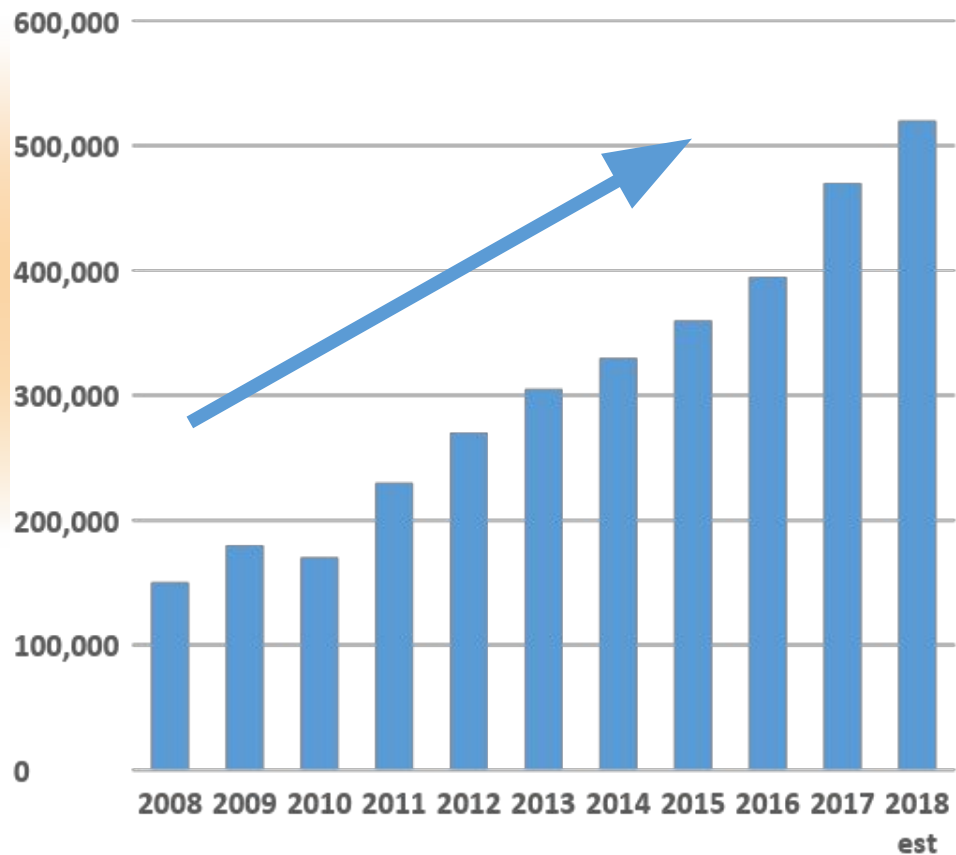
Rafael Verduga, gerente general de Texcumar.

Texcumar ha invertido más de US\$ 7 millones en un programa genético para convertirse en uno de los responsables de que Ecuador sea el mayor productor de camarón del mundo.

VISTAJO

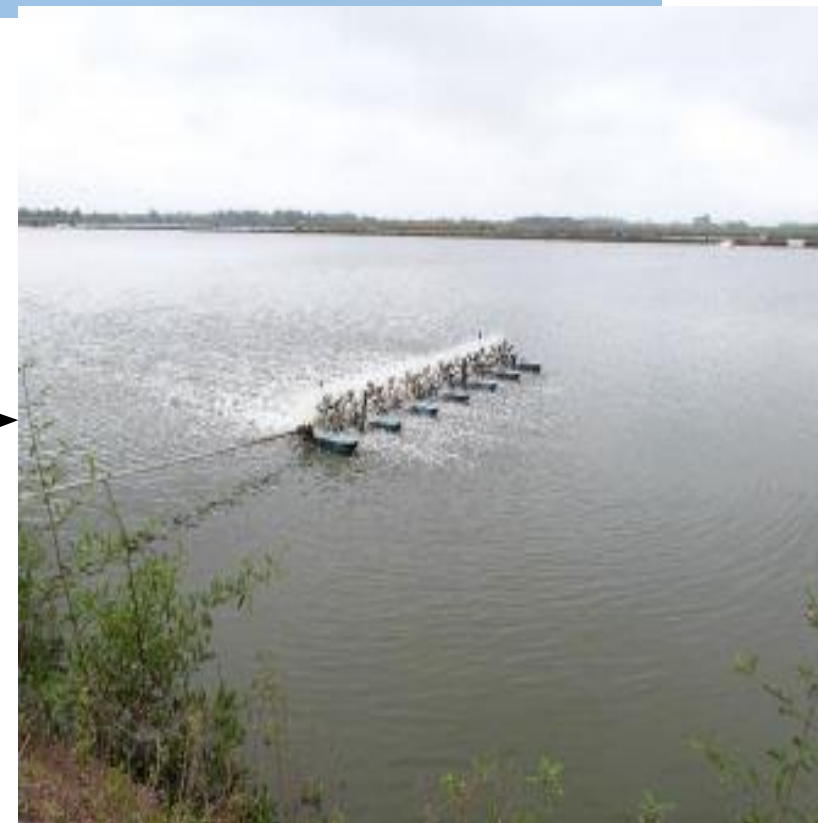
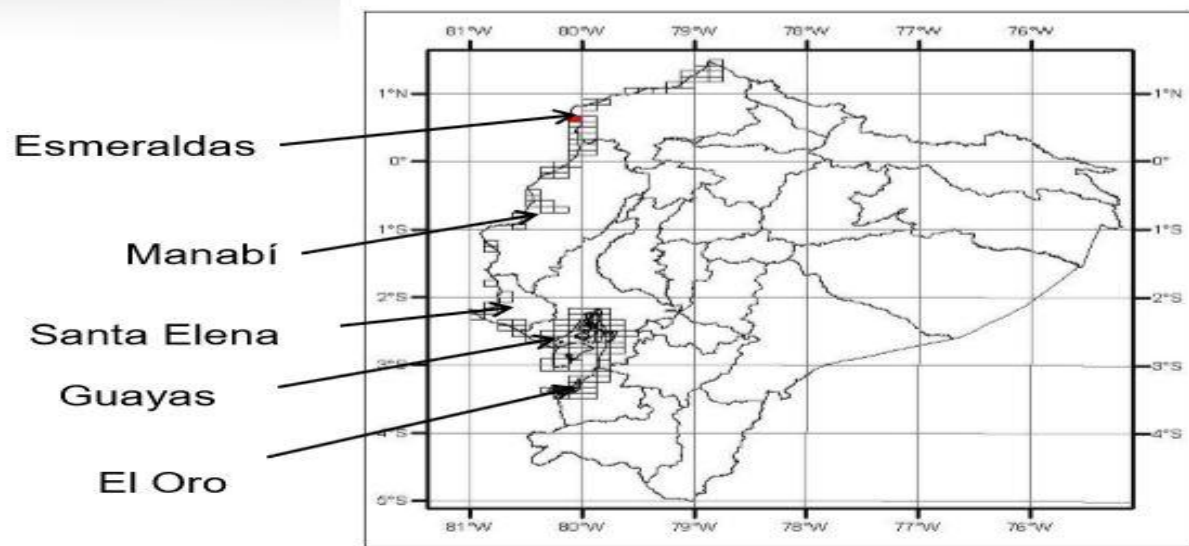
Ecuador:

Production Increasing through technical/efficiency Gains



**Higher Pond
Survivals
Lower FCR
Higher Pond Yields
Shorter Cycles**

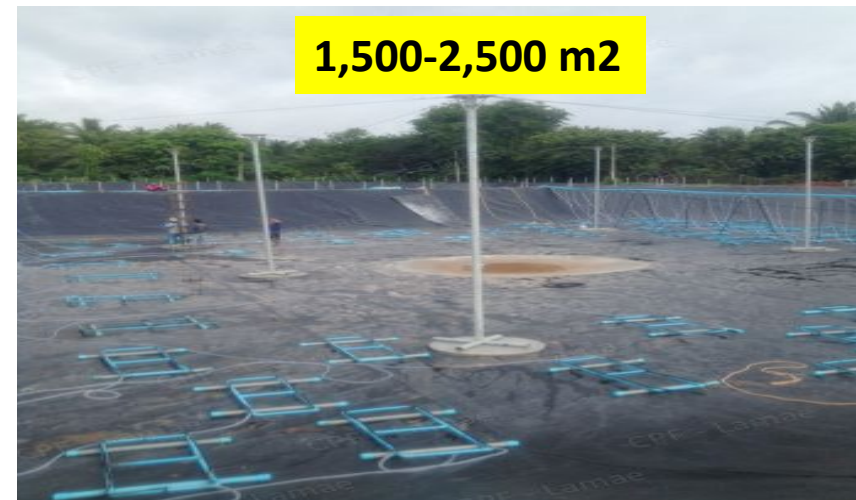
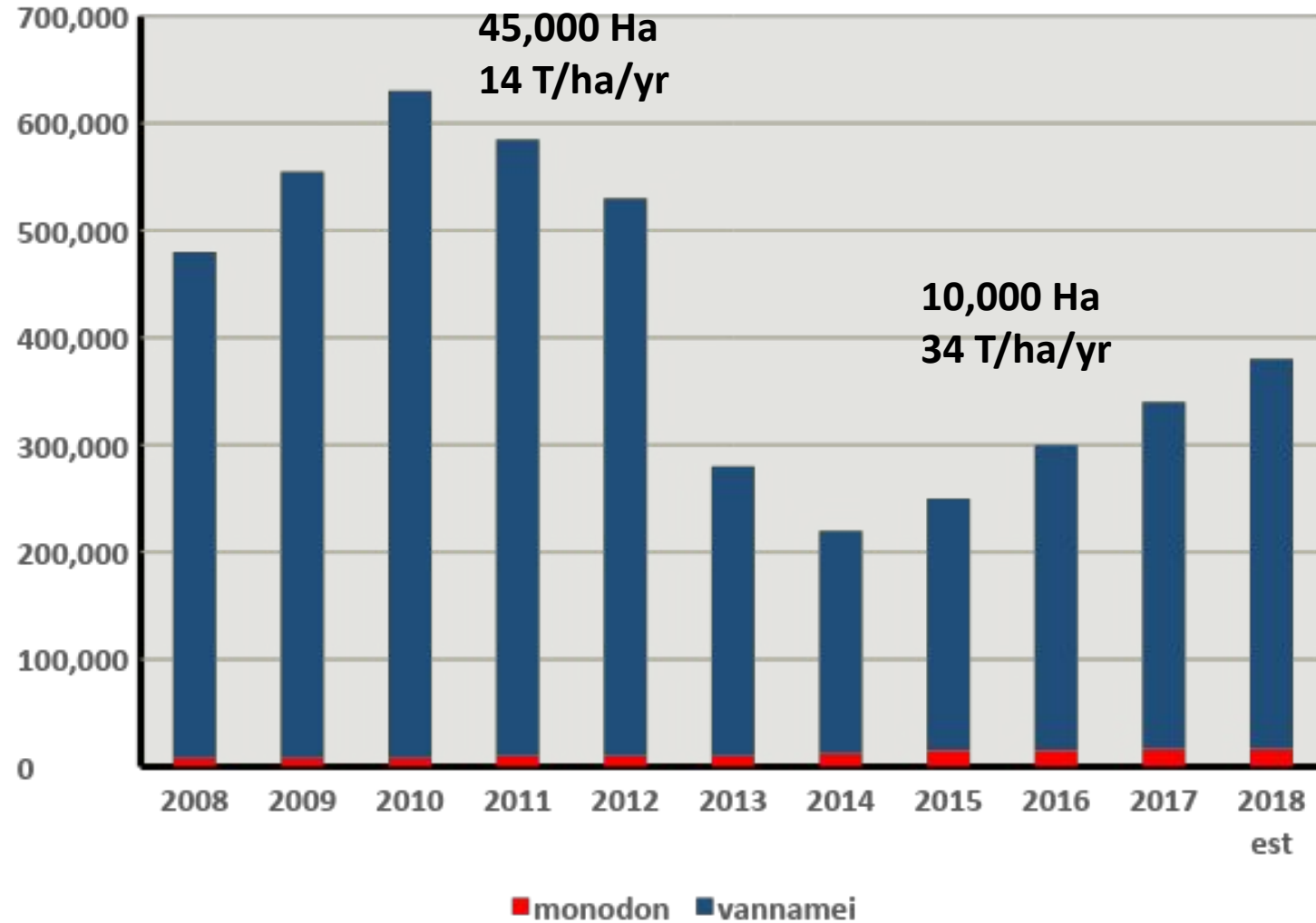
Ecuador expands production through “horizontal greed” 220,000 Ha of Ponds being operating which can be "intensified”



<2019: 10-15 pcs/m²

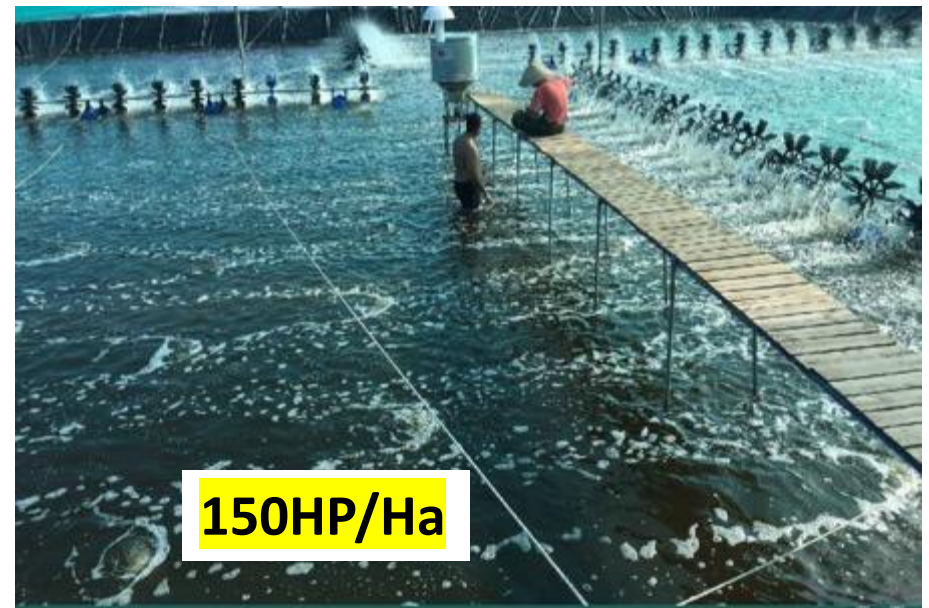
2021: 30-40 pcs/m²
Partial <3.5 tons/ha biomass
Total harvest: 6 tons/ha

Thailand (Asian) production: Production Increase through “Vertical “ greed intensification



As culture densities are increased, must change culture systems to manage and maintain health

- Smaller ponds,
- more efficient water exchange
- Shading
- Auto feeding with efficient toilets
- Higher aeration



150HP/Ha

Why has Asian Intensive Culture had more Issues than “more extensive” culture



	2010	2021		2010	2021
Stocking per m ²	75-100	350-450	Carrier control	Dipterex	Chlorine
Yield (kg/rai)	2,200	5,000-6,500	Probiotics	minimum	more
Survival (%)	85	65	HP / ha	35	85
ADG (g/day)	0.19	0.29	Max feed rate (kg)	250	800
MBW (gms)	14-18	24	Aeration/Feed (kg/HP)	7	9.5
FCR	1.5	1.7			
Failure Rate (%)	<5	>25			

Have Farmers exceeded Carrying Capacity in 2021

How Should Brazilian Shrimp Culture Evolve?



Brazil is not Ecuador

Brazil is not Asia

Brazil is Unique

**Feed
Commodities**

**Renewable
Energy**

**Undeveloped
Lands**



**Brazil is missing Healthy , Fast growing, Shrimp Stocks
Not lethal diseases; but slow uneven Growth to small
size**



How can an industry be Sustainable and Profitable

if the Livestock are not Healthy?



Non SPF

Not healthy



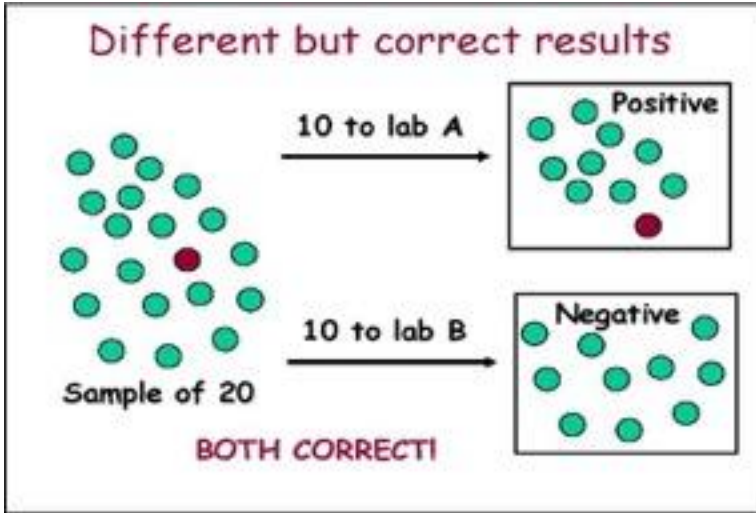
SPF

Healthy



SPF is a process and not a PCR test result

PCR only + short term quarantine does not replace SPF shrimp

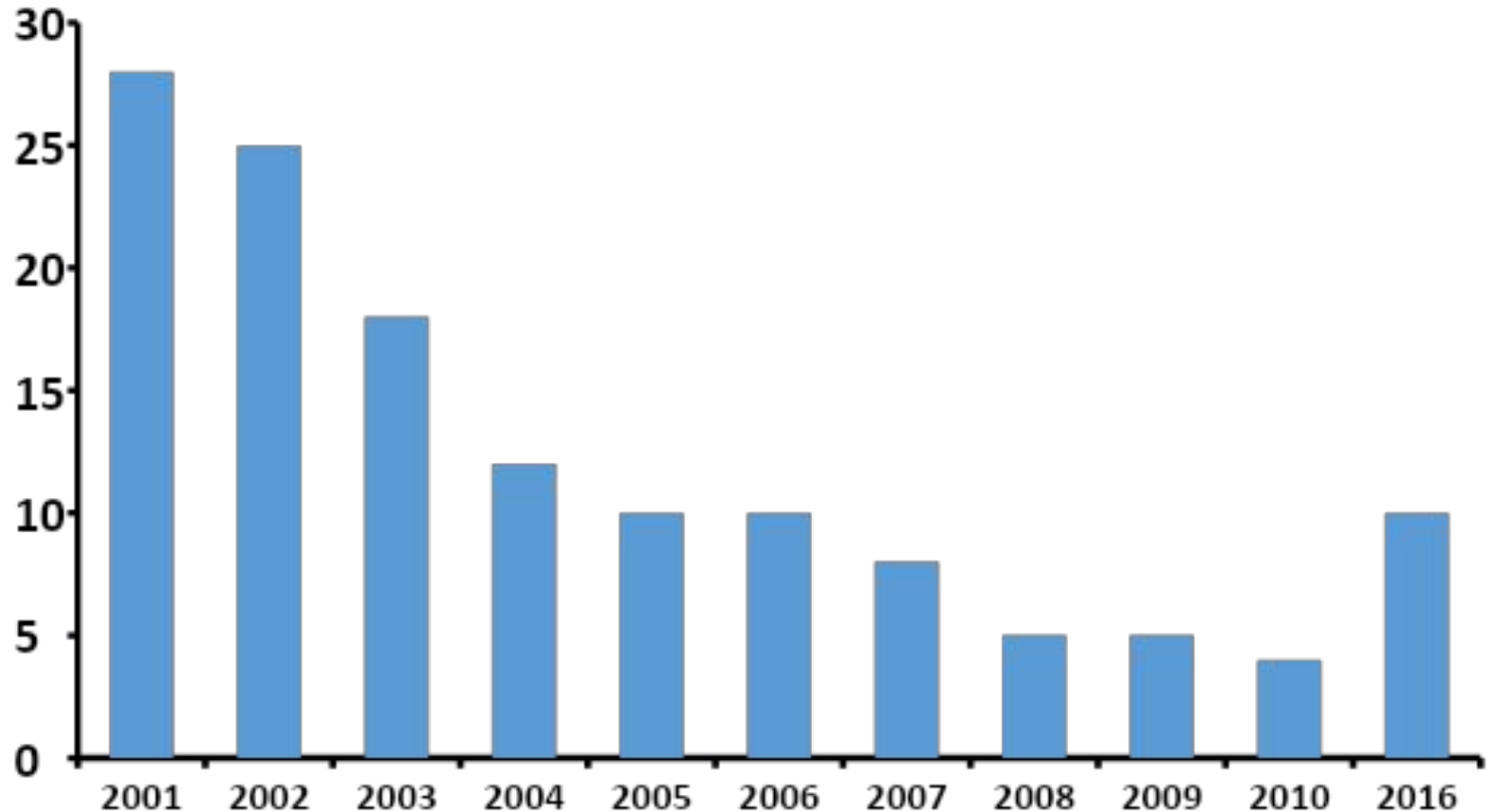


Monodon (2004)

result of PCR testing

(8 known pathogens)

Clean SPF shrimp reduced WSSV failure rate in Thailand



Before PCR tested wild broodstock and post larvae



A TALK I GAVE IN INDIA 2019;
Farmers explained failures and poor pond performance to GENETICS ONLY

Shrimp Genetics are Not Everything

(A Holistic Approach to Success)

Robins McIntosh
Charoen Pokphand Foods
Bangkok Thailand



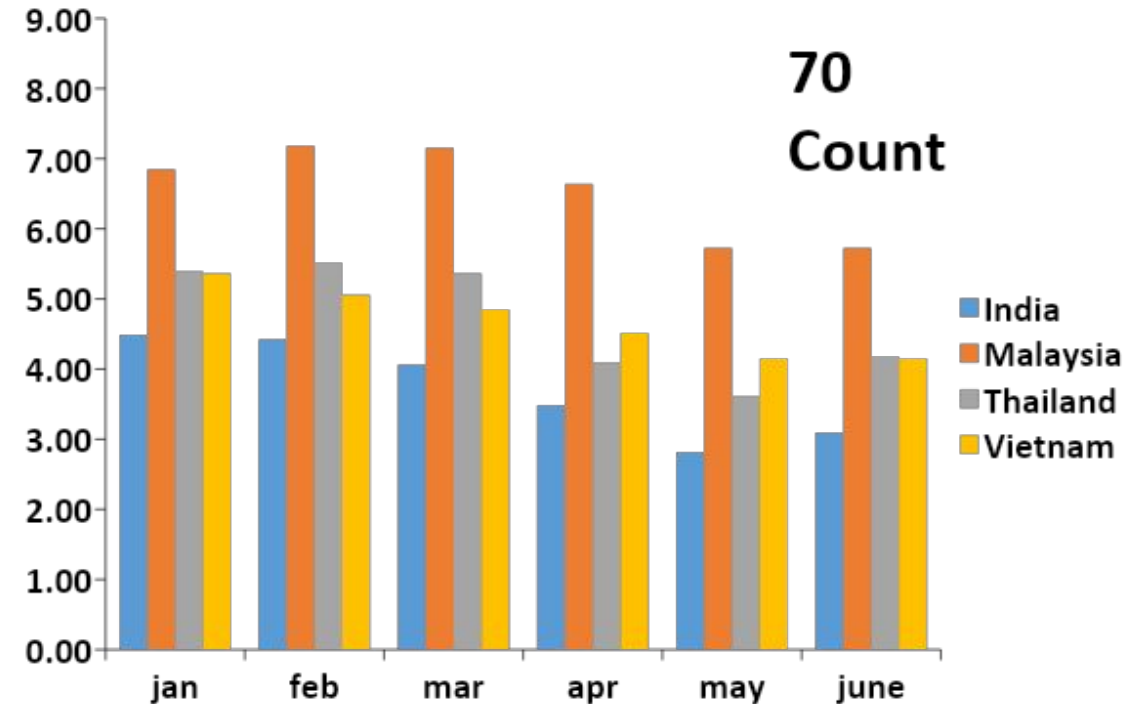
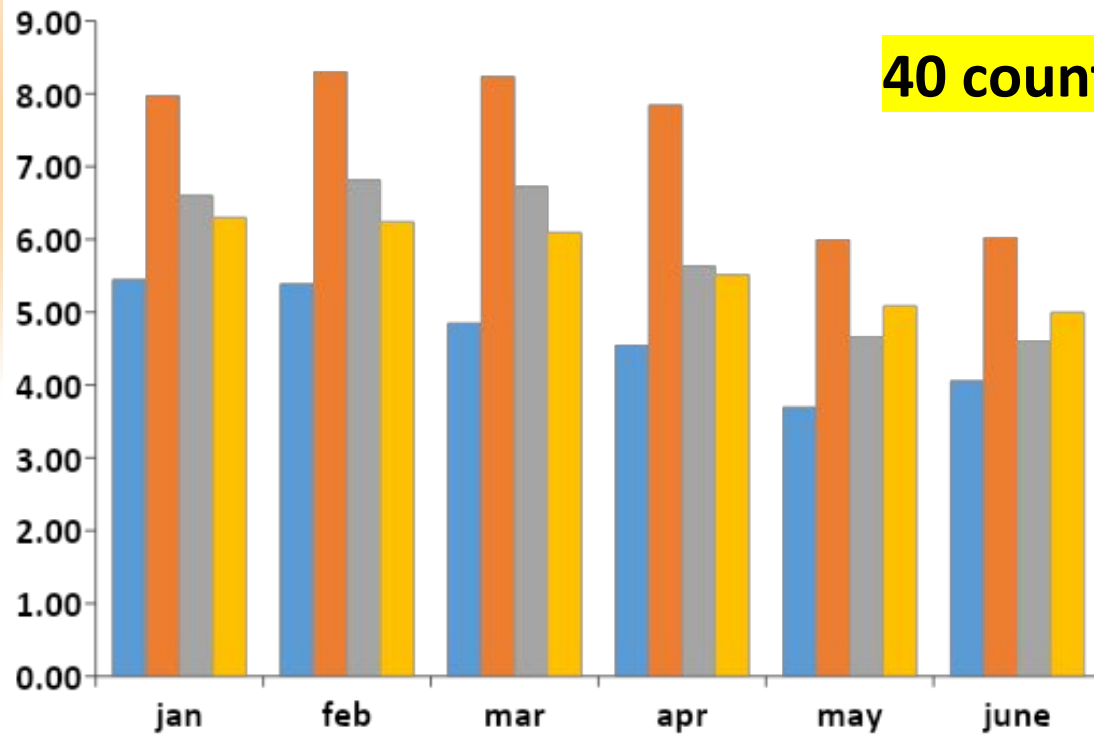
Efficient farming requires understanding of the Economics of Farming



$$\text{Profit} = \text{sales price} - (\text{direct costs} + \text{indirect costs})$$

Costs: Producers can (or should) be able to exercise control

Sales price: Is outside of Producers control



Farm gate price: 2018, size 70 and 40 count

“ Efficient Vannamei farming ” favors “large” sizes



Ecuador has moved from 20 gram to > 30 gram harvest

	70 count	40 count	25 count
Survival Rate (%)	80	70	65
Growth (ADG)	0.22	0.29	0.33
FCR	1.40	1.55	1.65
DOC (Days)	68	86	115
Cost per kg (Depreciation, Interest, corporate)	3.50	3.85	4.15
Cost/kg/day	0.0514	0.0447	0.0360
Value/kg/day	0.05294	0.0767	0.0725
Profit/day/kg	0.001	0.009	0.036

Economic Sensitivities: Growth, Survival, FCR

(based on 60 count, 15 Tons/hectare)



SURVIVAL %	FCR	GROWTH (g/day)	CHEMICALS (USD/Ha)	DIRECT COST (USD /KG)
80	1.3	0.3	1,500	3.10
80	1.3	0.3	5,000	3.30
80	1.6	0.3	1,500	3.50
60	1.6	0.3	1,500	3.80
80	1.6	0.2	1,500	4.00
60	1.6	0.3	5,000	4.10
60	1.8	0.3	1,500	4.20
60	1.8	0.2	5,000	5.20

Selective Genetics has Completely changed what is possible



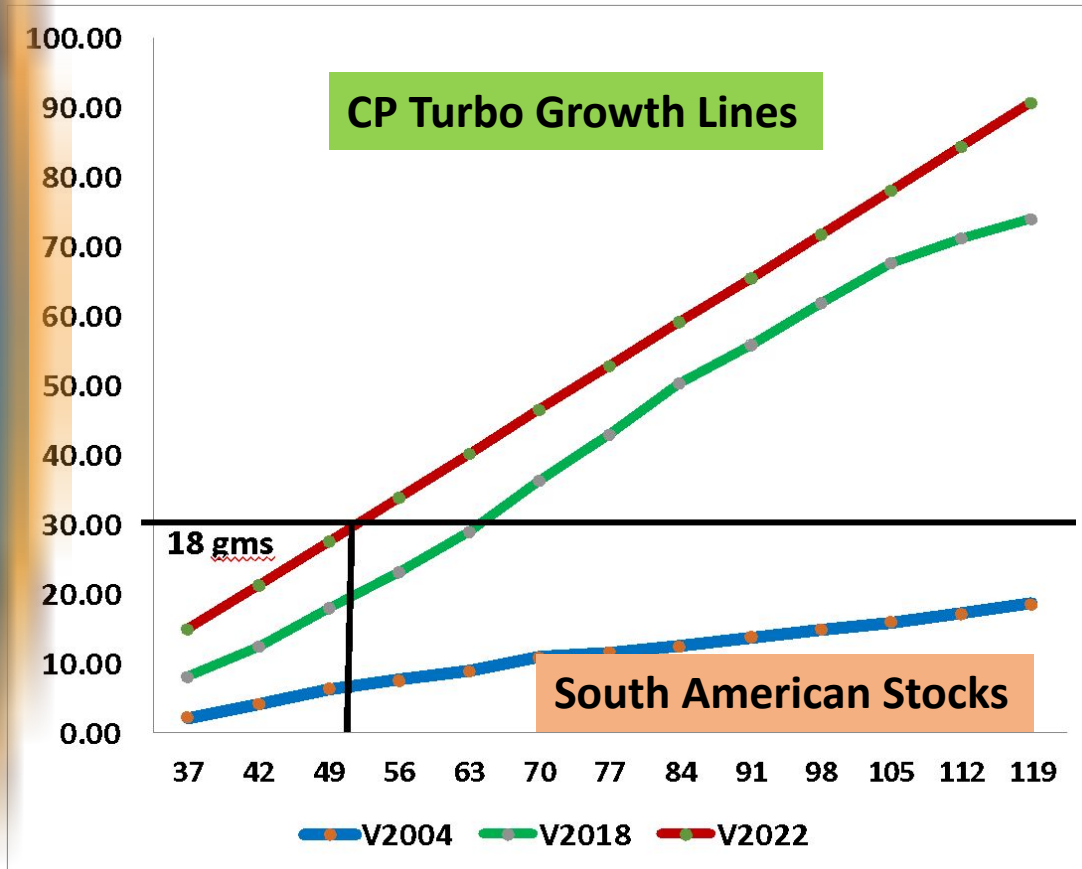
**160 grams Female in 180 days Culture
5 Tons/Ha**



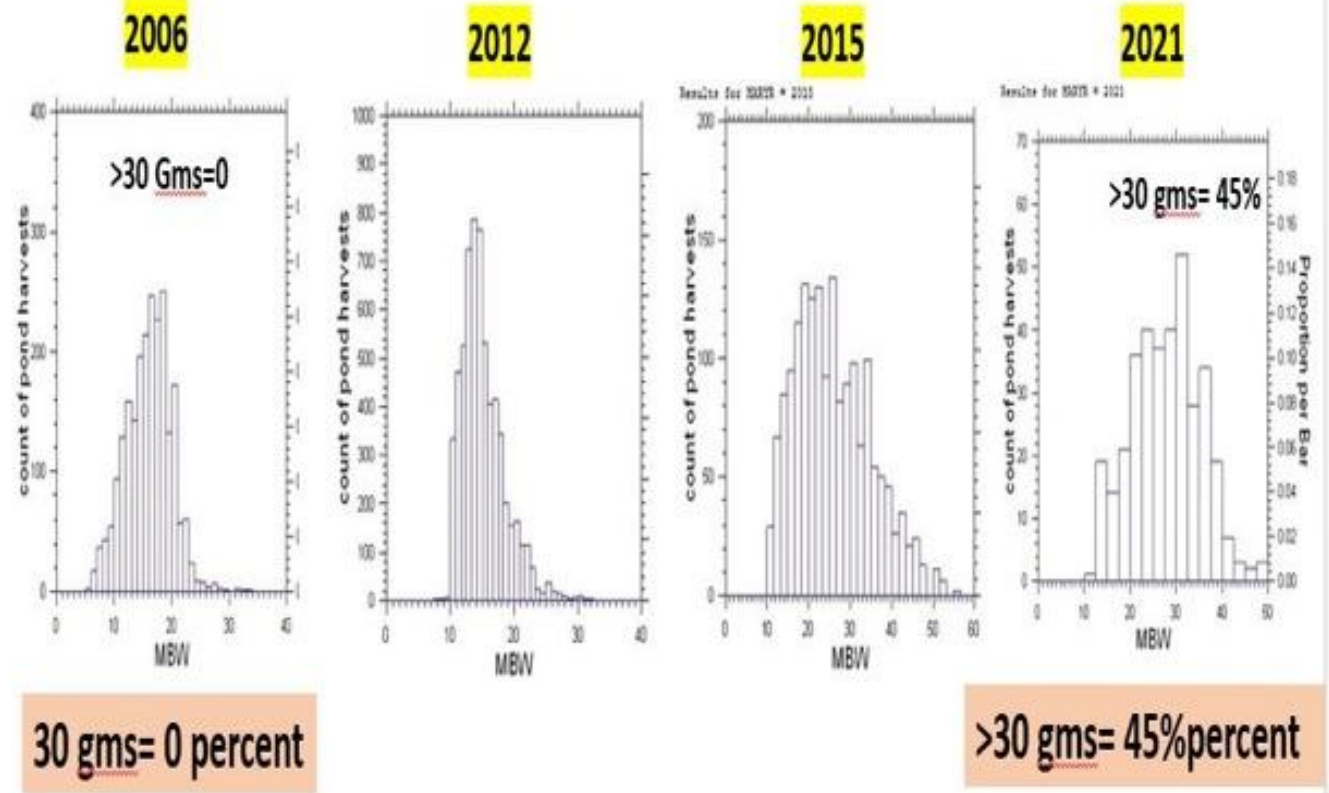


Genetics are not Everything; BUT Genetics are Important

Growth Rate potential, Shrimp Harvest Size, Disease Tolerance, Robustness



Constant Improvement in Harvest Size

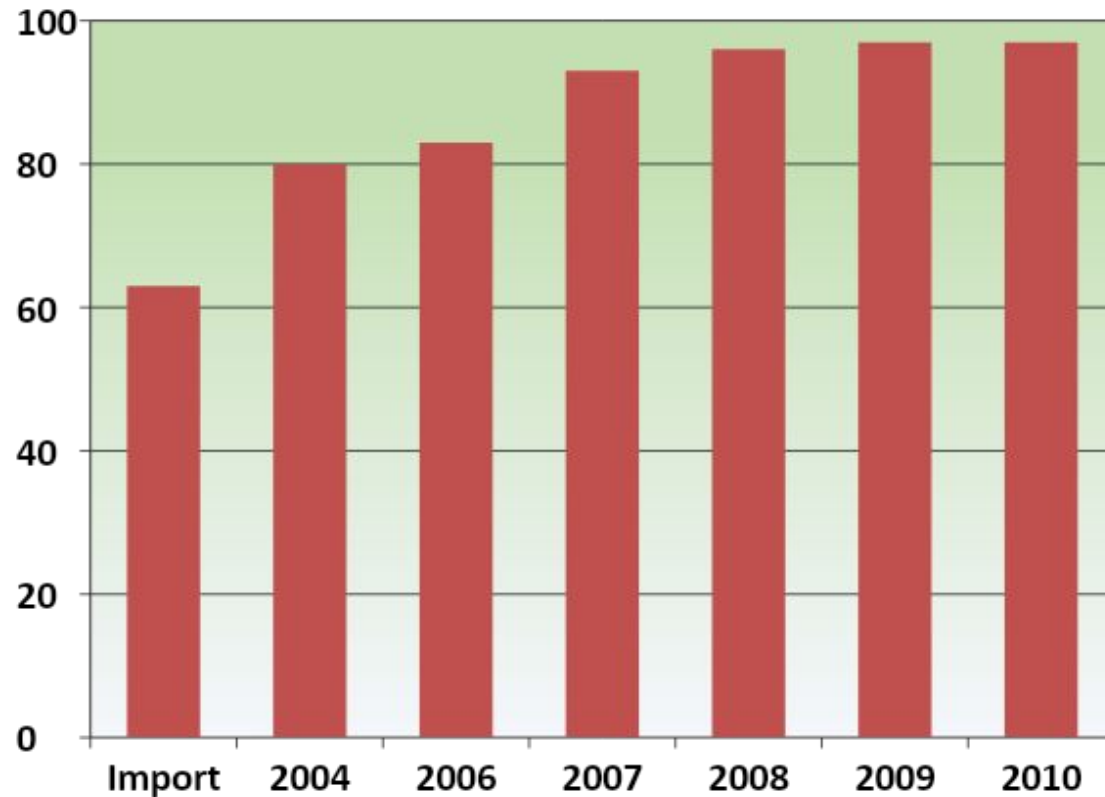


Selection of Disease Tolerance in SPF Populations

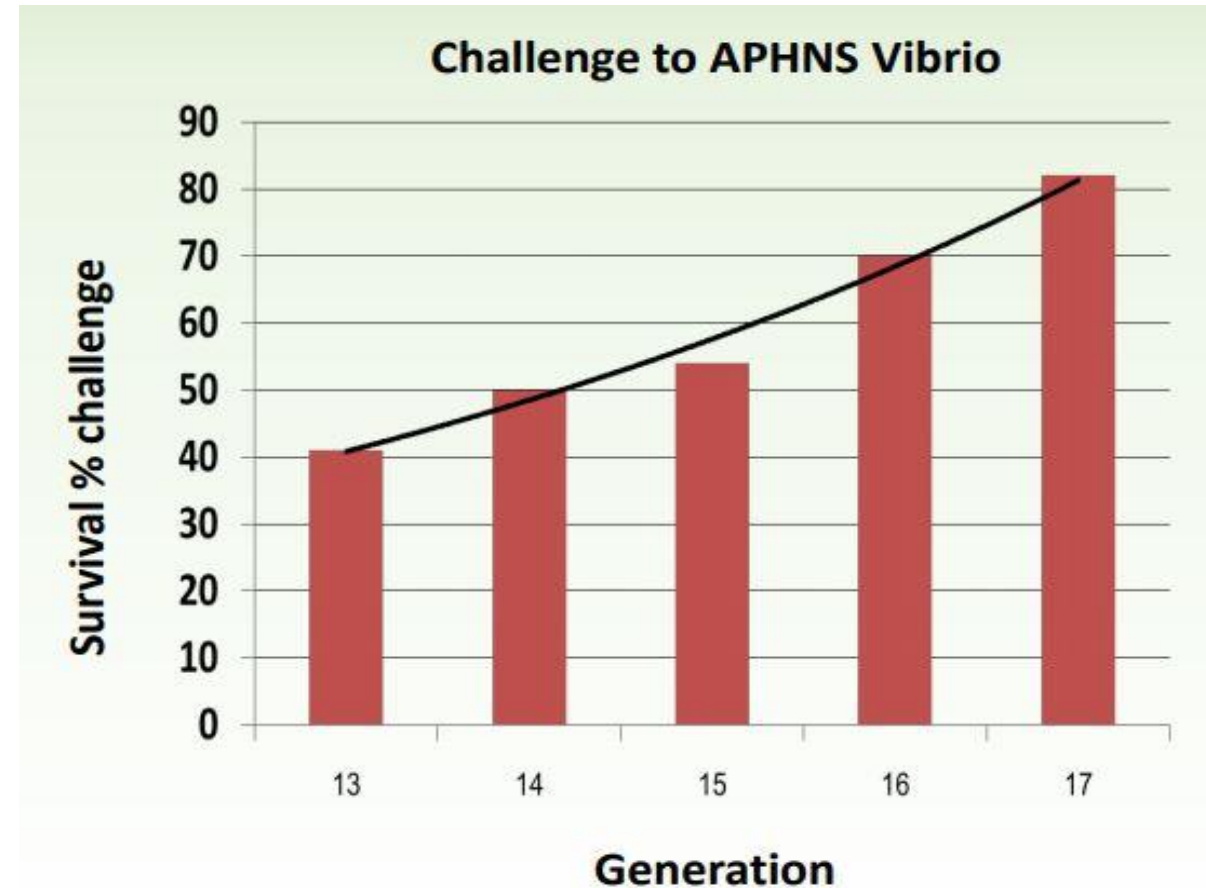
Successful Family Selection for Disease Tolerance through phenotypic selection



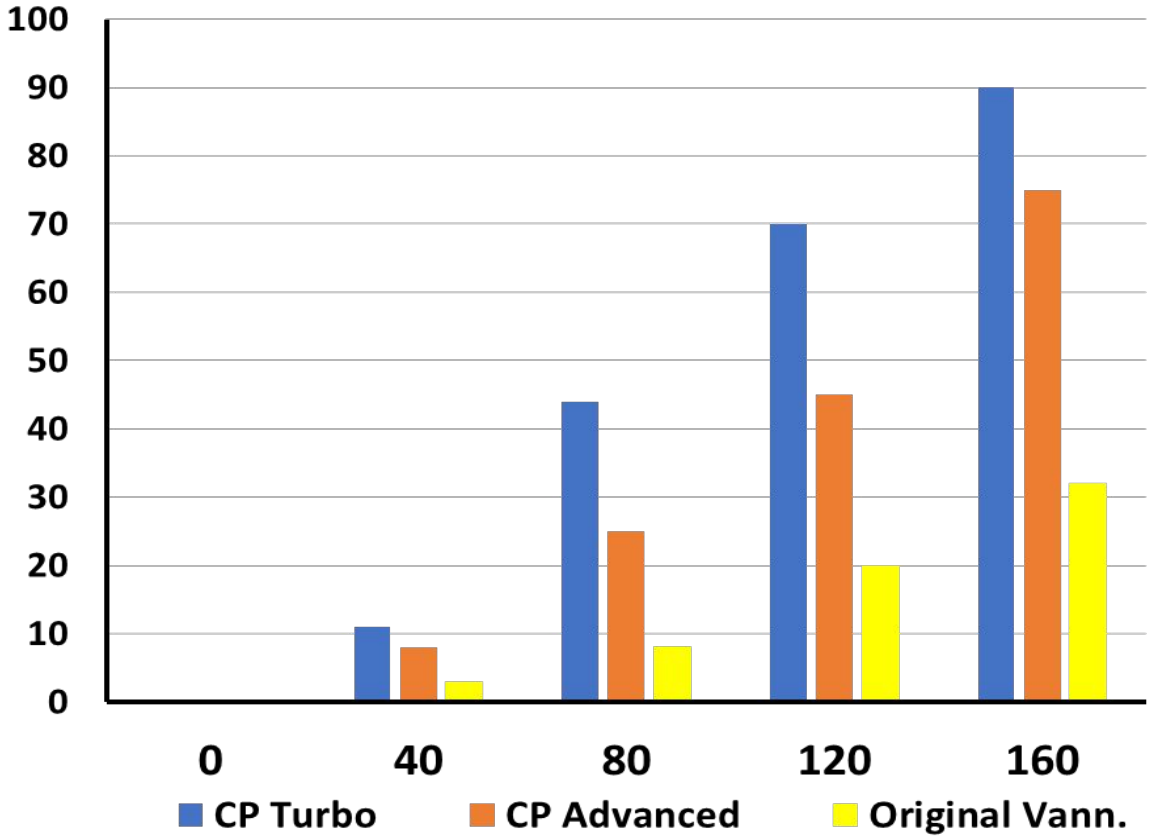
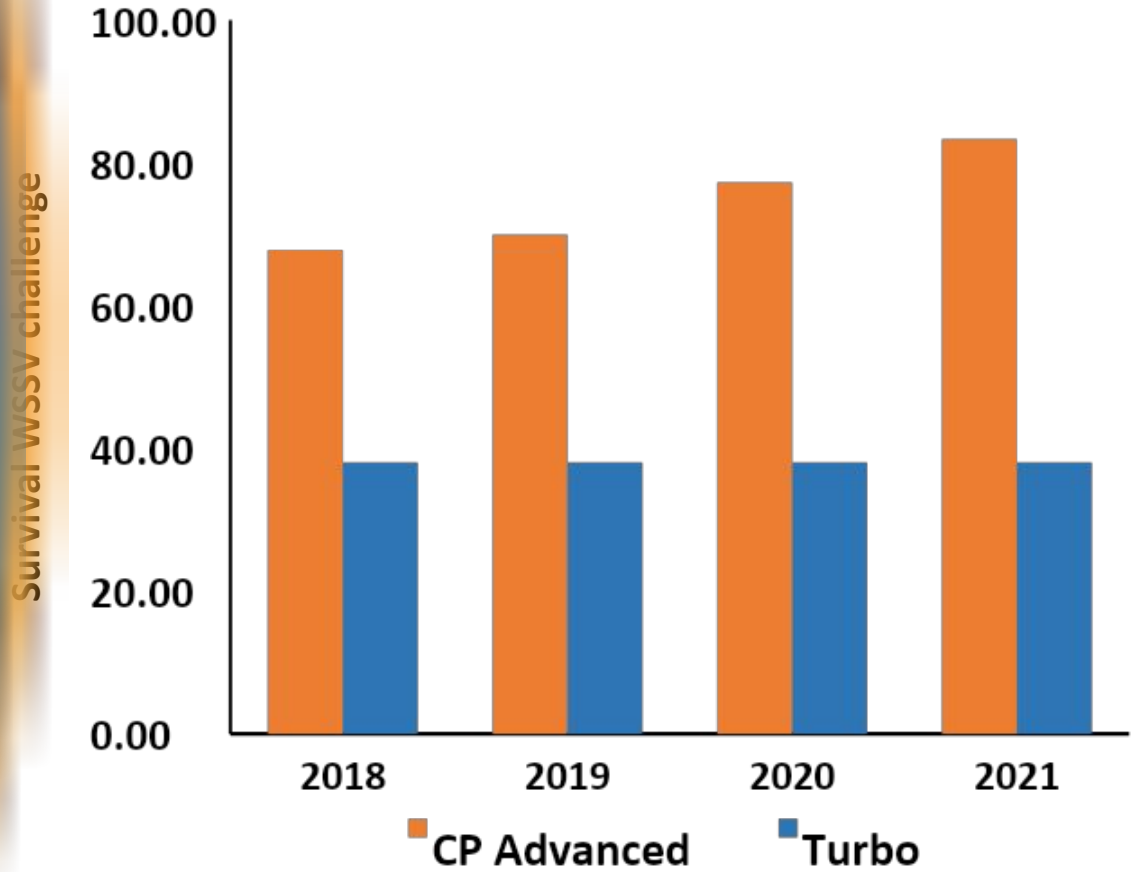
TSV >99%



EMS > 80%



WSSV Tolerance is Complex (Genetics) But Tolerance is possible in SPF shrimp

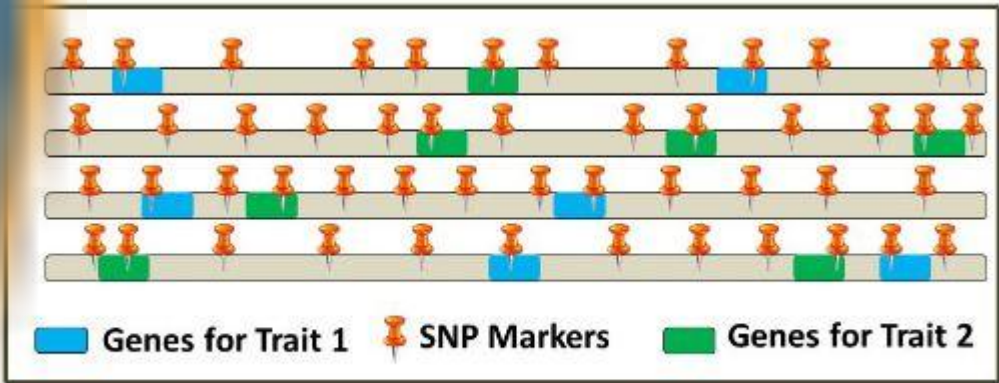
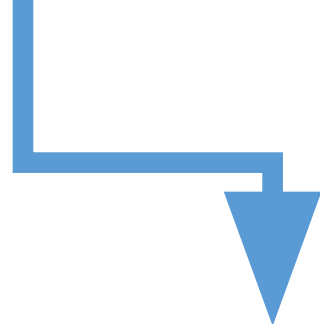




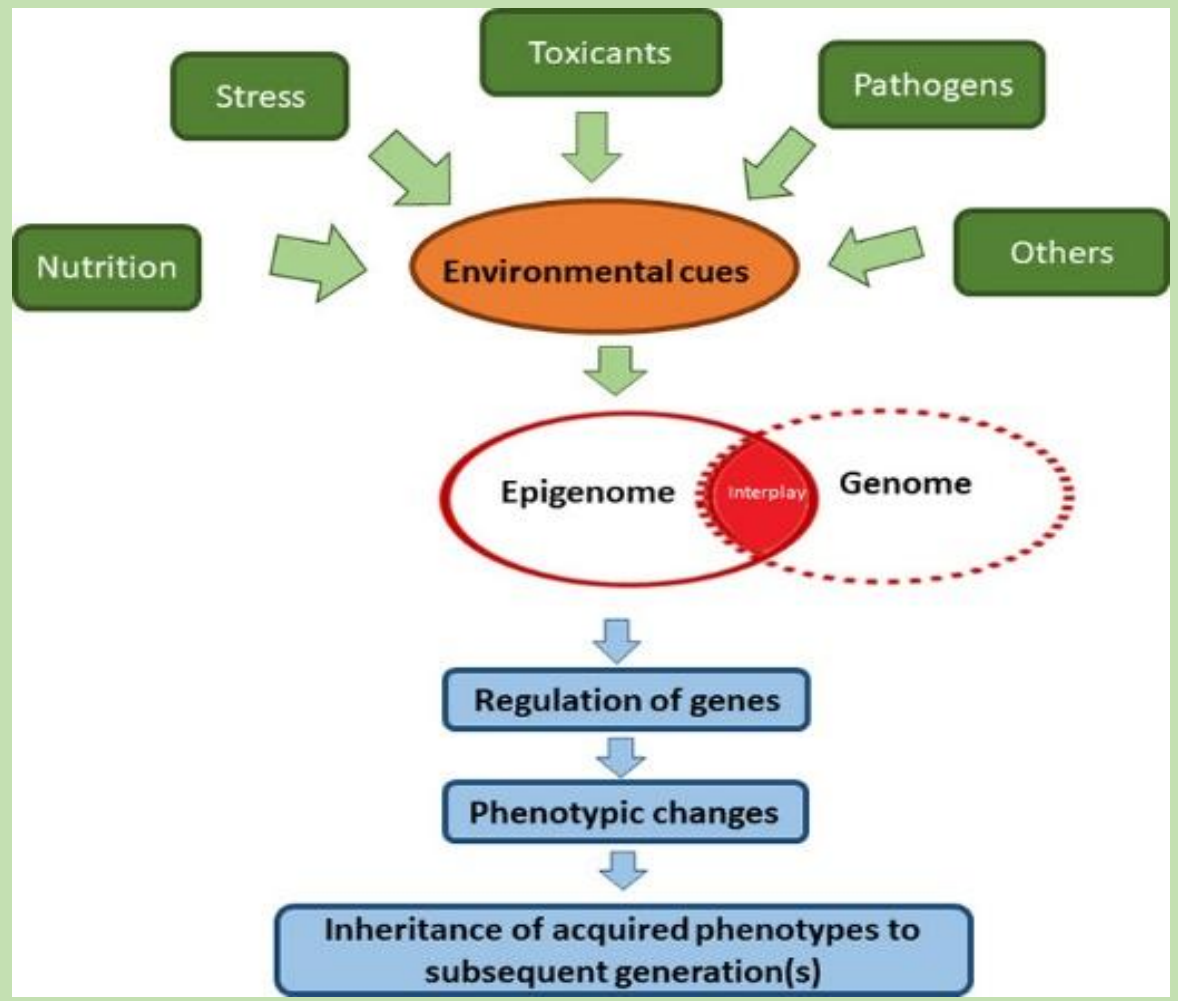
2019: Introducing CP KONG : more robust, WSSV tolerance

Increase robustness through selective Genetics/ family and individuals

Classic challenge provides Inputs to develop multi trait SNP chips



Increase tolerance through manipulation of the genome (epigenetics)



The future is now: Utilize Marker Assisted Selection Makes individual and low heritable selection possible



USE of Microarrays
to select individual

Robustness
WSSV tolerance
EHP tolerance
Color

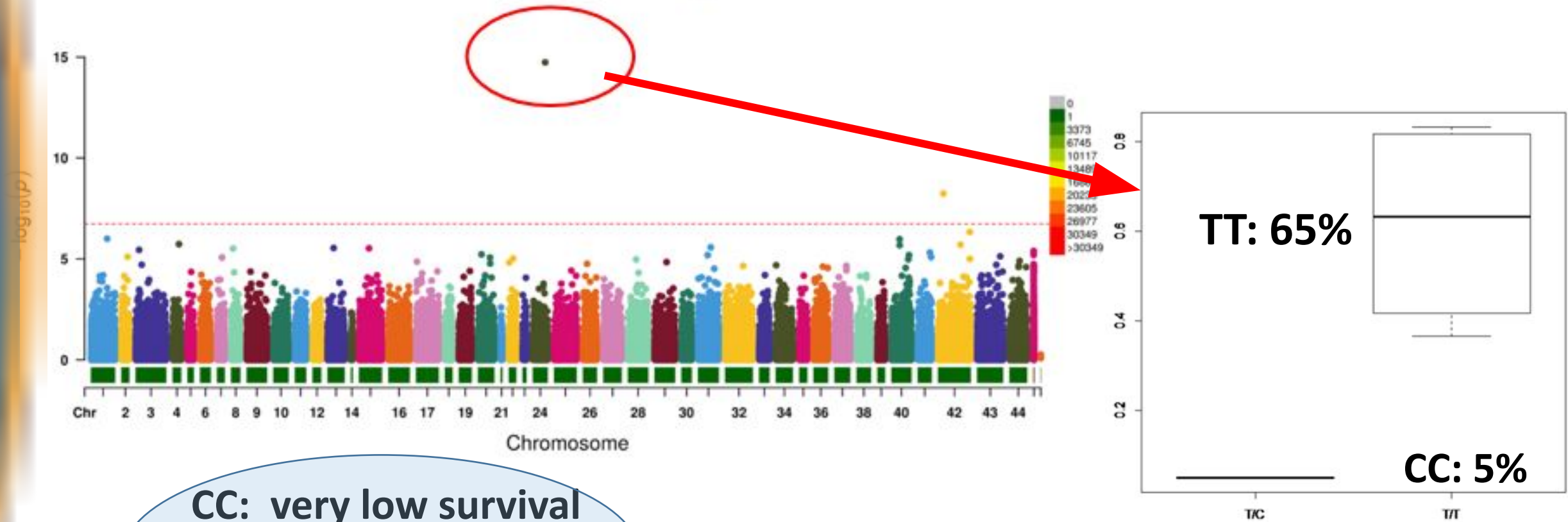


CPF genome collection: every shrimp from Pedigree



CARMEN: Genome sequenced and annotated

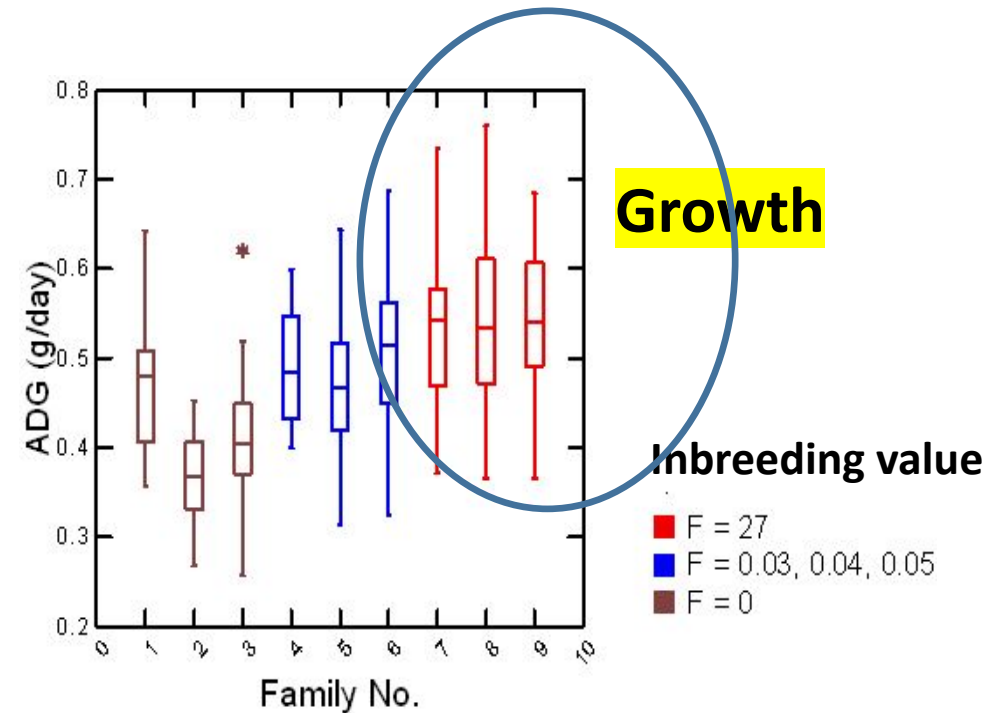
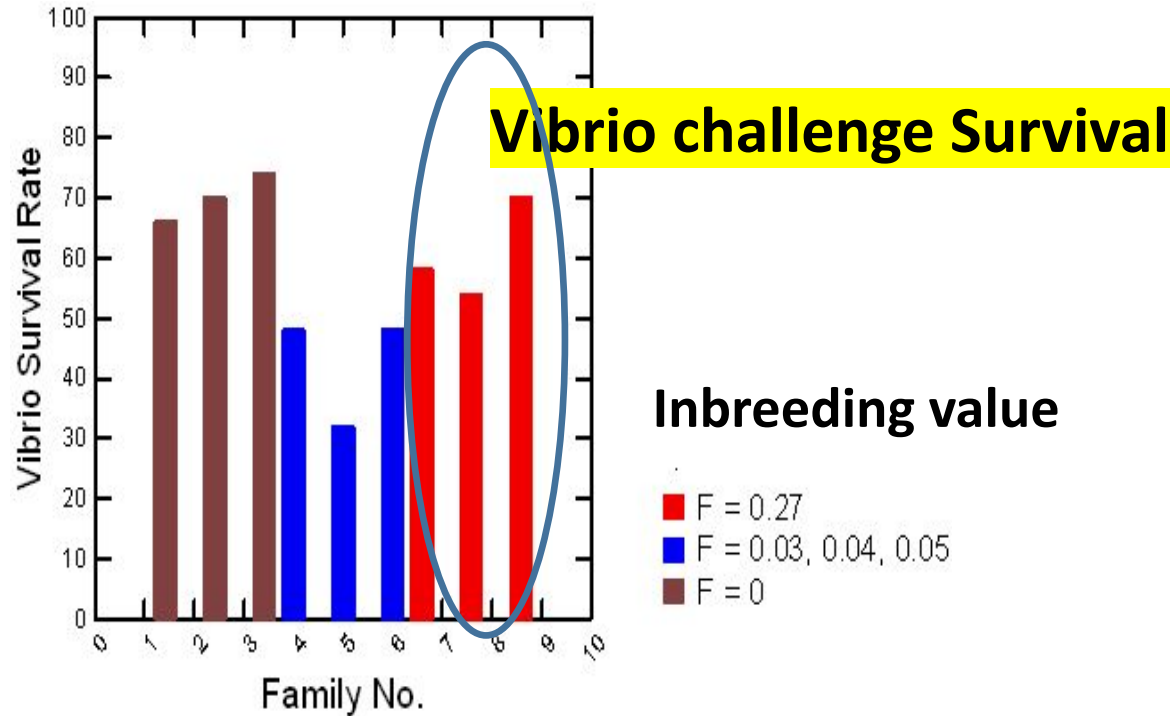
Identification for Survival Markers (WSSV Tolerance)



CC: very low survival
CT: moderate survival
TT; high survival

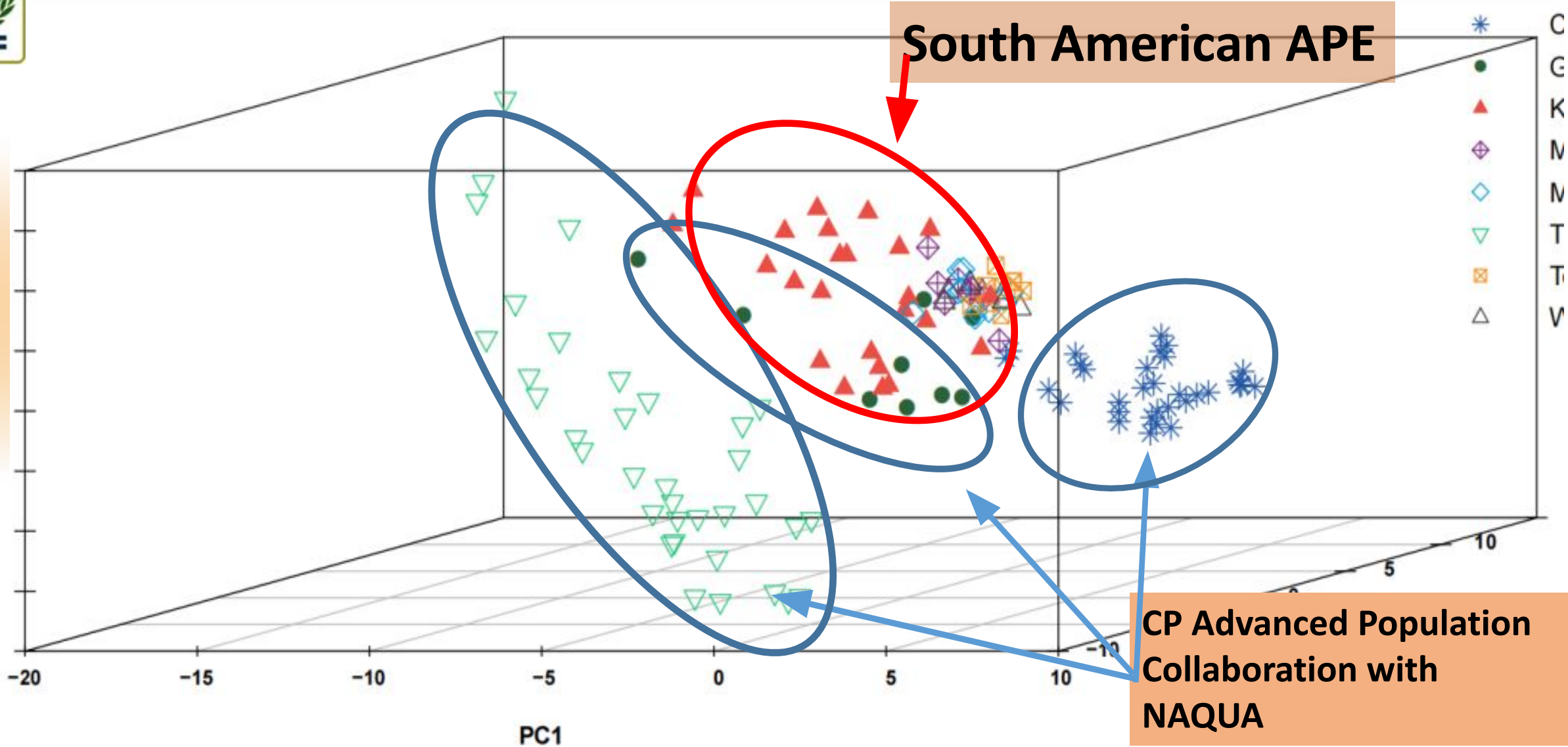
Survival rate of families with different genotypes marker

Inbreeding has little effect on CP Populations



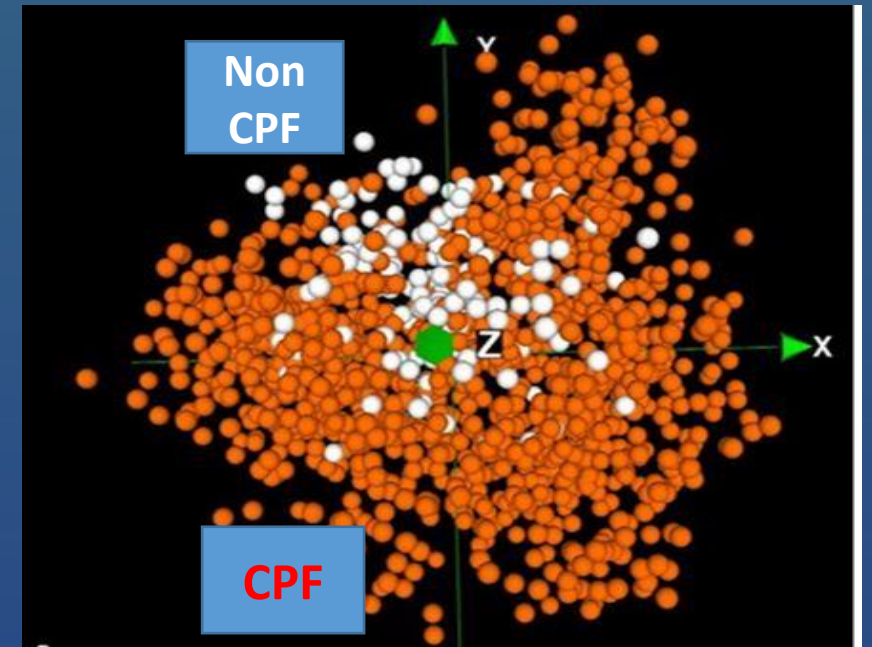
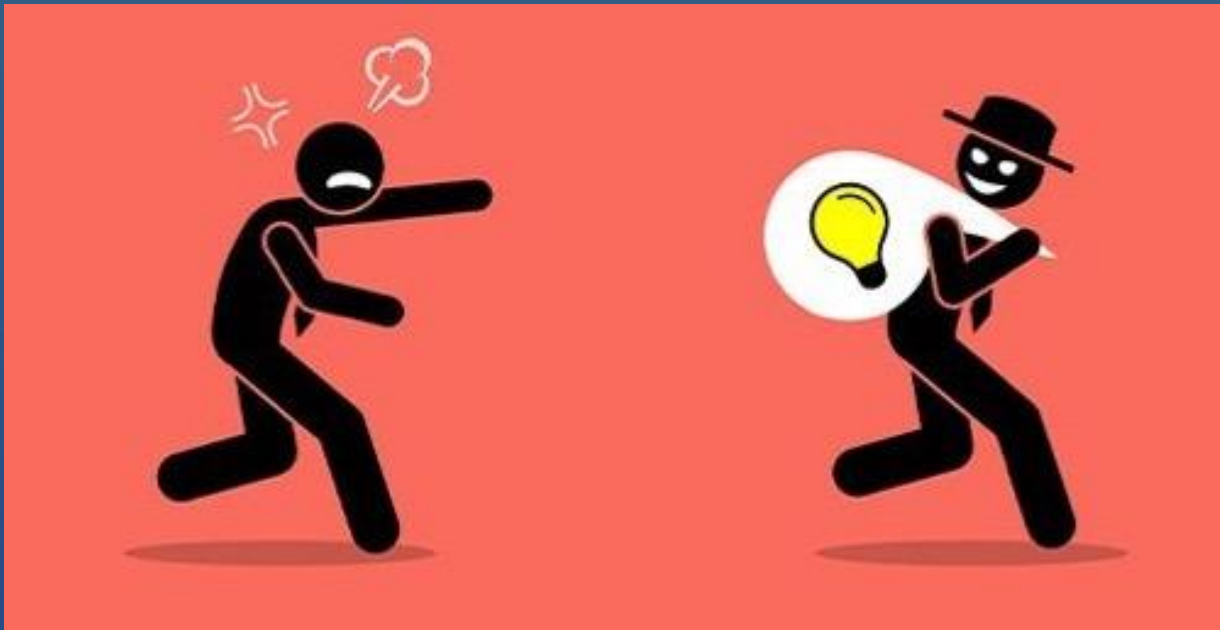
**Inbreeding Coefficient of CPF shrimp stocks
both pedigree and molecular determination: .03-.042**

Shrimp Populations comparisons : Diversity Important for Tolerance and Robustness



Largest Issue for Shrimp Breeding going Forward:

- Protection of Intellectual property of genetic materials
- Running a “proper genetic program” requires large investment:
- A question we are asking : why would we continue to invest if 5-10 years of investment can be lost overnight



Robustness emphasized: A shrimps capacity to maintain high health in adverse environmental, pond conditions



Considerations:

- Inbreeding
- Genetic Diversity
- Heterozygosity
- Innate Immune system
- Pond Management



No Genetics can Overcome Management Issues



Same Genetics/Different Management

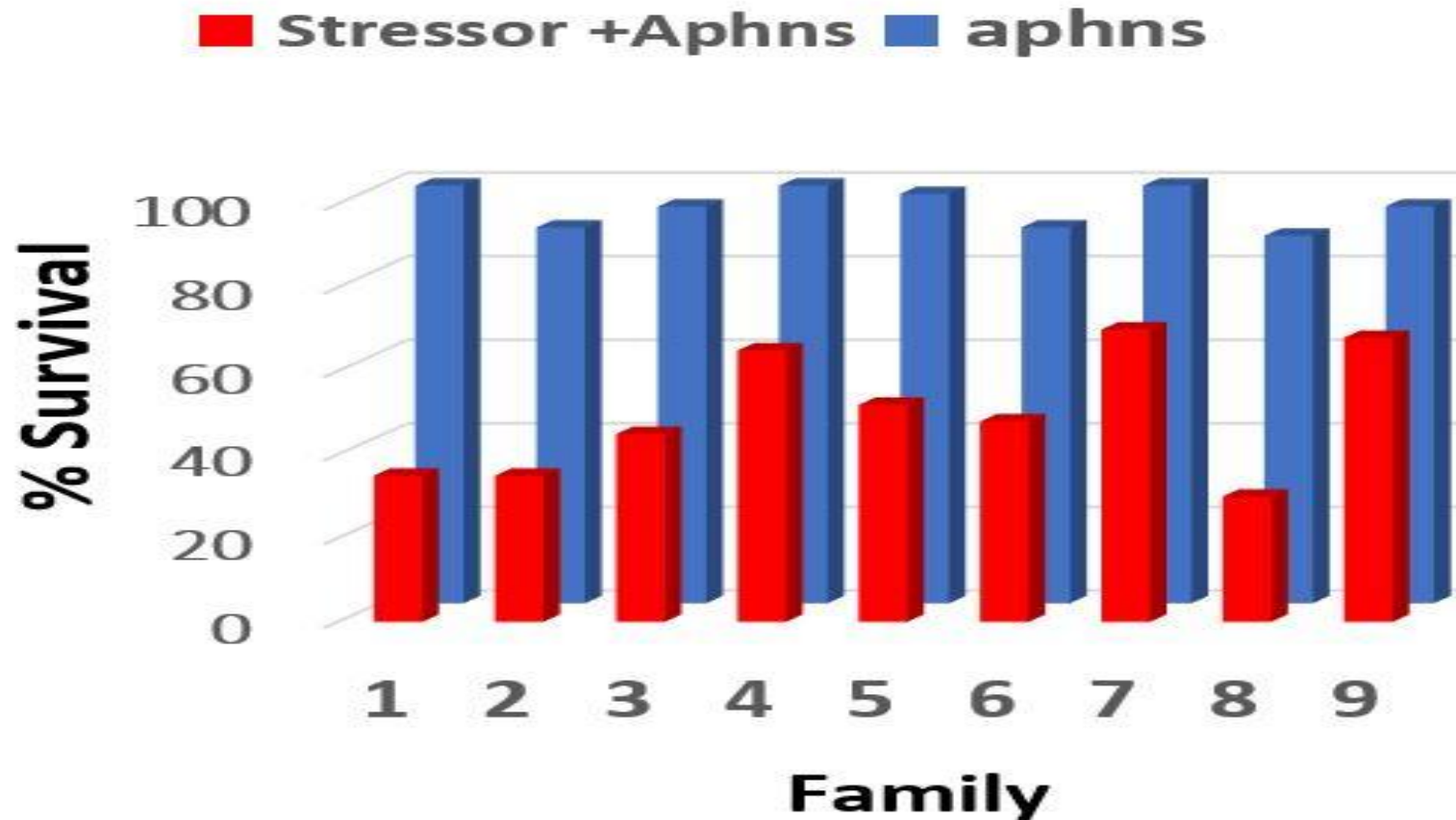


Management must be targeted to full filling the requirements of “New Stocks”

Management must be targeted at reducing stress; no robustness can overcome “extreme” stresses

Management must understand (define) the carrying capacity of the system

Stresses make shrimp more susceptible to disease



APHNS 10x4

Stressor= 20 ppm NO₂

Presence of Pathogens do not mean Disease!!

Minimize STRESSES:

Low oxygen

Nitrites

pH fluctuation

Temperature fluctuation

Sulfides

High CO₂

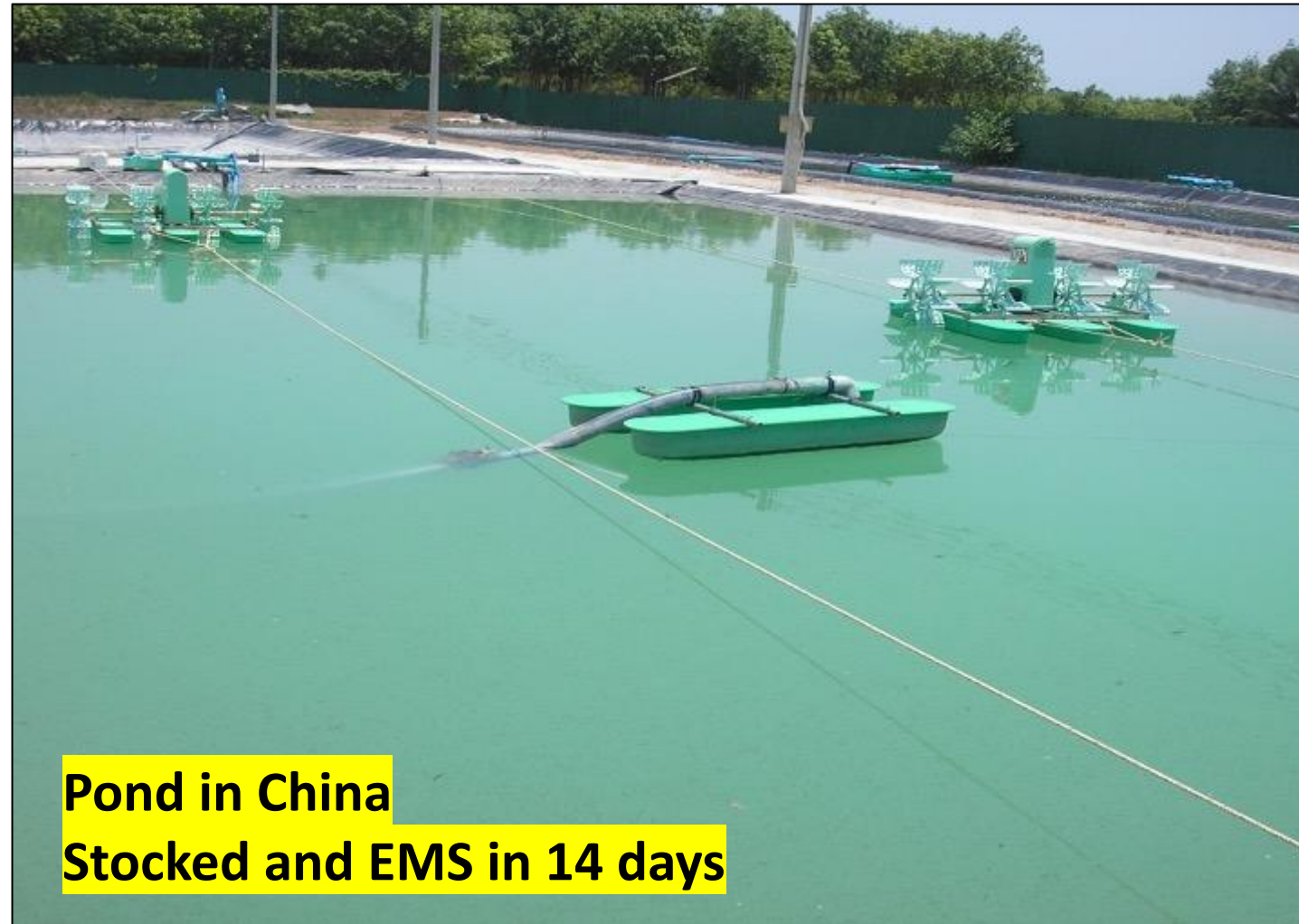
Toxicity

Nutrient deficiency

Disinfection and negative effect on the Microbiome



- Disinfection- removes virus, but also
- Enhances biofilm and vibrio development
- Has not positively impacted
either EMS for EHP issues



**Pond in China
Stocked and EMS in 14 days**

Holistic Bio-security: Reduction in Pathogen Loads and Control of Culture Stresses



Failure rate from WSSV

Stresses must be controlled

Use of Disinfectants; destroy diverse ecological balances

Over Use of Probiotics and Chemicals

Overstocking for the carrying capacity: oxygen, feed rates, etc

Accumulation of wastes, resulting in nitrites, carbon dioxide etc

The main aim of biosecurity is to protect shrimp health and to increase and protect shrimp production through the prevention, control and management of biological risk factors

Asian Style Culture can be successful: smaller ponds 500m² to 2,000m²



Parameters	value
Stocking Rate (pcs/sq.m)	50-100
Growth ADG (g/day)	0.35
Survival Rate (%)	>90%
Yield (tons /hectare)	15-30
Harvest Size (grams)	30
Crops/year	3-4

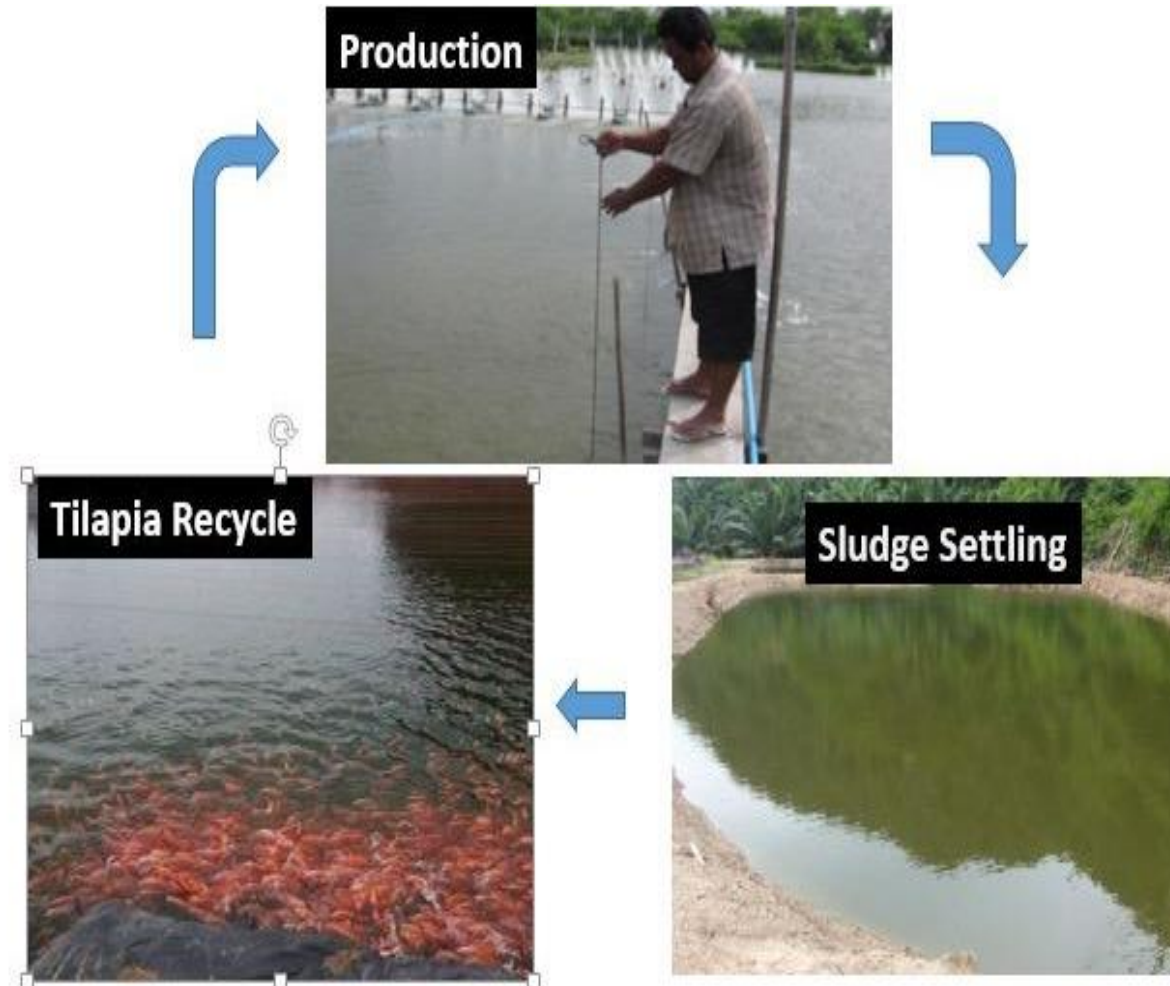
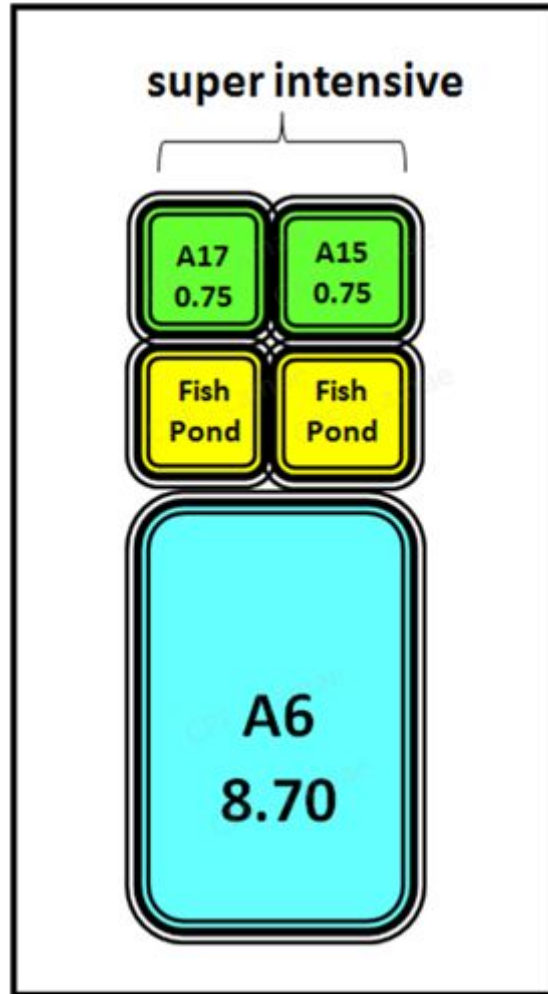
- Control stocking rates
- Sufficient aeration per stocking
(200-300 kgs/HP)
- Sufficient aeration / Feeding rate
(Different Genetics/DifferentGrowth Rates)
- Center sump or Shrimp toilet
- Hard bottom or Sealed liner
- Eliminate disinfection/excessive probiotics
- Use healthy virus free PL

All Ponds, all Systems can fail, if “Carrying Capacity” is exceeded



0.2 Ha Small ponds/ lined	Successful	High Failure
Stocking Rate (pcs/m²)	<120	>200
HP Aeration/ kg shrimp biomass (max)	350	>550
HP Aeration/ kg Feed /Day (max)	7	9.5
Maximum Biomass (kg/hectare)	30,000	50,000
Shrimp Toilet	Yes	Yes

Successful Intensive Farming today; Smaller ponds, waste removal and treatment, Stocking within Limits

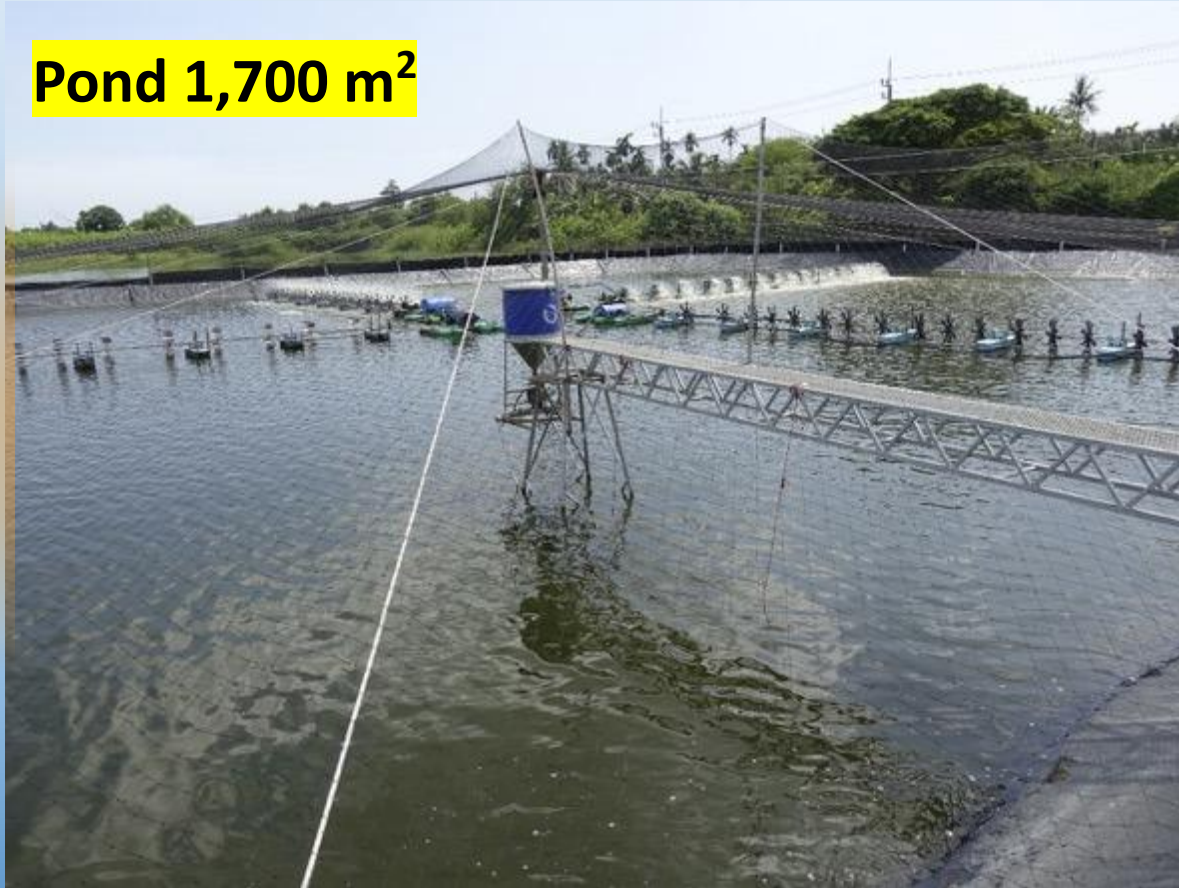


A very Profitable Shrimp Farm in Thailand!

Consistent results for 2 years; 8 cycles



Pond 1,700 m²



Aeration: 24 HP



Stocking Rate: 110/m²; Survival 92% FCR 1.15 Harvest Size >30 grams

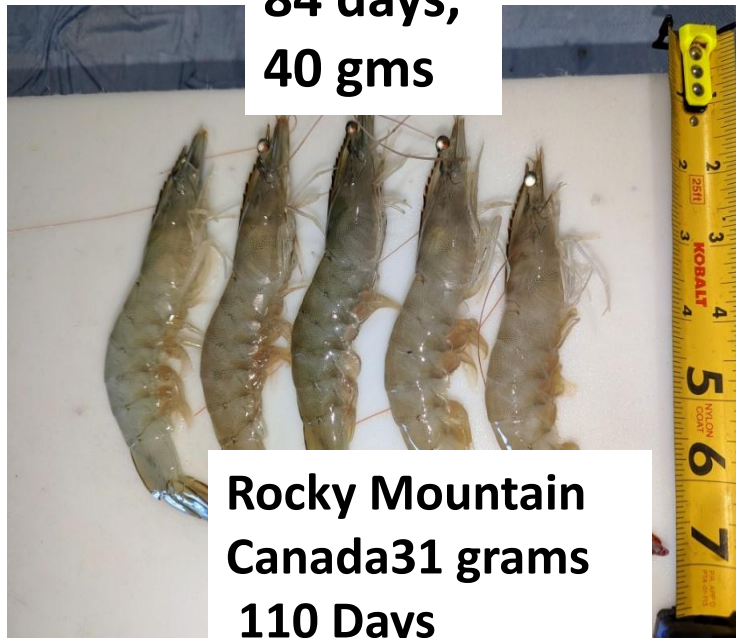
Shrimp 2022 from Homegrown Shrimp USA



**Triple J
110 days**



**Triple J
Missouri
84 days,
40 gms**



**Rocky Mountain
Canada 31 grams
110 Days**



**Morocco
40 days**



Triple J 123 days



Rocky Mountain Canada



OBRIGADO