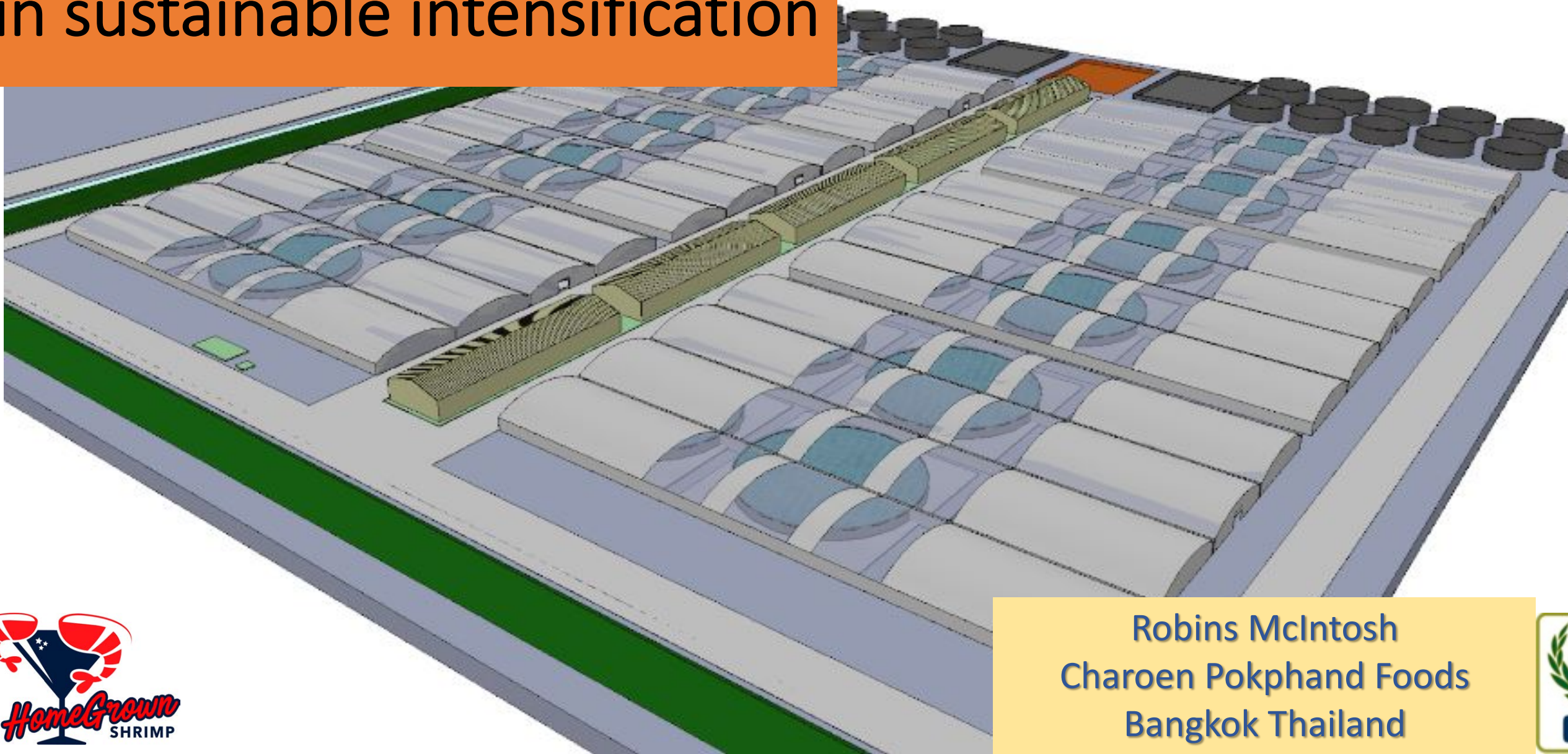


Amazing advances in sustainable intensification

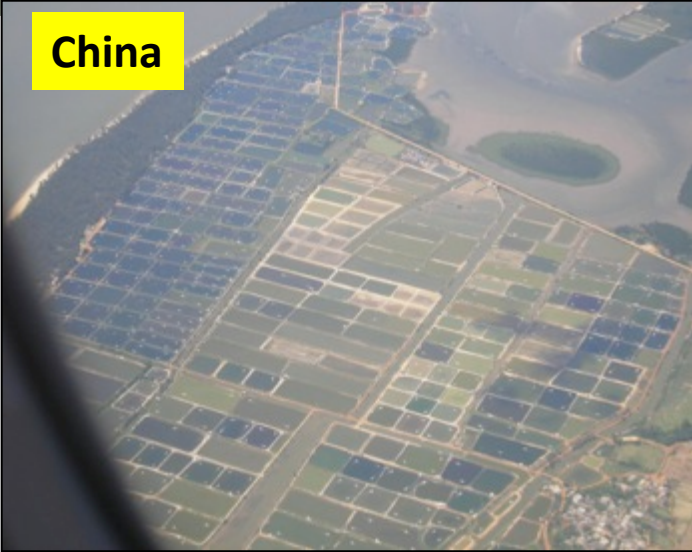


Robins McIntosh
Charoen Pokphand Foods
Bangkok Thailand



Today's Asia

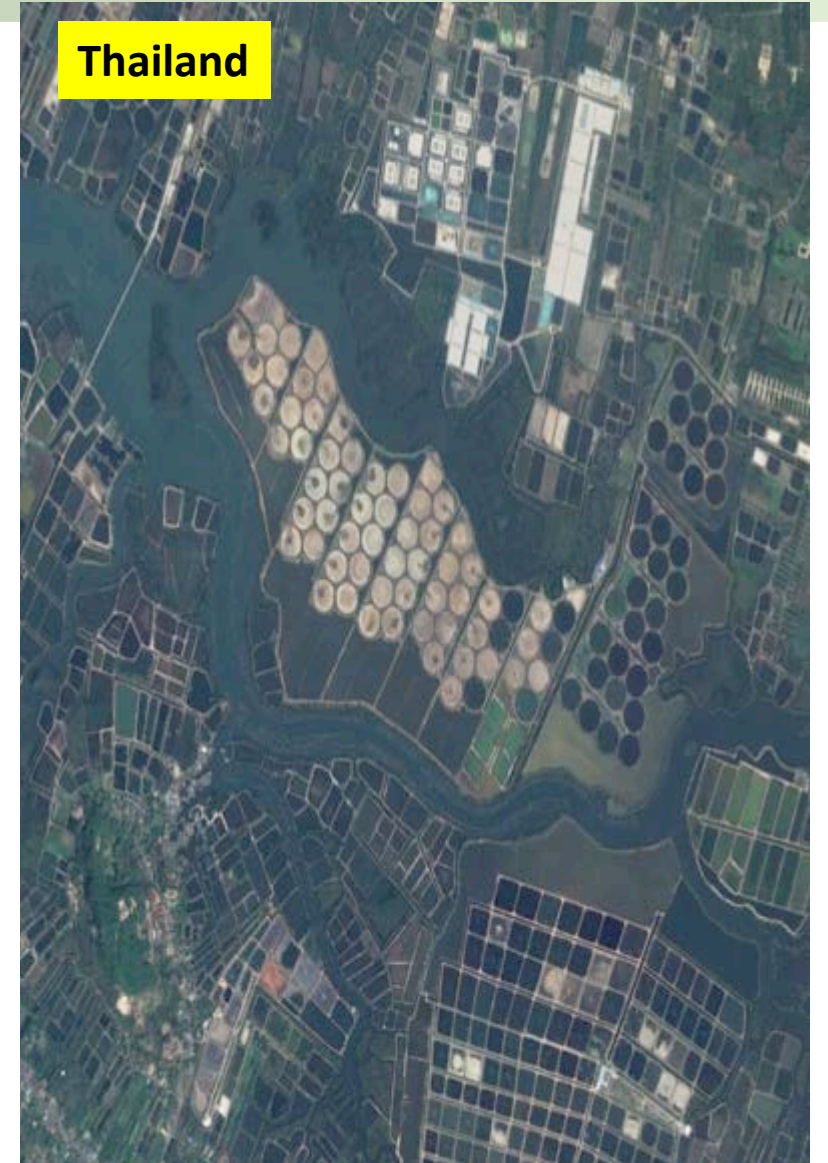
China



Indonesia



Thailand



India

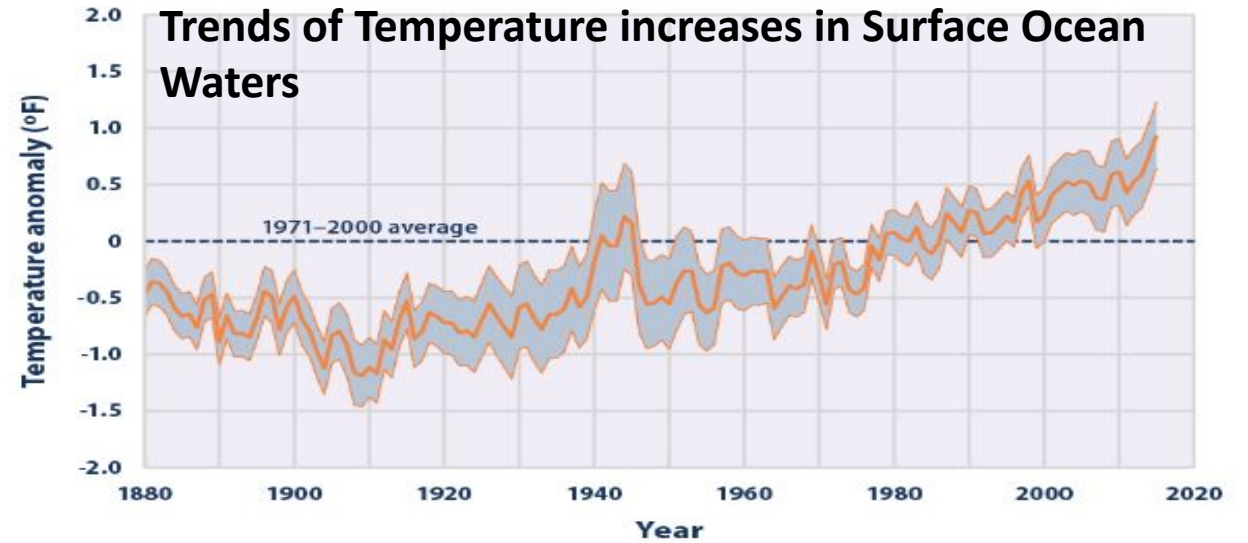


Vietnam



Today's World

Increased eutrophication South China Sea



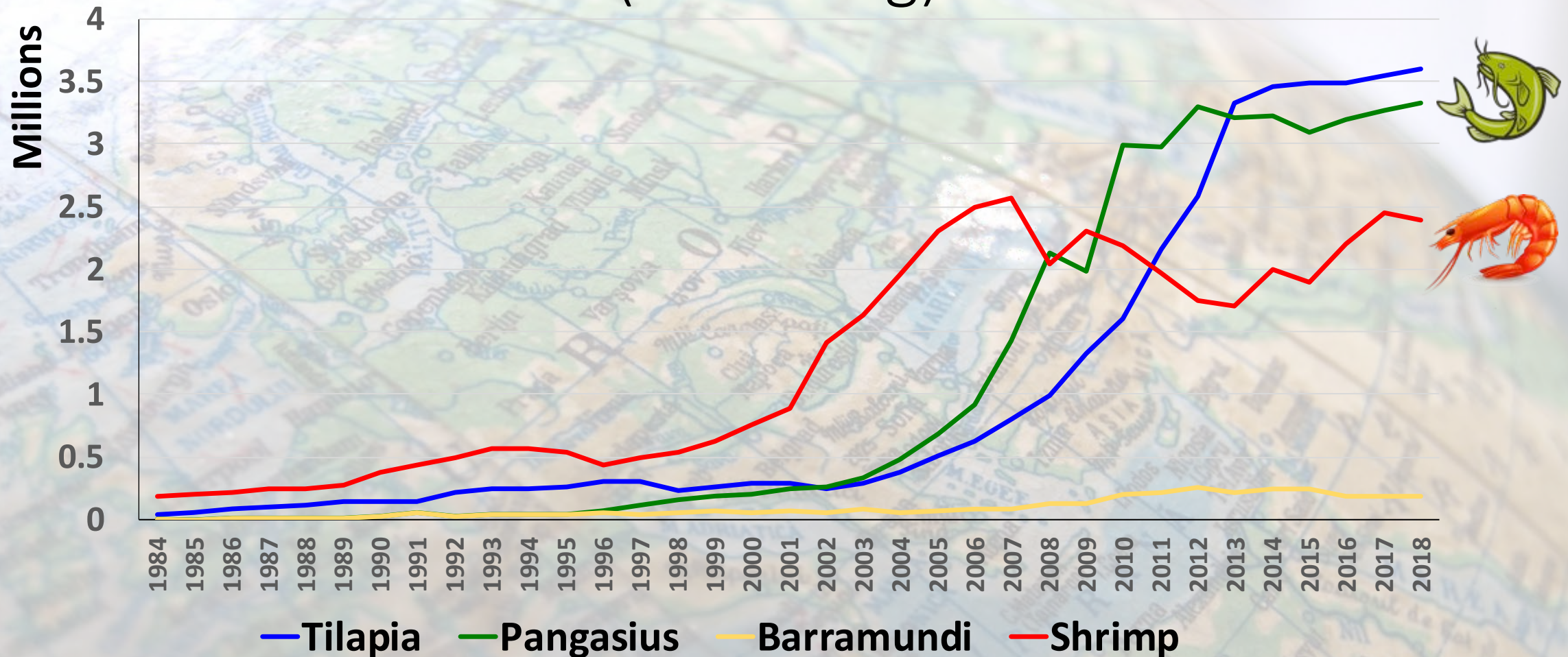
Headlines: Mekong River at its lowest in 100 years Threatening food supply



Bacterial increase and HAB's in South China Sea



Today's Asian Aquatic Production (Flat lining)



**Note that the rapid increase from 2000 to 2010-2012 has been followed by a period of stagnation:
Why?**

Necessity is the Mother of Invention

Shrimp Farming has evolved over time

Generation 1

G1



No aeration,
500-3 tons/ha
Large ponds;
5-30Ha

Generation 2

G2



Aeration, feed
3-12 tons/ha
1-2 Ha

Generation 3

G3



Viral biosecurity,
Domesticated
shrimp,
10-20 tons/ha
0.5-1 Ha

Generation 4

G4



Toilets,
Recirculation,
More aeration,
Auto-feeder
15-40 tons/ha
0.2-0.5 Ha

Generation 5

G5



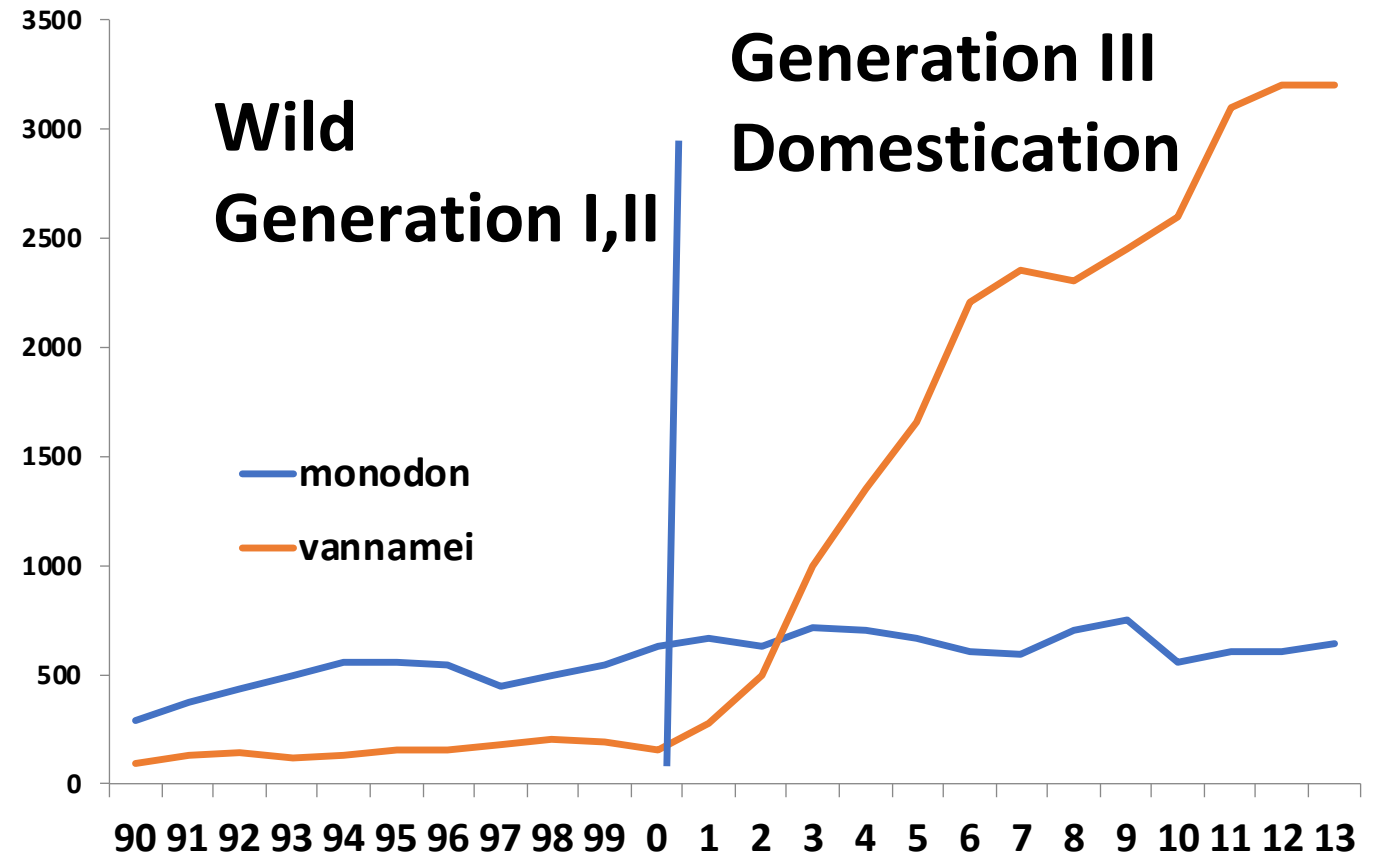
Total recirculation,
total waste capture
More control on
environment
30-60 tons/ha
0.2-0.5 Ha

Generation III:

Developed in response to WSSV and monodon slow growth virus



Biosecurity/ SPF stocks
(viral exclusion)



Generation IV developed in response to EMS

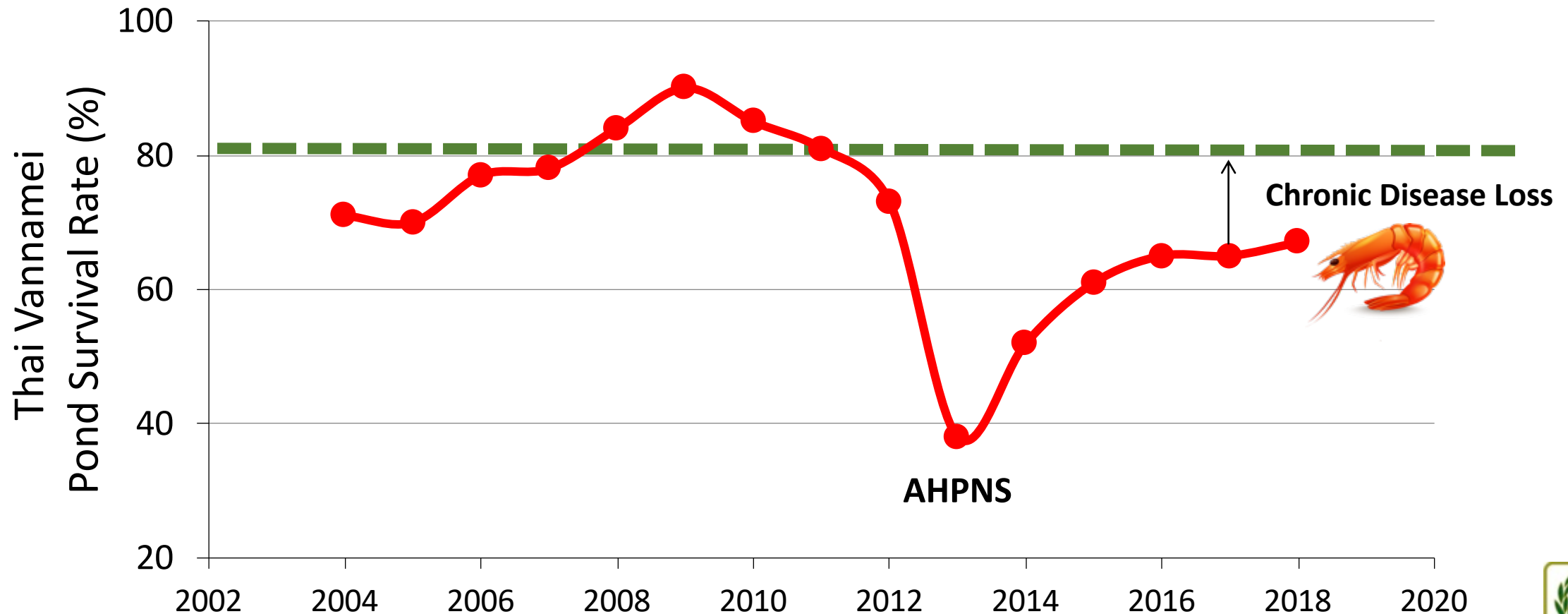


Designed and Managed for viral exclusion; bacterial limitation, stress reduction, and based on the use of SPF/SPT shrimp stocks with increased pond robustness

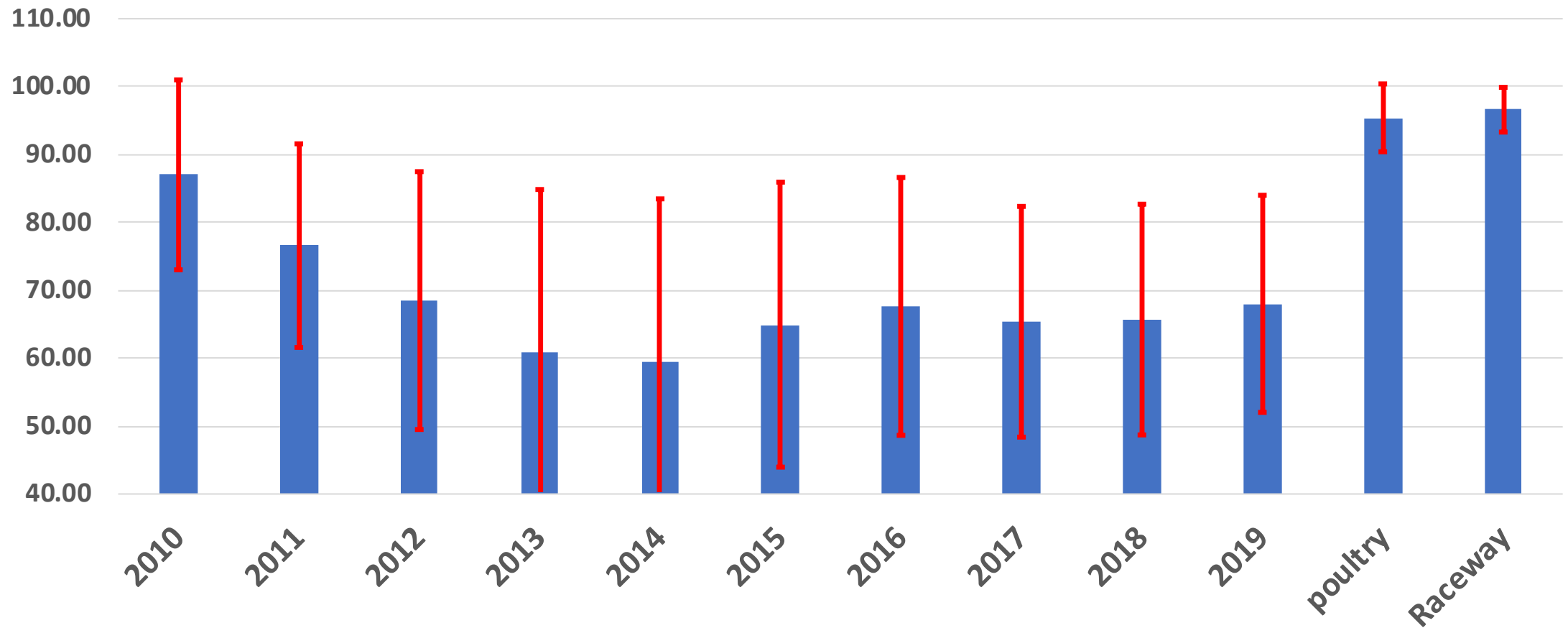
Post EMS

Must recognize we have some fundamental issues
with aquatic health today: GEN 4 technology

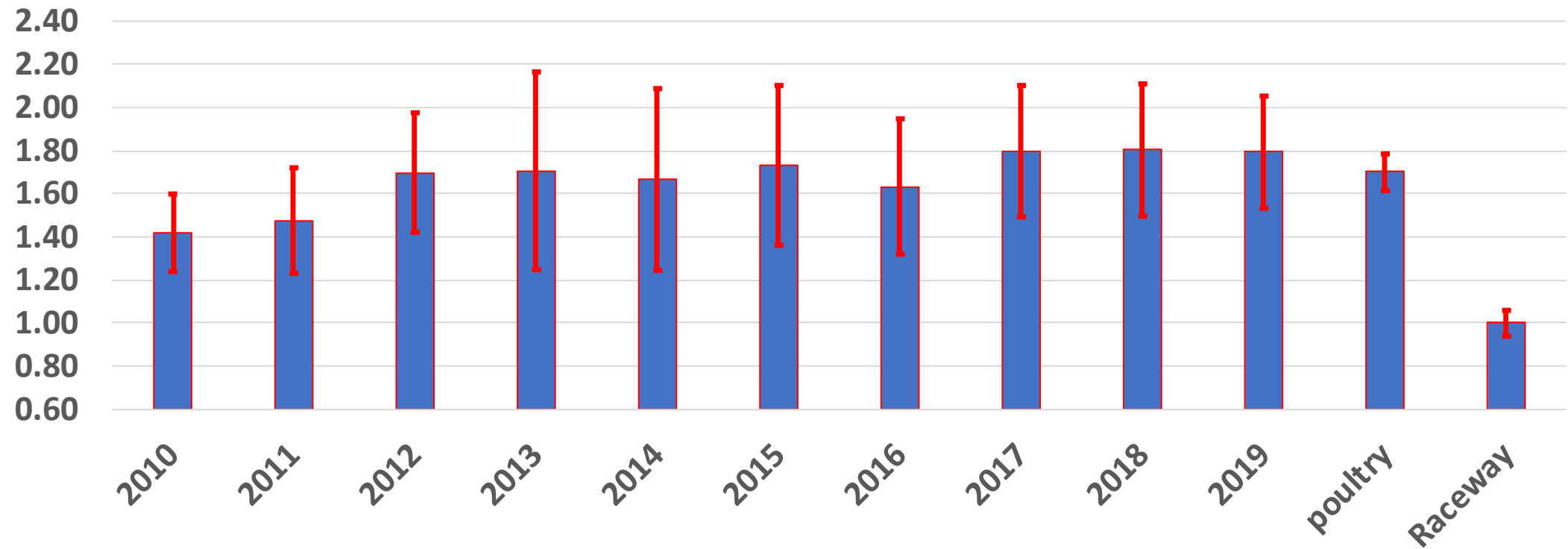
We must solve the continues chronic “no name” losses in production systems today



Survival never recovered to pre-EMS levels
with higher variance (lower levels of predictability)



Feed efficiency has decreased post EMS (note high variance)



Poultry and Shrimp:

Similarities and Differences

Poultry Broilers

0 and 56 days

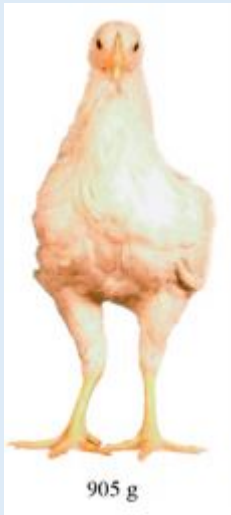
1957



2005



Growth, efficiency, and yield of commercial broilers from 1957, 1978, and 20051: F.E. Robinson



FCR: 2.8
Survival: 95%

FCR: 1.9
Survival: 95%

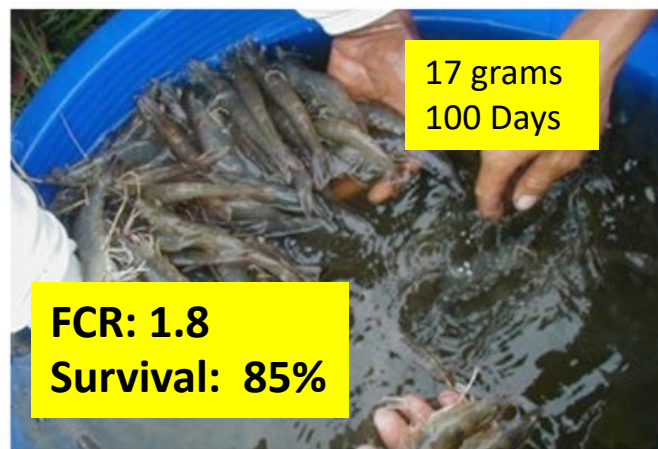
Shrimp Vannamei

Post larvae 12 and harvest size

2004



2016



Environmental and Management Factors effecting VARIANCE in Performance

Poultry

- Disease Cost (Cocci): 60%
- Temperature Regime: 15%
- Stocking Density: 10%
- Feed Form
- Litter Quality 15%
- Lighting
- Immune Development

Shrimp

- Disease Cost (EHP, vibrio)
- Temperature Regime (stability)
- Stocking Density
- Feed Form and distribution
- Sediments
- Immune Development (innate)

Shrimp Broodstock Raceways demonstrate the “possibilities” of controlled culture systems



Survival: 96%, FCR 1.0-1.2; biomass gain **100-200 gms/m²/day**

Survival: 95%, FCR 1.7-1.8; biomass gain **800-1000 gms/m²/day**

Requirements of a Sustainable Shrimp Model GEN V Farming

Like Poultry: It is about CONTROL

- **High Annual Yield** (tons/ha)
- **Consistent** High Survival, Low FCR, and low Failure rates
- **Converted Shrimp farm land** or constructed on non environmentally sensitive lands (not coastal)
- **Recycle** all Water within the production cycle and between production cycles
- **Capture all shrimp wastes** and transform the wastes to no environmental impact form

Transformation of Guatemala

Large 10 Ha ponds to 0.5 Ha Controlled Ponds

GEN II



2014

Yield: 8 tons/ha/year
Survival: 45%



2015



Shrimp Toilet



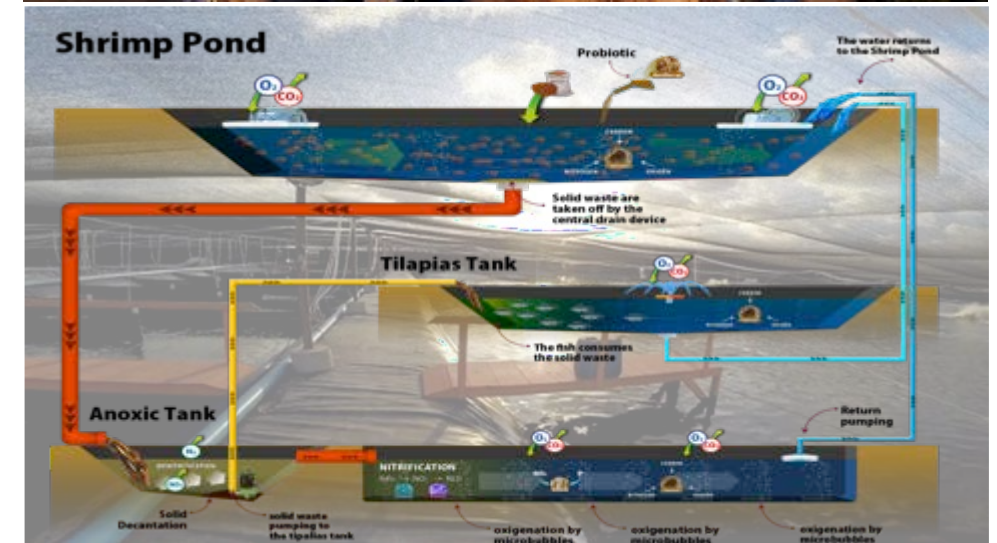
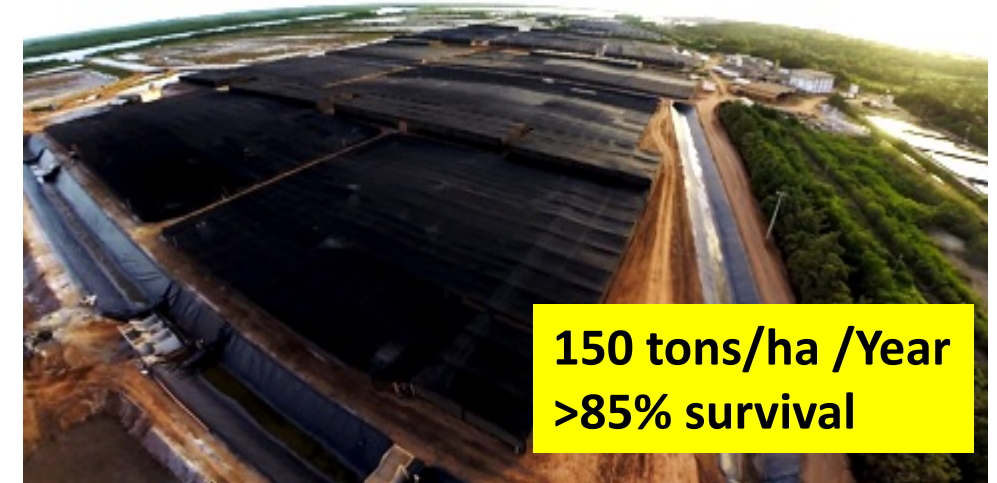
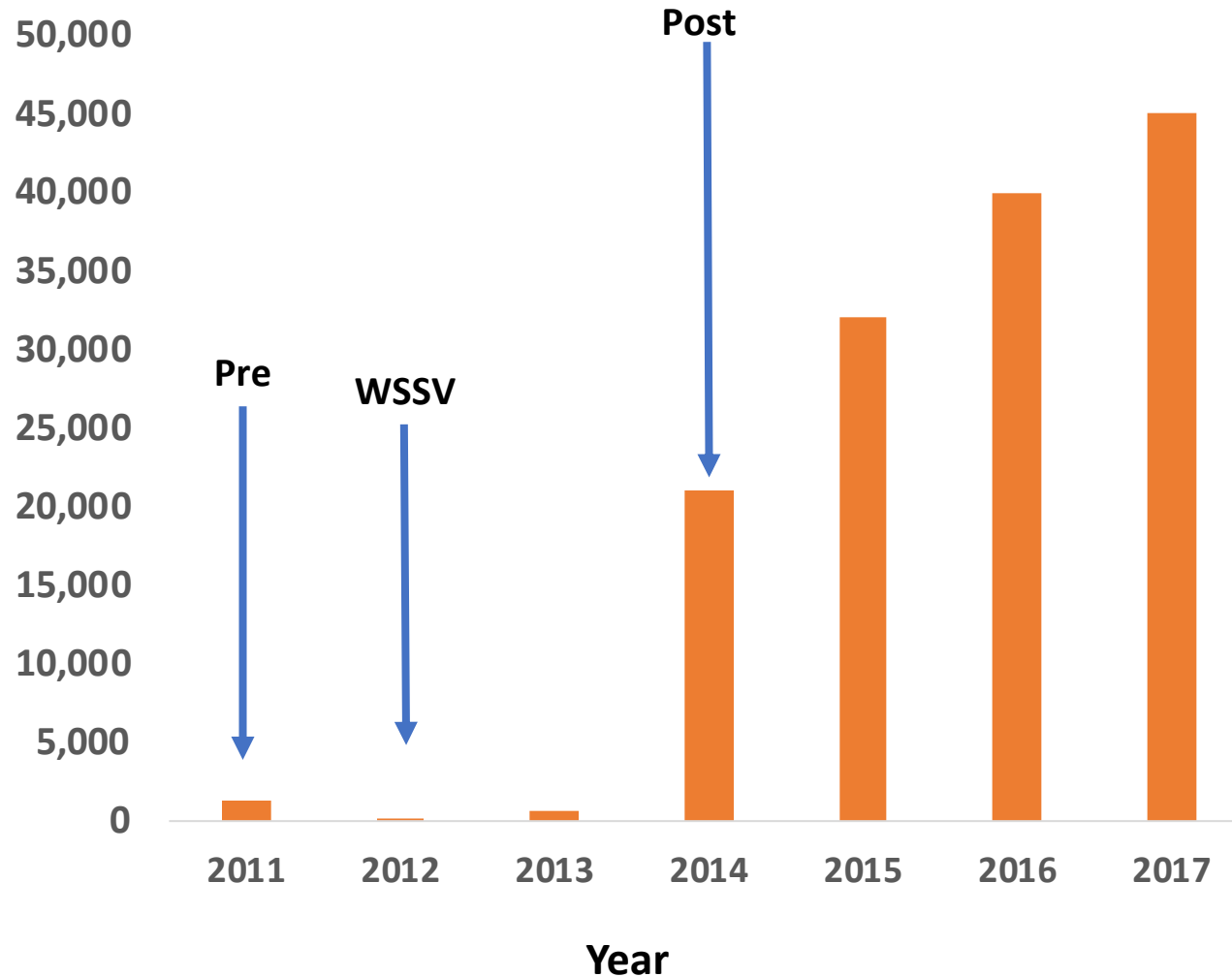
2016

Yield: 120 tons/ha/yr
Survival: 75%

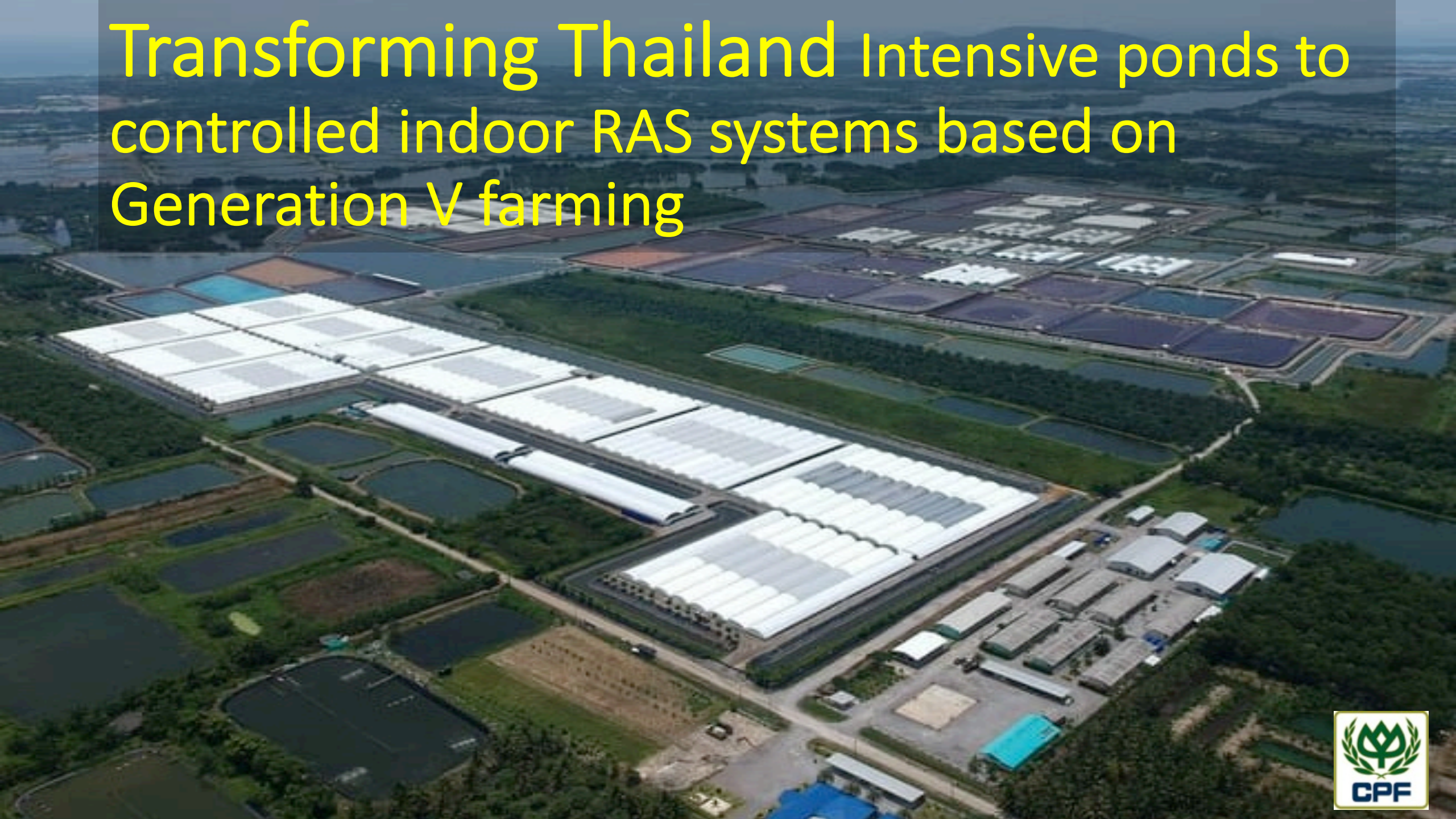
GEN IV

Transformation of Camanor, Brazil

from a large American Semi –culture Gen II ponds to RAS Gen V system
(total recycle, total waste capture)



Transforming Thailand Intensive ponds to controlled indoor RAS systems based on Generation V farming





GEN V model Farm

Inland, Non-Coastal Land

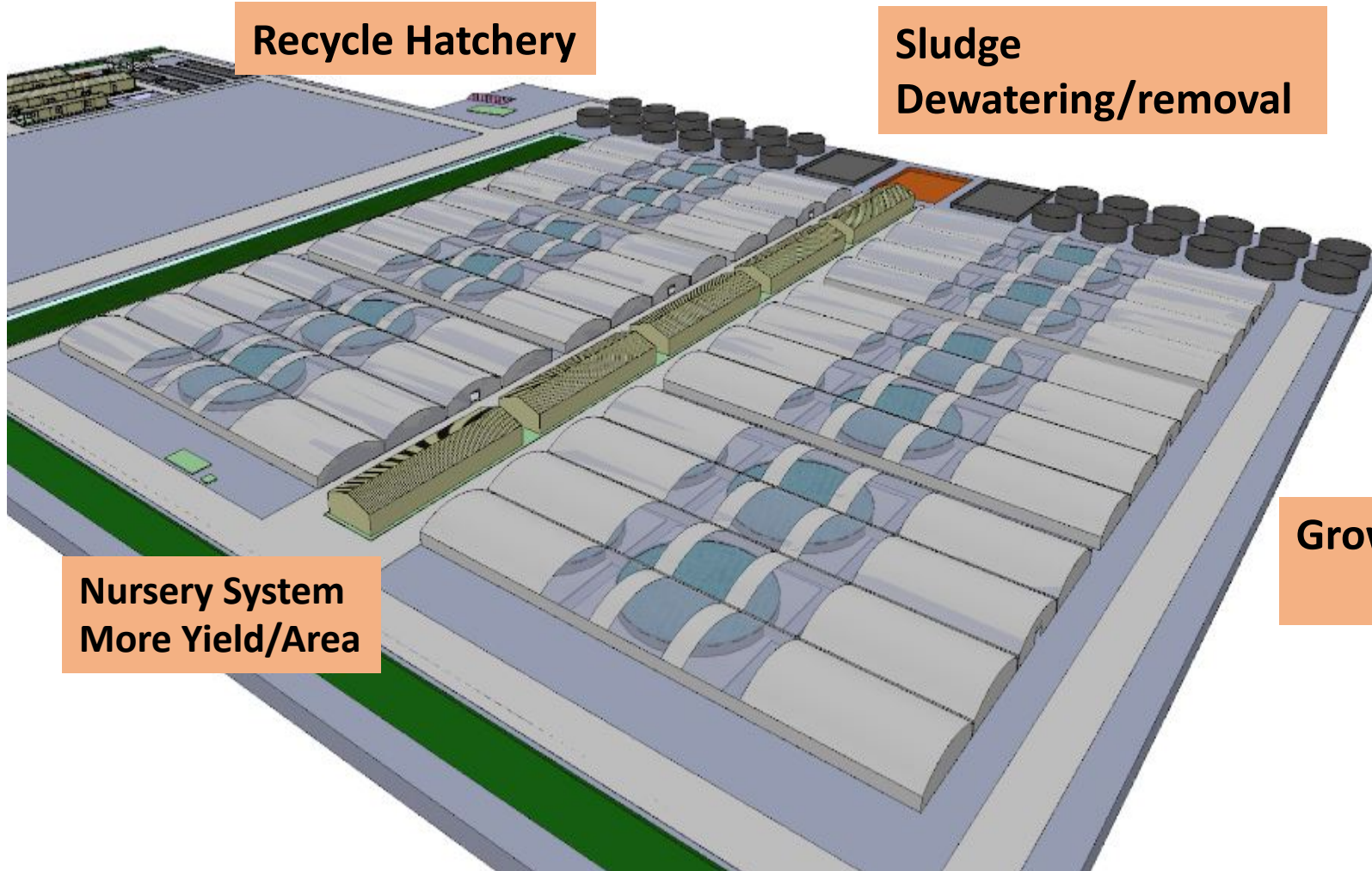
Recycle Hatchery

**Sludge
Dewatering/removal**

**Recycle Water
Nitrification/Denitrification**

**Nursery System
More Yield/Area**

**Grow-out Tanks in stable environment
Yield: 144 tons/ha/yr**



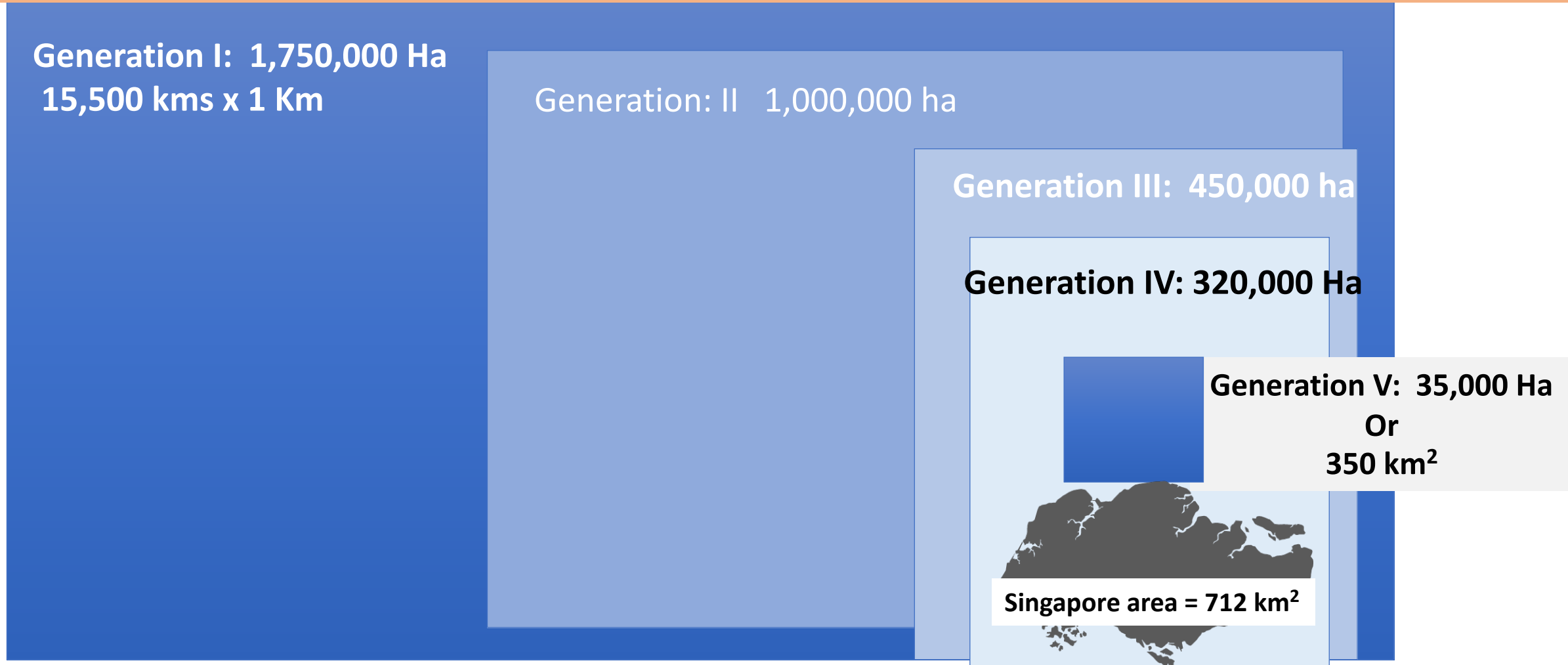
New Systems will need to reduce the waste to a recyclable material



CONTROL IS KEY TO PRODUCING MORE FROM LESS:

	1995 (Wild <i>P. monodon</i>)	2017 Generation 4	2025 Generation 5
Yield (tons/hectare/year)	4	35	200
Days of Culture (30 grams)	135	100	70
FCR	2.3	1.5	1.2
Protein retention efficiency	15	28	35
Fish In: Shrimp Out	3.2	0.7	0.5
Fish Meal (% fishery by product) (CPF)	0	100	100
Water exchange: m3/ton	20,000	3,600	0-200
Energy (kwh/ton)	3,400	2,750	2,400

Area to produce the Worlds Shrimp 10 years forward 5.0 million tons



Today 700-800,000 Hectares of Ponds producing the 3.8 million tons of shrimp; 5 tons/ha/year average

GEN V: Less Area / More Shrimp with Less Resource exploited

Return 750,000 hectares to Coastal habitats



Amazing Hatcheries

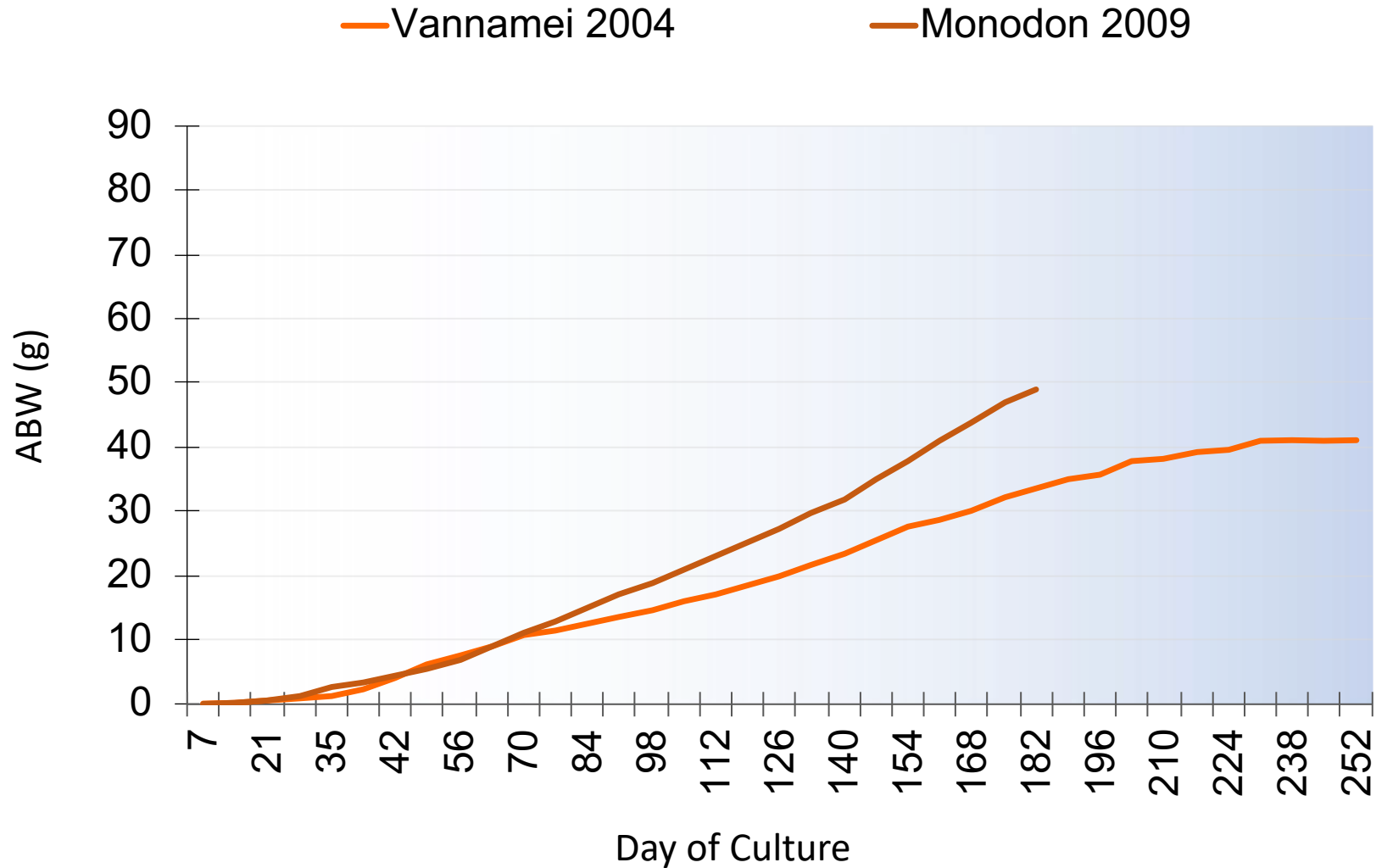
High survival of disease-free post larvae, no ablation,
no wild fresh feeds



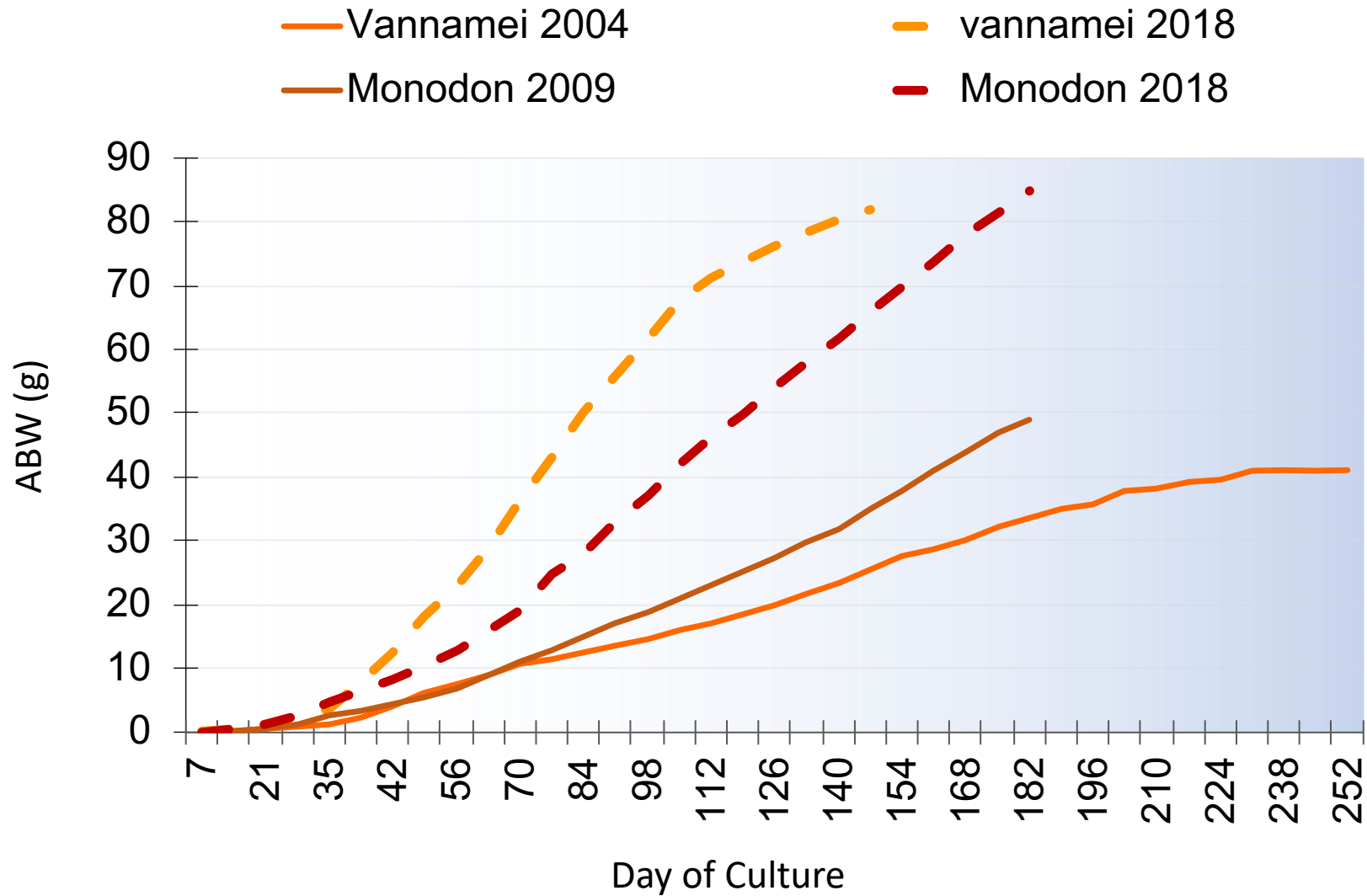
10x larger PL



Selective Genetics have transformed the Industry



Selective Breeding: Changes the Economics



42 grams in 100 days



CPF vannamei after 16 generations of breeding



160 grams in 180 days

42 grams in 100 days



160 grams in 180 days

CPF Vannamei after 16 generations of breeding:

CPF monodon after 8 generations of breeding

Where will these species be in 10 years



35 grams in 105 days

Biotechnology

Making what was Impossible-Possible



Carmen: Genome sequenced



Using SNP's for MAS

Less Labor, More Precision with Automation



Monitoring Ponds



Monitoring feed manufacture



Post larvae counting/measurements

Automated Shrimp Processing



Enjoying my Favorite Food

And

oo

Generation V Farming

