# GLOBAL SHRIMP FARMING SITUATION

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the global aquaculture alliance

iAqua
IMPROVING AQUACULTURE



# GLOBAL AQUACULTURE ALLIANCE

- Communications
  - *Global Aquaculture Advocate* magazine
  - Website (www.gaalliance.org)
  - Electronic newsletter
- BAP Certification
  - Market driven standards for best practices
- Annual GOAL meeting
  - Production, markets
- Advocacy
  - Issues and solutions

GOAL
2014 HO CHI MINH CITY VIETNAM
OCT 7-10 SHERATON SAIGON HOTEL & TOWERS

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- Health
- Breeding
  - *Kona Bay vannamei*
  - *Brunei monodon*
- Nutrition
  - *Fishmeal replacement*
- Hatchery
- Farm
- Seafood
  - *Kauai Shrimp*
  - *Kauai clams*

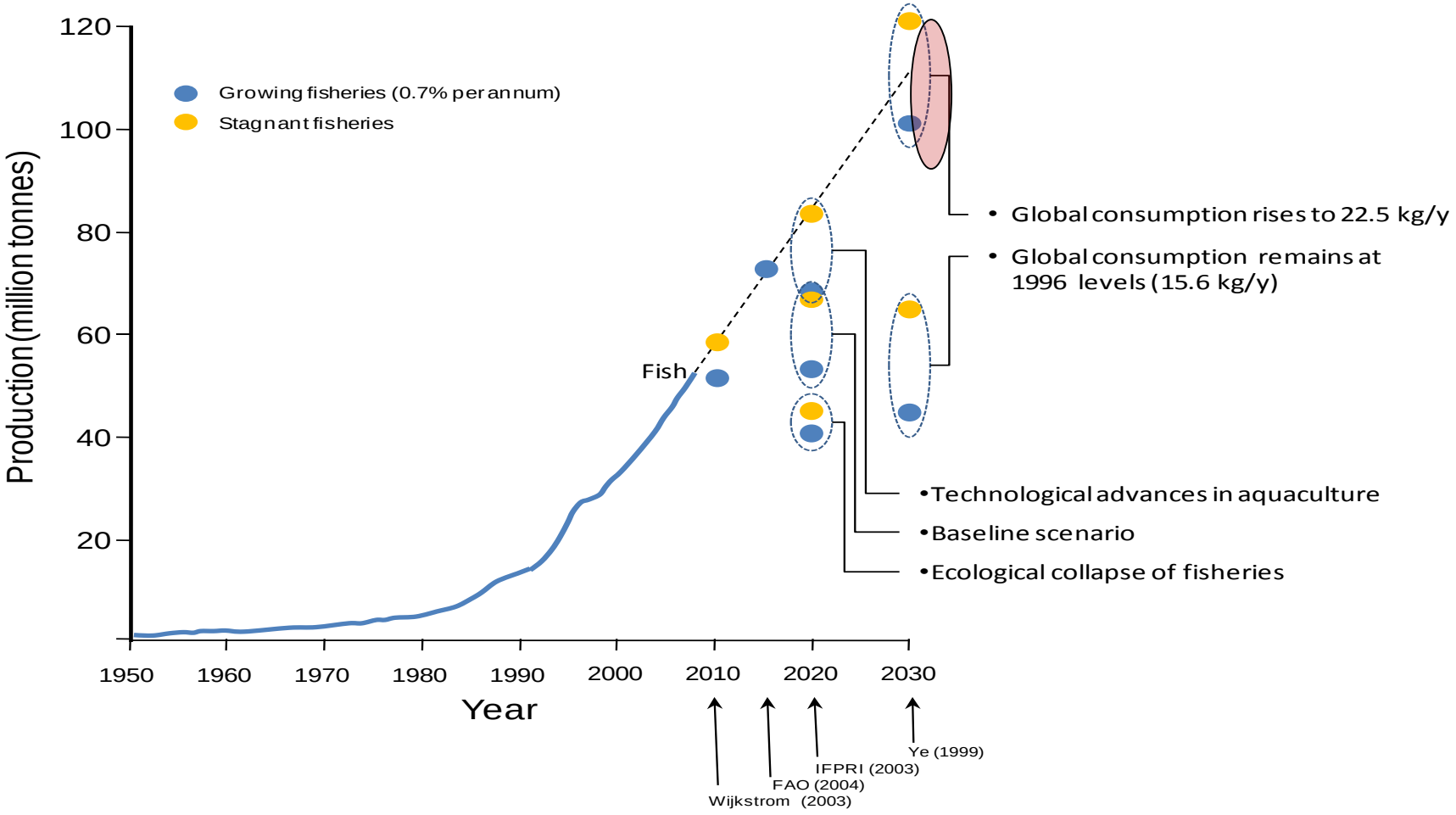
Hawaii, USA

Brunei

# TOPICS

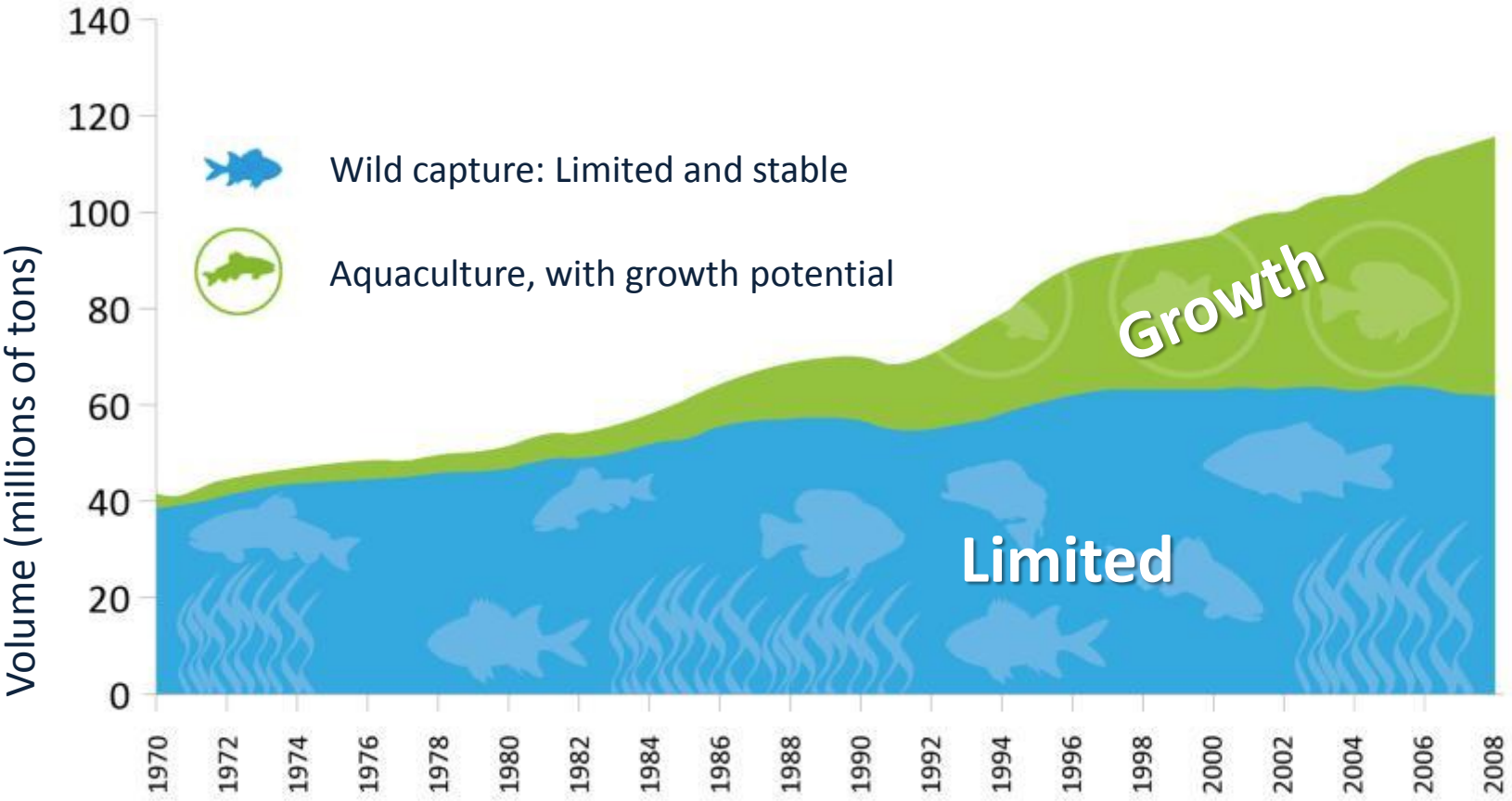
1. **The Challenge**
2. Disease Case Studies
3. Shrimp Health Management
   - The Past
   - The Present – Early Mortality Syndrome
   - The Future
4. Conclusions
5. Panel Discussion

# 1. “FISH TO 2030” PROJECTS EXCEPTIONALLY STRONG GLOBAL SEAFOOD DEMAND

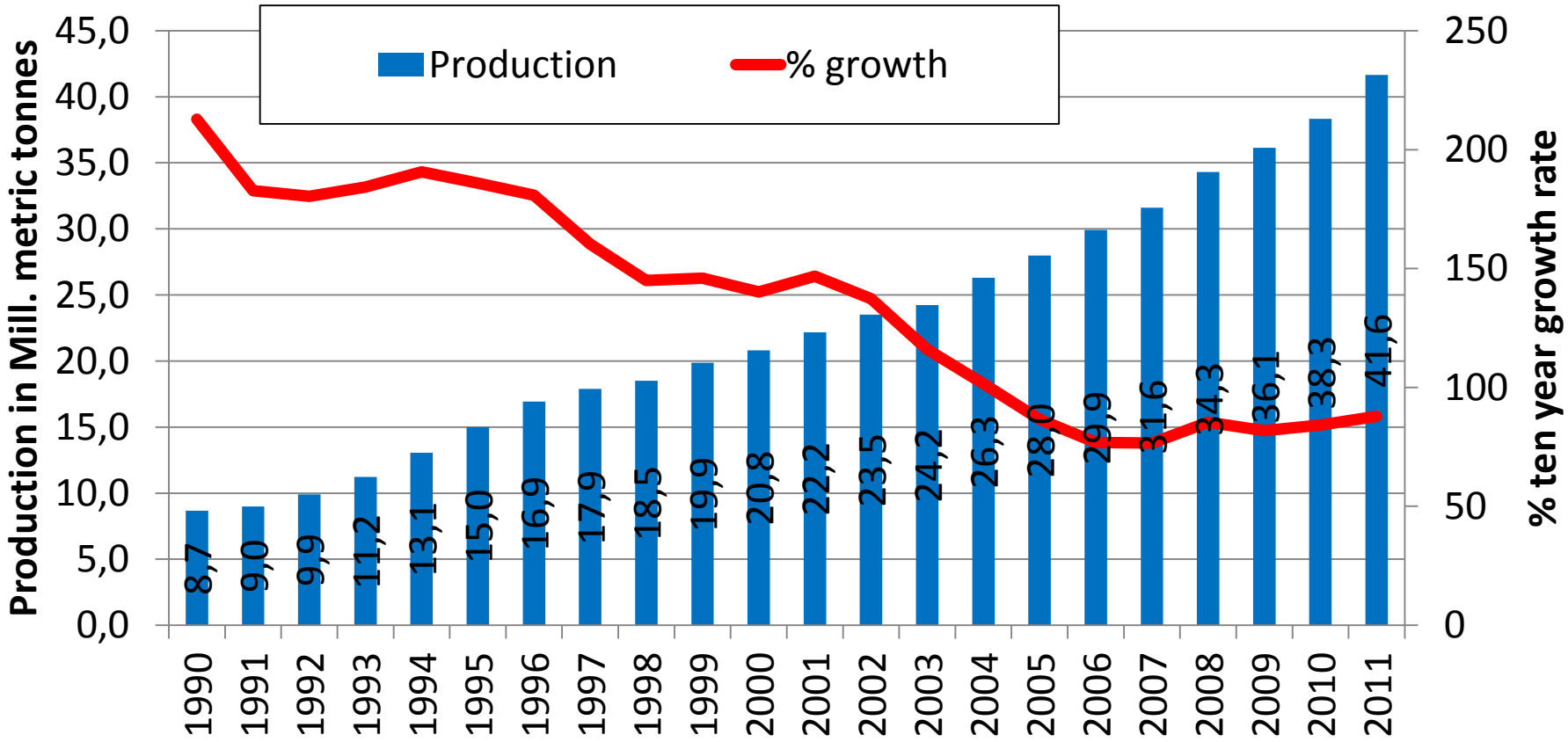



*Source:* Hall, S. Blue Frontiers (2011), WorldFish Centre

# 2. AQUACULTURE IS THE ONLY WAY TO INCREASE OUR SEAFOOD SUPPLY



# 3. THE GROWTH RATE OF AQUACULTURE IS SLOWING DOWN






Source: FAO

# 4. DISEASE IS THE PRIMARY FACTOR LIMITING THE GROWTH OF AQUACULTURE

1. Disease
2. Feed
3. Environment
4. Financing
5. Market

# TOPICS

1. Our Challenge
2. **Disease Case Studies**
3. Shrimp Health Management
   - The Past
   - The Present – Early Mortality Syndrome
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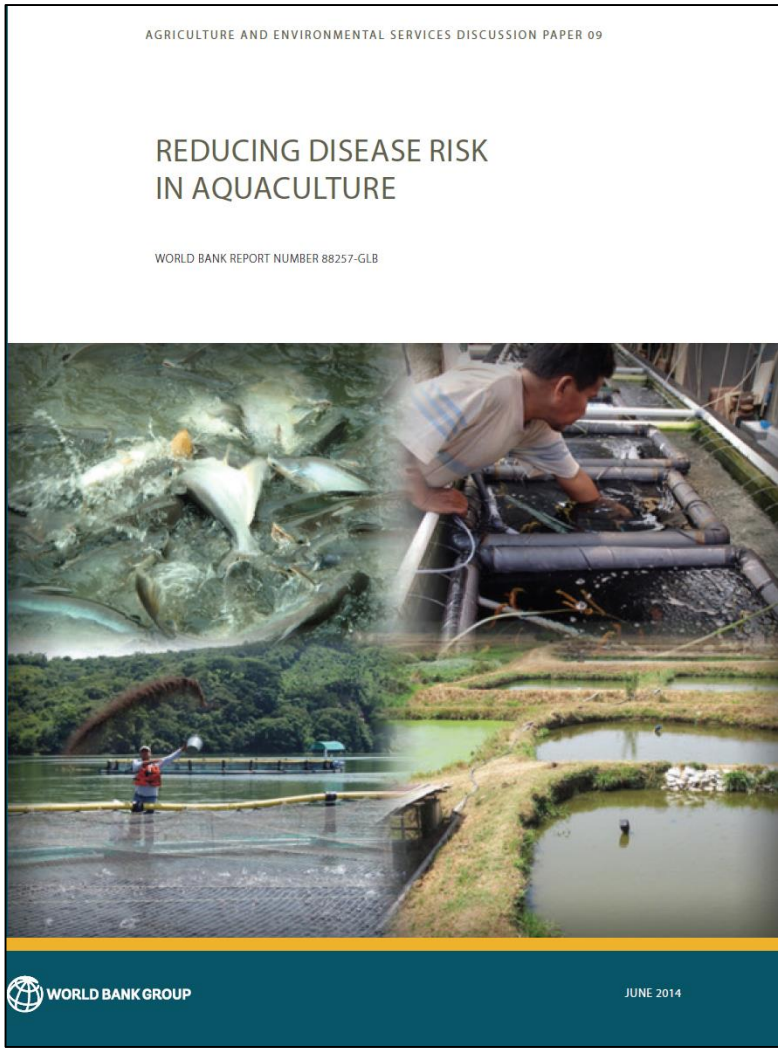
# HOW CAN WE REDUCE DISEASE RISK?

- Lessons Learned in Responsible Aquaculture
  - Initiated in 2011 by the World Bank, the Responsible Aquaculture Foundation, and GAA.
- Objectives
  - To conduct case studies on selected epidemics
  - To identify common causes and solutions
  - To improve preventative management, policy, and regulation.

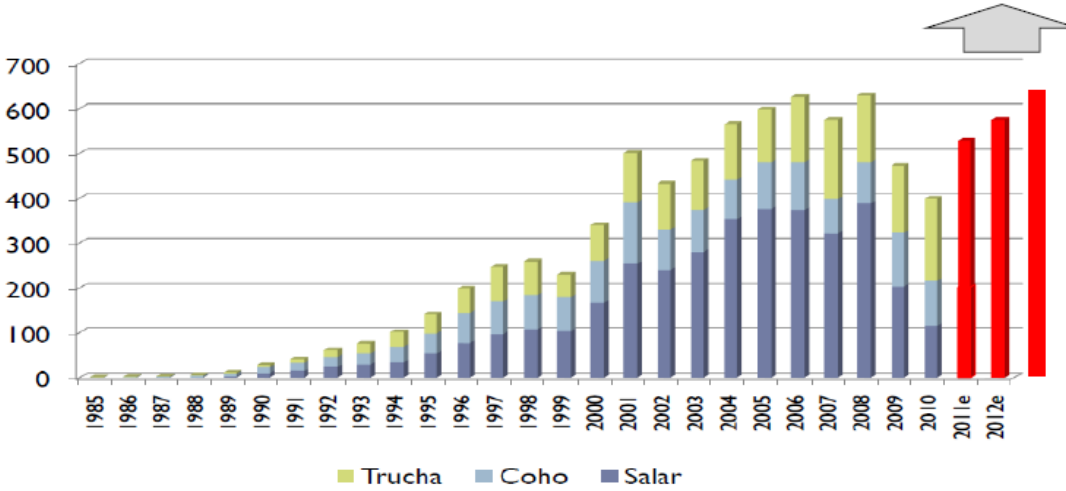
# "REDUCING DISEASE RISK IN AQUACULTURE"

- Three Case Studies:
  - 2011: ISA in Chile
  - 2012: EMS in Vietnam
  - 2013: WSSV in Mozambique and Madagascar
- Report can be downloaded from the GAA website:
  - www.gaalliance.org/newsroom/whitepapers.php



# 2011 CASE STUDY IN CHILE: INFECTIOUS SALMON ANEMIA VIRUS

- Producers captivated by rapid growth of the sector.
- Inadequate biosecurity, surveillance, zone management
- Fast response by industry, banks, and regulators

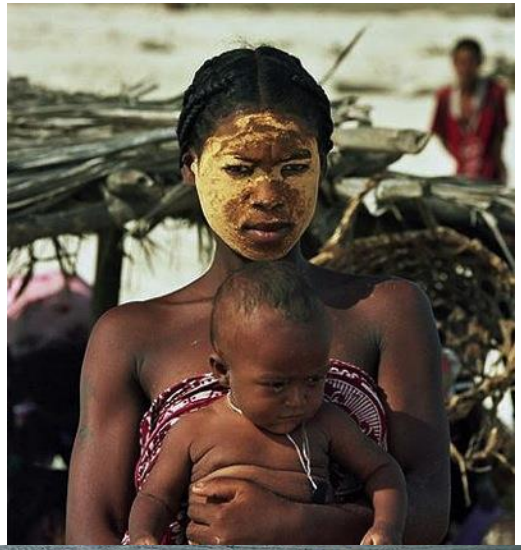



# 2012 CASE STUDY IN VIETNAM: EARLY MORTALITY SYNDROME OF SHRIMP

- EMS started in China and spread to Vietnam, Malaysia, Thailand, and Mexico
- Study began before cause of disease was known, but members of the team identified the pathogen a few months later.
- Inadequate biosecurity, sanitation, quarantine, and surveillance.

# 2013 CASE STUDY IN MOZ AND MAD: WHITE SPOT VIRUS OF SHRIMP

- Strain identification of the WSSV pathogen indicated that it originated from the Middle East.
- Limited surveillance and biosecurity
- Need for cooperation between Mozambique and Madagascar




# TOPICS

1. Our Dilemma
2. Disease Case Studies
3. **Shrimp Health Management**
   - The Past
   - The Present – Early Mortality Syndrome
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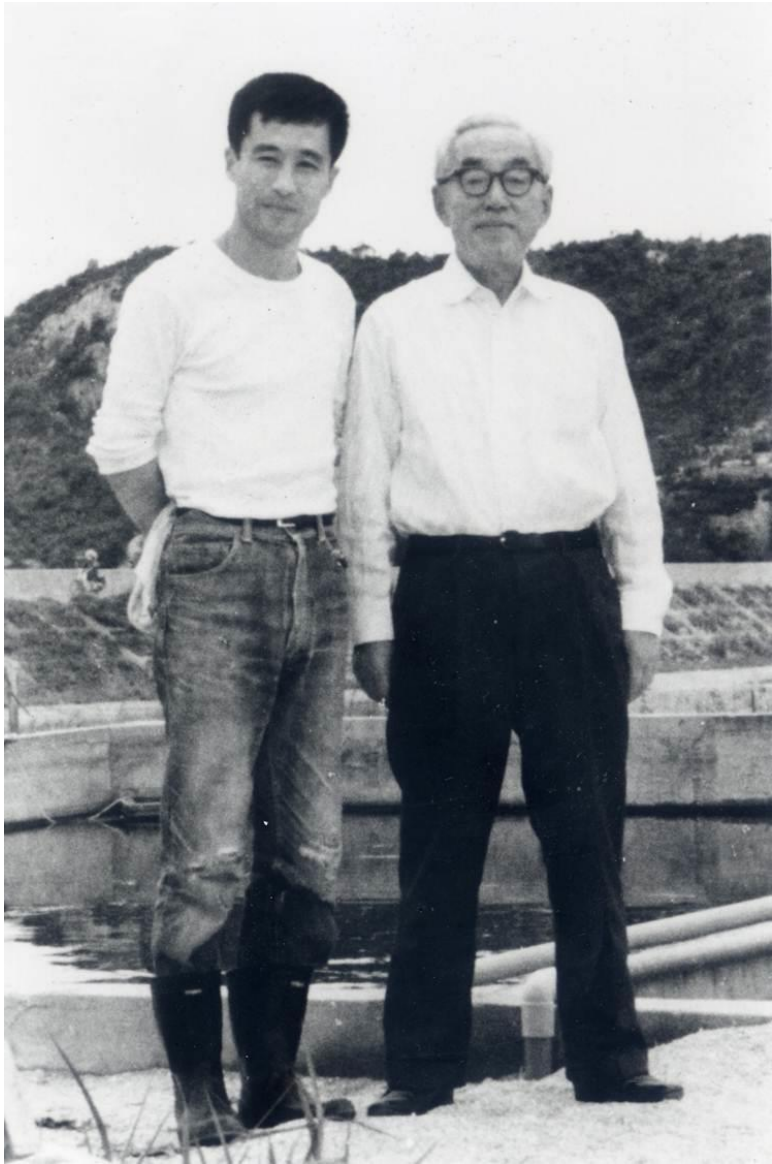
## THE PAST: *BEGINNING WITH PRIMITIVE SYSTEMS, LOW YIELDS*

- For centuries, shrimp farming was conducted in a very primitive manner
  - Crude, tidal ponds
  - Wild postlarvae
  - Minimal control of stocking density, predators, environment, nutrition, or health

# The Past:

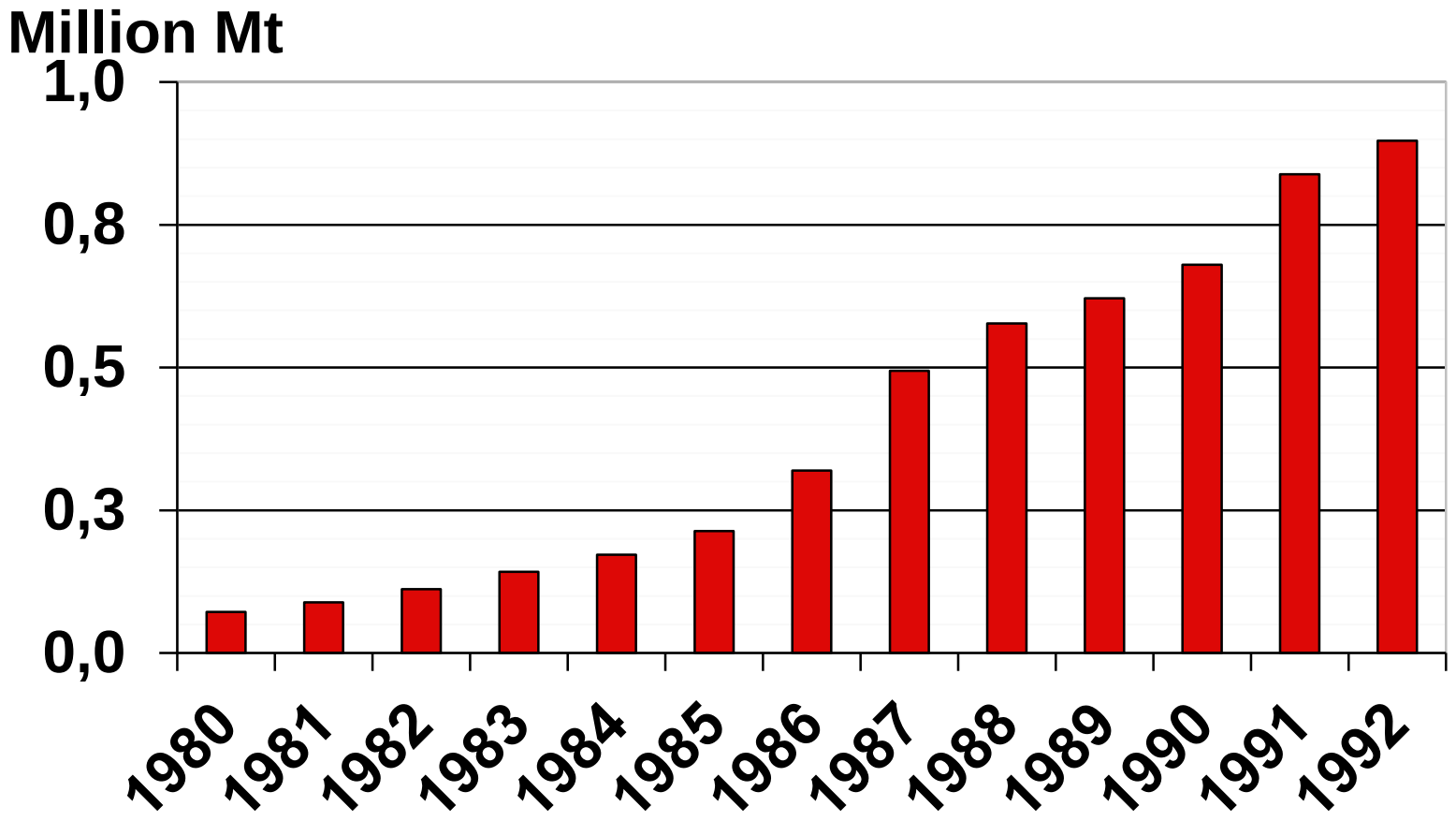
*Learning the fundamentals to increase control*

- Dr. Fujinaga (1938-1968)
  - Developed techniques for spawning, larval rearing, and growout of *P. japonicus*
- Dr. Liao (1968-1985)
  - Transferred Fujinaga's technology to *P. monodon* in Taiwan
  - Intensive farming systems of Taiwan became the model for Asia



# TAIWAN IN 1980’S:
## INTENSIFICATION AND FRAGMENTATION

# RAPID INDUSTRY EXPANSION, BUT HIGHLY VULNERABLE TO DISEASE



# REPEATED DISEASE OUTBREAKS

| Year | Countries | Disease |
|---|---|---|
| 1982 | Ecuador | BP |
| 1988 | Taiwan | YHV |
| 1992 | China, pandemic | WSSV |
| 1994 | Ecuador, pandemic | TSV |
| 2002 | Thailand, Indonesia | MSGV |
| 2004 | Brazil, Indonesia | IMNV |
| 2006 | Belize, Mexico | PvNv |
| 2010 | China, Vietnam, Malaysia, Thailand, Mexico | EMS |

# WSSV EPIDEMIC TRIGGERED ENVIRONMENTAL ATTACKS.

- WSSV began in China and spread throughout Asia and Americas.
- Global shrimp production was flat for a decade.
- Critics asserted that shrimp farming is inherently unsustainable (mangrove destruction, pollution, banned chemicals, social issues)
- Supreme Court of India ruled against shrimp farming in 1996.

# FORMATION OF GAA

- Founded in 1997
- Gathered facts to refute exaggerations
- Developed Codes of Practice for Responsible Shrimp Farming in 1999
- Developed BAP standards for certification of farms, hatcheries, feed mills, and processing plants
- Great improvements in mangrove conservation, pollution, etc.
- 1.4 mlllion MT now BAP certified.

# WSSV EPIDEMIC LED TO IMPROVED HEALTH MANAGEMENT

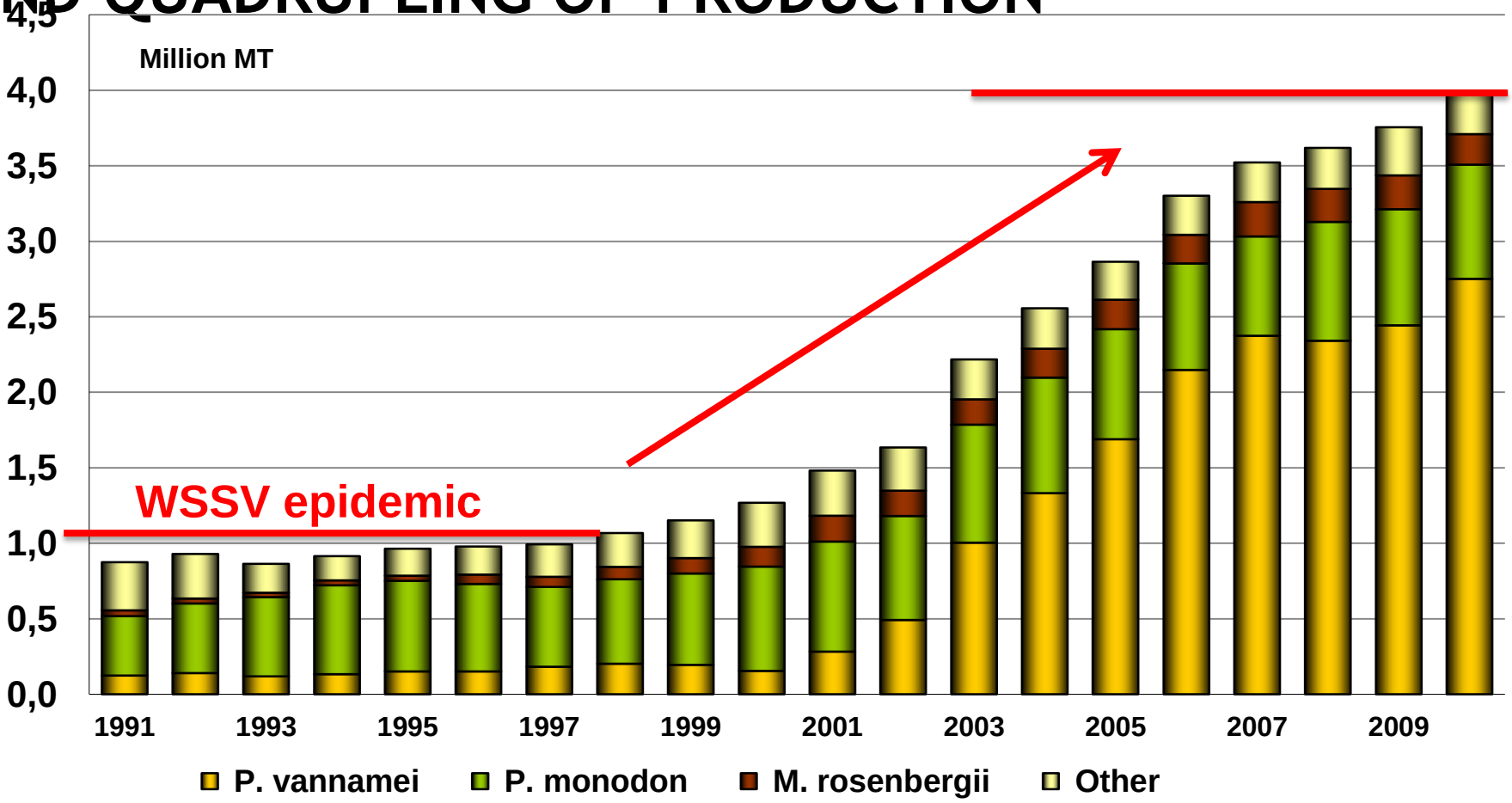
- Biosecurity
  - Widespread use of PCR testing
  - Tightening regulations on movement of animals
- Farm management
  - Reduced water exchange which led to development of biofloc systems
  - Control of disease carriers with disinfectants, crustacides, and bird netting

# THE BREAKTHROUGH: SPF *L. VANNAMEI*

- Breeding of Specifc Pathogen Free stocks by Oceanic Institute in Hawaii
- Initial trials successful in Texas, but failed in Ecuador due to Taura Syndrome Virus

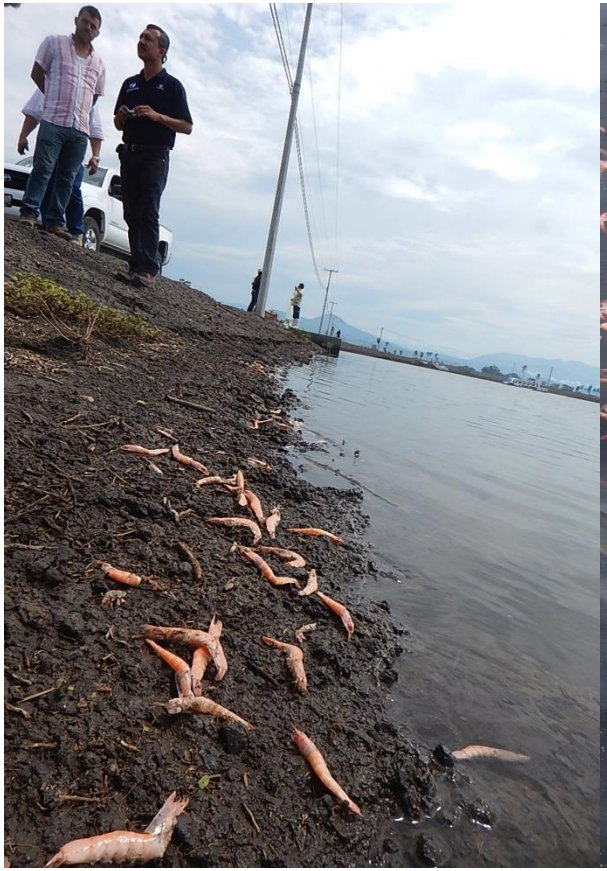
- Bred SPF stocks for resistance to TSV
- Rapidly replaced infected *P. monodon*.
- Led to development of private breeding companies (e.g., CP, SIS, Kona Bay).

# WSSV EPIDEMIC LED TO INDUSTRY TRANSFORMATION AND QUADRUPLING OF PRODUCTION

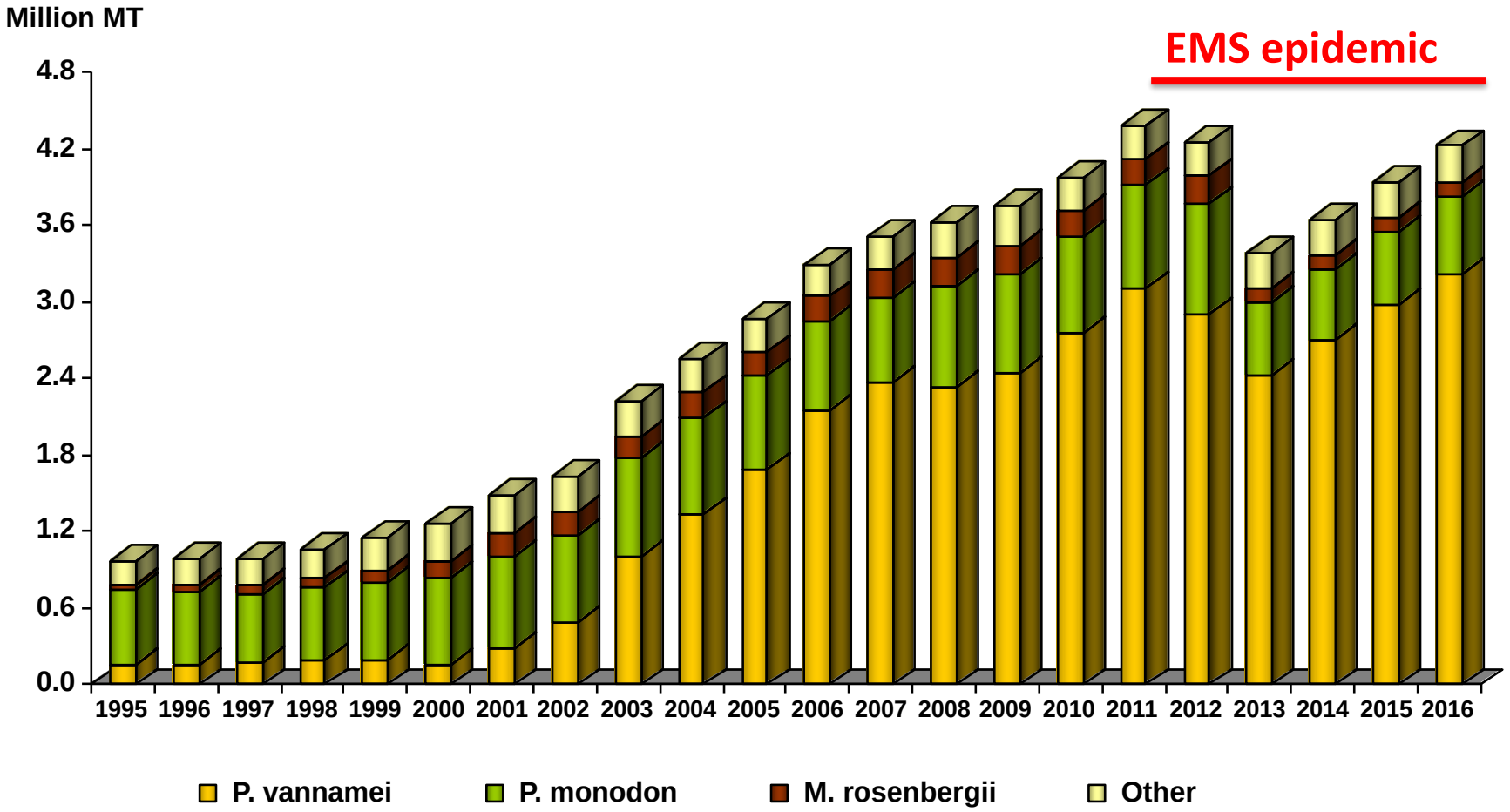



Sources: FAO (2013) for 1991-2011; GOAL (2013) for 2012-2015.

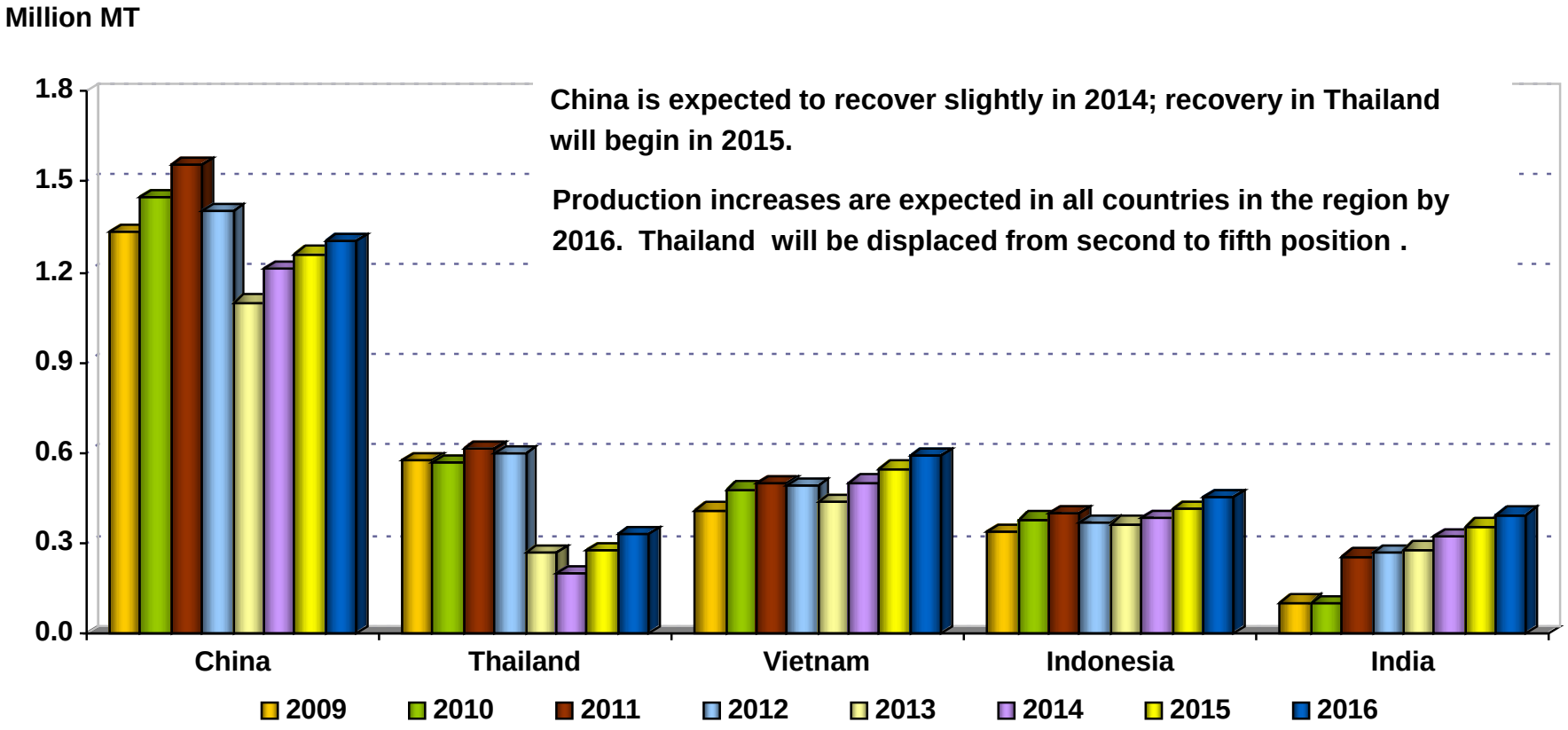
# THE PRESENT
## *ANOTHER EPIDEMIC – EARLY MORTALITY SYNDROME*



# SHRIMP PRODUCTION IS DOWN, BUT THE TIDE IS TURNING



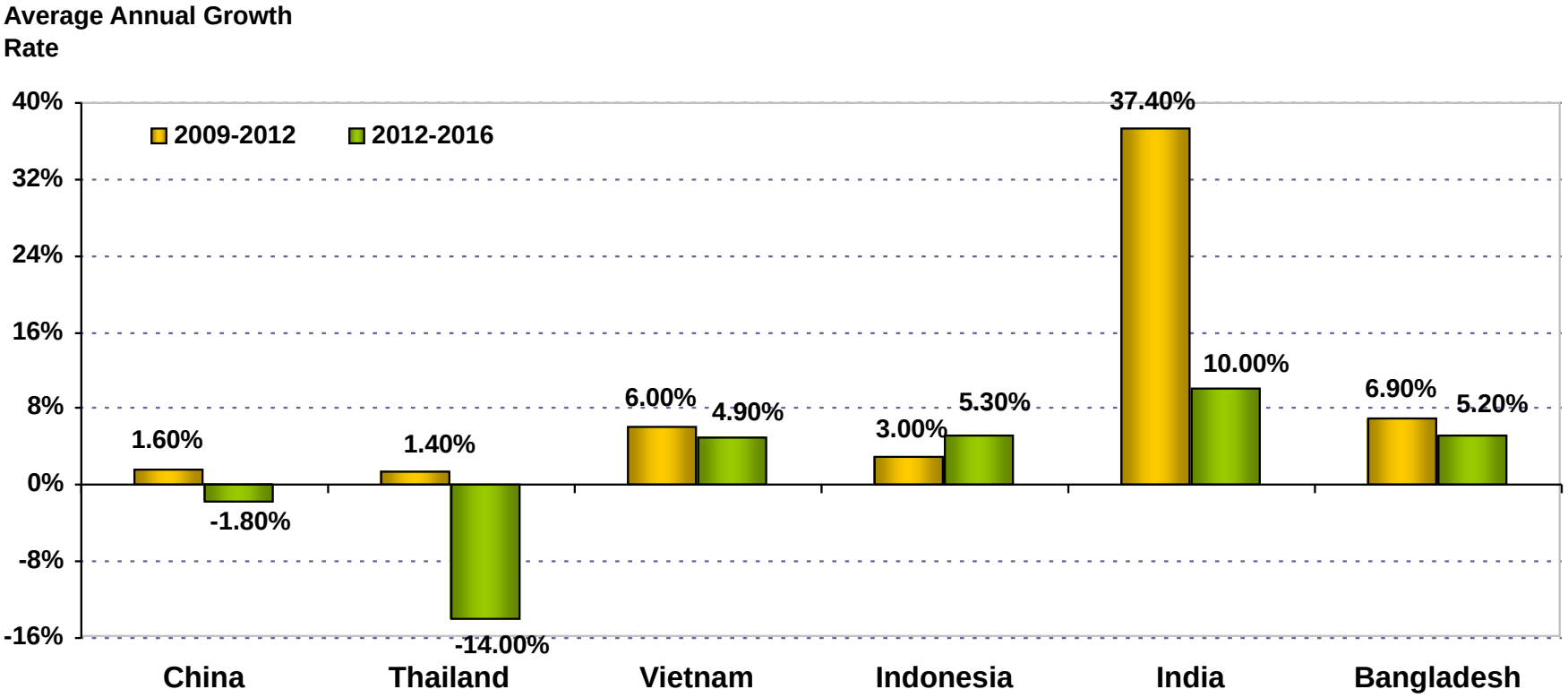
# SHRIMP AQUACULTURE IN ASIA: 2009 – 2016
# MAJOR PRODUCERS




**Sources: FAO (2014) for 2009-2012; GOAL (2014) for 2013-2016.**

***M. rosenbergii* is not included.**

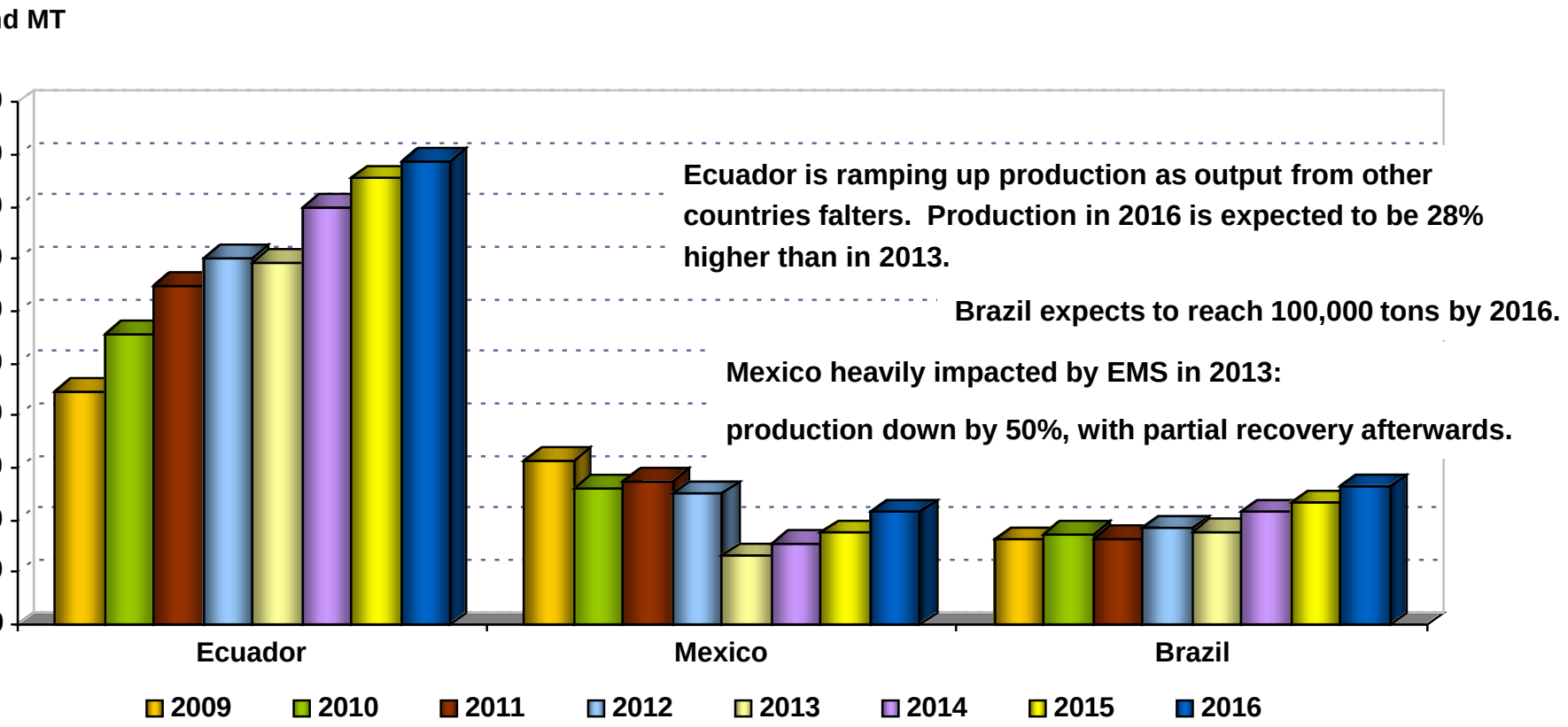
# SHRIMP AQUACULTURE IN ASIA:
# 2009-2012 VS. 2012-2016




**Sources: FAO (2014) for 2009-2012; GOAL (2014) for 2013-2016.**

***M. rosenbergii* is not included.**

# SHRIMP AQUACULTURE IN LATIN AMERICA: 2009 – 2016
# MAJOR PRODUCERS

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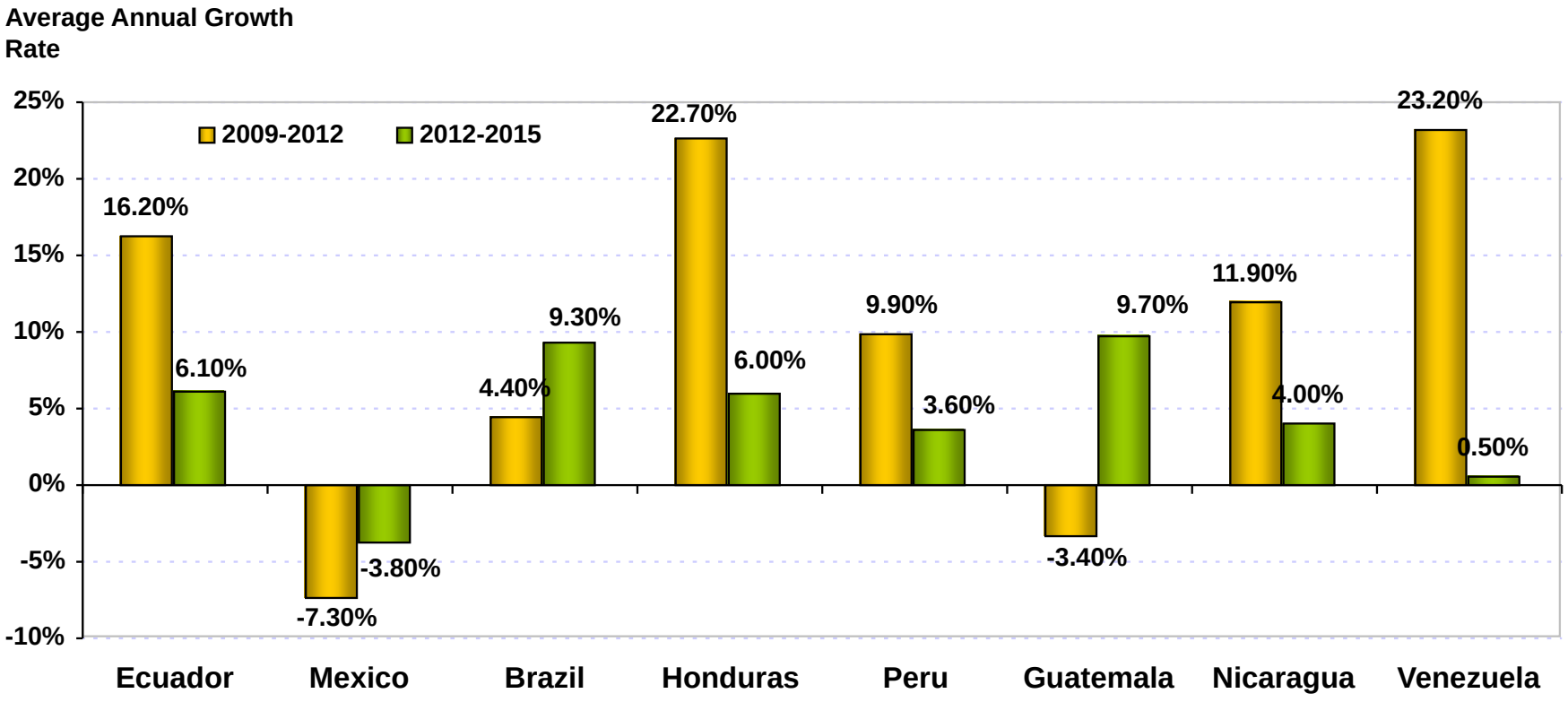
# SHRIMP AQUACULTURE IN LATIN AMERICA: 2009-2012 VS. 2012-2016




**Sources: FAO (2014) for 2009-2012; GOAL (2014) for 2013-2016.**

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# 2014 SURVEY ON EMS IN AFFECTED COUNTRIES

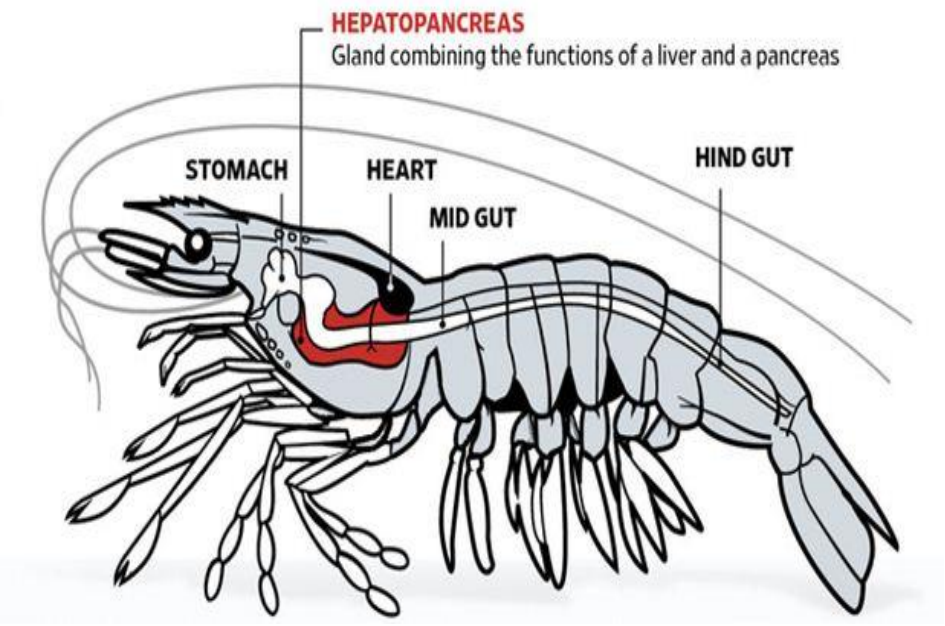
- Expert Committee
  - Patrick Sorgeloos, Don Lightner, Victoria Alday, Noriaki Akazawa, Stephen Newman, Loc Tran, James Brock, Bruno Gil, Indrani Karunasagar, Randall Brummett, Huang Jie, Angus Cameron, CV Mojan, Peter van Wyk, George Chamberlain
- Online survey of farms in each affected country
  - Identify practices associated with successful EMS management
  - Dr. Brendan Cowlan will summarize during the panel
- Followup case studies of selected farms
  - In-depth audits to validate trends seen in survey

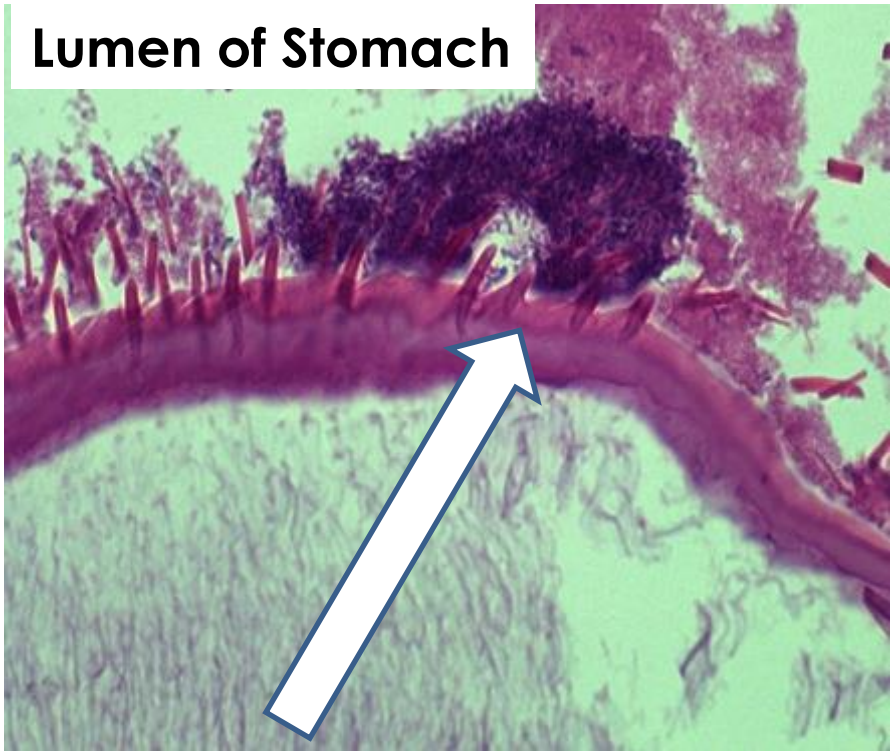
# THE EMS EXPERT COMMITTEE TESTED THE SURVEY BY INTERVIEWING VIETNAMESE FARMERS

# WHAT HAVE WE LEARNED?

- Early mortality syndrome (EMS), or acute hepatopancreatic necrosis syndrome (AHPNS), is a bacterial disease caused by a strain of *Vibrio parahaemolyticus*
- It does not affect humans

# EMS COLONIZES THE STOMACH AND PRODUCES A TOXIN THAT DAMAGES THE HEPATOPANCREAS

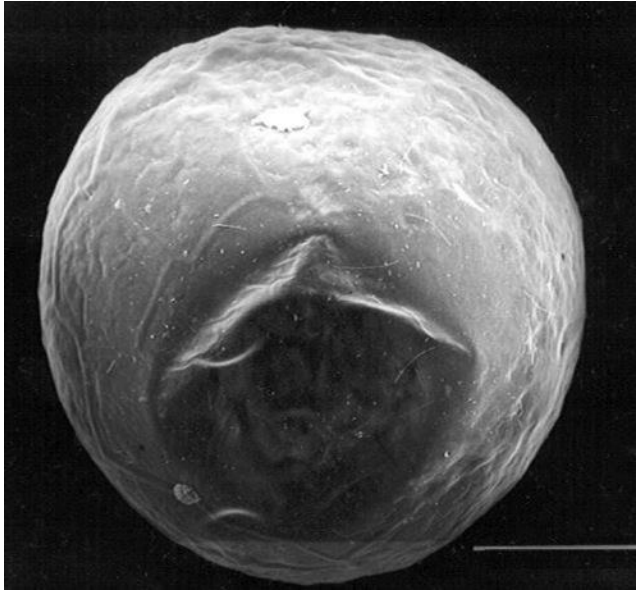



**Microcolony of bacteria growing on epicuticle of gastric wall**

# HOW IS IT TRANSMITTED?

- Vertically
  - Can be carried in broodstock and larvae
  - Live feeds for shrimp reproduction, esp. polychaete worms are a major concern
- Horizontally
  - Cannibalism, consumption of carriers, fecal/oral, and water.

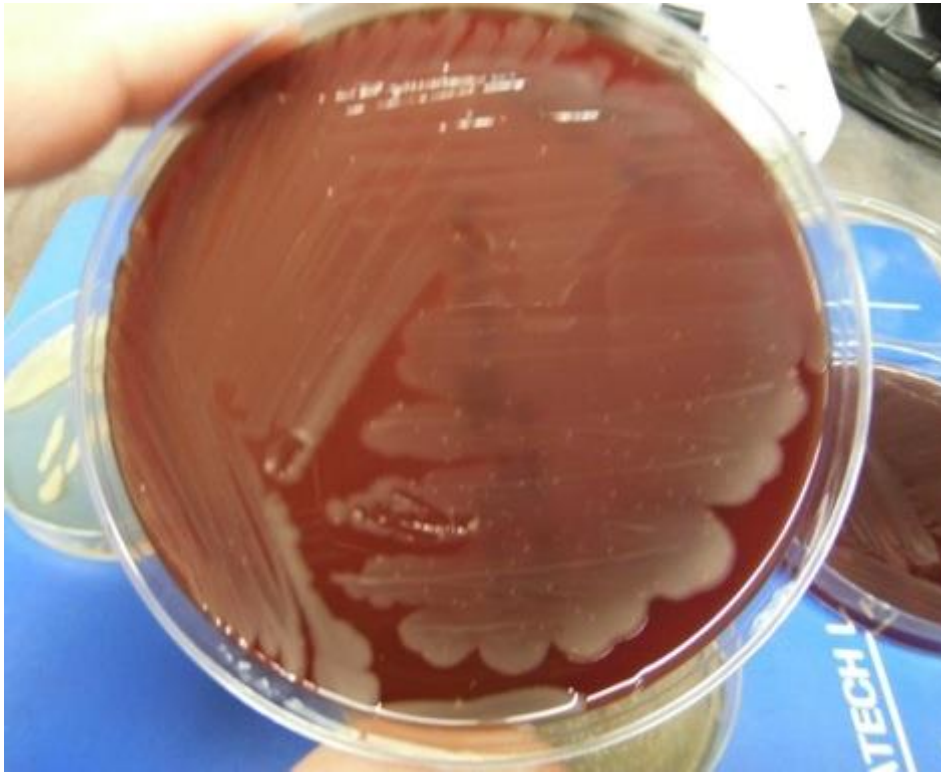


Bacterial plaque on egg

Cannibalism

# WHY IS THE EMS PATHOGEN DIFFERENT THAN A VIRUS?

- Unlike viruses, it does not require a host organism to replicate
- Once established in the environment. It colonizes quickly
- It can be displaced by a mature microbial community



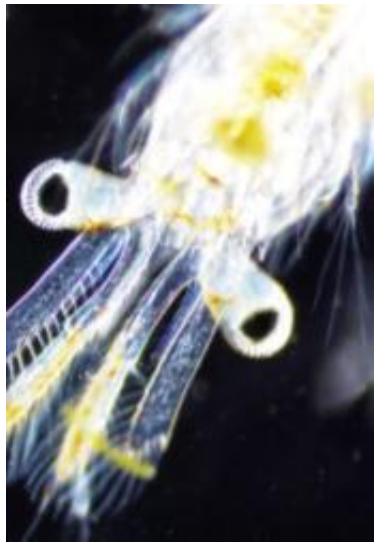
# A LUCKY, UNEXPECTED BREAK:
## GENETICALLY-RESISTANT *L. VANNAMEI*

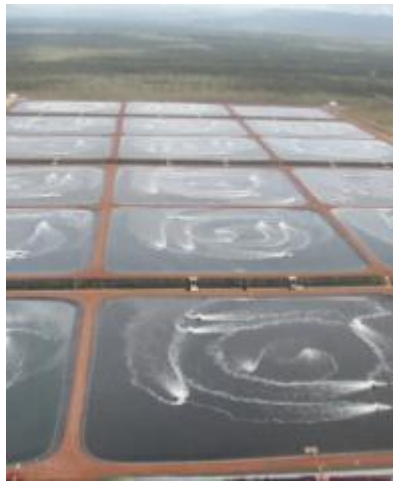
- Survey revealed a promising trend with EMS-resistant *L. vannam*ei in Mexico
- Preliminary followup data supports this trend:

| **Shrimp Production in EMS-Affected Areas in Sonora, Mexico** | | |
|---|---|---|
| | EMS-resistant | Non-resistant |
| Production (kg/ha) | 1,800-2,000 | 150-300 |
| Survival (%) | 45-90 | 20-30 |
| Pre-harvest | 18 | -- |
| Final harvest | 28 | 32-36 |

# PUTTING IT ALL TOGETHER

- Diagnostics
  - Improved PCR tests
- Breeding
  - Genetic resistance to EMS
- Hatchery
  - Avoid infected foods
  - Improve sanitation
- Farm
  - Manage microbial community
- Feed
  - Additives to improve EMS resistance





# WHAT'S NEXT?

- We are learning to manage EMS, but already other new diseases are emerging
  - Microsporidean parasite
  - Covert Nodavirus

# STUDY OF 200 SHRIMP PONDS IN THAILAND

| AHPND | No AHPND but bacterial lesions | Early mortality but No HP lesions | Collapsed HP epithelium | Normal HP |
|---|---|---|---|---|
| **03**, **07**, **11**, 12, **16**, 20, **32**, 34, 40, 45, 47, 50, 52, **54**, 55, 58, 73, **74**, 82, 83, 84, 87, 90, **91**, 92, 93, 105, **110**, **112**, 116, **119**, **122**, **126**, 131, 144, **150** | 04, 05, 21, 24, 44, 51, 69, 75, 79, 86, 88, 96, 99, 101, **117**, **130**, 133, 136, 139, 143 | **57**, **70**, **98**, **100**, **111** | 02, 15, **17**, 25, 26, 29, 30, 37, 38, 46, 48, 49, 53, 64, 65, 76, 80, 81, 95, 97, 104, 109, 113, 114, 115, 123, 125, 127, 128, 134, 135 | 01, 06, 08, 09, 10, 13, 14, 18, 19, 22, 23, 27, 28, 31, 33, 35, 36, **39**, 41, 42, 43, 56, 59, 60, 61, 62, 63, 66, 67, 68, 71, 72, 77, 78, 85, 89, 94, 102, 103, 106, 107, 108, 118, 120, 121, 124, 129, 132, 137, 138, 140, 141, 142, 145, 148, 149 |
| 36/148 (24%) | 20/148 (14%) | 5/148 (3%) | 31/148 (21%) | 56/148 (38%) |

Infected with the microsproidian *E. hepatopenaei* (EHP) 72/148 = 49%

Mortality <35 days (study definition of EMS = 21/148 = 14%)

Infected with white spot syndrome virus (WSSV) = 8/148 = 5%

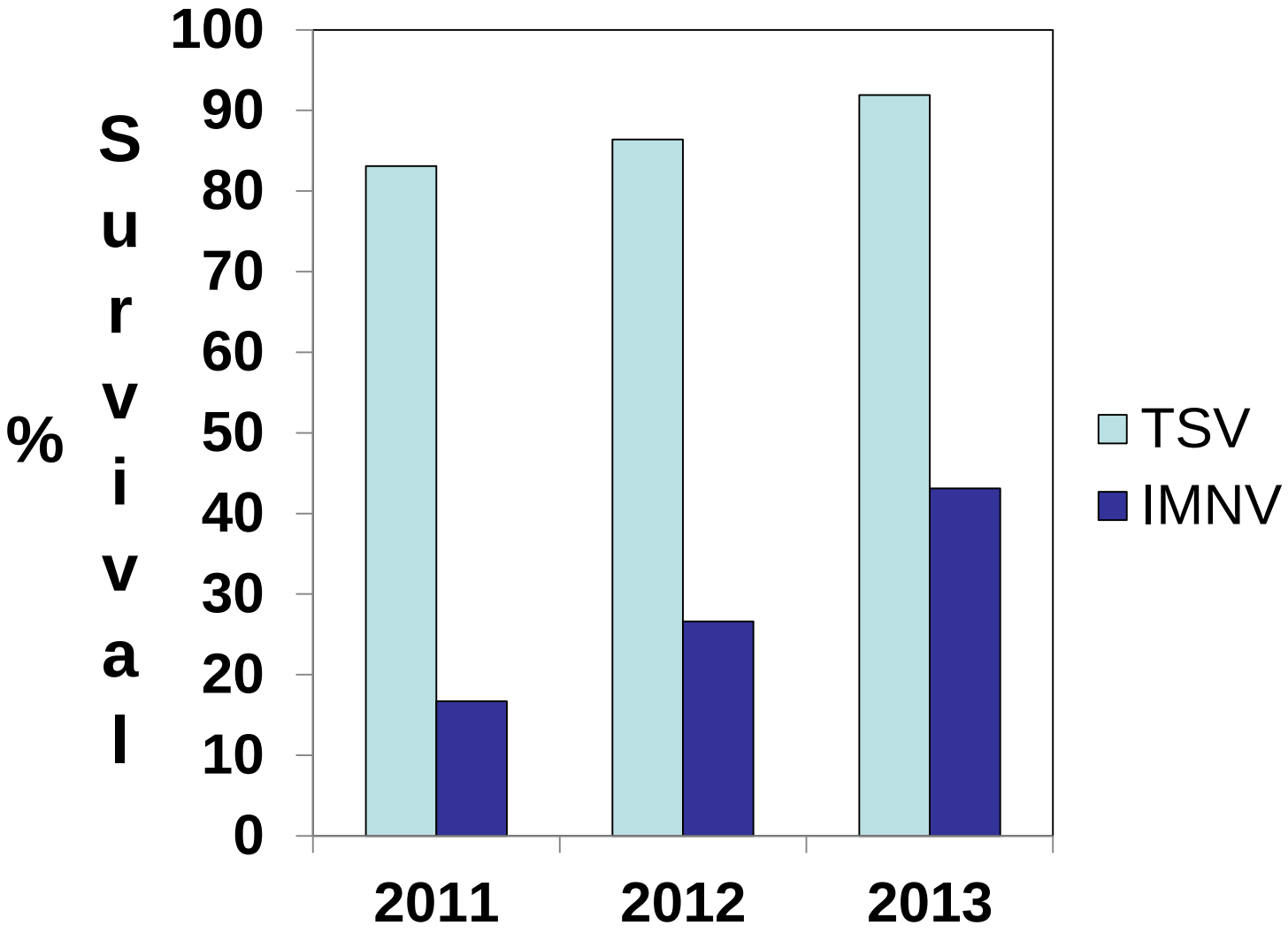
Covert mortality nodavirus (CMNV) = 64/148 = 43%

Specimens 146 and 147 un-readable (poor fixation)

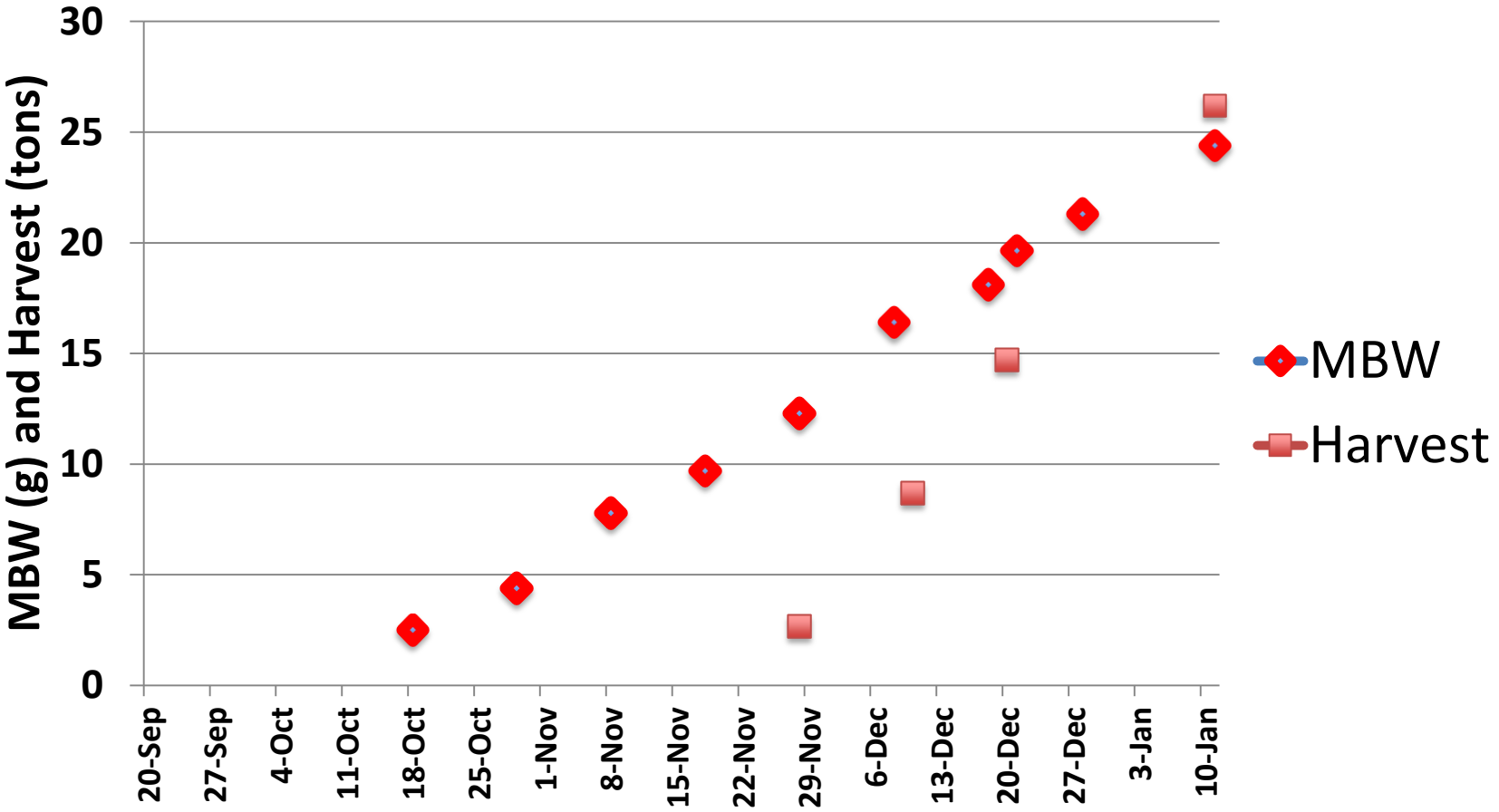
# THE FUTURE

- Our journey
  - As shrimp farming matures, it must continue to develop improved controls that help reduce disease risk, increase production, and improve sustainability.

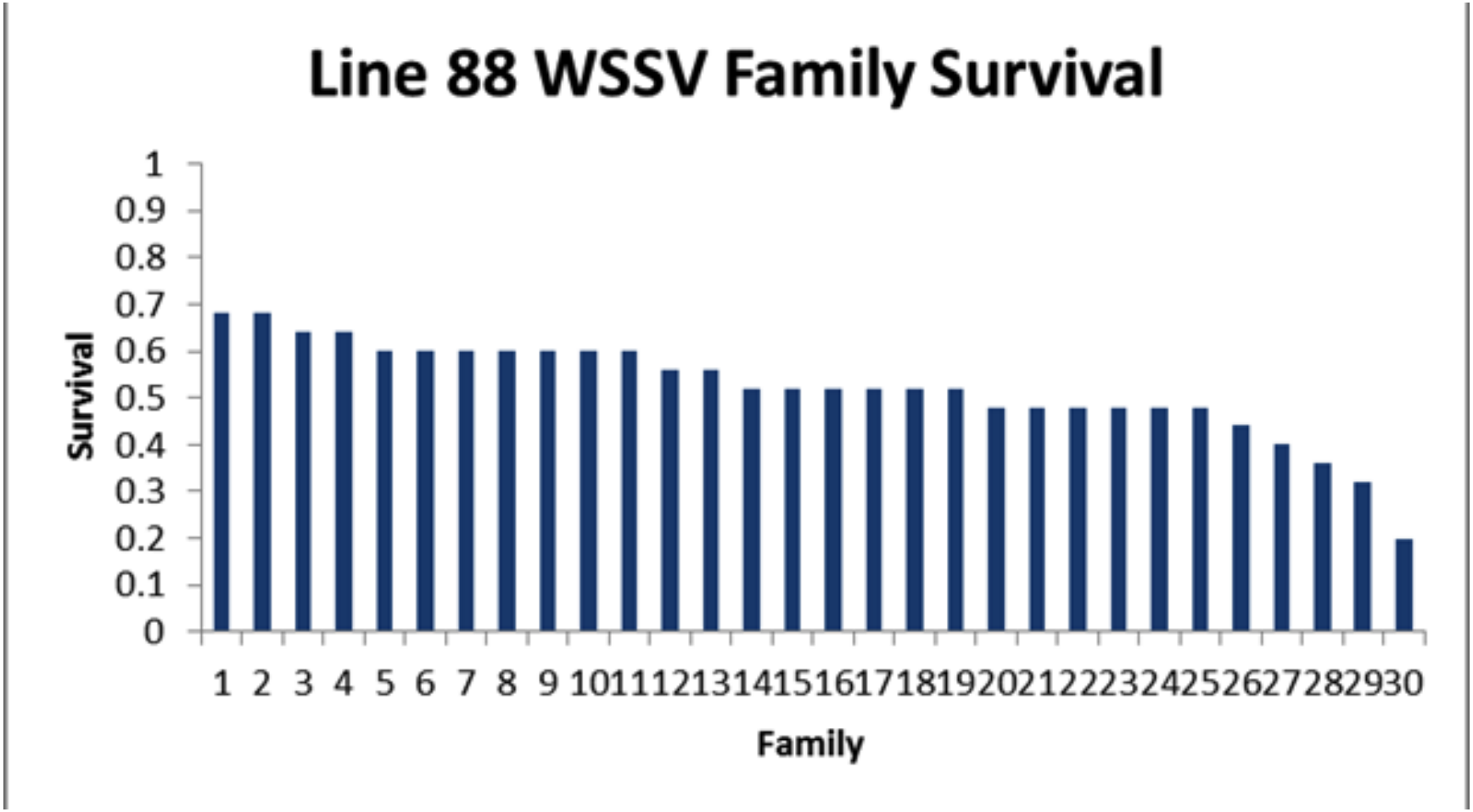
# BRAZIL SHOULD CONSIDER SPF/SPR L. VANNAMEI



# INDONESIA IS ACHIEVING FAST GROWTH AND HIGH YIELDS DESPITE IMNV (MAKASAR, INDONESIA 114 DAYS)

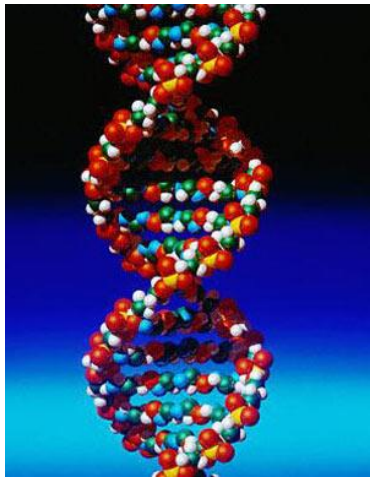


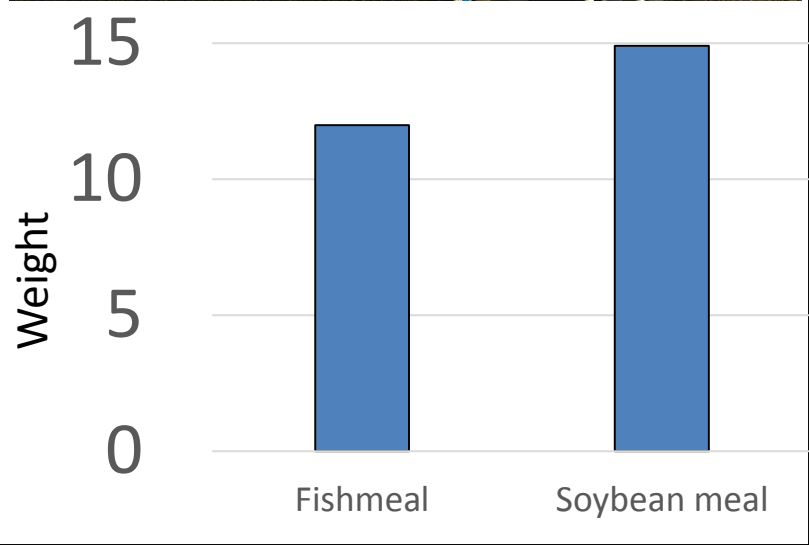
# SPF STOCKS WITH RESISTANCE TO WSSV ARE ALSO AVAILABLE



# MARKER-ASSISTED BREEDING

- Molecular Markers (SNPs) used for trait identification in mainstream agriculture.
- In Hawaii, soy farmers are funding research on markers for dietary soy tolerance in shrimp





# DEEP INTENSIVE PONDS

- Deep ponds (3-5 m) used in Vietnam for *Pangasius* now being built for shrimp in China
- Can achieve yields of 30-50 mt/ha/cycle.

Pangasius

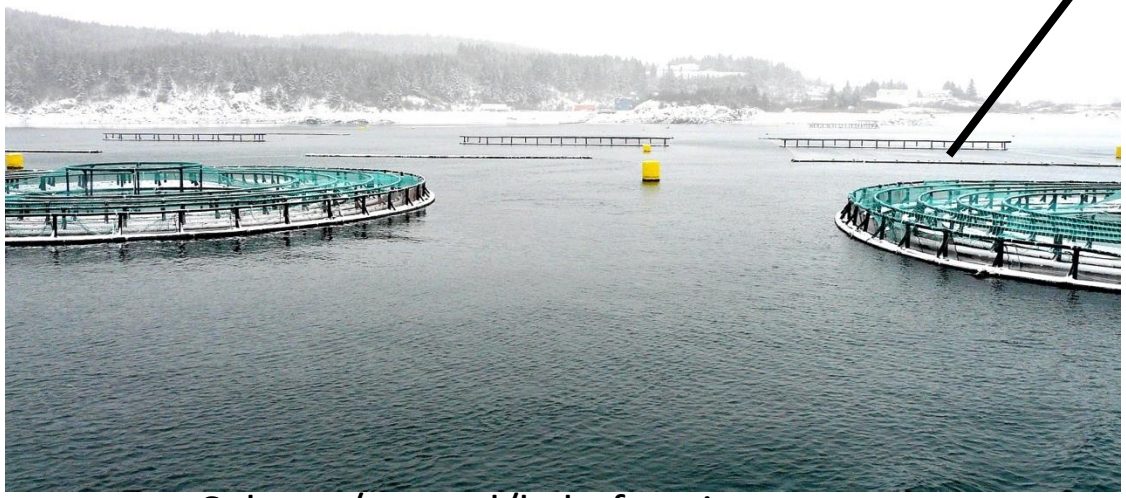
# MORE EFFICIENT FEEDING

- Salmon farms achieve the lowest FCRs in aquaculture
- Centralized computer controlled feeding systems being used in shrimp ponds in Brunei to drive down FCR

Salmon farming

# INTEGRATED MULTI-TROPHIC AQUACULTURE

- Mussels feed on algae and organic waste from salmon farms in Chile
- Clams feed on algae and organic waste in shrimp ponds in Hawaii and produce a valuable secondary crop.



Salmon/mussel/kelp farming

# ZONE MANAGEMENT STANDARD

- Zone management standards are under development as BAP 5th star
  - Proximity among farms
  - Veterinary services
  - Quarantine
  - Management practices
  - Information sharing

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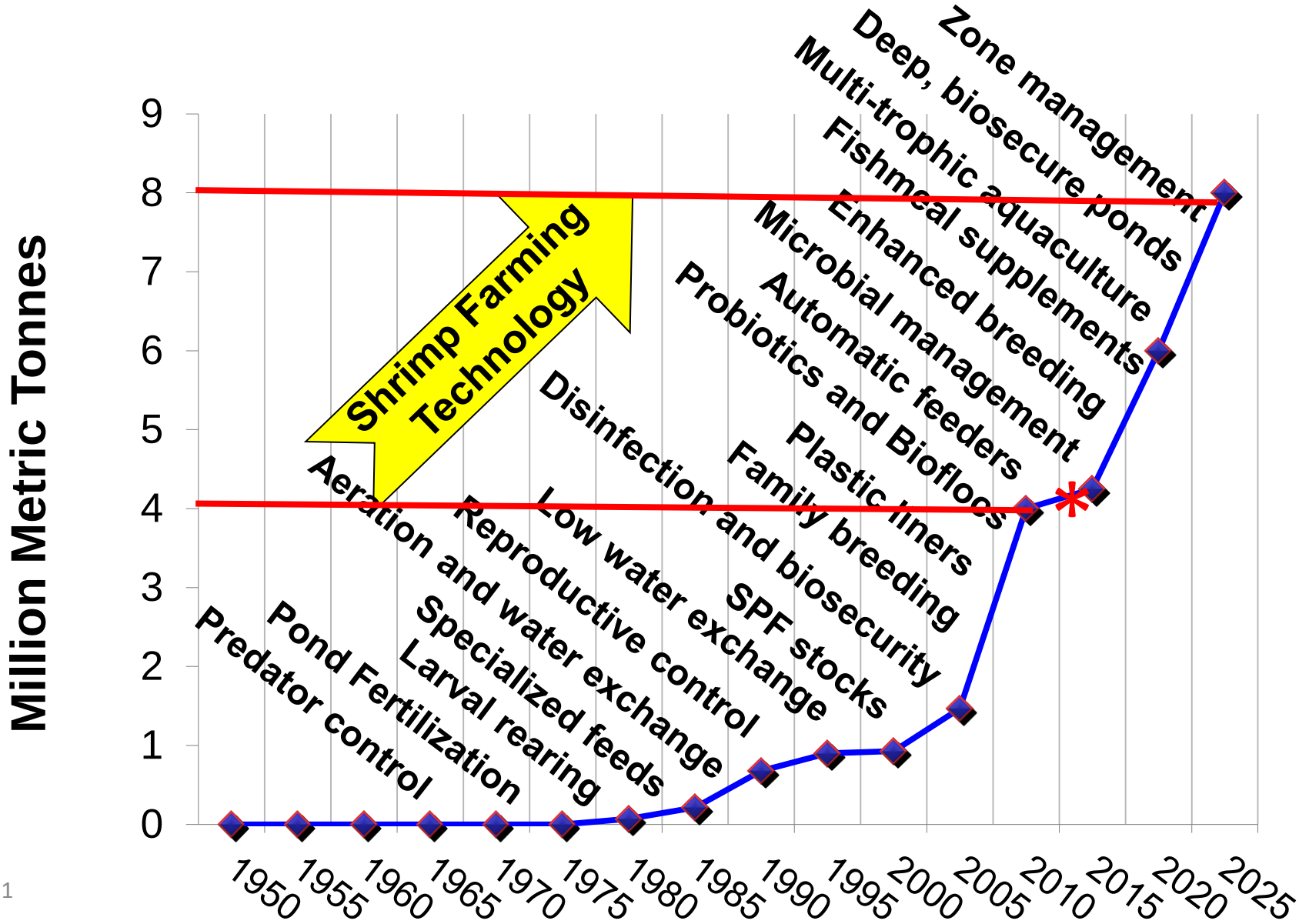
# OUR EXPECTION: SHRIMP FARMING WILL DOUBLE IN THE NEXT DECADE



# CONCLUSIONS

- Seafood demand is strong due to rising middle class in Asia and aquaculture is the only way to meet this increasing demand
- Disease is a key factor limiting industry growth, but the industry is recovering from EMS.
- Brazil is in a strong position to implement improving technology and expand production to meet the growing global shrimp demand.
- Major opportunities:
  - Utilize SPF *L. vannamei* lines that are genetically resistant to IMNV and WSSV
  - Implement biosecure intensive systems