

Aquatic Animal Diseases and Emerging Threats, role and achievements of

Kuwait Institute for Scientific Research (KISR)

Workshop on enhancing aquatic animal health and biosecurity

26-29 October 2025, Jeddah, Saudi Arabia

Dr. Sherain N. Al-Subiai
KISR
Kuwait



World
Organisation
for Animal
Health

Organisation
mondiale
de la santé
animale

Organización
Mundial
de Sanidad
Animal

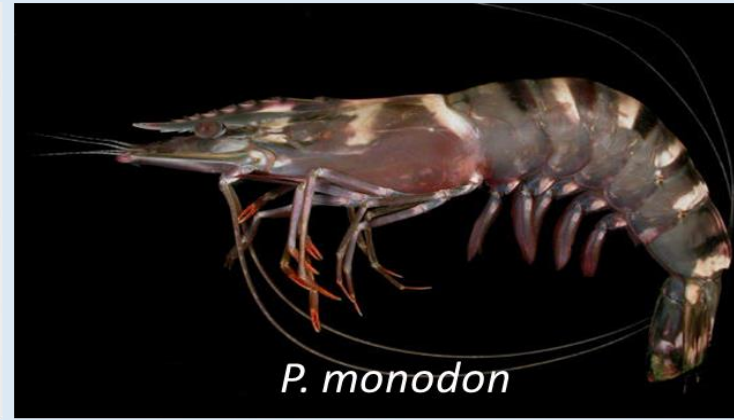


وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture

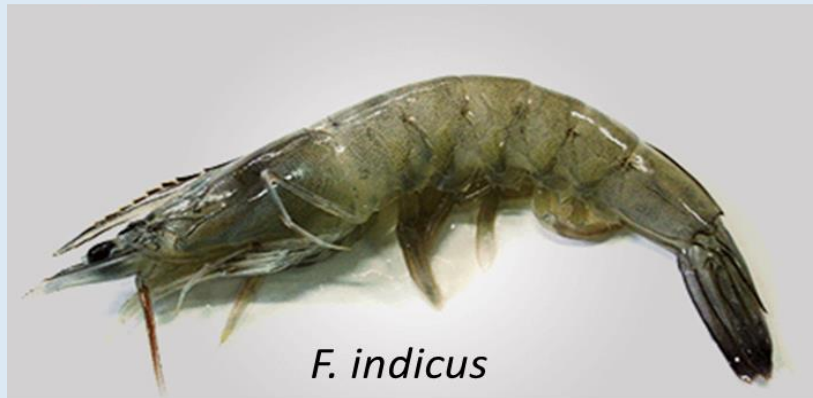
Kingdom of Saudi Arabia المملكة العربية السعودية



L. vannamei



P. monodon



F. indicus

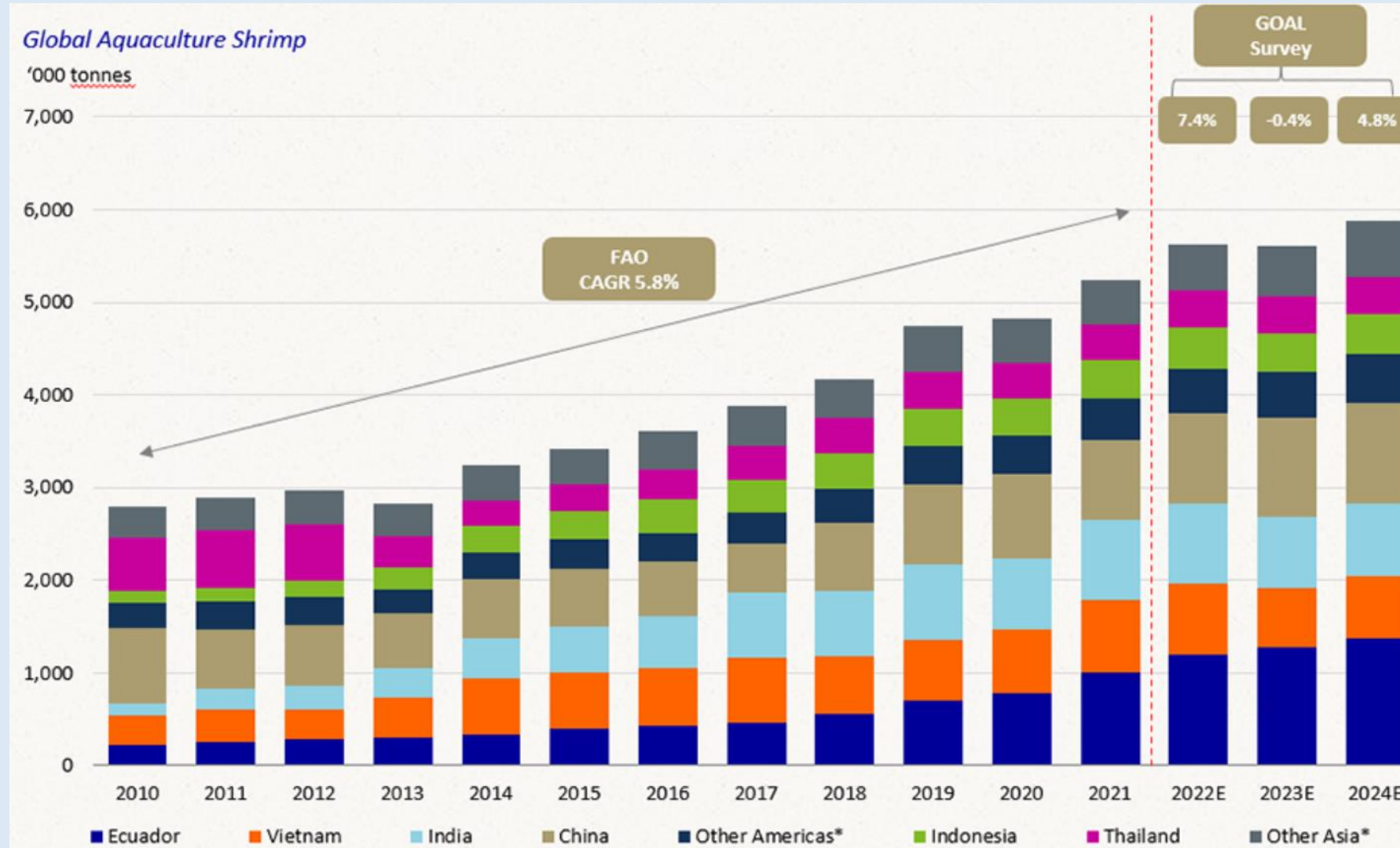


M. rosenbergii

- Global farmed shrimp production was approximately 8 million MT, of which *L. vannamei* accounted for 80%, *P. monodon* 9%, and other species (including other penaeids and *Macrobrachium* spp.) 11% (sustainablefisheries-uw.org, 2023).
- The proportion of freshwater species is estimated at about 5–7% (FAO, SOFIA data)

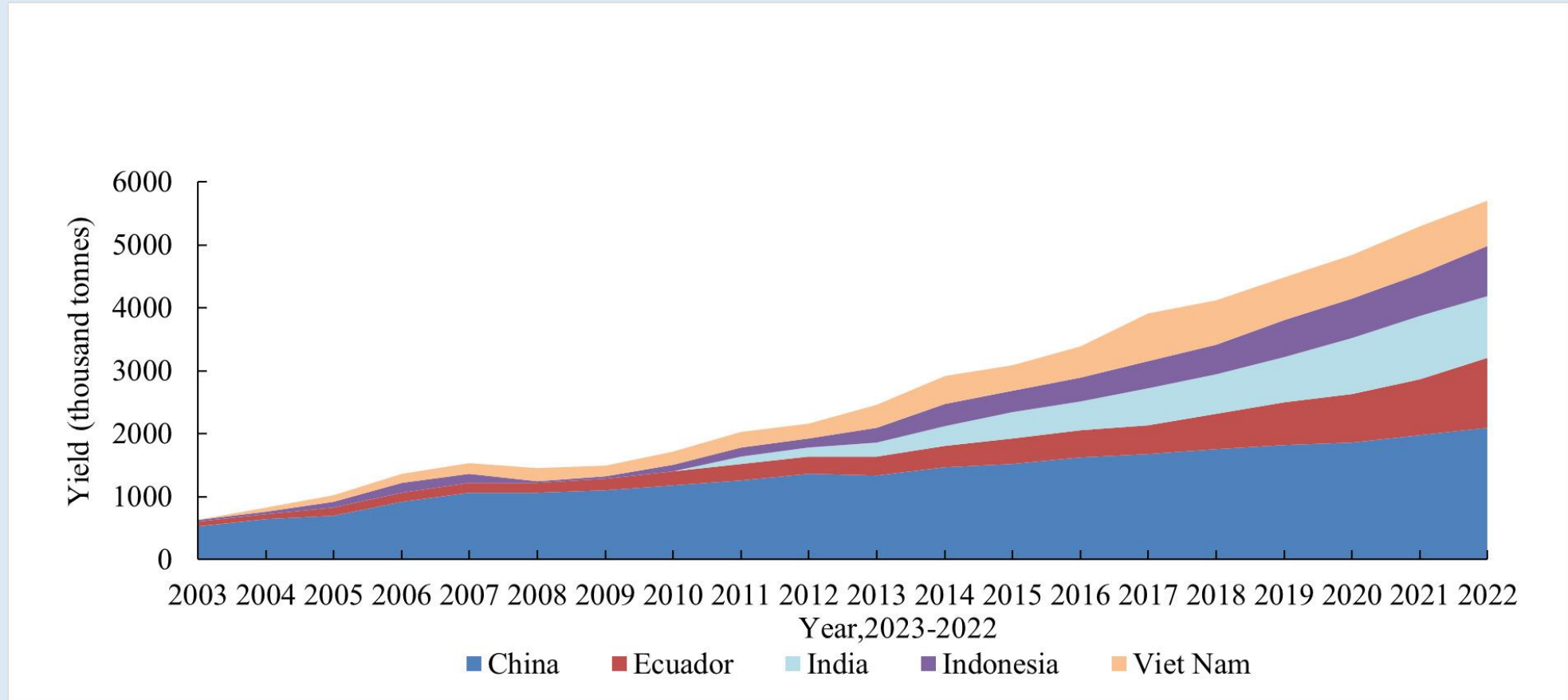


Global Farmed Shrimp Production (2010-2024)





Top Five Producers of *L. vannamei* (FAO, 2024)





***Environmental
Pollution***



Challenge in Shrimp Farming



In Vietnam, the disease has been observed since 2010 but the most widespread devastation due to EMS has only been reported since March 2011 in the Mekong Delta (South Vietnam). It affects the main shrimp production areas of Tien Giang, Ben Tre, Kien Giang, Soc Trang, Bac Lieu and Ca Mau provinces with



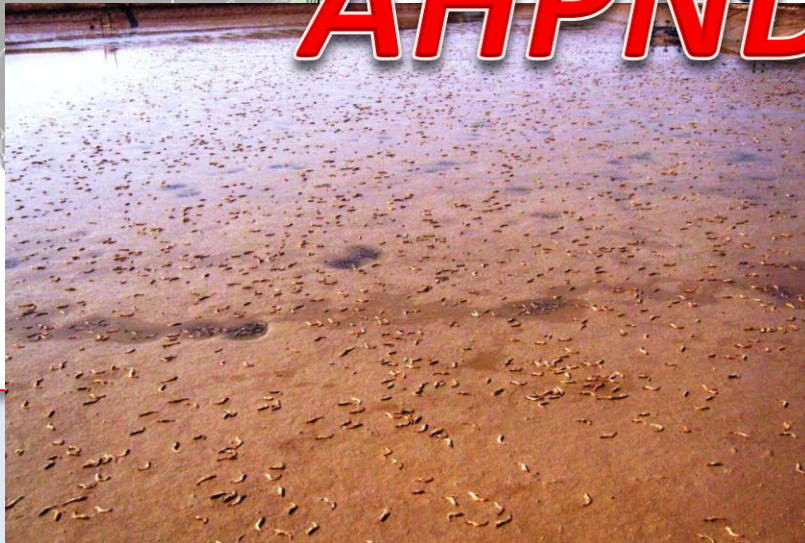
DISEASE ADVISORY

Early Mortality Syndrome (EMS)/Acute Hepatopancreatic Necrosis Syndrome (AHPNS):
An emerging threat in the Asian shrimp industry

Vietnam - 2010

DISEASES

AHPND, WSSV, EPH



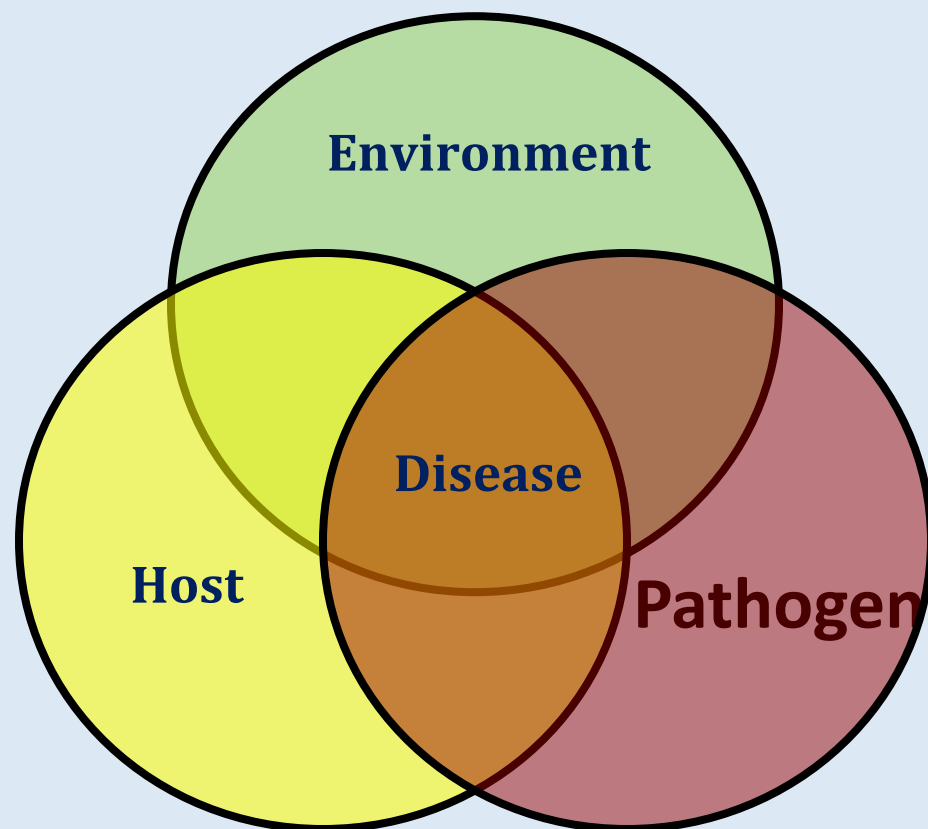
Shrimp production
infection from
ca.

ed ponds were
most by disease of which 6%



13

from EMS Countries



Environmental stress

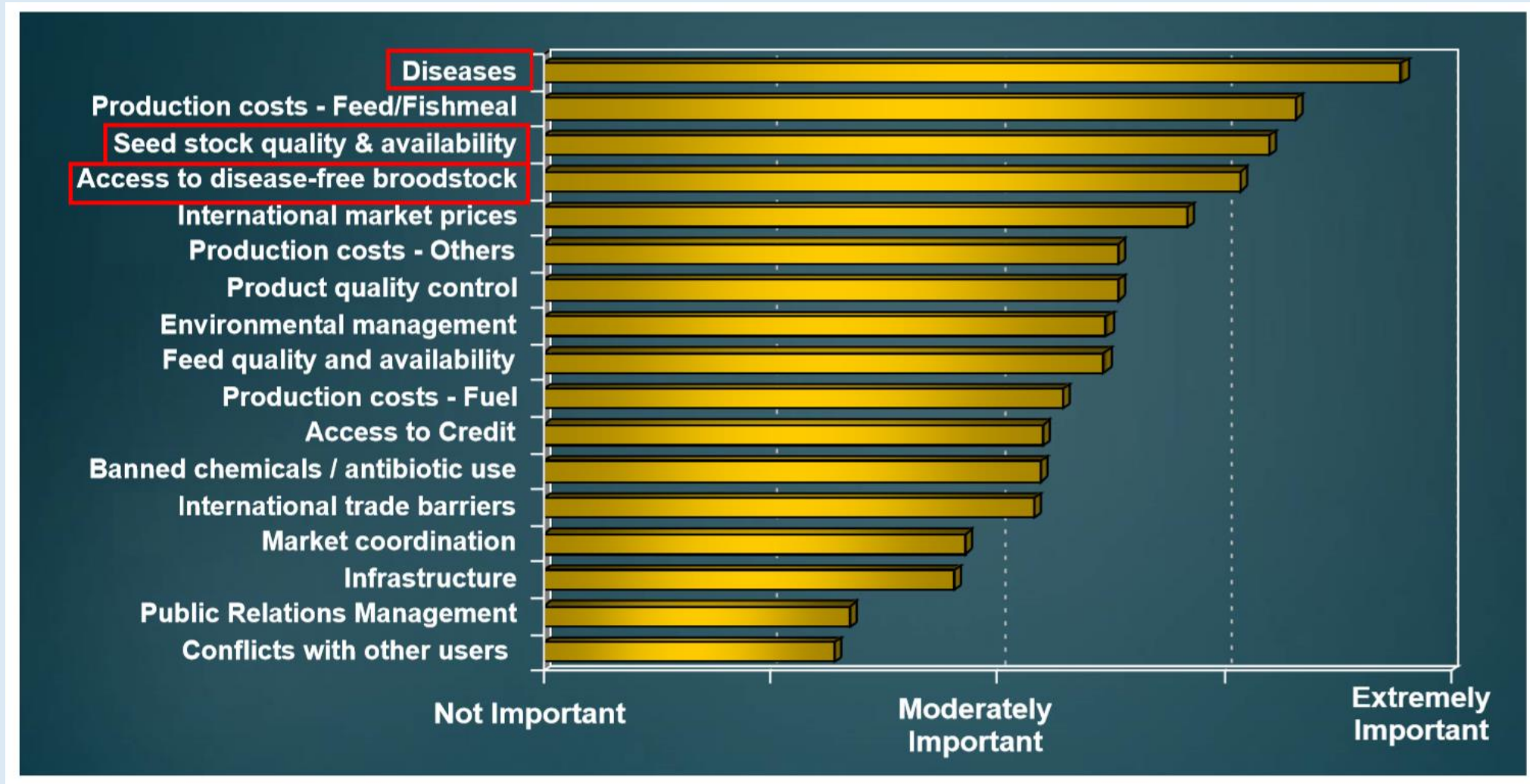
- Rapid changes and/or out of optimal ranges of water temperature, salinity, pH and DO

Physical and physiological stress

- Transportation of shrimp/postlarvae
- Spawning and moulting process



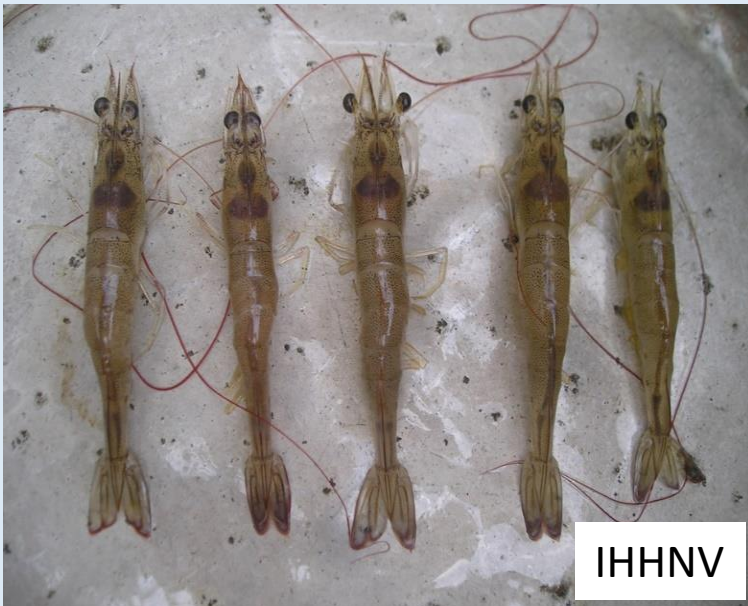
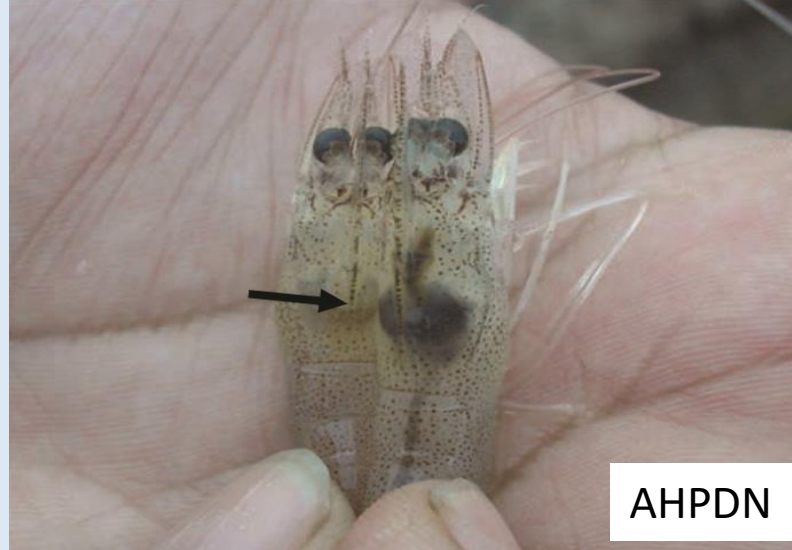
Priority of Limits in Commercial Shrimp Farming in the World

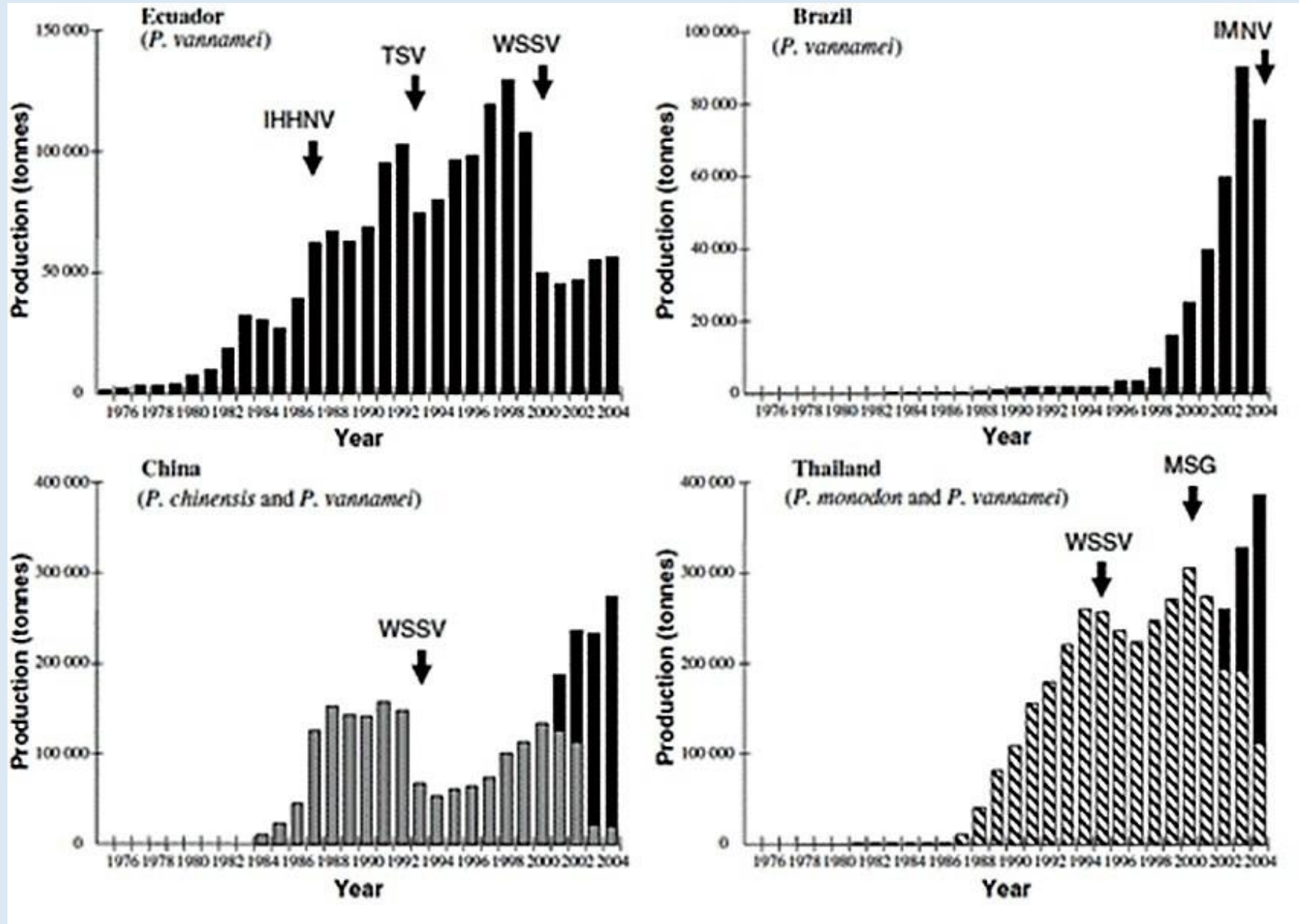


listed specific pathogens of crustaceans

The OIE now lists 9 diseases of shrimp in the Aquatic Animal Health Code (OIE, 2018), which are considered to be transmissible and of significant socio-economic and/or public health importance

- Acute hepatopancreatic necrosis disease (AHPND/EMS)
- White spot syndrome virus (WSSD)
- Taura syndrome virus (TSD)
- Infectious hypodermal and haematopoietic necrosis (IHHND)
- Infectious myonecrosis virus (IMND)
- Yellow head virus genotype 1 (YHD)
- Necrotising hepatopancreatitis (NHPD)
- White tail disease (WTD)
- *Aphanomyces astaci* (crayfish plague)

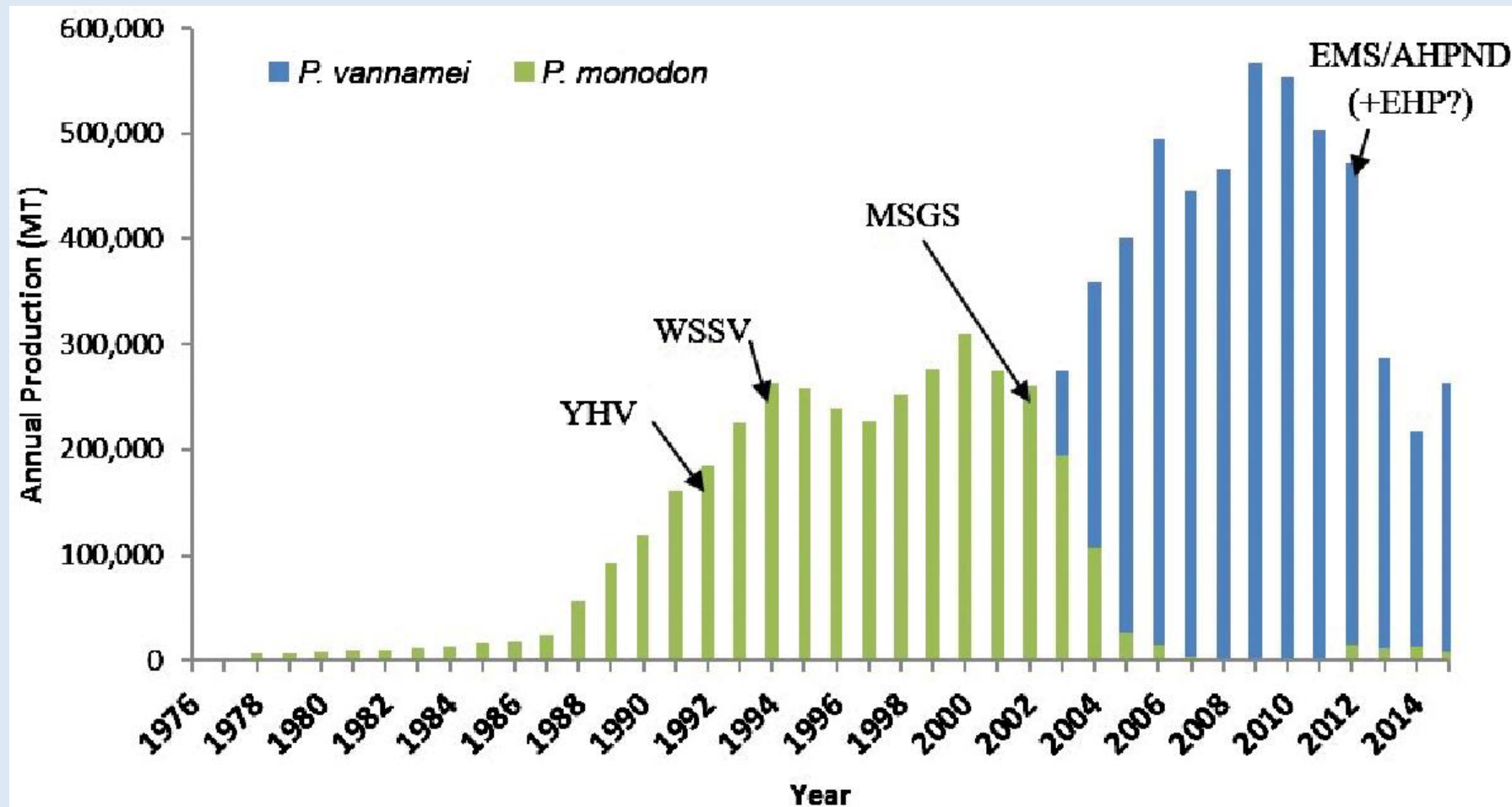






SPECIES TRANSITION CAN GIVE SOLUTIONS?

Effect of Transition of species on Disease Outbreak



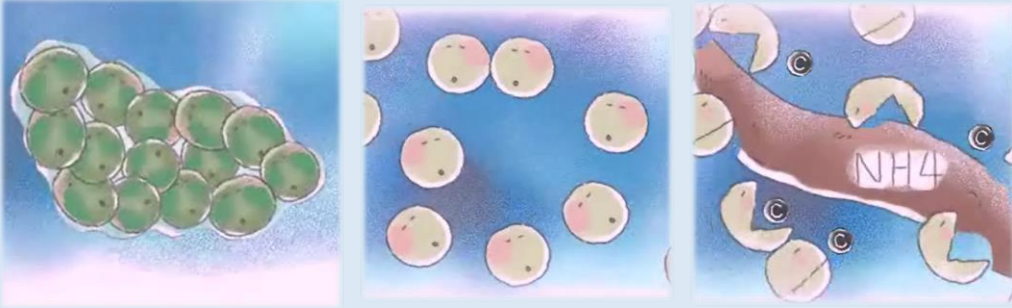
Annual shrimp production in Thailand from 1978 to 2015 illustrating the transition period of *L. vannamei*'s dominance over *P. monodon*



BIOFLOC SYSTEM CAN GIVE SOLUTIONS?



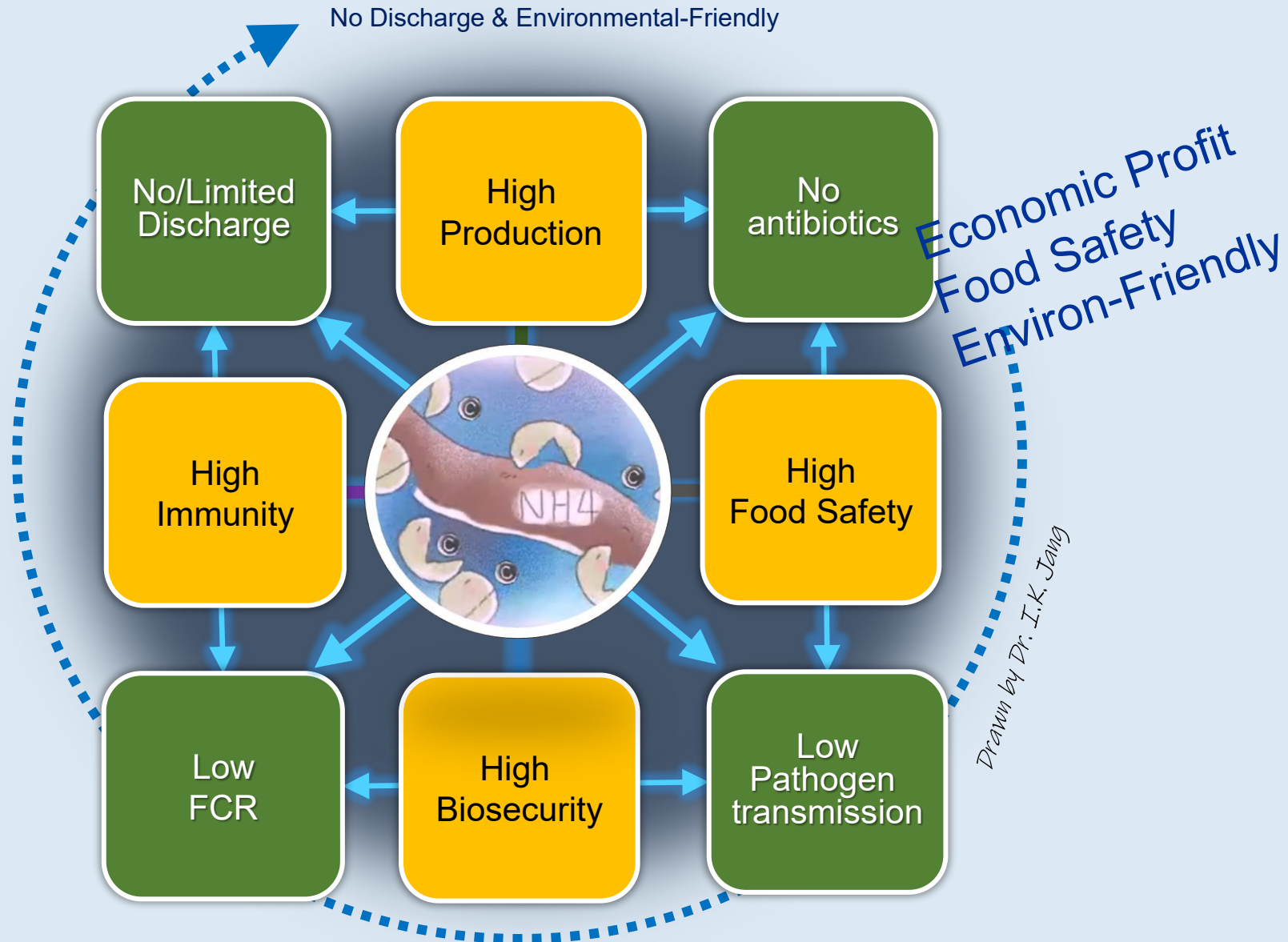
What is Biofloc System?



Bioflocs consist of a variety of bacteria, fungi, microalgae, detritus and other suspended organisms



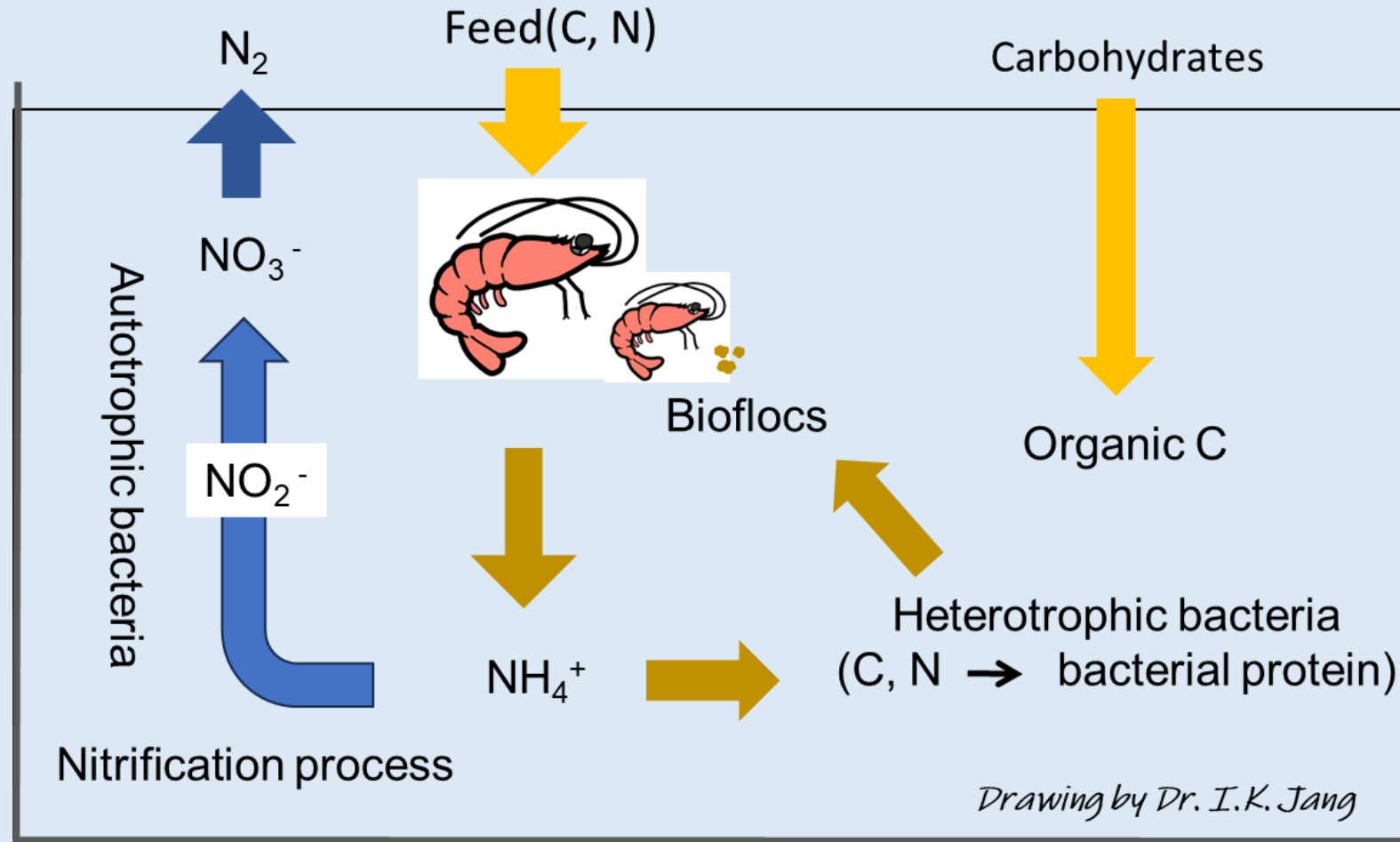
Tool to enhance production, reduce water exchange (environmental pollution) and minimize the disease introduction



- The most critical limiting factor in aquaculture is the accumulation of ammonia, a metabolic waste of cultured organisms.
- This constraint becomes more severe as biomass increases.



Heterotrophic Pathway is dominant





Well developed biofloc water



Bioflocs settled in Imhoff cones





Effect of bioflocs on growth and immune activity of Pacific white shrimp, *Litopenaeus vannamei*

post

Su-Kyoung Kim
& In-Kwon Jang¹Department²AgriLife

Correspondence

400–420.

Jang et al. BMC Immunology 2011, 12:70
<http://www.biomedcentral.com/1471-2172/12/70>

Can Biofloc Enhance Shrimp Immunity?

RESEARCH ARTICLE

Open Access

Selectively enhanced expression of prophenoloxidase activating enzyme 1 (PPAE1) at a bacterial challenge in Pacific white shrimp (*Litopenaeus vannamei*)

a bacterial challenge in Pacific white shrimp (*Litopenaeus vannamei*)

In-Kwon Jang



Contents lists available at ScienceDirect

Fish & Shellfish Immunology

journal homepage: www.elsevier.com/locate/fsi

Abstract

Background
innate immunity

Full length article

Distinct regulation patterns of the two prophenoloxidase activating enzymes corresponding to bacteria challenge and their compensatory over expression feature in white shrimp (*Litopenaeus vannamei*)

Zhenguo Pang, Su-Kyoung Kim, Jiaping Yu, In-kwon Jang*

National Fisheries Research & Development Institute, Ulwang-dong 707, Jung-gu, Incheon 400-420, South Korea



ARTICLE INFO

Article history:
Received 4 October 2013
Received in revised form

ABSTRACT

Prophenoloxidase activating enzyme 2 (PPAE2), which belongs to the second PPAE family of prawns, was isolated from white shrimp *Litopenaeus vannamei*. The currently identified lvPPAE2 and lvPPAE1 from our former report were taken as model candidates to analyze the relationship of the two shrimp PPAE

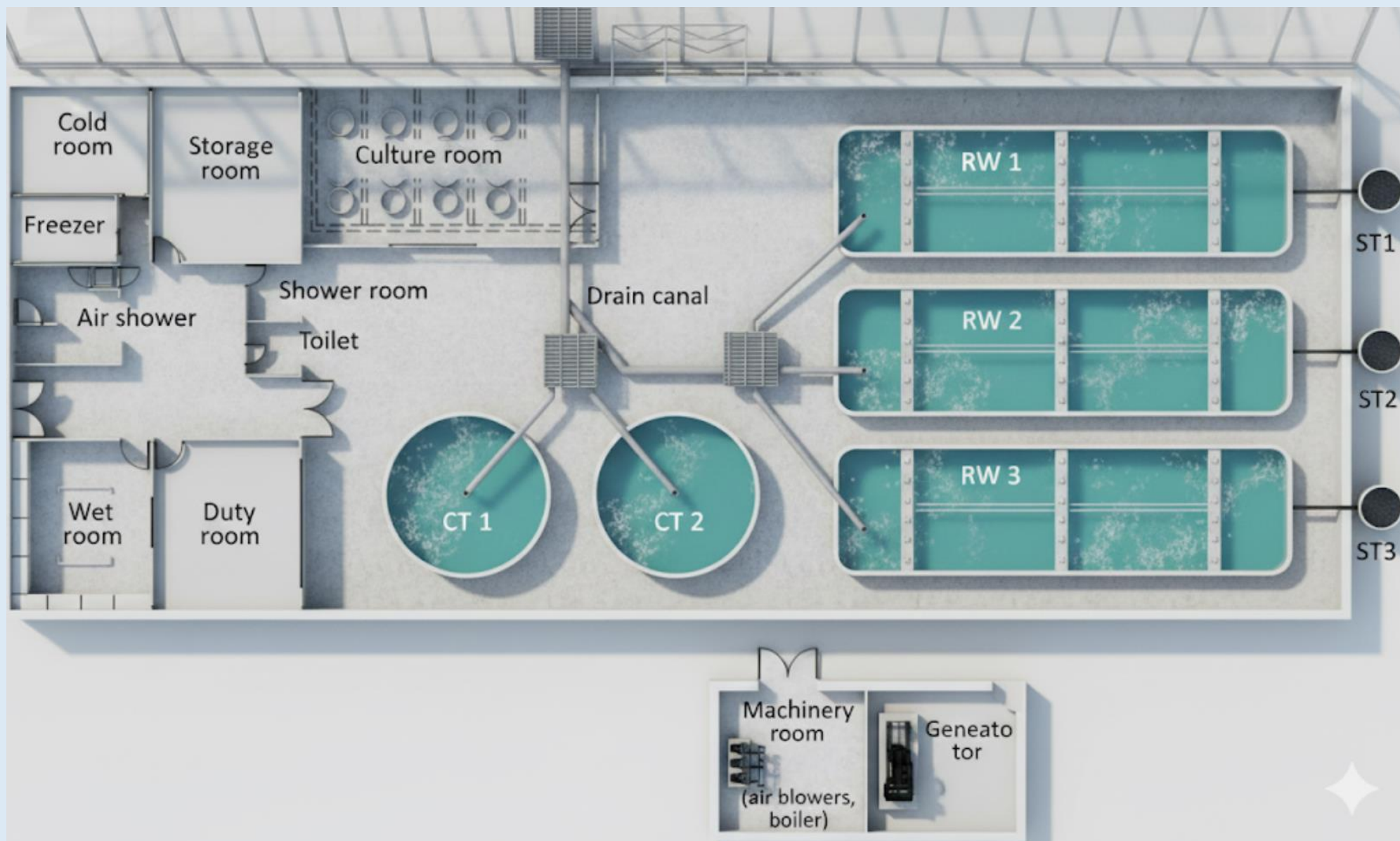
CASE STUDY IN KUWAIT DESERT

- Since 2016, the Kuwait Institute for Scientific Research (KISR) has been developing shrimp farming technologies based on biofloc technology (BFT)
- In 2020, KISR established the Inland Shrimp Research Farm (ISRF) in the Kabd desert area
- Using low-salinity groundwater, the ISRF team achieved super-density production of *L. vannamei* in both indoor tank systems (3.0–4.5 kg/m²) and outdoor pond systems (2 kg/m²)





Inland Shrimp Research Farm (ISRF)

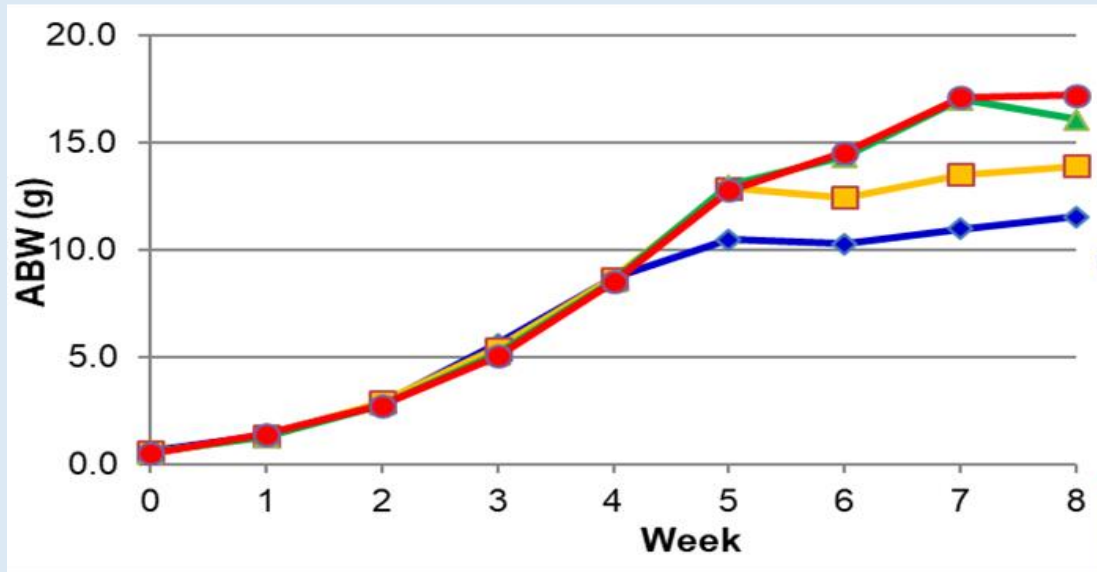






Performance Grow-out culture with Mg-adjustment

Shrimp weekly growth



Mg/Ca:3

Control-no Mg





Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture



Enhancing the performance of *Litopenaeus vannamei* nursery and grow-out by modifying Mg/Ca ratios in biofloc systems using low-salinity groundwater of Kuwait Desert

Sherain N. Al-Subiai^a, In Kwon Jang^{a,*}, Sun-Hye Bae^{a,b}, Hong-seok Yoon^{a,c},
Sumaiah Hussain^a, Sabeekah AlNuaimi^a, Muhammad Al-Foudari^a, Enas Al-Hasan^a

^a Aquaculture Program, Environment and Life Sciences Research Center, Kuwait Institute for Scientific Research, State of Kuwait

^b West Sea Mariculture Research Center, National Institute of Fisheries Science, Taejeon, Republic of Korea

^c Division of Fisheries Life Sciences, College of Fisheries Science, Pukyong National University, Busan, Republic of Korea

ARTICLE INFO

Keywords:

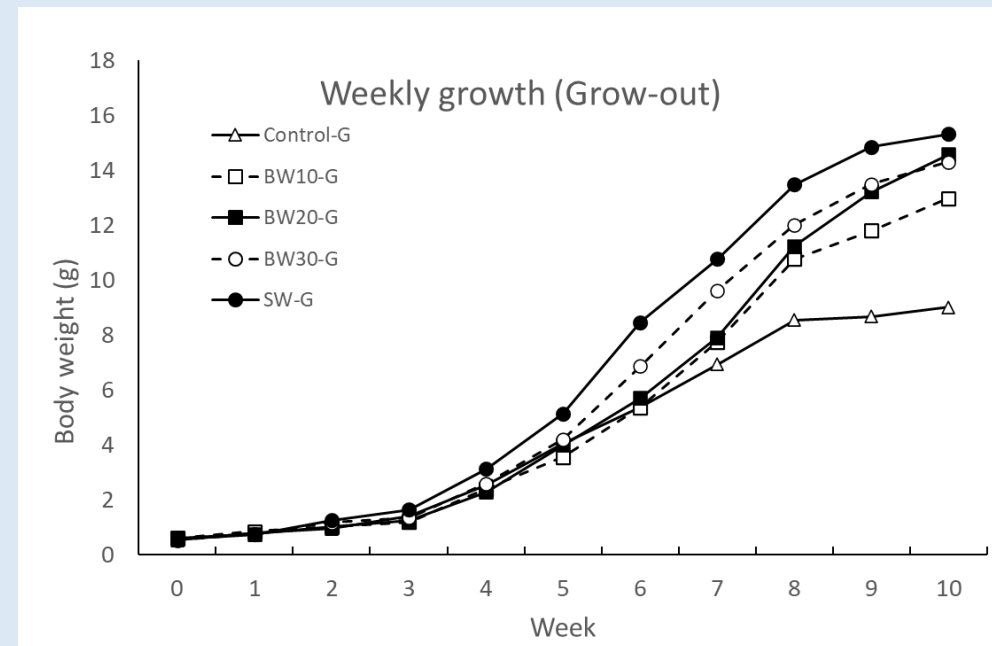
L. vannamei
Biofloc
Ionic modification
Inland shrimp farming
Kuwait Desert

ABSTRACT

Kuwait has one of the most arid climates in the world, with brackish groundwater that has excessively high hardness due to limestone-rich aquifers with suboptimal ionic compositions, high evapotranspiration, and scarce water sources for shrimp farming. The study aimed to assess whether increasing the magnesium to calcium (Mg/Ca) ratio through Mg-supplementation could enhance shrimp performance, despite the absolute magnesium concentration being higher than diluted seawater of the same salinity. The study comprised a 4-week nursery and an 8-week grow-out trial with Pacific White Shrimp (*Litopenaeus vannamei*) in low-salinity groundwater in a biofloc system. Experimental groups included a groundwater control (Mg/Ca ratio 0.49) and three different Mg/Ca ratios (about 1, 2 and 3) in three replicates. Postlarvae (0.02 g) and juveniles (0.54 g) were stocked at a density of 1250 and 250 m⁻³ in the nursery and grow-out trials, respectively, in 1,000 L tanks. In the nursery trial, the control exhibited a final weight of 0.174 g and a survival rate of 58.5%, which was significantly lower in comparison to all Mg⁺² treatments, exceeding 0.215 g and 92.5%, with no significant differences between the three treatments. The grow-out trial revealed a proportional increase in growth rate with the Mg/Ca ratio, showing a significantly better performance in treatments with Mg/Ca ratios of 2.12 or higher. The Mg/Ca 2 treatment exhibited the best performance, with a survival rate of 70.8% and a yield of 2.89 kg m⁻³ of mean weight 16.3 g. The results showed that Mg/Ca ratios have an affect both survival and growth in postlarvae, but only growth in juveniles and larger shrimp. The study suggests that increasing the Mg/Ca ratio above 1.07 and 2.12 through magnesium supplementation can significantly improve shrimp growth in nursery and grow-out phases in low-salinity water. Additionally, the expression of immune-related genes such as prophenoloxidase (Cecropin), superoxide dismutase (SOD), and other immune-related genes were analyzed.

Performance Grow-out culture with Brine

Group	Control-G	BW10-G	BW20-G	BW30-G	SW-G	p-value
Initial BW (g)	0.52±0.03	0.61±0.02	0.59±0.01	0.52±0.09	0.55±0.03	0.1427
Final BW (g)	9.0±0.2 ^b	13.0±1.9 ^a	14.6±0.2 ^a	14.3±1.3 ^a	15.4±0.8 ^a	0.0007
Survival rate	89.2±3.3	72.0±11.3	83.6±5.8	89.0±6.9	88.0±3.1	0.0612
Total production (kg)	1.61±0.09 ^c	1.88±0.41 ^c	2.41±0.17 ^{ab}	2.56±0.41 ^{ab}	2.70±0.12 ^a	0.0059
Yield (kg/m ³)	2.01±0.11 ^c	2.35±0.51 ^c	3.02±0.22 ^{ab}	3.20±0.51 ^{ab}	3.37±0.15 ^a	0.0054
FCR	1.35±0.06	1.18±0.29	1.05±0.17	0.93±0.09	0.94±0.04	0.1332
SGR (%/day)	4.07±0.11 ^b	4.35±0.24 ^a	4.58±0.01 ^a	4.73±0.24 ^a	4.75±0.11 ^a	0.0007
Daily water exchange (%/day)	0.32	0.34	0.38	0.36	0.39	





Contents lists available at ScienceDirect

Desalination

journal homepage: www.elsevier.com/locate/desal



Utilization of the desalination brine for enhancing inland shrimp farming in Kuwait

Sherain N. Al-Subiai^a, In Kwon Jang^{a,*}, Sumaiah Hussain^a, Enas Al-Hasan^a,
Muhammad Al-Foudari^b, Ali Al-Odwani^c, Sarah Al-Jutaili^a, Tae-Jin Choi^d

^a Coastal and Marine Resources Program, Environment and Life Sciences Research Center, Kuwait Institute for Scientific Research, Hamad Al-Mubarak Street, Building No. 90004, Area No.1, Ras Salmiya, Kuwait

^b Food Security Program, Environment and Life Sciences Research Center, Kuwait Institute for Scientific Research, P.O. box 24885, Safat 13109, Kuwait

^c Water Desalination Technologies Program, Water Research Center, Kuwait Institute for Scientific Research, Doha East Power Station, Kuwait

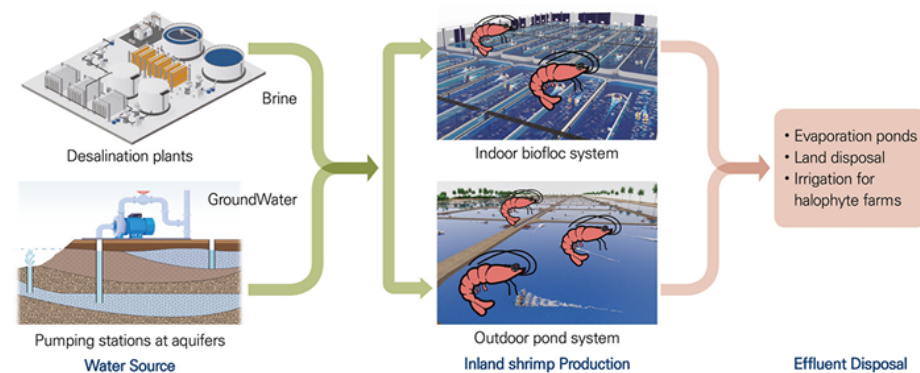
^d Department of Microbiology, School of Marine and Fisheries Sciences, Pukyong National University, Busan 48513, Republic of Korea

HIGHLIGHTS

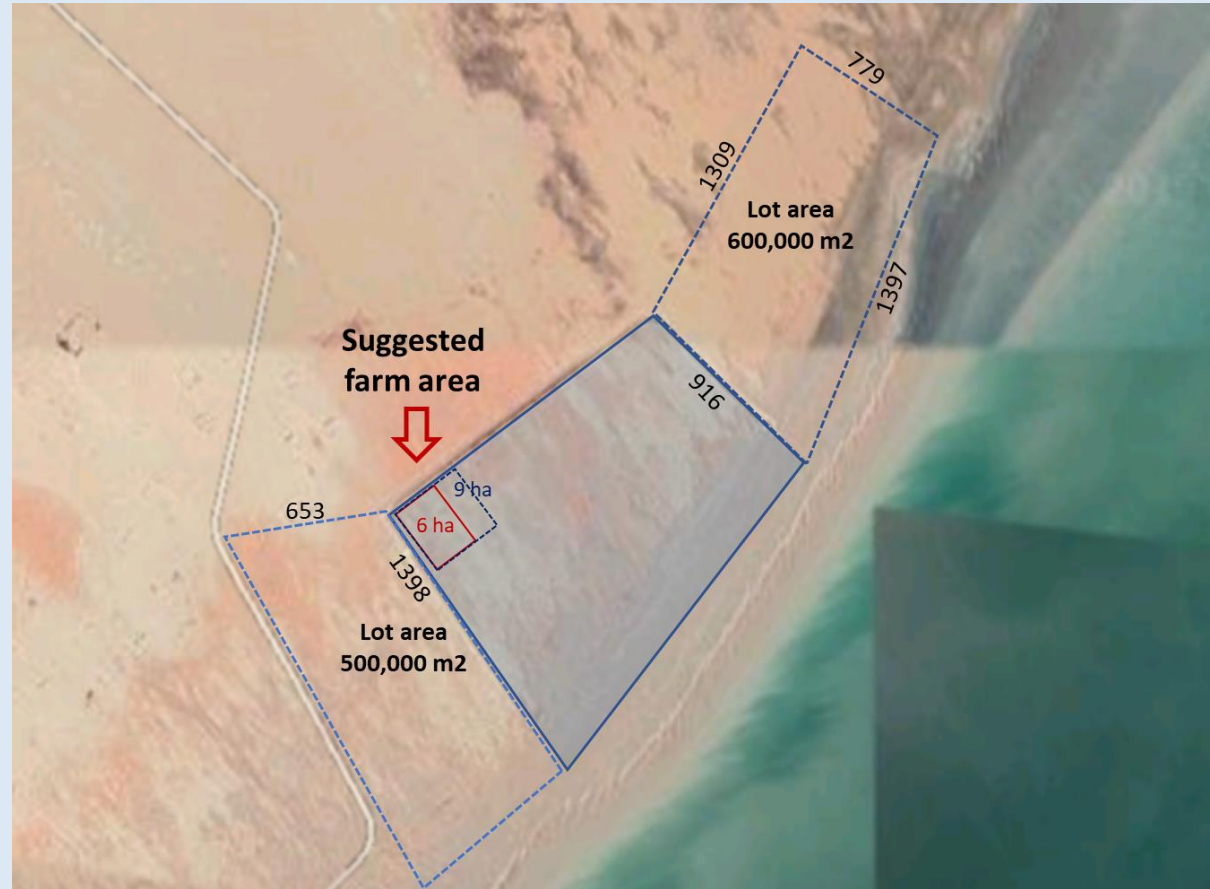
- RO brine can modify ionic ratios for *L. vannamei* culture in low-salinity groundwater.
- Replacing 20% of groundwater with brine significantly enhanced *L. vannamei* growth.
- Brine replacement is more viable for low-salinity shrimp farming than adding ions.
- Pond trial with brine replacement outperformed commercial low-salinity shrimp farms.
- Brine-reuse model supports inland low-salinity shrimp farming in arid regions.

GRAPHICAL ABSTRACT

Brine-reutilization Economic Model for Inland Shrimp Farming



Fish/Shrimp Production Complex at Bar-Gudai





Acknowledgment



Thank you!

12, rue de Prony, 75017 Paris, France
T. +33 (0)1 44 15 19 49
F. +33 (0)1 42 67 09 87

woah@woah.org
www.woah.org

[Facebook](#)
[Twitter](#)
[Instagram](#)
[LinkedIn](#)
[YouTube](#)
[Flickr](#)



World
Organisation
for Animal
Health

Organisation
mondiale
de la santé
animale

Organización
Mundial
de Sanidad
Animal



وزارة البيئة والمياه والزراعة
Ministry of Environment Water & A

Kingdom of Saudi Arabia المملكة العربية السعودية

