



Food and Agriculture
Organization of the
United Nations



THE WORLD BANK
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Stakeholder Consultation on Progressive Management Pathway (PMP) to Improve Aquaculture Biosecurity

World Bank Headquarters, Washington, D.C. 10-12 April 2018

DRIVERS AND PATHWAYS FOR AQUATIC ANIMAL DISEASE EMERGENCE

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What does aquatic food security look like?

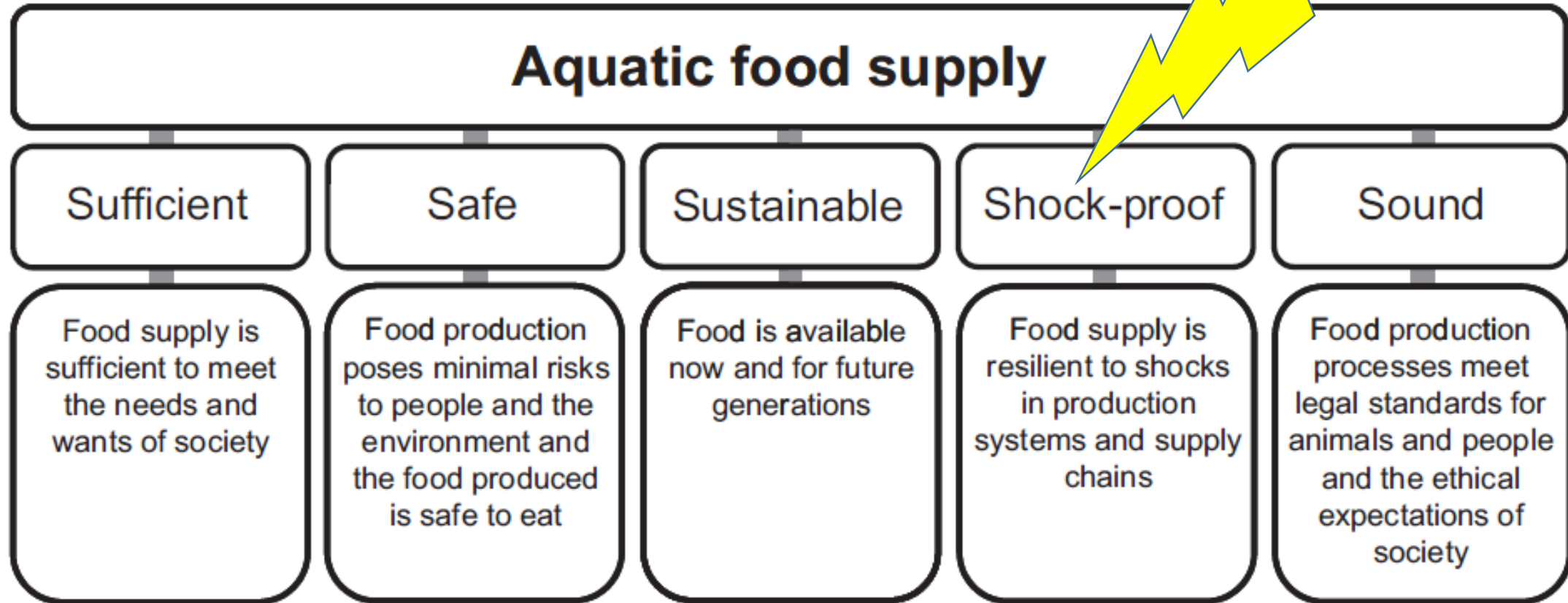
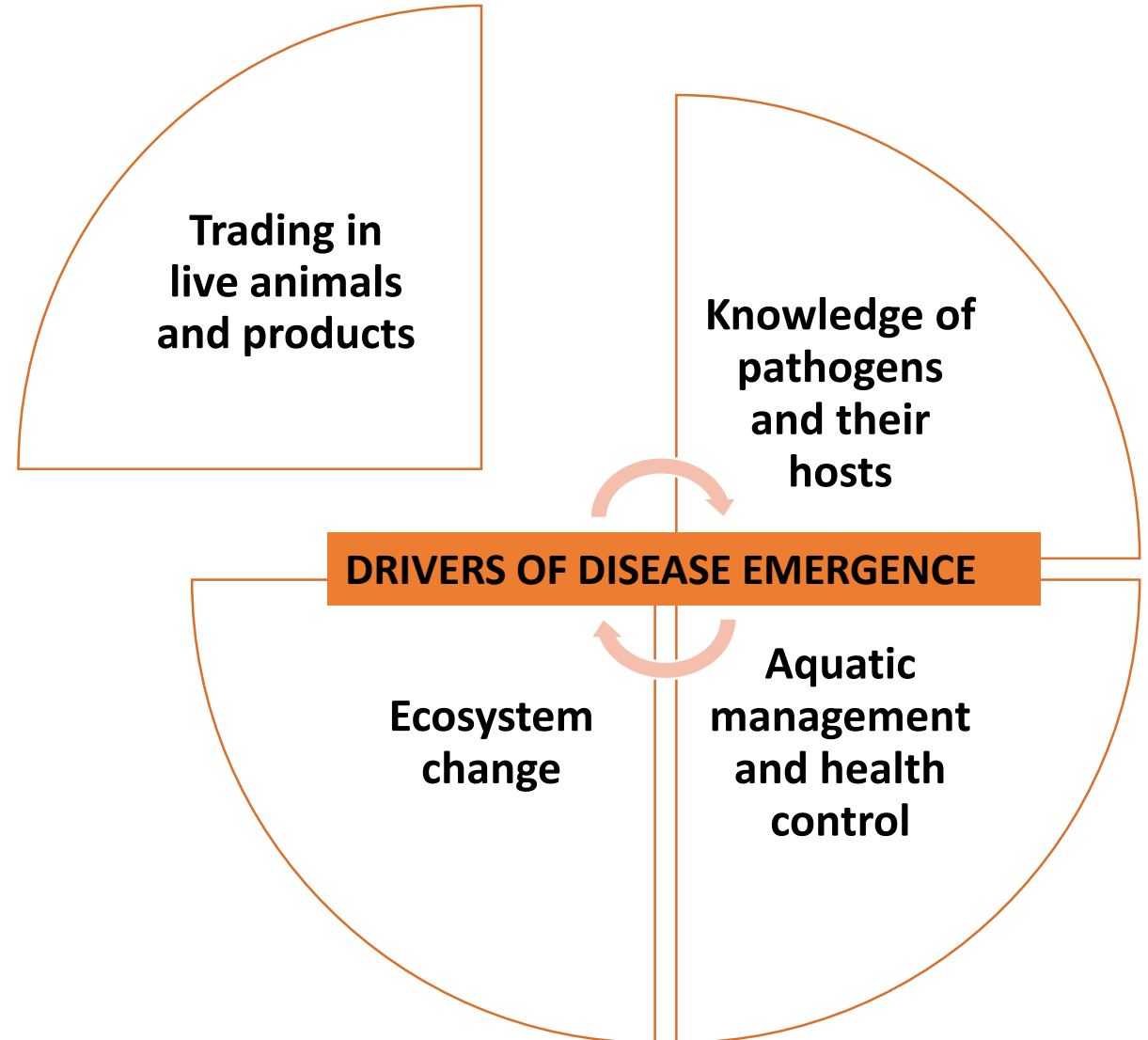


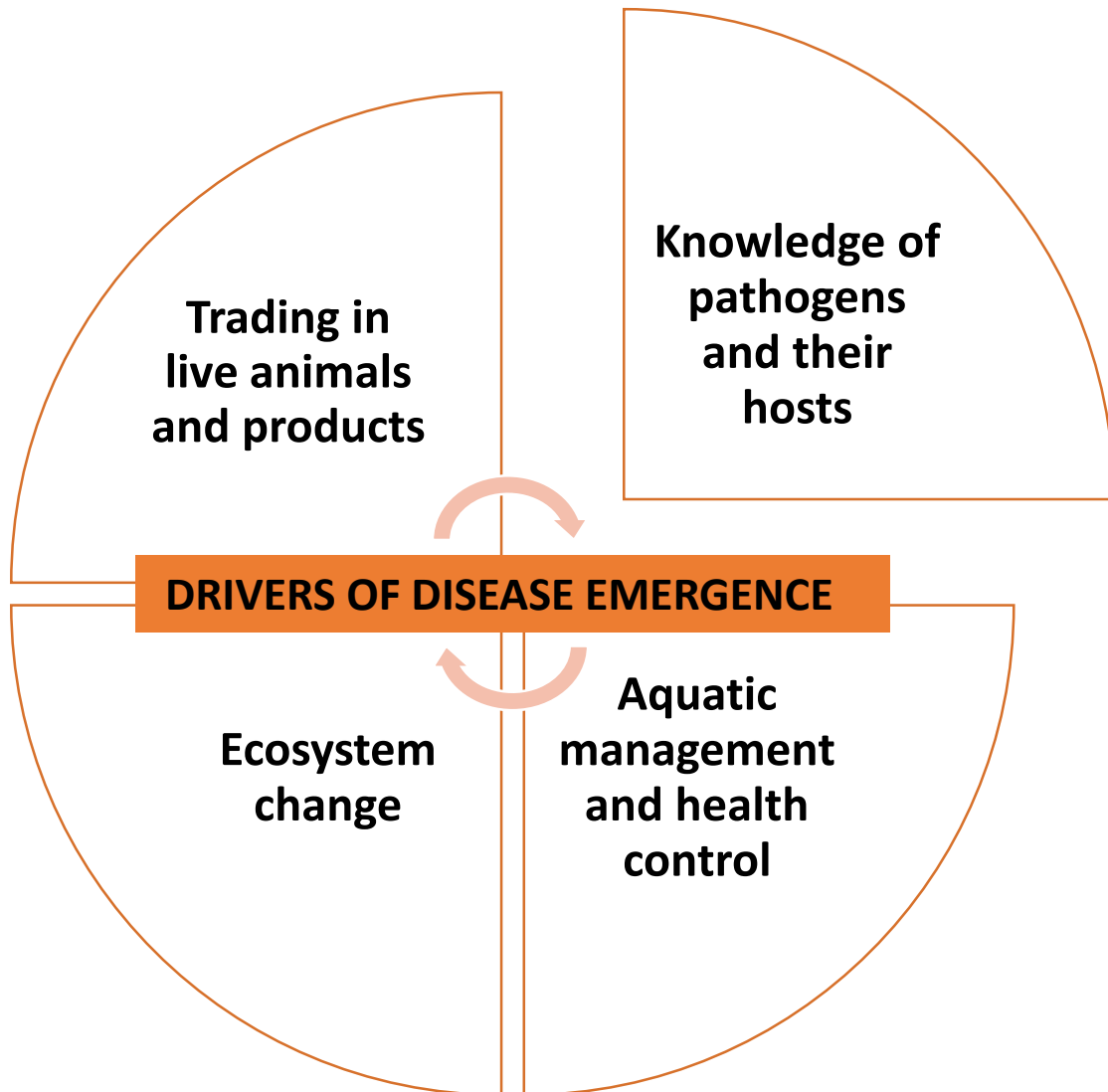
Figure 5 Five elements of a food supply which contribute to food security.

Drivers of emergent disease in aquaculture

- Highly traded commodity (70% exposed to international trade)
- Hyper-diverse species range (>500) farmed compared to terrestrial systems
- Live animals (larvae, fry, adults) and their products (live, fresh, frozen) traded internationally
- Many species farmed outside of native range
- Invasive animals and pathogens can be traded with primary host
- Ornamental aquaculture trade is large and growing
- Some diversion to unintended usage (e.g. angling baits)

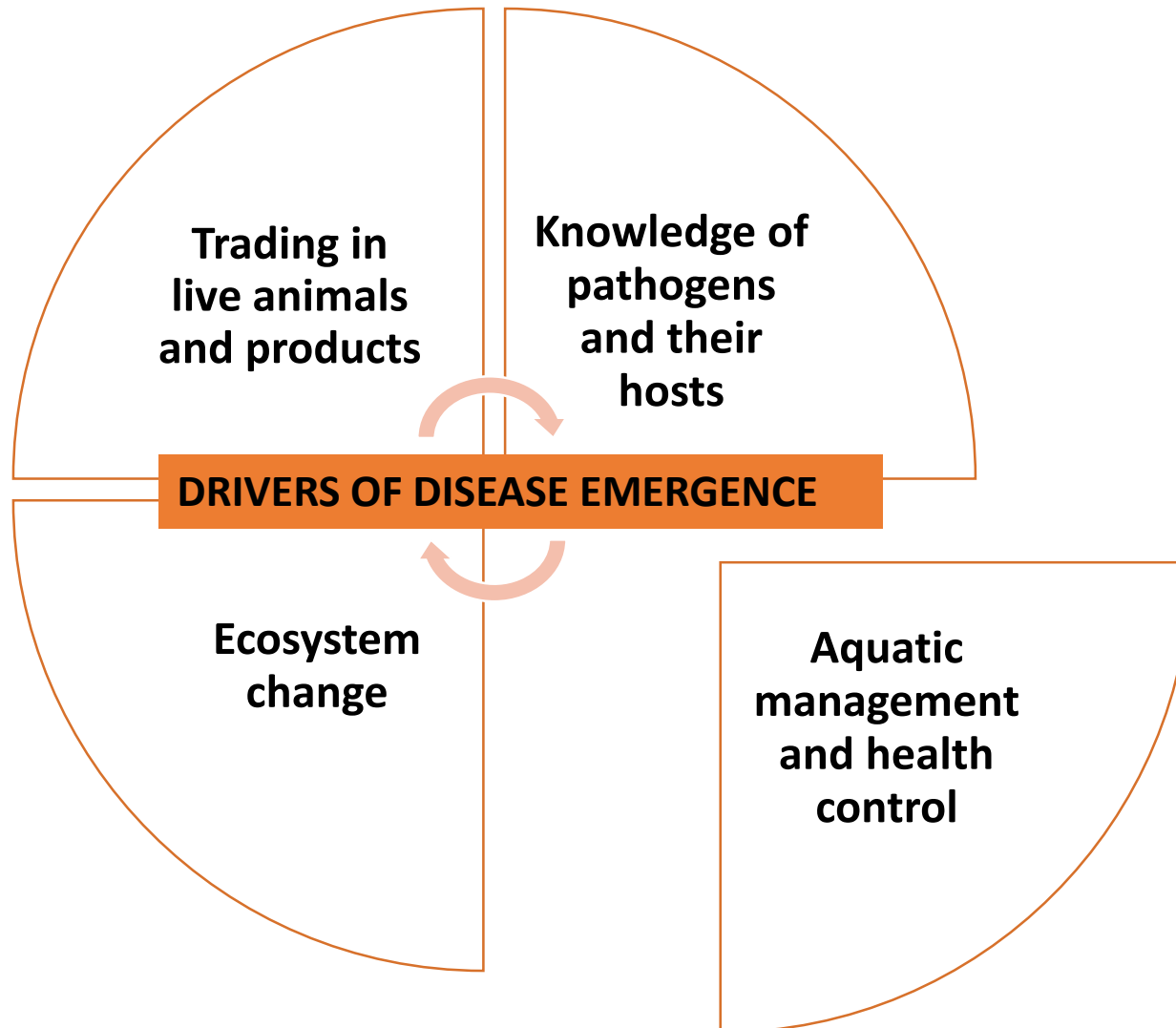


Drivers of emergent disease in aquaculture



- The unique aquatic medium
- Slow collective awareness of new threats
- Lack of basic pathogen data (e.g. transmission)
- Lack of basic host data (e.g. immunity, genetics)
- Diagnostics focussed on known/listed diseases
- Breeding strategies not in place for many species (e.g. SPF, SPR, selective breeding)
- Misuse of stock (e.g. SPF) in some cases
- Limited availability of vaccines (fish) and other credible control options (invertebrates)
- Societal barriers to innovative control/surveillance strategies (e.g. POND)
- Societal barriers to innovative genetics (e.g. GMO)

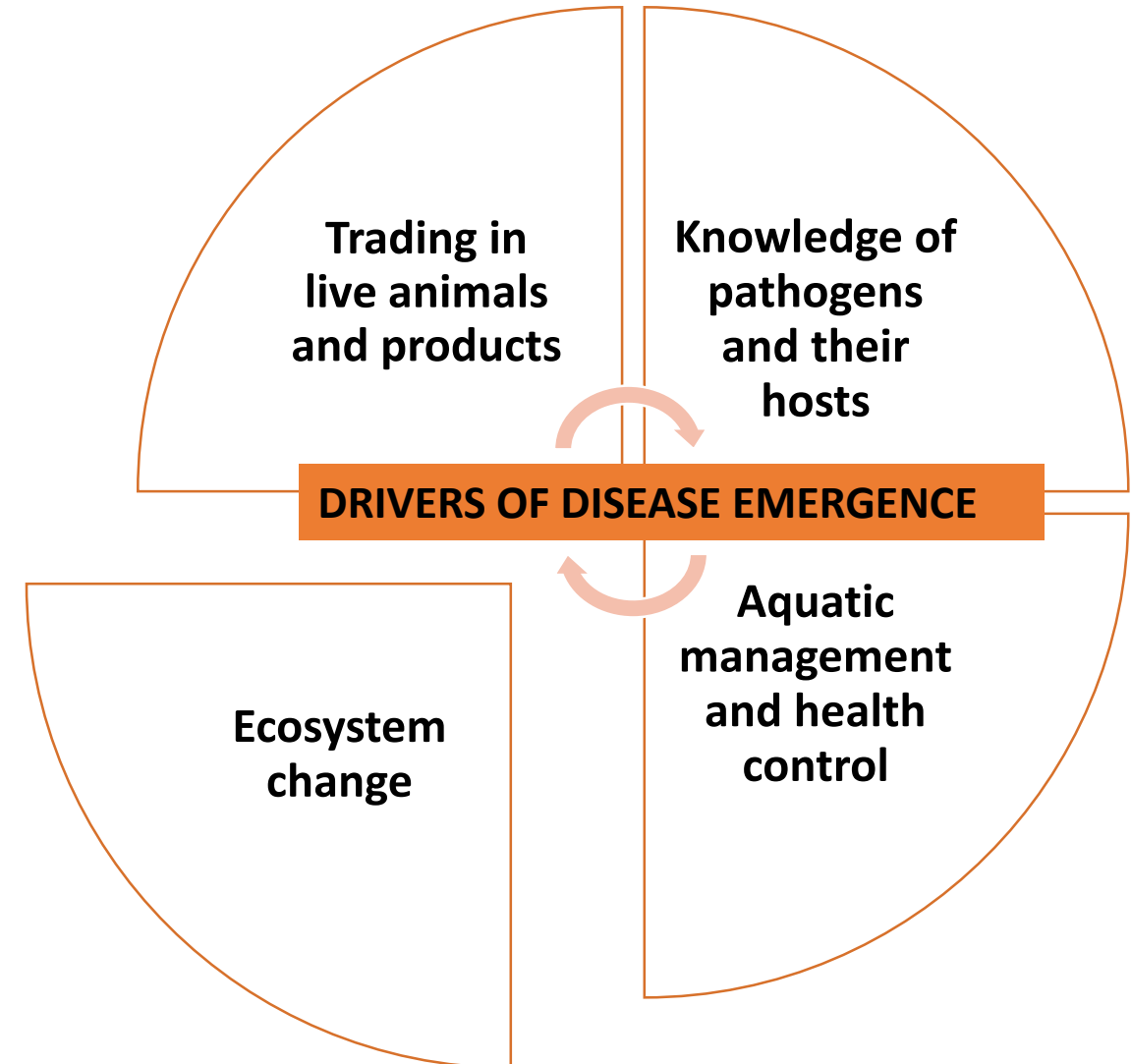
Drivers of emergent disease in aquaculture



- Multiple institutions involved in AHM. The Competent Authority?
- Inadequate or poorly implemented biosecurity measures/low capacity for emergencies
- Inconsistent or weak implementation of international standards etc
- Perceived low incentive to report on known and emergent diseases (trade)
- Weak regulatory framework and public-private sector partnership working
- Mismatch between research agenda and farmer/commodity sector needs
- Few national pathogen/host inventories

Drivers of emergent disease in aquaculture

- Physico-chemical conditions in aquaculture are often sub-optimum for host
- Aquatic hosts are cold-blooded (highly responsive to stressors)
- Animals may be farmed outside of native/optimum range
- and, in waters in which they are naïve to native microbial hazards
- Aquatic medium is pathogen rich, diversity changes with environment conditions
- Some hosts (e.g. crustaceans, molluscs) must calcify (susceptible to acid-base changes)
- Pathogens evolve and spill-over and spill-back relative to wild populations



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**Trading in
live animals
and products**

**Knowledge of
pathogens
and their
hosts**

DRIVERS OF DISEASE EMERGENCE

**Ecosystem
change**

**Aquatic
management
and health
control**

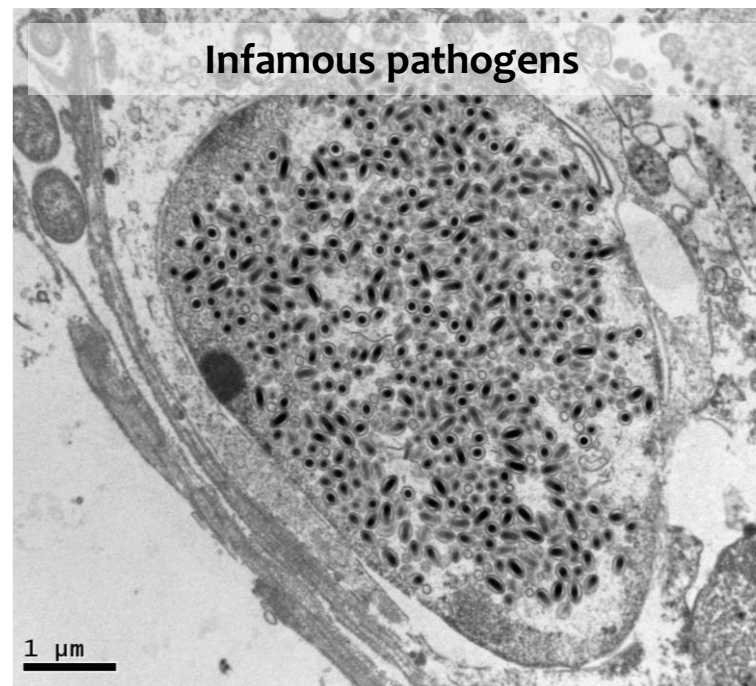
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Disease is the #1 issue in limiting yield, reducing profit and preventing investment



Emergence rate is high

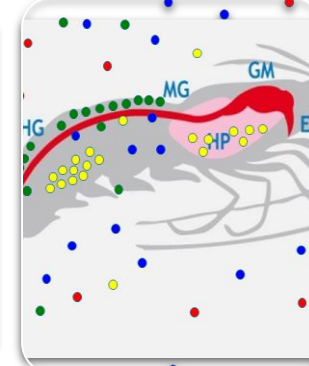
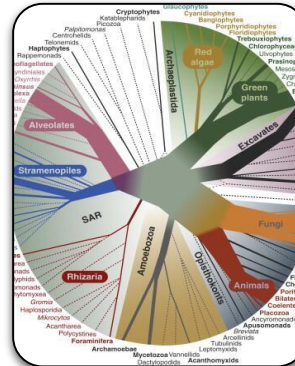
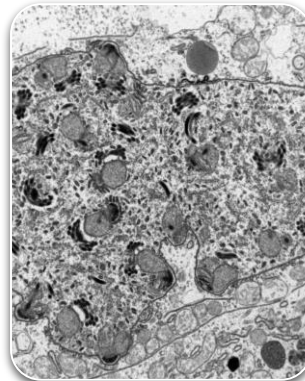


Deficit in trained professionals/AH investment



Dispersed industry. 90% in Asia

New Paradigms



**Improved
Networking
of AHPs**

More
efficient
networking
of a globally
deficit
resource

**Fast track
diagnostics &
surveillance**

Pathogen
genome data
open access

Translate
genome data
to diagnostics

**Decentralise
diagnostics**

Utilize farmer
network

Centralise the
data for
management

**Decipher
background
diversity**

Pre-emergent
threats better
understood

Refine
diagnostics
for listed taxa

**Single
pathogen to
pathobiome**

Microbial
consortia and
disease
outbreaks

Microbiomes
and immunity

**Embrace tech
and parallel
field thinking**

Cutting edge
approaches in
medicine,
agri-tech etc

Remove silos

**Create
resilient
hosts**

Open access
host genome
data

Selective
breeding,
SNPs, edits..

Citation: Stentiford GD, Sritunyalucksana K, Flegel TW, Williams BAP, Withyachumnarnkul B, Itsathitphaisarn O, et al. (2017) New Paradigms to Help Solve the Global Aquaculture Disease Crisis. PLoS Pathog 13(2): e1006160. doi:10.1371/journal.ppat.1006160

OPINION

New Paradigms to Help Solve the Global Aquaculture Disease Crisis

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Summary



Disease is *the* major impediment to **enhanced sustainable production** from the global aquaculture sector

Understanding, and acting on, the **critical drivers** for disease emergence is now vital

Completion of the crop cycle will become a **core measure** of sustainability

Aquaculture systems must better **mimic the ecology** of wild systems (host, environment, pathogen)

Moving majority of industry to **'insurable'** is a critical component of achieving growth targets

Closer Govt-Academic-Industry-society working to tackle this **grand challenges** in future

Definitions

What is 'disease'? clinical or pathological manifestation of *infection*

What is an 'infection'? entry and development or *multiplication* of an infectious agent in or on the body

What is an 'emergent disease'? a new infection resulting from the evolution or change of an existing pathogenic agent, a known infection spreading to a new geographic area or population, or a previously unrecognised pathogenic agent/disease diagnosed for the first time and which has a significant impact on animal or public health'

What is a 'listed disease'? Those which fulfil a set of defined criteria relating to their potential for *consequence* (e.g. significant production losses), *spread* (e.g. infectious etiology known, potential for international spread, disease-free regions exist) and *diagnosis* (robust diagnostics are available)

What defines a 'susceptible host' mean? Hosts in/on which *replication* of a defined infectious agent occurs