FAO/ASTF Project: GCP/RAF/510/MUL:

Enhancing capacity/risk reduction of emerging Tilapia Lake Virus (TiLV) to African tilapia aquaculture: Intensive Training Course on TiLV

4-13 December 2018. Kisumu, Kenya

in cooperation with Kenya Marine Fisheries Research Institute (KMFRI) and Kenya Fisheries Service (KeFS)

Session 2: Diseases of aquatic animals

Aquatic animal health management

Melba.Reantaso@fao.org

Food and Agriculture Organization of the United Nations

Aquaculture is dynamic and complex!

About **580** species cultured:

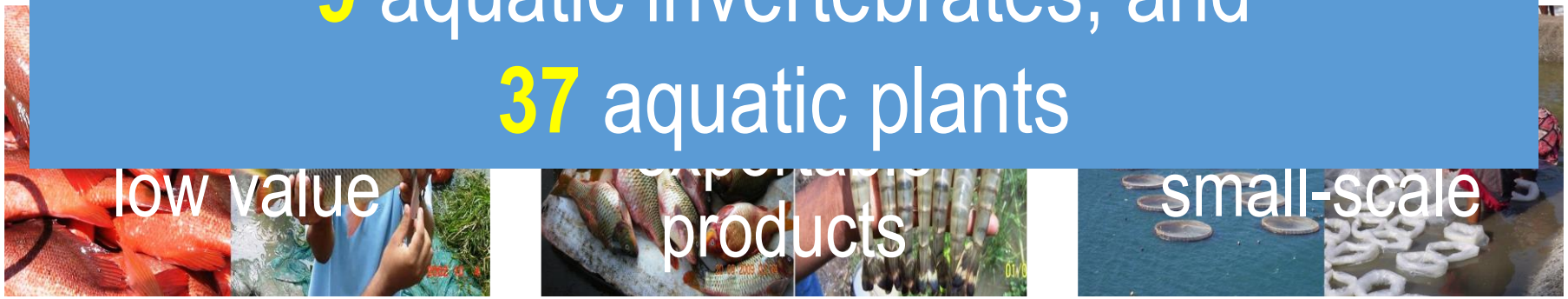
362 finfishes (including hybrids)

104 molluscs, **62** crustaceans,

6 frogs and reptiles,

9 aquatic invertebrates, and

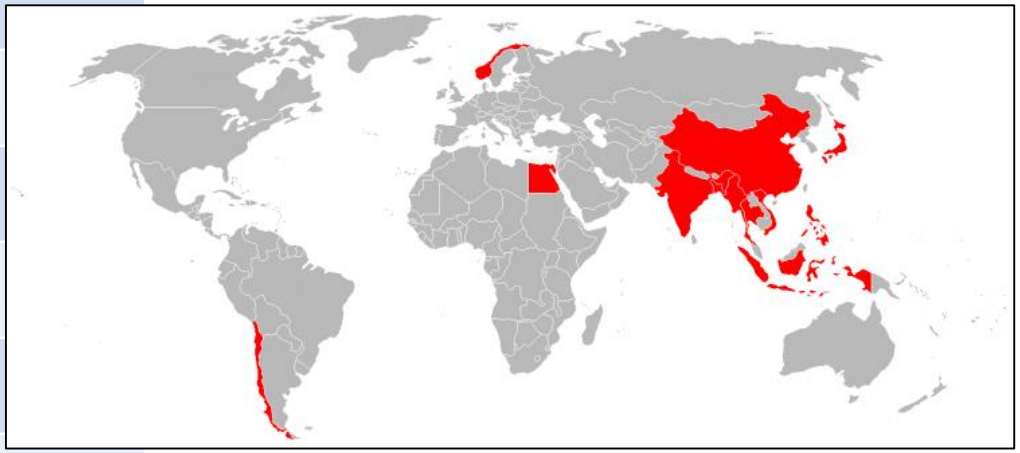
37 aquatic plants

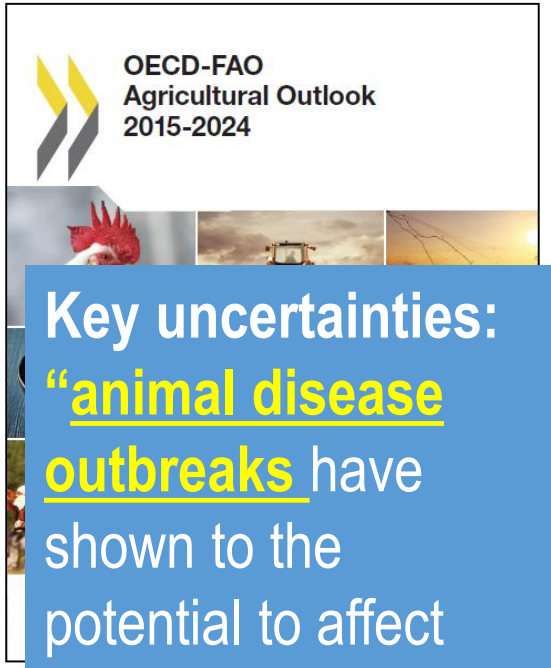


Food and Agriculture Organization of the United Nations

Country	Quantity (million tonnes)	Value (USD)
1. China	49.2 million tonnes	USD 144.7 billion
2. India	5.7 million tonnes	USD 10.6 billion
3. Indonesia	5.0 million tonnes	USD 9 .0 billion
4. Vietnam	3.6 million tonnes	USD 9.3 billion
5. Bangladesh	2.2 million tonnes	USD 5.6 billion
6. Egypt	1.4 million tonnes	USD 1.8 billion
7. Norway	1.3 million tonnes	USD 7.6 billion
8. Chile	1.0 million tonnes	USD 7.9 billion
9. Myanmar	1.0 million tonnes	USD 2.0 billion
10. Thailand	0.96 million tonnes	USD 2.5 billion
11. Philippines	0.8 million tonnes	USD 1.8 billion
12. Japan	0.7 million tonnes	USD 4.0 billion

Top 12 aquaculture producers

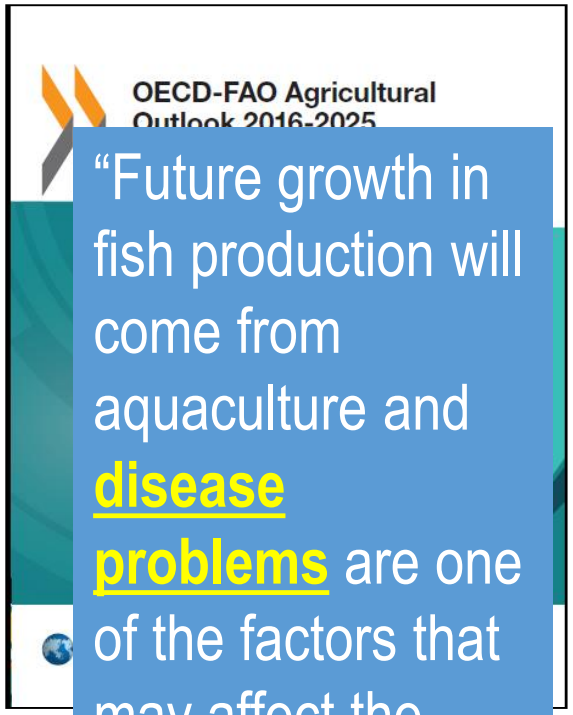




http://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2015_agr_outlook-2015-en

http://www.fao.org/3/a-i3102e.pdf

Key uncertainties: "animal disease outbreaks have shown to the potential to affect aquaculture production and subsequently domestic and international markets depending on the size and the species involved"



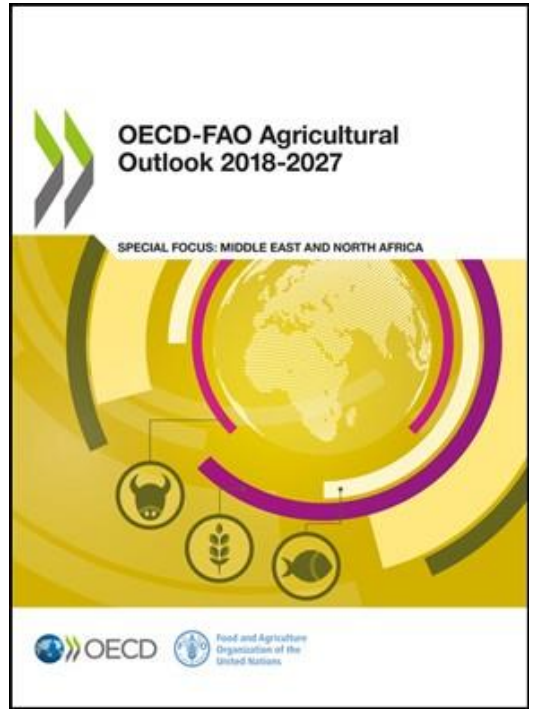
"Future growth in fish production will come from aquaculture and **disease problems** are one of the factors that may affect the prospects of this sector".

Agricultural Outlook

e effort of the Organisation fo
Co-operation and Development an

gether the commodity, policy and
expertise of both organisations and
m collaborating member countries
an annual assessment of prospects
oming decade of national, regional
al agricultural commodity markets.

OECD: 35 Member countries from North and South America to Europe and Asia-Pacific. They include many of the world's most advanced countries but also emerging countries like Mexico, Chile and Turkey



Chapter 8: Fish and seafood: Project highlights

For production, these include issues related to …**transboundary issues with respect to … diseases and escapes**…

What are TAADs?
Transboundary aquatic animal diseases

- highly contagious/transmissible **(infectious!)**
- potential for very rapid spread irrespective of national borders **(no passport!)**
- cause serious socio-economic and possibly health consequences **(high risk and high impact!)**
- OIE lists about 30 aquatic pathogens/diseases which fit established criteria for listed diseases in terms of consequence, spread and diagnosis **(important to trade!)**
- one of the negative impacts trade globalization **(important pathway!)**

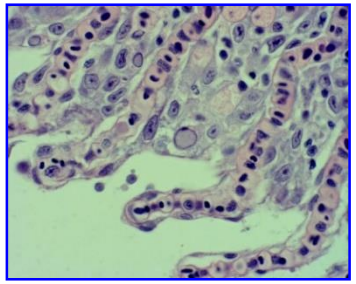
Diseases (infectious) in Aquaculture

- Exotic: Diseases that are **important to trade** (OIE list of diseases), governed by international standards, set of criteria to be met to be included in the list, pathogens/diseases of important traded species (e.g. finfish, crustaceans, molluscs, amphibians), reporting/notification is recommended during an outbreak
- Endemic: Diseases that are **consistently affecting production** of aquaculture species: hatchery, nursery and grow-out levels, e.g. bacteria, parasites, fungal, virus
- Emerging: **known** (new geographical areas or new susceptible species) **and unknown aetiology**

Examples of TAADs

1. Epizootic ulcerative syndrome (EUS)
2. Tilapia lake virus (TiLV)
3. Acute hepatopancreatic necrosis disease (AHPND)
4. Infectious myonecrosis virus (IMNV)
5. Koi herpes virus





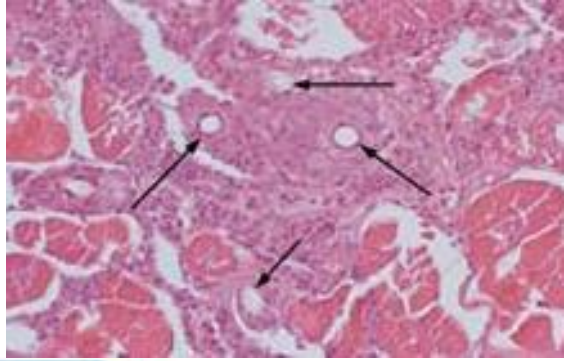
Epizootic ulcerative syndrome (EUS)

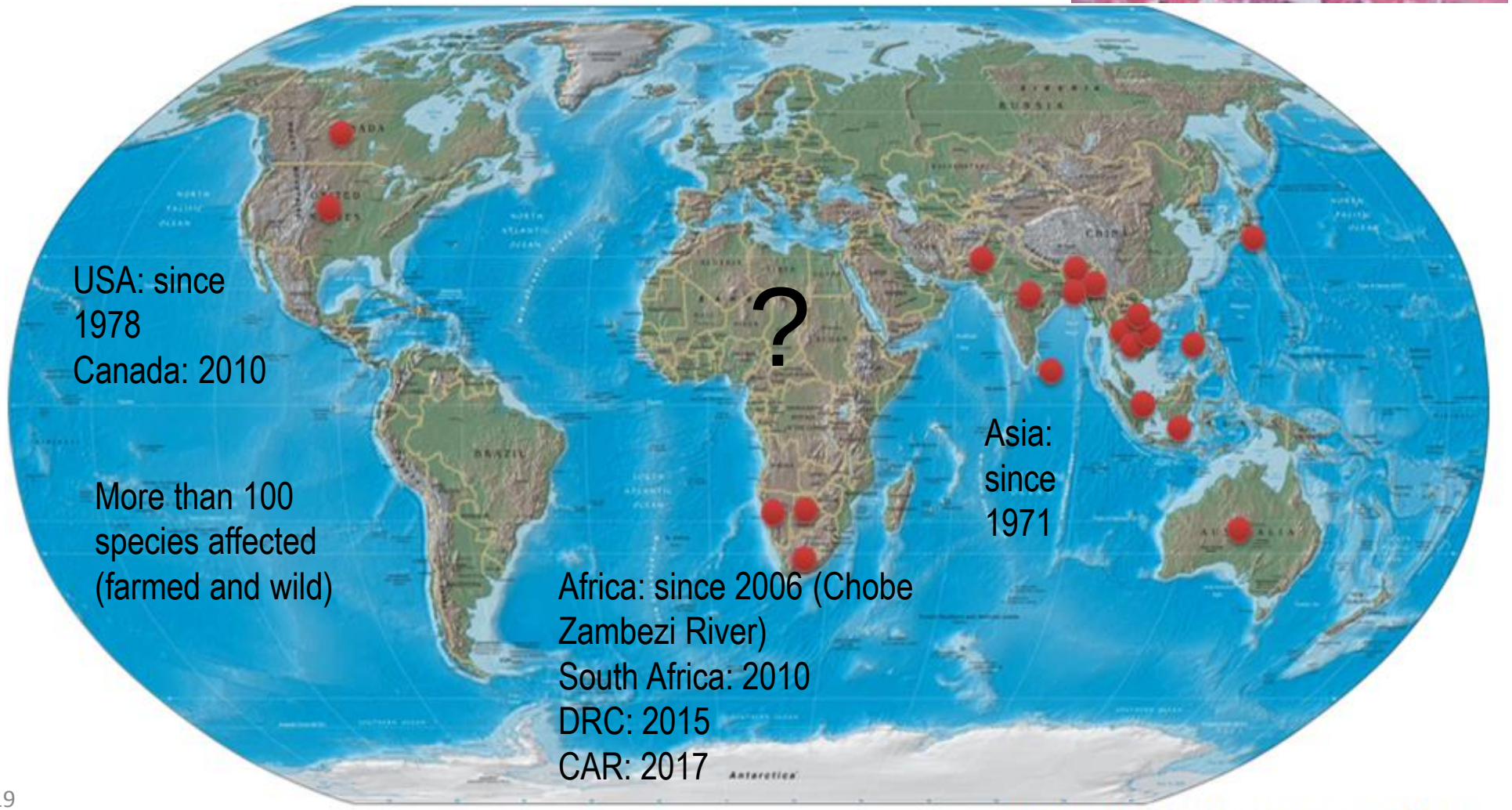
International spread of Epizootic ulcerative syndrome (EUS) and emergence after 10 years in southern Africa

- Çaused by a fungi: *Aphanomyces invadans*
- 1971 first described in Japan as an *Aphanomyces* (fungal) infection (Egusa and Masuda, 1971)
  - mycotic granulomatosis (MG)
- 1972 epizootic cutaneous ulcerative syndrome in estuarine fishes in Australia
  - red spot disease (RSD)
- since 1978 USA
  - ulcerative menhaden disease (UM)
- 1986: major outbreaks since 1985 in Asia
  - Epizootic ulcerative syndrome (EUS)
- 2002 (Australia, Diseases in Asian Aquaculture V)
  - Epizootic granulomatous aphanomycosis (EGA)
  - Ulcerative aphanomycosis

Baldock *et al*., 2005; FAO, 2007/2008

Epizootic Ulcerative Syndrome (EUS)





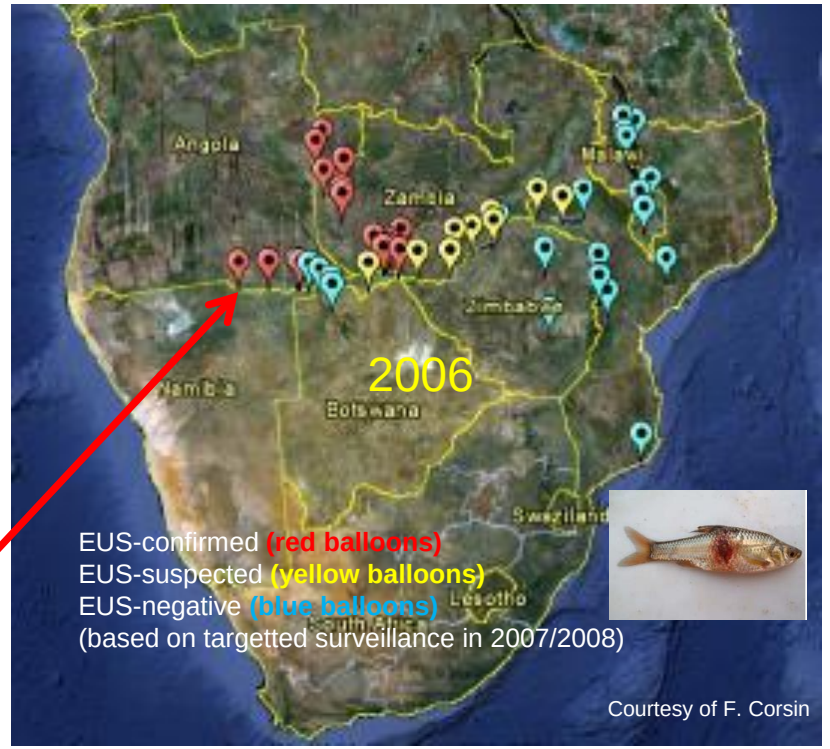
Created by Stephen Reichley, OSU

Risks of potential spread of EUS to other parts of Africa:

•More than 25 fish species susceptible to EUS in southern Africa, including important species such as cichlids, catfish , tigerfish, yellow fish and other large species

•Affects wild fish populations and few aquaculture farms (Namibia)

•Home to a wide variety of indigenous and endemic species; 3200 freshwater fishes (FishBase, 2004)



•High risk of spread from one lake or river system to another with same or closely related fish fauna

•Heavy rainfall and flooding that may interlink the drainage system

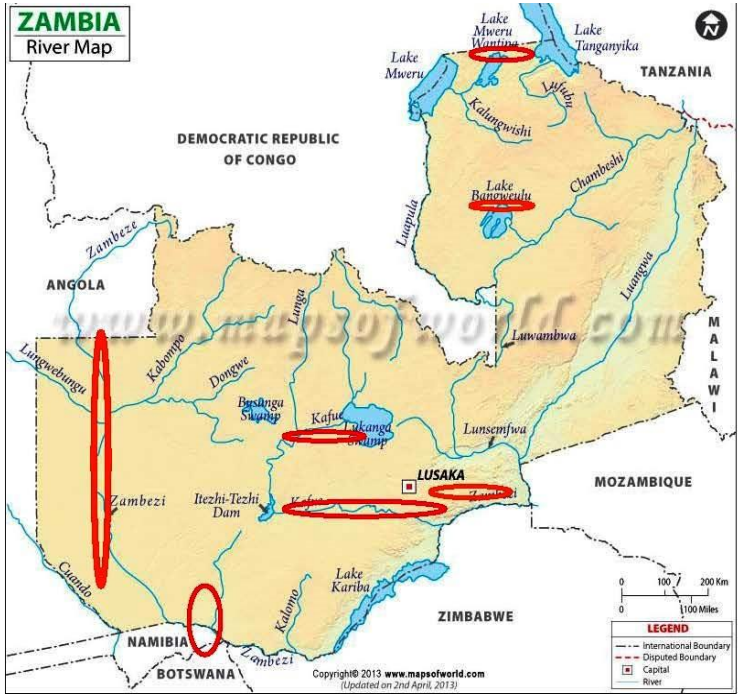
•human activities not conforming to appropriate biosecurity

•Pathways: movement of fish for aquaculture; angling; ornamental trade; natural upstream or downstream movement of fish, birds

Risks of potential spread of EUS to other parts of Africa:

Impacts in Zambezi River

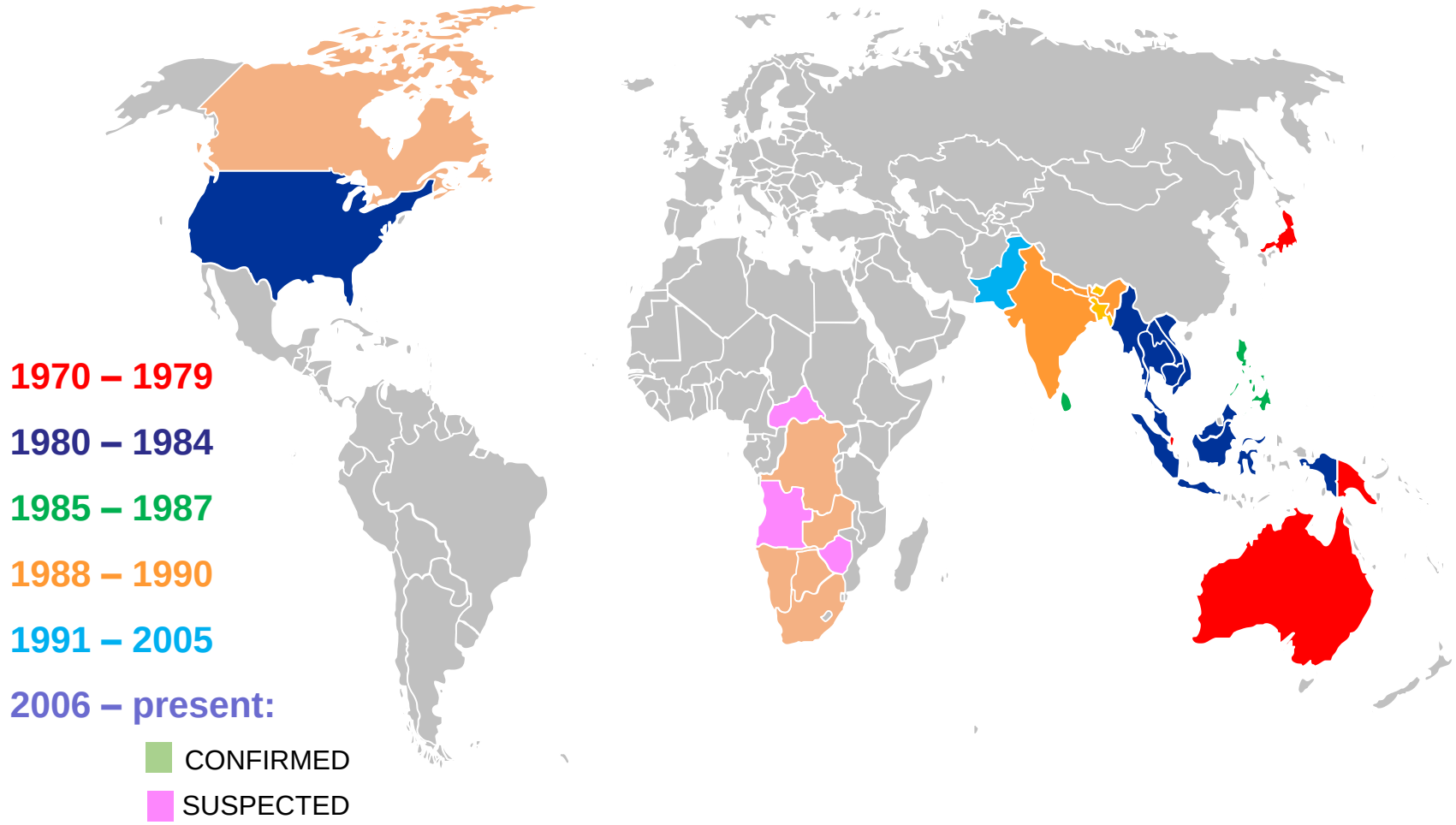
- 4th longest river in Africa, bordered by 7 countries
- 200 fish species, endemic to the river
- 32 million people inhabiting the Zambezi river valley
- River is important for local livelihoods and nutrition, heavily fished; recreational angling



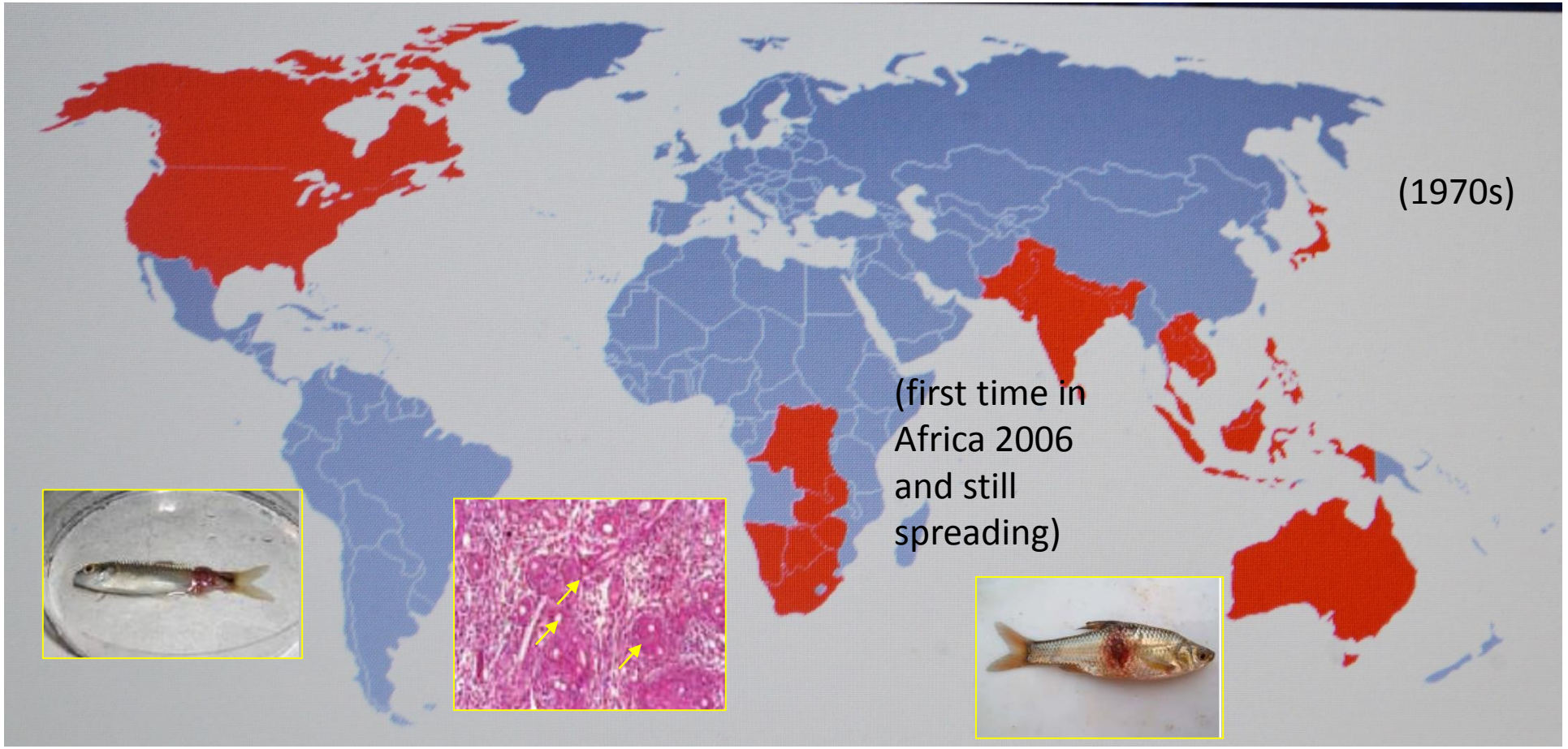
ZAMBIA: over 2000 villages affected; e.g. Western Province, 850 000 people, solely dependent on subsistence fisheries, one of the poorest region, with 18% HIV/AIDS prevalence, 85% of population living in villages along the Zambezi River

Global Distribution of Epizootic Ulcerative Syndrome (EUS)

Chronology of global occurrence of EUS (Lilley *et al.*, 1998; Baldock *et al.*, 2005; FAO, 2009, Huchzermeyer *et al.*, 2012)



This indicative map shows countries which reported occurrences of EUS does not mean that country is infected



Current distribution of **Epizootic ulcerative syndrome (EUS)**

Note: Indicative map shows countries which reported occurrence of EUS – does not mean that whole country is infected:

Asia-Pacific: 15; Africa: 8; North America: 2

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Examples of chronology of disease/pathogen emergence in aquaculture

1970s

Gyrodactylus (salmon)

EUS (many finfish)

1980s

MBV (shrimp)

LCDV (tilapia)

ISA (salmon)

IPNV (tilapia)

Sea lice (salmon)

WSSV, HPV, IHHNV, BP (shrimp)

NHP (shrimp)

Many bacterial, fungi, parasitic diseases affecting all phases of production (hatchery, nursery, grow-out). Vaccines available for some bacterial diseases

1990s

YHV, TSV (shrimp)

KHV (carps/koi carp)

Vibriosis: *Vibrio (harveyi, damsela, alginolyticus, vulnificus, penaeicida)* **(shrimp)**

2000

MoV, IMNV, CMNV, LSNV (shrimp)

AHPND (shrimp)

TiLV (tilapia)

EHP *Enterocytozoon hepatopenaei* (shrimp)

VNN (tilapia and marine finfish)

Parasites

Bacteria

Virus Fungi

Current known distribution of AHPND and TiLV based on OIE notification, scientific reports, stakeholder information

Diseases in aquaculture: examples from largest aquaculture-related epizootics

Disease (observation in the field)	Diagnosis	Reporting /communication (national or OIE)	Containment (vaccine, treatment, husbandry)	Management (cost-effective)	Disease freedom	National and international confidence to the sector
EUS (1970s): fungi	1980s					
WSSV (1980s): virus	mid-1990s					
KHV (2000s): virus	mid-2000	OIE: 2006				
AHPND (2009): bacteria	2013	OIE: 2016				
TiLV (2009): virus	2014	Still being assessed	2018 ?			

Long time lapse: years

$$$$ losses: production, market = livelihoods, export earnings, food supply = socio-economic and environmental impacts

$$$ spent: producers/government/academe: biosecurity (policies, prevention, diagnosis, surveillance, containment, training/education, research, trade disputes, etc); compensation; alternatives)

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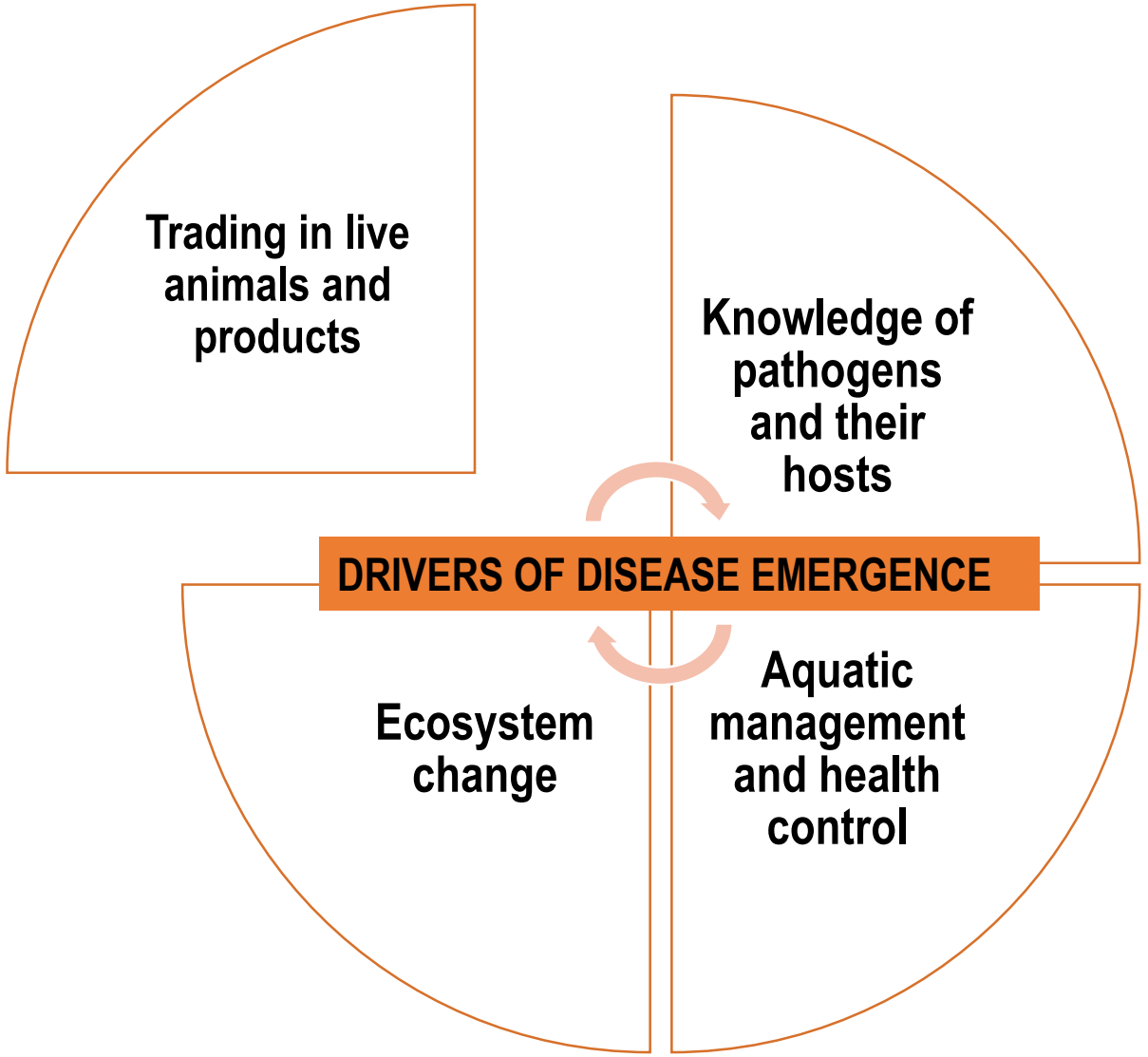
Drivers and factors affecting emergent disease in aquaculture

- 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)



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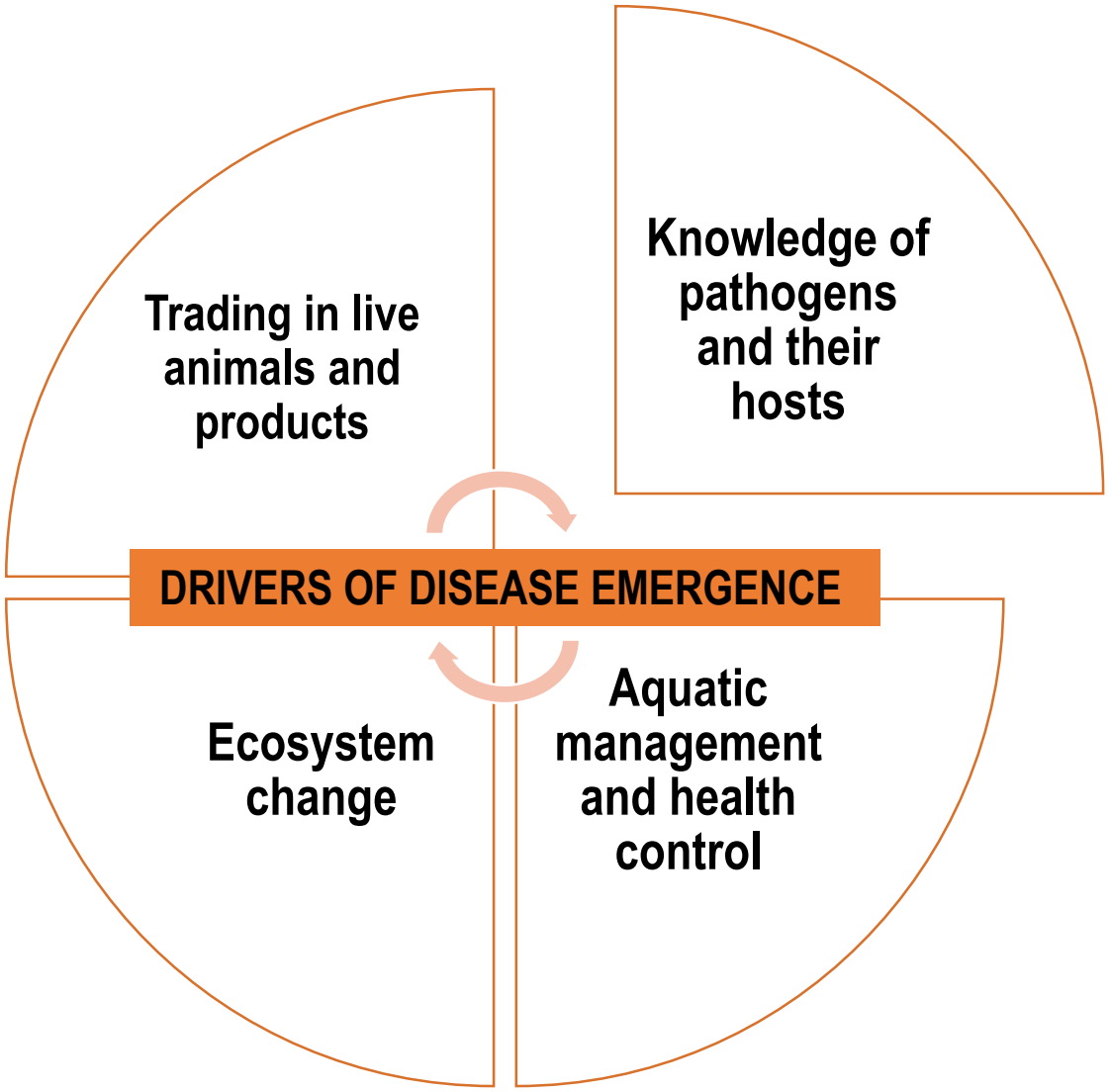
Drivers and factors of emergent disease in aquaculture



- 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
- Societal barriers to innovative genetics (e.g. GMO)

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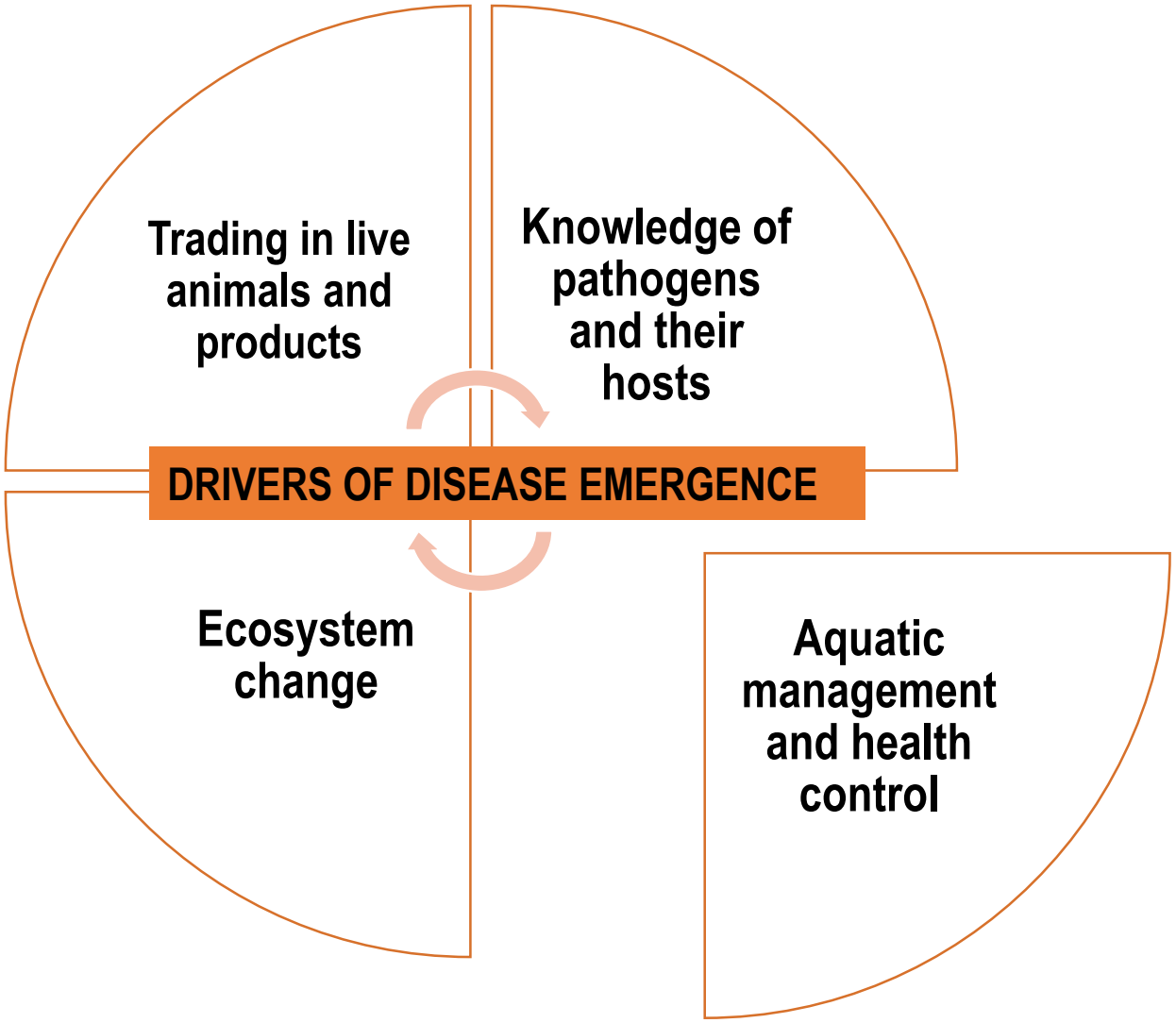
Drivers and factors of emergent disease in aquaculture



- 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

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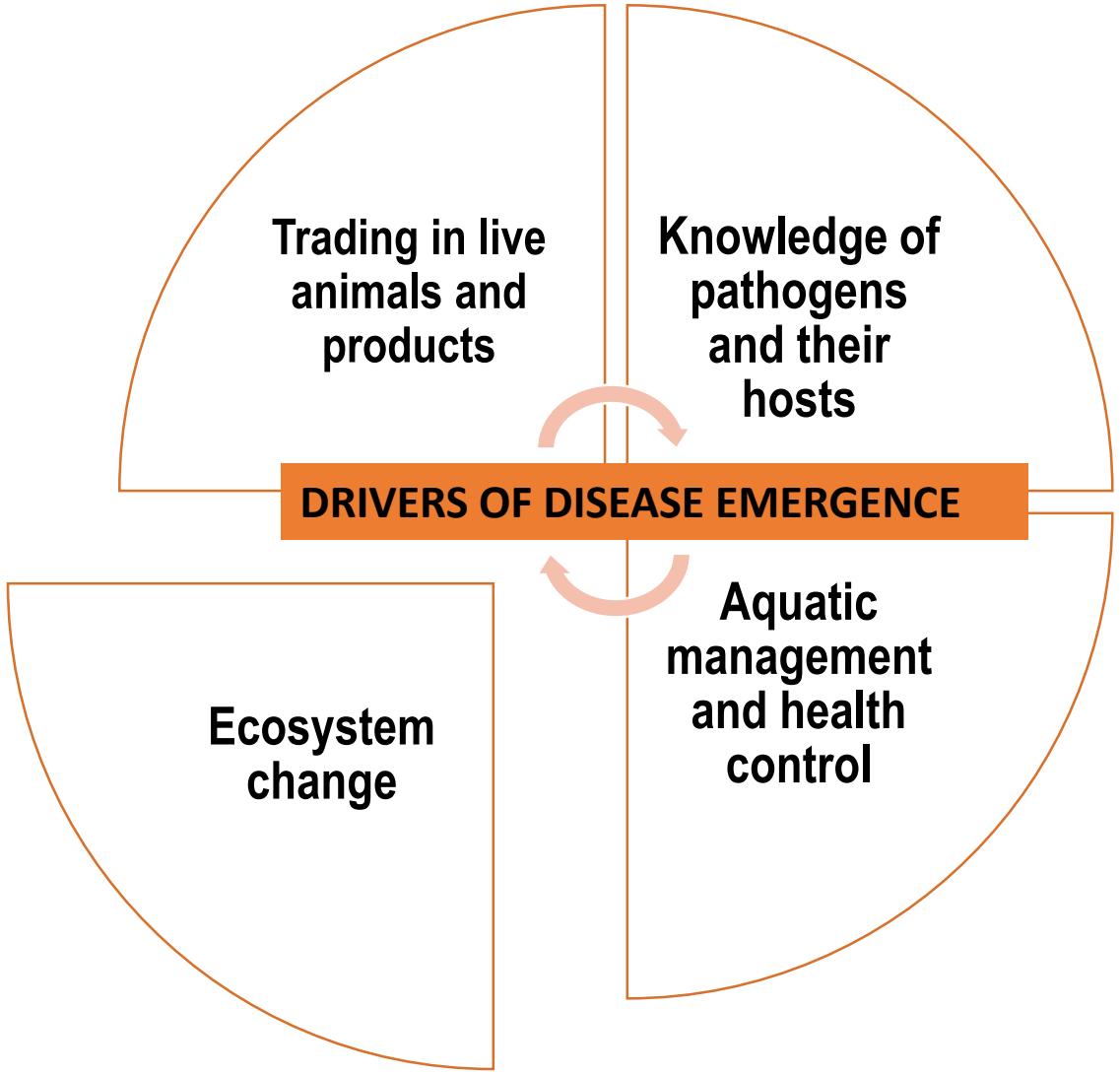
Drivers and factors of emergent disease in aquaculture

- 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
- Pathogens evolve and spill-over and spill-back relative to wild populations
- Some hosts (e.g. crustaceans, molluscs) must calcify (susceptible to acid-base changes)



What can we do?

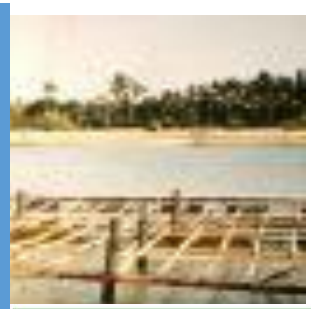
Before the disease or after

Prevention	?	Solution
Pro-active	vs	Reactive
<$$	vs	>$$$$$$$

Aquaculture is a very dynamic sector – site/location specific

Aquatic animals require more attention in order to monitor their health

- not readily visible except in tank holding conditions
- live in complex and dynamic environment
- feed consumption and mortalities are hidden under water

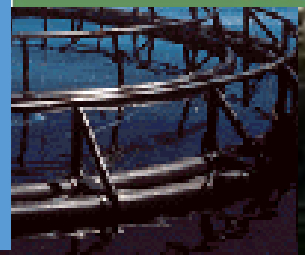


Range of diseases are also varied

- some disease with low or unknown specificity
- many with non-specific symptoms

Complexity of aquatic systems makes distinction between health, sub-optimal performance and disease obscure

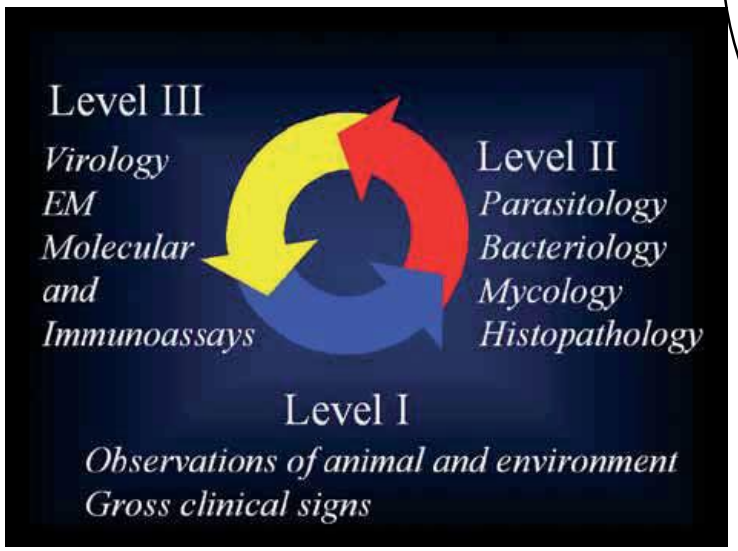
- Diseases not caused by a single event
- End result of a series of linked events involving the interactions between the host, the environment and the presence of a pathogen (Snieszko, 1974).

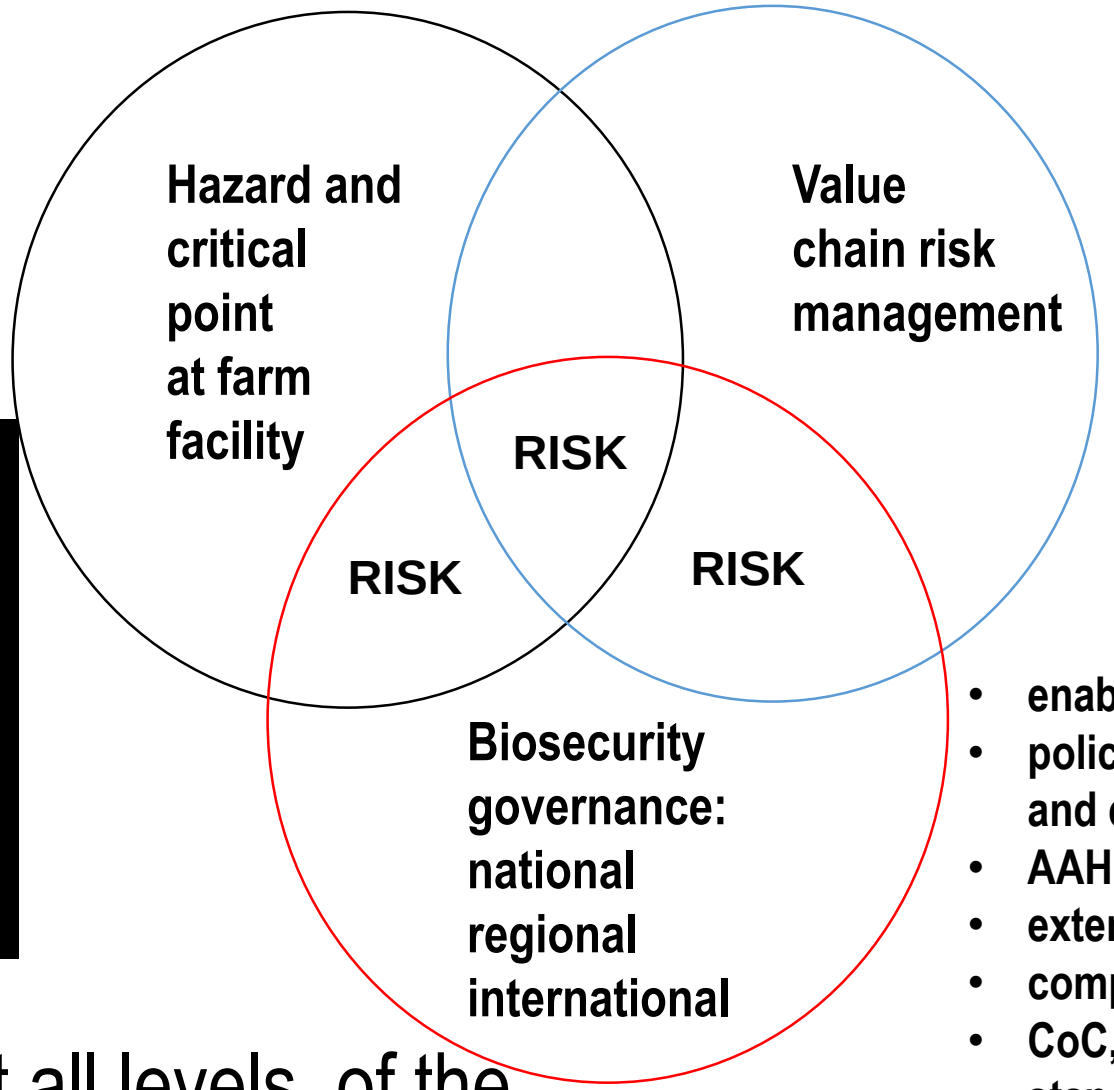


Spread of disease from either cultured fish to wild fish or vice-versa

- presence of pathogen in both fish and water source;
- presence of susceptible host;
- viability, in terms of number and longevity, of pathogen in the environment;
- viable infection route.

- hatchery
- nursery
- grow-out
- processing plants
- even markets





- risky areas in the value chain
- supplier of inputs and products
- trading practices

- enabling environment
- policies, legislation and enforcement
- AAH services
- extension services
- compliance: GAP
- CoC, trading standards
- certification schemes
- fisheries/veterinary authorities

Managing the risks at all levels of the aquaculture chain

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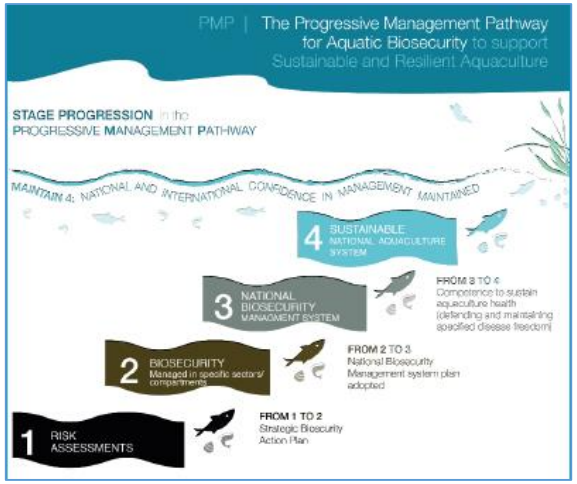
Outcomes of a Multi-Stakeholder Consultation on Progressive Management Pathway (PMP) to Improve Aquaculture Biosecurity

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

Melba Reantaso
Melba.Reantaso@fao.org

Purpose

- **took stock** of the current aquatic animal health and biosecurity situation in aquaculture with a view to identify the bottlenecks and root causes.
- **introduced a new concept** to address aquatic disease problems **- Aquaculture Biosecurity Progressive Management Pathway (PMP**). The PMP is a step-wise risk management framework that should introduce the building blocks for biosecurity capacity that are relevant to national needs at every stage
- **built consensus** on the PMP approach with the aim of developing a **global Plan of Action.**



Participation: n=40

- Governments
- Regional and international intergovernmental organizations
- Industry
- Academe
- Development aid agencies and foundation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World
Organisation
for Animal
Health


Veterinærinstituttet
National Veterinary Institute


SHRIMPVET


Cefas


sernapesca
Servicio Nacional de Pesca y Acuicultura


المجموعة الوطنية للاستزراع المائي
NATIONAL AQUACULTURE GROUP


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FROM THE AMERICAN PEOPLE


UNIVERSITEIT
GENT


NACA


Norad


SEAFDEC


FUTUREFISH


nutreco


WorldFish


ROYAL NORWEGIAN MINISTRY OF
TRADE, INDUSTRY AND FISHERIES


UF UNIVERSITY of FLORIDA


European
Commission


Ministry of Oceans and Fisheries
National Institute of Fisheries Science


AFRICAN UNION
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE


ABCC
ASSOCIAÇÃO BRASILEIRA DE CRIADORES DE CAMARÃO

FAO/MSU/WB Multi-Stakeholder Consultation on
Progressive Management Pathway (PMP) to Improve Aquaculture Biosecurity
World Bank Headquarters, Washington, D.C. 10-12 April 2018

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What is a Progressive Control Pathway (PCP)?

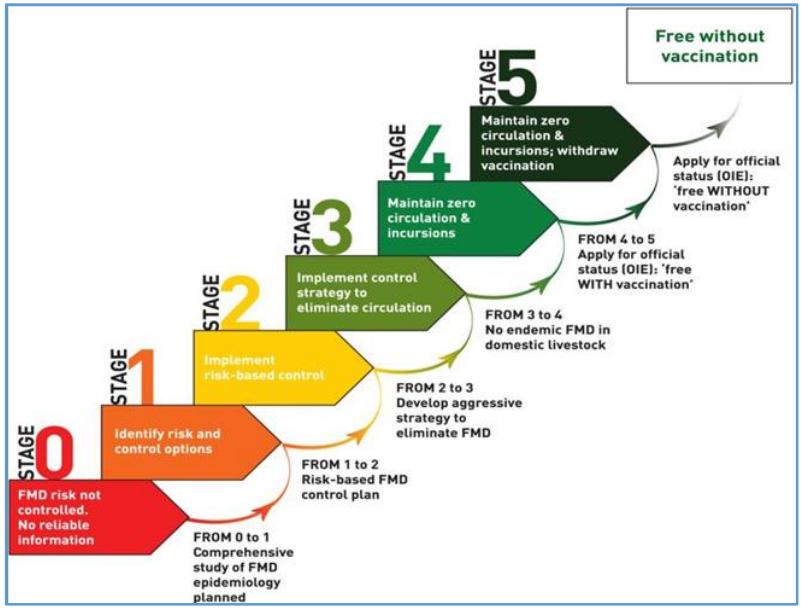
Step-wise approaches are increasingly used for the **reduction**, **elimination** and **eradication** of a range of major **livestock and zoonotic diseases** including:

- **Foot and Mouth Disease (FMD), Peste des Petits Ruminants (PPR), Rabies, African Animal Trypanosomosis (AAT)**

PCPs provide systemic frameworks for **planning** and **evaluating** field interventions and **enable** realistic disease control objectives to be defined and achieved.

PCPs have been used since 2008 by FAO and become adopted as joint tools with the OIE (FMD, PPR), or developed/owned by global alliances (rabies, AAT)

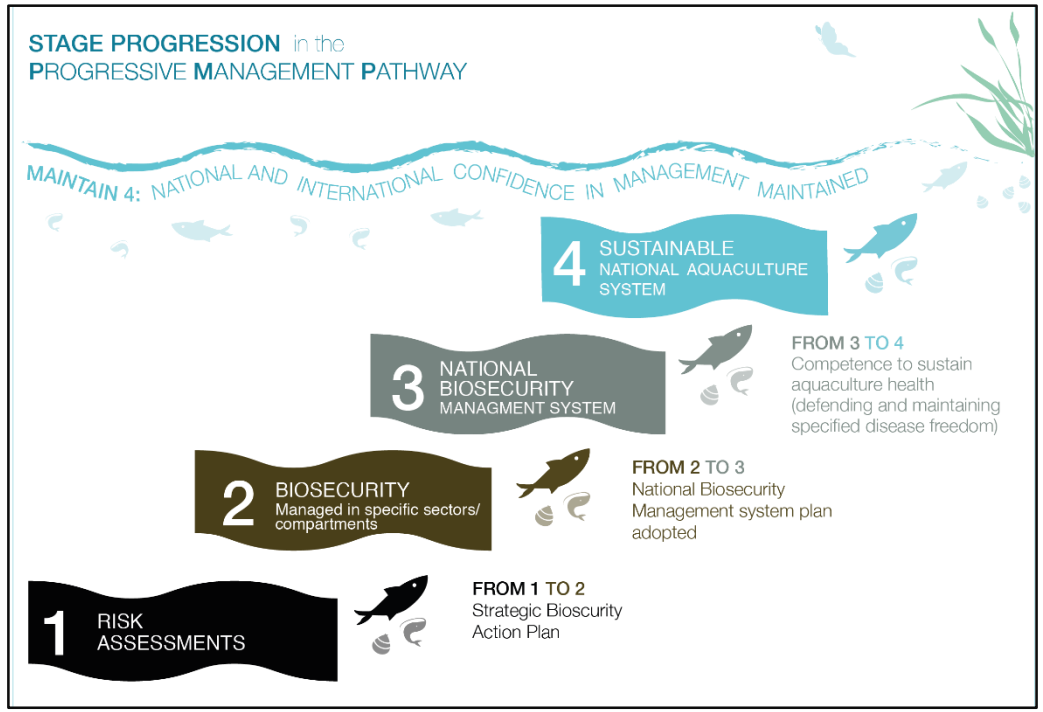
PCP-FMD



- Developed by FAO and EuFMD in 2008
- 5 stages that progressively increase the level of FMD control
- Consist of set of activities focused on identifying and addressing the risk for FMD introduction and spread
- Intended to assist FMD-endemic countries to progressively reduce the impact and burden of FMD

4 stages risk-based collaborative progressive

PMP | The Progressive Management Pathway for Aquatic Biosecurity to support Sustainable and Resilient Aquaculture



- Builds on management capacity
- Bottom-up and top-down approaches
- Strong stakeholder involvement & promotes risk management at producer level as part of national approach
- able to generate early warning information from monitoring and surveillance activities contributing to OIE notification
- At national level or targeted geographically
- Evidence-based and transparent assessment
- Fast-track system

Risk assessment → Biosecurity in Specific Sectors → National Biosecurity Management → Sustainable & Resilient AB

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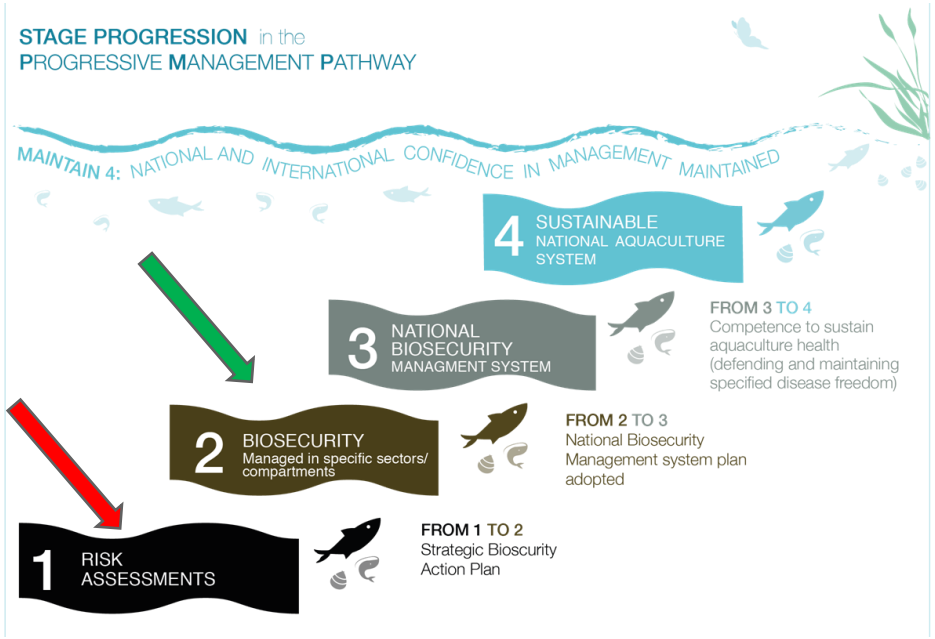
The Progressive Management Pathway (PMP) for Aquatic Biosecurity to support Sustainable and Resilient Aquaculture



Stages 1 and 2

PMP Stage 1 focus -

- **National strategy** that has confidence and support of the **stakeholders** (private and public) and common agreement on a long term vision
- **Principal hazards** and **risks** that affect aquaculture health and production: exotic, endemic, emerging diseases (known and unknown); map risks and gaps, identify negative impact on ecosystem
- **Strategic Biosecurity Action Plan** which will be the 'gateway pass' to enter **Stage 2**

PMP Stage 2 focus -

- **Implementation** of a **Biosecurity Action Plan** in **specific sectors/compartments**
- **Co-management** is expected to continue and strengthen the implementation and the improvements
- Should this stage move forward additional biosecurity efforts at ports and borders must be included
- Countries will need: **evidence** Strategic Biosecurity Action Plan implementation, & **commitment** through a National Biosecurity Management System in order to enter **Stage 3**

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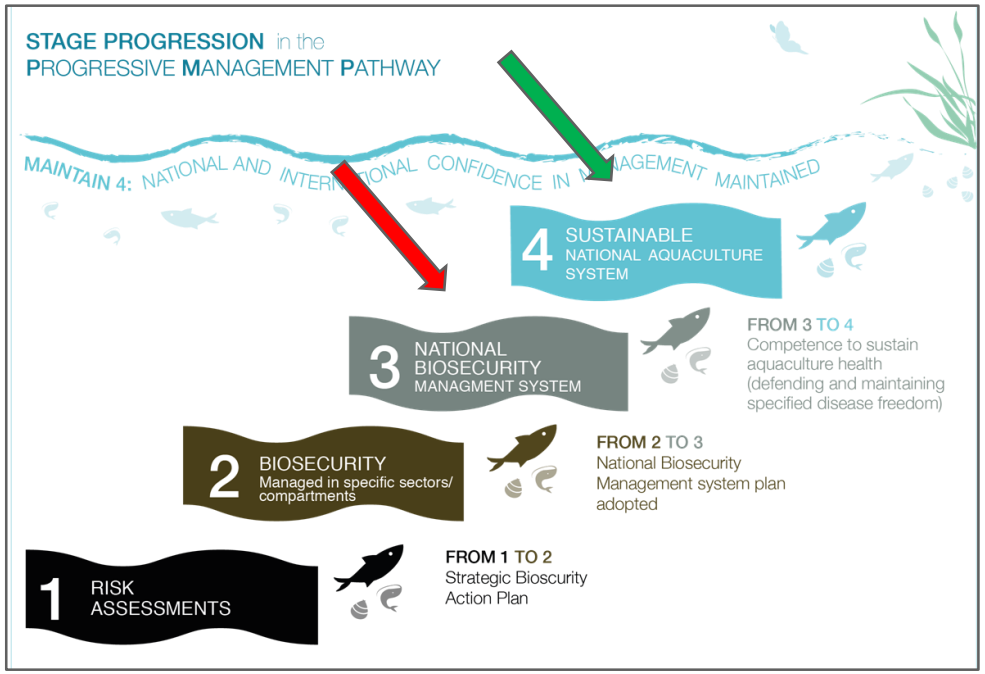
The Progressive Management Pathway (PMP) for Aquatic Biosecurity to support Sustainable and Resilient Aquaculture



Stages 3 and 4

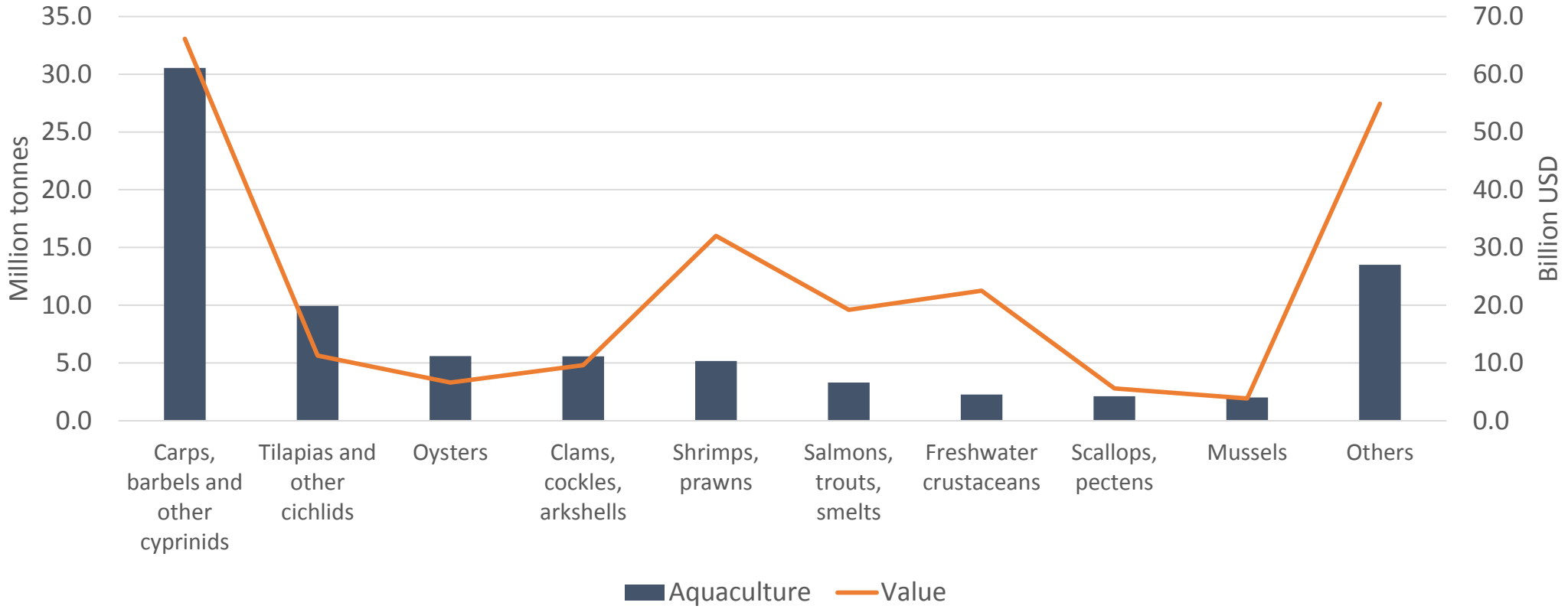
PMP Stage 3 focus -

- Zoning, restrictions of movement and reporting of any disease/emerging problems through constant surveillance should be in place
- Once the management system is found to be capable to sustain the Aquaculture health by defending and maintaining specific disease freedom it can move forward to **Stage 4**

PMP Stage 4 focus

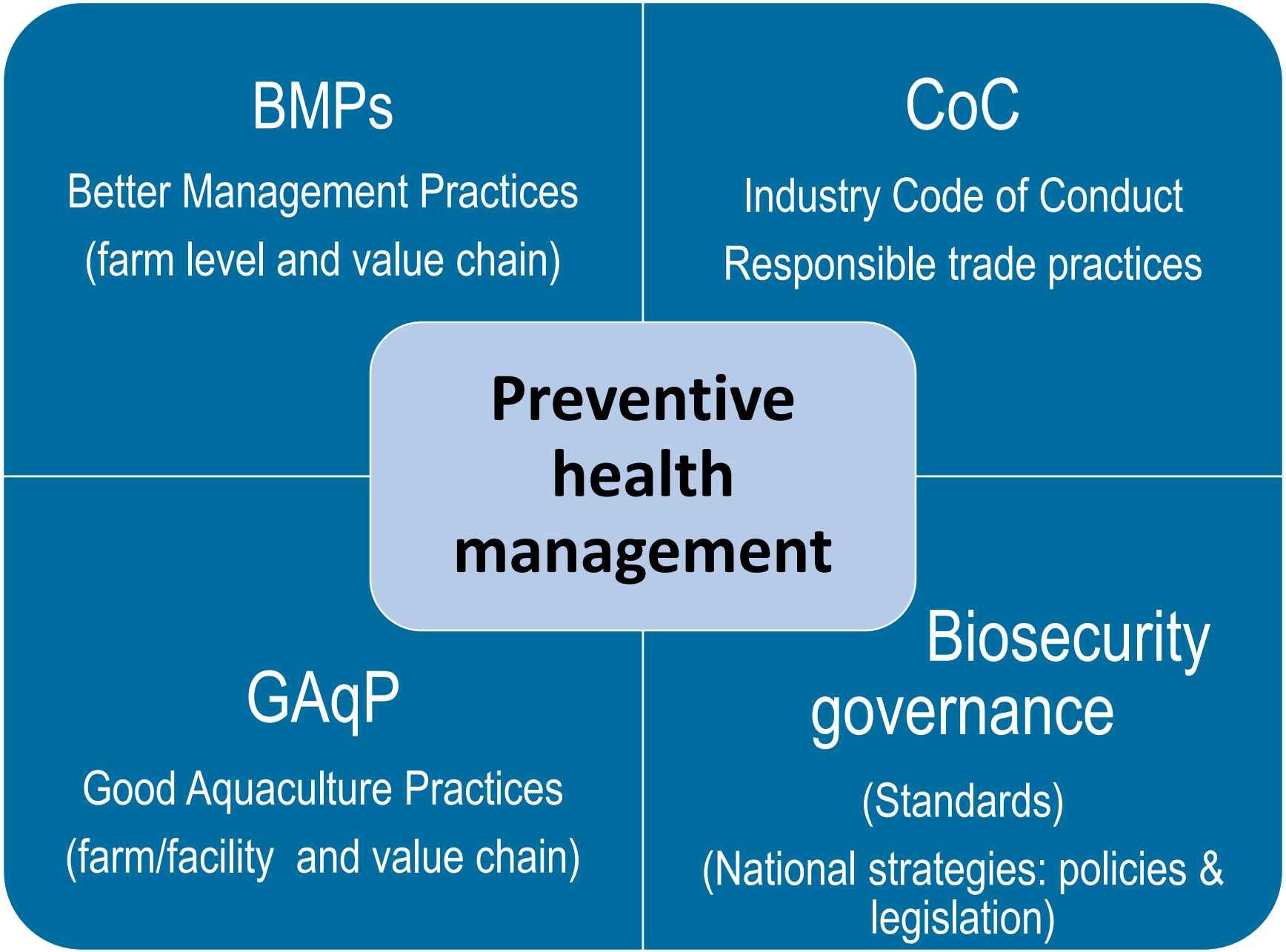
- End stage - Achievement of a Sustainable and Resilient National Aquaculture System acquired through the capacity to maintain confidence, biosecurity system, emergency preparedness and preventive measures
- All these activities must be coordinated and maintained, otherwise a 'downgrading' of the PMP status may result

Aquaculture animal production (2016)
Main species groups



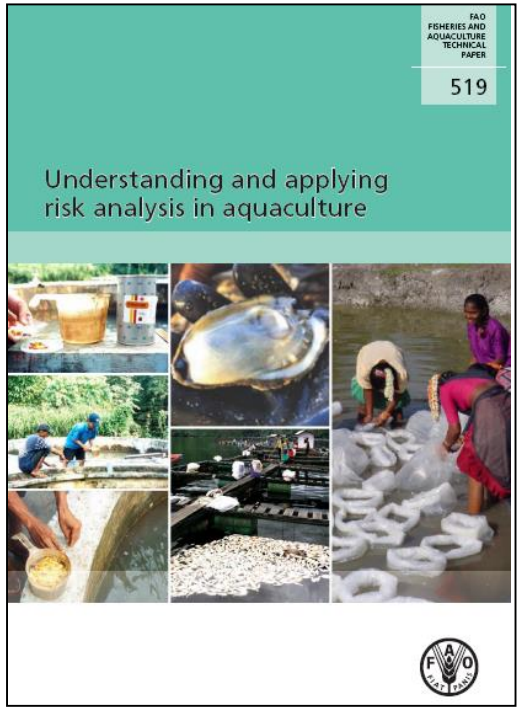
Biosecurity: reducing and managing risks

- **prevention** – reducing the probability of the risk occurring
- **mitigation** – reducing the impact of a risk event will bring and when everything else had failed; and
- **coping** – reducing the impact of a risk event that has occurred


BMPs
Better Management Practices
(farm level and value chain)
CoC
Industry Code of Conduct
Responsible trade practices
Preventive health management
GAqP
Good Aquaculture Practices
(farm/facility and value chain)
Biosecurity governance
(Standards)
(National strategies: policies & legislation)

National, sub-regional, regional and international framework

- **National level**: institution clearly identified with clear mandate; competence of Competent Authority on aquatics; **PPP!**
- **Sub-regional and regional levels**: same agroecological conditions, similar species/systems; trade practices; regional networks/bodies
- **International level**: standards – assist countries in reducing the risks of TAAD introduction and spread **- implementation**



Risk sectors in aquaculture

Food safety/Human health risks

Food Safety/Human Health Risk Analysis

- Microbiological risks in food

Genetic risks

Genetic Risk Analysis

- Genetic Risks in aquaculture
  - From new species & strains
  - From GMOs, triploids, etc.

Ecological risks

Ecological Risk Analysis (ERA)

- Ecological impacts of introduced & transferred species (pests & Invasives)

Examples:

- Transmission of disease organisms
- Biological interaction of escapes with wild populations including predation, competition, genetic impacts, etc.
- Physical interactions with aquatic life
- Physical impacts on aquatic ecosystems

Pathogen risks

Pathogen Risk Analysis (PRA)

- Pathogen risks posed by international & domestic movements, including on-farm

Sustainable Aquaculture Development

Financial risks

Financial Risk Analysis

- Business risks in aquaculture
- Costs to society of pathogens, pests, invasives

Social risks

Social Risk Analysis

- Risks to aquaculture from society
- Risks to society from aquaculture

Environmental risks

Environmental Risk Analysis (ERA)

- Risks to the physical & biological environment in which aquaculture takes place

Examples:

- Organic and chemical pollution
- habitat change & loss
- impacts on wild populations
- secondary impacts on other production systems

Shared responsibility

- Protect farm
- Protect industry
- Protect the aquatic environment
- Both small-scale and commercial-scale
- Cost of prevention is lower than costs of managing diseases when they occur

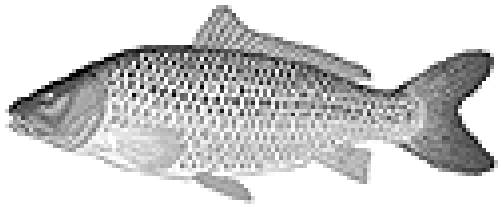
Tools: Best practice guidance – going back to basics!

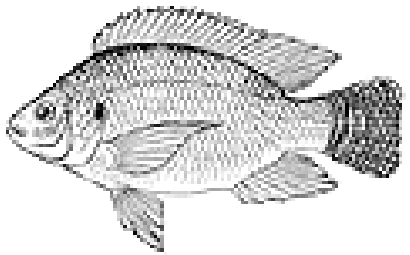
Best practice guidance for carp, tilapia and shrimp	
Know your fish	Maintain good husbandry and water quality
Know your pathogens	Manage stock health
Know your systems	Respect food safety
Know your risk/contamination pathways	Respect environment
Source healthy seeds	Implement biosecurity plan including rapid response to disease emergencies

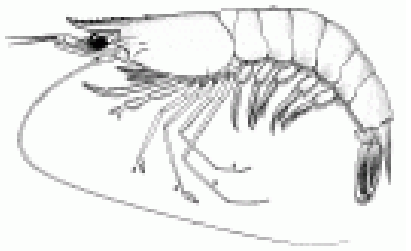
Maintain vigilance vs complacence; pro-active vs reactive

Immediate reporting of anything 'unusual'

Biosecurity plan = RISK







Food and Agriculture Organization of the United Nations

Tools, capacity and skills development especially for decision-makers, non-specialists as well as laboratory and field personnel

operational manual (field and laboratory procedures, questionnaires, recording, sheets)

data collection, database, analysis, etc.

field and logistics requirements

alternatives to antibiotics

Putting farmers in the equation

Disease costs are too high for small-scale sector to survive

Getting them involved and utilise their indigenous knowledge

Making them aware of the risks and helping them manage the risks at farm level

How do you deal with thousands of small-scale aquaculture producers?

Understanding their needs and expectations

Provide feedback and updates

Important role of farmers

Effective technologies and strategies which are accessible and affordable to the resource-poor small-scale sector

Farmers administer antibiotic treatment (tetracycline) with poor success.

Not only in the acknowledgement!