© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Economic impact of disease and biosecurity measures

Edgar Brun
Chris Rodgers
Marios Georgiadis
Trond Bjørndal

Veterinærinstituttet
National Veterinary Institute

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Objectives

- Outline global, national and regional economic value of aquaculture
- The impact of diseases
- Describe how well structured biosecurity programs will enhance production, producer and national economics, trade, and animal health and welfare.

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Outline

- Background
- Global production and economic value
- Impact of diseases
- Biosecurity and economic considerations
- Conclusions

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Background (1)

General focus on

- Sustainable economic production and trade
- Justification of disease control
- Sustainable environmental stewardship
- Welfare and ethics

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Background (2)

Veterinærinstituttet

Some characteristics of modern aquaculture

- Global trade in products and living organisms
- Fish is globally the most traded food
  - 22% of this trade is aquaculture products
  - aquaculture provides > 40 % of the global food fish supply
- Intensive and extensive production systems
- Aquaculture is vital for many local/regional and national economies, both financially and w.r.t. employment
- Continuous development of technology
- Traditional and novel species for culture
- Increasing focus on “healthy” food production

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Background (3)

- Diseases have become one of the main constraints to sustainable aquaculture production and trade
- Many examples of translocation of infectious agents by host movement
- Increasing understanding of a need for coordinated preventive actions between stakeholders
- International, national and farm level biosecurity measures have become essential to control and prevent infectious diseases and their devastating economic consequences

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Veterinærinstituttet

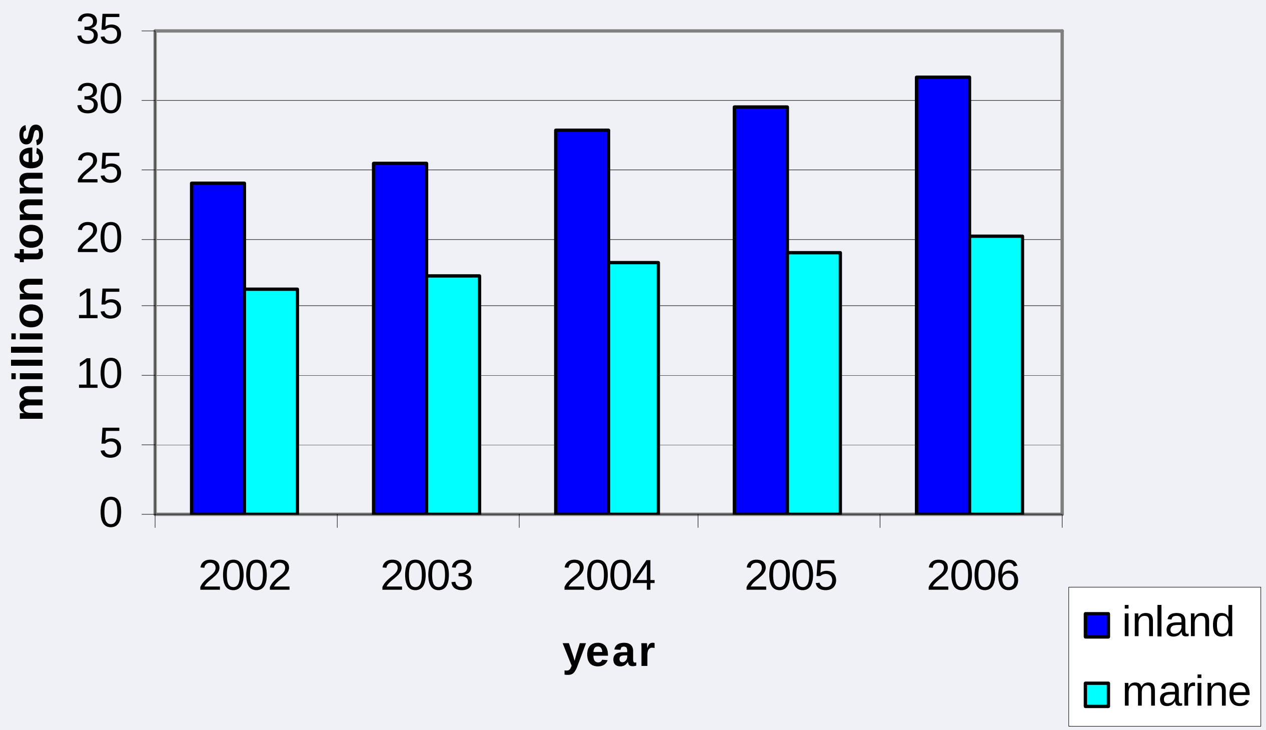
Production

The State of World Fisheries and Aquaculture 1998 :

"...total world aquaculture production will have reached between 35 million and 40 million tonnes of finfish, crustaceans and molluscs in 2010"

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

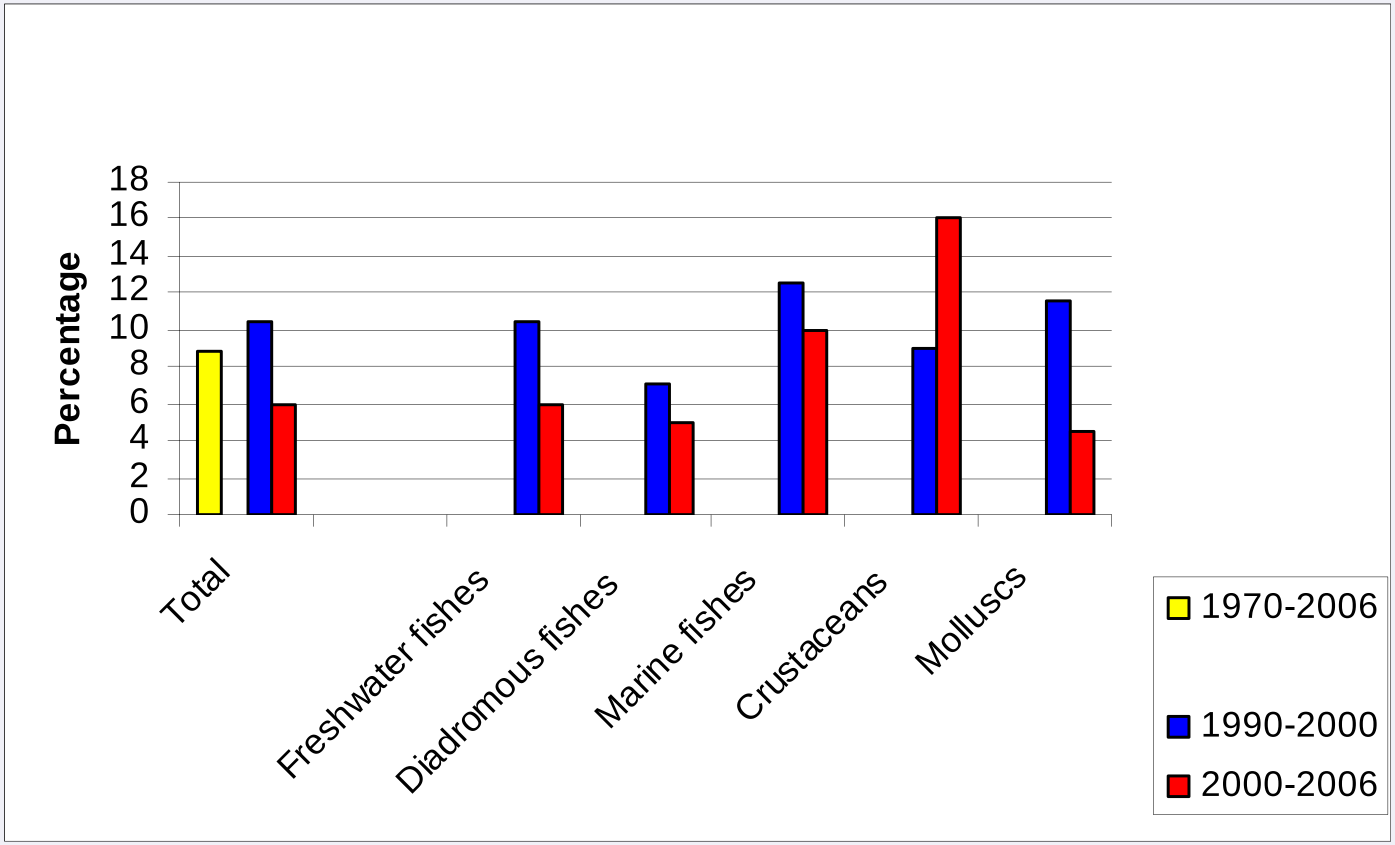
World aquaculture production
(FAO 2008)



Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Production growth rates
(FAO 2008)



Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

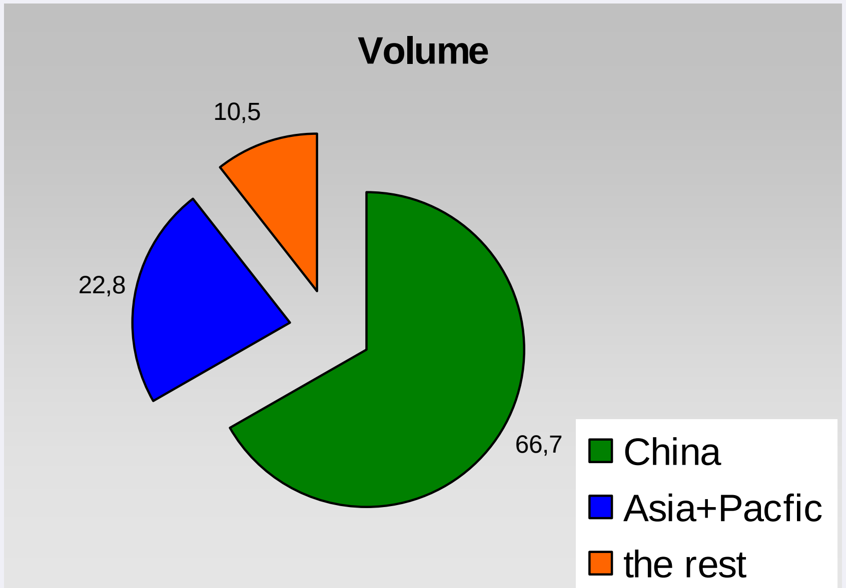
Top 10 Producer Countries 2006 (FAO)

Country	Tonnes (mill)
China	34.4
India	3.1
Vietnam	1.7
Thailand	1.4
Indonesia	1.3
Bangladesh	0.9
Chile	0.8
Japan	0.7
Norway	0.7
Philippines	0.6

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Production volume 2006 (FAO)

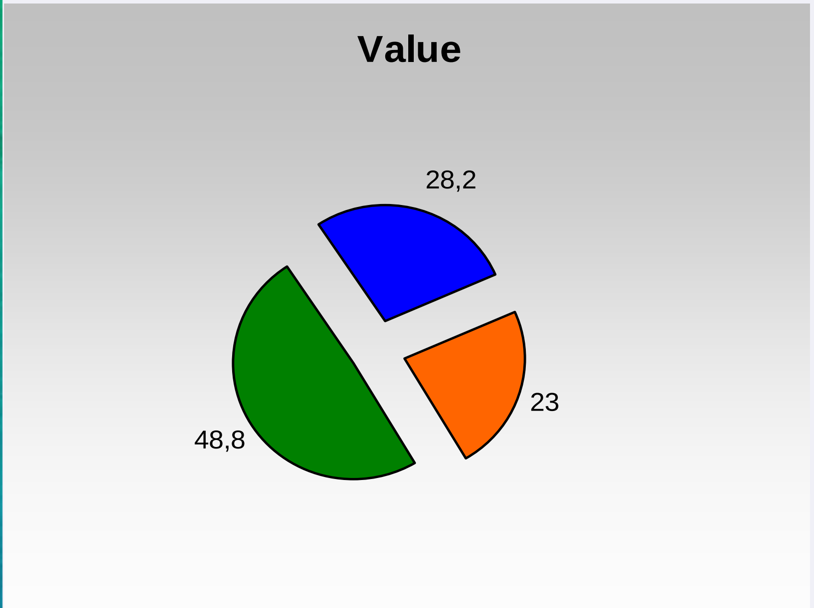


	Volume (%)
China	66,7
Asia+Pacfic	22,8
Europe	4,2
Latin Am + Caribbean	3
Africa	1,5
North America	1,2
Near East	0,6

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Production value 2006 (FAO)



	Value (%)	In billions
China	48,7	38,4
Asia+Pacfic	28,2	22,2
Europe	9,1	7,2
Latin Am + Caribbean	8,5	6,7
North America	2,2	1,7
Africa	1,8	1,4
Near East	1,5	1,2

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Economic value relative to

- Farmgate level
- National export
- Socio-economic considerations
  - Regional
  - National
- Stock market

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Economic value
(World Bank)

In 2006, global farmgate value of aquatic animals was estimated to US $ 78.8 billion

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Global loss from diseases

(World Bank report 2006)

- Estimates of loss may have different assumptions
- Total loss of US $3 billion per year (1997/2001/2006)

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Examples

- Losses due to shrimp diseases: US $3 billion for 11 countries (Asian+S/N Am) for the period 1987–94
- Bangladesh; 15% reduction in production (questionnaire 2004)
- In Ecuador (1999/2000), WSD caused production losses valued at US$ 600 – 1,000 million – all production units affected, several 100,000s jobs lost in the sector
- In China (1993) and Thailand (1996), white spot disease (WSD) alone caused more than US$ 400 and 500 million in production loss
- Annual losses finfish species in China > US $120 million (1990-1992)

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Examples

- Sea-lice mortalities have cost the EU salmon farming industry an estimated €14 million per year
- Infectious salmon anaemia cost the industries of Norway, Scotland, and Canada in the order of US $60 million (MacAlister Elliot and Partners, 1999).
- ISA outbreak in Scotland 1998/1999: £ 20 mill
- Annual ISA cost in Norway and Canada : US $ 10-15 mill (Hastings et al 1999)

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Cost of disease

Cost = loss + expenditures

Loss: reduction in benefits

Expenditures : additional input

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Cost of disease (expenditures)

- Farm level
  - biosecurity measures (incl. vaccination)
  - treatment
  - extraordinary
- National level
  - legislation
  - control and surveillance
- Indirect cost
  - cost to society (social, welfare, environmental)
  - negative externalities
  - insurance/potential government compensation
- Other effects
  - adjustments in market shares
  - price may increase due to lower supply

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Impact of diseases

- Animal and herd productivity
- Trade

- Environment

- Animal welfare
- Human welfare

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Effects on productivity

- Biological and economic feed conversion rate
  - Feed intake
    - altered ability of intake
    - altered ability to digest feed
  - Growth rate
- Mortality/morbidity
  - biomass for sale
  - yield consumable
- Flexibility in production
- Immunosuppression
  - increased sensitivity to other diseases
- Genetic improvement

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Trade

- Lower margins
- Reduced quality and thus value of products
- Negative publicity may cause reduced demand for products
- Trade restrictions (national and international)
- Loss of market access / market shares

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Environment

- Increasing infectious load
- Introduction of new agents
  - new host species

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Welfare

- Animal welfare
  - suffering of animals in captivity
- Human welfare
  - loss of earnings/jobs
  - recreation
  - the apprehension of a healthy environment
  - eating food of (potentially) sick animal
  - working with sick animals

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Biosecurity

“Prevention is better than cure”

The process and objective of managing biological risks associated with food and agriculture (*food production*) in a holistic manner (FAO).

The probability of avoiding introduction or re-introduction of an infectious agent to the farm (Stott et al., 2003).

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Biosecurity

- Must be based on
  - risk profile of actual disease(s)
  - epidemiology of the disease
  - efficient farm level strategies
    - good management practice
    - testing
    - quarantine
    - vaccination (if available)
- Includes legislation and on-going surveillance and control programmes
- Non-agent/disease specific

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Production function

Diseases will reduce the efficiency by which input are converted into output

Biosecurity

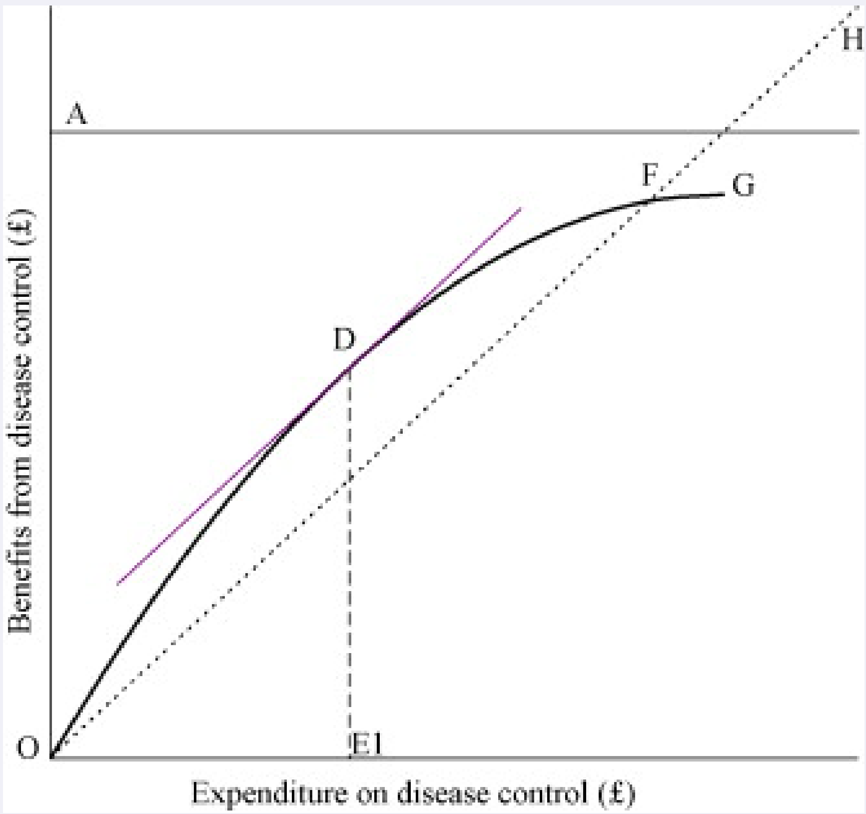
- will reduce the probability of infectious exposure (known and unknown) and curtail its effect (holoistic)
- is additional input to the production function
- may increase output or lower the need for input
- should be balanced between benefit and cost

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Veterinærinstituttet

Benefit function (ODFG) based on showing point of maximum net benefit (*D*) from expenditure E1. Maximum benefit (disease eradication) is shown by the limit A.



Tisdell, 1995 and Stott et al., 2008

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Control of ISA, VHS, IHN in the UK

- Cost-benefit analysis (national level)
  - for running programmes
- Data collection from the literature + interviews
- Assumptions on
  - disease and outbreak scenarios
  - epidemiology
  - trade
  - surveillance cost and outbreak cost (governmental/private)
- Indirect costs (consumers, export, human welfare, lost non-use-value)
- B/C- ratio
  - ISA : 3.2 - 4.3
  - VHS: 5.7 - 6.8
  - IHN : 0.8 - 1.0

Moran and Fofana, 2007

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Cost of PD in Norway

- Partial budgeting (farm level)
  - Model DC= L+CE-I
- Data collection from literature + interviews (farm data bases)
  - mortality, quality (price), treatment, etc.
- DC= NOK 14.4 mill (10.5 -17.8 mill) per site of 500,000 fish (~ 100 cases in 2007)

Veterinærinstituttet

Aunsmo et al., 2008

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Optimisation of benefits from biosecurity measures

- Risk of introduction
  - risk profile of various diseases
  - endemic vs new disease
  - probability of biosecurity breakdown
- Epidemiology of the disease
- Farm characteristics
- Awareness of opportunity costs

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Conclusions

- Biosecurity measures essential in any biological production chain
- Biosecurity measures essential to control the devastating effects of diseases and maintain global trade
- Cost of biosecurity is a necessary input in the production function
- Models for promoting and optimizing benefits of biosecurity measures are needed to secure the understanding of the b/c-relationship so that best practice is understood and adopted

Veterinærinstituttet

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.

Veterinærinstituttet

Conclusions

- Animal health economics and disease impact is a multidisciplinary complex issue
  - large set of production, epidemiological and biosecurity data required
  - data may be difficult to achieve
- Aspects not easily quantified are left out of traditional analyses
  - animal welfare impacts
  - environmental damage

© IABC 2009. Do not duplicate or use material without written permission from the IABC Organizers or the senior author.