Veterinærinstituttet
Norwegian Veterinary Institute

WOAH Collaborating Centre for Epidemiology and Risk Assessment of Aquatic Animals (Europe)

Reference Centre

World Organisation for Animal Health
Founded as OIE

Biosecurity in aquaculture

Regional Workshop for WOAH National Focal Points for Aquatic Animals IV Cycle Chioggia (Italy)

18th - 20th October 2023

Saraya Tavornpanich, DVM, MPVM, PhD

- Senior researcher, Norwegian Veterinary Institute, Norway
- Coordinator of the International Centre for Aquatic Animal Health Development at NVI
- Head of WOAH Collaborating Centre for Epidemiology and Risk Assessment of Aquatic Animal Diseases (Europe)

Veterinærinstituttet
Norwegian Veterinary Institute

Outline

- General principles of biosecurity plans, and evaluation
- A systematic approach for quantifying biosecurity measures
- Fundamentals for success
- Challenges

Veterinærinstituttet
Norwegian Veterinary Institute

Benefits of Biosecurity in Aquaculture

Improve market access

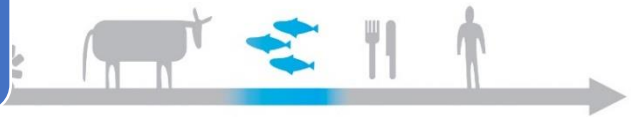
Increase productivity

- **Survival, Growth,**
- **Feed conversion**

Reduction in the use of veterinary medicinal products

Reduction in production costs

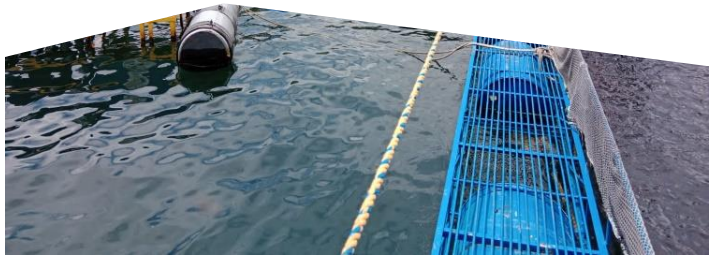
Reduction rate of emergence antimicrobial resistance



Benefits of Biosecurity in Aquaculture

"Are we currently at an adequate level of biosecurity, or is there room for improvement?"

"How can we objectively... connection between good bio... benefits?"

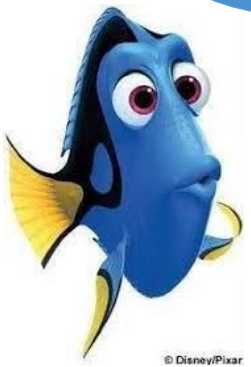


- Survival, Gr...

Reduction in production costs

Reduction rate of emergence antimicrobial resistance

What is Biosecurity?



Veterinærinstituttet
Norwegian Veterinary Institute

Biosecurity

Defined as “a set of management and physical measures designed to mitigate the risk of introduction of pathogenic agents into, or spread within, or release from, aquatic animal production”

Aquatic Animal Health Code, Chapter 4.1 provides recommendations on the development and implementation of biosecurity measures for aquaculture establishments
https://www.woah.org/en/what-we-do/standards/codes-and-manuals/aquatic-code-online-access/?id=169&L=1&htmfile=chapitre_biosecu_estab_aqua.htm

Veterinærinstituttet
Norwegian Veterinary Institute


Aquaculture production systems
vary in control over environmental
conditions and quality of water source

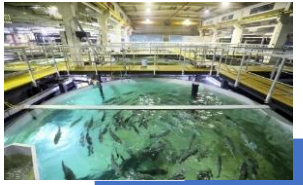
Aquaculture production systems
Farm categories for biosecurity evaluation

Semi-open systems

- Production in cages, net pens, suspended baskets, rope systems

Semi-closed systems

- Production in ponds, raceways, floating enclosures, and flow through tanks



Closed systems

- Indoor, RAS with safe water supply and high control of environment

Know your facility

The design, location and infrastructure of your farm will determine how biosecurity can be managed

- Site location and features (geographical location; infrastructure such as buildings, roads, water intake and outlet; surrounding farms, rivers, coastline)
- Cultured species and their susceptible pathogens

Veterinærinstituttet
Norwegian Veterinary Institute

Know your facility

- Layout of the farm
  - Production Areas:
  - Stock Movements:
  - Water Management:
  - Feed Storage:
  - Waste Disposal:
  - Processing Facilities:
  - Access Points:
  - Quarantine Facilities:
  - Equipment and Vehicle Storage:
  - Footbaths and Disinfection Areas:
  - Escape Prevention:
  - Marinas and Boat Ramps:
  - Species-specific Features:
  - Site Security:

Transmission pathways

Identify potential pathways

Risk analysis

Evaluate the biosecurity measures to address risk

Water

Personnel and visitors

Animals

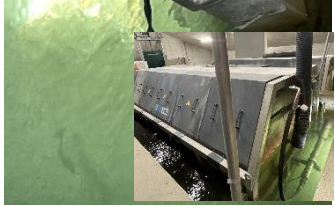
Facility

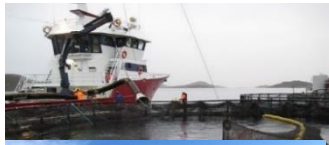
Vectors

Animal products and waste

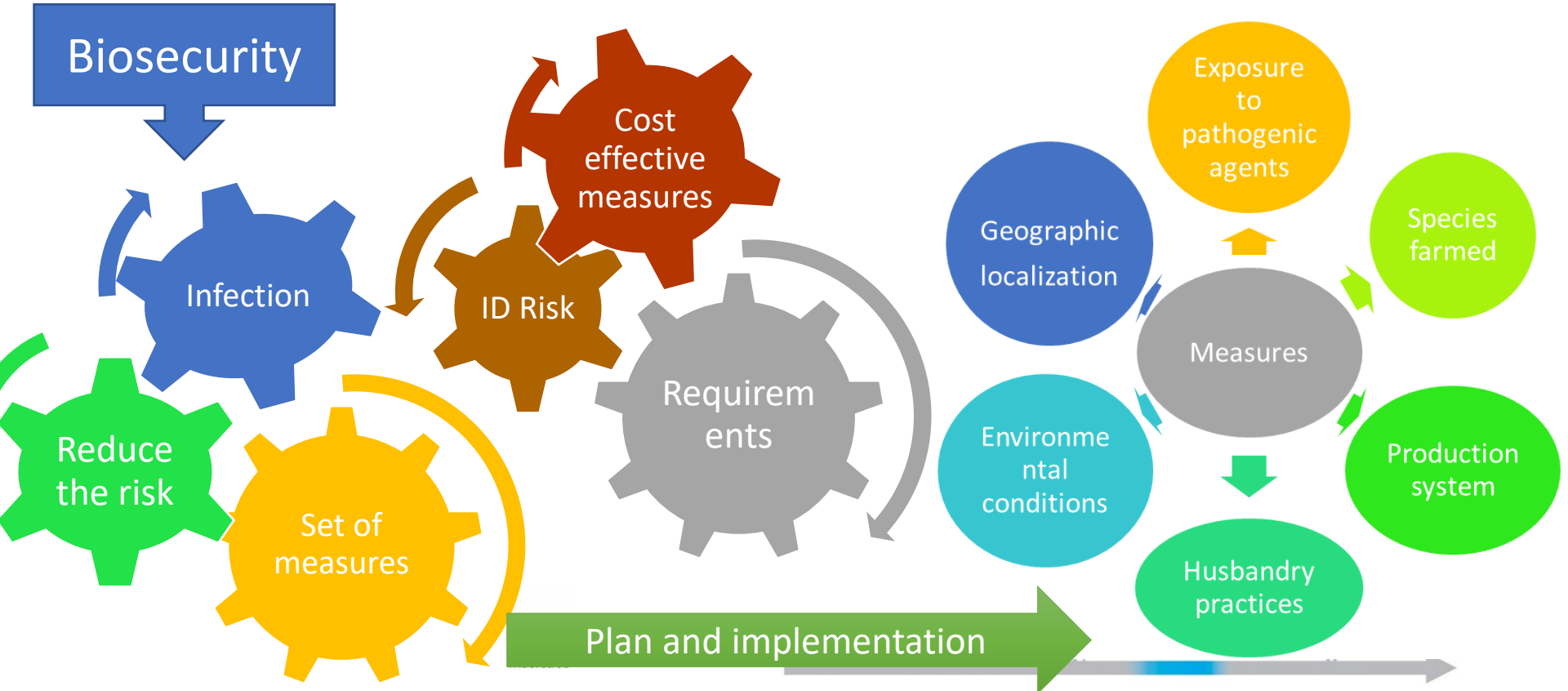
Fomites

Feed





Principles, Plans, Implementation



Why quantify biosecurity measures?

- “*Being able to measure is to be able to improve*”.
- Biosecurity can be measured or expressed in numerical terms.
- To assess and enhance biosecurity, we evaluate a farm's current status, identifying strengths and weaknesses over time and making comparisons among farms in the same category. This informs targeted measures for overall improvement."

The concept and methodology

BIOCHECK.UGENT POULTRY

ELSEVIER

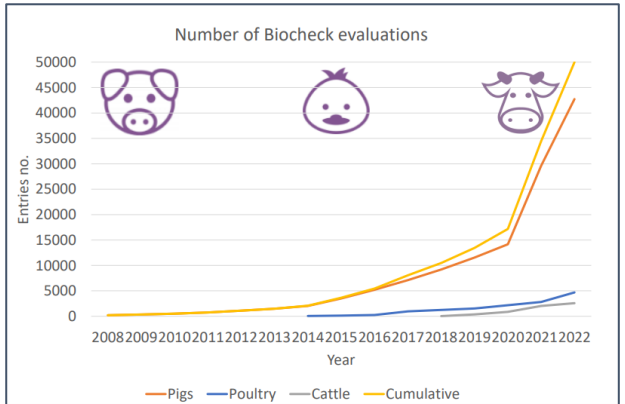
Poultry Science
Volume 93, Issue 11, 1 November 2014, Pages 2740-2751

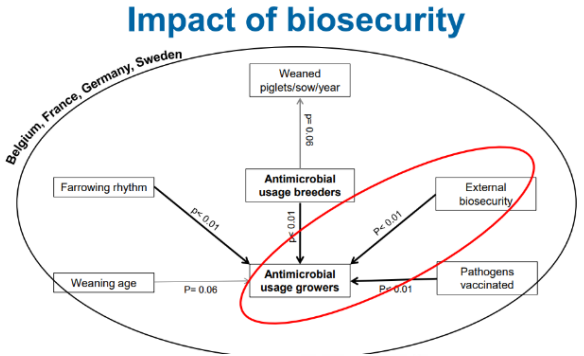
Immunology, Health, and Disease

Biocheck.UGent: A quantitative tool to measure biosecurity at broiler farms and the relationship with technical performances and antimicrobial use

P. Gelaude *, M. Schlepers *, M. Verlinden †, M. Laanen *, J. Dewulf *

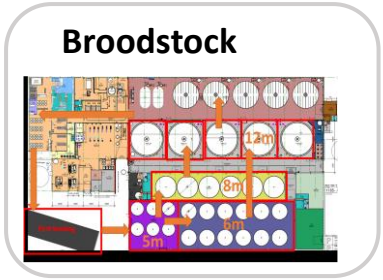
	Before	After	Change
External biosecurity	64	69	+5
Internal biosecurity	73	77	+4
Mortality first week	1,08	1,27	+0,19%
Total mortality	3,54	3,05	-0,49%
Average daily weight gain	57	57	+0
Feed conversion	1,8	1,7	-0,1
Performance index	318	332	+14
Antimicrobial use (TI)	**192**	**136**	**-29%**

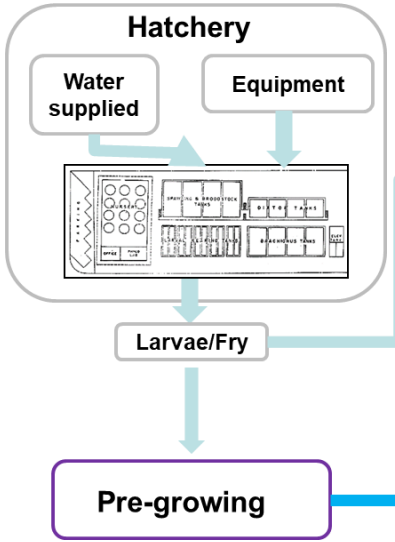


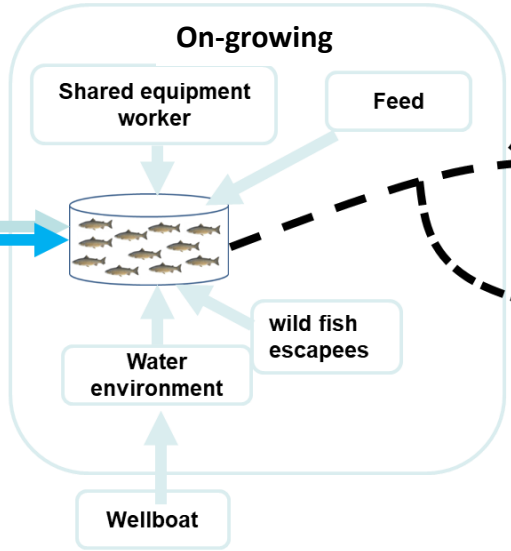


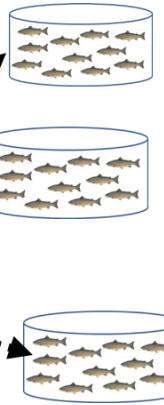
Systematic approach for biosecurity quantification

The 1st step: subject experts & literature review on production system and potential pathways of disease introduction and spread





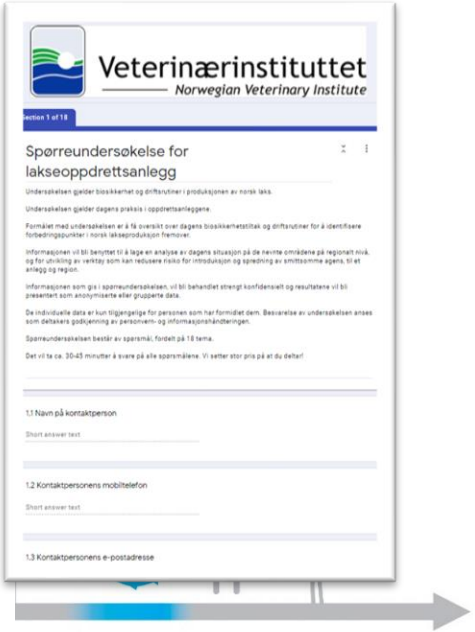




Systematic approach for biosecurity quantification

The 2nd step is the process of formulating scoring questions and collecting farm data.

Develop a comprehensive and generic questionnaire to gather information on farm general characteristics, production management, health management, disease reporting, diagnostic capacity, biosecurity practices and record keeping…



Systematic approach for biosecurity quantification

The third step involves creating a score for subcategories within both external and internal biosecurity.

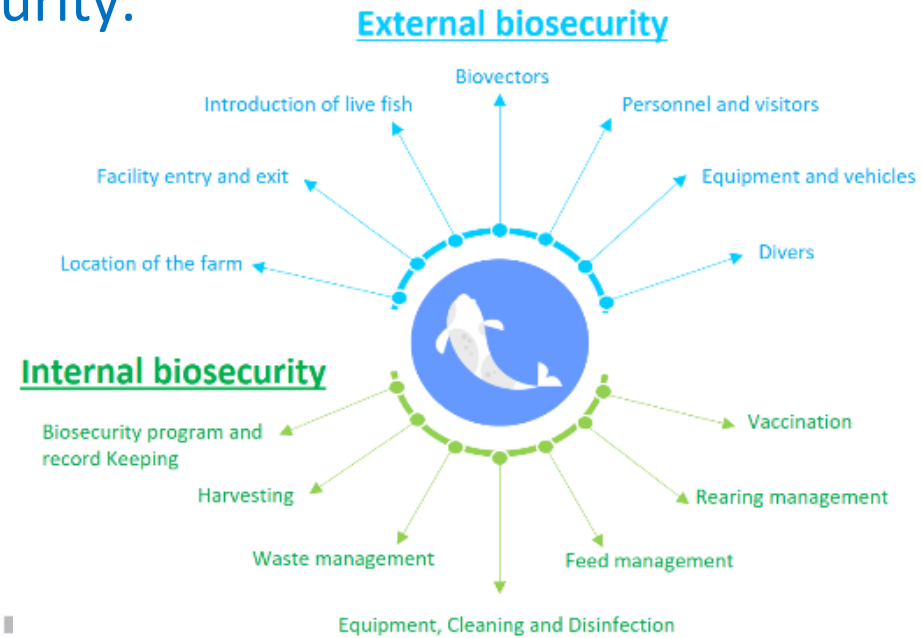
A selected subset of data for biosecurity evaluation

↓

Subcategories (external, internal)

↓

Scoring
- Number of questions
- Farmer's answer



Systematic approach for biosecurity quantification

Biosecurity measures vary in importance depending on the pathogen.

We assigned weight factors with the help of subject experts.

$$Subcategory\ score = \frac{\sum_{i=1}^{n} \left(score\ of\ question_{(i)} * weight_{question(i)}\right)}{maximum\ score\ of\ subcategory}$$

Table: Experts' weights for each subcategory

	Subcategory weight			
	Hatcheries (On-land)	Pre-growing (On-land)	On-growing (On-land)	On-growing (Open-sea)
Subcategories				
Location of the farm	4.8	5.9	6.6	10
Facility entry and exit	6.7	6.5	6	-
Introduction of live fish	11.2	11.5	10	11
Feed and water supply	8.8	10.1	8.4	6
Biovectors	4.9	4.2	5.5	6
Personnel and visitors	7.9	6.2	6.2	6
Use of divers	-	-	-	6
Equipment and vehicles transport into farm	8.7	7.6	7.3	7
External biosecurity total	53	52	50	52
Vaccination	7.1	8.5	5.4	6
Disease management	8.5	8.7	8.4	11
Rearing management	6.1	6.7	7.3	6
Feed management	4.4	4.3	5.1	4
Waste management	5.4	5.6	6	5
Harvesting	-	-	4.1	4
Equipment, Cleaning and Disinfection on-site	8.5	7.9	7.2	7
Biosecurity program and record keeping	7.0	6.3	6.5	5
Internal biosecurity total	47	48	50	48

Systematic approach for biosecurity quantification

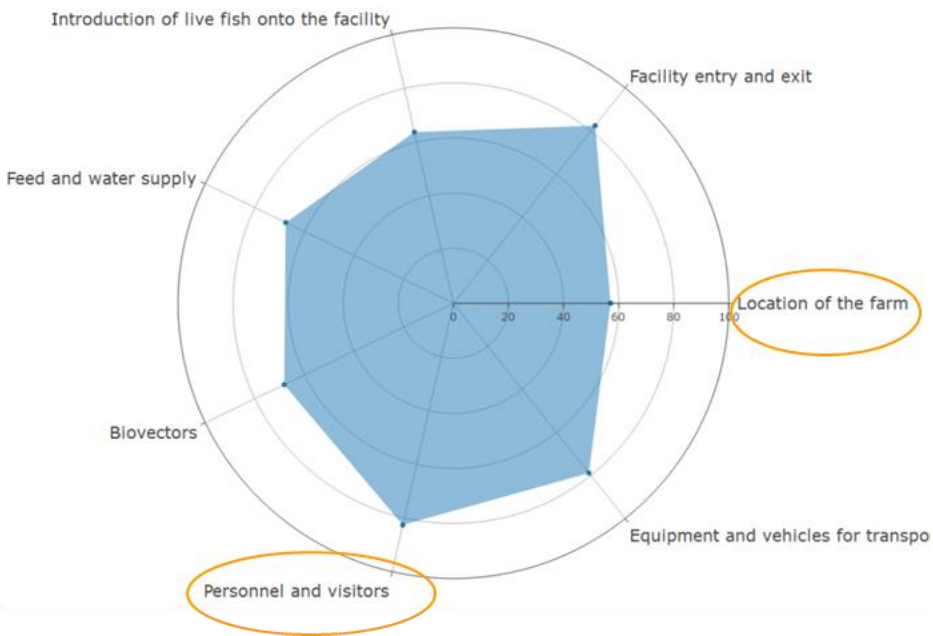
The results are presented as percentages, with 100% being the maximum.

Farm owners can use these percentages to compare their performance with the average of other participating farms.
This helps them easily identify areas in need of improvement.

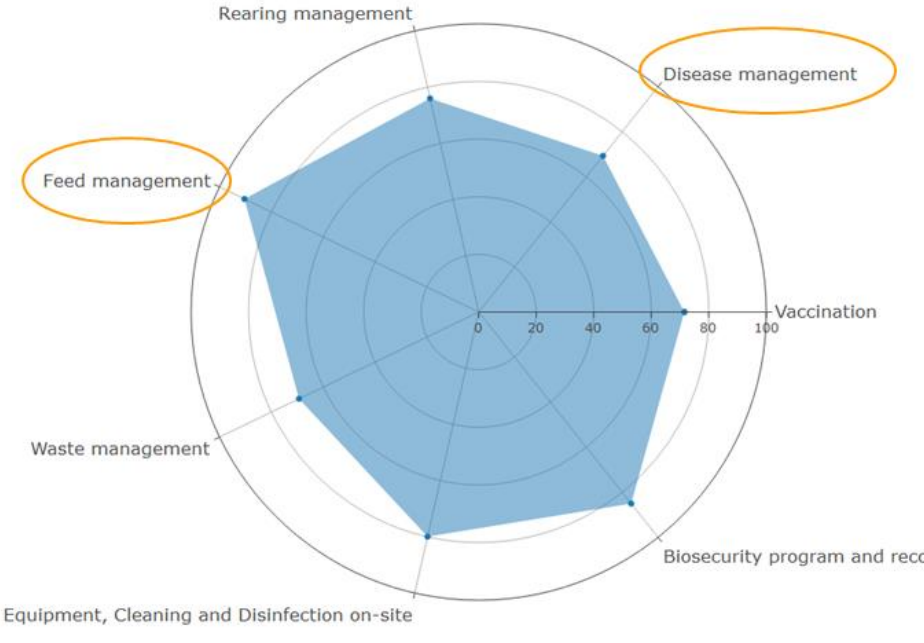
	My scoring	Average for Norway	Boxplot
External Biosecurity			
1) Location of the farm	66.7%	78.6%	
2) Introduction of eggs	93.3%	71.6%	
3) Introduction of live fish onto the facility	100%	78.6%	
4) Feed and water supply	90%	67.1%	
5) Biovectors	100%	73.8%	
6) Personnel and visitors	84.2%	81.2%	
7) Equipment and vehicles for transport of live fish, feed and waste	66.7%	66%	
Subtotal external Biosecurity	**85.8%**	**73.8%**	
Internal Biosecurity			
8) Vaccination	77.3%	71%	
9) Disease management	100%	71.6%	
10) Rearing management	100%	85.3%	
11) Feed management	100%	86.5%	
12) Waste management	100%	87.5%	
13) Equipment, cleaning and disinfection onsite	76.9%	85.4%	
14) Biosecurity program and record keeping	100%	72%	
Subtotal internal Biosecurity	**93.5%**	**79.9%**	
Overall Biosecurity			
Overall biosecurity	**89.6%**	**76.9%**	

Systematic approach for biosecurity quantification

Average *external* biosecurity score = 71%



Average *internal* biosecurity score = 74%

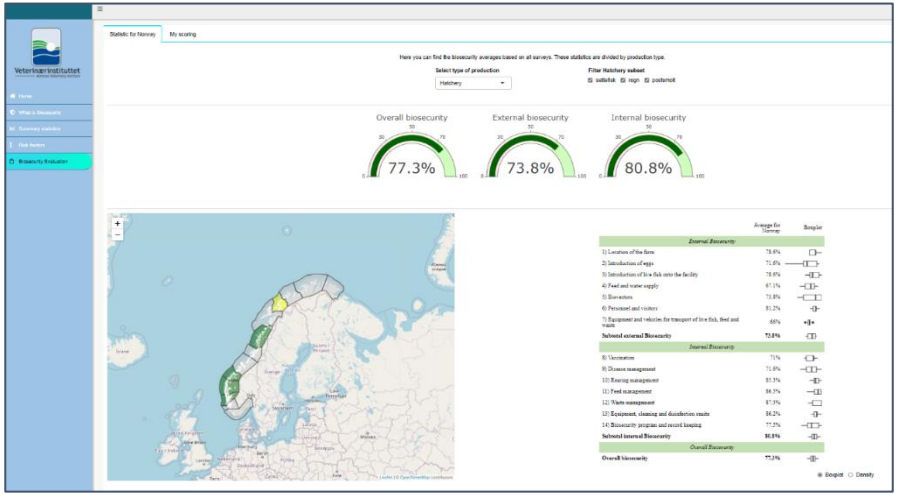


Systematic approach for biosecurity quantification

Dashboard for Norwegian salmon production

Biosecurity quantification

Farmer Self-assessment



Veterinærinstituttet
Norwegian Veterinary Institute

Systematic approach for biosecurity quantification

- Through a collaboration, a dashboard with a biosecurity quantification tool specifically designed for Colombia's aquaculture industry will be developed.
- This tool will be developed using the existing biosecurity checklists intended for both intensive commercial small-scale farmers.

N°	ASPECTO A VERIFICAR	REFERENTE NORMATIVO (Ley 1, 2018 de 2018)	TIPO DE CRITERIO Fundamental (F) Mayor (My)	(SI) (NO) (N/A)
1.	**REQUISITOS DE INFRAESTRUCTURA**			
1.1	Dispone de barreras de aislamiento o cerca perimetral, barreras de aislamiento natural u otros mecanismos que delimita el paso de otros animales o personas ajenas al predio. En establecimientos con áreas concesionadas, está delimitada y señalizada el área dispuesta o concesionada.	Artículo 4. Num 4.2.1.1	F	
1.2	El establecimiento tiene señalizada visiblemente cada una de sus áreas.	Artículo 4. Num 4.2.1.2	My	
1.3	Se cuenta con estanques, tanques, jaulas, jaulones, piscinas y/o acuarios con el espacio requerido en función de las especies cultivadas, etapa de desarrollo y el bienestar animal.	Artículo 4. Num 4.2.1.3	F	
1.4	Se evidencia que el establecimiento cuenta con áreas físicas para almacenar los insumos veterinarios (alimentos para animales y medicamentos veterinarios) y esta se encuentra sin contacto directo con el piso, retirado de la pared y en adecuadas condiciones de temperatura y humedad.	Instructivo CRI.CRS.I.SA-ACU.002	My	
2.	**BIOSEGURIDAD**			
2.1	Se evidencia que el ingreso de vehículos y personas es el mínimo necesario de acuerdo a las actividades del establecimiento de acuicultura y se registra su ingreso. El registro como mínimo incluye: Objeto de la visita, hora de ingreso, placa del vehículo si ingresa, procedencia, nombre completo y firma.	Anexo. Num. 2.1. 5.2	F	
2.2	Posee un procedimiento documentado y registro actualizado de desinfección de vehículos, acorde al número, tamaño y frecuencia de ingreso de los vehículos y se asegura su desinfección completa, e indica los productos utilizados, operación y mantenimiento.	Anexo Num. 2.1.1; 5.3	F	
2.3	Posee un procedimiento documentado donde indique a las personas que ingresan al establecimiento las medidas básicas de bioseguridad dispuestas, éstas deben incluir el cambio de ropa y calzado de calle por una dotación limpia hecha de material de fácil lavado y desinfección, debe indicar el procedimiento de lavado y desinfección de las manos antes de ingresar a las diferentes áreas. Para el caso del ingreso de personas que hayan estado con anterioridad en establecimientos acuícolas, estas deben cumplir con un tiempo de vacío sanitario de 72 horas entre una explotación y otra.	Anexo Num. 2.1.2	F	
2.4	Se ingresa al predio solo animales acuáticos provenientes de establecimientos certificados como bioseguros por el ICA y en el caso de importaciones de predios que estén habilitados por el ICA.	Artículo 10 Num 19.4. Anexo Num 2.2.1	F	
2.5	Comercializa material genético sólo a establecimientos acuícolas registrados ante el ICA y el mismo es transportado en empaques desechables nuevos y/o en vehículos previamente acondicionados para tal fin.	Artículo 10 Num 10.5 y 10.6	F	
2.6	Se mantiene y documenta la observación sanitaria de los peces recién ingresados por un tiempo de mínimo de 15 días con el fin de observar que no existan signos clínicos de enfermedades y se informa al proveedor sobre los problemas detectados.	Anexo Num. 2.2.2	F	
2.7	Se evidencia que no se utiliza materia fecal fresca o sin procesar de aves, porcinos o bovinos para fertilizar los estanques acuícolas.	Artículo 11 Num 11.4	F	
2.8	Se mantiene las condiciones de bioseguridad y sanidad requeridas para los establecimientos acuícolas y los operarios del establecimiento tienen conocimiento	Artículo 10 Num 10.8	My	

Systematic approach for biosecurity quantification

Biosecurity Guidelines for Ghana Aquaculture:

- A collaboration with Ghana fishery commission under Fish for Development (FfD) program
- Biosecurity quantification approach to a pilot population of tilapia farms in Lake Volta area.

ture credit: Fisheries Commission, Fish Health Unit, Northern ctor.

Biosecurity (EU, Animal Health Law)

REGULATION (EU) 2016/429 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law')

Article 4:

'biosecurity' means the sum of management and physical measures designed to reduce the risk of the introduction, development and spread of diseases to, from and within: (a) an animal population, or (b) an establishment, zone, compartment, means of transport or any other facilities, premises or location

Veterinærinstituttet
Norwegian Veterinary Institute

Biosecurity (EU, Animal Health Law)

The new animal health regulations requires all approved aquaculture facilities to have a documented and professionally assessed biosecurity plan. The biosecurity plan must address measures to reduce the biosecurity risks and contain the following information:

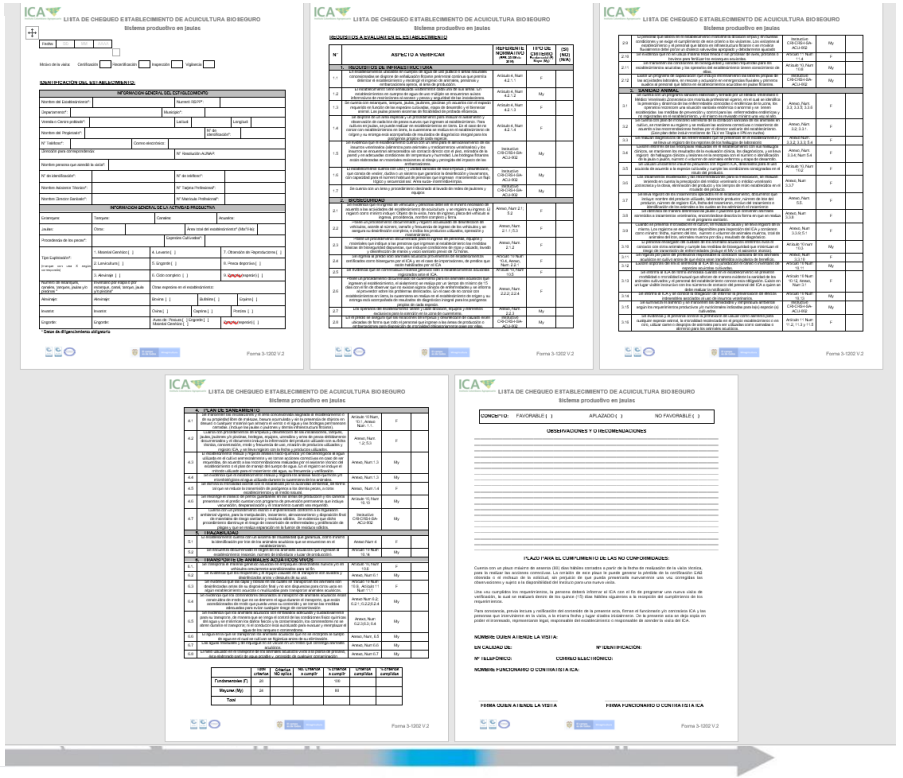
- Locks in and out of the facility, and routines for visitors
- Distinguish between different departments in the facility if relevant
- Equipment that is shared between several facilities
- How dead fish are picked up and handled
- Routines and equipment for washing and disinfecting equipment
- Routine for disinfection of roe
- How the transporter's documentation for washing and disinfection is verified before loading or unloading aquaculture animals in the facility

- Health monitoring, and health status in the area
- Coordination of operations in the area
- Distance to other facilities, waterways, slaughterhouses, etc.
- Water source and treatment, and drainage
- Health status of fish taken into the facility
- Moving fish
- Vaccination
- Traffic to and from the facility

Biosecurity (Checklist, Certification)

Latin America:

- Latin American and Caribbean Aquaculture Society (LACQUA): Aquaculture Biosecurity Principles and Guidelines
- Aquaculture Stewardship Council (ASC): Certification Standards for Responsible Aquaculture



Fundamental for success

- Baseline knowledge
- Bridge terrestrial and aquaculture competences
  - Use existing knowledge on terrestrial side
- Ownership to program
- Understanding the socio-cultural environment of operations
- Networking and collaborating
- Awareness of dynamics of aquaculture

Veterinærinstituttet
Norwegian Veterinary Institute

Fundamental for success

Farm competence

Local/site health knowledge

Collection of relevant farm-data in a standardized way

Reporting abnormal behaviour

- essential for early detection
- feedback mechanisms
- acknowledgment to “data collectors”
- demystifying purpose of data collection

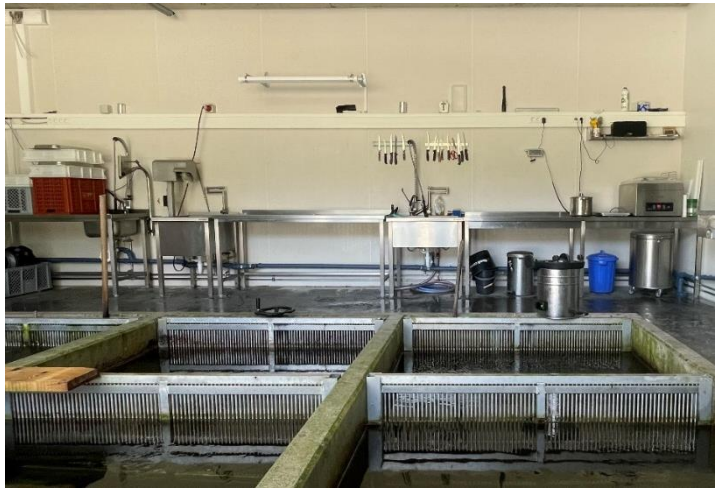
Fundamental for success

- Regular monitor of animal health
- Immediately isolate and treat any disease or infected fish
- Regular disease screening test




Fundamental for success

- Regular cleaning and disinfection
- Facility is in good condition of maintaining
- Establishment is free of weeds, rubble, garbage, disused objects or any waste material.
- Implemented procedures for the management and disposal of sanitary risk materials and solid waste



Veterinærinstituttet
Norwegian Veterinary Institute

Fundamental for success

(Standard) operating procedures

Quarantine measures. (Isolation and observation)

Vehicles disinfection

Entering people, materials, and equipment to the production area

Animal health program (Including monitoring health Plan)

Side effects of veterinary supplies notification

Cleaning and disinfection for: facilities (cages, ponds, tanks), containers, storage rooms, equipment, etc.

Management and final disposal of sanitary risk materials and solid waste.

Movement of live animals

Unusual mortalities or alterations in the productive parameters notification

Management and final disposal of mortality

Importation certification or document of origin of the animals

Fundamental for success

Educate and train workers in the farm biosecurity plan to be a normal and integrated part of their daily work

- Staff understand and apply the biosecurity measures adopted

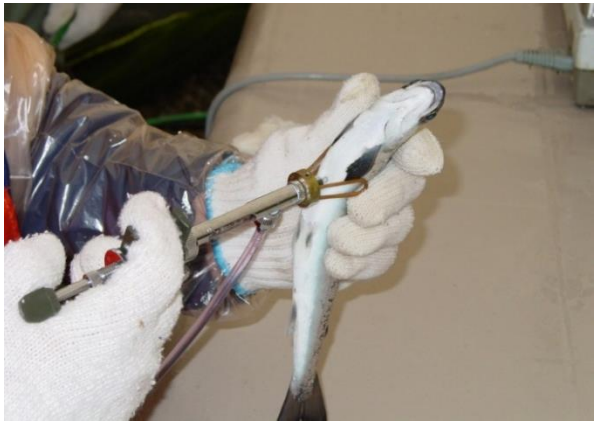
- Staff training program

* Include: daily activities, health and welfare, etc.

Veterinærinstituttet
Norwegian Veterinary Institute

Vaccination

- Vaccines plays a crucial role in enhancing biosecurity within aquaculture production
- Reduce transmission risks
- Lower treatment costs
- Promote sustainability
- Guidelines for export vaccinated fish - Agreement between importer and exporter



Veterinærinstituttet
Norwegian Veterinary Institute

Fundamental for success

Government competence

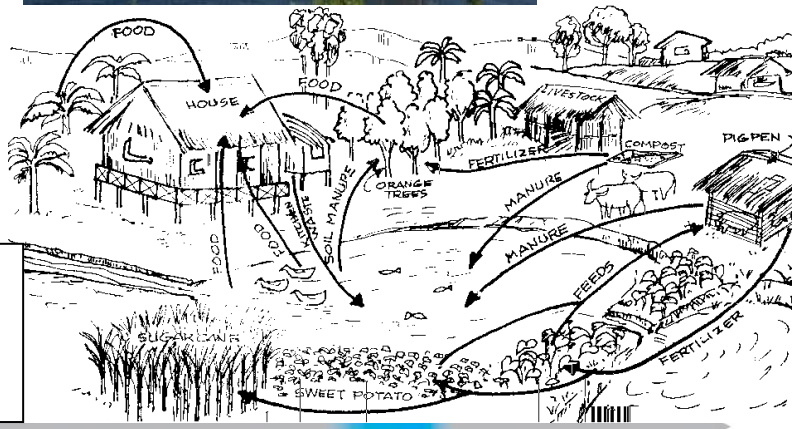
Develop appropriate legislation

- national policies, enforc
  legislati
  at the farm/state/national
  Define jurisdictional responsibility and consistency with international standards and obligations (WOAH, SPS – agreement)

Existing regulations and guidelines not implemented

- Identify most important diseases for listing
- Implementation of surveillance programme
- Identify stakeholders, Stimulate interaction between industry and research institutions

Small-scale farmers are the backbone of many rural communities in both industrialized and non-industrialized countries



More than 500 aquatic species are in culture

Ensure the basic understanding among competent authority that aquatic animals can get infectious diseases

Challenges

- Small Farmers without facilities or technical assistance to apply with the standard.
- Lack of knowledge about the real number of small farmers
- Decision-making without the employment of diagnostic tests
- Unusual mortalities or alterations in the productive parameters are not reported
- The Costs/Benefits are not clear or not enough in farmers point of view

Contributors to development of the aquaculture biosecurity quantification tool

From top to bottom and left to right:

- Kari Norheim
- Saraya Tavornpanich
- Jacob Zornu
- Edgar Brun
- Kofitsyo Cudjoe
- Ketil Skår
- Mona Dverdal Jansen
- Arve Nilsen
- Margarida Leandro
- Maria-Fernanda Serrano De La Cruz









Norad

ICA
Instituto Colombiano Agropecuario

ÅKERBLÅ

Benchmark® Genetics

Veterinærinstituttet
Norwegian Veterinary Institute