Food and Agriculture Organization of the United Nations

Organisation des Nations Unies pour l'alimentation et l'agriculture

Organización de las Naciones Unidas para la Alimentación y la Agricultura

Centre for Environment Fisheries & Aquaculture Science

International Launch Webinar Bivalve mollusc sanitation for growing areas

11 July 2024

Esther Garrido Gamarro

Fishery Officer, FAO

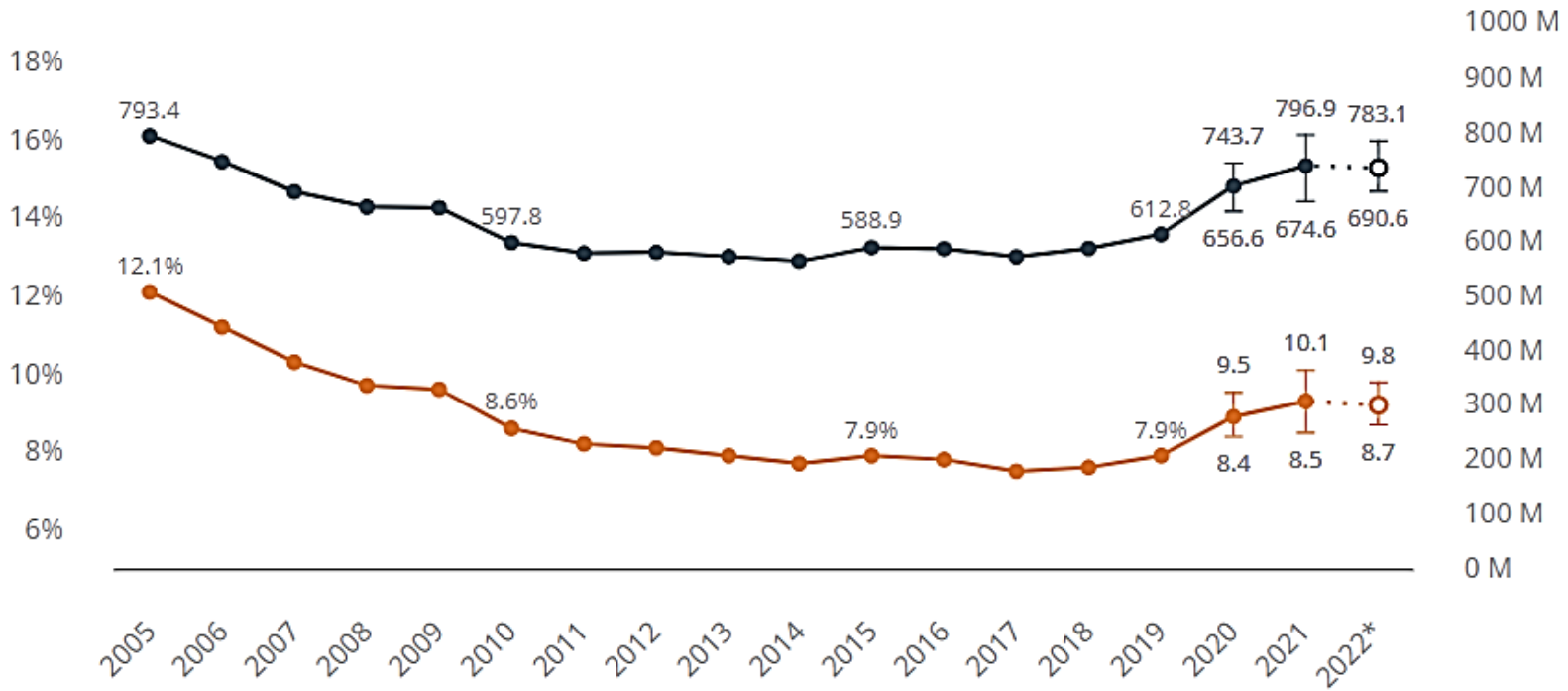
WORLD PRODUCTION OF FARMED MOLLUSC

Species or species group	2018	2019	2020	2021	2022	Share of species in species group, 2022 (%)
	(thousand tonnes, live weight equivalent)					
Molluscs	**17 524**	**17 407**	**17 869**	**18 434**	**18 911**	**100**
Oysters	5 998	6 129	6 270	6 685	7 072	37.4
Clams, cockles and arkshells	4 212	4 100	4 350	4 426	4 514	23.9
Scallops	2 141	2 055	1 970	2 077	2 022	10.7
Sea mussels	2 093	2 032	2 046	2 024	1 927	10.2
Constricted tagelus	853	869	860	860	848	4.5
Other molluscs	2 227	2 222	2 373	2 363	2 528	13.4

BIVALVES REPRESENT A NUTRITIOUS AND LOW-IMPACT FOOD SOURCE THAT IS UNDERUTILIZED

“New innovations in production in this sector could fulfil the protein needs of nearly one billion people in the most vulnerable global regions”

David F. Willer and David C. Aldridge



Between 691 and 783 million people faced hunger in 2022 (FAO, 2022)

Table 1 | Nutritional properties and environmental footprints of selected food items that can be farmed in the tropics

	Beef	Pork	Chicken	Tilapia	Bivalves	Shrimp	Rice	Soya	Wheat
Nutrient									
Protein (mg $kcal^{-1}$)	98	64	121	205	**150**	242	19	88	33
Omega 3 (mg $kcal^{-1}$)	0.5	0.3	0.7	1.9	**4.8**	0.3	0.1	2.6	0.2
Iron (μg $kcal^{-1}$)	10.1	3.3	5.7	5.4	**34.3**	5.2	11.8	24.1	9.9
Zinc (μg $kcal^{-1}$)	23	8	10	3	**61**	17	3	7	8
Vitamin B12 (ng $kcal^{-1}$)	10	3	4	15	**126**	15	0	0	0
Vitamin A (IU $kcal^{-1}$)	0.1	0.1	0.1	0.1	**2.30**	0.51	0	1.2	0
Environmental footprint									
Land use (ha per t protein)	50	2	3	7.5	**0**	16.4	21.2	0.578	4.62
Greenhouse gas emissions (tCO_2 per t protein)	337.2	57.6	42.3	40.7	**11.1**	161.7	2.36	1.04	3.54
Freshwater use (m^3 per kg protein)	112.5	56.5	34.3	15.9	**0**	4.4	19.81	5.76	11.84
Eutrophication potential (kg P per t protein)	180	120	40	82	**-148**	104	109	17.8	30

Bold values indicate that bivalves provide maximal nutritional value for minimal environmental footprint. Environmental footprints are based on today's production methods and fresh consumption of bivalves. Production intensification and increased food processing are expected to increase footprint values, but sustainable development methods could minimize environmental costs. IU, international unit. Data on beef, pork, chicken, tilapia, bivalves and shrimp were obtained from ref. [6], data on rice, soya and wheat were obtained from refs. [33,39], and ref. [9] was used for unit conversion.

Sustainable bivalve farming can deliver food security in the tropics

David F. Willer and David C. Aldridge

NATURE FOOD | VOL 1 | JULY 2020 | 384–388 | www.nature.com/natfood

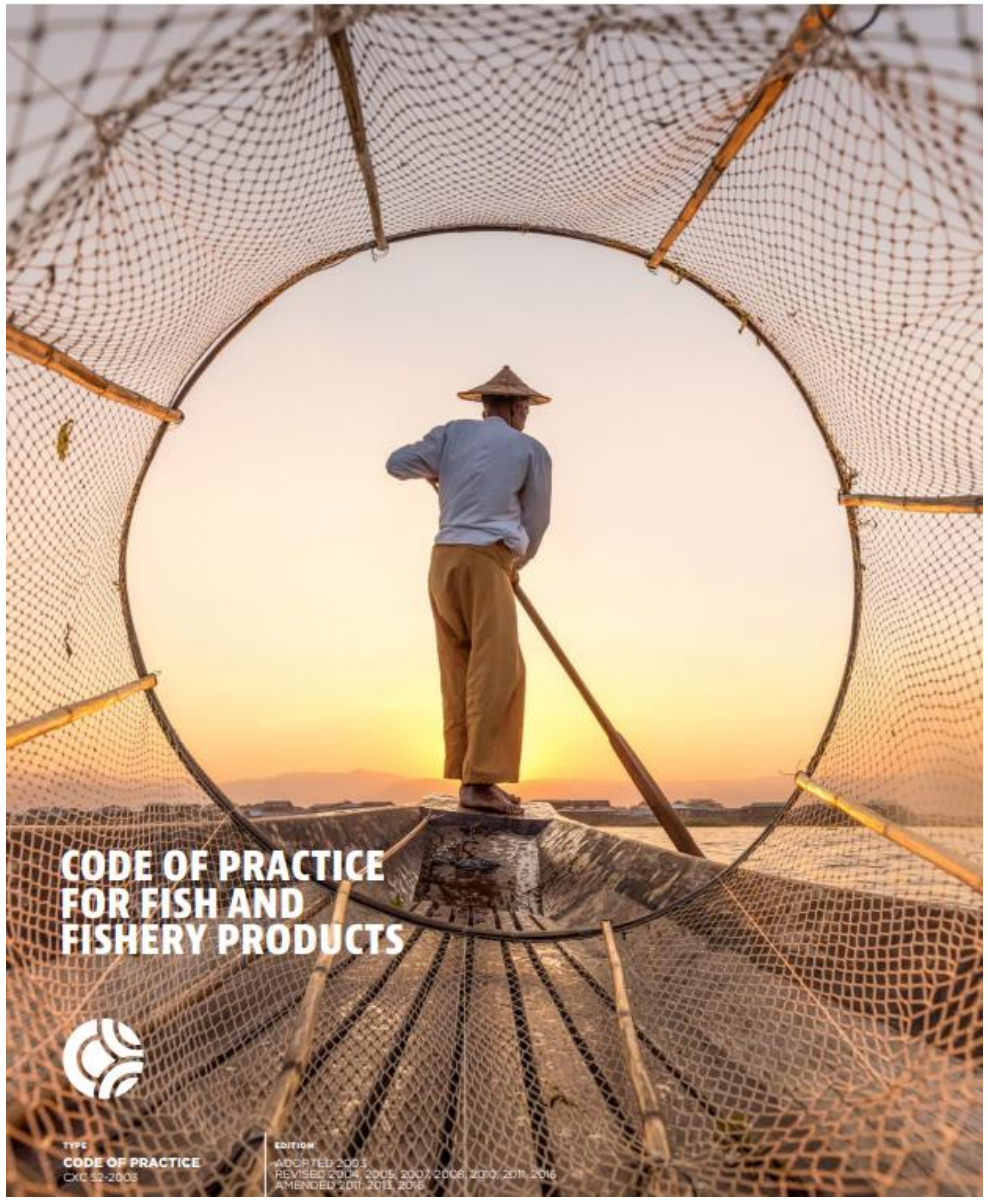
RELEVANT CODEX STANDARDS AND GUIDELINES

- **Codex Code of Practice for Fish and Fishery Products – Section 7**
- **Standard for live and raw bivalve molluscs** (Codex Stan 292 – 2008 Rev 2015).
- Guidelines on the Application of General Principles of Food Hygiene to the Control of Pathogenic *Vibrio* Species in Seafood (CAC/GL 73-2010) **- Annex on control measures for *Vibrio parahaemolyticus* and *V. vulnificus* in bivalve molluscs**
- Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food (CAC/GL 79-2012) **- Annex on Control of Hepatitis A Virus (HAV) and Norovirus (NOV) in bivalve molluscs.**

Food and Agriculture Organization of the United Nations

World Health Organization

CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS



Standard for live and raw bivalve molluscs (Codex Stan 292 – 2008 Rev 2015).

1.4. Food Additives

Food additives are not permitted in live bivalve molluscs.

1.5. Contaminants

The products covered by this Standard shall comply with the Maximum Levels of the *General Standard for Contaminants and Toxins in Food and Feed* (CXS 193-1995) and the maximum residue limits for pesticides and/or veterinary drugs established by the Codex Alimentarius Commission.

The following provisions apply to the edible parts of live bivalve mollusc (the whole part or any part intended to be eaten separately).

Name of biotoxin groups	Maximum level /kg of mollusc flesh
Saxitoxin (STX) group	≤0.8 milligrams (2HCL) of saxitoxin equivalent
Okadaic acid (OA) group	≤0.16 milligrams of okadaic equivalent
Domoic acid (DA) group	≤20 milligrams domoic acid
Brevetoxin (BTX) group	≤200 mouse units or equivalent
Azaspiracid (AZP) group	≤0.16 milligrams

Standard for live and raw bivalve molluscs (Codex Stan 292 – 2008 Rev 2015).

1.6. Hygiene

Growing area monitoring programs, irrespective of the type of indicator bacteria used, must ensure that live bivalve molluscs destined for direct human consumption meet the *E.coli* limit as identified below when tested in accordance with an MPN method specified in ISO 16649-3 or equivalent.

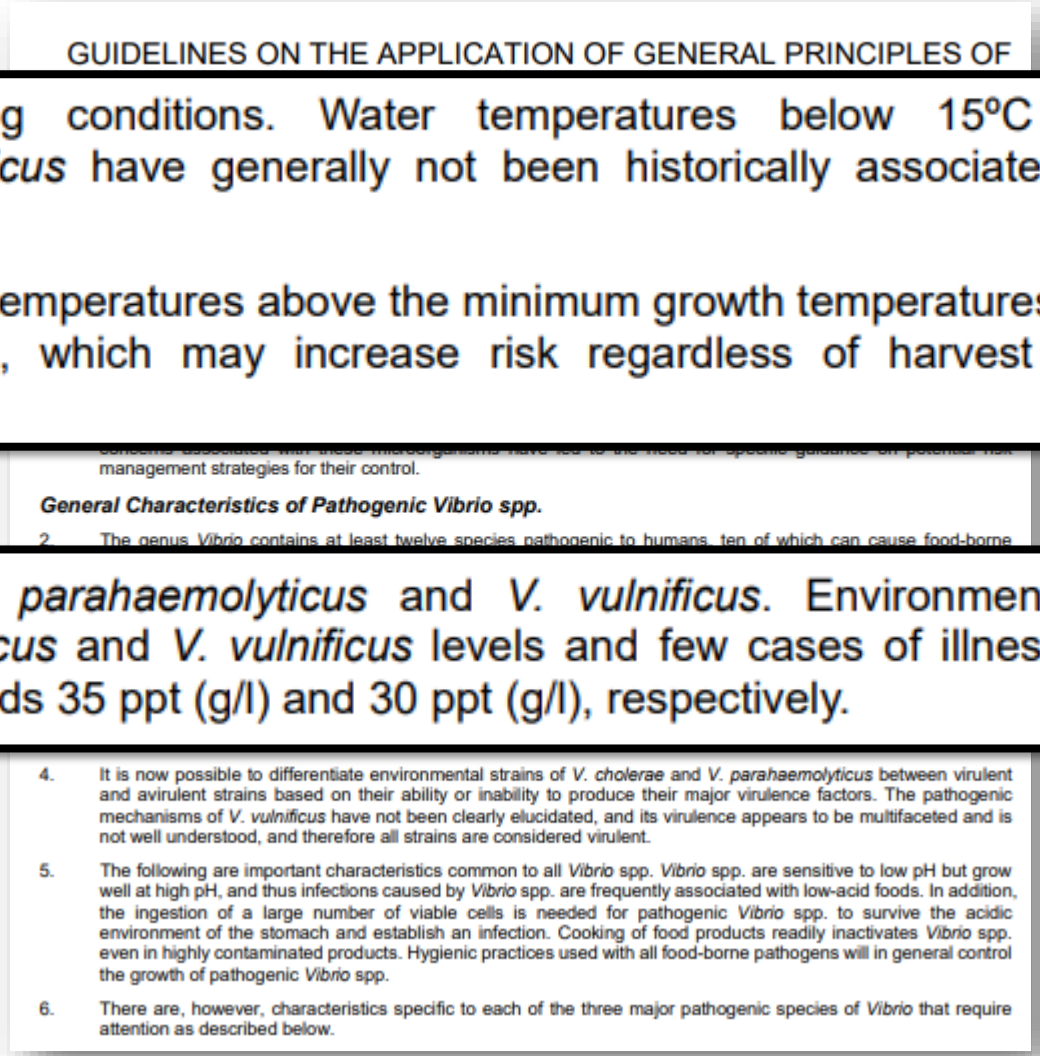
In analysis involving five (5) 100g samples of the edible parts (the whole part or any part intended to be eaten separately), none may contain more than 700 *E. coli* and not more than one (1) of five (5) samples may contain between 230 and 700 *E.coli*, or equivalent as decided by the competent authority having jurisdiction.

Microorganism = *Escherichia coli*	n=5	c=1	m=230	M=700	3 Class Plan

where 'n'= the number of sample units, 'c'= the number of sample units that may exceed the limit 'm', and 'M' is the limit which no sample unit may exceed.

Guidelines on the Application of General Principles of Food Hygiene to the Control of Pathogenic *Vibrio* Species in Seafood (CAC/GL 73-2010) - **Annex on control measures for *Vibrio parahaemolyticus* and *V. vulnificus* in bivalve molluscs**

measures that can be used to minimise the pathogenic Vibrio spp. in seafood.



GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF

Water temperatures representative of harvesting conditions. Water temperatures below 15ºC [12] for *V. parahaemolyticus* and below 20ºC for *V. vulnificus* have generally not been historically associated with illnesses;

Time period to first refrigeration and post-harvest air temperatures above the minimum growth temperatures for *V. parahaemolyticus* (10ºC) and *V. vulnificus* (13ºC), which may increase risk regardless of harvest water temperature;

management strategies for their control.

General Characteristics of Pathogenic Vibrio spp.

2. The genus *Vibrio* contains at least twelve species pathogenic to humans, ten of which can cause food-borne

Salinity ranges and optima are different for *V. parahaemolyticus* and *V. vulnificus*. Environmental and epidemiological data indicate low *V. parahaemolyticus* and *V. vulnificus* levels and few cases of illnesses are associated with bivalve molluscs when salinity exceeds 35 ppt (g/l) and 30 ppt (g/l), respectively.

4. It is now possible to differentiate environmental strains of *V. cholerae* and *V. parahaemolyticus* between virulent and avirulent strains based on their ability or inability to produce their major virulence factors. The pathogenic mechanisms of *V. vulnificus* have not been clearly elucidated, and its virulence appears to be multifaceted and is not well understood, and therefore all strains are considered virulent.

5. The following are important characteristics common to all *Vibrio* spp. *Vibrio* spp. are sensitive to low pH but grow well at high pH, and thus infections caused by *Vibrio* spp. are frequently associated with low-acid foods. In addition, the ingestion of a large number of viable cells is needed for pathogenic *Vibrio* spp. to survive the acidic environment of the stomach and establish an infection. Cooking of food products readily inactivates *Vibrio* spp. even in highly contaminated products. Hygienic practices used with all food-borne pathogens will in general control the growth of pathogenic *Vibrio* spp.

6. There are, however, characteristics specific to each of the three major pathogenic species of *Vibrio* that require attention as described below.

Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food (CAC/GL 79-2012) - **Annex on Control of Hepatitis A Virus (HAV) and Norovirus (NOV) in bivalve molluscs.**

CONTROL OF HEPATITIS A VIRUS (HAV) AND NOROVIRUS (NoV) IN BIVALVE MOLLUSCS

INTRODUCTION

SECTION 1- OBJECTIVES

2. This annex provides advice to governments on a framework for the reduction of HAV and NoV in bivalve molluscs, with a view towards protecting the health of consumers and ensuring fair practices in food trade. The primary purpose of this annex is to minimize the likelihood of human illness arising from the presence of HAV and NoV in bivalve molluscs. This annex also provides information that will be of interest to the food industry, consumers, and other interested parties.

SECTION 2 - SCOPE, USE AND DEFINITION

2.1 SCOPE

3. This annex is applicable to bivalve molluscs and focuses on control measures to minimize and/or prevent contamination of bivalve molluscs with HAV and NoV with the aim of preventing or reducing human illness.

FAO TOOLS

Food and Agriculture Organization of the United Nations

FAO FISHERIES AND AQUACULTURE TECHNICAL PAPER

690

Joint FAO-IOC-IAEA technical guidance for the implementation of early warning systems for harmful algal blooms

With the technical support of

unesco

IAEA International Atomic Energy Agency

Atoms for Peace and Development

JOINT FAO/WHO

TECHNICAL PAPER

Toxicity Equivalency Factors for Marine Biotoxins Associated with Bivalve Molluscs

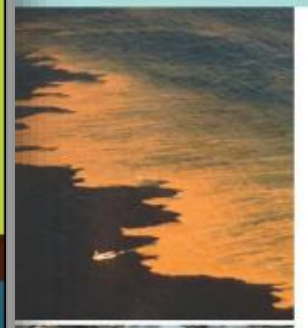
Food and Agriculture Organization of the United Nations

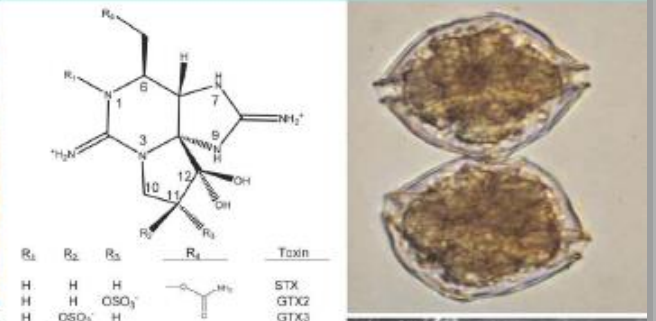
World Health Organization

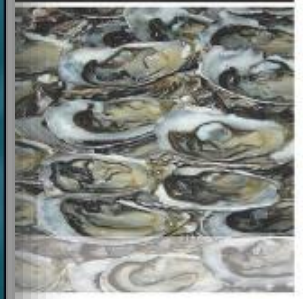
FAO FISHERIES AND AQUACULTURE TECHNICAL PAPER

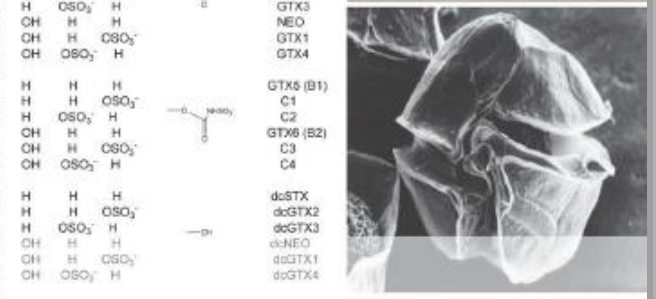
551

Assessment and management of biotoxin risks in bivalve molluscs



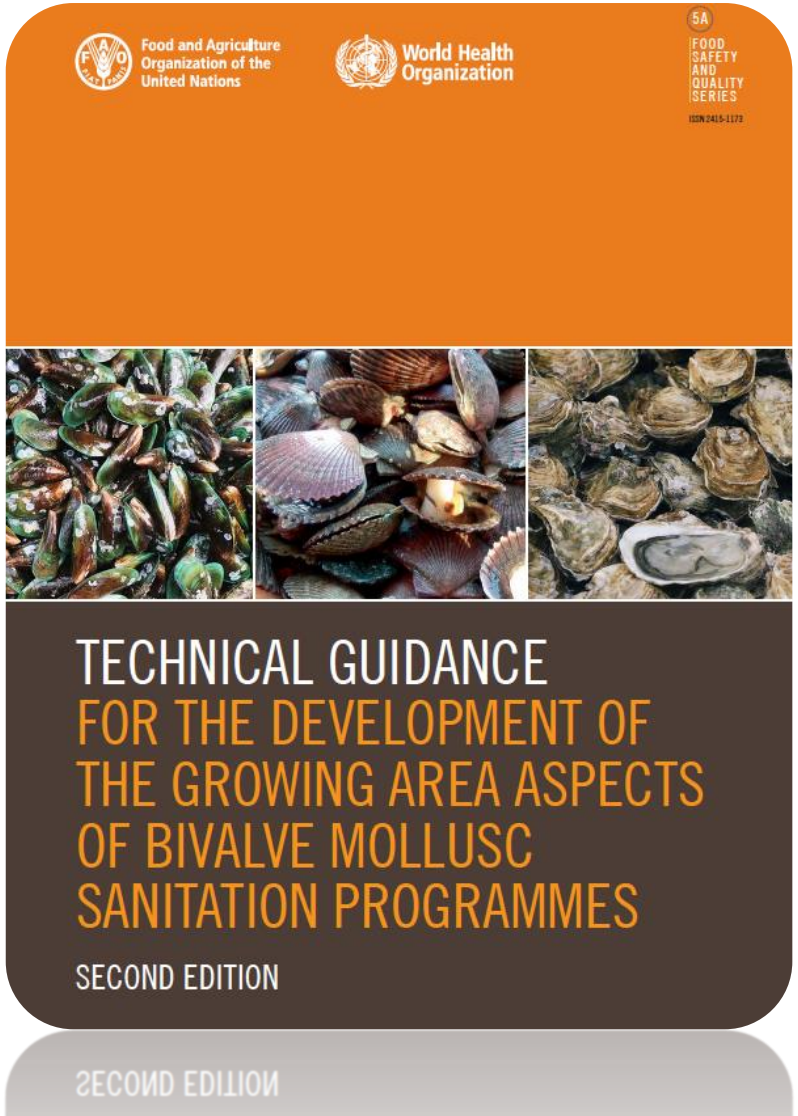






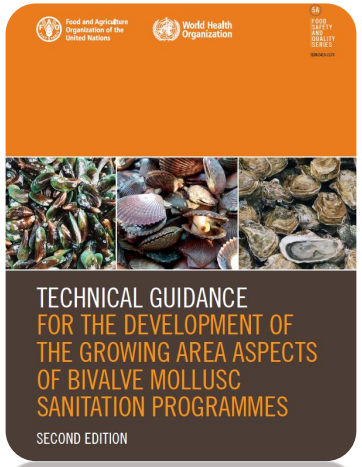
R_1	R_2	R_3	R_4	Toxin
H	H	H		STX
H	H	OSO_3^-		GTX2
H	OSO_3^-	H		GTX3
OH	H	H		NEO
OH	H	OSO_3^-		GTX1
OH	OSO_3^-	H		GTX4
H	H	H		GTX5 (B1)
H	H	OSO_3^-		C1
H	OSO_3^-	H		C2
OH	H	H		GTX6 (B2)
OH	H	OSO_3^-		C3
OH	OSO_3^-	H		C4
H	H	H		dcSTX
H	H	OSO_3^-		dcGTX2
H	OSO_3^-	H		dcGTX3
OH	H	H		dcNEO
OH	H	OSO_3^-		dcGTX1
OH	OSO_3^-	H		dcGTX4

SCOPE OF THE GUIDANCE DOCUMENT



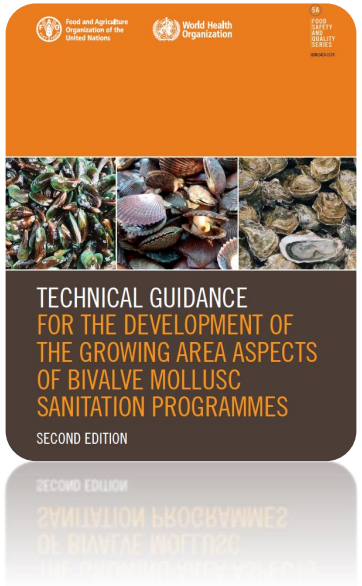
- Consideration has been given mainly for microbiological hazards.
- Applies to Section 7.2 of Code of Practice - Primary production of molluscs for consumption as live or raw bivalve molluscs.
- Also applies for:
  - Section 7.4 – Assessment and management of areas used for relaying and
  - Section 7.6.2. Areas used for conditioning and wet storage in natural environment.

First step–Developing Growing Area Risk Profile



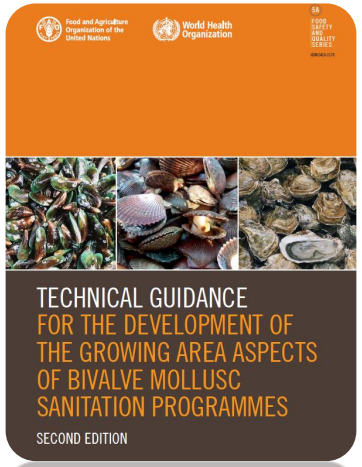
- Outline the scope of risk profile;
- Review existing legal framework, current industry situation, resources available;
- Determine the extent of assessment area;
- Review epidemiological and public health data;
- Consider intended use of products and consuming population;
- Determine hazards to be considered;
- Outline programme capabilities and capacities;
- Perform cost benefit analysis;
- Document Growing Area Risk Profile.

Next step-Growing Area Assessment



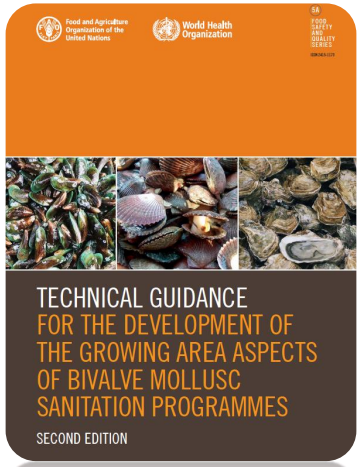
- Data collection – sources of contamination, effect of geographical, hydrographical, meteorological and other environmental factors;
- Shoreline survey – planning and conducting the survey;
- Indicator/hazard survey – human and animal enteric pathogens, marine Vibrio spp, biotoxins, chemical contaminants;
- Data analysis and assessment
- Documentation of growing area risk assessment
- Outcomes:
  - Determining the extent of classified growing area
  - Recommendations for primary monitoring
  - Risk management recommendations

Next step-Growing Area Monitoring



- Primary monitoring
  - Defining purpose
  - Selection of sample matrix – water/bivalves
  - Sampling site selection
  - Sampling frequency, strategy
- Ongoing monitoring
  - Basis of ongoing monitoring
  - Indicators/Pathogens to be monitored
  - Number and location of sampling points
  - Frequency of sampling for fecal indicator bacteria
  - Frequency and sampling for other indicators and pathogens
- Documentation

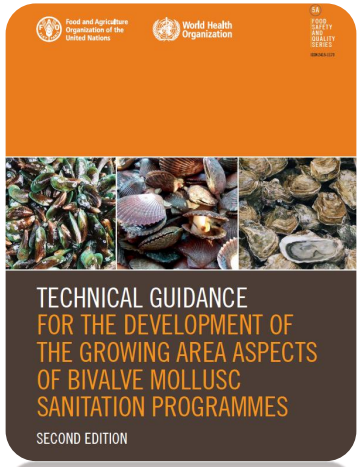
Next step-Classification categories



- Category I: Fit for direct human consumption
- Category II: Need for depuration or short term relay
- Category IIIa: Need for long term relay
- Category IIIb: Need for postharvest treatment (cooking, high pressure, canning)
- Category IV: Not fit for human consumption in forms generally consumed.

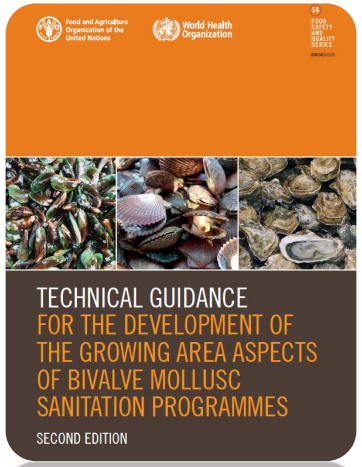
Next step-Growing area management and review

- Growing area management
  - Considerations on the capability of responsible authorities
  - Expected event management
  - Unexpected event management
  - Notification of interested parties
  - Growing area surveillance (patrol and enforcement)
- Growing area review
  - Review period and plan
  - Review of pollution sources
  - Review of on going monitoring data
  - Documentation of review



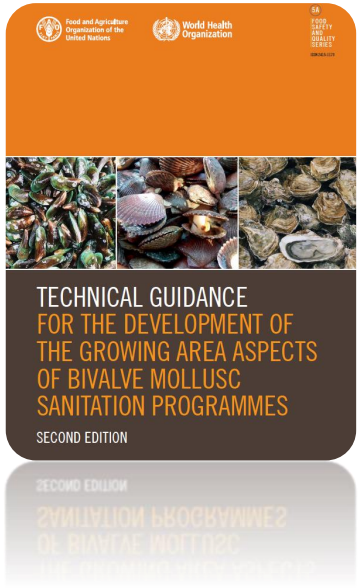
Annexes

- Annex 1: Growing area risk profile template
- Annex 2: Growing Area assessment template
- Annex 3: Waste water treatment and collection system questionnaire
- Annex 4: Shore line survey checklist
- Annex 5: Shore line survey plan template
- Annex 6: Shore line survey report template
- Annex 7: Key considerations in undertaking and assessing drogue study
- Annex 8: Key considerations in undertaking and assessing key hydrodynamic modeling



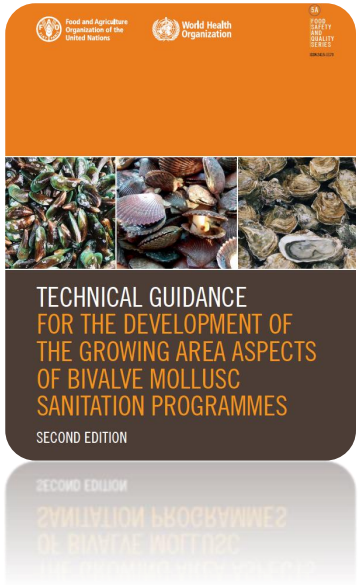
Annexes

- Annex 9: Key considerations in undertaking and assessing dye study
- Annex 10: Buffer zone determination with respect to enteric viruses
- Annex 10a: Recommended dilution rations for sewage treatment works buffer zones
- Annex 11: Guidance on use of male specific coliphage
- Annex 12: Example sampling protocol
- Annex 13: Example sample transport protocol
- Annex 14: Example analysis of results from primary fecal indicator monitoring



Annexes

- Annex 15: Event management plan template – Expected events
- Annex 16: Event management plan template – Unexpected events
- Annex 17: Surveillance of growing areas – additional considerations
- Annex 18: Growing area review template
- Annex 19: Example assessment of results from ongoing fecal indicator monitoring



Food and Agriculture Organization of the United Nations

FAO elearning Academy

THE COURSE SERIES “BIVALVE MOLLUSC SANITATION”

Course

Bivalve Mollusc Sanitation: Growing Area Risk Profile

This first course in the e-learning series introduces the technical guidance framework for the development of growing areas for bivalve mollusc sanitation programmes. It describes the potential hazards present with live or raw consumption of bivalve molluscs and provides guidance on the completion of a Growing Area Risk Profile (GARP).

2 h 30 m

Course

Bivalve Mollusc Sanitation: Growing Area Assessment and Review

This second course in the e-learning series details the Growing Area Assessment and review process for establishing a bivalve mollusc growing area sanitation programme. The course provides a framework for data gathering, analysis, assessment and review of potential hazards in the growing area for bivalves intended for human consumption.

5 h

Course

Bivalve Mollusc Sanitation: Growing Area Monitoring

This third course in the e-learning series details the Growing Area Monitoring activity in a bivalve mollusc sanitation programme. The course describes sample plans, how to conduct sampling and the laboratory analysis of microbiological hazards in a growing area for bivalve molluscs intended for human consumption.

2 h 30 m

Course

Bivalve mollusc sanitation: Growing area classification and management

The fourth course in the e-learning series details "Growing area classification" and "Growing area management" in a bivalve mollusc sanitation programme. The course describes the process of risk categorization for a growing area as well as the overall management of a growing area in a bivalve mollusc sanitation programme.

2 h 10 m