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FAO Reference Centre for Bivalve Mollusc Sanitation

Joint Cefas - FAO Virtual Regional Workshop on Bivalve Mollusc Sanitation for Asia and Pacific

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The FAO Reference Centre for Bivalve Mollusc Sanitation is funded by the United Kingdom Department of Food, Environment and Rural Affairs (Defra) and the United Kingdom Food Standards Agency.

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The FAO Reference Centre for Bivalve Mollusc Sanitation is funded by the United Kingdom Department of Food, Environment and Rural Affairs (Defra) and the United Kingdom Food Standards Agency.

Foreword

This document summarises relevant information from the virtual workshop hosted by the FAO Fisheries Division and Cefas as the FAO Reference Centre for Bivalve Mollusc Sanitation using virtual conferencing technology on 9th – 11th December 2020. It includes the workshop agenda, delegate contact information, workshop minutes, feedback scores and comments from the delegates.

Dr Rachel Hartnell

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Delegate List

Country	Delegate	Organisation
Bangladesh	Dr. Md. Houmyoun Kabir Khan	Department of Fisheries (DoF)
Bangladesh	Md. Jewel Shaik	Department of Fisheries (DoF)
Bangladesh	Md. Yousuf Khan	Department of Fisheries (DoF)
India	Dr. Vasant Kripa	Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying
Indonesia	Sofian Ansori	Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Muhammad Fathoni	Directorate of Marketing, DG of Product Competitiveness, Ministry of Marine Affairs and Fisheries
Indonesia	Izhamil Hidayah	Agency for Marine and Fisheries Research and Human Resources, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Ahmad Jauhari	Fish Quarantine and Inspection Agency, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Helwijaya Marpaung	Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Anggun Ratnawulan	Fish Quarantine and Inspection Agency – Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Ngurah Sedana Yasa	Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Indonesia	Mintut Silowati	Directorate General of Product Competitiveness, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia
Malaysia	Shirlene Maria Anthonysamy	INFOFISH
Malaysia	Ms. Rashima Baharuddin	Fisheries Development Authority of Malaysia
Malaysia	Sujit Krishna Das	INFOFISH
Malaysia	Ms. Rozana bt. Johari	Fisheries Biosecurity Centre Kuala Lumpur
Malaysia	Ms. Rosmawati Maludin	

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Country	Delegate	Organisation
Malaysia	Ms. Roziah bt. Mat Zin	Fisheries Biosecurity Centre Kuantan
Malaysia	Dr. Wan Norhana bt. Md. Noordin	Fisheries Research Insitute
Malaysia	Ms. Dianatul Azni Mohd Yazid	
Malaysia	Dr. Siti Dina bt. Razman Pahri	Department of Fisheries Malaysia
Pakistan	Dr. Aamir Mahmood Memon	Livestock and Fisheries Department, Government of Sindh Karachi. Assistant Director Fisheries Directorate of Fisheries Sindh (Marine) Karachi
Pakistan	Dr. Ali Muhammad Mastoi	
Pakistan	Dr. Aslam Jarwar	Director Marine, Fisheries Department, Government of Sindh, Karachi
Pakistan	Khawar Parvez Awan	FAO
Pakistan	Dr. Mukhtiar Ahmed Mahar	Centre for Coastal and Deltaic Studies
Pakistan	Dr. Sher Khan Panhwar	Centre of Excellence in Marine Biology, University of Karachi Laboratory of Marine Fisheries Resource Conservation and Management
Pakistan	Dr. Syed Babar Hussain Shah	Directorate of Fisheries Sindh (Marine)
Philippines	Leni Abagon	
Philippines	Sheryll A. Aguirre	Bureau of Fisheries and Aquatic Resources
Philippines	Sandra Victoria R. Arcamo	Bureau of Fisheries and Aquatic Resources
Philippines	Alvin G. Awatin	Bureau of Fisheries and Aquatic Resources National Fisheries Laboratory Division Aquatic Toxicology Laboratory
Philippines	Mea Baldonado	
Philippines	Leah Mora T. Cabella	Conservation and Environmental Protection Section, FRMD

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Country	Delegate	Organisation
Philippines	Racquel Ferrer	Bureau of Fisheries and Aquatic Resources – National Integrated Fisheries Technology Development Center
Philippines	Juan R. Relox Jr.	Conservation and Environmental Protection Section FRMD
Philippines	Marc Lawrence J. Romero	Bureau of Fisheries and Aquatic Resources
Philippines	Dennis E. Tiotangco	Fisheries Inspection and Quarantine Division Bureau of Fisheries and Aquatic Resources
Philippines	Demosthenes F. Togonon	
Thailand	Ms. Rungaree Bootkhunthot	
Thailand	Ms. Hathaichanok Bouvaree	
Thailand	Ms. Krissana Chankaew	Department of Fisheries
Thailand	Jiraporn Jarungsriapisit	Aquatic Animal Health Research and Development Division, Department of Fisheries
Thailand	Mrs. Passarapa Kaewnern	Fish Inspection and Quality Control Division, Department of Fishery
Thailand	Ms. Supamas Kai-cum	Fisheries Commodity Standard System and Traceability Division
Thailand	Mrs. Anchira Maneevong	Fish Inspection and Quality Control Division
Thailand	Mrs. Renuka Nitiboonyabordee	Fish Inspection and Quality Control Division
Thailand	Mr. Akom Singhabun	Department of Fisheries
Thailand	Benjaporn Somridhivej	Aquatic Animal Research and Development Division
Thailand	Ms. Arporn Tepanich	Department of Fisheries
Thailand	Chomdao Wongtadum	Aquatic Animal Research and Development Division
Turkey	Hüseyin Dede	General Directorate for Fisheries and Aquaculture
Turkey	Derya Evin	Certified Aquaculture Engineer Department of Animal and Animal Products Border Control General Directorate of Food and Control Ministry of Agriculture and Forestry

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Country	Delegate	Organisation
Turkey	Onur Hasaltuntaş	
FAO	Violetta Costanzo	FAO Fisheries Division
FAO	Esther Garrido Gamarro	FAO Fisheries Division
FAO	Giulia Loi	FAO Fisheries Division
FAO	Gloria Loriente	FAO Fisheries Division
FAO	Dr. Iddya Karunasagar	FAO Invited Technical Expert (Nitte University)
UK	Craig Baker-Austin	Food and Agriculture Organisation Reference Centre
UK	Rachel Hartnell	Food and Agriculture Organisation Reference Centre
UK	James Lowther	Food and Agriculture Organisation Reference Centre
UK	Michelle Price-Hayward	Food and Agriculture Organisation Reference Centre
UK	Louise Stockley	Food and Agriculture Organisation Reference Centre
UK	Andrew Turner	Food and Agriculture Organisation Reference Centre
UK	Andrew Younger	Food and Agriculture Organisation Reference Centre

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World Class Science for the Marine and Freshwater Environment

Virtual Regional Workshop on Bivalve Molluscs Sanitation

Agenda

Dates: 9th, 10th and 11th December 2020
Virtual meeting: https://fao.zoom.us/meeting/register/tJIkce-tqDgsHN2FVkdpX4-dxZDL5nucbqxy

All timings are UK time GMT - Start time – 7:30 9th December End time – 10:30 11th December

Day one- 9thDecember 2020– 7:30 – 10:30 chair -Esther Garrido Gamarro

1. Opening address and welcome from FAO Rome (10 mins) [Esther Garrido Gamarro]
2. Welcome introductions, and an introduction to the Centre for Environment, Fisheries and Aquaculture Science (Cefas), importance of bivalve molluscs (20 mins) [Rachel Hartnell]

3. Presentation from each participating country
   - 3.1. Bangladesh – **Md. Yousuf Khan,** Department of Fisheries
   - 3.2. India - **Dr. Vasant Kripa**, Coastal Aquaculture Authority (CAA)
   - 3.3. Indonesia - **Helwijaya Marpaung**, Ministry of Marine Affairs and Fisheries
   - 3.4. Malaysia - Fisheries Development Authority of Malaysia
   - 3.5. Pakistan - **Mukhtiar Ahmed Mahar** and **Khawar Parvez Awan**, Centre for Coastal and Deltaic Studies, University of Sindh Campus Thatta, Sindh.
   - 3.6. The Philippines - **Marc Lawrence J. Romero**, Department of Agriculture - Bureau of Fisheries and Aquatic Resources

Break 9:00 – 9:05

   - 3.7. Thailand **- Ms. Supamas Kai-cum**, Fisheries Commodity Standard System and Traceability Division, Department of Fisheries
   - 3.8. Turkey - **Hüseyin Dede**, General Directorate for Fisheries and Aquaculture, Ministry of Agriculture and Forestry of the Republic of Turkey

4. The aims of this workshop (10 mins) [Rachel Hartnell]
5. Questions? (20 mins) [All]

Day two - 10th December 2020- 7:30 – 10:30 – chair Rachel Hartnell

6. An overview of the Technical Guidance for the Development of the Growing Area Aspects of Bivalve Mollusc Sanitation Programmes (30 mins, including questions) [Dr Iddya Karunasagar]
7. Role and work programme of the FAO Reference Centre for Bivalve Shellfish Sanitation (10 mins, including questions) [Rachel Hartnell]
8. Overview of hazards associated with bivalve mollusc consumption – Hazard characterisation and risk assessment (30 mins, including questions) [James Lowther]
9. Understanding and tackling emerging risks (20 mins, including questions) [Craig Baker-Austin]

Break 9:00 – 9:05

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10. Goals and Priorities - Round table – what challenges to increasing safe production of bivalve molluscs do responsible authorities face - All participants

3 groups (of delegates) [RED, BLUE, and YELLOW]
Three topics – each topic has one Cefas facilitator and one Cefas note taker

Topic 1	What is the vision for bivalve shellfish production, is it driven by domestic or international export demands, what does success look like? [Michelle Price-Hayward and Andy Younger]
Topic 2	Human health hazards associated with bivalve molluscs and risk mitigations, what are the specific risks (if any) in your country, what do you know about the different ways of controlling risks to the shellfish consumer? [James Lowther and Craig Baker-Austin]
Topic 3	Given what you know of FAO Reference Centres – where do you see areas for future support, practically what would they look like, what are the barriers, if any, to making this happen? [Rachel Hartnell and Louise Stockley]

Day three –11th December 2020 - 7:30 – 10:30

Session 1, Chair - Esther Garrido Gamarro

11. Recap from previous day – goals and priorities (20 mins, including questions) [Rachel Hartnell]
12. Principles and components of the Growing Area Risk Profile (GARP) (20 mins, including questions) [Michelle Price-Hayward and Andy Younger]
13. Overview of Growing Area Assessment (20 mins, including questions) [Michelle Price-Hayward]
14. Growing Area Monitoring and Classification (20 mins, including questions) [Andy Younger]

Break 8:50 - 8:55

Session 2, Chair – Rachel Hartnell

15. Laboratories - Sample collection, transport, analysis and quality of test results (30 mins, including questions) [Louise Stockley]
16. FAO Reference Centre web resources and E-learning (10 mins, including questions) [Louise Stockley]
17. Mechanisms to request technical assistance from FAO (10 mins, including questions) [Esther Garrido Gamarro]
18. Plenary and bivalve molluscs quiz (20 mins, including questions) [Gloria Loriente and Rachel Hartnell]
19. Workshop close, thanks and closing address (10 mins) [Esther Garrido Gamarro and Rachel Hartnell]

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Minutes of the Virtual Regional Workshop on Bivalve Mollusc Sanitation for the FAO Asia and Pacific Region, 9th – 11th December, 2020

Opening

Dr Esther Garrido Gamarro (EGG) of the FAO Fisheries division welcomed delegates to the virtual workshop and laid out the technical arrangements for participation. She then outlined the context for the establishment of the FAO Reference Centre (RC) for Bivalve Mollusc Sanitation, highlighting the large potential for expanding bivalve mollusc production in many coastal countries around the world, alongside the particular challenges around international trade, given the ability of bivalves to concentrate contaminants from their growing waters.

Welcome, introduction to the workshop, to Cefas and the importance of bivalve molluscs

Dr Rachel Hartnell (RH), director of the FAO RC provided information on Cefas, as the organisation designated as the RC, including an overview of its international activities in a diverse range of countries around the globe. She further explained the importance of seafood in general and bivalves in particular in terms of helping to provide a sustainable and healthy source of food for the global population, whilst highlighting the various challenges in providing bivalves that are safe to eat, and to international trade in this commodity.

Presentations from participating countries

A series of presentations were given by representatives of the eight participating countries from the Asia and Pacific region, namely Dr Md. Yousuf Khan (Department of Fisheries, BANGLADESH), Dr Vasant Kripa (Coastal Aquaculture Authority, INDIA), Helwijaya Marpaung (Ministry of Marine Affairs and Fisheries, INDONESIA), Dr Siti Dina bt. Razman Pahri (Division of Fisheries Biosecurity, MALAYSIA) Mukhtiar Ahmed Mahar and Khawar Parvez Awan (Centre for Coastal and Deltaic Studies, PAKISTAN) Marc Lawrence J. Romero, (Bureau of Fisheries and Aquatic Resources, the PHILIPPINES), Ms. Supamas Kai-cum (Department of Fisheries, THAILAND) and Hüseyin Dede, (General Directorate for Fisheries and Aquaculture, TURKEY). In each case the representative provided an overview of bivalve production, official controls and trade within their country, alongside the national ambitions for further development of the sector. The series of talks highlighted the diversity of bivalve production within the region, ranging from relatively undeveloped sectors with small-scale or research level harvesting to large well-developed sectors with sophisticated national control programmes and significant export markets. In many cases however delegates highlighted the potential for further bivalve production and trade.

Aims of the workshop

RH introduced the workshop agenda and outlined the central aim of the workshop, namely, to help the delegate countries achieve **enhanced production of safe bivalve molluscs** through in the short term, the provision of information on bivalve sanitation, and in the longer term, the formation of relationships between competent authorities and testing labs in the delegate countries and the Reference Centre and FAO Fisheries Division**.**

Overview of the FAO/WHO Technical Guidance

Prof. Iddya Karunasagar of Nitte University, India (formerly of the FAO Fisheries Division) outlined the development and publication of the FAO/WHO Technical Guidance for the Development of the

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Growing Area Aspects of Bivalve Mollusc Sanitation Programmes. This document was produced by an international working group of experts in the field (including Prof. Karunasagar) under a mandate to develop detailed guidance within the framework within Section 7 of the Codex Code of Practice for Fish and Fishery Products, with the aim of facilitating the implementation of national Bivalve Sanitation programmes. Prof. Karunasagar further provided an overview of the contents of the guidance (covered in more detail in subsequent presentations).

Introduction to the role of the FAO Reference Centre for Bivalve Shellfish Sanitation, and overview of online resources including e-Learning

RH summarised the roles and responsibilities of the FAO RC, and provided delegates with an overview of the range of information currently available through the website of the RC (https://www.cefas.co.uk/faobivalves) including protocols and technical guidance, information and contact details for RC staff and in particular links to eLearning modules on bivalve sanitation developed in collaboration with the FAO eLearning academy (two modules available currently with more in development).

Overview of hazards associated with bivalve mollusc consumption – Hazard characterisation and risk assessment

Dr James Lowther (JL) of the FAO RC provided information on the main hazards associated with bivalves, with particular emphasis on microbiological hazards including *Salmonella* spp., *Vibrio* spp., norovirus and hepatitis A virus. Evidence of the occurrence of these pathogens in the Asia and Pacific region, in shellfish-linked outbreaks, passive surveillance of retail shellfish and the wider population was presented. The potential of contaminated shellfish to cause significant outbreaks of illness in consumers, as exemplified by the largest ever recorded shellfish-related outbreak that had occurred in the Asia and Pacific region (>290,000 cases of hepatitis A virus linked to consumption of clams in China) was outlined. The need to assess the potential contribution of different hazards as part of the Growing Area Risk Profile (GARP) was presented, as was the possibility of including a hazard survey (direct testing of shellfish or water samples for pathogens) as part of the Growing Area Assessment (GAA). Brief details of the technical requirements of the testing methods, with particular focus on methods for viruses were provided.

Emerging risks

Dr Craig Baker-Austin (CBA) of the FAO RC presented an overview of emerging and potential emerging risks to human health as a result of contamination of bivalves. Particular focus was given to *Vibrio parahaemolyticus and V. vulnificus* (the global distributions of these pathogens are changing significantly due to climate change), hepatitis E virus (a zoonotic pathogen linked to pigs, deer and other animals that has significant potential for shellfish-borne transmission), tetrodotoxin (a potent neurotoxin produced by marine bacteria) and SARS-CoV-2, causative agent of the COVID-19 pandemic (foodborne transmission is not known at present but the virus' emergence highlights the need for vigilance). Phylogenetic and environmental monitoring tools for tracking such emerging risks were detailed.

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Break out session – Goals and priorities

The delegates were divided into three groups of around 15-16 each. The groups were then cycled round three virtual break out rooms, each headed by a facilitator and note taker from the FAO RC, to discuss three topics; their national VISION for bivalve production, the HAZARDS associated with bivalve production in their country and their priority areas for SUPPORT from the FAO RC. A number of recurrent themes in these discussions were identified by the FAO RC and summarised in a presentation given by RH. These themes included in particular questions around:-

- microbiological methods and testing (including PT provision and the establishment of laboratory networks),
- the need for support with programme assessment and pilot projects,
- methods and recommendations for stakeholder education,
- the desire for support with monitoring for harmful algal biotoxins and other chemical contaminants.

Overview of Growing Area Risk Profile

Michelle Price-Hayward (MPH) and Andy Younger (AY) of the FAO RC provided an introduction to the concept and stages of the GARP as described in the FAO/WHO Technical Guidance. The GARP is the initial information gathering stage of the assessment of a newly proposed bivalve production area; the bases for making the decision to proceed to a full assessment were described.

Overview of Growing Area Assessment

MPH gave a presentation on the requirements for a full GAA of a new production area, as described in the FAO/WHO Technical Guidance. This is a more in depth procedure than the GARP, involving a more through collection of information, plus the generation of new data through shoreline and hazard/indicator surveys. The different types of data analysis (descriptive/semi-quantitative/quantitative) were described, and the outcome, in terms of accurate mapping of the proposed area, and a primary monitoring plan including defined sampling points was explained.

Growing area monitoring and classification

AY explained the need for both primary and ongoing monitoring (using microbiological testing) of bivalve production areas, and the principles of classification (particularly the distinction between areas where bivalves are judged fit for consumption raw without the need for treatment after collection, and areas where treatment is required). The different benefits of monitoring using indicator organisms or pathogens, and shellfish flesh or water samples were detailed. The different choices in designing a monitoring and classification system were illustrated with reference to the United States (US) and European Union (EU) systems. Requirements for conditional classifications and the use of buffer zones around point sources of contamination were explained.

Sample collection, transport, analysis and quality of test results

Louise Stockley (LS) of the FAO RC provided an overview on the requirements for sample collection, transport and analysis, in order to guarantee high quality information is used for monitoring and classification. The requirement for fixed protocols for sample collection, submission, testing and reporting of results was explained. Technical details on reference and alternative methods for the indicator organisms *E. coli* and FRNA bacteriophage were given. Finally, the value of laboratory

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accreditation and regular proficiency testing in guaranteeing the quality of test results was demonstrated.

Chemical detection methods for biotoxins

In response to the high level of interest expressed by the delegates during the break out session, Dr Andy Turner of the FAO RC was invited to make an additional presentation on the topic of methods for biotoxin detection. This comprehensive talk included details of the history of biotoxin testing, including the widespread use of animals, and the development of replacement methods based on toxin chemistry. Methods for the major classes of toxins (ASP, PSP and DSP) were described alongside developing methods for other emerging toxin groups. Approaches to validation and in-lab verification of biotoxin methods and the organisation of toxin monitoring programmes were described.

Mechanisms to request technical assistance

EGG explained the principal mechanisms available to member countries to access technical assistance from the FAO, namely the Technical Cooperation Programme (funded directly by FAO), the Technical Cooperation Programme (funded by the beneficiary country) and the Government Cooperative Programme (funded by a donor country or financing institution).

Quiz

Immediately before the close of the meeting, the delegates were invited to take part in a virtual multiple choice quiz to test their knowledge of the topics covered in the workshop.

Closing

The meeting concluded with EGG and RH summarising the workshop activities across the three days, and thanking the delegates for their attendance and engagement with the FAO Fisheries Division and FAO RC in helping to ensure a successful virtual workshop.

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FAO RC responses to "chat" questions from workshop delegates

During the meeting, delegates were encouraged to submit questions using the online chat function. These questions are listed here, with responses prepared by the FAO RC.

- **How are the risks of heavy metals in shellfish best managed?**
  In the Codex code of practice on fish and fishery products heavy metals are identified as a hazard in the production of bivalve molluscs due their reported wide ranging physiological toxic effects in man. The code of practice recommends that certain substances (e.g. cadmium) should not exceed maximum permissible levels in the edible parts of the product but does not specify either heavy metal species or permitted levels. Depending upon the geographical region or trading block, maximum or guidance permissible heavy metal levels in foods, including bivalve molluscs, may vary. Additional information, including guidance levels for cadmium in bivalve molluscs other than oyster and scallops, can be found in Codex General Standard for Contaminants and Toxins in Food and Feed (CXS 193-1995). In the European Union maximum levels for bivalve molluscs are set for lead, cadmium and mercury (1.5 mg/kg wet weight (lead), 1.0 mg/kg wet weight (cadmium) and 0.5 mg/kg wet weight (mercury)). Maximum permitted levels for products for EU are set out in Commission Regulation (EC) 1881/2006, sampling regimes and methods of analysis given in Commission Regulation (EC) 333/2007.

- **Is there any program to conduct any research mechanism on molluscs bivalves with academia with FAO or CEFAS?**
  There are range of international funding mechanisms to facilitate cross national/international working, many of these programmes are facilitated through FAO, please see workshop presentation 17. In addition, a range of capacity and capability programmes are available through UK Overseas Development Assistance (ODA) funding programmes. Cefas works in partnership with our core government department Defra to help identify and maximise the outcomes of international programmes supporting sustainable seafood production in a number of countries. There are also a range of international funding bodies with a focus upon developing links between research organisations and researchers in academic institutes which may be applicable although eligibility criteria vary. Cefas' business development unit monitors calls for opportunities to apply for funding for collaborative projects. If you have a particular interest in working with Cefas please contact us for more information.

- **Is there any method or technique to eliminate *Vibrio* spp. or other bacteria from live product to serve live to market?**
  There are various methods that can be used to reduce vibrios in shellfish (and by extension other bacteria), but they do vary quite markedly in how much they work and if they kill the product. Those that don't kill the shellfish include the following:-

  Harvesting curfews: Harvesting curfews aim to ensure oysters are harvested under conditions which mitigate V. parahaemolyticus growth in oysters. Examples include early morning harvests (before the maximum heat of the day) and within specific tidal periods. The latter example is based on the scientific observation that V. parahaemolyticus levels increase when oysters are exposed on the sunny mudflats by a receding tide, then decrease when the tidal

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waters submerge the shellfish and filter-feeding recommences. However, it must be recognized that the climatic and tidal conditions in other countries are different around the world. Local research should be undertaken to ascertain the harvesting and environmental conditions conducive to mitigating the vibriosis food safety risk.

Harvesting cessation: Harvesting cessation can be used both as a reactive measure in response to illness and a proactive measure to prevent illness. Proactive measures can be based on temperature or salinity levels in the environment, measured or based on remote sensing models, or can be based on restrictions for harvesting during months associated with peak illness.

Re¬submersion: Re-submerging is used in Canada and the United States of America as a V. parahaemolyticus mitigation process and the US FDA has validated this process. The re-submerging practice is usually defined as harvesting, culling, and placing oysters in larger cages for re-submerging in a deeper water body or for re-submersion by the tide. This practice requires availability of water space deep enough for re-submersion. Industry would need to design systems whereby the intertidal product is harvested, shifted and anchored in deeper water or submerged in the incoming tidal waters on the lease, in a manner from which they can be directly harvested. For example, one commercial shellfish operator uses a barge fitted with a crane to harvest the cages of re-submerged oysters.

Deep water suspension: Deep water suspension, or the movement of oyster nets into cooler waters when water temperatures exceed 15 ◦C can be considered as method of Vibrio risk reduction. To date, little data on this intervention exists, however it may represent a cost-effective management option. As with other control measures, consideration of how these practices may impact other factors (e.g. for biotoxin and classification status) should also be taken into account.

Relaying: There is limited information on the success of relaying as a treatment step to remove Vibrio parahaemolyticus. However, recent US FDA studies confirm that relaying to higher salinity and/or cooler waters shows promise for reducing Vibrio parahaemolyticus levels, with around seven days enough to reduce Vibrio parahaemolyticus levels in oysters. It should be recognized that there is the potential for V. parahaemolyticus in the relayed lots to contaminate other shellstock growing in the new water space.

Depuration: Depuration or purification is one of the major treatment processes in controlling the public health risks associated with microbially-contaminated shellfish. According to the Codex Code of Recommended Practice for Fish and Fishery Products, depuration means the reduction of microorganisms to a level acceptable for direct consumption by the process of holding live bivalve molluscs for a period of time under approved, controlled conditions in natural or artificial sea water suitable for the process, which may be treated or untreated. Historically shellfish depuration has not been considered an appropriate process for mitigating or eliminating the vibriosis food safety risk. Unfortunately, depuration has been shown to be ineffective in reducing a range of pathogenic Vibrio species, such as V. cholerae and V. parahaemolyticus from bivalve matrices. However, a recent study suggests that optimal V.

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parahaemolyticus depuration occurred at a temperature of 12.5 °C and stocking density of two oysters/L of artificial seawater. The mean depuration time to achieve a target reduction of 3.52 log was 3.17 days, and 5 days to achieve a level of >30MPN/g.

Temperature Controls: Experiments with oysters artificially contaminated with V. parahaemolyticus found that treatment of 50 °C for 10 minutes was needed to reduce the concentration by >5 log10 MPN/g. Treatment at 50 °C for only 5 minutes or treatment at 45 °C for 20 minutes only achieved reductions of 3.9 and 2.6 log10 MPN/g, respectively. Ice slurries were effective for rapidly cooling oysters (24 °C to 10 °C within 12 minutes), but repeated dipping of oysters caused the ice to become contaminated with faecal coliforms, Clostridium perfringens, V. vulnificus and total V. parahaemolyticus. However, the concentrations of Vibrio spp. were unchanged in the flesh of the oysters after 15 minutes submersion in the contaminated ice slurry. Another study found that on-board and dockside icing did not predictably reduce the concentration of V. parahaemolyticus in oysters, and icing significantly and negatively affected oyster survival. Ice slurries have been used extensively in the USA since 2014 and demonstrated a 95% reduction in reported illnesses compared to peak illness reporting in 2013. The impact of climate change on shellfish safety may mean it is necessary for countries and regions undergoing increased risk to assess and potentially implement enhanced control measures, such as cold-chain interventions to reduce illnesses associated with V. parahaemolyticus.

- **According to the presentation on hazards, a coordinated approach is needed from Competent authority, private sector, academia & consumers to prevent Bivalve Mollusc associated risk. As a consumer what can we do?**
  As a consumer it is important to realise firstly that bivalve molluscs are a healthy and nutritious food, but also that they can present risks of illness due to their filter-feeding nature. It is possible for the consumer to educate themselves about the different levels of risk provided by different species, different harvest seasons, different cooking methods etc., however the most important step a consumer can take is to understand that in shellfish harvested in nationally approved areas by reputable business operators, measures to reduce risk will have been taken. For shellfish harvested outside of such legal programmes the risks are uncontrolled.

- **If an existing cultivation area is known to receive a lot of contamination from anthropogenic activities, is it better to create a new cultivation area that is far from human activities? In our country, many cultivation activities are carried out by local people and are traditionally done.**
  Yes – it is best to set up cultivation areas as far away as possible from human inhabited areas and human activities. It is important to remember how well bivalve shellfish can concentrate contamination (up to 100x for E. coli). As we discussed at the workshop, shellfish farmers have been known to contaminate their own shellfish by careless dumping of faecal and other waste, so that is also something to watch out for.

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- **Have you come across any example of recreational fishing being allowed in bivalve production areas in order to encourage agrotourism industry?**
  Not in terms of specifically encouraging agrotourism, at least not on a large scale. As mentioned at the workshop, diving for scallops is popular among recreational divers in some areas and this may attract divers from elsewhere. 'Salting' for razor clams at low tide is occasionally practised in some areas. Recreational fishing (also termed 'casual gathering') is practised for most bivalve species but is normally limited e.g. to around 5kg per person per day in the UK.

- **Can you give a general idea which institutions are involved in the area of monitoring, assessment and classification in the UK?**
  There are different institutions involved in assessment, monitoring and classification depending on which part of the UK. For England and Wales, the competent authority is the Food Standards Agency, who then competitively tenders the various aspects. An independent environmental consultant is currently contracted to undertake sanitary surveys, Cefas is contracted to manage monitoring and classification, local authorities are responsible for conducting monitoring and the samples are tested by various laboratories around the country. In Scotland and Northern Ireland, these arrangements differ slightly.

- **In our country bivalve molluscs monitoring is conducted by the Central Government, yet currently most growing areas (sea <12 miles) are owned by Provincial Government, of all the activities mentioned, any suggestion what kind of task or authority should be better given to the areas' owner?**
  With regard to which tasks should be given to the Provincial Government as the growing area owner, I would suggest that sampling, testing and enforcement would be the obvious tasks. Results could then be sent to Central Government colleagues with them co-ordinating the classification programme (including growing area assessments/sanitary surveys) and deciding on the classifications themselves. We have this type of set up within the UK. The benefit of a single Central Government department making all the classification decisions is that you are more likely to get a consistent application of classifications across the whole country. Sampling and testing protocols should also be determined by your Central Government department and used by all the Provincial Government officers, again to ensure consistency.

- **Is it possible to find PSP-positive shellfish but not PSP-producing microalgae at the time of sampling?**
  There are a few factors here which can be considered.
  Firstly, the effectiveness and representative nature of the sampling. It is possible that a water sample taken at any given time may not be fully representative of the entire shellfish bed under control. It is therefore important that water sampling is conducted as effectively as possible to increase the chances of capturing and sampling any microalgal cells that may be present
  Many research works show there is a delay between PST-producing algal blooms occurring and the toxins accumulating within the shellfish tissues. The delay between the two can vary depending on the nature of the bloom and the shellfish species, as well as the environmental scenario (water temperature, water current flow)

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The representativity of the shellfish sampling is also important. Individual organisms accumulate toxins to differing extents depending on their individual physiology, so it is important to sample enough animals and to ensure these provide an appropriate representation of the shellfish monitoring point.
So with all this in mind, there are enough variabilities to result in the scenario where a PST-positive shellfish may not coincide with a detectable microalgae in the water.
Similarly, given there are non-toxin producing Alexandrium species, it is possible to see microalgal producers of PSTs, but because these are detected only to genus level, there may be no toxins in the shellfish.

- **How long can the PSP toxin last in shellfish? Can delaying the harvest time eliminate the toxin content in these shellfish?**
  The length of time the PSP toxins remains in the shellfish is highly dependent upon a number of different factors. These include 1) the shellfish species contaminated 2) the total toxicity of the toxins present at the time of concern 3) environmental factors such as water temperature and feeding activities. We find that certain species such as blue mussels (Mytilus edulis) depurate their toxins relatively quickly. Sometimes, for example, total toxin concentrations above the maximum permitted levels can reduce to low levels within a week or two. However, other species including some razor clams, butter clams, scallops are known to retain toxins much longer, and in some cases up to two years! As such, it is critically important that decisions on harvesting/regulatory safety are made based on official control monitoring results. In the UK, if a shellfish bed is deemed unsafe due to total PSP >MPL, then it then requires two "safe" results (<MPL) in a row, to enable the shellfish farm to re-open. Once your area has dealt with such scenarios, you will begin to understand the toxin dynamics relevant to your region and your shellfish species. If in any doubt, always test.
  So to directly answer your question, yes, delaying harvest time can eliminate the toxins, but this is highly dependent on a number of things, and must be tested thoroughly without making any assumptions.

- **Is there any impact of cyanobacterial algal toxicities on the shell fishery? can we detect cyanobacterial toxicity in mussels and oysters?**
  This has happened in some regions of the world at certain periods of time. There is a famous example of microcystins produced by cyanobacteria accumulating in estuarine mussels and killing sea otters which fed on the molluscs. Other examples are in the literature, and laboratory experiments have shown that microcystins and nodularins can accumulate rapidly in molluscs. With the majority of cyanobacteria being freshwater species, this uptake is only likely to happen when significant blooms occurring in freshwater environments, and then flow into the coastal environment where shellfish may be growing. Methods have been validated for the determination of microcystins in shellfish.

- **Is there any survey for biotoxin like sanitary survey prior to commercial production?**
  The hazard survey aspect of the growing area assessment is where you might wish to consider biotoxin hazards. However the testing for this would need to be carefully targeted to give the best chance of identifying presence of the hazard and this can be a challenge.

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- **Biotoxin monitoring is quite expensive, any recommendation how to reduce the frequency of the regular monitoring?**
  According to the EU legislation, biotoxin monitoring should be conducted weekly, unless a risk assessment has been conducted and can demonstrate that a lower frequency (e.g. fortnightly or monthly) is safe to be conducted. Clearly, data is required to generate the information needed to carry out this risk assessment, which needs to be conducted on a weekly basis for a period of time, ideally over several years, given the variability of toxin levels, both spatially and temporally. However, once the risk assessment has been conducted, if a low risk is found in certain areas at certain times of the year, then in the future less frequent samples could be taken for official control testing. Please do note, however, that toxin-producing microalgal blooms can proliferate very quickly indeed, so any reduction in sampling frequency can be dangerous without a full portfolio of evidence that this is the correct and appropriate thing to do.

- **How can we prevent the shellfish to be contaminated with toxin? or which measures can we take for prevention or reduction of toxins in shellfish?**
  The process of prevention and reduction is still in its infancy, and there are no formal methods for achieving depuration artificially for marine toxins and/or for preventing uptake of toxins, if the toxin-producing microalgae are present in the water surrounding the shellfish harvesting area. Research has in recent years demonstrated the potential for some forms of chemical, physical and biological control of blooms/toxins, but these have not yet been developed into commercialised strategies. Similarly, research does exist investigating methods for depuration of toxins from water or shellfish, but none of these methods can be used in a commercial shellfish harvesting environment. Overall the only way to reduce toxins in shellfish is to wait for toxins to be depurated naturally in the water, so delaying harvest until toxins are below the safety thresholds. This is where a reliable rapid test kit approach for quality testing of batches is important.

- **Can the microbiology aspect can be ignored if the shellfish are consumed in cooked form? So the examination is more focused on the aspect of biotoxins. Currently the shellfish in our country is still consumed well-cooked for domestic needs.**
  As your question infers natural marine biotoxins are heat stable when bivalve shellfish are processed using normal cooking or processing methods and thus in cooked product could be expected to constitute the greatest risk to public health. Whilst some changes can occur, if anything a loss of water from the seafood product can result in the concentration of toxins within the flesh and subsequent higher toxicity levels. As such, it is critically-important that appropriate toxin testing is conducted on live unprocessed shellfish prior to processing.
  The primary purpose of microbiological monitoring of either bivalve shellfish or their growing waters is to provide an assessment of the risk of human enteric pathogens, and to dictate any post-harvest processing requirements for bivalves before they are placed on the market. Microbiological monitoring may also indicate higher risk of other anthropogenic pollution derived hazards present in the growing areas (for example from sewage or industrial contamination) which may constitute elevated public health risks. Most bivalve shellfish sanitation programmes include microbiological monitoring in the growing area supplemented with microbiological testing at the point at which products are placed on the market. The

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intended use of bivalve molluscs may inform the point within supply chain where microbiological controls are applied, but due to issues of palatability bivalve shellfish are often consumed after light cooking which may not be sufficient to inactivate some pathogens, and thus even if subject to normal cooking methods bivalve molluscs may constitute elevated risk relative to other foodstuffs. As with many foodstuffs' microbiological food safety and/or food hygiene criteria are recommended as a minimum at the point at which products are placed in the market.

It is further noted that countries wishing to export bivalve shellfish as raw, raw frozen or processed product would need to meet the microbiological standards required by the importing country. For bivalve shellfish typically this will involve microbiological monitoring and classification of growing areas and microbiological criteria applied to end product.

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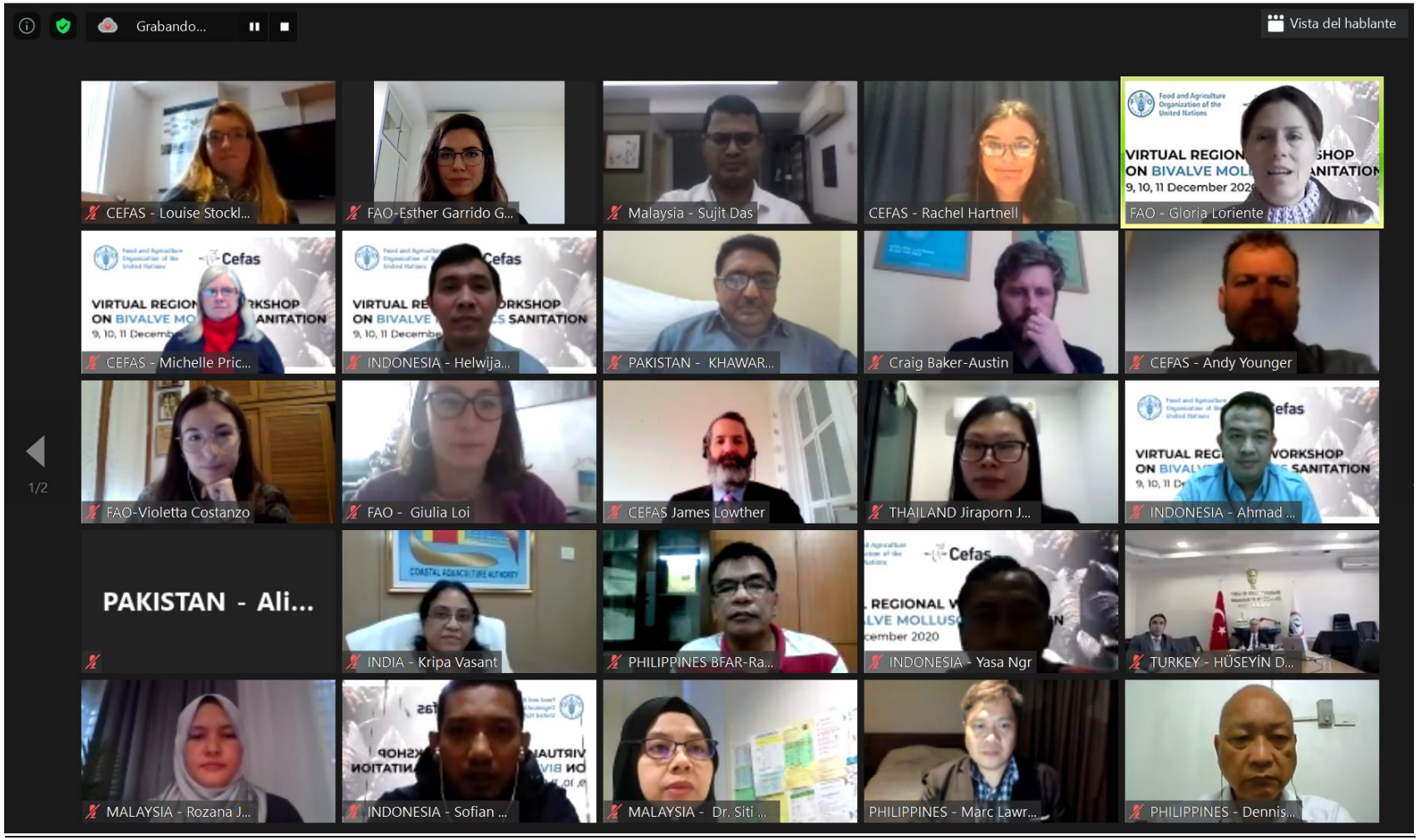

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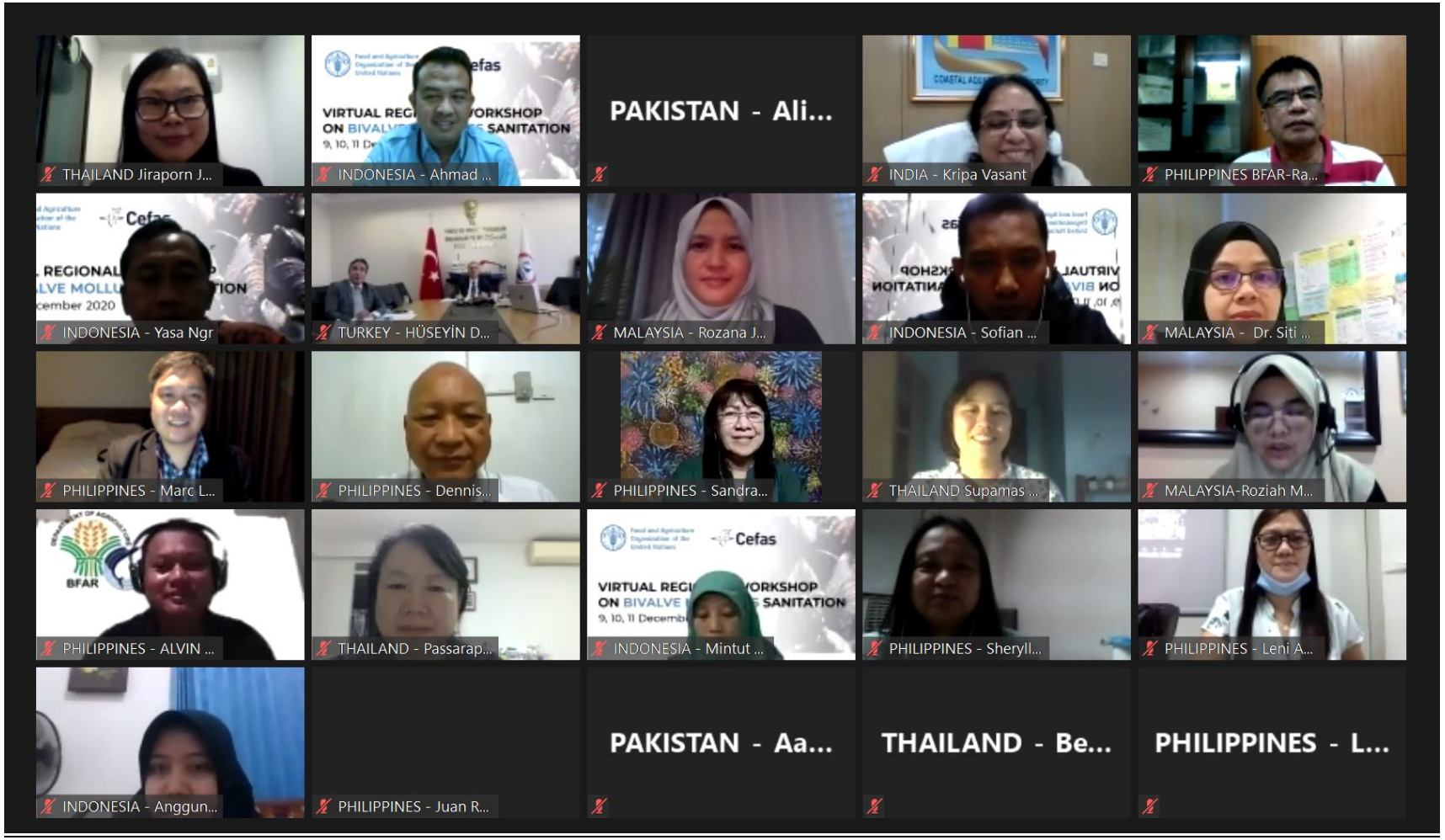

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Benefits and impact assessment – Joint FAO-Cefas virtual regional workshop on Bivalve Mollusc Sanitation for Asia and Pacific

INPUTS FROM CEFAS AND FAO

Selection of appropriate delegate countries through a selection matrix
Production of the Workshop agenda
Content of the Workshop presentations
Planning of the Workshop break out sessions

OUTCOMES

Formation of a network of Competent Authorities across the Asia and Pacific region with responsibility for the development and operation of bivalve mollusc sanitation programmes

OUTPUTS OF THE WORKSHOP

Presentations from the Workshop
Minutes of the Workshop
Answers to delegate chat questions from the Workshop
Anonymous feedback from workshop participants

POTENTIAL IMPACTS

Helping the delegate countries achieve enhanced production of safe bivalve molluscs
Development of an industry with environmental and societal benefits
Provision of safe and nutritious food products for domestic consumption
Increase in international and intercommunity trade opportunities, GDP increase

Aim – Enhanced food security through capability and capacity building for bivalve mollusc safety supported by FAO and UK government

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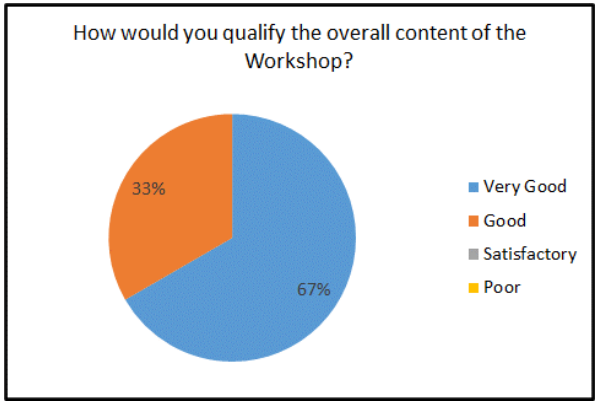
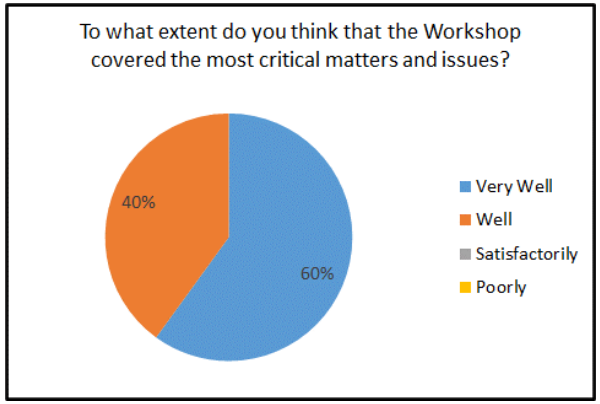
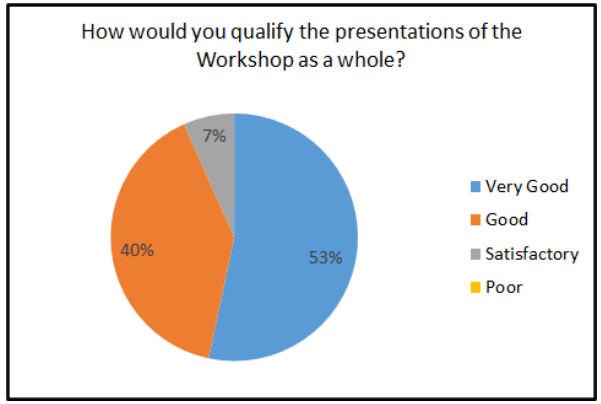
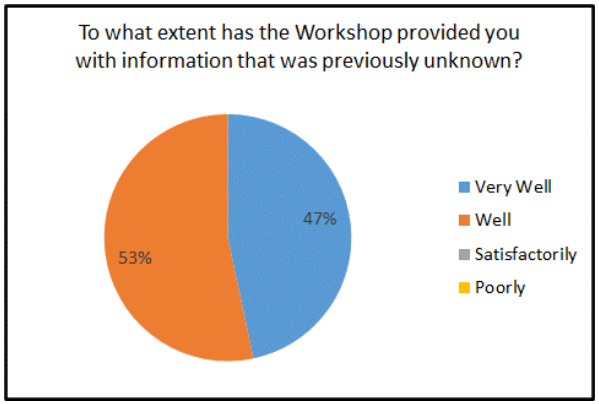
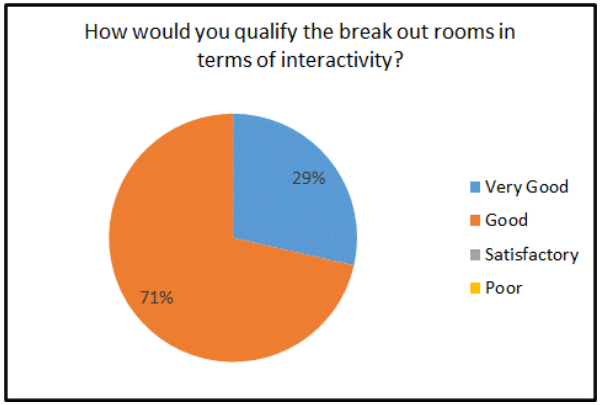
Anonymous Participant Feedback Results

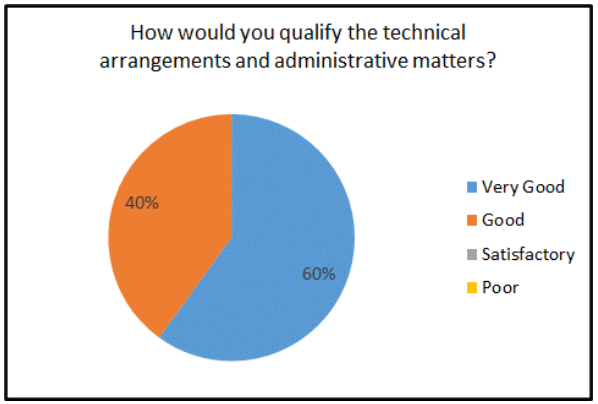












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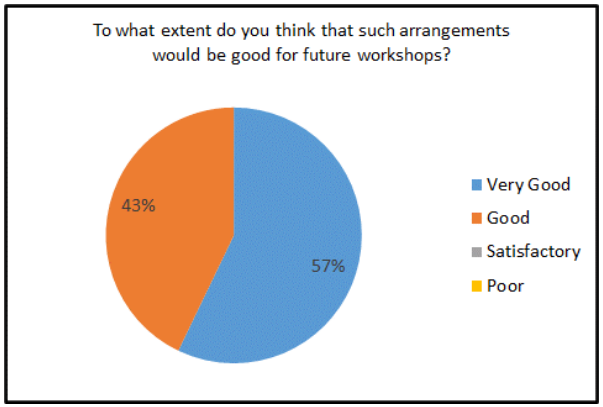

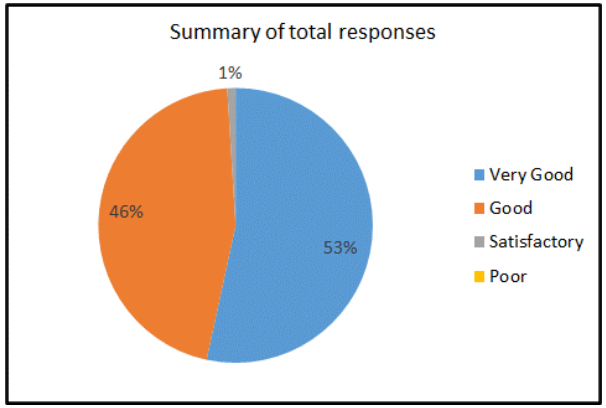

Comments :-

1. Many edible species of Bivalves are naturally found in many countries but their domestic consumption is nearly negligible and wild caught are exported in small quantities. CEFAS need to Technically assist these countries to develop bivalves aquaculture for export purpose.
2. I hope would be better in the next workshop
3. I am very happy to be part of this workshop and acknowledge with high appreciation for the organization. Hopefully this workshop will benefit overall for the scientific community and concerned boundaries within national level.
4. Do you have data on present status of export/import of freshwater and marine bivalves? If yes, please provide us species wise quantity and value of export/import data of major 10 importing and exporting countries involved.
5. We are happy to participate the workshop. Hope this will continue in future.
6. Overall, it was a very good and interesting virtual workshop. Please add more time for break (maybe around 10 minutes) since some of us need to pray during that time. Thanks
7. I'm looking forward to risk assessment in bivalve molluscs Workshop
8. The workshop should be done every year for updating information
9. We are very helped by this workshop, hopefully in our country a good sanitation system will be established in terms of administration and laboratory testing
10. The overall performance of the head (FAO-CEFAS) was awesome and wonderful. I acknowledge here the workshop was very informative and interesting. Such workshops should be carried out in future for the betterment of this sector.
11. Breakup sessions should have adequate time for each countries/participants able to convey their views on the particular subjects.

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Food and Agriculture Organization of the United Nations

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