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HOW AI WILL TRANSFORM HOW WE FARM
By Chelsea Andrews
Artificial intelligence (AI) is transforming our world and how we operate in unprecedented ways. In recent years we’ve seen its emergence into aquaculture, but at a much slower pace than other industries such as healthcare and agriculture. This article discusses current examples of AI in aquaculture and what can be expected in the future. How can AI help lead the revolution towards sustainable aquatic production, and what is holding us back?

INSECT PROTEIN: THE FUTURE OF FEED
By Martin Zorrilla and Nada Dhaoui
Insect protein has taken centre stage in the search for alternative proteins in animal feed. The novel insect protein industry has scaled production in recent years, with a growing number of new companies appearing in Southeast Asia. Insect production offers the region an opportunity to decrease import-dependence while supporting local aquaculture producers with a price stable product. Meanwhile a growing body of evidence from commercial and academic trials illustrate that insect protein is a viable fishmeal replacement in carnivorous fish diets, and in many cases results in improved immune response and gut health outcomes.

SOLVING A GLOBAL COLDCHAIN PROBLEM IN A REMOTE FILIPINO FISHING VILLAGE
By Tamara Mekler
High-end coolers are out of reach for millions of small-scale fisherfolk, and more affordable options are few and far between. Fortuna Cools, a social enterprise founded by graduate students from Stanford University, is addressing the needs of underserved fishing communities by using human-centered design, a mindset and methodology that places users at the centre of the problem solving process. The result is an affordable cooler that is insulated with a widely available, under utilised, agricultural waste product: coconut husk fibre.

AQUACULTURE
HOW AI WILL TRANSFORM HOW WE FARM
By Chelsea Andrews

FEATURE
FISH FRAUD – A THREAT TO THE SUSTAINABILITY OF THE GLOBAL SEAFOOD SUPPLY CHAIN
By Alan Reilly

INSECT PROTEIN: THE FUTURE OF FEED
By Martin Zorrilla and Nada Dhaoui

FISHING
COVID-19 THROWS THE INDIAN FISHERIES SECTOR OUT OF GEAR
By Nikita Gopal, Leela Edwin & Ravishankar C.N.

SOLVING A GLOBAL COLDCHAIN PROBLEM IN A REMOTE FILIPINO FISHING VILLAGE
By Tamara Mekler

INDUSTRY PROFILE
DR SANGEETA MANGUBHAI
Fiji Country Director of the Wildlife Conservation Society (WCS)
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[World Sustainability Organization]
With the latest update on the number of COVID-19 infections being 10 million worldwide and with close to half a million deaths, we know for a fact that we have yet to reach the peak of this appalling pandemic. Businesses and borders are starting to open up, but only time will tell when full recovery can be declared. Meanwhile the WTO has announced that world trade is expected to fall by 13%-32% this year as result of the pandemic. Despite the uncertainty, we will continue to monitor the impact of COVID-19 on the evolving trends in the fisheries and aquaculture sector.

In this issue of the INFOFISH International, we bring you many industry updates in addition to the array of articles in the different sections, including the revolution of internet of things (IoT) through Artificial Intelligence (AI) and how AI can help lead the revolution towards sustainable aquatic production. As it stands, AI is increasingly being applied in fisheries and aquaculture, offering greater efficiency and management of culture systems. The article on how AI can transform a farm discusses current examples of the technology in aquaculture and what can be expected in the future. On this note, with the advent of technology, the combat against fish fraud is challenging and complex, requiring the industry to respond with an effective method for traceability and food testing. This article talks about mitigation measures, among others, and the role of Codex Alimentarius in this endeavour.

You should also look out for another interesting write up on the use of insect protein as an alternative protein in animal feed including the role it can play in reducing import dependence, thus supporting local aquaculture industries. In like manner, the article on addressing deficiencies in cold chains talks about how, through a collaborative ‘human-centred’ approach, smallscale fisher communities in the Philippines are benefitting from the development of a cooler insulated with coconut husk fibre.

There are also important updates on the impact of COVID-19 across the global seafood industry with an article that talks about its repercussions on the Indian fisheries sector. The authors provide an account of the wide-ranging effects of the pandemic, and put forward several suggestions for the industry to move forward under these changed circumstances.

We also invite you to catch the synopses of the multiple webinars INFOFISH has organised over the last two months covering shrimp to tuna as well as technical advancements in fisheries and aquaculture amidst this ravaging pandemic. Do look out for other upcoming events in the INFOFISH Webinar Series, including Tuna Webinars in our effort to keep the global industry informed and updated.

We wish you, your friends and family well during this difficult time; please remember to take extra precautions to keep yourselves safe and healthy.

Happy reading.

Shirlene Maria Anthonysamy

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Resúmenes de los principales artículos

08 FRAUDE PESQUERO: UNA AMENAZA PARA LA SOSTENIBILIDAD DE LA CADENA DE SUMINISTRO MUNDIAL DE PRODUCTOS PESQUEROS
Por Alan Reilly
El pescado y los productos pesqueros conforman una de las categorías de alimentos que están más frecuentemente expuestas al fraude en el mercado mundial. Abordar este problema es una tarea compleja, y requiere que la industria alimentaria desarrolle e implemente sistemas eficaces de trazabilidad de los alimentos basados en la ciencia, como también métodos mejorados para las pruebas de autenticidad de los alimentos que incluyan sistemas documentados para la Evaluación de Vulnerabilidad al Fraude Alimentario (FFVA). El Codex Alimentarius tiene un rol importante en el desarrollo de directrices basadas en la ciencia y en el establecimiento de estándares para la industria pesquera, en particular sobre cómo llevar a cabo una FFVA y cómo implementar medidas de mitigación para combatir el fraude en la cadena pesquera.

21 EL COVID-19 Y SUS CONSECUENCIAS ENEL SECTOR PESQUERO INDIO
Por Nikita Gopal, Leela Edwin y Ravishankar C.N
El confinamiento, los cierres y el distanciamiento social debido al Covid-19 afectaron a todas las áreas de los sectores de la pesca y la acuicultura, incluyendo la captura, los desembarques, el procesamiento y la comercialización, así como también el almacenamiento en estanques. Los grupos que normalmente están en desventaja, como la mano de obra inmigrante y de mujeres, se vieron especialmente afectados. Los autores proporcionan una descripción de los efectos de la pandemia y presentan varias sugerencias para que la industria avance en medio de estas circunstancias cambiantes.

32 ¿CÓMO TRANSFORMARÁ LA IA LA FORMA EN QUE CULTIVAMOS?
Por Chelsea Andrews
La inteligencia artificial (IA) está transformando de formas sin precedentes nuestro mundo y la manera en que operamos. En los últimos años hemos visto su aparición en la acuicultura, pero a un ritmo mucho más lento que en otras industrias, como la salud y la agricultura. Este artículo analiza ejemplos actuales de IA en la acuicultura y lo que se puede esperar en el futuro. ¿Cómo puede la IA ayudar a liderar la revolución hacia una producción acuática sostenible y qué nos está frenando?

44 PROTEÍNAS DE INSECTOS: EL FUTURO DE LAS RACIONES
Por Martin Zorrilla y Nada Dhaoui
Los insectos han tomado un lugar central en la búsqueda de proteínas alternativas para las raciones animales. La nueva industria de proteínas de insectos ha aumentado la producción en los últimos años, con un número creciente de empresas que aparecen en el sudeste asiático. La producción de insectos ofrece a la región la oportunidad de disminuir la dependencia en las importaciones al tiempo que apoya a los productores acuícolas locales con un producto de precios estables. Mientras tanto, las crecientes pruebas acumuladas en ensayos comerciales y académicos demuestran que la proteína de insecto es un reemplazo viable de la harina de pescado en las dietas de peces carnívoros, y en muchos casos se obtiene una respuesta inmune mejorada.

49 RESOLVER UN PROBLEMA DE LA CADENA DE FRÍO EN UN REMOTO PUEBLO PESQUERO FILIPINO
Por Tamara Mekler
El almacenamiento en frío es un gran problema para las cadenas de suministro de productos pesqueros en los países en desarrollo. Los sistemas de refrigeración de alta gama están fuera del alcance para millones de pescadores en pequeña escala, y las opciones más asequibles son pocas. Fortuna Cools, una empresa fundada por estudiantes graduados de la Universidad de Stanford, aborda las necesidades de las comunidades pesqueras desatendidas mediante el diseño centrado en el ser humano, una mentalidad y una metodología que ubica a los usuarios en el centro del proceso de resolución de problemas. El resultado es un refrigerador asequible que aísla con un producto de desecho agrícola local: fibra de cáscara de coco.

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Rodrigo Misa
Résumés des articles de fond

FRAUDE SUR LE POISSON – UNE MENACE SUR LA DURABILITÉ DE LA CHAÎNE D’APPROVISIONNEMENT DES FRUITS DE MER AU NIVEAU MONDIAL
Par Alan Reilly
Le poisson et les produits de la pêche sont l’une des catégories d’aliments les plus fréquentes qui font l’objet de fraude sur le marché mondial. S’attaquer à ce problème est une tâche complexe, exigeant que l’industrie alimentaire développe et mette en œuvre des systèmes de traçabilité des aliments efficaces et basés sur la science et des méthodes améliorées pour les tests d’authenticité des aliments qui incluent des systèmes documentés pour l’évaluation de la vulnérabilité à la fraude alimentaire (FFVA). Le Codex Alimentarius a un rôle important à jouer pour élaborer des directives scientifiques qui définissent des normes pour l’industrie des fruits de mer sur la manière de mener une FFVA et de mettre en œuvre des mesures d’atténuation afin de lutter contre la fraude existant dans la chaîne des fruits de mer.

COVID-19 JETTE LE SECTEUR DES PÊCHES DE L’INDE HORS CIRCUIT DE COMMERCIALISATION
Par Nikita Gopal, Leela Edwin et Ravishankar C.N
Les règles de confinement et de distanciation sociale dues à la Covid-19 ont touché tous les secteurs des pêches et de l’aquaculture, notamment de la capture au débarquement, la transformation et la commercialisation, ainsi qu’au stockage dans les étangs. Les groupes qui sont généralement défavorisés, comme les travailleurs migrants et les femmes, ont été particulièrement touchés. Les auteurs rendent compte des effets étendus de la pandémie et proposent plusieurs suggestions pour que l’industrie progresse dans ces nouvelles circonstances.

COMMENT L’IA TRANSFORMERA NOTRE ÉLEVAGE ?
Par Chelsea Andrews
L’Intelligence Artificielle (IA) transforme notre monde sans précédent et la façon dont nous fonctionnons. Au cours des dernières années, nous avons vu son émergence dans l’aquaculture, mais à un rythme beaucoup plus lent que d’autres industries telles que les soins de santé et l’agriculture. Cet article présente des exemples actuels de l’IA appliquée dans l’aquaculture et ce à quoi on peut s’attendre à l’avenir. Comment l’IA peut-elle aider à mener la révolution vers une production aquatique durable, et qu’est-ce qui nous retient ?

PROTÉINE ISSUE DES INSECTES : L’AVENIR DE L’ALIMENTATION
Par Martin Zorrilla et Nada Dhaoui
Les protéines issues des insectes occupent une place de choix dans la recherche de protéines alternatives pour l’alimentation animale. La nouvelle industrie des protéines d’insectes a augmenté sa production ces dernières années, avec un nombre croissant de nouvelles sociétés apparaissant en Asie du Sud-Est. La production d’insectes offre à la région une opportunité de réduire la dépendance aux importations tout en soutenant les producteurs aquacoles locaux avec un produit à prix stable. De même, un nombre croissant de preuves issues d’essais commerciaux et universitaires montrent que la protéine issue d’insecte est un substitut viable de la farine de poisson dans les régimes alimentaire du poisson carnivore, et dans de nombreux cas, ce type de protéine améliore son système immunitaire et sa santé intestinale.

RÉSOUDRE UN PROBLÈME MONDIAL DE CHAÎNE DU FROID DANS UN VILLAGE DE PÊCHEURS PHILIPPINS ISOLÉ
Par Tamara Mekler
L’entreposage au froid est un énorme problème dans toutes les chaînes d’approvisionnement de fruits de mer dans les pays en développement. Les glaciers haut de gamme sont hors de portée pour des millions de petits pêcheurs et les options les plus abordables sont rares. Fortuna Cools, une entreprise sociale fondée par des étudiants diplômés de l’Université de Stanford, répond aux besoins des communautés de pêcheurs mal desservies en utilisant une conception centrée sur l’utilisateur. Le résultat est une glacière abordable qui est fabriquée à partir des déchets issus de l’agriculture locale : la fibre de noix de coco.
鱼类欺诈 – 对全球海鲜供应链可持续性的威胁

Alan Reilly

鱼和鱼产品是全球市场上最易遭受欺诈的食品类别之一。解决该问题是一项复杂的任务，要求食品行业开发和实施有效且科学的食品可追溯性系统，以及用于食品真实性测试的改进方法，其中包括用于记录食品欺诈漏洞评估（FFVA）的系统。国际食品法典委员会在制定科学的准则方面起着重要作用，这些准则为海鲜行业在如何进行FFVA以及如何实施缓解措施打击海鲜链欺诈方面制定了标准。

新冠肺炎使印度渔业陷入困境

Nikita Gopal, Leela Edwin和Ravishankar C.N

新冠肺炎下采取的封城和社交距离规定影响到了渔业和水产养殖部门的各个领域，包括从捕捞到上岸、加工、销售和池塘放养。通常认为的弱势群体，如农民工和妇女，受到的影响尤其严重。作者介绍了该流行病的广泛影响，并就如何在这些变化下促进渔业发展提出了几条建议。

人工智能将如何改变我们的养殖模式

Chelsea Andrews

人工智能（AI）正以前所未有的方式改变着我们所处的世界以及我们工作的方式。近年来，我们看到了人工智能在水产养殖中的应用，但是其发展速度比医疗保健和农业等其他行业要慢得多。本文讨论了水产养殖中应用人工智能的案例以及未来的展望。人工智能如何帮助引领可持续水产养殖的革命，这其中会遇到什么困难?

解决一个偏远的菲律宾渔村中的全球冷链问题

Tamara Mekler

冷藏是发展中国家海鲜供应链中的一个大问题。高端冷却器对于数百万的小型渔民来说是遥不可及的，而且负担得起的选项极少。斯坦福大学研究生创办的社会企业Fortuna Cools通过人性化的设计，即在解决问题过程中以用户为中心的思想和方法，满足了服务水平低下的捕渔区的需求。这一当地人买得起的冷却器就是利用当地农业废品椰子壳纤维作为隔热材料制成的。

昆虫蛋白：饲料的未来

Martin Zorrilla 和 Nada Dhaoui

在寻找动物饲料中的替代蛋白方面，昆虫蛋白已成为关注的焦点。近年来，新型昆虫蛋白产业已实现规模生产，东南亚出现了越来越多的新公司。昆虫蛋白生产让该地区能更少地依赖进口，同时为当地水产养殖提供价格稳定的产品。同时，越来越多来自商业和学术试验的证据表明，昆虫蛋白是肉食鱼饲料中可行的鱼粉替代品，并且在许多情况下可改善免疫反应和肠道健康。
خلاصة لأهم المقالات

الغذ في الأمساك - تهديد لاستدامة سلسلة تزويد المنتجات البحرية على الصعيد العالمي

Alan Richmond

تعتبر الأسماك والمنتجات السمكية من أكثر الثروات البحرية أهمية، الذين يتم تغذية الفقراء في جميع أنحاء العالم. وتعد الأسماك مصدر غذاء مهم للعديد من الشعوب في جميع أنحاء العالم. ومع ذلك، فإنها تxicoتية، ولها استدامة خاصة بسبب تقلبات البيئية والممارسات الاستدامة غير المسؤولية. وقد أظهرت التجارب الأخيرة أن الفوائد الصحية المحتملة للرجيمات البحرية يمكن أن تكون محدودة، وتتطلب تغييرات ملموسة في سلوك استزراع الأسماك لزيادة الإنتاجية والفعالية.


ملاحظات: في إطار سوفت مارك، يتم تزويد الأسماك والمنتجات السمكية على أسواق الأسماك البحرية، ويعتبر الاستدامة وسلامة البيئة الأولويات في الاستزراع المتقدم. فضلاً عن ذلك، فإن الأسماك البحرية تعتبر مصدر غذاء مهم للعديد من الشعوب في جميع أنحاء العالم.

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FISH FRAUD – A THREAT TO THE SUSTAINABILITY OF THE GLOBAL SEAFOOD SUPPLY CHAIN

By Alan Reilly

Fish and fishery products are one of the most frequent categories of foods that are subject to fraud on the global market. Tackling the issue is a complex task, requiring the food industry to develop and implement effective, science-based food traceability systems and improved methods for food authenticity testing that include documented systems for Food Fraud Vulnerability Assessment (FFVA). There is an important role for the Codex Alimentarius to develop science-based guidelines that set out standards for the seafood industry on how to conduct a FFVA and how to implement mitigation measures to combat fraud in the seafood chain.

New legislation and requirements in both the EU and the US, as well as other countries, should help improve seafood traceability.

Introduction

The fish and fishery product sectors, like any of the major food industries, are potentially vulnerable to a wide range of criminal activity. An example of such criminal activity, food fraud, is committed when food is deliberately placed on the market, for financial gain, with the intention of deceiving the customer. Many incidences of fraud in the seafood chain often go undetected or unreported; consumers may be unaware they are victims of fraud and those in the seafood industry are sometimes reluctant to report criminal activity that may damage brands or harm reputations. Nonetheless, incidences of fish fraud undermine consumer confidence and legitimate businesses, erode trust and can result in serious economic losses. More importantly, fish fraud can put consumers’ health at risk.

Different forms of fish fraud occur in both domestic and international fish marketing chains. Fraud can occur at any point in the fish marketing chain but is most frequently reported in the retail and catering sectors. The primary motive behind fish fraud is the deception of customers for economic gain.

Common types of fish fraud include species substitution, where high-value species are replaced by less expensive varieties; mislabelling of fish to conceal the geographical origin of illegally harvested species; and the undeclared use of food additives to increase the weight or enhance the colour of fishery products (Table 1). It can be difficult to identify fish species once heads, skin and fins are removed. The definitive identification of fish to species level using traditional morphological methods is difficult, if not impossible, when fish are processed into fillets, ready-to-eat breaded or battered products, or highly processed in pre-prepared fish meals.

A practice that undermines the sustainability of the seafood supply chain is illegal, unreported and unregulated fishing (IUU) where IUU captured fish are illegally marketed and laundered through the legitimate fish marketing chain. This leads to deceptive marketing practices with respect to the geographical origin of catches through mislabelling, falsification of documentation, and endangering consumers’ health. On a wider scale, sustainable fishing practices are undermined, fish stocks are threatened, and both food and economic security in developing countries are put at risk.
Table 1: Types of fish fraud

<table>
<thead>
<tr>
<th>Fraud Activity Type</th>
<th>What’s involved?</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mislabelling</td>
<td>Low valued species labelled as higher valued fish; illegally caught fish labelled as legitimately captured species; fish species mislabelled for tax avoidance purposes</td>
<td>Smoked farmed salmon labelled as wild Atlantic smoked salmon; conventionally farmed salmon labelled as organically produced; laundering of IUU captured fish through the legitimate fish marketing chain</td>
</tr>
<tr>
<td>Enhancement</td>
<td>The use of unapproved additives or the undeclared use of approved additives for improving the appearance of fish or fishery products</td>
<td>The colour of fresh tuna intensified through the use of carbon monoxide or illegal use of nitrates/nitrites; use of industrial dyes or toxic chemicals to enhance the colour of spices used in fishery products; undeclared use of food additives such as water-binding agents to deceptively increase the weight of products</td>
</tr>
<tr>
<td>Dilution</td>
<td>Partial replacement or addition of an ingredient to a fish product to increase the overall weight or bulk volume</td>
<td>Over-glazing or over-breading of fish or fishery products; dilution of fish sauce; false Net Weight declaration; injection of gels into prawns to increase weight</td>
</tr>
<tr>
<td>Substitution</td>
<td>Similar to mislabelling where high valued species are replaced by low value species</td>
<td>Fish species fraud – e.g. selling pangasius as high value white fish species such as cod or haddock; substituting wild captured salmon with farmed species; falsely declaring the geographical origin, species, or method of production; marketing illegally harvested shellfish which causes foodborne illness</td>
</tr>
<tr>
<td>Counterfeiting</td>
<td>Violation of food legislation, such as counterfeiting, is a crime in itself, and is not primarily food fraud, although there is a food fraud component</td>
<td>Fraudulent marketing of fish or fishery products by an unauthorised individual as a brand name product</td>
</tr>
<tr>
<td>Theft and resale</td>
<td>Theft of fish or fishery products and resale into trade through “grey market” channels</td>
<td>Stolen fishery products marketed through unapproved channels</td>
</tr>
</tbody>
</table>

Scale of fish fraud

The complex nature of the globalised seafood supply chain and the economic pressure to provide cheaper fish and fishery products have contributed to the growing prevalence of fish fraud. There are different estimates of the scale of fish fraud as many countries do not have the capacity to monitor fraudulent activities in the marketing chain and do not have developed official food control programmes to regulate fish business operators.

An international investigation into food fraud carried out across 57 countries and coordinated by Interpol/Europol (Europol, 2016) demonstrated the vulnerability of the fish marketing chain. Fishery products were identified as the third-highest risk category of foods with the potential for fraud. While the precise scale of fish fraud is unknown, the cost of fraud to the overall global food industry is estimated to be in the region of €30 billion. The economics of fish fraud is characterised by high benefits, low penalties, and low probability of detection, which result into high profits for fraudsters. Fraudulent benefit is the price difference between low value and high value fish species or between farmed and wild captured products. Penalties and sanctions in many countries are rare or relatively low in financial terms and official food control programmes in many countries do not involve authenticity monitoring or testing.

More than €100 million worth of potentially dangerous food and drinks was seized in an international monitoring programme involving 78 countries and coordinated by Europol’s Intellectual Property Crime Coordinated Coalition and Interpol. Following this exercise, the head of Europol’s European Serious and Organised Crime Centre said that “criminals will take advantage of any and every opportunity open to them to make a profit and the volume of the seizures confirms that food fraud affects all types of products, and all regions of the world”.

Numerous reports from different parts of the world show that fish fraud is not a new problem and that the number of reported incidences of species substitution and mislabelling have increased worldwide. A major global study in the United States found that fish mislabelling occurred at every stage of the fish marketing chain, from the point of landing through to processing, distribution, retail and catering. The study reviewed more than 200 published studies on fish fraud from 55 countries and found that, on average, 20% of all fish samples tested were mislabelled. A follow up study in 2018 reported that one in every 5 of the 449 fish tested were mislabelled and one-third of the establishments visited sold mislabelled seafood.

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The European Commission\(^6\) conducted a coordinated control programme across all member states to assess the extent of mislabelling in the white fish market. Almost 4,000 samples were tested in 29 countries, and a 94% compliance rate with labelling regulations was found. A recent study using DNA barcoding of fish authenticity in the catering sector in 23 European countries found that 26% of fish were mislabelled and that 31% of outlets sold mislabelled seafoods\(^7\). Similar studies of fish fraud have been reported in most major seafood markets\(^8\).

**Box 1: Food safety consequences of mislabelling fish**

**Incidences of puffer fish fatalities in Bangladesh**

Some species of puffer fish (*Lagocephalus sceleratus*) contain tetrodotoxins, which are powerful neurotoxins that can cause fatalities. Death is caused by muscular paralysis, respiratory depression and circulatory failure. In recent years, there have been reports of fatalities associated with the consumption of puffer fish in Bangladesh resulting from unscrupulous marketing of toxic fish in communities that would have no knowledge about the risks to health from puffer fish. In 2008, inland populations in Bangladesh unknowingly purchased cheap puffer fish at local markets, which gave rise to three outbreaks with 141 cases and 17 deaths. A similar outbreak occurred in Khulna, involving 37 cases with 8 fatalities in 2002\(^9\). In 2016, five people in an inland community in Sylhet died from eating puffer fish\(^10\).


Detecting fish fraud using DNA forensic analysis

Subjecting fish and fishery products to DNA analysis is a definitive method for identification of fish down to species level. DNA barcoding works by using species-specific, short genetic sequences of mitochondrial DNA to distinguish between fish species. This is a very useful technique for testing the authenticity of fish and can be used on both raw and cooked products. Once a fish has been subjected to processing with the removal of morphological features such as the skin, head and tail, it becomes extremely difficult to differentiate between species by visual inspection alone. DNA barcoding is a well-established method for authenticity testing of fish species; however, the method is not routinely available in all official food control laboratories, particularly those in developing countries. Reliable DNA genetic markers can also be used to trace the exact location of fish capture and now provide authorities with the tools to identify illegally caught fish.


\[^10\] https://www.mdpi.com/1660-3397/6/3/456

\[^11\] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6597049/
Fish fraud mitigation

Combatting fish fraud is a complex challenge for both food control authorities and the fisheries industry. In most countries, no single government agency is responsible for regulating fish fraud, and no single food law directly addresses all aspects of this criminal behaviour. Responsibilities are usually shared across official food regulatory authorities, border protection agencies, customs import authorities and specialist agencies within the national police force. A successful fraud mitigation programme will involve close collaboration between different national and international regulatory agencies. To ensure sustainability and to meet the current demands of the global fish marketing chain to combat fish fraud, an effective science-based fish traceability system must be able to identify fish species, the geographical origin, and to distinguish between wild-captured and farmed products. The detection methods must also be able to identify fresh and frozen fish, and the many different forms of processed fish that are currently traded.

Following on from the European horsemeat scandal of 2013, food regulations in many countries have been strengthened to include provisions for food fraud prevention and mitigation.

Box 2: Drivers of fish fraud

The primary driver of fish fraud is economic gain for the perpetrators. Some of the most common examples of fish fraud are substitution of lower-value species for more expensive varieties, mislabelling illegally caught fish, and laundering through the legitimate fish marketing chain.

Other factors that contribute to fish fraud are:
- the globalisation of the fish chain and the consequently longer supply lines that provide greater opportunities for fraudulent activities;
- the low risk of detection of species substitution by food control authorities that lack dedicated official food control programmes targeting food fraud;
- a lack of harmonisation between common fish names applied at national and scientific naming level (some species have the same common names);
- weak import controls where modern accredited methods of fish species identification using DNA barcoding are not routinely used;
- poor coordination at national level between food control authorities and other agencies of state that have responsibilities for criminal investigation and tax evasion;
- traceability programmes relying on paper certificates and documents that can be easily falsified;
- the absence of an internationally agreed regulatory definition of “food fraud”;
- lack of awareness by fish business operators – need to introduce fish and fishery product authenticity testing based on DNA barcoding as a matter of routine for all industry transactions;
- fish catch certificates not being required as a matter of routine for all business transactions;
- the absence of food fraud threat and vulnerability assessments by food business operators;
- the continued downward pressure on prices in the fish marketing chain; and,
- poor food laboratory capacity to support official food control programmes, and absence of analytical methodology to detect food fraud, species substitution and adulteration.
Professor Alan Reilly worked at the Food Safety Authority of Ireland (FSAI) for sixteen years where he was responsible for setting up and managing this national food regulatory authority. He was Chief Executive of the Authority from 2009 to 2015. Under his leadership, the FSAI became one of the most successful and effective food safety agencies responsible for enforcing regulations and coordinating the national food control programme. While working at the FSAI he led the team which uncovered the European horsemeat scandal where processed beef was fraudulently replaced with horsemeat. A graduate of University College, Dublin and Brunel University, London, he is an Adjunct Professor at the Institute of Food and Health, University College Dublin; and also an Adjunct Professor at the School of Food Science and Environmental Health, Technological University Dublin. He is a former member of the Advisory Forum of the European Food Safety Authority and a former Board Member of the Irish National Accreditation Board. He is the chairman of the Scientific Advisory Board of the European Food Information Council. He is also a Fellow of the International Academy of Food Science and Technology and a Fellow of the Institute of Food Science and Technology of Ireland.

For instance, the European Union food control regulations have been revised to require food control authorities to “identify possible intentional violations of the rules perpetrated through fraudulent or deceptive practices” and to include “financial penalties applicable to violations of the rules perpetrated through fraudulent or deceptive practices to be sufficiently deterrent and set at a level which seeks to exceed the undue advantage for the perpetrator resulting from those practices”.

Private industry food standards have also been revised in recent years. Many standards, such as the Food Safety System Certification (FSSC) 22000 and the British Retail Consortium (BRC) global standard for food safety, now require food businesses to carry out food fraud vulnerability assessments and to have food fraud mitigation plans in place.

### Food fraud vulnerability assessment

The fisheries industry needs to develop evidence-based food fraud mitigation measures based on risk assessment and vulnerability analysis. Such measures will minimise the risk in purchasing fraudulent or adulterated food raw materials or ingredients; will ensure that all product descriptions and claims are authentic and verified; and that all outsourced production processes are controlled.

Food fraud mitigation measures should be implemented in parallel with risk-based food safety management systems based on the principles of the Hazards Analysis and Critical Control Point (HACCP) System. The steps involved in developing a food fraud mitigation plan (Box 3) are very similar to those required in developing risk-based HACCP plans. Key activities include the evaluation of the history of previous food fraud occurrences, where the product has been sourced from, the complexity of the supply chain, and the adequacy of traceability within the chain. Individual industries need to conduct vulnerability assessments to identify potential sources of food fraud within their supply chains, and to prioritise control measures to minimise the chances of receiving fraudulent or adulterated ingredients or products.

As there are no international guidelines available, there is an important role for the Codex Alimentarius to develop science-based guidelines that set out standards for the seafood industry on how to conduct a Food Fraud Vulnerability Assessment (FFVA) and how to implement mitigation measures to combat fraud in the seafood chain.

**Box 3: Steps to be taken by the seafood sector in developing a food fraud mitigation plan**

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Obtain senior management commitment</td>
</tr>
<tr>
<td>Step 2</td>
<td>Establish a product fraud assessment team</td>
</tr>
<tr>
<td>Step 3</td>
<td>Identify potential product fraud risk</td>
</tr>
<tr>
<td>Step 4</td>
<td>Undertake a product fraud vulnerability assessment</td>
</tr>
<tr>
<td>Step 5</td>
<td>Conduct a supplier fraud vulnerability assessment</td>
</tr>
<tr>
<td>Step 6</td>
<td>Develop a product fraud mitigation plan</td>
</tr>
<tr>
<td>Step 7</td>
<td>Implement and monitor the product fraud mitigation plan control measures</td>
</tr>
<tr>
<td>Step 8</td>
<td>Review and update the product fraud mitigation plan</td>
</tr>
</tbody>
</table>

### Summary

Food fraud presents major challenges for both food control authorities and the food industry from the viewpoints of protecting brands and reputations, and minimising risks for consumer health. In tackling food (fish) fraud, those in the seafood industry need to expand their food safety management programmes to include documented systems for Food Fraud Vulnerability Assessment (FFVA). This involves implementing measures to identify potential sources of fraud within their supply chains, and prioritising control measures to minimise the risk of receiving fraudulent or adulterated raw materials or ingredients.  

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12 Regulation 625/2017/EC
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Market Trends

Disruptions in foreign markets and seafood supply chains with suppressed demand continue to hurt the seafood sector amidst the COVID-19 pandemic. China is trying to dig itself out of a steep economic slump while the rest of the world still battles with the pandemic - the path to recovery is looking slow and painful.

SHRIMP

Supply

Control measures in main producing countries particularly in India, Vietnam and Thailand due to the COVID-19 pandemic are beginning to ease. Pond stockings have begun and processing plants are slowly starting to continue their full capacity production. During a recent INFOFISH shrimp podcast (please see page 52-53), Dr. Manoj Sharma, Director of Mayank Aquaculture in Gujarat, India cited that farmers in Andhra Pradesh have started stocking in May and some 70-80% of them are expected to go for seeding in June. The available raw materials kept in cold storages during the lockdowns due to the pandemic will solely be used by processing plants.

Japan: Although the Japanese government has ended its COVID-19 state of emergency, a number of business are not taking any chances with the number of new cases fluctuating recently. Restrictions continue to be imposed on dine-in sushi shops and restaurant chains (fast-food, hotels etc.) causing a slowdown in sales of shrimp. On the other hand, sales in the retail sector (supermarkets and online) continue to rise, particularly for basic shrimp products for home cooking and ready-to-eat lunch boxes.

Shrimp imports in Japan during January – April 2020 increased marginally at 62 640 tonnes (0.90%) compared to the same period in 2019. Supplies from the top producers such as Vietnam, Indonesia and India have increased slightly while supplies from Thailand and Argentina declined. Frozen shrimp products which comprised 68% of Japan’s total shrimp imports increased to 42 776 tonnes (2.35%) during the review period. India and Vietnam continued to show positive growth for supplies of frozen shrimp while products from Indonesia and Thailand declined.

USA: Shrimp sales continue to be positive in the retail sector, particularly in supermarkets, while food service demand is down due to COVID-19 control measures. Sales are expected to remain steady and firm particularly for processed products (easy to prepare and ready-to-eat) in the next few months. The supply of farmed shrimp to the US is expected to be less in June and July due to delayed cropping in Asia (which only started in May/June).

Total shrimp imports into the US increased to 220 314 tonnes (13%) during January – April 2020 as compared to the same review period in 2019. Supplies from top exporters India, Indonesia and Ecuador were up. The increased supplies from Indonesia for breaded shrimp, India for peeled and Ecuador for shell-on product forms, are the reasons for the growth in imports.

Europe and other markets: Overall shrimp demand in Europe is generally weak, though lockdown measures are being lifted cautiously. Restaurants and cafes are limiting patrons for the purpose of adhering to the social distancing rules. Demand for shrimp has shifted to retail (supermarkets). While there is an increased demand for frozen small-sized shrimp for home cooking, sales of larger sized shrimp have plunged and these are sold at lower prices.

Ecuadorian shrimp exports to Spain during the first quarter of 2020 increased significantly by 76% at 11 985 tonnes compared to the same period in 2019. Some Ecuadorian shrimp companies are now targeting new markets in the EU as they no longer depend solely on China.

Meanwhile, China is slowly recovering from its economy slump after the severe lockdowns but media reports have indicated that a very high risk of a second wave looms large. The overall shrimp imports in China increased by 30.23% (239 167 tonnes) in the first four months of this year, from 183 649 tonnes in the same period last year. Imports of warm-water shrimp went up to 209 172 tonnes (30.12%) valued at US$3030 million, with significant supplies from Ecuador, Vietnam and Malaysia. Similarly, frozen cold-water shrimp increased from Canada, Greenland and Taiwan (20 107 tonnes from 13 137 tonnes in the 2019 review period).

TUNA

Fishing in the Western and Central Pacific (WCP) is reported to be mixed i.e. some vessels are experiencing good catches and others, poor. Thai canneries are reporting moderate raw material inventories as finished goods orders for foodservice sizes remain low. Several ports have relaxed their rules and are allowing transshipment to take place. Skipjack prices remain low since May.

Catches in the Indian Ocean have been reduced due to bad weather recently. Local canneries are reporting moderate raw material inventories. Skipjack and yellowfin prices have fallen further, and the outlook for the yellowfin market in particular is reported to be very bleak.

Fishing in the Eastern Pacific is reported to have slowed down to a moderate rate. Furthermore, many fishing vessels are being delayed in port due to quarantine orders or lack of crew as a result of COVID-19 restrictions. Raw material inventories remain healthy for now and many canneries in Ecuador are operating at 100% capacity. Skipjack prices have recovered slightly due to the likely decrease in landings. However, yellowfin prices have moved down again due to lower demand.
Catches in the Atlantic Ocean continue to be affected by strong currents and remain at a moderate-to-low level. As some local canneries are closed due to COVID-19, raw material inventories have increased to moderate levels. (Source: FAO – Globefish).

**Thailand:** Foodnews reports that the price of skipjack tuna raw material in Bangkok fell to US$1 200/tonne at the end of May. During this period, small and medium size companies were negotiating at US$1 250/tonne. According to local industries, the drop in price is due to good catches experienced at a time when demand for frozen fish has been flat since early April; thus canneries have taken advantage of the situation. In addition, the drop in price was related to the Ramadan period which ended in the last week of May, during which time canned tuna demand and sales to Muslim countries traditionally slow down.

**Europe:** Canned tuna sales continue to grow in EU countries as they start to emerge from lockdowns. In Q1 this year, Ecuador, China and Papua New Guinea (PNG) dominated canned tuna trade to the EU.

Prepared tuna exports from Ecuador to the EU recorded 42 000 tonnes in Q1 (+ 26.90% y-o-y), of which 30% was pre-cooked tuna loins. The average price for the review period is down by 13%. Spain received the bulk of the Ecuadorian tuna imports (38%), followed by the Netherlands (14.7%), Italy (9.8%), Germany and France (7% each). Shipments to the UK shared 8.25% of the total.

Shipments from China to the EU increased by 45% to 33 000 tonnes in Q1 as compared to the same period last year. Much of the imports comprised “fillet known as loins of skipjack, prepared or preserved”. The price (fob) was down 17% year on year. Most of the shipments were recorded in January, as trade in February and March was completely disrupted by the pandemic.

Imports from PNG reached a record high of 14 000 tonnes (+58%) during January – March. The average price for the period was down 9.3% year-on-year. The bulk of exports were prepared or canned tuna. The top EU27 destination for PNG tuna products are: Germany (7 000 tonnes), followed by the Netherlands and Spain (about 2 000 tonnes each), and France (1 000 tonnes). The UK, which left the EU on 1 February, received 1 000 tonnes.

**Japan:** Online sales are gradually becoming more popular for high end seafood including tuna, which are offered at huge discounts. While restaurants are trying to pull through, mass-market outlets like supermarkets and auction markets are relatively lively. The fresh and frozen tuna market trade continues to weaken as daily landings are mostly from local waters and almost none from imports. Flight disruptions to Japan have affected the supply of whole fresh tuna flown in on dry ice from Malta (Japan’s biggest fresh tuna supplier), Sri Lanka, Fiji, and Indonesia.

**USA:** Imports of frozen tilapia (including fillets) in the first quarter of 2020 increased by 25.6% (36 070 tonnes) in volume and 6.83% (US$104.9 million) in value as compared to the same period of 2019. With many restaurants closing down in the US due to the pandemic, retail sales are experiencing strong demand for inexpensive forms of protein such as tilapia. The US imported 29 464 tonnes worth US$76.1 million of frozen tilapia from China, an increase of 29% and 7% in volume and value respectively. China’s supply to the US market remains the most significant flow in the tilapia trade.

**Vietnam:** Pangasius sales in the first quarter of 2020 contracted 29.3% year-on-year to US$334 million, as shipments were significantly disrupted due to the pandemic, causing a downward trend of exports to most of Vietnam’s major pangasius markets. Exports of frozen pangasius fillets to China amounted to 29 209 tonnes in the first three months, an increase of 60.16% as compared to the same period in 2019. However, exports to the US were down by 16.25% (22 392 tonnes) during the review period. Similarly exports to other major markets such as the EU, ASEAN and Latin America dropped due to logistical problems in Q1.

Exports to China picked up around March, immediately after China exited from a long period of lockdown. However, those imports were designated primarily for stockpiling out of fear that future sales would be restricted by an extension of measures taken by Vietnam in the first half of April to restrict the spread of COVID-19. Exports to the US are expected to pick up gradually in the next few months as the foodservice sector there cautiously opens. There has been a great demand in the retail sector, thus companies in Vietnam have been advised to focus on processed products with high added value as well as to adapt the packaging process to suit the retail segment.

**FISHMEAL AND FISH OIL**

**Peru:** The government of Peru, the leading global fishmeal and fish oil producer, has introduced a number of preventative measures that have direct implications for the anchovy industry. These include restrictions on boats entering ports, social distancing policies for crew members and a directive to prohibit boarding for people over the age of 60. These measures will lead to a decline in fishmeal and fish oil production in 2020.

On the demand side, with restaurant closures and a sharp contraction in trade, there is lower demand for farmed fish, and thus the need for feed. However, with the pandemic now under better control in China, it is expected that Chinese demand for fishmeal will strengthen once the country’s pig farming and aquaculture sectors begin to show signs of rebound. In the short term, prices are expected to continue their upward momentum as a result of poor raw material supply from Peru (Source: FAO – Globefish).
PRICE TRENDS • COLD STORAGE HOLDINGS • IMPORT TRENDS

FROZEN WHITEFISH

FISHMEAL/FISHOIL (US$/MT)

JAPAN COLD STORAGE HOLDING: SELECTED PRODUCTS (MT)

JAPAN COLD STORAGE HOLDINGS TUNAS (MT)

JAPAN: MONTHLY IMPORTS OF SHRIMP & TUNA (MT)

USA: MONTHLY SHRIMP IMPORTS
**Commodity & Market Update**

**Bivalves**

**COVID-19 disrupts bivalve production and trade**

Last year was very positive for bivalve consumption worldwide, with good demand and generally higher prices. However, COVID-19 has now changed this picture completely. In early 2020 the Chinese market shut down, and in the subsequent months, European countries and the US followed suit. At present, bivalve trade is almost non-existent, with growers keeping the bivalves in the water, hoping for a better trade environment in the second half of the year. In many affected countries, bivalve growers have requested government assistance to cover their business losses.

**Mussels**

World mussel trade was stable in 2019, remaining at the levels reached in 2018. Some 370 000 MT entered international trade, on par with the corresponding 2018 figure. The main importing countries were France, the Netherlands and Italy. On the export side, Chile dominated the market, with 76 000 MT exported in 2019. Chilean mussel producers had to cope with the civil unrest in the country on top of COVID-19, all of which have caused normal economic activities and logistics to cease. In fact, exports of mussels from Chile were 9 000 MT in the last quarter of 2019, 4 000 MT less than in the same period of 2018 as social conflict affected trade performance.

The European Union is one of the main markets for live mussels, but imports decreased in 2019. Some 216 000 MT were imported by the European Union last year, which is 4 000 MT lower than in 2018.

**Oysters**

Christmas sales of oysters in 2019 were very strong, exceeding expectations. Prices went up greatly, as supplies were difficult, especially in France. However, the year’s average showed a slight decline in the oyster trade: some 70 500 MT entered international trade in 2019, some 7% less than in 2018. France was the main exporting country, reporting some increase in sales, despite the norovirus disease problems experienced by its oyster producers at the end of 2019. Then, in the first four months of 2020, the oyster market felt the impact of COVID-19. Easter, which is normally a main sales period for oyster consumption, reported bleak demand for the product, far lower than in recent years. In addition, most oyster consumption occurs in restaurants, all of which are closed in Europe at the moment.

**Clams**

International trade of clams is concentrated in Asia, with Japan and the Republic of Korea as the main markets and China as the main supplier. In 2019, trade in clams reached 291 000 MT, a 4% increase over 2018. In Europe, international trade is almost absent, as the domestic markets are supplied by national producers. Clams are mainly used in the restaurant trade in southern Europe, but due to COVID-19 restaurant closures, there was practically no demand for this product in early 2020.

**Scallops**

International trade in scallops is rather limited, not exceeding 150 000 MT per year. Total world trade was 170 000 MT in 2019, more or less on par with the 2018 trade. China is both the main importer and exporter, accounting for 40% of scallop imports and 33% of exports.

In 2019, Peru came back as a main scallop exporter, after four rather difficult years. In 2019, some 10 000 MT of scallops were exported from Peru, which is 40% more than in 2018, and three times the low 2017 figures. Scallop production in Peru had been affected by a strong El Niño in 2016 and 2017.

Some US scallop producing companies that concentrate on the mainland Chinese and Hong Kong markets have reported sharp declines in 2020 orders and this trade is unlikely to recover in the near future.
Outlook

Worldwide, producers are allowing longer growth times for their bivalves and are not restocking aquaculture areas. As a result, supply this year will be far lower than compared with normal production years. The complete closing of the restaurant trade all over Europe has led to the disappearance of normal demand for fresh and live bivalves. Prices are low, and aquaculture companies are closing down, waiting for government support in order to survive.

The gross domestic product in southern Europe is forecasted to decline at least in the first half of the year, and demand for bivalves will suffer as a result. The normal tourist season in the summer months will not materialise, leading to very low bivalve consumption (likely at only 10-20% of the normal consumption rate) during these months.

In the longer term, many small-size production and trading companies in Europe, Asia and the US are unlikely to reopen their businesses until 2021, and some may not even survive the dire economic impacts of COVID-19 at all.

Source: FAO Globefish
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COVID-19 THROWS THE INDIAN FISHERIES SECTOR OUT OF GEAR

By Nikita Gopal, Leela Edwin & Ravishankar C.N

The lockdown and social distancing rules due to Covid-19 affected every area of the fisheries and aquaculture sectors from catching, through landing, processing, and marketing, as well as stocking of ponds. Groups which are ordinarily at a disadvantage such as migrant labour and women, were especially impacted. The authors provide an account of the wide-ranging effects of the pandemic, and put forward several suggestions for the industry to move forward under these changed circumstances.

Introduction

As country after country is being affected by the Covid-19 pandemic, the impacts are visible on every aspect of human activity. To contain the spread, most countries have put in place restrictions on human movement and interaction through a series of measures which includes protocols for hand washing and sanitisation, temperature checks at busy areas for early detection of potential infections, social distancing and restrictions in numbers participating in community events, and lockdowns where all but essential services are suspended.

The International Labour Organisation (ILO) estimates that the world over, about 2.7 billion workers representing 81% of the world’s workforce has been impacted (ILO, 2020), with the severity being more in the informal sector. India enforced a nationwide lockdown on 25 March 2020 (Government of India, 2020) although some States in the country had already enforced measures before that. The initial lockdown, which was for 21 days, was subsequently extended to the 3rd of May and later to 31st May.

Just like every other sector, the massive marine fisheries sector has also been affected by the lockdown measures, though fisheries activities were subsequently given some exemptions with directives to follow all protective measures. With a catchable annual fisheries potential of 4.41 million tonnes, India’s marine fisheries is an important economic sector. In 2016, catches totalled 3.5 million tonnes, constituting 4.53% of global harvests in that year and ranking the country fifth in the world (FAO, 2018). Fishing contributes 0.96% towards the fisheries sector’s total Gross Value Added (GVA) and 5.37% GVA from the agriculture sector (Handbook on Fisheries Statistics, 2019). In all, about 14 million people depend on fisheries and aquaculture in the country (FAO; NFDB), and fish is eaten by almost 35% of the Indian population.
The fisheries supply chain can broadly be described to include production, processing and marketing activities. Production, where the fishermen go out to sea and harvest the fish; processing, which can be small scale processing like drying for the domestic market or commercial fish processing mainly targeting export markets; and marketing, a wide network of marketing channels through which fish travels throughout the country to reach the consumers. There are several ancillary activities like net making and mending, land-based work in fish landing centres and harbours, ice making factories that supply ice to stakeholders throughout the supply chain, marketing functions, transportation to and from the fish landing centres and harbours, to name the major ones.

In all these activities, the Indian marine fisheries sector supports about four million people in the nine coastal states, besides the Lakshadweep and Andaman & Nicobar islands (Sathianandan, eprints CMFRI), living in 3 432 marine fishing villages and with more than 90% of the fishermen being from traditional fishing communities.

The sector has been known for its varied levels of dynamism with respect to production, prices and numbers of people involved in the supply chain. About eight million fishermen are directly engaged in fishing, which is a main source of income for them. The fisherwomen support family incomes by selling, curing, drying and other processing activities, besides taking care of the food and nutritional needs of the family. The commercial processing sector, which is primarily export-oriented, brings in about INR 470 billion annually and contributes about 2.2% of export earnings (Department of Commerce and Industry, Ministry of Commerce & Industry, Government of India, 2020).

Consequent to the lockdown on 25 March 2020, most of these activities have been impacted. Though the long term impact of the pandemic will be known in the months to come, the immediate impacts have already been significant. This has been mainly due to disruptions in the supply chain, including major uncertainties in production and marketing.

Considering the activity profiles in the sector and the ways in which these activities are usually conducted, the concept of social distancing is practically impossible. Any peak hour activity would mean hundreds of persons teeming at landing centres/ harbours or markets, engaged in unloading the fish from the boats, weighing and sorting the catches, auctioning, breaking ice for supply to the boats as well as traders, and wholesalers and retailers waiting to take the fish to the markets. The time within which each activity is conducted is usually short and all activity is completed in a couple of hours. This is the reason for a sense of urgency and the resulting crowded conditions. This was also one reason that it was imperative to put restrictions in place when the infections began to spread. A complete closure was the first step that could be conceived; however this had several different impacts.

Impact on fishing operations

The Indian fishing sector is very diverse and ranges from very small traditional, subsistence fishing to large scale mechanised commercial fishing. These are generally classified into three sectors, viz. the mechanised sector where propulsion to the fishing ground and the fishing operations are by mechanical means; the motorised sector where the fishers reach the ground using vessels propelled by small engines but fishing is done manually, and the non-motorised sector where no mechanical power is used at all (Edwin, 2018).

During and immediately after the lockdown, fishers already at sea could not land their catches as harbours and landing centres remained closed. This resulted in thousands of fishermen being stranded in various places along the coast (Times of India, 2020). They were forced to stay onboard with very minimal facilities and basic living supplies running out. The harvested fish also could not be stored properly and there were cases in Maharashtra (Hindustan Times, 2020) and Kerala of the fish being thrown back into the sea to at least safeguard the higher priced varieties with the available ice onboard. One shrimp trawler in Kollam, Kerala, reported a loss of about INR 0.3 million worth of catch (Peter Mathias, personal communication, 30 March 2020).

Others couldn’t set forth for fishing trips. Even when relaxations were announced and the Union government had introduced revised guidelines (for both marine and inland), not all fishermen could start fishing again. However, after States announced implementation guidelines depending on the ground situation (Government Order no. 40-3/2020-DM-I(A)), fishing could be resumed. In Kerala for instance, only smaller boats (with a crew of up to five) could operate (The Hindu, 2020). In Tamil Nadu and Karnataka, only three fishers are allowed to go on board their non-motorised/motorised (<10 hp) fishing vessels (Times of India, 2020). In Tamil Nadu, particular days have been allotted to the fishing vessels for conducting fishing operations as per the schedule prepared by the Department of Fisheries. This excluded several fishers from going onboard, because they were crew on mechanised fishing vessels like trawlers or on traditional fishing vessels like ring seiners where a number of fishermen are normally to be found in a single vessel. This resulted in almost 90% of the fishers being rendered jobless as per a rough estimate.
Gujarat, Tamil Nadu, Goa, Maharashtra etc. opened up fishing activities and started issuing tokens for conducting fishing operations in a phased manner. In the meanwhile, the 60-day trawl ban also came into effect from 15th April (The Hindu, 2020; Govt. of Goa order no. DF/OFFS/SOC.ASSOC/COVID-19/2020-21/GOVT. FILE/18; MumbaiMirror, 2020).

Most fisher families fall below the poverty line in most States and are not known for their saving habits (Rao et al., 2016). Being in a highly unpredictable profession, they are never certain of their incomes but must continue to fish to stay afloat. The lockdown thus has had severe impacts on family incomes. Based on a quick survey among 50 fishermen in Kerala, Tamil Nadu and Goa working on different types of fishing vessels like trawlers, ring seiners, purse seiners, longliner-cum-gill netters and traditional gill netters, we tried to estimate the extent of loss of fishing days/trips and incomes for the fishermen in the country.

As is the only possibility during this time, information was collected through mobile phone communication, which has become the handiest equipment and means of communication to stay connected as well as gather and disseminate information during these changed circumstances. The fishers were asked about the number of fishing days/trips lost and the reduction in income. On average, traditional ring seiners lost about 16 days and gill netters 18 days of fishing during the lockdown period. Mechanised boats like trawlers lost about four fishing trips during the months of March to April, gill netters-cum-longliners and purse seiners who undertake longer fishing trips lasting up to 20 days at a time, have lost 1-2 trips.

There are about 210 thousand motorised and non-motorised, and about 66 thousand mechanised vessels in the country. Conservative estimates on loss of income were on average, INR 17.45 billion during the lockdown period (late March to April third week).The landings had been poor from January onwards and in most places only 27% of the boats were plying, with bigger boats running losses for most trips undertaken as the catches were not commensurate with the operational expenditure (Murugesan S, personal communication, April 16, 2020). In this scenario, when the lockdown was enforced, they could not compensate the workers. Fishing community members get small compensations from State Welfare Boards as direct benefit transfers. However, migrant workers from other States were left in the lurch as there are no provisions for monetary compensation for them but basic needs were taken care of.

As mentioned earlier (at the time of writing), the annual fishing ban has already been initiated in the east coast States. All mechanised boats have stopped all types of fishing activities and only smaller country crafts using below 10 hp engines are permitted to conduct fishing. Another Covid-19 condition is to continue to practice social distancing even while fishing, and thus there is a restriction on the number of fishers onboard, which is a maximum of three to five fishers. Other precautions like wearing masks, frequent washing of hands etc. are also insisted upon.

These guidelines need to be widely disseminated and more awareness as opposed to fear must be created among the fisherfolk. The Central Institute of Fisheries Technology (ICAR-CIFT) has already prepared advisories for the sector in regional languages and these have been widely disseminated (ICAR-CIFT, 2020). Fishing villages are densely populated in every State and it is imperative that they are not exposed to the infection by any means. The efforts of State and Central governments in trying to provide support to the sector are commendable but there are still several areas that need special focus. Though challenging, it is important to ensure that fishermen and women are able to pursue their livelihoods in complete safety and without fear.

Already, fishermen’s associations both on the east (where the seasonal fishing ban has already begun) and the west (where it will start in June) coasts have started requesting the State and Union governments to review the bans. This is because the fishers have already been affected by the lockdown and they stare at another two months of unemployment unlike labour in other sectors who at least have an expectation of being able to get back to work. While measures are being taken to compensate them during this period, these are acknowledged as insufficient and not commensurate with their average earnings. Besides, an extended dependence on financial support may have long-term psychological impacts, and it also does not take into consideration the contribution of women to the family income.

Under these circumstances, a debate is needed on whether some leeway should be given on the timing of the seasonal ban this year. While conservation is extremely important for fisheries sustainability, the fishers must also be able to pursue their livelihoods. In case there is a rethink on the period of the fishing ban, there must also be definite measures in place on how to implement it. If the ban continues, then there must be a rejig of the existing social security measures that support the fisher community during that period. There must be clear cut provisions for providing them other economically beneficial options, rather than to expect them to live on the compensation provided. Inland fishing and aquaculture could be options which can be encouraged through very specific programmes. This would mean that they are gainfully employed till such time as they can resume regular work.

Women have to be specifically supported, with either assured
Employment through MGNREGA (The Mahatma Gandhi National Rural Employment Guarantee Act) schemes or other wage earning programmes.

**Impact on fish handling and marketing**

One unintended effect has been that with auctioning at harbours having almost completely ceased, marketing in many States has been taken up under the aegis of fishermen’s associations or village/harbour council/committees. Transportation is restricted and States like Kerala have set the model for regulating the entry and exit of vehicles into the fishing harbour and the number of labourers for loading/unloading in order to limit the number of workers. At any given time, about 2,000 regular workers, including auctioneers and others engaged in harbour duties, can be found in a medium-sized harbour (Murugesan S, personal communication, April 16, 2020; Charles George, personal communication, April 2, 2020). Besides this, harbours also have a floating population of about 500 persons, mainly big and small traders. This number has now been drastically reduced, and in many places, harbours have been completely closed.

Deserted harbour during lockdown.

Karnataka has not permitted fishing vessels to land their catch at the harbours, but to prevent crowding, they do allow landings in designated fishing villages. In most States, retail markets are not operating. Wholesale markets are still functional but with timing restricted and people constrained, footfalls have reduced drastically. The fish also could not be sold as transport facilities had either completely stopped or were not plying from these centres. Bigger primary markets like Kasimedu in Chennai, Tamil Nadu, and Munambam in Ernakulam, Kerala, are seeing hardly any activity. Retail trade in all landing centres has been restricted or banned. Dry fish traders in Andhra have not been able to market their produce, nor are there enough storage facilities (Times of India, 2020).

Apex fisheries cooperative organisations like the Matsyafed in Kerala and corporations like the Karnataka Fisheries Development Corporation have stepped in and have been playing more active and decisive roles in the sale of this much wanted animal protein. In Goa, cooperatives have stepped in to distribute fish as the markets remain closed. This may be continued after conditions return to normal so that the extent of middlemen involvement in the supply chain, especially at the first point of sale, is reduced.

Even though the administrative machinery in all the coastal States has been taking huge efforts to streamline activities at landing sites, under the existing regulations, problems of lack of cleaning materials like soaps, sanitisers, chlorinated water and masks have been reported by the fishermen and other stakeholders. Those who enter the harbours and landing centres have also to be monitored for body temperature. These measures are difficult to implement, albeit necessary, considering the type of activities that are usually seen at fish landing places.

Another major section of the fisher population, the fisherwomen, has been the hardest hit. About 60% of all fish sellers in the country are women and most of them work in the unorganised sector. While there are associations and cooperatives for fishermen, not many cover or include women and their needs. It is now evident that the impacts of any disaster are different for men and women. In the whole discourse on fisheries under the Covid-19 lockdown, the discussion largely centered on how fishing can be reestablished and how markets can be made functional. The special needs of fisherwomen have not been looked into, or mentioned. They are now home-bound and are not able to carry out their livelihood activities. With only men going fishing and with fish not available for sale and for other uses like drying, women are at the receiving end.

Women are generally small-scale vendors who collect the day’s material from the wholesaler and sell it either in markets or door-to-door. With other psychological issues due to the stress of uncertain livelihoods, their problems require special attention. Suitable relief measures should be put in place to take care of family food and nutritional needs. This will reduce the stress that the women are facing, in addition to the loss in employment and incomes. Increasing domestic violence has also been reported and this needs to be viewed seriously.

**Labour-related challenges in fishing**

The sector’s functions in all States depend heavily on migrant labour (Nikita Gopal et. al, 2007; Swathilekshmi P.S. et. al., 2011; Jeyanthi et. al., 2015; Nikita Gopal, 2018). Whether onboard fishing vessels or in landing centres and markets,
migrant labour from places like West Bengal, Odisha, Assam, Madhya Pradesh and Uttar Pradesh now constitute the major workforce in almost all coastal States. In some States like Kerala, almost 45% of the labour force onboard are migrants. Several of them work at land-based menial jobs in harbours and landing centres like ice breaking, cleaning etc. Usually they come through their relatives and friends, and their major reasons for entering the sector are the lack of other employment opportunities in their places of origin and the hope for better wages.

With almost all activities coming to a standstill, these workers now find themselves unemployed. Leading mostly a bare minimum existence, they usually do not have enough savings to tide themselves over this situation. Also, due to their low education levels and no protection of trade unions, they often face exploitation. They usually do not have any legal contractual arrangements with their employers (Nikita Gopal, 2020; unpublished) and so cannot claim any benefits from them, as instructed by the government in other sectors, such as social security benefits. The migrant labour who go onboard are temporary labour and they do so in the absence of regular crew members or as a stop-gap arrangement. Since the work is purely temporary or even stop-gap, they sometimes do not get other basic facilities that the regular workforce would have received like sufficient rest during or between trips, or safety equipment and medical support. Several States have been giving special emphasis to taking care of the food and other requirements of the migrant workers. However the question remains whether this workforce will be available to the sector once the lockdown is lifted. Even now they are unable to find work and the tendency would be to return to their home States once the restrictions ease.

States have initiated several programmes to ease the impact including direct social assistance like cash (linked to other social security schemes) and food transfers through the Public Distribution System or PDS which provides subsidised essential commodities to the poor, including for the unorganised sector. More needs to be done to address the loss of employment and wages as fishing is a way of life for many and they do not know how to engage in any other form of employment. In the meantime, most fishing units are sourced through loans and waiver/deferment of repayments may be allowed.

Impact on seafood processing

With their in-house workers who usually stay in accommodation provided by factories, these establishments have remained functioning through the lockdown period (all out-of-factory pre-processing has come to a standstill). Still, the number of in-factory workers had to be reduced to adhere to the provisions of social distancing and even though factories have been allowed to operate, restrictions of labour movement cause operating bottlenecks. Factories will probably be able to meet the immediate market demands but the issue will arise when they try to restart full production.
after the lockdown. The full impact on the seafood processing sector will be obvious only in the months to come.

We have been told that the industry has had to hold their shipment orders, with countries in the grip of the pandemic asking for delaying shipments. However consignments already at sea were allowed to land at the importing country ports in spite of original export documents being held up due to lack of courier services (Edwin Joseph, personal communication, April 15, 2020). Hotels and restaurants in almost all countries have almost completely stopped purchases due to the lockdowns and social distancing measures preventing people from eating out. Take-away food is still allowed but this trend is also likely to be hit.

The exports of seafood in this financial year (up to January 2020) have already decreased by 22.32% in terms of quantity. However the value returns have actually gone up by 1.24%. The quantity exported in January 2020 when compared to last year was still rising for major buyers like China, the US, the EU and Japan. However, after January the situation changed when the spread of the pandemic began to take over the world, coupled with the lockdown in India, suspending most commercial activities.

The real problem that the industry is likely to face when the lockdown eases is the question of whether the migrant labour, who are the backbone of the industry, will be ready to work in the changed circumstances. While several measures were taken to see that the labour force was well taken care of during the crisis, the general sentiment of the labour force has been to find a way to return to their home States. As of now, since inter-state transportation is still not possible, this may not be a near-future possibility for most of the workers. The processing sector, however, will have to ensure that the directives of the government on social distancing and individual protection are followed. This may mean that the plants can operate only with cut-down staff numbers as the conditions at floor level involve staff (mostly women) working in close proximity to each other and this may not be possible in the times ahead.

Another issue is that the industrial scale seafood processing industry is today largely dependent on aquaculture for its raw material. The harvest on the east coast has either been pre-poned (brought forward) due to the pandemic in some cases, and in other cases there has been distress harvesting. The State government of Andhra Pradesh has stepped in and fixed a base price to help the shrimp farmers (Times of India, Mar 29, 2020); however, some amount of procurement at lower prices has already taken place, which will be advantageous to the processors. The lack of labour may hamper further harvesting if the lockdown continues. Furthermore, though aquaculture activities have been exempt from the lockdown, there are variations in State regulations as far as Covid-19 control measures are concerned and not all activities may be taking place.

The difficult road ahead

Probably no sector of the economy will be the same again, or it will at least take a while to return to normal again. The changed situations across all sectors will require changes in approaches. This is also an opportunity to make the production and marketing of fish more harmonised so that the benefits are equitably shared. Since there is already a regulation in place for fishing, this can be rationalised to include all types of fishing.

The importance of hygiene in all human activities needs no further emphasis and this can be introduced mandatorily onboard all fishing crafts. At least till the pandemic passes, social distancing rules while fishing cannot be relaxed.

This is also a time to think of strategies to make fishing more sustainable and conservation-oriented. Some indicative steps for reducing effort in fishing and improving quality of fish landed include the scheduling of fishing operations; for example, taking turns in fishing or deployment of fishing vessels in a staggered manner, as decided by the harbour/fishing village management councils. This practice was followed during lockdown in certain States and it should be continued. It will help in bringing about the much needed reduction in fishing effort required for conservation purposes. Monitoring this move at sea may be impossible but it can be achieved through sensitising the fishermen.

Another important aspect that needs constant monitoring is the prevention of IUU (Illegal, Unreported, and Unregulated) fishing. As the numbers of local fishing vessels are regulated and many States are restricting bigger vessels from fishing, there is every possibility that our resources are being targeted by fishing vessels from other countries. This has to be strictly monitored so that our fishers are not deprived of the resources they depend on.

Further, the landing centres and harbours are normally notoriously crowded and these can be regulated and better organised. Following the rules of social distancing, the handling, transportation and packaging of fish landed is being done by a limited number of workers. Unauthorised persons need not be provided entry. Management committees can be entrusted to manage landings and also price regulation to reduce the dependence on middlemen in the system and make marketing more transparent. In fact auctions, which had been done away with during the lockdown, can be
discontinued in all maritime States, to avoid crowding these spaces.

If these measures are followed, better quality can be ensured for the consumers at reasonable prices. All pre-processing in landing centres/harbours must be banned. There must be separate spaces for parking vehicles like trucks which are used to transport the fish and several smaller vehicles of traders and retailers. Markets can also be regulated along these lines to ensure sales efficiency and reduced crowds. Direct marketing can be initiated with the help of cooperatives. This way, the production, processing and marketing of catch can be done by the fishing community themselves.

The world however, will try to keep trade going as it needs to avoid food shortages such as that caused by all trade shutting down. In the long run, this may be beneficial to the industry. There will be more demand for retail packs from supermarket shelves. This will mean repacking of the block frozen material that may have been ready for export. Processors may have to rethink marketing strategies and modify existing inventories to meet the new demands of the importing countries/ buyers.

As Dorothy Ng’ambi Tembo, the International Trade Centre (ITC) Executive Director ad interim says, “it is critical that markets stay open and that supply chains remain intact. Global protection and not global protectionism should be the focus”. We are hopeful that the Indian seafood processing sector can rebound and reach its projected target of USD 10 billion by 2022.

References


Dr Nikita Gopal is Principal Scientist with the Indian Council of Agricultural Research-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, Kerala, India. Her areas of work include trade and markets in the fisheries sector; evaluation of fisheries technologies; and socio-economic studies among fishing communities. For the past several years she has also been actively engaged in gender research in fisheries and aquaculture and has worked on women in seafood processing sector; in small scale aquaculture and fisheries; and in marketing and other post-harvest activities. In association with NACA she worked on an international project on gender in aquaculture in Thailand, Cambodia, Vietnam and Lao PDR. She is an elected Fellow of the Society of Fisheries Technologists of India (FSFT). She is a senior leader of the Gender in Aquaculture and Fisheries (GAF) movement of the Asian Fisheries Society (AFS) and has received several AFS awards including the AFS Gold Medal (2019) and AFS Merit Award in 2013.

Dr Leela Edwin is Head, Fishing Technology Division at the Indian Council of Agricultural Research-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, Kerala, India and has been working in this Division since 1986. Her areas of work have been in improving the ring seine gear for which she was awarded the Jawaharal Nehru award for Post Graduate Research from the ICAR. She has been working on the upgrading of boat building materials for the past several years and has introduced FRP sheathed wooden boats from low cost timber. This work has been awarded by the Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India, with the 4th National Award for Technology Innovation in Petrochemicals & Downstream Plastics Processing Industry (Runner Up) in the field of Polymer Science and Technology. She is currently working on green technologies in fishing with the introduction of green combination fishing vessel and carbon foot printing in the sector using the LCA approach.

Dr Ravisankar C.N. is Director, Indian Council of Agricultural Research-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, Kerala, India, having joined the Institute in 1991. He had earlier headed the Fish Processing Division. His areas of specialisation include fish processing and packaging technologies and he has developed, popularised and transferred many technologies to the seafood industry. He has more than 260 international and national publications to his credit and has filed 17 patents. Among several other recognitions, he was awarded the Outstanding Team Research Award in the field of Fish Products Technology, from the Indian Council of Agricultural Research, New Delhi; K. Chidambaram Memorial Award from Fisheries Technocrats Forum; Gold Medal for his Ph.D. work; and a Merit Certificate from the Royal Institute of Public Health & Hygiene, London. He was instrumental in establishing a Business Incubation Centre with office and pilot plant facility for entrepreneurship development in fish and other food products.
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Dr Mangubhai, unless one is actively connected to Fiji and other countries in the Pacific, not much is known about the fisheries sector, so this interview will be of interest to many readers. Let’s start with climate change, an issue which affects almost every country in the world, and then we’ll move on to the sub-sectors.

As an island nation, Fiji must be particularly worried about the impact of climate change, and reports indicate that last year, climate change legislation was being prepared for Parliament to consider. What are the salient features of this proposed Bill as they pertain to fisheries in Fiji?

Fiji, like its neighbouring Pacific Island countries, is one of the lowest contributors of global carbon emissions and yet will be severely impacted by global warming, rising sea level, and extreme weather patterns. The increased intensity and destructive nature of cyclones in recent years (for example Category 5 Cyclone Winston in 2016 and Category 4 Cyclone Harold in 2020), is a reminder of our increasing vulnerability. For example, the Wildlife Conservation Society (WCS) documented significant damage to coral reefs and impacts to the food security and livelihoods of fisheries-dependent communities (including women) post-Cyclone Winston. In addition, increase in flooding associated with extreme weather events cause higher incidences or outbreaks of water-borne diseases like typhoid, leptospirosis, and dengue, particularly when associated with poor land practices (e.g. vegetation removal, high livestock density).

While Fiji’s proposed Climate Change Bill is wide ranging, it specifically creates new government bodies tasked with meeting emission targets, as well as a mechanism for regularly reviewing existing policies and creating new policies to address climate change. The proposed Bill also promotes the integration of climate change mitigation and adaptation across all sectors, including fisheries. This, coupled with Fiji’s draft Ocean Policy (currently out for public consultation) which proposes the 100 percent management of our ocean, are positive steps in the right direction.

As someone who has worked in Australia, East Africa, Indonesia and the South Pacific, would you agree that the labour and skills of women fishers are often downplayed, notwithstanding their vital contribution to food security, livelihoods, and national trade? How should gender sensitive coastal fisheries management plans be translated into action bearing in mind that the welfare of women fishers is not a priority for most governments?

I could not agree more. Fisheries is not gender neutral, and it is critical to recognise the contribution that both women and men make to the fisheries sector. Women in particular contribute both to subsistence (i.e. household food security) and commercial fisheries to different degrees depending on culture, context, gender norms and relations. In places like Fiji, women glean and fish across a wider diversity of habitats, and collect a wider range of species than men. This makes them also more resilient to disturbances. For example, after Cyclone Winston we found women were more easily able to swap to different fisheries (more so than men) and bring in much needed income for their families. To make sure women are counted as equally as men, it is important that subsistence fisheries be included in national statistics and accounting. We need to remember women operate in diverse ways along fisheries value chains. At the same time, we all need to do our part to create processes that are gender inclusive – this means, women need to be part of fisheries planning, management and development dialogues.

However, none of this is going to happen until we change some of the institutional culture within government regulations.

ministries and fisheries organisations to make them more gender aware, gender sensitive, and gender inclusive. One way to do this could be to ensure that gender inclusion and equality is part of the key performance indicators of those in leadership positions. Another way is to create internal policies that promote gender equality, and mechanisms to monitor the implementation of those policies. And we need to move away from this “culture of silence” and make gender equality the norm.

This issue of gender sensitivity is in fact, addressed in the global FAO document “Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication” (SSF Guidelines). However, specific to the Pacific, it has been reported that the Secretariat of the Pacific Community (SPC) has compiled its own practical guide on improving gender inclusion in coastal fisheries, and that this guide is in support of an instrument called “A New Song for Coastal Fisheries, Pathways to Change: The Noumea Strategy” (the New Song). How does the gender handbook contribute to the New Song?

It is important to understand that most fisheries managers and practitioners are technical people who have received little to no training in gender. The “Handbook for Pacific gender and social inclusion in small-scale fisheries and aquaculture” published by SPC in 2019 focuses on the responsibilities of Pacific Island governments to help promote sustainable development outcomes for all people relying on coastal fisheries and aquaculture for their subsistence and livelihoods. Specifically, the handbook has been designed to give practical guidance for government staff and practitioners working on fisheries and aquaculture on how to improve gender and social inclusion in their work. Without receiving training and capacity building, the fisheries sector will continue to perform poorly in terms of gender and social inclusion.

What about vulnerable groups such as migrants and children? How can we ensure that fisheries management programmes in the Pacific and elsewhere, are guided by a human rights approach?

Similar to my response to the previous question, I think it is unrealistic for us to expect the sector to apply a more human rights-based approach (HRBA) to fisheries unless we can: (i) clearly explain what a HRBA is; (ii) help them understand how and why a HRBA applies to the fisheries sector; and (iii) how a HRBA will help fisheries managers and practitioners achieve better outcomes for fisheries and the people that are dependent on the sector. In doing so, we need to recognise where the sector is doing well, and where it might need to improve or change its approaches. I think sitting and working with managers and practitioners to put a human rights lens on their work in real tangible ways will help. And there are FAO guidelines on how to take a HRBA – the next step is to bring these global guidelines down to ground, and apply them in the unique social and cultural contexts of the Pacific.

Another often contentious subject for the small-scale fisheries sector in many countries, including those in the Pacific, is tenure and access rights. According to FAO data, over half of the Pacific island population rely on coastal fisheries as the main source of food and income; and besides, fishing is regarded as a social, cultural and tradition in the region. It is understandable therefore, that community-based fisheries management (CBFM) is seen as a way to empower local fishers to take control of marine resources that ensure their food security and livelihoods. What does CBFM look like in Fiji?

CBFM in Fiji is largely focused on supporting communities design and implementing management rules with locally managed marine areas. This involves supporting a bottom-up process that integrates traditional ecological knowledge with science, and includes traditional management systems to help communities achieve their objectives, largely revolving around food security, livelihoods and the maintenance of cultural practice. CBFM should be able to adapt to changing circumstances and the needs of local communities, and include ‘generational equity and justice’ – in other words, the current generation should not deplete or extirpate current natural resources, leaving insufficient resources for the next generation.

And finally, one of the goals of WCS-Fiji by 2019 was that it will help resolve five major conservation challenges at local to national levels in Fiji, including: climate change adaptation, interaction of human livelihoods and conservation, and biodiversity loss accelerated by non-native species. Because these are challenges which are common to other coastal areas of the world, what are some best practices and lessons learned that you’d like to share with readers from other countries?

Three of the biggest things we have learnt are: (i) gender and social inclusion must become core to everything we do, and staff and colleagues need guidance, mentoring and support in this space. If we want more long-term sustainable outcomes for nature and people, we need to make sure we are particularly sensitive to how we engage those that are vulnerable or marginalised in society; (ii) it is important to take a broader holistic approach, paying particular attention to the intersection and relationship between environmental and human health; and (iii) we need to improve our environmental, social and economic resilience to climate change, natural disasters and global pandemics.

HOW AI WILL TRANSFORM HOW WE FARM

By Chelsea Andrews

Artificial intelligence (AI) is transforming our world and how we operate in unprecedented ways. In recent years we’ve seen its emergence into aquaculture, but at a much slower pace than other industries such as healthcare and agriculture. This article discusses current examples of AI in aquaculture and what can be expected in the future. How can AI help lead the revolution towards sustainable aquatic production, and what is holding us back?

Introduction

Aquatic farmers have been withstanding the emergence of unexpected diseases since the industry’s inception as a commercialised sector. Despite significant progress towards diagnostics and treatments, these unwelcome surprises continue to make waves throughout the broader value chain. As highlighted in the 2019 Global Aquaculture Alliance conference, diseases, production costs, and international market prices were among the top five of the 17 challenges faced by shrimp producers.

As the industry sets its sights on expansion, technology, specifically artificial intelligence (AI), will play a critical role in shaping its future and alleviating such obstacles. With more and more AI-based tech companies appearing in the industry every year, it’s no longer a question of when this will happen, but how fast and what must be done to expedite the process?

Simply put, AI is the ability of a computer programme or a machine to solve a problem. Familiar examples in our everyday life include Google Maps, which uses AI to find
the fastest routes by avoiding traffic, or You Tube that tailors playlists based on our listening habits. How AI is leveraged in parallel industries such as healthcare and food production, may also provide us with a look into aquaculture’s potential technological roadmap.

Source: GOAL 2019

AI in healthcare and agriculture

A study conducted by Google, in partnership with Northwestern Medicine, demonstrated that machine learning could increase radiologists’ accuracy when detecting lung tumours by reducing false positives by 11%\(^1\). Other studies mention that because of the growing demand for MRI and CT scans, radiologists must review one image every four seconds\(^2\) to meet daily workloads. Using AI to improve the speed and accuracy of the MRI readings reduces strain on the healthcare system by eliminating intrusive follow up procedures and also lowering unnecessary patient anxiety.

These examples demonstrate how AI improves data interpretation to understand present events, but what about the prediction of future events? Would you believe that by assessing mobile phone activity, such as the number of calls or speaking rates, researchers can generate predictions of a user’s risk for mood and anxiety disorders?\(^3\) This is


just the beginning; the proliferation of wearables to collect data combined with AI means that doctors will be able to detect potentially fatal incidents at an earlier and treatable phase. Unfortunately, it’s not possible to equip every shrimp in a pond with a wearable device, but the concept is still inspiring!

In agriculture, farmers are deploying robots, ground-based wireless sensors, and drones to assess growing conditions such as weather, temperature, water usage and soil. By 2050, a typical farm is expected to generate an average of 4.1 million data points every day. This may sound like a nightmare to some, but it’s a data scientist’s dream! This extra information is significantly increasing yields by providing insights that help farms operate more efficiently.

Here are some examples of how AI is empowering agricultural farmers:

- Irrigation systems to water just enough
- Automation and robotics to control weeds by identifying and spraying only on impacted areas
- Robots to pick and pack ripe fruits
- Deep learning algorithms to identify potential product defects and nutrient deficiencies in soil
- Drones to detect diseases and pests

**Advances in aquaculture**

Aquaculture is a few years behind agriculture when it comes to leveraging AI, but this is changing. Leveraging smartphones amongst aqua farmers as a method of data collection is an efficient and cost-effective way to increase the adoption of AI in the industry. As an example, XpertSea’s new mobile app enhances farmer’s visibility over pond growth, using AI to determine individual shrimp weights through only a picture. Digitalising farm growth data makes it easier to detect abnormalities against historical data. It also makes it easier to share standardised information with external consultants when seeking advice on pond performance.

In the future, a farmer could be alerted of an animal’s health status or risk for disease by taking a picture of a shrimp. The key is to leverage existing data in combination with AI to identify problems before the farmer can visibly see them. This could provide access to a broader database of knowledge and prevention methods, possibly reducing dependencies on antibiotics and emergency harvests. As more parameters are added into the assessment—such as water quality, weather forecast, feeding rates, genetic family or hatchery provider—AI will uncover the conditions where certain pathogens thrive, improving the farmer’s ability to take action.

Though not as easy as in agriculture, the transparency of the water environment in offshore fish farms allows for data acquisition through the use of underwater cameras or robots. Norwegian tech company, Cage Eye, for example, produces AI-based feeding systems that leverage hydroacoustic technology to monitor fish movements. Combining this data with machine learning algorithms, they quantify fish behaviour and measure appetite in the cage, making it possible to optimise feeding routines and improve growth. As feed often represents the highest cost to a fish farmer, optimisation leads to better feed conversion ratios and higher profits.

While the turbidity of an inland shrimp farming environment creates great difficulty in implementing the same type of system, AI is still being integrated into feed prescriptions. Again using Xpertsea as an example, leveraging the company’s Growth Platform as a centralised shrimp farm database, feed companies are integrating feeding tables to generate recommended prescriptions for the farmer. As additional farm variables are added, such as weather, AI models could automatically predict future feeding adjustments.

It is not so far-fetched to imagine a scenario where a technician receives an alert on his phone (one that is not manually generated by his manager) to reduce tomorrow’s feeding by 8% due to changes in water parameters because of an upcoming rainstorm. Through this type of preventative action, farmers could reduce waste by only using what is required, leading the way towards more sustainable practices.

As the aqua-feed industry increases in competitiveness, so does the need for suppliers to leverage real-time farm data and AI to optimise how their feed performs. The same can be said for input companies, who are often challenged by farmers on their product’s effectiveness. In a race to the bottom for pricing, the winners of tomorrow will be able to justify higher prices by using AI to achieve optimal product performance through prescriptions tailored to the individual pond. As XpertSea feed and health partners have already started working on such models, the future is not far from reality.

However, producers and input providers are not the only ones who can benefit from applying AI to aquaculture. The whole value chain can and will be impacted. For example, another

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4 Business Insider Intelligence. The Internet of Things 2020. March 2020
Norwegian startup, Dynaspace, combines satellite images with machine learning to monitor productivity and forecast aquaculture production on a global scale. Their database can be updated in as little as every five days.

While cloud coverage remains the main impediment to maximising satellite imagery, one could imagine its ability to bring transparency to productivity, disease outbreaks and production forecasts. AI will improve real-time access to information, such as:

- How many ponds are stocked?
- Is there a dangerous algal bloom?
- What is the forecasted shrimp supply in the coming weeks?
- When is a farm ready to harvest?

**Challenges for growth**

One of the overarching challenges for AI to reach this vision is collecting massive, reliable and digitised datasets about all parameters involved in farming, such as growth, feed, soil, water parameters, genetics, water, temperature, and more.

Traditional practices such as visual inspections and non-digital records are just a few of the things slowing down the industry’s ability to upgrade. If standardised tools are not used on farms, then this data is challenging to use in building reliable software models. Otherwise, production information may not be accessible or may be biased towards the person’s experience and the conditions of the environment in which they operate. Not to mention, many tools that can standardise this process may still be perceived as being too expensive for smaller farmers to access (think digital water probes, automatic feeders, PCR tests, and more).

Until recent years, aquaculture innovations have not received as much financial support when compared to their agricultural companions. But as the market dynamics shift towards protein diversification, and other movements such as the ‘Blue Revolution’ gain traction, more investment will go into the sector, helping to lay the foundation for industry-changing technologies. According to a study published by the Food & Land Coalition, more than US$300 billion will be spent on disrupting global food systems in the next decades. As predicted by others, more than half could be spent to revamp aquaculture.

What we see in the industry today is only the beginning. In a world of digitalisation where it is becoming increasingly more common for large amounts of data to be recorded, AI will thrive. It will assist farmers and stakeholders throughout the aquaculture value chain by becoming a key asset in their day-to-day operations. If we let it, AI has the potential to become as routine in aquaculture as the apps that we use in our daily life, such as Google Maps or You Tube. We must be supportive and not fear its expansion as it could hold the key to unlock solutions to some of the industry’s oldest challenges.

Traditionally, practices such as visual inspections, non-digital records, and manual sampling are some of the challenges in collecting reliable data.
AQUACULTURE

Major land-based salmon farming projects to continue

Norway/USA – Nordic Aquafarms has confirmed that this year it plans to go ahead with construction of salmon land-based RAS facilities in the US, located in Belfast (Maine) and Humboldt (California). The Maine facility (which is awaiting approval of permits) will be a 54-acre project with a complete value chain from eggs to processed fish, and with a capacity to produce 30 000 tonnes of fish per year. The 50-acre site in California is envisaged to begin operations in 2021 (subject to approvals), and together with the Maine facility, the company expects to eventually produce some 50 000 tonnes of salmon per year for the US market.

Meanwhile, Nordic Aquafarms’ facility in Norway (Fredrikstad), which is also the country’s first large-scale land-based salmon farm, will deliver its first high-quality salmon to selected European customers in Q2 2020.

Potential aquaculture expansion

Singapore – Disruptions to the global supply chain due to the pandemic have lent greater urgency to Singapore’s push to become less reliant on food imports. In 2019, domestic production from offshore farming was around 4 700 tonnes of fish which contributed to 10% of total seafood consumption in 2019. This output was from 110 offshore fish farms, most of which are located to the north, in the waters that separate Singapore and Malaysia. The Singapore Food Agency is reported to be conducting surveys in the waters to the south for potential aquaculture sites to establish sustainable farming systems.

Alert for decapod iridescent virus (DIV1)

Vietnam - The Agriculture Ministry has urged preventative measures against the spread of decapod iridescent virus 1 in the country’s provinces bordering China, in order to protect the Vietnamese shrimp farming industry. The disease, which can affect key species of shrimp aquaculture including white-leg shrimp (*Panaeus vannamei*) and giant freshwater prawn (*Macrobrachium rosenbergii*) has yet to be detected in Vietnam, according to the Ministry, but fears of its spread have been stepped up after an outbreak in the Chinese province of Guangdong in February this year.

In order to improve biosecurity, the Ministry has requested the National Steering Committee against Smuggling, Trade Fraud and Counterfeit Goods to instruct its operatives in provinces bordering China to take measures against the illegal import, transport and sale of shrimp seeds, prawns and aquaculture feeds. Failure to comply would invite stiff penalties.

Boost to mussel farming sector

New Zealand – On 9th June, the Deputy Prime Minister Winston Peters announced funding of NZ $19.95 million from the Provincial Growth Fund (PGF) to expand the Sugarloaf Wharf at Te Kouma. “The aquaculture sector in Thames-Coromandel contributes NZ$70 million to the district’s GDP and is responsible for 350 jobs. But the sector has long been significantly constrained by a lack of capacity at Sugarloaf Wharf, which handles 90% of the North Island’s mussel production”, he said.

The PGF funding will be used to build a raised wharf platform with four new berths to allow for increased commercial activity and a separate facility for launching recreational boats. “The new wharf, Te Ariki Tahi Sugarloaf, will accommodate up to 42 000 tonnes of mussels a year, to meet increased demand from recently granted consents that have extended mussel farming space in the Hauraki Gulf by 775 hectares,” added Mr Peters.

FISHING

Bay of Bengal fishing ban

Bangladesh – A fishing ban in the Bay of Bengal will last from May 20 to July 23. During this period, fishermen who refrain from fishing will get 40 kilograms of rice per month, said the Fisheries and Livestock Minister. “We want to ensure that more fish is produced, and to make that happen, we need to implement the government’s order strictly”, he said. Representatives from the Ministry of Livestock and Fisheries, law and enforcement agencies, fisheries department and the respective divisional commissioners were also present at the meeting.

Stimulus package announced

India – The fisheries sector will benefit from a US$2.65 billion scheme in an economic package announced by the Prime Minister in the wake of the coronavirus crisis. Aimed at doubling incomes by 2024, the five-year scheme from fiscal 2020-21 to fiscal 2024-25 will help to improve infrastructure and boost investment in the sector, as well as provide insurance coverage for fishermen and their boats and provide employment to more than 5.5 million people.

Of the total, US$1.45 billion is for infrastructure and aquaculture while the remaining US$1.19 billion is for infrastructure investment such as fishing harbours, cold chains and markets.

Jagdish Fofandi, President of the Seafood Exporters Association of India (SEAI), said the scheme will also increase the competitiveness of fish and fisheries products, increasing exports and strengthening traceability standards. Fisheries, like other sectors, was affected by a lockdown and even now although work has commenced, many processing units are still working at under-capacity. Furthermore, the fishing season will...
enter a low period soon as the rains begin. Fish farmers meanwhile, have lost more than a month of the season because of Covid-19. He added that there may be a drop of about 25% in exports this fiscal year (US$6.7 billion in 2019) due to these factors.

(Editor’s note: More on the Indian fisheries sector is contained in an article in this Issue of the INFOFISH International, entitled “Covid-19 throws the Indian fisheries sector out of gear” on pages 21-28).

Handline yellowfin fishery achieves MSC certification

Indonesia - In May 2020, MDPI (an independent foundation in Indonesia focused on achieving responsible and sustainable fisheries), the North Buru and Maluku Fair Trade Fishing Association, Anova Food, and PT Harta Samudra announced that the handline yellowfin tuna fishery on Buru Island has attained MSC certification. This is the first such handline fishery in the world (and the second fishery in Indonesia) which has been awarded the certification.

In 2013, MDPI had implemented a Fisheries Improvement Project (FIP) for small-scale handline fishers in Eastern Indonesia with industry partners, Anova Food and PT Harta Samudra. Fair Trade certification was obtained in 2014, and the lessons learned from that experience contributed to the results of MSC pre-assessment conducted in 2018. At about the same time, MDPI signed an MoU with the Ministry of Marine Affairs and Fisheries (MMAF) to collaborate in strengthening market access for Indonesian tuna products through

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certification. In 2019, with support from MMAF and the strong results from pre-assessment, the decision was made to enter into MSC full-assessment.

Ghost Net Retrieval Project

The Maldives - As the first ever recipient of World Animal Protection’s ‘Joanna Toole Ghost Gear Solutions Award’, the International Pole & Line Foundation (IPNLF) is using the Award to launch a new initiative: The Ghost Net Retrieval Project in the Maldives. In partnership with the Olive Ridley Project, this project is aimed at incentivising Maldivian fishers to collect ghost nets they encounter during their fishing operations.

According to Zacari Edwards, IPNLF Socio Economic Manager and co-coordinator of the Global Ghost Gear Initiative’s Building Evidence Working Group, the project is ready to be piloted by the local one-by-one tuna catching sector working off Gemanafushi Island, in the southern region of the Maldives, and that there is a high potential for the approach of this project to be replicated and introduced in many other fisheries throughout the world. The Island Council has also agreed to provide their full support in helping to arrange the transportation of nets landed on the island and to identify an appropriate storage facility for collected ghost nets.

MARKETING

New shrimp import regulation

Australia – New restrictions on imports of shrimp addresses the biosecurity risks related to the Enterocytozoon hepatopenaei (EHP) parasite. Previous regulations were regarded as too lax on the current importing requirements. Among other things, uncooked shrimp products will now be deveined and certified by relevant authorities prior to import.

These new restrictions do not apply to cooked, deep-processed battered or ground products, nor to prawn products originating from Australia that have been processed at Thai Union-approved facilities. In 2019, Australia imported about 28 400 tonnes of shrimp worth US$125 million, a drop of 9.92% in volume and 15.6% in value over imports in 2018.

Strategy to boost value of tuna exports

Barbados - The fishing industry in Barbados and United Nations agencies have drafted a new “Oceans Economy and Trade Strategy” to increase the value of the island’s tuna exports. If fully implemented, it could dramatically boost tuna export revenue from US$0.303 million in 2015 to US$7.5 million in 2027. Fishers would earn an additional US$2.5 million over the same period.

The aim is to give the nation’s fishing industry the tools needed to move up the tuna value chain, away from the low-value unprocessed whole fish currently exported, and towards fresh boxed tuna loins which sell for a higher price in global markets.

The project addresses aspects of the national fishing industry where improvements are needed such as fleet efficiency, quality controls and most importantly, infrastructure. The strategy also calls for updating national regulations related to fisheries in the Caribbean, such as the Barbados Fisheries Act, to strengthen sanitary standards and traceability systems so that exporters can apply for voluntary sustainability certifications, such as the Marine Stewardship Council (MSC) label.

Government ban on exports

Cambodia - The government has temporarily suspended fish exports in order to ensure domestic food security and stabilise fish prices, both of which have been disrupted by the Covid-19 pandemic. Meanwhile the Ministry of Agriculture, Forestry and Fisheries will work on strengthening the fish farming sector for local needs.

In 2019, Cambodia exported 9 190 tonnes of fresh fish products and 4 910 tonnes of processed fish products, down by 3.4% and 1.8% respectively over 2018. Most of the exports went to neighbouring countries. In the same year, seafood imports were about 130 000 tonnes.

China authorises imports of Chilean seafood online

China/Chile - China has accepted a proposal from Chile to authorise and certify the imports of Chilean seafood products online. Chile’s fisheries and aquaculture service, Sernapesca, is facilitating the exports, thanks to the use of electronic certification. This allows for reduced response time while looking after workers’ health amidst the Covid-19 health crisis. The certification process can be modified during holidays and weekends, encouraging more seafood deliveries by air. China and Chile already have a free trade agreement in place.

Drop in inspection rate for Indian shrimp

Japan – The 100% inspection rate requirement on imports of Indian black tiger shrimp into Japan has been reduced to 30% following no traces of antibiotic residues found in the required time frame. Japanese authorities had been inspecting every single shipment looking for residues of the synthetic anti-bacterial drug furazolidone. Japan consumes nearly 40% of India’s black tiger exports. In 2019, India exported 1 957 tonnes of shrimp to Japan, an increase of 13.94% from 2018.

Surge in online sales

Malaysia - In March, the National Fishermen’s Association (NEKMAT) announced that the sale of fresh fish and seafood through its website
(www.nekmatbiz.com.my) has seen a 100 percent increase since enforcement of Covid-19 restrictions on movement in the country.

Its Chairman, Abdul Hamid Bahari, said prior to the Movement Control Order (MCO), online sales amounted to only RM10 000 to RM20 000 a month, but during the MCO period of over a month, NEKMAT has recorded sales exceeding RM100 000. Besides selling online through its portal, NEKMAT also sells direct to customers through Facebook. “For the direct selling method through Facebook, 84 949.90 kilogrammes of fish have been sold, involving a total of 19 256 transactions and sale amounting to RM400 067.45”, he said. The seafood ordered through Facebook is delivered to the customers by 40 ‘runners’. He added that NEKMAT has a fish stock of 50 tonnes at all times, but that it was a struggle initially to keep up with the overwhelming demand.

Steep fall in seafood exports

Myanmar – Exports from both catch and culture sectors in Myanmar have declined drastically as the US and the EU, which together take up some 45% of the country’s seafood, battle with the impact of Covid-19. The remaining 55% is accounted for by China and Thailand, which have also been affected by the pandemic. According to U Myo Nyunt, secretary of the Myanmar Fisheries Products Processors & Exporters Association (MPEA), as reported in the Myanmar Times in May, “all international orders have been cancelled and we have not received any new orders from the EU since they are all locked down.” Fisheries exports, including border and maritime trade, generate an average of US$700 million in revenue, according to the Ministry of Commerce. Before Covid-19, the sector had been forecast to generate US$750 million in export revenue in fiscal 2019-20.

Within the country in April and May, cold storage facilities and factories were not allowed to open, and fishing and aquaculture activities ceased. The MPEA warned that the aquaculture sector could face longer disruptions if farmers are unable to restock and that the shortage of supplies for processing will halt upstream fishing and aquaculture activities from June to August. The Association is now projecting the largest loss in history for the sector between March and August, and is calling on the government for more aid.

Market summary for Norwegian seafood

Norway - According to the Norwegian Seafood Council, seafood exports in the first quarter of 2020 totalled
664 000 tonnes worth NOK 28.6 billion (US$ 2.79 billion). The value of these exports increased by NOK 2.9 billion (US$ 0.28 billion) or 11% against the same period in 2019, partly due to the weakening kroner. Salmon exports were found to increase by 2% in volume and 11% in value in the first quarter year on year. Similarly, there was an increase in exports for trout, herring, mackerel, frozen cod, clipfish, salted fish and shrimp.

In their update on 28th May published on the NSC website, analysts have summarised key features in the development of Norwegian seafood exports so far:

- Prepackaged seafood products have been the winner during this pandemic. While seafood products usually sold to the hard hit restaurant markets are assumed to make a recovery long term, weaker purchasing power in the markets will prove a challenge for many traditional seafood products such as clipfish, saltfish and stockfish
- Eating seafood at home has increased in most markets
- Increased sales through online channels
- Increased unemployment means people have less disposable income. It is uncertain how this will affect the consumption of the various seafood products.
- For cod products, there is a great deal of uncertainty as to how this reduced purchasing power in the main markets will affect demand and exports in the future
- As the restaurant sector gradually reopens in different markets, we will see an increase in seafood exports

- Despite increased shipping rates to overseas markets, we are seeing a shift in the flow of fresh salmon towards Asia. This is due to the reopening of markets such as China, Hong Kong and South Korea.

**Thai Union reports higher sales but lower profits**

**Thailand** - Thai Union Group PCL reported first quarter sales of THB 31 103 million, an increase of 5.9 percent year-on-year and its best first-quarter sales performance in three years. North America contributed 43 percent of total sales in the first quarter, followed by Europe at 30 percent, the Thai domestic market at 11 percent, and other markets at 16 percent. However, profits are down (-20% compared to Q1 in 2019) due to foreign exchange losses and lower equity income.

The media release continues “The frozen sector (mainly shrimp) declined by 5.1%, while ambient seafood sales (primarily canned tuna and other fish) jumped 16.2%. Overall volume advanced 6.7% YoY, driven largely by the purchases of ambient seafood as consumers dialed up home cooking and dining due to restaurant closures and lockdowns around the world imposed by governments seeking to contain the coronavirus (SARS-CoV-2) pandemic. While the spread of the deadly Covid-19 respiratory disease caused by the virus did not present raw material issues for the company’s supply chain efficiency during Q1, the contagion did impact frozen and chilled seafood sales, particularly in the United States and Thailand. This was partially offset by positive sales results in Japan and other Asian countries.”

**New Executive Order should enhance competitiveness**

**USA** - Stronger America through Seafood (SATS), an industry coalition that advocates for increasing Americans’ access to healthy, sustainable and affordable seafood, has commented on its website regarding the new Executive Order by President Trump. The Order aims to increase coordination among agencies and clarifies existing regulations to reduce barriers that currently limit offshore aquaculture in Federal waters. Furthermore, it outlines regulatory reform to maximise commercial fishing, combat IUU fishing, and outlines a process for developing Aquaculture Opportunity Areas suitable for commercial aquaculture in Federal waters. SATS president Bill DiMento said that the Order is an important step towards improving the competitiveness of the US seafood supply chain.

**Tra exports to US and China increased in March**

**Vietnam** - Tra fish exports to some major markets like the US and China are gradually increasing though the fisheries industry is still struggling to cope with the fallout of the pandemic. According to the Vietnam Association of Seafood Exporters and Producers (VASEP), exports to the US in the first half of March increased by 18.8% year-on-year. Exports to the US are expected to continue to strengthen with the lowered anti-dumping rates on Vietnamese tra fish (pangasius) products following the fifteenth period of review. Vietnamese tra fish have been subject to US anti-dumping duties since 2003 and annual reviews ever since.

Exports to China were worth nearly US$13 million, US$1 million up month-on-month, and some businesses believe that exports to China will increase sharply in the coming months. However these exports to other major markets like the EU, ASEAN, Brazil, Mexico, Colombia, and Australia will drop from the same period last year due to the impact of the virus. Among other factors, transport and forwarding of goods remains difficult.

**Covid-19 opportunities and challenges**

**Vietnam** - The Vietnam Association of Seafood Exporters and Producers (VASEP) reports that in the first quarter of 2020, Vietnam’s seafood exports were about US$1.6 billion, nearly 10%
lower than the same period in 2019. The most affected markets include China (-27%), EU (-16%), South Korea (-11%) and ASEAN countries (-7%). In terms of species, pangasius exports dropped by 29%, cephalopod exports -24%, and tuna -10%, although shrimp rose slightly by 1.8%.

VASEP lists the following challenges facing the industry:

- Decrease in purchasing power from markets (recovering slowly)
- Some businesses forced to close or sold to other investors
- Outstanding debts may increase, affecting other sectors (e.g. banking, medicines, chemicals, packaging materials)
- Increasing production costs
- Cut back on stocking of ponds, causing material shortages in the future and raw material prices will soar
- Supply chain interrupted
- Increasing inventories and shortage of cold storage space
- Labour shortages
- Investor confidence in Vietnam and Vietnam’s seafood has increased significantly (thanks to effective policies to combat the pandemic)
- The main competitors, such as India and Ecuador, are seeing a reduction of about 50% in production and exports due to blockades and quarantine measures. Indonesia, the Philippines and Thailand are also scaling back on production, which may give Vietnam more space to increase output to gain a bigger market share of the markets.
- There will be a shift in production from China to Vietnam, especially after the US-China trade war and the Covid-19 pandemic
- The demand for raw materials from Vietnam may increase
- The world market demand for convenient and value-added fishery products is up
- Supporting industries for aquaculture (producing medicine, chemicals, packaging materials, equipment, equipment for aquaculture, processing, etc.) have a chance to develop in Vietnam, thereby creating favourable conditions for seafood businesses to be more active in production.

In its forecast, VASEP says that seafood exports in the second quarter will not be able to fully recover because some markets are still strongly affected by the pandemic, especially the EU market. In the short term, exports to China also may not recover to the pre-pandemic level.
Shrimp exports increase in Q1

Vietnam - Despite the pandemic, Vietnam recorded shrimp export growth to some key markets such as Japan and the US in the first quarter of this year. According to the Vietnam Association of Seafood Exporters and Producers (VASEP), Japan has moved to first place with US$ 118 million worth of sales (+ 3.35% over the same period of last year) accounting for 23% of the total shrimp export value. Likewise, the US became the second largest export market for Vietnamese shrimp because of higher demand for food, including shrimp, during the pandemic. In the first three months of 2020, Vietnam’s shrimp export value to the US market reached US$103.3 million. However, shipments to many other major export markets decreased in value against the same period of last year, including the EU (-16%), the Republic of Korea (-6.3%) and China (-6.4%).

Sharp recovery in shrimp exports

Ecuador – According to the National Chamber of Aquaculture (CNA), shipments of shrimp to its main market, China, are on the rise with the easing of lockdown restrictions. Exports in April 2020 rose by 59% as compared to the previous month. However, sales to European markets (especially Italy, Spain, UK) dropped in March and April as orders were put on hold due to the collapsed foodservice sector. Nevertheless, despite the pandemic, overall Q1 global export figures for Ecuadorian shrimp show an increase of 13% year on year to 485.3 million pounds and +8% in value at US$1.22 billion. Domestic shrimp processing plants are said to have been running at between 40-45% of capacity during the restrictions period.

CNA has called on the government to allow shrimp producers to defer tax payments for a while. Meanwhile, aid to the Ecuadorian shrimp sector came from the World Bank, which approved US$506 million in emergency loans and grants.

Salmon exporters worry about latest Covid-10 outbreak

China - After eight weeks without a single locally transmitted case of Covid-19, parts of Beijing are back in lockdown and people travelling to and from the city are being required to quarantine. A new cluster of infections traced from Xinfadi, a fruit and vegetable market in the Fengtai district of Beijing, has led to consumers shunning imported salmon after the Chairman of the market said that the virus was found on the chopping board of a seller of the product. Exporters from across the globe such as Chile, Norway, Australia, and Denmark’s Faroe Islands are now concerned for the future of the US$700 million market for imported salmon in China.

Wu Zunyou, chief epidemiologist of China’s Center for Diseases Prevention and Control said that the virus can survive on the surface of frozen food for up to three months and that the agency “highly suspects” contaminated goods as the source of the latest outbreak. While not proven that the virus can be transmitted through frozen food that’s later thawed, salmon has been taken off the shelves in supermarkets and grocery delivery platforms across major Chinese cities. The salmon boycott comes on the back of a sharp decline in seafood exports to China in Q1 due to the pandemic.

Meanwhile, Hong Kong’s Center for Food Safety (CFS) is testing samples from imported salmon as a precaution, according to an official press release. A CFS spokesperson said that “According to current scientific information, there is no evidence indicating that humans can be infected by the novel coronavirus via food (including aquatic products). Nevertheless, given that raw or undercooked aquatic products are high-risk, if they are uncooked or under-heated, consumption of food contaminated with bacteria or viruses may cause food poisoning.”

GDST 1.0 standards announced

In their media release dated 16th March, the Global Dialogue on Seafood Traceability (GDST) - a major industry forum involving more than five dozen companies worldwide - announced the first-ever global standards for tracking seafood products from point of origin to point of sale. GDST says that the standards are a critical step forward in the fight against illegal fishing and unethical labour practices and are changing the game for an industry under increasing pressure to demonstrate its compliance with high standards for ethical sourcing.

It highlighted the fact that illegal fishing, which fuels overfishing and environmental degradation as well as human rights abuses such as slavery at sea, is estimated at up to one quarter of fish caught by commercial fishers globally, with upwards of US$36 billion in illegal fish products entering seafood markets yearly. Complex seafood supply chains mask these issues and contribute to fraud and the mislabelling of products in seafood markets.

FOS new sustainability criteria

Friend of the Sea (FOS) has published version v.4 of its Wild Caught Standard and v.2 of its Audit Guidance. Both documents are available on the FOS website(https://friendofthesea.org/).
According to FOS, the new Standard is part of the Sustainable Fisheries and Fleets program. The key objective of the program is to improve the health of the ocean and reduce damage to species and the marine environment caused by commercial fishing operations. The updated Wild Caught Standard has changes that include banning shark finning and ghost fishing gears while requiring TEDs (Turtle Excluder Devices). The new Standard will become mandatory after a three-year transition period.

New online community launched

Global Aquaculture Alliance (GAA) has announced the launch of Connect, a new online aquaculture community forum for aquaculture professionals, i.e. the LinkedIn equivalent of the seafood and aquaculture space. The platform is open for anyone to join. Connect is designed as a site for seafood industry news, research, events, species-specific discussions, sharing of information, and networking opportunities with other professionals.

COVID-19: implications on food loss and waste

In an article by Ansen Ward published on the FAO website “Food Loss and Waste in Fish Value Chains” (http://www.fao.org/flw-in-fish-value-chains/resources/articles/covid-19-hygiene-and-sanitation/en/), it was stated that changes caused by COVID-19 will be seen through all stages of the value chain from the origin to the consumer.

Fishers will have to play their part in improving on-board handling and hygiene and sanitation. Trader and buyer will also have to improve hygiene and sanitation. There will be new ways to minimise contact during the handling of products, reducing the risk of cross contamination and damage to products. This may have implications on the way in which fish and fish products are made available to final consumers and the way in which transaction processes are conducted. Hygiene and sanitation may also be augmented with new, or more use of, packaging materials, which will prevent contamination and may prolong storage life.

Improving hygiene and sanitation will require investment. Some markets will require upgrading and consumers may be given more access to hand washing facilities. Workers will require training in improved hygiene and sanitation standards. Furthermore, inspection authorities will need to invest more time and effort into monitoring new or existing standards and explore new ways of inspecting, embracing improved technology and equipment.

Fishmeal and fish oil supply & demand

IFFO, The Marine Ingredients Organisation recently held a Members Meeting Webinar to give the latest news from across the global industry. According to the press release, the China Director Maggie Xu presented the latest market and regulatory insights from the country. Xu noted that both the fishmeal and fish oil markets have been negatively impacted by restrictions due to Covid-19 and unpredictable weather conditions. Overall aquafeed output in China is expected to remain steady or slightly muted due to these conditions. Increased consumption of marine ingredients should come from the pig sector, which continues to recover after the African Swine Fever outbreaks decimated the Chinese hog stock in 2019. In terms of domestic supply of marine ingredients, China’s output from whole fish has decreased in recent years whereas supply from by-products has remained stable.

Giving a global perspective, IFFO’s Market Research Director, Enrico Bachis, gave an update on both demand and supply of marine ingredients, based on IFFO’s extensive network of companies providing a constant and reliable flow of data on production, trade and prices. In 2019 both fishmeal and oil output experienced a decrease with respect to 2018, on the back of poorer catches especially in Peru, Iceland and Denmark. As usual, landings in Peru will play a major role in determining the global trend, and for this year the expectation is of something slightly above the 2019 output. Global marine ingredients supply should be just short of 5 million tonnes of fishmeal and around 1 million tonnes of fish oil. With the assumption of a fish oil yield of 3.5% of the anchovy catches in Peru, the overall supply of fish oil this year could at best match that of 2019, although a small decrease is more likely given the poor results in Europe.

FAO publishes latest SOFIA report

The 2020 edition of The State of World Fisheries and Aquaculture (SOFIA) has a particular focus on sustainability. This reflects a number of specific considerations. First, 2020 marks the twenty-fifth anniversary of the Code of Conduct for Responsible Fisheries (the Code). Second, several Sustainable Development Goal indicators mature in 2020. Third, FAO hosted the International Symposium on Fisheries Sustainability in late 2019, and fourth, 2020 sees the finalisation of specific FAO guidelines on sustainable aquaculture growth, and on social sustainability along value chains. (Editor’s note: for more details please go to the Publications section on page 65).
INSECT PROTEIN: THE FUTURE OF FEED

By Martin Zorrilla and Nada Dhaoui

Insect protein has taken centre stage in the search for alternative proteins in animal feed. The novel insect-protein industry has scaled production in recent years, with a growing number of new companies appearing in Southeast Asia. Insect production offers the region an opportunity to decrease import-dependence while supporting local aquaculture producers with a price stable product. Meanwhile a growing body of evidence from commercial and academic trials illustrate that insect protein is a viable fishmeal replacement in carnivorous fish diets, and in many cases results in improved immune response and gut health outcomes.

The buzz about insects

Over the past decade the feed industry has changed its perspective on insects. In general insects were considered as pests or a nuisance at best, but now they are seen as a pivotal ingredient that can transform the feed supply chain.

This change in thinking starts with the intuitive knowledge that insects are a major part of the diets of aquaculture species in the wild. That intuition is backed up by science; over a decade of careful trialing has demonstrated that insect protein is both highly digestible and palatable in the diets of numerous farmed species, from salmon to barramundi.

Along with the science, a growing cohort of growth-stage companies have emerged to transform insect production from lab scale to commercial scale manufacturing. Aquafeeds containing insect protein, although at low inclusion rates, are now available on the market and major players in the feed industry have dedicated teams working on securing supply. This year the International Platform of Insects for Food and Feed (IPIFF) announced that its 64 member companies
alone had produced a total of 6,000 tonnes of insect protein in 2019. While these numbers are still small compared to conventional commodities, most insect companies are now bringing their first commercial facilities online, marking the start of aggressive expansion.

Insect producers have attempted to mass-produce several species, including mealworm, fruit flies and locusts; however the majority have focused their efforts on one particular species - the Black Soldier Fly (*Hermetia illucens*). The Black Soldier Fly (BSF) stands out among the world’s 120,000 fly species due to several key traits: they do not need to feed as adults so they accumulate protein and fat in their larval stage, they can feed on a remarkable range of organic material, and they produce large numbers of offspring (600-900 per female). Because of this, BSF can be easily bred, fed on a range of organic materials and easily processed into nutrient dense products. Crucially, BSF are a beneficial species: they are not pests, they do not transmit diseases and are not attracted to human dwellings or food.

**Taking flight in Asia**

The majority of the insect protein companies are based in Europe, where the environmental sustainability of the industry has been welcomed by investors and regulators alike. However, Asia, Southeast Asia in particular, has been home to the second wave of innovation and development in the insect industry. This is because the region is ideally suited to be a centre of insect protein production as well as consumption. The insect of choice, the Black Soldier Fly, is tropical in origin and therefore performs well in the tropical countries of Southeast Asia. The region also allows for low operating costs and proximity to the factory-grade food by-products needed as insect feed. Asia accounts for no less than 50% of the lost nutrition in the global food supply chain, much of it from industrial food processing that can be used for insect production.

Yet, agricultural production in the region is limited compared to its growing population, creating an import-dependence problem that insect protein can help to solve. It is estimated that by 2030, Asia will be home to almost half of the global population but contain only one-quarter of the world’s agricultural land. This has contributed to a reliance on imported feed ingredients like fishmeal and soybean meal, both of which are mostly imported from South America, to support growing livestock and aquaculture industries.

Over the past decade, dependence on imported material has grown to 75-80% in aquafeeds for countries like Vietnam and Malaysia. In 2017, Chinese demand for protein ingredients grew by 7% while its soybean meal production actually fell by 1.5%. Meanwhile, government-led efforts to incentivise corn and soy production in countries like Indonesia have not succeeded in creating a meaningful domestic supply. Most Asian countries lack the large tracts of farmland required for soybean production, and the region’s already depleted fisheries means that fishmeal production can only decrease.

In this context, insect protein can play a crucial role as a scalable local supply of protein to support the continued growth of the aquaculture industry in Southeast Asian countries. The Bangkok-based Asian Food and Feed Insect Association (AFFIA) includes 12 members that are producing insects for animal feed. Indeed, a growing cohort of insects-as-feed companies have chosen to open or move to Asian countries. As the fledgling industry scales up, it may present the region with a way to lower import-dependence as well as production costs.

An example of one such company is Nutrition Technologies, founded in 2014. Having always seen Southeast Asia as the epicentre of the insect protein industry, the company operates in Singapore, Malaysia and Vietnam with further regional expansion in the works. Production is currently centralised in Johor Bahru (Malaysia), where factories produce a high quality protein meal (Hi.Protein®), oil (Hi.Oil®) and frass (Hi.Frass®) from Black Soldier Fly larvae.

These larvae are reared on agricultural and food-processing byproducts in a vertical farming system that ensures product
safety and traceability. The larvae undergo only seven days of high-growth rearing, after which they are processed into protein meal and oil. Within Malaysia, these products represent one of the only locally produced protein ingredients suitable for use in aquaculture. The scalability of the system means that dependence on imported protein ingredients in countries like Malaysia can be substantially reduced without requiring large tracts of land to do so. For instance, the facility in Johor Bahru can produce more protein in one square metre than a hectare of soybeans can yield in the same amount of time.

Applications in aquafeed

Insect protein has emerged as a clear front-runner in the race to develop alternative proteins for aquaculture feed. The reason for this has always centered on its ability to replace fishmeal. Unlike plant-based alternatives, insect protein is both highly palatable and highly digestible for carnivorous species. However, as a natural food source that many aquaculture species have evolved to eat, insect protein has a much greater role to play than as a protein source alone. Recent research has demonstrated a range of beneficial effects on aquaculture species when insect protein is used in feed, including positive changes in microbiota and gut health.

Moreover, a growing body of research has demonstrated that insect meal as an alternative aquafeed ingredient in aquaculture seems to be promising both at technical-productive level and at consumer acceptance level. The evidence in favour of insect protein comes both from academic and commercial trials. Black Soldier Fly protein meal has been tested in commercial salmon feed produced by Skretting Norway and was first tested by Nordlaks in 2018, where fish showed the same growth performance when fed on BSFL protein as with traditional protein sources. In 2019, Le Gouessant Aquaculture and a European insect company succeeded in 100% fishmeal substitution with insect protein in rainbow trout feed without negative effects.

While insect protein has been shown to have a suite of potential roles in aquafeed, most academic studies have focused on its potential as a fishmeal replacement. Belghit et al. (2019) investigated the use of partially defatted BSFL meal used in total substitution of fishmeal in the diet of Atlantic salmon. The authors found that a 100% replacement of fishmeal by BSFL meal was possible without negative effects on growth performance, feed utilisation, nutrient digestibility, liver traits, or the sensory qualities of the fillet. Insect meal has also been proven to be a relevant protein source in shrimp diets. Renna et al. (2017) showed that a partially defatted BSFL meal can substitute 50% fishmeal in rainbow trout diets without impacting growth performance. Many other studies investigating BSFL meal in different fish species have demonstrated its relevance as a fishmeal replacement (Fig 2).

Fig 2: FM replacement by BSFL meal in diets of a wide range of aqua species observed without adverse effects
inclusion of BSFL meal in Atlantic salmon diet had no effect on amino acid digestibility compared to control diets with fishmeal.

The results above demonstrate that the residual presence of chitin in insect based diets and which is hardly digested by many fish species, does not have a huge impact on insect digestibility. However, insect protein has much more potential than as a highly digestible fishmeal replacement. Evidence is growing that insect products improve immune response and modulate fish microbiota. For instance, Terova et al. (2019) reported that insect meal (BSFL meal) positively modifies trout gut microbiota not only by increasing the amount of beneficial lactic acid and butyrate-producing bacteria but also by increasing Actinobacteria which are often identified as chitin degraders.

Some of the most exciting research has been in shrimp, where insect meal has been shown to increase resistance to disease and improve immunity. Motte et al. (2019) reported that shrimp fed diets in which fishmeal was replaced by mealworm meal showed a lower mortality rate than those which received diets including only fishmeal after a challenge with *Vibrio*. The treatment from this study with a 50% fishmeal replacement with insect protein resulted in a 76.9% lower mortality rate than the control diet, suggesting that insect meal could have immunostimulating benefits. The immunological benefits of insect are thought to be related to their chitin content, which has been found to be an immunostimulant in both shrimp and fish. Besides chitin, insect meal and BSFL meal, in particular, is rich in lauric acid, a medium-chain fatty acid with antimicrobial properties.

**A glimpse into the future**

It will be some time before insect protein shows up in every aquafeed product ingredient list. But the question is increasingly when, and not if, it will do so. With insect protein production on the rise, companies in the feed industry are increasingly playing an active role in supporting this new industry and its promise of an environmentally friendly price-stable alternative to conventional ingredients.

Ultimately, insect protein has many contributions to make not only to feed companies and end users but also to the countries where production occurs.

Supplementary bulletins...

- **European Price Report (EPR)** is a monthly bulletin with comprehensive coverage on European markets. Produced by FAO-Globefish, EPR reports on market trends and prices for coldwater as well as tropical species namely cod, hake, Alaska pollack, herring, farmed salmon/trout, European sea bass/sea bream, tuna, tropical shrimp and cephalopods and more.

- **INFOFISH International**, the longstanding bimonthly magazine distributed globally since 1981, is also included as a complimentary copy (by surface mail) to subscribers of the fortnightly INFOFISH Trade News.

- **Globefish Highlights** is the commodity report which outlines quarterly market trends and outlook on tuna groundfish, shrimp, lobster, cephalopods, small pelagics, fish meal and fish oil.

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SOLVING A GLOBAL COLDCHAIN PROBLEM IN A REMOTE FILIPINO FISHING VILLAGE

By Tamara Mekler

Cold storage is a huge problem across seafood supply chains in developing countries. High-end coolers are out of reach for millions of small-scale fisherfolk, and more affordable options are few and far between. Fortuna Cools, a social enterprise founded by graduate students from Stanford University, is addressing the needs of underserved fishing communities by using human-centered design, a mindset and methodology that places users at the centre of the problem-solving process. Their first step was moving to a remote fishing village in the Philippines. In an interesting example of what can be achieved when small-scale communities are treated as partners in finding local solutions to problems, Fortuna Cools developed an affordable cooler that is insulated with a widely available, under-utilised, agricultural waste product: coconut husk fibre.

Introduction

Glance at a map of the Philippines and its upwards of 7 000 islands, and look for Luzon, the largest island. Just southwest of that you’ll notice a tiny speckle: that’s Lubang island. That speckle is home to a community of one hundred families of small-scale fishermen, who earn their livelihoods catching the famous yellowfin tuna. Yellowfin, also known as ‘ahi tuna’, is prized around the world for its lean meat, delicious as sashimi, grilled, seared—you name it.

To catch these giant creatures, Kuya Jaime and Kuya Edgar venture out 10 kilometres from the shore in a dugout outrigger wooden canoe, or bangka. On lucky days, they return after an exhausting 13-hour trip under the tropical sun with at least one, sometimes up to four, yellowfin tuna stacked inside their boat, tails hanging over the edge. Once the villagers spot them on the horizon, word spreads around. Their wives, Ate Rochie and Ate Leni, and children hurry to greet them, and help them hoist the bangka up on the sandy beach, while fellow fishermen and friends admire their bounty. Soon, two helpers arrive with a sheet of canvas and two bamboo sticks to carry the tuna, one by one, to the local buying station, just a few feet away from the beach. It’s an extraordinary sight to the untrained eye, so it takes a second to notice that something is off.

Yellowfin is a high-value species, coveted globally by the most distinguished chefs and inspired home-cooks. Yet these particular ones have been rotting in the sun for hours at a time; there’s no ice in sight. There is no room for coolers in the fishermen’s bangkas, and ice without coolers is just a puddle of water in the Filipino heat. What seemed like a precious catch was worth pennies on the dollar at local markets that operate on quantity, not quality.

This was the problem we identified when our partners at the International NGO, Rare, invited our team of graduate students from Stanford University’s Design School to meet a community of small-scale tuna fishermen in Tagbac, Lubang. The warm and enthusiastic welcome from the community and the support from our partners at Rare, along with our now-piqued curiosity, drew us in immediately.
The picture was complex: multiple stakeholders operating in a long and convoluted supply chain extending from the sea off the coast of Tagbac to major Filipino cities and beyond, to the European, US, and Asian seafood markets. Yet, constant throughout the supply chain, was a lack of coolers. Fishermen often skipped cooling altogether, while small traders gathered plastic tubs and old refrigerators to serve as makeshift coolers. Others packaged tuna individually with bubble wrap and duct tape.

Meanwhile, seafood supply chains dealing with smaller species were dominated by the same product: the polystyrene (or "styrofoam") icebox, a fragile, bulky, and environmentally harmful disposable product. While some premium commercial-scale operations had more durable and expensive alternatives, there was an obvious cold storage problem in most Filipino seafood supply chains.

This might sound like a straightforward problem. After all, there are tons of high-end coolers of all shapes and sizes on the market that could keep fish cold even on the most blazing tropical days. The issue with these is price. High-end coolers focus on aspirational features, and though they might inadvertently address the needs of the fishers, they’re beyond reach for all but few in this low-margins business.

A human-centred, collaborative solution

This mismatch will persist in a world where one of the most common approaches to business is to transpose solutions from elsewhere, because these will tend to be solutions that poor people cannot afford. The general wisdom concerning the poor is that they lack the ability to pay for high-quality goods. To be sure, people with scarce economic means have to be pickier about how they spend their money. But it is possible to address the needs of underserved communities with high-quality, low-cost products. Our team set out to do so using the human-centred approach to problem-solving, a mindset and methodology that places users at the centre of the design process. By learning from their needs, wants, behaviours, and constraints, and cultivating empathy and collaboration, we have built a product that is affordable by design, and that enjoys strong market fit. The human-centred approach relies on a five-step iterative process: empathise, ideate, define, prototype, test, and repeat. These steps are a guide to building a collaborative partnership between the user and the designer.

The obvious first step for our team was moving to Lubang Island and spending the summer living with the small-scale tuna fishermen of Tagbac. We built a custom-fitted wooden box for Jaime’s boat, familiarising ourselves with boat dimensions and the local manufacturing capacity, and surveying the array of materials available on the island. We went fishing aboard a small bangka to witness first-hand how fisherfolk move around their boat while at sea and experience the space constraints that influenced all of their equipment decisions. The fishing trip was an invaluable lesson in empathy and humility: waking up at two in the morning, bracing the waves under the moonless night sky, eating raw fish and cold rice minutes after throwing up from seasickness, and dozing off under the midday heat ten hours into the trip... and hiding my disappointment over our no-catch day.

We held town halls with the fishermen and their wives during which we heard about the cooler of their dreams, and the cooler of their nightmares. We escorted a shipment of fish from the beach to one of the largest wet markets in Manila, witnessing it change hands four times while traveling aboard four different vehicles: a tricycle, a ferry, a van, and a Jeepney. We picked up a shipment of twelve tuna from the airport... and hiding my disappointment over our no-catch day.
in Manila and watched as the 50+ kilogram giants were transformed into lean filets destined for Hong Kong.

We built dozens of prototypes with the help of local tailors, and made tweaks after the fishermen put them into action. On one of our more memorable days, our most avid tester, Edgar Monteloyola, pointed to his catch upon arrival to shore and remarked, “It’s much more shiny than usual, much better quality.” Each prototype was an opportunity to test our assumptions and go through another round of iteration. It taught us what was most important to our users, and how to streamline the solution to keep the price within reach.

Early on, when our focus shifted to scaling-up — we had the heat-sealing gun glued to our hands for months — we learned that the Philippines was missing the manufacturing capacity to build some of our designs. We could export the manufacturing to China, though it would complicate the logistics and raise our production costs. Moreover, together with our partners, we had envisioned a Filipino-made cooler for Filipino fisherfolk.

So we went back to the drawing board seeking alternatives, when it occurred to us that we could insulate our coolers with a widely-available, under-utilised, natural resource: coconuts. Coconut husk fibre is a cheap and durable material with amazing thermal insulation properties. Husks are the byproduct of a massive coconut industry—more than 10 billion husks are burned as waste every year in the Philippines alone. We would turn this agricultural waste product into strong, attractive and affordable coolers.

Fortuna Cools Co. is now in the first year of sales of this cooler 2.0. We are partnering with seafood and produce suppliers, fisherfolk cooperatives, and non-profit organisations across five provinces in the Philippines to keep food fresh throughout their supply chains with Fortuna’s Coconut Coolers. We source from small-scale coconut farmers and build our coolers with pre-existing fibre processors, supporting the local economy in one of the main coconut-farming regions of the Philippines. One of our first customers, Charlene Tan, the founder of Good Food Community, a community-shared agriculture and vegetable delivery service in Manila, loves the natural, indigenous look of our coolers, and told us that they “think of our Fortuna Cooler as a member of our family.”

User-centric solutions can scale

Our user-centric process raises the question of scalability. There is an inherent tension between the specificity that arises from deliberately designing for a particular user, and the scalability needed for a sustainable business. Yet while the communities of fishermen and fish suppliers for which we designed our coolers live in remote areas of the Philippines, millions have this problem around the world. By going to the small community of tuna fishermen in Lubang Island, we unearthed a global problem. The micro lens showed us a macro picture. When we took the time to understand exactly what small-scale fishermen were looking for (what was important to them, what were their constraints, etc.), we were actually gearing up to meet not just their needs, but also the needs of millions of fishermen and seafood and produce suppliers around the developing world. We’ve been contacted by fisherfolk, logistics companies, and others hailing from places like Indonesia, Papua New Guinea, Mexico, and Mozambique.

There are countless opportunities for affordable solutions for the world’s poor via design tools geared to understanding the needs of these users. While on the ground, we learned of a few: developing more sustainable and affordable fishing gear and safer fishing boats; streamlining supply chains to improve the processing and cold-storage of seafood and creating traceability systems; promoting alternative sources of livelihood in stressed fisheries and empowering communities through novel financial services and networks, and beyond. Innovators that spend time in fishing communities learning from fishermen and their families, middlemen, seafood processors, retailers, consumers, and any other actor in the value chain, will be amazed by what they find.
A special podcast on the global shrimp trade was organised by INFOFISH on 13th May in view of the greatly altered landscape of the industry due to the Covid-19 pandemic. The speakers were Ms Fatima Ferdouse, independent consultant on international fishery trade and marketing; Dr Manoj M Sharma, Director of Mayank Aquaculture Private Limited, Gujarat, India; Mr José Antonio Camposano, Executive President of the National Chamber of Aquaculture of Ecuador; and Mr Jim Gulkin, Group Managing Director of Siam Canadian Limited. The podcast was moderated by INFOFISH.

Beginning with an overview of the global shrimp market (2019-Q1 2020), the speakers went on to discuss parameters such as production/supply chains, changing consumption trends, online trade, and product forms, as well as shared their predictions on the industry through the rest of the year.

Overview of the global shrimp market

Global imports were about three million tonnes at an estimated import value of US$22 billion, with four markets (China, the EU, US, and Japan) absorbing some 80% of the total in both value and volume terms. Analysis shows that China was the top importer in 2019: officially, imports indicated about 722 000 tonnes but with unreported trade particularly from Vietnam and increasingly from Myanmar, that adds another 90 000-100 000 tonnes, totalling about 812 000 tonnes of imports last year. The second biggest importer of shrimp in 2019 was the European Union (808 000 tonnes), the US (700 000 tonnes) and Japan (220 000 tonnes). The leading suppliers to China in 2019 were Ecuador (+262%), India (+300%), Thailand (+58%), and Vietnam (177%).

Continuing into 2020, the single most important event was the Covid-19 pandemic. Foodservice sales are now down by probably 80-90% and it may be several years before the sector recovers. Retail ratcheted up very quickly as people stayed at home but still wanted to eat food they liked. In the US, retailers experienced very good in-store and online purchases of these shrimp products, particularly frozen items which could be bought perhaps once a week and stored in home freezers.

Sales of Ecuadorian shrimp to the US in January (which at that time was not severely impacted) were about 9 000 tonnes in volume compared to 6 000 tonnes to China and it marked the first month in about eight years that shrimp exports to the US were higher than China. In March, Ecuador exported around 119 000 tonnes of shrimp (original prediction: 140 000 tonnes). The drop was not only due to the conditions in China, the EU and the US, but also because Ecuador was itself affected by Covid-19, especially in Guayaquil province, which accounts for 80% of the total production and 95% of the total processing capacity of the country.

Global production

The estimated total production last year for farmed shrimp (vannamei and black tiger), excluding freshwater, is about 4.45 million tonnes. China was at the top with 1.4 million tonnes, India 800 000 tonnes, Vietnam 550 000, Indonesia 370 000, Thailand, about 300 000, and Ecuador 620 000 tonnes. China imports more shrimp, meaning that its own production is utilised within the country. In contrast, the aquaculture sector in India and Ecuador is highly export oriented.

In 2019, Indian shrimp farmers produced close to 800 000 tonnes of shrimp but in 2020 due to the sudden lockdown, an estimated 4-5 billion seed had to be discarded. This year’s production may be 60-70% of last year’s volume (approximately 500 000 tonnes), 60-70% of which will come from Andhra and the rest from West Bengal. If this prediction is realised, there may be a global oversupply as other countries like Indonesia are also likely to produce large volumes from the seeding of their ponds which has taken place after Eid.

Changing consumption patterns

Moving on to the sharp rise in online shopping, home deliveries, demand for retail packs and convenience foods, and adaptations in the HORECA sector, the question was...
asked if the current trends would be the new normal. The consensus was that things have changed for good.

Online purchasing, which was already popular amongst consumers in China, is picking up in the US, Europe and other parts of Asia, where people are starting to realise that it is fast, easy, and good quality items are delivered to doorsteps. In the US, retailers are cognisant of the need to produce something which is affordable. Shrimp from India, Thailand, Indonesia, and Vietnam are sold in smaller consumer packs at less than premium prices by all the major US retailers such as Wal-Mart and Safeway. Canned fish and other foods saw a surge of panic buying but one can expect that the increased consumption will continue after the pandemic ends as people have become more familiar with these items.

The speakers concurred that eating shrimp in many countries is part of the culture. In the rest of Asia (excluding China), Southeast Asian consumers purchase more finfish rather than shrimp. The reasons are varied: frozen consumer packs tend to be in bulk (about 2 kg) with limited availability of consumer retail packs, people are used to buying fresh shrimp (including thawed, frozen products), and their relatively high prices.

**Closing remarks**

With regard to the HORECA segment and airlines, there is some recovery with the easing of restrictions, but demand remains poor at the moment. And if, as mentioned previously, there is a global over-supply of shrimp towards the end of the year, then overall market prices are likely to be weak. Conversely, if farmers decide to be conservative and hold back on seeding, then we could see a fairly stable market. For the moment though, the market is not likely to strengthen significantly as we enter the second half of the year. Retail alone is not enough to give it that shot in the arm. Restaurants are not likely to be crowded any time soon, especially with the social distancing rules in place. Many restaurants and hotels are going out of business, as the numbers of consumers and tourists will remain low at least until the end of this year. For foodservice, if there is even a 20% recovery between now and the new year, that would be very good.

The speed with which the industry adapts to producing shrimp of the sizes and forms that are most in demand, is important. Covid-19 is also a reminder how fragile the market is, and that the industry must seek to diversify markets, adapt to changing consumer patterns, and ensure that food safety issues are addressed. In the end, we will find ourselves with a different consumer, requiring a different way of promoting our products.

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**THE SPEAKERS**

**Mr José Antonio Camposano** is the Executive President of the National Chamber of Aquaculture of Ecuador, a private institution acting on behalf of the Ecuadorian shrimp industry. A major focus for the CNA is to promote a sustainable business model through which aquaculture can generate growth and well-being for the local communities in Ecuador.

**Mr Jim Gulkin** is Group Managing Director of Siam Canadian Limited, a major international trader of frozen seafood. The company is based in Bangkok but has offices in eight countries, including Vietnam, China, India, Indonesia, Myanmar, and most recently, Argentina.

**Dr Manoj M Sharma** is Director of Mayank Aquaculture Private Limited, Surat, Gujarat State, India, since 2009. He is active in the Surat and Gujarat Aquaculture Farmers’ Association. Dr Sharma has an MSc in Fisheries management and a PhD in Fisheries Science (shrimp farming).

**Ms Fatima Ferdouse** is an independent consultant on international fishery trade and marketing. During her 33 years’ full time employment with UN-FAO and INFOFISH, she worked in an advisory capacity with fishery industries, policy makers and development organisations in the Asia Pacific, Latin America and Africa. Currently she also works as a Consultant Market Analyst at FAO-Globefish.
INFOFISH Webinar Series 2020

The INFOFISH Webinar Series 2020 continued with an event on 9th June entitled “Technical Advancements in Fisheries and Aquaculture”, organised by INFOFISH and sponsored by Growel Group India. The panel of speakers comprised Dr Melba G.Bondad-Reantaso, Aquaculture Officer, FAO, Rome Italy; Mr Marcell Boaventura, Sales Manager-APAC, ADM/Bern Aqua; Mr Ravikumar Bangarusamy, General Manager-Technical, Growel Feeds India Private Ltd., India; and Dr Nguyen Duy Hoa, Global Technical Director, Empyreal Products, Cargill Inc. A total of 607 participants from 41 countries had registered to participate in the webinar.

The webinar aimed to address key technical issues faced by industry stakeholders and sought to reinforce the importance of working towards resilient and sustainable aquaculture production. Furthermore, the fisheries sector is currently facing unprecedented challenges due to the on-going coronavirus pandemic which has resulted in decreased consumption of seafood because of the misleading perception that it could be spread through seafood products and food packaging.

The first speaker, Dr Melba Reantaso, mentioned that “Biosecurity is the most important sustainability challenge. Numerous unmanaged disease outbreaks with high economic losses reflect an immature aquaculture industry (Table 1). FAO launched the Progressive Management Pathway for improving aquaculture biosecurity with close integration of public-private partnerships, and through the existing framework, enhanced capacity and the appropriate risk based approach”.

Sustainable intensification in the hatchery and nursery will be ensured by enhanced risk management, application of IoTs, robust seed, better feed (including live feed), artemia substitution; reducing the use of antibiotics and increasing probiotics application, as mentioned by Mr Marcell Boaventura during his presentation.

“Farmers cannot control the market price so controlling the production cost is the fundamental key”, said Mr Ravikumar. He added that quality seed, functional feed and better farm management can help the farmers in minimising production cost and continuing sustainable shrimp farming.

Dr Nguyen Duy Hoa stated that reducing shrimp disease risks requires a combination of better water quality management, increased investment in health nutrients and use of high-growth genetic resources for better average daily growth.

During the question and answer session, Dr Melba was asked “How can the private sector be involved in the Progressive Management Pathway (PMP) for improving aquaculture biosecurity?”. She replied that PMP-AB provides a platform for industry stakeholders and governance authorities to work together to accomplish biosecurity action plans.

In a question to Mr Boaventura: “Will Internet of Things (IoTs) take the lead in the aquaculture sector in the next decade?”, he replied that IoTs and AI give us the leverage to understand how we do, what we plan and how to achieve. Technology will give us the assurance and validation that we need to continue or change, and we all can take advantage of that.”

Mr Ravikumar was asked: “When using high protein feed, farmers face high Total Ammonia Nitrogen levels in ponds so what is the optimum protein content and how to manage the feed waste?” He replied that stringent feed management,

Table 1: Economic losses due to diseases in aquaculture

<table>
<thead>
<tr>
<th>Period</th>
<th>Species</th>
<th>Disease</th>
<th>Losses (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987-1994</td>
<td>Shrimp</td>
<td>Several pathogens</td>
<td>3 019 million</td>
</tr>
<tr>
<td>1998-1999</td>
<td>Salmon</td>
<td>ISA</td>
<td>39 million</td>
</tr>
<tr>
<td>2010-2017</td>
<td>Shrimp</td>
<td>AHPND</td>
<td>12 billion</td>
</tr>
<tr>
<td>2015</td>
<td>Shrimp</td>
<td>AHPND</td>
<td>&gt;26 million</td>
</tr>
<tr>
<td>2017</td>
<td>Tilapia</td>
<td>Several pathogens</td>
<td>450 million</td>
</tr>
<tr>
<td>2017</td>
<td>Shrimp</td>
<td>Several pathogens</td>
<td>1.6 billion</td>
</tr>
<tr>
<td>2017</td>
<td>Oyster</td>
<td>Several pathogens</td>
<td>540 million</td>
</tr>
<tr>
<td>2017</td>
<td>Seaweed</td>
<td>Several pathogens</td>
<td>190 million</td>
</tr>
</tbody>
</table>

application of functional feed and slightly underfeeding than overfeeding can reduce the feed wastes in shrimp farms. The optimum protein content for *vannamei* in India ranges from 34-38%.

Dr. Nguyen responded to the question “Is it better to include health nutrients in the feed than treating diseased shrimp after a disease outbreak?” by explaining that shrimp are cold blooded animals, not like livestock or humans. Having only health nutrients in feed cannot build adequate immunity, but a combination of health nutrients, feed with better digestibility, quality PL, and better pond management can make it possible.

The video link and presentations are accessible on the INFOFISH Website (www.infofish.org). Please keep following our social media sites (Facebook, LinkedIn, Twitter and YouTube) for announcements and updates on forthcoming webinars and podcasts.

### The Speakers

**Dr. Melba G. Bondad-Reantaso**  
FAO Fisheries and Aquaculture Department, Rome, Italy  
An aquatic animal health specialist, Dr Melba Bondad-Reantaso joined FAO in 2004 and holds the aquaculture biosecurity (AB) global portfolio. She spearheaded the Progressive Management Pathway initiative (used for livestock diseases), for improving aquaculture biosecurity. Continuing initiatives include policy guidance, risk assessments, surveillance, emergency response and disease burden.

**Mr. Marcell Boaventur**  
Sales Manager - APAC, ADM/Bern Aqua  
Mr. Marcell Boaventur is a blue thumb leader with more than 18 years of experience in aquaculture operations, aqua feeds, business development, integrated marketing and is an active member of a global aquaculture network.

**Mr. Ravikumar Bangarusamy**  
General Manager, Growel Group, India  
Mr. Ravikumar, B. has worked in the aquaculture field for more than 25 years in India and other countries, including with the Network of Aquaculture Centres in the Asia-Pacific (NACA), IFC-WorldBank Group, Asian Development Bank (ADB) and WorldFish Centre projects.

**Dr. Nguyen Duy Hoa**  
Global Technical Director, Empyreal Products, Cargill Inc.  
Dr Nguyen Duy Hoa spent more than 17 years at the National Research Institute for Aquaculture No.2 in Vietnam (RIA2), then he joined INVE in 2012 at which time he developed a successful three-phase shrimp farming protocol in a heavy EMS area. From 2013 to 2016 he worked as Shrimp Technical Service Manager and Aqua Technology Application Manager for Cargill Vietnam where he was involved in developing a best farm management package for shrimp. He is now with the Empyreal Team, a business under Cargill North America.
INFOFISH Webinar Series 2020

A virtual training session entitled “Aquatic Animal Health Management and Compliance to International Trade Obligations” was organised by INFOFISH on 11 June 2020. The speakers were Dr. Rohana Subasinghe, International Consultant and former Chief of Aquaculture Branch, FAO Fisheries and Aquaculture Department; as well as Dr. Iddya Karunasagar, International Consultant and former Senior Fisheries Industries Officer, FAO. INFOFISH was represented by Mr. Sujit Das, Technical Officer.

The training session was specially designed for the INFOFISH Member Countries to be updated on aquatic animal health management, compliance to international trade obligations, and implementation of HACCP. A total of twenty participants from six INFOFISH Member Countries attended the training; participants raised their questions and exchanged their views, and the speakers duly responded to them.

In his presentation entitled “Trade in Aquatic Animal Commodities”, Dr. Rohana Subasinghe emphasised that international trade volume of live aquatic animals is extremely high. Over one billion ornamental fishes (4 000 freshwater and 1 400 marine fish species) from more than 100 countries are being traded. All movements of live aquatic animals involve an element of pathogen, genetic and/or ecological risk. Considering the current global trade situation, a national policy of “zero risk” is not realistic but it is often possible to reduce the risk to an acceptable level.

HACCP programmes have been implemented since the mid-nineties as a control measure to ensure food safety. It provides a preventive approach to identify, evaluate and control food safety hazards. As testing looks at only a small proportion of the products being produced by a factory, and sanitary inadequacies may not be detected by testing, we need to adopt HACCP as a preventive measure, stressed Dr. Iddya Karunasagar during his presentation entitled “HACCP and Aquatic Product Safety- Global Overview”.

Mr. Sujit Das said during his presentation, entitled “National Strategies on Aquatic Animal Health Management: Key Considerations”, that most of the Asian aquaculture producing nations have adopted National Strategies for Aquatic Animal Health (NSAAH); however, it is high time to revise and update these procedures with a view to reducing Anti-Microbial Resistance (AMR) in aquatic food production systems.

During the question and answer session, Dr. Subasinghe was asked: “Supermarkets, retailers and end-consumers are increasingly demanding products which are not linked to sanitary issues, but are related to environmental and human rights that might result in the exclusion of some of the small-scale farmers who are unable to meet the cost of compliance. What suggestions would you give for developing countries to empower small-scale farmers? In reply, Dr. Subasinghe mentioned that it is a very pertinent question not only for the aquaculture sector but also for many food producing sectors. The requirement for environment friendly products is increasing due to the rising awareness of the consumers on the issue. “My advice to the small-scale sector with regards to compliance to the said requirements and to access international markets, is that they need to form a cluster or group, run the operation according to best management practices and apply for a third party certification system”, he said. In a separate question on movement of live ornamental fishes, he replied that as these fishes are not considered food
animals, unfortunately, their trade is not necessarily regulated by international standards and guidelines. As an example of one of the risks, he mentioned the spread of Koi Herpes Virus (KHV) in some countries. He added that we should keep in mind that movements of fish are for transfers, translocation and reintroduction but for introduction of new/non-native species, we have to wait for at least third generation (F3) breeding to be completed. To an additional question, he answered that we quarantine live aquatic animals, and not products.

Dr. Karunasagar was asked whether aquatic animal health pathogens can be transferred through frozen products. In reply, he said that WSSV has been present in Asia since the early 90’s and frozen shrimp has also been traded for a long time, but we have not had any incidence of WSSV being transferred from one country to another through frozen shrimp intended for human consumption. To another question on whether we need a separate SOP to handle infectious diseases like SERS COVID-2 (COVID-19) in future, he replied that existing Good Aquaculture Practices (GAP) are comprehensive, and as this virus cannot spread through water or food, there is no need for a separate SOP.

The video link and the presentations are accessible on the INFOFISH YouTube Channel (https://www.youtube.com/watch?v=MikQyaGKZMU). Please keep following the INFOFISH website and social media sites for announcements and updates on the forthcoming webinars, podcasts and training sessions.

The Speakers

Dr. Rohana Subasinghe
International Consultant & Managing Director, FUTUREFISH

Dr. Rohana Subasinghe is a specialist in aquaculture development and aquatic animal health management. He retired from FAO in October 2015, while serving as the Chief of the Aquaculture Branch. He joined FAO in 1994 and took responsibility in implementing many programmes and projects on aquaculture and aquatic animal health at national, regional and international levels, worldwide, until his retirement. Among others, at FAO, he was also responsible for analysing global trends in aquaculture development. For fifteen years, he served as the Technical Secretary to the Sub-Committee on Aquaculture of the Committee on Fisheries of the FAO, the only global inter-governmental forum on aquaculture which meets every two years. A former teacher at the University of Colombo and Universiti Putra Malaysia, Dr. Rohana earned his PhD from Stirling University. He is a founder member and former Chair Person of the Fish Health Section of the Asian Fisheries Society. He is an honorary life member of the World Aquaculture Society (WAS) and is the President of the Asia-Pacific Chapter of WAS.

Dr. Rohana is still active in the field of fisheries and aquaculture, currently extending his years of experience and expertise, as a consultant, to many agencies and institutions worldwide.

Dr. Iddya Karunasagar
International Consultant

Dr. Iddya Karunasagar obtained his Masters and Ph.D. degrees from Mysore University, India and did postdoctoral research at the University of Maryland, USA; University of Sendai, Japan; Natural Resources Institute, UK and University of Wurzburg, Germany. He served the University of Agricultural Sciences, where he rose from the position of Assistant Professor to Head of Division of Fisheries Sciences and took up the position of Director of Research at Karnataka Veterinary Animal and Fisheries Sciences University and National professorship of the Indian Council of Agricultural Research.

Dr. Karunasagar was part of FAO/WHO microbiological risk assessment in the late 90’s and served as drafting member of Vibrio risk assessment (2000-2005). He then joined FAO as Senior Fisheries Industries Officer and led a team on fish quality and safety. He played a key role in several FAO/WHO food safety risk assessments which led to the development of international food standards at Codex Alimentarius Commission. He represented FAO in meetings of Codex Committee on Food Hygiene and Codex Committee on Fish and Fishery Products. He was Lead Technical Officer for several food safety projects in Asia, Europe, Africa, South Pacific, Caribbean Islands and Latin America. He played a pivotal role in the development of WHO Five Keys for Safer Aquaculture Products.

Since his retirement from FAO, Dr. Karunasagar has been working as International Consultant with various agencies like Asian Development Bank, International Trade Center and British Standards Institute.

Mr. Sujit Das
Technical Officer, INFOFISH

Mr. Sujit Das is an aquaculture professional having more than 15 years of experience in fisheries and the aquaculture sector in the South and South East Asian countries. He obtained his Bachelor’s degree in Marine Science and Master’s degree in Aquaculture from the Institute of Marine Sciences and Fisheries, University of Chittagong, Bangladesh. He embraced different technical positions in diverse national, multinational companies and development organisations under DFID-UK.

His area of interests include innovation in aquaculture production systems, responsible aquatic animal health management and value added seafood products development. He is working to ensure sustainable and resilient aquaculture through achieving Sustainable Development Goals (SDG-17). At present, he is helming the Technical Advisory Division of INFOFISH as a Technical Officer.
Following the postponement of the 16th World Tuna Trade Conference to 19-21 May next year due to the Covid-19 pandemic, INFOFISH is organising a series of webinars with Undercurrent News as media partner, to discuss prevailing issues specific to the tuna industry as well as the unprecedented challenges that have now arisen, emerging trends in technology, sustainability, the ‘new normal’ and more. The first in this series of tuna webinars was organised on 17th June, entitled “Redefining the Global Tuna Industry”. Follow-up webinars will be held in the coming months, including a special pre-event leading up to TUNA 2021.

The speakers were Mr Phil Roberts, Managing Director of Tri Marine International Pte Limited (also the Chairman of the 16th INFOFISH World Tuna Conference and Exhibition, TUNA 2021); Mr Luciano Pirovano, Global Sustainable Development Director for Bolton Food; and Dr Darian McBain, Global Director of Corporate Affairs and Sustainability at Thai Union. Marine Instruments and Maldives Industrial Fisheries Company (MIFCO) were both Platinum Sponsors of the event, Ensis Fisheries Pvt Ltd was the Silver Sponsor, and Satlink as the Bronze Sponsor. The webinar was moderated by INFOFISH and a total number of 200 persons participated in the event.

There was consensus amongst the speakers that in general, the tuna industry was able to adapt fairly fast to the drastic changes brought about by the pandemic despite the lockdowns, transportation halts and outbreaks of disease in major tuna fishing and processing centres such as in Ecuador. Meanwhile retail sales of canned tuna have surged and the foodservice sector has suffered, with recovery still a long way off. Some valuable lessons have been learned, one being that it is important to have a diverse supply chain and to know who your suppliers are so that in times like this, you can work collaboratively with them to ensure that processing plants are still able to receive raw material as far as possible and that those supplying consumers with staples such as canned tuna are able to do so. In other words, that there is continuity in the value chain.

Should sustainability take a back seat to factors like food security and prices? The speakers thought that the converse was true. Since the pandemic began, consumers have become more interested in finding out if their supplies were safe, healthy, and traceable. There is also now an added emphasis on people and the environment, which again are linked to sustainability. Supply chains are made up of, and by, humans (including migrant labour) and so it is important to have a protected working environment for them, and that they are able to get to their jobs safely. People need to be at the heart of businesses. The industry needs to come up with strengthened social protection programmes for fish workers so that in case another global disaster strikes, these workers will still be able to feed their families, and that they live in a healthy environment with proper accommodation.

Sustainability in the environment is important because as the pandemic has taught us, problems arise when there is undesired interaction between humans and animals. Similarly the health of people is linked to the health and resilience of the oceans. With regard to the sustainability of stocks in the oceans, the point was brought up that IUU fishing is now much more difficult to carry out as compared to a decade ago simply because of the many uses of technology such as VMS that are being employed, as well as a range of e-reporting systems so that there is less need for physical observers to be on-board. Technology will in fact continue to be an increasingly vital part of the tuna industry after the pandemic, not only in sustainability but also in places such as processing plants where one can expect to see more automation.

Moving on to perhaps the most familiar tuna product for consumers: canned tuna. Tuna unfortunately suffers an image problem and much more could be done to make it attractive
to a new generation of consumers rather than regarded as an old fashioned food. How do we engage with our consumers interactively to create awareness of how good the product is, and how to use it in their cooking regularly? A good example of a product that is seeing double digit growth is tuna salads in Europe, because it fits in with what the consumer wants. In other regions such as Asia however, tuna is not a traditional food and therefore more work is required to engage with the consumers there. South Korea and Mexico are interesting examples of how tuna has crept into the local cuisine.

Price-wise, tuna is not that expensive but anyway, even for premium products, it depends on how it is marketed to consumers (healthy, convenient, safe, and versatile). With regard to whether there were increased sales of tuna from MSC certified fisheries and those from non-certified fisheries, the consensus was that a rise, if any, has not been noticeable during this pandemic period but there is every reason to expect that consumers will continue to be willing to pay more for sustainable products.

With regard to challenges faced by the fishermen, the recent drop in fuel prices was discussed as a positive thing for the industry because of the savings. However, in many cases these fuel savings were cancelled out because unfortunately for those in this sector, the price of tuna in the markets also fell at the same time. Another major problem for fishing vessels has been the closure of ports and landing sites, and that the fishers have to remain at sea because there is no transport available for them to return to their homes. The longer the disruptions continue, the greater the likelihood of operational problems arising.

The recording of the webinar can be accessed via: http://infofish.org/Webinar/index.php/redefining-the-global-tuna-industry

THE SPEAKERS

Mr Phil Roberts MBE is Managing Director of Tri Marine International Pte Limited/Chairman, 16th INFOFISH World Tuna Conference and Exhibition, TUNA 2021. He has worked in the deep water trawling and shrimp industries, and since 1988 in the tuna catching, processing and trading sectors. He has been with the Tri Marine group since 1997, and since 2013, he is Managing Director of Tri Marine International Pte Limited, the parent company of Tri Marine’s integrated global trading, processing and catching companies.

Dr. Darian McBain is Global Director of Corporate Affairs and Sustainability at Thai Union. She holds a PhD on social indicators for global supply chain analysis from the University of Sydney, where she serves as an Adjunct Senior Lecturer of Integrated Sustainability Analysis. She is also a board member of the not-for-profit Be Slavery Free. Dr McBain is the winner of the Edie Sustainability Leader of the Year Award 2018, the Ethical Corporation 2018 Responsible Business Leader of the Year, the SeaWeb Seafood Leader of the Year for Vision 2019, and is one of CSR Asia’s Sustainability Superwomen 2019.

Mr Luciano Pirovano is Global Sustainable Development Director for Bolton Food. In 2008, he participated in the creation of the ISSF (International Seafood Sustainability Foundation) as a founding member and is now Chair of the ISSF Board of Directors. He actively participated in the launch of the “Responsible Quality” project, Bolton Food’s Corporate Social Responsibility strategic approach to sustainability, extending into several projects such as, for example, the multi-year partnership with WWF.
INFOFISH organised a virtual training through a webinar entitled “Market Intelligence and Market Analysis Training” on 23 June 2020 for INFOFISH Member Countries. The training aimed to provide exposure on accessing and analysing trade data and market information, market intelligence and market analysis. There were 34 participants from five Member Countries (Bangladesh, Cambodia, Fiji, Malaysia and Thailand) as well as from the SEAFDEC Secretariat in Bangkok, Thailand.

The training began with a briefing by Shirlene Anthonysamy, Director, INFOFISH, on the principles, methods and factors involved in carrying out a market analysis. The highlight of the training was guidance on access to the online trade databases available in order to prepare a market analysis. The tools included FAO-Globefish, the International Trade Centre (ITC), US NMFS and Japan Customs websites, and the FAO FishStatJ software. Access to, and navigation of, these websites and how to extract data statistics, was demonstrated by INFOFISH Trade Promotion Officers Joelyn Sentina and Apimeleki Cokanasiga.

The presentations were followed by a question and answer session. There were requests for INFOFISH to have specific hands-on or practical sessions on accessing the data tools, and also an e-commerce training session for small scale fishers. These requests were noted and will be responded to in due course.
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Realtime underwater monitoring

BIOceanOR, a startup at the University of Nice Sophia-Antipolis, France, has developed an “underwater weather station” which is able to monitor water quality in real time and also predict its future quality. Suitable for use in fish farms, the autonomous system is equipped with long-range communication technology (LoRaWan and Iridium).

BIOceanOR’s AquaREAL platform allows for alert thresholds to be sent via SMS or email, received in real time anywhere in the world. The data can be downloaded in raw format (CSV format). AquaREAL features a configurable interface, is accessible by web browsers or smartphones, provides data security, and alerts are sent to smartphones and e-mail.

The most powerful genomic profile for vannamei

The GeneSeek® Genomic Profiler™ (GGP) Shrimp 50000 (GGP Shrimp 50K), designed by NEOGEN Genomics (USA) in collaboration with Centre for Aquaculture Technologies (CAT) Canada, provides genomic selection and pedigree evaluation for the Pacific white shrimp (Litopenaeus vannamei) to accelerate genetic improvement during breeding programmes. The array contains over 50,000 genome-wide single nucleotide polymorphisms (SNPs), validated by using broodstocks from several commercial breeding programmes.

According to Neogen Genomics Director Jeremy Walker (jwalker@neogen.com), the solution delivers more accurate evaluation of genetic merit, genome-wide selection, comparative genetic studies and higher density imputation. These advantages, plus a host of causative mutations, make the GGP 50K the most advanced chip to power genetic improvement.

Technical specifications:
- Includes 6,500 published single nucleotide polymorphisms (SNPs) proven for genome-wide association studies (GWAS)
- Designed for GWAS and genomic selection
- 43,474 high-quality and informative SNPs from varied geographic regions
- SNPs are strategically spaced across the mapped shrimp genome
- 60 putative functional SNPs for ammonia tolerance, growth, and disease resistance

Microorganism feeds for fish

A recent press release by Calysta reported that together with Bluestar Adisseo Company (Adisseo), a joint venture named Calysseo will be established to develop FeedKind®, an innovative feed solution for aquaculture, and to provide exclusive supply for Asian markets.

FeedKind has been extensively trialled as a replacement for animal protein

FeedKind protein, developed in Norway over two decades, is a family of highly digestible feed ingredients produced by a natural fermentation process. It is composed of naturally occurring microorganisms, is non-GMO, and does
An increasing number of companies are going into production of vegan alternatives to fish.

In the last few years there has been a surge in number of start-ups looking to create a consumer ‘seafood’ product, but without incorporating actual seafood. While sales of vegan ‘seafood’ have been on the rise in Europe and the US, the question remains as to how much of the market it will capture. In the US, the country with the most vegan seafood start-ups, plant-based seafood made up only 1% ($9.5m) of the dollar amount of all retail sales of plant-based meat in 2019.

Swedish start-up Hooked is one such company, currently developing what it says is the world’s first plant-based shredded salmon and tuna alternatives. The company says the final product will have a comparable nutritional profile and taste like real fish, and also importantly, contributes towards the sustainability of wild fish resources. The products are made from soya protein isolate, with added seaweed for a fishy flavour. Algal oil is added as a source of omega-3 fatty acids.

In the Netherlands, Vegan Seastar has just launched its first products: No Tuna & Zalmon, which use tapioca starch and glucose from seaweed in addition to Omega3 oils from rapeseed and flaxseed. The company has also developed vegan alternatives to sashimi, sushi and nigiri dishes. Novish, another Dutch company, has recently signed a deal to distribute vegan ‘fish’ burgers and sticks in Canada.

Vegan ‘seafood’ companies are also gaining ground in the UK, such as Good Catch which is marketing fish-free ‘tuna’ made of a legume blend (for protein) and algal oil (for omega-3 fatty acids). There is also the first vegan ‘fish’ and chip shop which opened in 2018 in London. The owners Sutton & Sons, say that vegan items (‘prawn’ cocktail, ‘calamari’ strips, and ‘lobster’ roll) contribute about 20% of their total revenue.

In Asia, Singapore has become a leader in alternative seafood. The Singapore Institute of Food and Biotechnology Innovation began collaborating in August 2019 with the Singaporean branch of Sophie’s Kitchen, a US plant-based seafood company, on fermenting microalgae to produce a protein substitute. California-based Sophie’s Kitchen opened in 2011, and has since made a name for itself for its plant-based canned ‘tuna’, frozen ‘crab’ cakes, ‘fish’ fillets and ‘shrimp’, frozen and refrigerated smoked ‘salmon’. These products are soy-free, being made of konjac (also known as elephant yam) and yellow pea.

In 2022, delivering 20,000 tonnes of FeedKind® protein per year.

Another alternative protein feed for fish is being developed by KnipBio, using many different strains of methyllobacterium that convert ethanol, methanol and other abundant, low-cost feedstocks into single-cell protein. The company is looking at three specific product strains. The first is a straightforward fishmeal replacement that mirrors the protein and amino acid content of conventional fishmeal. The second is a fishmeal replacement that also provides valuable prebiotics designed to improve fish gut health. The third adds a range of important carotenoids useful for a number of high-value fish species. The company is already marketing KnipBio Meal, which is sold as an effective, affordable feed replacement for fish species.
Compact RAS facility

Recirculating Aquaculture Systems (RAS) are considered to be among the most high-tech aquaculture production systems due to their robustness, efficient control of the environment, waste and pathogen management, along with the possibility to include a wide range of culture species.

The Alpha NanoRAS is a compact, transportable full water treatment unit which promises excellent water quality (low TSS, high nitrification rates and excellent gas balance) and designed to ensure safety and biosecurity. It includes mechanical filtration (drum filter with 40 micron screens and automatic backwash), biofilter (in three chambers with option to work as fixed bed or moving bed), gas balancing filter (to extract the CO\(_2\) from the water while adding oxygen to saturation), UV light (for disinfection purposes), lift pump (to pressurise the water back to the fish/shrimp tanks), motor control cabinet including frequency drives and HMI touch screen. Optional features include an ozone and skimmer system, heating/chilling system, heat recovery system, and sludge treatment system.

Pre-commissioned and a plug ‘n’ play solution. Built using environmentally friendly, recyclable, food-grade PP, it is corrosion free in saltwater, and has a footprint of 2.5m\(^2\) and a production capacity (species dependant) of 9 to 14 tonnes/year.

Manufacturer: Alpha-Aqua AS, Denmark (www.alpha-aqua.com)

Artificial light technology to reduce bycatch

UK-based SafetyNet Technologies has developed a device called Pisces which uses artificial light technology to alter the behaviour of fish and other marine species so as to reduce unwanted bycatch by upwards of 60% while increasing fishing revenues. This programmable LED device can be fitted to a range of commercial fishing gear types and has been successfully field-tested with a variety of commercial fish species. The company says it is designed to improve the effectiveness and performance of fishing operations by increasing the proportion of target species harvested per vessel trip, reducing sorting time and facilitating compliance with fishing regulations.

Manufacturer: SafetyNet Technologies, UK (www.sntech.co.uk)

Advance warning on sea lice

A Bergen-based aquaculture analytics company, Manolin, has launched a new tool which gives salmon farmers advanced warning about outbreaks of sea lice and pancreas disease (PD). Combining geospatial analysis and machine learning models with production data, the tool aims to provide farmers with a more holistic view of fish health.

Manolin members access a real-time dashboard to identify sites at risk from pancreas disease (PD) and lice events. By integrating production, health, and environmental data – such as inventory, growth, feed, mortality, treatments, oxygen and salinity – customers gain a comprehensive data archive broken down by site, generation and cage.

Members also receive custom reports digging deeper into production analysis and industry trends. Current users – covering 42 percent of Norway’s salmon farming industry – receive automated email alerts for nearby lice and treatment activity to enable preventive action.

Manufacturer: Manolin, Bergen, Norway. Information: Natalie Brennan (nat@manolinaqua.com), Chief Operating Officer.

Underwater robots

When you need to have an underwater eye, Remotely Operated Vehicles (ROVs) come in useful. One company has produced what it calls the REVOLUTION ROV, equipped with automated station holding, camera, sonar, and manipulator, which is capable of rotating 260 degrees for situational awareness. It runs on batteries for up to eight hours, has a depth rating of 305 metres, and is equipped with robust vectored thrusters to move laterally and work in currents.

Manufacturer: Deep Trekker, Canada. Information: sales@deeptrekker.com
THE STATE OF WORLD FISHERIES AND AQUACULTURE: SUSTAINABILITY IN ACTION

Published by the Food and Agriculture Organisation (FAO), Rome, Italy, 2020.

The 2020 edition of The State of World Fisheries and Aquaculture is devoted to the topic of ‘Sustainability in Action’. It demonstrates the significant and growing role of fisheries and aquaculture in providing food, nutrition and employment. It also shows the major challenges ahead despite the progress made on a number of fronts. For example, there is growing evidence that when fisheries are properly managed, stocks are consistently above target levels or rebuilding, giving credibility to the fishery managers and governments around the world that are willing to take strong action.

However, the report also demonstrates that the successes achieved in some countries and regions have not been sufficient to reverse the global trend of overfished stocks, indicating that in places where fisheries management is not in place, or is ineffective, the status of fish stocks is poor and deteriorating. This unequal progress highlights the urgent need to replicate and re-adapt successful policies and measures in the light of the realities and needs of specific fisheries. It calls for new mechanisms to support the effective implementation of policy and management regulations for sustainable fisheries and ecosystems, as the only solution to ensure fisheries around the world are sustainable.

Among other things, the report highlights major trends and patterns observed in global fisheries and aquaculture and scans the horizon for new and emerging areas that need to be considered if we are to manage aquatic resources sustainably into the future.

This publication can be downloaded from the FAO website at no cost.

WELFARE INDICATORS FOR FARMED RAINBOW TROUT

Produced by Nofima, the Institute of Marine Research (IMR), the Norwegian Veterinary Institute (NVI), and Nord University (all of which are based in Norway); and the University of Stirling, UK.

Part A gives an overview of fish welfare, and outlines what is known about the welfare needs of each species, and conditions that may affect the fulfillment of these needs. Part B outlines fit-for-purpose indicators for assessing fish welfare in different production systems, such as sea cages and flow-through production systems. Part C adopts the same approach and assembles welfare indicator toolboxes for different routines and operations, such as pumping, crowding, grading, vaccination and slaughter. The WI toolboxes in Part C are set up to give you some guidelines on how and why they should be used.

The trout handbook is 310 pages long and can be downloaded for free from the Nofima website.
Publications in Brief//

MARINE STEWARDSHIP COUNCIL SUSTAINABLE TUNA HANDBOOK
*Published by the Marine Stewardship Council, May 2020.*

This handbook comes at a critical time: with the global demand for tuna increasing over recent decades, the pressure on local populations and ecosystems has also intensified. At the same time, the diversity in the sector has fuelled questions related to gear type and fishing methods, species, sustainability, and environmental impact, to name a few.

In addition to examining fishing gears and methods, species, impacts and issues, this handbook also profiles a range of MSC certified tuna fisheries illustrating how different types of fisheries can meet the MSC Standard, even with varied gear types, fishing methods, species and management approaches. It examines how these fisheries gained their sustainability credentials, including the actions they have taken over time, to achieve and maintain their certification. Common themes include:

- Improved observer coverage
- Improving management to protect tuna stocks in the long term
- Minimising fishery impacts on other species, including overfished stocks and Endangered,
- Threatened and Protected (ETP) species

THE FISHERIES AND AQUACULTURE ADVANTAGE: FOSTERING FOOD SECURITY AND NUTRITION, INCREASING INCOMES AND EMPOWERMENT
*Published by the International Fund for Agricultural Development (IFAD), 2019.*

This report presents selected achievements and lessons from the growing portfolio of fisheries and aquaculture investments supported by the International Fund for Agricultural Development (IFAD). The introduction summarises key issues and gives an overview of IFAD-supported actions and impacts of working with smallholders in developing countries. In keeping with IFAD’s drive to bring together and strengthen the key mainstreaming themes of climate and the environment, nutrition, gender, youth and indigenous peoples, the introduction touches upon all of them. A number of “witness statements” present the impacts of IFAD-supported engagement in fisheries and aquaculture on the lives of individual smallholders, and five case studies from the ongoing portfolio (Brazil, Cameroon, Djibouti, Eritrea and India) give concrete examples of how IFAD is working to support smallholders.

*The report can be downloaded at no cost from the IFAD website.*
The FISH INFONetwork (FIN) consists of seven independent partners who cover all aspects of post-harvest fisheries and aquaculture. Fifty national governments have signed international agreements with the different FIN services and are using the expertise of these services to develop the fishery sector worldwide.

The FIN pages are a regular feature in the four network magazines:
- INFOFISH International
- INFOPESCA Internacional
- EUROFISH Magazine
- INFOSAMAK Magazine

They present the FIN-wide spectrum of activities, showing actions and results.

The FIN has more than 70 full-time staff and works with more than one hundred international experts in all fields of fisheries. Through its link from FAO GLOBEFISH to the FAO Fisheries Department, it also has access to the latest information and knowledge on fisheries policy and management issues worldwide.

The execution of multilateral and bilateral projects is one of the main activities of the network. It is also widely known for its range of publications and periodicals as well as for the organisation of international conferences, workshops and training seminars. All eight services offer different possibilities for co-operation with the private sector, institutes, government offices and donors.

For more information on the FISH INFONetwork visit the website www.fishinfonet.org.

**FAO and French institute produce report on El Niño’s impact on fisheries and fish farming**

El Niño is widely known as a climate pattern that begins over the Pacific Ocean but wreaks havoc on ecosystems in land and water far away from its origin. Its consequences include droughts and major harvest shortfalls in large swathes of Africa and Indonesia, forest fires in Australia, and serious flooding in South America. However, its impact on the fisheries and aquaculture sector is largely unknown. To remedy this FAO has published, in partnership with French National Research Institute for Sustainable Development (IRD France), a report, *El Niño Southern Oscillation (ENSO) effects on fisheries and aquaculture*, which captures the current state of knowledge on the impacts of ENSO events across sectors, from food security to safety at sea, from fish biology and fishing operation to management measures. While understanding of ENSO has developed greatly since the 1950s, researchers have also been confounded as its incidences are rarely similar. Adding to the complexity is that the frequency and intensity of these events appear to have intensified in the past two decades, with some climate models suggesting these trends may continue as the climate changes.

The report identifies five broad types of ENSO:
- Extreme El Niño
- Moderate Eastern Pacific
- El Niño
- Moderate Central Pacific
- El Niño
- Coastal El Niño
- Strong La Niña

For marine fisheries, the volume as well as the dominant species in fish catches can change dramatically depending on the type of ENSO. While the bulk of the net change is on Eastern Pacific fisheries, there are notable impacts on some fish populations in the Atlantic Ocean and some impact on tuna fisheries in the Indian Ocean. An IFFO report from 2016 shows that of the 20m tonnes of raw material used for fishmeal and fish oil production globally, some 14m tonnes are whole fish and about half of this comes from Latin American fisheries. The impact of ENSO events on these fisheries thus has repercussions on fishmeal and fish oil production and, by extension on fish feed manufacturing and prices.

Fostering nimble fishing techniques can contribute to resilience, as Peruvian fishers showed when they adjusted to catch more shrimp that moved into warmer waters and thus offset the missing anchoveta. At the same time, the authors note that El Niño events do not necessarily favour productivity of alternate species such as sardine and mackerel but rather increase their susceptibility to capture — relevant information for fisheries managers. Evidence also suggests that ENSO events can significantly impact aquaculture output, particularly for marine plants, molluscs and crustaceans. The report can be downloaded from http://www.fao.org/documents/card/en/c/ca8348en.

**FAO brief: How COVID-19’s impact on fisheries and aquaculture can be mitigated**

Fisheries and aquaculture are also affected by the spread of COVID-19. Producers, processors, traders, and consumers both directly and indirectly feel the impact of the virus, and for populations that depend heavily on seafood for food security and nutrition, the consequences of the virus can be severe. FAO has therefore released a brief on how COVID-19 is affecting the fisheries and aquaculture sector and suggested measures to support the different players in the supply chain. Production, for instance, may suffer from the imposition of sanitary measures on board that make fishing difficult, crews may not be able to join their vessels due to travel restrictions, and the necessary supplies of bait or ice may not be available. Both fisheries and aquaculture production and distribution are affected by the closure of markets, the shutdown of the HORECA sector, and restrictions on flights and cargo movements. In the processing sector issues with cross border transport, uncertain supply of raw materials, and market restriction are among the challenges companies must face. COVID-19 is also likely to have an impact on fisheries management and policy as stock assessments, fisheries observer programmes, and science and management meetings may be postponed or cancelled. Measures to support the different elements in the supply chain extend from expanding government purchases of seafood to maintain demand and prevent a slump in prices, through extending credit and microfinance facilities to fish farmers to ensuring smooth passage of goods at ports, rail terminals, and at border crossings. The complete brief is available at http://www.fao.org/documents/card/en/c/ca8637en
2020

MAY

19-21 Aquaculture UK
Aviemore, Scotland
https://aquacultureuk.com/

27-29 (POSTPONED)
INOFISH WORLD TUNA TRADE CONFERENCE & EXHIBITION (TUNA 2020)
Bangkok, Thailand
http://tuna.infofish.org/

JULY

8-10 Indo Fisheries
Jakarta, Indonesia
https://www.indofisheries.id/

AUGUST

21-23 China International (Guangzhou) Fishery and Seafood Expo
Guangzhou, China
http://www.chinafishex.com/index.asp

SEPTEMBER

21-23 Seafood Expo Russia
Saint Petersburg, Russia
https://seafoodexporussia.com/en/

23-25 International Indonesia Seafood & Meat Expo
Jakarta, Indonesia
https://iism-expo.com/

30 Sept - 2 Oct Japan International Seafood & Technology Expo
Tokyo, Japan
https://seafood-show.com/japan/

OCTOBER

15-17 Aqua Fisheries Myanmar (Aqua MY)
Yangon, Myanmar
aquafisheries-expo.com

15-17 Future Fish Eurasia
Fuar Izmir, Izmir, Turkey
eurasiafairs.com

26-28 VIEFTISH
Ho Chi Minh, Vietnam

26-28 World Seafood Shanghai (SIFSE)
Shanghai, China

NOVEMBER

3-5 SEAFEX
Dubai, UAE
www.seafexme.com

4-6 Busan International Seafood & Fisheries Expo (BISFE)
Busan, South Korea
www.bisfe.com

18-20 Seafood Expo Asia
Singapore Expo, Singapore
https://www.seafoodexpo.com/asia/

DECEMBER

14-18 World Aquaculture 2020
Singapore
http://www.marevent.com

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