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PEARLS THROUGH TISSUE CULTURE – THE PROMISE

By Ajai Kumar Sonkar
Traditionally, pearl culture entails introducing live mantle tissue into the gonad region of another oyster of the same species, together with a nucleus around which the pearl will form. Through his research, the author has discovered an innovative in-vitro pearl culture technique, not unlike that used in organ culture, which promises to give a much-needed boost to marine pearl culture. With this new approach, the oysters are kept safe from predators and poachers, and the production cost of the pearls is also substantially lower.

TECHNOLOGICAL TRENDS AND INNOVATIONS IN AQUACULTURE: AN UPDATE

By Sujit Krishna Das
Unlocking the immense potential of disruptive technologies is the key to achieving greater global food security as well as making the difference in establishing responsible and transparent fishery value chains. This article will provide comprehensive updates on innovations in aquaculture, describing in brief its history, current technological interventions, traditional vs smart farming, importance of sustainable intensification, collaboration and partnerships. It will also take a peek into the future, focusing on ‘sustainability-focused’ innovations and attempt to chart the way forward.

ENHANCING GOVERNANCE IN ASIAN SMALL-SCALE FISHERIES VALUE CHAINS

By Firoza Buranudeen
The small-scale fisheries sector in Asia is still lagging behind and those involved in its value chains remain mired in poverty as well as suffer inadequate access to basic human rights. One major reason for this is a lack of significant representation in national decision-making processes, resulting in poor governance and regulatory frameworks, and which in turn perpetuate inequity throughout the value chains. Understanding how small-scale communities function and adopting a collaborative, participatory approach may help in efforts to enhance governance in this sector.

THE US TUNA MARKET SHOULD THINK LIKE A STARTUP

By Jan Tharp
The COVID-19 pandemic has turned the US tuna market upside down. Effects include dramatic increases in labour costs coupled with workforce shortages, supply chain disruptions, freight cost increases in tandem with availability decreases, and shortages of packaging materials. Through the chaos, the pandemic has prompted an upsurge of younger consumers to the category; consumers with whom Bumble Bee have consistently struggled to find relevancy. The startup mentality illustrates how our industry can use innovative thinking and digital tools to establish thriving connections with younger generations for years to come.

MARKETING AND PROMOTION OF ARTISANAL GROPER FARMING IN THE MALDIVES

By Ahmed Rashid
As the Maldives is surrounded by the ocean, the fisheries sector and the food that comes from the sea are of great significance to its population. In line with its vision of maintaining the fisheries sector as being one of the greenest in the world, the government is further developing its blue economy through the establishment of a grouper farming project at Adh. Atoll. The results have been encouraging; however, the author recommends increased focus on the marketing and promotional aspects in order for the beneficiaries of the project to fully realise the viability of grouper farming.

BRIAN TSUYOSHI TAKEDA
Founder and CEO of Urchinomics, a Norway-based aquaculture venture that aims to turn ecologically destructive sea urchins into high valued seafood products.

Cover image: Ecologically restorative, ranched Murasaki urchins
Credit: Urchinomics
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In the blink of an eye, another year is ending. There is a collective feeling of accomplishment at INFOFISH that we have been able to adapt to the new working environment and have continued to serve the fishery industry worldwide. In this regard, we extend our sincere appreciation to INFOFISH Member Countries, regional and international organisations such as FAO, captains of industry and many other leading voices, for their support and collaboration in these challenging times. We look forward to another productive year with our partners in the industry.

Appropriately, we begin our last issue of this year with a look at how the COVID-19 pandemic has turned the US tuna market upside down - labour costs, workforce shortages, supply chain disruptions, freight cost increases, etc. We are privileged to have an article on this topic, penned by Jan Tharp, CEO of Bumble Bee Foods, whose tenure has seen the company rise above the challenges posed not only the pandemic, but also other crises. Interestingly, Ms Tharp suggests that even established companies should adopt the start-up mentality to generate innovative thinking where it matters most.

This theme of innovation runs through two other articles in this issue, one on pearl culture and the other containing a review of technological advances in aquaculture. In the former, the author presents the results of his successful research on an innovative technique for in-vitro pearl culture, not unlike that used in organ culture, and which promises to give a much-needed boost to marine pearl culture. The other article describes topics such as traditional vs smart farming, importance of sustainable intensification, collaboration and partnerships. It also takes a look at upcoming ‘sustainability-focused’ innovations and attempts to chart the way forward.

Also related to innovation, readers will be fascinated by the advances being made in sea urchin farming, as related by Brian Takeda, Founder and CEO of Urchinomics, which is a Norway-based aquaculture venture that aims to turn ecologically destructive sea urchins into high valued seafood products. A beautiful photograph of the sea urchins cultured by the company can be seen on the Cover of this issue.

Under the Marketing category is an article on group farming in the Maldives, an activity which promises to elevate incomes for the small-scale communities living at atolls. The results have been encouraging; however, the author recommends increased focus on the marketing and promotional aspects in order for the beneficiaries of the project to fully realise the viability of group farming.

Still on the subject of small fishing and aquaculture communities, no one would deny that they play an irreplaceable role in ensuring food security and sustaining livelihoods of people all through the supply chain, but in practice the sector is not treated with the respect that it deserves. In this context, and as a curtain raiser to the International Year of Artisanal Fisheries and Aquaculture (IYFA 2022) declared by FAO for next year, this issue contains an article calling for the greater involvement of SSF in decision-making processes to ensure equity and resilience for all.

In addition to the articles mentioned above, we invite you to read through the rest of the magazine, the contents of which are intended to provide a holistic view of the global fisheries industry – such as industry notes, marketing information, as well as notes on innovations and equipment.

We wish you happy reading and a wonderful year-end holiday season. May 2022 bring better times for all!

Shirlene Maria Anthonysamy
Director, INFOFISH
Resúmenes de los principales artículos

EL MERCADO ESTADOUNIDENSE DE ATÚN DEBERÍA PENSAR COMO UNA EMPRESA EMERGENTE ...............................................8
Por Jan Tharp

La pandemia de COVID-19 ha puesto patas arriba el mercado estadounidense de atún. Los efectos incluyen aumentos drásticos en los costos laborales junto con escasez de mano de obra, interrupciones de la cadena de suministro, aumentos en los costos de flete y menor disponibilidad, y escasez de materiales de empaque. Además, la pandemia ha provocado el incremento de consumidores jóvenes en la categoría; consumidores con los que hemos luchado constantemente para conectar. La mentalidad de una empresa emergente (startup) ilustra cómo nuestra industria puede utilizar el pensamiento innovador y las herramientas digitales para establecer conexiones prósperas con las generaciones más jóvenes en los próximos años.

PERLAS A TRAVÉS DEL CULTIVO DE TEJIDOS - PROMETEDOR .................................................................22
Por Ajai Kumar Sonkar

Tradicionalmente, el cultivo de perlas implica la introducción de tejido vivo (manto) en la región de las gónadas de otra ostra de la misma especie, junto con un núcleo alrededor del cual se formará la perla. A través de su investigación, el autor ha descubierto una innovadora técnica de cultivo de perlas in vitro, similar a la utilizada en el cultivo de órganos, que promete dar un impulso muy necesario al cultivo de perlas marinas. Con este nuevo enfoque, las ostras se mantienen a salvo de depredadores y cazadores furtivos, y el costo de producción de las perlas también es sustancialmente menor.

MARKETING Y PROMOCIÓN DE LA ACUICULTURA ARTESANAL DE MERO EN LAS MALDIVAS .................................................34
Por Ahmed Rashid

Dado que las Maldivas están rodeadas por el océano, el sector pesquero y los alimentos que provienen del mar son de gran importancia para su población. Según su visión de mantener el sector pesquero como uno de los más ecológicos del mundo, el gobierno está desarrollando aún más su economía azul mediante el establecimiento de un proyecto de cultivo de mero en Adh Atoll. Los resultados han sido alentadores. Sin embargo, el autor recomienda un mayor enfoque en los aspectos de marketing y promoción para que los beneficiarios del proyecto se den cuenta plenamente de la viabilidad del cultivo de mero.

DESARROLLOS TECNOLÓGICOS E INNOVACIONES EN ACUICULTURA: UNA ACTUALIZACIÓN ........................................53
Por Sujit Das

Apostar al inmenso potencial de las tecnologías disruptivas es la clave para lograr una mayor seguridad alimentaria en el mundo, así como para marcar la diferencia en el establecimiento de cadenas de valor que produzcan alimentos sostenibles y transparentes. Además, el 34º Período de Sesiones de la FAO-COFI y la 4ª Conferencia Mundial sobre Acuicultura Millennium +20 (Declaración de Shanghái) han reiterado la importancia de innovar y de las tecnologías para construir un sector acuícola sostenible, resiliente y transparente. Este artículo proporcionará actualizaciones globales sobre las innovaciones en la acuicultura, describiendo su breve historia, las intervenciones tecnológicas actuales, la acuicultura tradicional frente a la inteligente, la importancia de la intensificación sostenible, la colaboración y las asociaciones. También echará un vistazo al futuro, enfocándose en las innovaciones “centradas en la sostenibilidad” e intentará delinear el camino a seguir.

MEJORAR LA GOBERNANZA EN LAS CADENAS DE VALOR DE LAS PESQUERÍAS A PEQUEÑA ESCALA DE ASIA ..........59
Por Firoza Buranudeen

El sector de la pesca en pequeña escala de Asia todavía está rezagado y quienes participan en sus cadenas de valor siguen sumidos en la pobreza y sufren de un acceso inadecuado a los derechos humanos básicos. Una de las principales razones de esto es la falta de representación significativa en los procesos nacionales de toma de decisiones, lo que genera marcos regulatorios y de gobernanza deficientes y, a su vez, perpetúa la inequidad en todas las cadenas de valor. Comprender cómo funcionan las comunidades en pequeña escala y adoptar un enfoque colaborativo y participativo puede ayudar en los esfuerzos para mejorar la gobernanza en este sector.
Résumés des articles de fond

LE MARCHÉ AMÉRICAIN DU THON DEVRAIT SE CONSIDÉRER COMME UNE START-UP .......................................................8
Par Jan Tharp

La pandémie de la COVID-19 a bouleversé les habitudes du marché américain du thon. Les effets comprennent des augmentations spectaculaires des coûts et des pénuries de main-d’œuvre, des perturbations de la chaîne d’approvisionnement, des augmentations des coûts de transport parallèlement à une diminution de la disponibilité et des pénuries de matériaux d’emballage. Face au chaos, la pandémie a provoqué une recrudescence de jeunes consommateurs dans cette catégorie de produit, des consommateurs avec qui nous avons toujours eu du mal à trouver leur pertinence. La mentalité de start-up illustre comment notre industrie peut utiliser une pensée innovante et des outils numériques pour établir des liens florissants avec les jeunes générations pour les années à venir.

PRODUCTION DE PERLES PAR LA CULTURE DE TISSU – LA PROMESSE ............................................................................22
Par Ajai Kumar Sonkar

Traditionnellement, la perliculture consiste à introduire des tissus vivants du manteau dans Les gonades d’une autre huître de la même espèce, ainsi qu’un noyau autour duquel va se former la perle. Grâce à ses recherches, l’auteur a découvert une technique innovante de culture des perles in vitro, semblable à celle utilisée dans la culture d’organes, qui promet de donner un coup de pouce bien nécessaire à la culture marine des perles. Avec cette nouvelle approche, les huîtres sont protégées des prédateurs et des braconniers, et le coût de production des perles est également nettement inférieur.

COMMERCIALISATION ET PROMOTION DE L’ÉLEVAGE TRADITIONNEL DE MÉROU AUX MALDIVES .......................................34
Par Ahmed Rashid

Etant donné que les îles Maldives sont entourées par l’océan, le secteur de la pêche et la nourriture provenant de la mer revêtent une grande importance pour sa population. Conformément à sa vision de maintenir le secteur de la pêche comme l’un des plus verts au monde, le gouvernement continue de développer son économie bleue grâce à la mise en place d’un projet d’élevage de mérou sur l’Atoll d’Adh. Les résultats ont été encourageants ; cependant, l’auteur recommande de se concentrer davantage sur les aspects marketing et promotionnels afin que les bénéficiaires du projet réalisent pleinement la viabilité de l’élevage de mérou.

DÉVELOPPEMENTS TECHNOLOGIQUES ET INNOVATIONS EN AQUACULTURE : UNE MISE À JOUR............................................53
Par Sujit Das

Libérer l’immense potentiel des technologies de rupture est la clé pour parvenir à une plus grande sécurité alimentaire mondiale et faire la différence en établissant des chaînes de valeur de la pêche responsable et transparente. De plus, la 34e session de la FAO-COFI et la 4e Conférence Mondiale sur l’Aquaculture Millennium +20 (Déclaration de Shanghai) ont réitéré l’importance des innovations et des technologies pour construire un secteur aquacole responsable, résilient et transparent. Cet article fournira des mises à jour complètes sur les innovations en aquaculture, décivant son bref historique, les interventions technologiques actuelles, l’agriculture traditionnelle par rapport à l’agriculture intelligente, l’importance de l’intensification durable, la collaboration et les partenariats. Il jettera également un regard sur l’avenir, en se concentrant sur les innovations ‘axées sur la durabilité’ et tentera de tracer la voie à suivre.

AMÉLIORER LA GOUVERNANCE DANS LES CHAÎNES DE VALEUR DE LA PÊCHE ARTISANALE ASIATIQUE ........................59
Par Firoza Buranudeen

Le secteur de la pêche artisanale en Asie est toujours à la traîne et ceux qui sont impliqués dans ses chaînes de valeur restent embourbés dans la pauvreté et souffrent d’un accès insuffisant aux droits humains fondamentaux. L’une des principales raisons de cette situation, est le manque de représentation significative dans les processus décisionnels nationaux, ce qui entraîne une mauvaise gouvernance et des cadres réglementaires inappropriés, et par ricochet, perpétuent les inégalités dans l’ensemble des chaînes de valeur. Comprendre comment fonctionnent les communautés de pêche artisanale et adopter une approche collaborative et participative peuvent aider dans les efforts visant à améliorer la gouvernance de ce secteur.
文章摘要

美国金枪鱼市场应该像创业公司一样思考
Jan Tharp
新冠疫情影响使美国金枪鱼市场发生了翻天覆地的变化。疫情带来的影响包括劳动力成本急剧增加以及劳动力短缺、供应链中断、货运成本增加与可用性下降、包装材料短缺。虽然金枪鱼行业发展遭遇困境，但疫情之下更多的年轻消费者购买金枪鱼，年轻人一直是我们想要开拓的消费群体。创业心态显示出金枪鱼行业如何使用创新思维和数字工具在未来几年与年轻一代建立蓬勃发展的联系。

通过组织培养养殖珍珠——未来前景
Ajai Kumar Sonkar
传统上，珍珠养殖需要将活的外套膜组织植入同一种族的另一只牡蛎的性腺区域，植入时与珠核一同植入，珠核是珍珠形成的地方。通过研究，作者发现了一种创新的体外珍珠养殖技术，与器官培养中使用的技术不同，这种急需的新技术有望大大推动海水珍珠养殖，这种新技术可以保护牡蛎免受捕食者和偷猎者的侵害，珍珠的生产成本也将大大降低。

马尔代夫石斑鱼手工养殖的营销和推广
Ahmed Rashid
由于马尔代夫四面环海，渔业和来自海洋的食物对其人口具有重要意义。为了让渔业一直位列世界上最环保的行业之列，政府正在通过在 Adh Atoll 建立石斑鱼养殖项目以进一步发展其蓝色经济，取得的成果令人鼓舞。然而，作者建议更多地关注营销和促销方面，以便项目的受益者充分认识到石斑鱼养殖的可行性。

水产养殖在技术发展和创新方面的近况
Sujit Das
实现更高水平的全球粮食安全以及建立负责任和透明的渔业价值链是释放颠覆性技术巨大潜力的关键。此外，第34届FAO-COFI会议和第四届全球水产养殖大会（上海宣言）重申了创新和技术对建立负责任、适应性强和透明的水产养殖业的重要性。本文将介绍有关水产养殖领域有关创新的最新情况，描述其简要历史、当前的技术干预、传统与智能农业、可持续集约化、合作和伙伴关系的重要性。本文还将展望未来，专注于“以可持续性为中心”的创新，并试图规划前进的道路。

加强亚洲小规模渔业价值链的治理
Firoza Buranudeen
亚洲的小规模渔业仍然落后，其价值链中的参与者仍然深陷贫困，无法充分获得基本人权。造成这种情况的一个主要原因是在国家决策过程中缺乏重要代表，导致治理和监管不善，进而使整个价值链中的不平等长期存在。解小规模渔区的运作方式并采用协作、参与式方法可能有助于加强小规模渔业治理。
خلاصة لأهم المقالات

ضرورة تبني سوق سمك التونة الأمريكية لعقلية الشركات الناشئة
Jan Tharp

بقت حالة كوفيد-19 إلى قلب موازين سوق التونة في الولايات المتحدة رأساً على عقب، وتشمل انعكاسات هذه الجائحة على هذه السوق ارتفاعاً ملحوظاً في تكاليف العمال مرفوعة بأسعار الفوائد العالمية، وتعطل سلسلة التوزيع علامة على ارتفاع كلفة الشحن للالتزام مع نفس المواد الخام، ونقص موارد التعبئة والتخزين. ويبين هذه الفوج، كيف بيد قوة كوفيد-19 إلى ارتفاع مستويات التعلم في هذه القنوات المستقبلية الذين قاما بهم باستمرار لمكافحة صلة وثيقة بهما. وتشكل عقلية الشركات الناشئة كيف يمكن لصناعات استخدام التفكير المبتكر والأدوات الرقمية لخلق تفاعلات وسلامة مع الأجيال الشابة للسلاسل الأولية.

اللؤلؤ من خلال زراعة الأحياء المائية-
Aji Kumar Sonkar

بقلم

تتضمن منظمة التوزيع المالي لزراعة اللؤلؤ إدخال نسيج الوشاح الحي في منطقة الغدد التناسلية لمحار آخر من نفس النوع، مع تشغيل النواة اللازمة للعنبة تقليدياً. البحث، من خلال وضع اللؤلؤ لزراعة والتي تعد بإتمام مطلوب بشدة الأعضاء، تم إعتماد نسيج ظهرت في الzyst مينور يعتمد على الصيادين، تقنية مبتكرة لزراعة اللؤلؤ في الكاتب.

التسويق والترويج لاستزراع الهامور في جزر المالديف
Ahmed Rashid

بقلم

مع رؤيتها الامتياز لتشمل أهمية كبيرة بالنسبة لسكانها. تشكل من البحر المتأتية غذاء لأما في المحيط، فإن القطاع الأحياء المائية لكون ظرًا نمو في العالم، تعمل الحكومة على تطوير اقتصادها من خلال إنشاء مشروع استزراع الهامور في "Adh Atoll". يتضمن من الاستزراع، التسويق والترويج في الفجر للماء.

التطورات والابتكارات الإيكولوجية في استزراع الأحياء المائية: تحديث
Sujit Das

بقلم

إن إطلاق المناخ الإيكولوجي لتحقيق الدور الإيكولوجي التكنولوجي في منطقة المحور الحي في إنشاء سلسلة قنوات مصائد الأسماك سويدة وشفافة. وفضلًا على ذلك، أكدت الدولة الرائدة في التسويق لجنة مصائد الأسماك التابعة لمنظمة الأغذية والزراعة (نافو) والمؤتمر العالمي لزراعة الأحياء المائية (نافو) على أهمية الإمكانات والقياديات لبناء قنوات استزراع الأحياء المائية يمكن أن تنمو في شكل مستدام، وتساهم في خلق الابتكارات وبناء استراتيجية الحوكمة.

تعزيز الحوكمة ضمن سلسلة قنوات الأسماك الصغيرة النطاق في آسيا
Firoza Buranudeen

بقلم

يظل قنوات مصائد الأسماك الصغيرة النطاق في آسيا متفلتين من الركود، ولا زال المشاركون في سلسلة القياس لهذه المصائد يعانون القلق والقلق وعدم كفاءة فرص الحصول على حقوق الإنسان الأساسية. ويكمن أحد الأسباب الرئيسية في هذا الوضع في افتقار بعض الفقاري إلى التدريب الموحد في عمليات مشاريع التوزيع المحلي، مما أدى إلى سوء الإدارة والأطر التنظيمية، والتي تهدف إلى استمرار عدم الازدهار في جميع مناطق سلسلة القنوات. ومن هنا المنطلق، قد يساهم ذلك في وضعية عمل المجتمعات الصغيرة واعتماد استراتيجيات تعاونية في الجهود المبذولة لتعزيز الحوكمة في هذا القطاع.

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Aziza E Amghari
THE US TUNA MARKET SHOULD THINK LIKE A STARTUP

By Jan Tharp

The COVID-19 pandemic has turned the US tuna market upside down. Effects include dramatic increases in labour costs coupled with workforce shortages, supply chain disruptions, freight cost increases in tandem with availability decreases, and shortages of packaging materials. Through the chaos, the pandemic has prompted an upsurge of younger consumers to the category; consumers with whom we have consistently struggled to find relevancy. The startup mentality illustrates how our industry can use innovative thinking and digital tools to establish thriving connections with younger generations for years to come.

When I was much younger, I loved to visit Disneyland and ride Space Mountain. I remember feeling a bit of adrenaline-filled vertigo as the car high speeds through a dark galaxy with steady inclines and steep drop offs. The lack of control coupled with the inability to predict the twists and turns created a state of controlled chaos. For a kid, this was exhilarating.

The impact of the global pandemic on business, in some ways, feels like the Space Mountain ride with significant ups and downs, information overload and a heightened pace of unpredictable change. However, unlike the roller coaster ride, the duration of this “new normal” is not known. But what we can control is how we adapt our businesses and our business strategies. Whenever there is any kind of significant change or shock to a system, there are those who move forward and those who are left behind. Those who move forward seize change as an opportunity to adjust their strategies, while others are slow to react and wait for things to return to the original state.

As an industry, we were given a golden opportunity over the last eighteen months to reconnect with our consumer base. People all over the country stocked their pantries with shelf stable products and canned seafood. Household penetration of Shelf Stable Tuna peaked at 55% during the height of the pandemic; the highest level we have seen in over a decade. No marketing campaign could have ever done what COVID-19 did for our industry in a few short months with millions of new consumers entering the category. The question is, what happens next?

Although we may have benefited from the shifts in consumer trends during the pandemic, it does not mean we have the luxury to rest. We will experience continued ups and downs, twists and turns in the US tuna category. At the time of writing, the impact of the new variants as well as the future cessation of some of the US government stimulus money on US shopping behaviour is unknown. What is known is that we are facing significant cost inflation due to input costs and the CPI (Consumer Price Index) is up 5.4% versus a year ago, driven by a 24.5% increase in energy prices.

What I would like to focus on are not the many downstream effects of COVID, but the same fundamental issue our industry faced pre-COVID: lack of relevancy with a younger consumer base. Yes, the COVID-implied crises are extremely important to address and maneuver through, and yes, we also need to continue to provide great tasting products to the baby boomers who purchase over 58% of canned tuna today, but there is an ever pressing need to cultivate relationships and usage occasions with a younger audience in order to survive long term. As our audience ages we must be highly aware of the needs of the next generations.
Generational changes

The Millennial generation makes up nearly a quarter of the total US population. With demands for transparency, a love for customisation and convenience, and a health- and planet-conscious mindset, this demographic’s preferences have made monumental shifts in food culture over the past decade.

Gen Z makes up 27% of our population. They are projected to be the most well-educated and most ethnically diverse generation to date. They also happen to be digital natives; born into the age of digital technology and immersed for their entire upbringing. The average member of Gen Z received their first smartphone before age 12. Being the first generation never knowing a world without technology, they are consistent users of restaurant apps, take-out and delivery as opposed to making meals regularly at home.

Whereas previous generations were more open to adopting their parents’ food habits that included canned staple items, generational transfer of the love of canned seafood is simply not happening like it used to. Therefore, our jobs are shifting from doing what we’ve always done very well, to being open minded and acting on opportunities to give new consumers more ways to be excited about canned seafood. We must embrace transformative thinking, add new tools to our toolboxes and adjust our business strategies to be laser focused on listening and meeting the consumers where they are.

Think like a startup

To become an innovative organisation, we need to emulate other innovative organisations; we need to begin thinking like a startup. Startups create something new under conditions of uncertainty. They aren’t shackled with the processes of the past. Their strategies are based on connecting with consumers and meeting them where they are. This allows them to identify new and innovative paths to reach and connect with the consumer. For our industry, not only are we trying to
create longevity, we’re also trying to recreate a connection to younger generations and transform our product to meet the food trends of the day. If we can think and act like a start-up, we will have a better chance of success. To begin thinking like a startup, here are a few considerations for our industry:

**Align your messaging with the consumer journey**

The number one thing a successful startup does is align messaging around their product or service with the consumer journey. The pandemic rapidly accelerated the percentage of consumers using online platforms for grocery purchases. Online grocery e-commerce sales exceeded 15 billion dollars last year and survey data suggests this trend will stick even after consumers begin to return to grocery stores and other channels for their needs. This is one of the largest opportunities for our industry to show up and meet the consumer on their purchasing journey, and to tell our story in a more compelling way.

Another opportunity to connect with consumers through messaging strategies is to leverage their heightened focus on health and wellness as well as weight management. Some 61% of US adults report undesired weight change during the first year of Covid and 42% say they gained more weight than intended with an average weight gain of 29 lbs. With 97% of consumers planning to follow a diet or eating plans more closely than in the past now that the vaccine is more readily available, our industry has a huge opportunity.

Canned tuna is a perfect protein to meet the needs of today’s consumer and there is no better time to talk about it than now. In fact, we should be talking about it anywhere and everywhere we can. Digital, social, in-store, in produce, at the seafood counter and in new channels of distribution. There is no other protein that delivers the amount of overall health benefits that tuna delivers per calorie. Whether consumers are looking to lose weight, build muscle or improve their overall health – our products meet their needs.

While businesses like ours that have been around for some time have an established connection with aging generations, we must consider that we are still in the early stages of building a relationship with the younger generations. Consistency in messaging is important to maintaining a brand image and should be considered a measure of success across all channels.

We must find a way around the challenge of communicating relevant product information in a clear, consistent manner that conveys the benefits of tuna in a manner a consumer can understand. We are expecting consumers to drink from a firehose with respect to how many messages we are conveying in our product category. The average consumer doesn’t understand most of them. Consumers looking to purchase a can of tuna are barraged by gear-type, fishing methodology, sustainability, GMO, BPA, heavy metals, protein content and health benefit claims which can sometimes be confusing to industry insiders much less a consumer and these messages simply can’t be conveyed adequately on a label.

Again, the solution to this problem can be found in educating our consumers online through social, digital, and online content. Digital also allows us to market to different consumers in ways we cannot do in-store. Consumers are online seeking information about companies, brands, and health claims. A digital presence allows us to be incredibly thorough and precise with our messaging.

**Digital, digital, and more digital**

Gone are the days when business success was strengthened with years of existence. Digital
Marketing strategies are routinely used by startups to directly engage with consumers and form personal relationships. Either through social media, couponing, digital couponing or QR codes, digital marketing allows us to tell our story in a way that a static tower of canned seafood in a store cannot. Whether the stories are about new usage occasions, recipes, sustainability programmes, packaging programmes or health and wellness, we now have a huge opportunity to connect with the consumer in ways that match what they are seeking.

For example, Chobani, which became number one in Greek yogurt sales in just a few short years of the category’s introduction in the US, used social media to encourage real fans of the brand to share their Chobani “love stories” by sharing posts and comments across digital channels. Greek yogurt sales surpassed traditional yogurt sales as many consumers got the message that the less sweet, more robust texture of Greek yogurt was a healthier choice. Once they received that message, they weren’t shy about sharing their passion about the product with others, generating a consumer-up campaign.

Digital marketing is not the only tool that new technologies offer to our industry. We have the opportunity to be incredibly thoughtful with product offerings in an omnichannel environment. Through the proper use of data and analytics, we can be much more precise about our offerings. Manufacturers need to decide what products and assortments are best for each channel of distribution. For example, pack sizes should reflect the usage occasion consumers seek. Purchasing a 48-count case of canned tuna online for a family of one is probably not ideal; paying significant freight and packing costs for a single can of tuna is also not practical. Through digital analytics we are much better positioned to understand which consumer is shopping which channel and tailor our product offerings to meet their individual needs.

Data and insights are the new currencies driving growth and relevancy. Like startups, we can differentiate ourselves by using the appropriate tools to target messaging and help generate actionable insights.

Show up in new ways

Finally, think back to where you had your first poke bowl. Was it at your house? Probably not. Rather, it was most likely in a restaurant. Like poke, if we want to gain relevancy with the younger consumer group, having tuna show up in fast food, fast casual, quick service and high-end restaurants is critical. Foodservice is the gateway to attracting the younger generation. Those that can find a way to bridge this gap will be in a strong position to establish relevance in adjacent categories like canned tuna.

The future

Innovative solutions can manifest from any situation, at any time. This is our moment to seize change. Our industry has a near-term opportunity to leverage the impact COVID has had on shopping behaviour and consumer needs. With the expanded consumer base driven by the pandemic, the stakes are high to use this opportunity wisely and connect on new levels. By thinking like a startup, taking advantage of digital tools, meeting our consumers where they are, and showing up in a consistent way across a variety of channels, we increase the odds of addressing some of the legacy issues around relevancy.

We need to talk about and celebrate tuna! We need to bring tuna back into the conversation and show pride in making one of the most nutritious, versatile food items on earth!

Just as the roller coaster car followed the track on Space Mountain through all the ups and downs and twists and turns and brought us safely to the other side, if we follow the tracks of the consumer and listen and watch their shopping behaviours as they navigate through the societal changes impacting their daily lives, we will come out of these challenging times in a better place.

Jan Tharp is President and CEO of The Bumble Bee Seafood Company, a 120-year leader in the seafood industry. She is known as a transformational leader within the industry, among her peers and with Bumble Bee employees and is dedicated to continuing to redefine what sustainability means for the seafood industry. Under her leadership, Bumble Bee was named one of the “Top Places to Work” in both 2019 and 2020 by the San Diego Union Tribune. Ms Tharp is a board member of the National Fisheries Institute and Gathered Foods. She is also Co-Chair of the Processing and Packaging Women’s Leadership Network.
Market Barometer//

Market Trends

SHRIMP

Supply: Supply constraints have been observed due to shipment delays and rising costs across activities associated with importing shrimp. Imports from major shrimp-supplying countries particularly from Asia are having supply chain problems following transportation disruptions. However, the high demand for shrimp products in the US for the upcoming holiday season were forcing exporters to endure the higher shipping costs brought by rising costs across supply chains. Prices for Vietnamese shrimp are continuing to rise, owing to more freedom from coronavirus restrictions and robust demand. In India, after nearly two months of exceptionally high prices, it is becoming clear that the current shortage of large-sized *vannamei* shrimp out of India will not be resolved any time soon. In Thailand, farmed *vannamei* supply is beginning to increase as cropping will finish by end of October.

Japan: The food service industry is preparing for an expected surge in consumption as the government eases restrictions in phases to restore social and economic activity while also trying to avert another wave of disease.

The cumulative volume of Japanese shrimp imports during January–July 2021 increased (+1.55%) to 111 624 MT from 109 920 MT in 2020 of the same period. Main suppliers Vietnam, Indonesia and Thailand recorded decreases while those from India increased. Declines were seen for most product categories during the review period except for prepared/preserved in airtight container which recorded an increase of 3.15%.

For the raw frozen shrimp category, imports during the review period grew by 1.17% at 76 744 MT. The decrease in imports in July was offset by an increase in imports from February to May. Demand for shrimp in the foodservice sector is likely to pick up slowly in the coming months following the lifting of the state of emergency and also the upcoming holiday season.

USA: Shrimp demand has continued to be very strong. Consumption is in an upward trend both in the retail and foodservice sector despite steadily rising prices. The reopening of the restaurant trade coupled with low supply has created a purchase frenzy never seen before. Impulse purchases have been observed at all levels of the supply chain, from raw materials to the final consumer. The soaring high costs for transportation, raw materials and production caused domestic suppliers to raise prices which are being charged to foodservice companies and retailers.

During January-July 2021, the cumulative total of shrimp imports was up by 27% at 479 658 MT compared to the same period in 2020. Among the main product groups, peeled shrimp products were the top purchase at 215 184 MT, comprising 44.86% of the total shrimp imports, followed by the shell-on category. All the main product groups recorded increases by 20%, 39.6%, 31.5% and 16.7% for shell-on, peeled, other preparation and breaded respectively. During this period, the increases in imports comprised the main indicator for the reactivation and recovery of the foodservice sector, together with a stronger retail sector. The continuous supply chain problems following transportation disruptions at the California port will cause a steady rise of prices of shrimp products at the wholesale level that will be passed to the consumers. However, demand will continue to be strong as the holiday season is approaching.

China: Shrimp imports during the first eight months of the year were down by 18.21% at 476 160 MT from 389 434 MT in 2020 of the same period. The decreases were due to less imports prior to the Chinese New Year celebrations in January. However, in the month of August, China’s monthly shrimp imports of frozen shrimp increased by 72.52% at 54 203 MT compared to the same time last year. In that month, 50 129 MT of frozen warmwater shrimp were imported, which is only the second time this year that the volume has reached the 50 000 MT mark after January. Imports increased from main suppliers Ecuador (56%), India (216%) and Thailand (123%) despite the on-going COVID-19 pandemic restrictions, while those from Vietnam (which is currently experiencing a new wave of the pandemic) have decreased.

TUNA

The Fish Aggregating Device (FAD) closure in the Western and Central Pacific Ocean (WCPO) is still in effect until September 30th, and fishing is said to be very poor. Nevertheless, Thai
in 2021, they were still 6.7% lower than the same period in 2019 prior to the pandemic.

**China:** Total tilapia exports during January - June 2021 increased by 7% at 201 000 MT compared to the same period last year. This increase in exports was due to the higher demand for breaded tilapia fillets that was up by 13.7% at 156 100 MT from 134 600 MT in 2020. While breaded fillet exports increased, frozen whole and fillets were down by 18% and 11% respectively. Demand for breaded tilapia fillets in Africa and Latin America recorded increases, including main markets: Mexico (55%), Cote d’Ivoire (39%), and South Africa (150%) as well as Kenya, Rwanda, Ghana, Congo, Costa Rica, Colombia, Peru and the Dominican Republic.

**FRESH FISH**

**Japan:** Fresh/chilled salmon imports during the first half of 2021 increased to 8 196 MT, a decrease in value to US$79.2 million as compared to the same period last year. Imports of Atlantic salmon dropped by 0.5% while Pacific salmon increased by 186% in volume during the review period. The minimal decrease in imports of Atlantic salmon was due to less supply by the main source Norway but this was compensated for by other suppliers, Canada and Australia. Meanwhile, the increase in total imports of fresh/chilled salmon was due to the significantly bigger supply of Pacific salmon from New Zealand.

**Hong Kong:** Imports of live marine foodfish increased by 144% in volume, to 8 218 MT, and by 48% in value, to US$ 44 million, in the first half of the year, as compared to the same period in 2020. Demand for high valued species in Hong Kong has been sky rocketing as all restaurants and live fish markets are back in business. Demand for groupers and other marine finfish has been up by 203% and 86%, respectively. The increased imports was also due to the easing of restrictions in transporting live fish from leading suppliers mainland China, Indonesia, Philippines, Thailand and Malaysia to Hong Kong.

**Southeast Asia: Foodnews** reported that Southeast Asian canned tuna production will continue to be disrupted due to the increasing number of COVID-19 infection cases in the area, which is impacting labour availability and forcing temporary closures of factories due to quarantine requirements. At the same time, the ocean freight crisis is hampering overseas demand for the final product. As a result, skipjack tuna raw material supply currently exceeds canneries’ demand in the western Pacific industrial hub, pushing raw material prices downwards in top canning Pacific hubs to US$ 1 300/MT fob Bangkok and US$ 1 700/MT ex-vessel Manta.

**FROZEN FISH**

**Japan:** Imports of frozen fish fillets and fish meat grew by 7% from 241 091 MT during the first half of this year as compared to the same period in 2020. Imports of most frozen fish fillets and meat items increased, with the exception of salmon and trout fillets, which fell. Despite the fact that imports climbed canneries continue to operate at reduced capacity and raw material supplies remain strong. Thai Union has ceased acquiring raw materials, resulting in a severe drop in demand for skipjack tuna and a sharp fall in prices. Due to COVID-19 regulations, carrier unloading continues to be limited to shorter hours.

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Market Barometer

Price Trends

FROZEN SHRIMP, C&F JAPAN (US$/Kg)  FROZEN SHRIMP, WHOLESALE TOKYO, JAPAN (¥ 1000/kg)

FROZEN SHRIMP, cfr USA  FROZEN SHRIMP, USA (ex-warehouse NY, US$/lb)

FROZEN SHRIMP, EUROPE (CFR, US$/kg)  FROZEN TUNA (US$/MT)
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**
TILAPIA

Tilapia sector growth to resume after shaking off pandemic effects

After the initial impact of the emerging COVID-19 pandemic in Q2 2020, the global tilapia industry was able to rapidly adapt to the new market landscape by leveraging its retail experience and price advantage. The sector is expected to resume its steady expansion in 2021, although rising costs present a challenge that must be overcome.

Production

The most recent available estimates, released by the Groundfish Forum at the end of 2020, put global tilapia production at almost 7 million MT in 2020. This figure would be approximately level with 2019 and would mark a significant slowdown relative to the long-term growth trend, reflecting the effects of the pandemic on production, processing and markets.

In China, the range of restrictions imposed in the early part of 2020 in an attempt to stem the spread of the virus initially translated into significant operational difficulties for tilapia farms in Southern China but their impact was short lived. By mid-year, the situation in China had improved considerably and the tilapia sector was able to restart before too much damage was inflicted. The total drop in China’s tilapia production in 2020 is expected to be around 3%, to around 1.7 million MT. Total supply from Asian producers, which also includes significant output from countries such as Indonesia and the Philippines, is estimated to have reached around 4.55 million MT, around 50 000 MT below the 2019 figure.

In Latin America, the tilapia aquaculture industry generally reported positive results despite the various challenges and uncertainties. Brazil produced 12.5% more tilapia than in 2019, at 486 000 MT, a growth rate that surpassed all other aquaculture species in the country. This figure was achieved despite the mass upheaval experienced in the first half of the year as the country was struggling with the rapid spread of COVID-19. Elsewhere, Mexico’s total farmed tilapia production during 2020 reached 72 595 MT. Mexican tilapia production fell significantly in 2020 compared to 2019 due to the pandemic, less projected demand and higher costs for producers. Some states registered decreases of up to 50%. Local governments in Mexico are providing tilapia fingerlings to support small-scale producers in poor areas, benefiting families by generating sources of employment. Colombia saw an increase in output in 2020, driven by the optimisation of farming areas and improvements in technology and feed.

Markets and trade

In the United States of America, the most important consumer market for tilapia, consumption remained relatively stable throughout the pandemic. The species, the fourth most popular fish species amongst US consumers, saw retail sales soar as housebound consumers sought out easy-to-prepare, versatile seafood options. According to the National Oceanic and Atmospheric Administration (NOAA), 190 453 MT of tilapia worth US$ 615 million were imported in 2020, representing increases of 10% in terms of volume and 2.3% in value compared with 2019. Frozen tilapia fillets made up most of these imports, accounting for 61% of value. China, the top supplier to the US market, faced various challenges in this market in 2020 due to a combination of factors such as supply contraction, competition from Latin American producers as well as Vietnamese pangasius, in addition to the 25% US tariff on Chinese tilapia imports. The latter tariff, imposed by the previous US administration as part of the US-China trade conflict, was lifted in April 2020 but then reinstated in August when the exemption for tilapia expired. Combined with rising production costs, this has made the traditional US frozen market increasingly less appealing for the Chinese producers and focus has been gradually shifting to developing alternative export markets, expanding the range of value-added products and increasing domestic sales.

In Latin America, too, the developments in 2020, particularly those driving up freight costs, offered marketers an incentive
to target the domestic market. At the same time, however, the difficulties faced by competing Chinese suppliers and the retail advantage of tilapia in the US presented an important opportunity to boost US sales. Colombia’s exports were 11 595 MT in 2020, 65% up compared with the previous year, consolidating its position as the main supplier of fresh tilapia to the US market. Brazil exported just under 6 000 MT to the US in 2020, and the industry is looking to increase export revenue. However, tilapia exporters remain frustrated by the EU ban on fishery products from Brazil that has been in place since the end of 2017. Meanwhile, Costa Rica exported 3 379 MT worth US$ 21 million during 2020, with almost the entirety of this volume consisting of fillets to the US. The foreign trade promotion agency (PROCOMER) is recommending offering competitive prices as well as products based on quality, to differentiate from Chinese tilapia.

**Prices**

Rapid market recovery after early year difficulties saw wholesale prices for Chinese tilapia remain relatively stable throughout 2020, averaging between CNY 7.5-8.0 (US$ 1.09-1.16) per kg for 500-800g live tilapia (DAP, Hainan) for most of the year. In the US market, however, increased import supply during the tariff exemption period helped push average prices down by 10% to US$ 3.29 per kg (CIF) for the year as a whole.

**Outlook**

Positive output growth is expected to resume for the global farmed tilapia sector in 2021, although there is some discrepancy in forecasts for Chinese production. Whereas some analysts were predicting an increase in production as the market recovery continues, more recent reports point to a further contraction this year, due to rising costs and a particularly cold winter affecting fish survival rates in Guangdong. The US market will remain challenging from the Chinese perspective, at least so long as the tariff remains in place, but domestic market interest from retail and foodservice buyers should be sufficient to keep prices from falling too far back after spiking in early 2021 on Lunar New Year demand. For other producers, pandemic-related developments remain a central focus and the speed at which vaccines are rolled out will have direct implications for freight rates, consumer demand, product preferences and operational costs.
INFOFISH speaks to …

BRIAN TSUYOSHI TAKEDA

Founder and CEO of Urchinomics, a Norway-based aquaculture venture that aims to turn ecologically destructive sea urchins into high valued seafood products.

Harvesting overgrazing sea urchins to stop them from destroying underwater kelp forests while at the same time serving up top quality urchin roe (uni) as delicacies in restaurants – what was the genesis of that idea?

In 2012, I had an opportunity to meet a delegation of Japanese fishers visiting Norway to see how they could rebuild after the 2011 tsunami destroyed their communities. What we learned was that the rebuilding of the houses and boats was one thing, but the greater threat was the explosion of sea urchin populations in their waters. According to the scientists, the tsunami washed away sea urchin predators like crabs and sea stars, allowing sea urchins to reproduce unhindered. They increased their biomass by over 700% in just the first two years alone, devastating the kelp forests that sustained so much marine life in the area.

It was when I learned about this underlying challenge that I thought “wait a minute… Norway has so much aquaculture technologies… there has to be a way to leverage this knowledge and apply it to the urchins.” So, we reached out to the government scientists and licensed some of their cutting edge technologies to see if we could use it to commercialise the urchins and help restore the kelp forests.

Our first trial...in 2014 went really well... almost too well... so we tried again in 2015 and it really showed promise. So much so that the Fisheries Minister of Norway visited our site in Japan to see with her own eyes! It was throughout these trials and interactions with scientists around the world that helped us understand that kelp forest lost due to urchin overgrazing was not just a Japan issue, but a global issue. We then decided to establish Urchinomics as a commercial venture in December 2016.

In terms of species, your focus seems to be primarily purple sea urchins. Does the company have plans to ranch other commercially important species such as, for instance, the red species which was once abundant in the waters off California?

Actually, our focus is primarily purple sea urchins in California, but we work with many other species around the world. For instance, in British Columbia, the sea urchin barrens are generally caused by an overabundance of red sea urchins. We have conducted validation trials in partnership with the Department of Fisheries and Oceans in British Columbia to see if our technologies can commercialise barren red urchins, and the result was a resounding yes.

When it comes to restoring kelp forests, the science is pretty clear that, if the barrens are caused by urchins, removing the urchins will allow the kelp forests to bounce back. So for most regions around the world, reducing the urchin population levels down to around two urchins per square meter will do the trick. For those areas that have lost their “spore banks” or, in other words, lost so much of their kelp that there aren’t any left to release spores and repopulate areas, then we will likely need to transplant kelp from other regions.

We also see restocking urchin predators as a novel way to rebalance the ecosystem. There is great research being done in Washington state and in Norway to restock predators to help keep urchin populations in check. As we scale up our ranching operations, we would like to collaborate with such initiatives so that we can accelerate kelp restoration.

We know that kelp forests have a vital role in providing food and shelter to marine species as well as in atmospheric carbon sequestration and oxygenating the oceans. Their massive decrease in countries like Japan, Norway, Canada, Australia, and the US, has been blamed on millions of hungry urchins, notwithstanding the warming of the seas due to climate change. Apart from reducing sea urchin populations at these barrens, what else could be done together with other stakeholders to regenerate kelp forests? And can you cite some success stories where forests have been successfully rehabilitated?
Now, just because we can do it though, does not mean we will do it. Today, in California, the kelp forest loss is near exclusively caused by the purple urchins. So, we will work towards commercialising the purple urchins, and getting as many of them out of the water as possible. We will only ranch California red urchins if they too become an ecological problem.

Early this year, it was reported that Urchinomics is working with Norwegian agencies in identifying new technological advances pertaining to urchin fisheries innovation and habitat restoration. What new developments can we expect to see within the next five to ten years that will contribute to both objectives?

Some of the leading Norwegian research institutes published an important “guidebook” as to how to restore kelp forests in Northern Norway. Urchinomics has been rallying our investors, philanthropists, researchers, and industry partners around this guidebook so that we can apply the methodologies presented in this “guidebook” in practice.

So, for example, one of our philanthropists funded a “rapid prototyping and innovation” project to develop more effective sea urchin traps that could help harvest sea urchins scalably and cost effectively. Another impact investor group helped us fund our pilot urchin ranching site in Stavanger, Norway, to validate the commercial potential of urchin ranching in Norway, and how such a venture could potentially fund urchin removal and kelp restoration. Finally, some of our institutional investors have begun funding R+D projects to quantify the amount of blue carbon that is bound and sequestered when urchin barrens are restored back into kelp forests. All of these initiatives, and many more in the pipeline, will improve our chances to restore vital kelp forests throughout the Northern coast of Norway, as well as other regions around the world, over the next 5 to 10 years.

Urchinomics has also announced that it would be setting up the world’s first commercial scale, ecologically restorative sea urchin ranch in Kunisaki, Oita Prefecture (Japan). Could you brief readers on the details, including the ranching method, feed formulation, projected yield, and product form?

Urchinomics has launched the world’s first, commercial scale, ecologically restorative sea urchin ranch in Kunisaki, Oita prefecture, Japan. We repurposed an existing fish processing site and installed 84 raceways and a full, recirculating aquaculture system so that we could ranch our urchins. Construction began during the Fall of 2020, and by April 2021, the site was formally launched.

Our first batch of urchins we put in our system in May were ranched by July and were sold to top restaurants in Oita, Tokyo and Taipei. We are now beginning to scale up our operations, as we seem to have overcome the many early stage, teething issues all new sites face when bringing such a system online.

We are well into the planning and design stage for another ranch in Japan, which we expect to be twice the Oita ranch.
We also have plans to build two more in Japan, as well as scale up our sites in California, Canada and Norway.

What are the long-term prospects for replication of this technology in other sites in Japan and other countries? For example, Chile, which is the main global producer of sea urchin roe and where the industry has suffered due to over-exploitation.

With the world discovering and demanding sea urchin roe at a time where roe-rich urchin stocks are collapsing and empty ones are occupying the ocean floor, prices have sky rocketed beyond anyone’s expectations. While on the surface this may seem good for us, it also means fishers are incentivised to take greater risks to swim farther and deeper in the remaining kelp forests to collect sea urchin roe and earn. We therefore see this price development as worrisome in the grand scheme of things. Our hope is that by giving fishers an alternative to fish empty, barren urchins right on the shore and make a living out of it, they will choose to fish them for us under much safer conditions rather than risk their lives to keep food on the table for their family. And as our supply increases, it will hopefully slow the upwards trend on pricing, and maybe help stabilise it as our volumes increase over time.

We understand that since ranching entails harvesting wild resources, internationally recognised sustainability certification such as the Aquaculture Stewardship Council would not seem to be relevant. Is this a drawback for the marketing of the roe to global markets in the US and Europe, as well as the potentially huge market in neighbouring China?

This is a very interesting question and I am glad that you brought this up. When we reached out to both MSC and ASC, we were rejected for certification. MSC told us they could not certify us because we fed the urchins and were therefore aquaculture. ASC told us they could not certify us either because we did not have a hatchery operation. Despite having a business model that restores marine ecosystems, the world’s two largest, most respected and credible certification schemes could not find a home for us because we did not fit the binary definition of wild-caught or aquaculture.

Fortunately though, the wider media has been helping us tell our story about our restorative business model, and our high-end sushi restaurant and Michelin starred restaurants are actively serving our products because they buy into the mission. These buyers take great care in understanding where their ingredients come from, and spend much more time learning about the backstory of everything they serve. This gives us the opportunity to properly tell our story and win their hearts.

As an example of the care high-end chefs take to learn about what they serve from their kitchen, here is a quote from Chef Sven Erik Renaa, the 2-star Michelin chef from Re-Naa in Stavanger, Norway: “… a fantastic product that is both luxurious and tastes like magic from the sea. And the feed they are fed is so sustainable. They take urchins that are.
destroying the ocean floor and make a raw material that the best chefs in the world would want to use…”

So, in conclusion, has our ability to not be affiliated with MSC or ASC hurt us…? Not really. But as sea urchin roe becomes more mainstream, I do hope we can find a way to affiliate ourselves with MSC or ASC. I have a tremendous respect for what they do and what they represent.

**With regard to the small-scale fisheries sector, does Urchinomics work (or plan to work) with communities in order to contribute to livelihood programmes in line with international initiatives such as Vision 2050 and the Sustainable Development Goals? The assumption here is that small-scale communities would not have the financial resources to establish a ranching set-up like the one in Kunisaki.**

Our coastal fishers are our most important stakeholder. It is our mission to ensure that their livelihoods are better off with us in their community than without. And we do this by buying the empty urchins at a fair price from the fishers, despite them having no real secondary value and are effectively worthless. We are also working with mission-aligned impact investors and state banks who provide loans to fishers so that they can jointly invest with us in urchin ranches. Further, we plan to allocate up to 49% of the equity in each of our urchin ranches for local, mission-aligned investors to join us, so that our venture becomes better integrated and embedded in the community. Kunisaki, as an example, is expected to have 20% local ownership by the end of this year.

**And on a final note, a key focus for Urchinomics seems to be identifying and working with partners and eco-investors to produce a commercial product as well as conserve resources and the environment. What is your business advice to new start-ups that similarly want to work on sustainability of resources and the eco-system while making it profitable at the same time?**

Your summary is spot on. Our efforts and results so far are very much a result of a wide network of mission-aligned stakeholders working towards the same outcome. We all play different parts in it, but the outcome we all want to achieve is the same. So yes, our partners are key to our success for sure.

Now, I don’t know if I am qualified to give advice, but I have observed that a monumental shift has taken place in terms of our understanding of our relationship with nature. I therefore think there is no better time than now to launch innovative ideas that can help restore the planet. While the answers to the who, where and how may change and require pivoting from time to time, by having a clear mission and a network of mission-aligned partners, things will come together and work out.
PEARLS THROUGH TISSUE CULTURE – THE PROMISE

By Ajai Kumar Sonkar

Traditionally, pearl culture entails introducing live mantle tissue into the gonad region of another oyster of the same species, together with a nucleus around which the pearl will form. Through his research, the author has discovered an innovative in-vitro pearl culture technique, not unlike that used in organ culture, which promises to give a much-needed boost to marine pearl culture. With this new approach, the oysters are kept safe from predators and poachers, and the production cost of the pearls is also substantially lower.

In normal pearl culture operations, a live graft tissue fragment prepared from the mantle of a donor oyster is implanted into the gonad region of a recipient pearl oyster of the same species, together with a spherical shell bead nucleus in contact with the graft piece.

The grafting of mantle tissue induces a sudden immunological upheaval in the body of the recipient organism, resulting in a reversal of differentiation and loss of specialised characteristics. The gonad region is actually not the normal place for the mantle tissue, so obviously the defence system of the body of the oyster tries to reject the unwelcome guest, but when it fails, and can survive such upheaval, the graft mantle piece is accepted by the body. The mantle tissue then grows and envelops the shell bead and secretes concentric thin micro-layers of pearl sac all around the nucleus.

Most researchers believe that secretions over the nucleus are the result of the oyster's reaction to a foreign body. However, the author has personally witnessed that in several instances, even though the nucleus is rejected, the mantle tissue grafted in the gonad is accepted in the body. The graft tissue still produces a pearl sac in an irregular shape even in the absence of a foreign particle. This observation suggests that the phenomenon of pearl sac secretion is a natural function of the mantle tissue which is carried out to construct the shell when it is at its original location.

This natural activity of the mantle occurs in every shellfish; they produce calciferous substances with two different types of crystallisation: calcite and aragonite. Often the secretions of shellfishes contain both types of crystallisation in different proportions or ratios.

The major minerals identified in the shell of the pearl oyster *Pinctada margaritifera* are more than 96% aragonite, about 2.6% calcite calcium carbonate and the remaining 1.3% an amorphous content. Aragonite is known to be a polymorph of calcite - it gives a pearly hue to the calciferous sacs while calcite crystallisation gives a non-shiny bony appearance to the sacs.

Experimental in-vitro pearl culture

In trials of in-vitro pearl culture, the mantle tissues of *Pinctada margaritifera* have been successfully induced to produce granular cells with aragonite crystals in the culture medium. The study revealed that the black hue of pearls produced by the mantle tissues of *Pinctada margaritifera* is influenced by both environmental and genetic factors. In other words, the genetic constitution of the oyster produces the dark hue; however, variety of colour and lustre is given impact by specific minerals and micronutrients added to the medium. These create specific epigenetic conditions, including temperature and alkalinity-like factors, which during incubation in vitro, impact the ratio of aragonite and calcite crystallisation, and which in turn determines the value of the pearls.
In the first batch of experiments, specimens of marine oysters *Pinctada margaritifera*, ranging in age from 18 months to two years, were selected and prepared. Mantle tissues were removed and sterilised according to strict aseptic protocols using filtered seawater, ethanol and antibiotics. These tissues were transported from the Andaman Islands to a tissue culture and cell biology facility located at Prayagraj, Uttar Pradesh, about two thousand kilometres away from the Andaman sea. Throughout transport, suitable osmolarity and alkalinity were maintained in the culture medium.

It was observed that the tissues were healthy even after 72 hours in the culture medium. The tissues were again sterilised and cut into different sizes to prepare the explants for a series of experiments (broadly tagged as A1 and A2).

In the A1 batch, tissues were placed in culture plates and culture medium and other supplementary minerals were added, as well as micronutrients and proteins extracted from various sources of marine origin such as seaweed, selected species of algae, calciferous substances of pearls/shells, etc.

At the same time, in the A2 batch, 1 x 3 mm size of mantle pieces folded with a shell particle of about 0.6 mm were inserted in about 6 x15 mm area of rectangular mantle tissue by making pockets in it through surgery. The mantle tissues were maintained in nutrient agar in culture flasks, constituting a culture medium in which supplementary substances were added in stages. Microscopic analysis identified cell proliferation on the 6th day in batch A1. Mixed cells were observed spreading from explants in prismatic structures.

Batch A2 explants were placed in gel; therefore nothing could be visibly observed under the microscope. Drops of liquid from the flasks were separately analysed periodically to monitor the bacterial and other growth.

On the 37th day, a population of granular cells was seen along with agranular cells in batch A1. Regular monitoring revealed that the numbers of granular cells were gradually increasing or converting to granular cells from agranular cells. On the 54th day, aragonite micro-crystals were seen on culture plates in batch A1.
In batch A2, on the 92nd day, an irregular pearl sac started appearing within the mantle tissue, as observed from the bottom of two culture flasks during monitoring without opening the flask. Microscopic analysis showed a wide spectrum of colours over the surface of irregular pearls formed in batch A2, and the high lustre indicated that aragonite crystallisation was the main component in the pearl sac.

**Research findings are promising**

Granular cell proliferation and aragonite crystal formations in batch A1 and irregular pearl sac formation in the mantle tissue surgically operated on with graft and shell particle in batch A2, have demonstrated the natural characteristic of mantle tissue genotypes in the nacreous secretion process leading to the successful biomineralisation process of the secretion in pearl formation in vitro. A key finding was that the secretion of nacre by mantle tissue is not necessarily the result of foreign body reaction.

The trial has revealed that the quality and colours of the pearls can also be enhanced by variation in media and by introduction of supplementary micronutrients and proteins. Precursor matrix of shells, extracts from seaweed and selected algae play a vital role in inducing the growth of the granular cells and aragonite crystal formations.

Standardised methodology with uniform and customised culture conditions can create uniform pearly layers over the nuclei with high lustre as micro-nutrients and other supplements can induce the formation of a high ratio of aragonite crystallisation seen in most valuable pearls.

**Benefits and scope of in-vitro pearl culture**

There are several advantages and benefits of in-vitro pearl culture. Generally, in the usual pearl culturing operations, bivalve molluscs are used. However, there are several other marine shellfishes including spiral shells and other marine gastropods (such as queen conch and abalone, to name a couple) which can produce gem quality pearls. Nuclei implantation and grafting are critical in this but are often not possible. The new tissue culture technology opens the way to producing pearls using the mantle of such shellfishes in in-vitro culture.

Open sea pearl culture faces several challenges such as pollution and natural disasters like rough seas, cyclones etc. Seaward culture installations require sheltered locations which are not commonly available everywhere, and security of the oysters from predators and poachers is also a big challenge. Tissue culture operations have no such issues and production cost is also substantially lower.

In open sea pearl culture operations, there is no control over environmental or seasonal variations which affect the colour and quality of the pearls. But through in-vitro culture, the epigenetic characteristics of the explant can be customised by supplementary micronutrients and minerals to achieve the desired result.

As mentioned earlier, in normal pearl culture operations, grafting of mantle tissues and nuclei implantation is done at the gonad region of the oysters. The gonad is not the natural place where the mantle tissue is normally located. This causes a sudden immunological upheaval in the body of the oyster and a large number of oysters die due to this. In the tissue culture method, however, death of the animals is minimal.

Most importantly, as one of the future objectives, cryopreservation (in liquid nitrogen) research will look at storing the granular cells proliferating in the culture flasks of explants which produce aragonite crystals of pearl sacs. These cells can then be cultured and proliferated anytime, anywhere as required. By this method, a pearl culture cell bank of several species can be created.

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**Dr Ajai Kumar Sonkar** is a scientist and independent researcher based in the Andaman and Nicobar Islands, India.
**First Atlantic salmon facility**

**Singapore** – In an agreement with UK-based Benchmark Genetics, Singapore RAS will receive deliveries of Atlantic salmon eggs for stocking in its land-based facility in Singapore once it is ready for operation in 2023. The first construction phase of a 1000-tonne facility is underway, with a projected expansion of up to 3000 tonnes in the next stage. Singapore RAS will be the first in the country to farm Atlantic salmon, all destined for the home market.

“We will build a RAS unit for Atlantic salmon in Singapore with a strong focus on sustainability and circular economy. Our experiences from similar projects in Northern Europe indicate that we must succeed in this. Our goal is to create a commercially profitable company that can function as a regional centre for knowledge and application of RAS technology in Southeast Asia,” explains Esben Johnsen, CEO of Singapore RAS.

**Boost for offshore seaweed and shellfish culture**

**New Zealand** – The Cawthron Institute has announced that it has received government funding to deliver two five-year strategic and impactful research programmes that “will further develop the country’s aquaculture industry and provide innovative approaches for freshwater fish management”.

The first, called “Ngā Punga o Te Moana: Anchoring our Open Ocean Aquaculture Future” aims to deliver the knowledge and technology New Zealand needs to accelerate and scale-up its shellfish and seaweed open ocean aquaculture systems. The second, called “Fish futures: preparing for novel freshwater

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ecosystems” will address the increasing stress on New Zealand’s freshwater fish from pressures such as human activity, climate change, pollution and threats from other species.

The Institute will be working alongside industry, community, Māori partners and other research organisations in developing new and responsive policies grounded by Treaty principles to better integrate the management of native and introduced fishes.

Seaweed potential at Lakshadweep

India - A farming project that aims to produce 30 000 tonnes of indigenous Gracilaria edulis and Acanthophora spicifera seaweed a year has been launched in the Lakshadweep archipelago, off the southwest coast of India. Technical support is being provided by the ICAR- Central Marine Fisheries Research Institute (CMFRI), which had worked with the Lakshadweep administration during 2020-21 on successful trials off the islands of Kiltan, Chetlah Kadmath, Agatti, and Kavaratti.

“The studies revealed that the island territory has a potential of producing nearly 30 000 tonnes of dry seaweed per year by farming only 1% (200ha) of its 21 290 ha of lagoon area (inhabited islands only) at the modest rate of 150 tonnes per hectare”, said ICAR-CMFRI scientist Dr K Mohammed Koya.

Under the programme launched on 21 August 2021, nearly 400 rafts seeded with G. edulis seed strains grown in the islands by the ICAR-CMFRI as well as the seed sourced from Rameshwaram, Tamil Nadu have been deployed. Additional units to reach the target of 2500 rafts are being added as the seed materials are developed in subsequent farming cycles of 45 days. The project will benefit 100 families belonging to 10 women self-help groups in different islands.

Innovations driving offshore aquaculture

Global - Norway and China will be the main growth centres for offshore aquaculture, and that up to 10 percent of the global salmon supply could be produced in offshore systems by the end of the decade, according to a recent report published by Rabobank.

The report explains that, after decades of rapid growth, legislation, carrying capacity, environmental issues, pollution and climate change are all limiting the growth of coastal aquaculture. At the same time, designs for new farms that can largely be controlled remotely are emerging – including floating, submersible and semi-submersible versions.

One conclusion is that if implemented well, offshore aquaculture could improve aquaculture’s biosecurity, sustainability, and animal welfare while reducing the environmental impact and supplying healthy marine proteins for the world’s growing population. As legislation can impede or inhibit growth and is often slow to change, offshore farming may also eventually develop in international waters, though clear global standards will need to be enacted to safeguard sustainable growth.

Update on innovative European seaweed project

EU - The Horizon 2020 Blue Growth project GENIALG is the first industry-driven project bringing together
pioneering companies in large-scale integrated European biorefineries and experts in seaweed cultivation, genetics and metabolomics to boost the seaweed industry. Its key outputs to date include:

- Demonstrating the techno-economic feasibility of cultivating land-based sea lettuce and of cultivating sugar kelp in the open sea;
- Applying the first genome-wide approaches and a customised phenotyping platform for seaweed strain selection and improvement to improve understanding of seaweed genetics and physiological traits;
- Creating new approaches for valorising new and existing products from seaweed compounds that have pharmaceutical applications;
- Developing novel marine enzymes and enzyme cocktails for seaweed fractionation.

The project has also improved access to information about seaweed farming best practices and the innovations of seaweed biorefinery, through the creation of:

- The GENIALG E-Learning Course on sustainable seaweed farming practices, which is freely available to students, current practitioners within the seaweed industry or anyone interested in entering the seaweed industry.
- The GENIALG Manual on Best Practices for Seaweed Farming, which contains information on biocontainment and management of pests and pathogens.
- The GENIALG Biorefinery Manual, which explains the benefits and sustainability of seaweed biorefinery processes.

Soy sector renews commitment to sustainable aquaculture

USA – In September, the U.S. Soybean Export Council (USSEC) announced the convening of the Global Aquaculture Industry Advisory Council with fresh multi-stakeholder representation from 11 academia, civil society, industry, public sector, and sustainability certification organisations around the world. The Council said that it was doing so to reaffirm the US soy farmers and industry’s commitment to shaping a
USSEC believes that soy protein is an excellent source of protein for the aquaculture and aquafeed industry due to its high protein content, balanced amino acid profile, and high level of digestibility for most cultured fish and shrimp species. As such, the Council says that it can replace high-cost animal proteins. A large majority of aquaculture diets now contain 25-30% soy as a key part of the formulation, and there are a variety of applications in which soy products can be used in aquaculture diets, including soybean meal, soybean oil, soy protein concentrate, full fat soybean meal, fermented soy, soy lecithin, soy hulls and soy isolates, among others.

Successful cultivation of giant trevally

Indonesia – The Directorate General of Aquaculture at the Maritime Affairs and Fisheries Ministry has announced a breakthrough in the cultivation of giant trevally, according to Antaranews.com. “Through a lengthy process of aquacultural engineering, trevally fish were successfully bred by the technical team of the Marine Cultivation Fisheries Center (BPBL) in Ambon,” said the Director General of Aquaculture at the Ministry, Tb Haeru Rahayu. Supplies of the fish -- locally known as ‘ikan bubara’ or ‘ikan kuwe’ – were previously met only by marine fishing.

BPBL Ambon reports that the survival rate from egg to fingerling stage is approximately 10%; after that, the survival rate rises to as high as 90% until the fish reach marketable size (about 500g) within 6 months. In addition to developing hatchery techniques to produce high-quality seeds, BPBL Ambon has also come up with the technology for farming trevally in floating net cages.

FIA-PNG wants Harvest Control Rules in place

Papua New Guinea – The Fishing Industry Association (FIA) has issued a call to the Western and Central Pacific Fisheries Commission (WCPFC) to implement Harvest Control Rules for the Western Central Pacific Ocean. This followed the July announcement by the Marine Stewardship Council (MSC) that the certification of 22 tuna fisheries in the Western Central Pacific Ocean could be suspended if the regional fisheries body fails to act on measures to keep the fisheries harvested at sustainable levels. “Urgent action is needed by governments to complete the WCPFC work plans, and we urge all stakeholders to lobby their representatives to ensure robust sustainability measures are reached for all tuna, especially WCPO tuna stocks at this time,” MSC said in a release.

FIA-PNG President and Chairman Sylvester Pokajam said “We at FIA-PNG recognise that tuna is vital for the economy, livelihood, and food security of our coastal communities and country, therefore it is extremely important to maintain the market access and comply with current retailers’ requirements, one of which is the MSC certification of the wild-caught tuna”. The certification faces suspension if no agreement is put in place by June 2023.

First Mover Forum

Indonesia - In September the International Pole and Line Foundation (IPNLF) announced a new collaborative initiative called First Mover Forum which aims to improve and promote innovative solutions for Electronic Monitoring (EM) and Electronic Catch-Documentation and Traceability (eCDT) among Indonesian fisheries. It involves widespread implementation of the latest technology and commercialising these solutions with stakeholders in the seafood and fishing industry.

IPNLF are long-standing supporters of these fisheries and, together with Asosiasi Perikanan Pole and Line dan Handline Indonesia (AP2HI) and the Ministry of Marine Affairs and Fisheries (MMAF), have been working with companies and other partners throughout the tuna supply chain to develop new technologies in the EM and eCDT space.

The Forum is a voluntary cross-sectoral group which represents government, industry, markets, NGOs and tech firms. Members fall into three categories; market members who can be either market end or customer facing; advisory members which include NGOs and technology experts, groups or associations; and finally, executive members who are those working in government, seafood processing or as vessel owners.

First MSC-certified clam fishery in China

China - The Yalu Estuary Manila clam (Ruditapes philippinarum) fishery in the China Yellow Sea, located on the border with North Korea, has been granted
Marine Stewardship Council certification, the first such fishery in China to be certified. The MSC said that the fishery’s successful certification follows a Fishery Improvement Project (FIP) in collaboration with seafood producer, Dandong Taihong Foodstuff, Nichirei Fresh Inc, a major supplier of clams to the Japanese market, and WWF Japan and China. Auditor SCS Global Services will continue to audit the fishery every year to ensure that it maintains the high levels of sustainability required for MSC certification, with a full reassessment after five years.

Dr. Cui He, President of China Aquatic Products Processing and Marketing Alliance (CAPPMA), was reported as having said: “The sustainable practices of the Manila clam fishery in these coastal mudflats will be a flagship for other fisheries in the area. They are leading the way in conserving the ecosystem and demonstrating how a sustainable fishery program can generate multiple benefits, balancing ecological conservation and economic return.”

**MARKETING**

Walmart (USA) buys sustainable tuna for inhouse brand

**Marshall Islands** – In a media release on 5 October, the Nature Conservancy (TNC) announced a groundbreaking partnership with the Republic of the Marshall Islands (RMI). Pacific Island Tuna, a TNC-RMI joint venture company, will supply sustainable canned tuna to Walmart stores across the United States. Walmart said it chose Pacific Island Tuna to supply it with Marine Stewardship Council-certified canned skipjack tuna for its in-house brand, Great Value.

The RMI’s economy relies heavily on revenue from the tuna industry. A significant portion of its non-aid income comes from the tuna industry, but this income represents a tiny fraction of the $26 billion global canned tuna market. As part of the deal, at least 40% of the company’s net income distributions will directly support community-based conservation and climate resilience projects, including the development and management of Marine Protected Areas and coral reef restoration. The other 60% of profits will be returned to Pacific Island governments. The Pacific Island Tuna co-operative model plans to expand to include other Pacific Island Nations in the future.

**Rising demand in the US for seafood analogues**

Credit: Good Food Institute

**USA** – According to the Good Food Institute, plant-based seafood accounted for only 0.1% of dollar retail sales of all seafood in the US last year. Nevertheless, demand is growing, from US$4.9 billion in 2018 to US$7 billion in 2020, and the Institute thinks that retail sales could grow by US$221 million if the category can capture the same seafood market
share as plant-based meat in the meat market.

In a related statement, Bloomberg Intelligence said that the total market for plant-based foods could represent up to 7.7% of the global protein market by 2030.

**Tuna analogue launched in October**

Japan - Tokyo-based Next Meats Co., a food-tech venture company that specialises in the research and development of Japanese-style alternative meat products, has announced the launch of a tuna analogue in October. It will be the latest in the line of plant-based ‘meats’ produced by the company, joining “NEXT Yakiniku” (the world’s first vegan Japanese barbecue meat analogue), the beef bowl analogue “NEXT Gyudon”, and the egg alternative NEXT EGG 1.0.

The founders of the company are optimistic about the market prospects, based on the fact that when Next Meats launched their e-commerce shop in June in the US, their stock of NEXT Yakiniku short-ribs sold out.

**Tuna exports to the EU continue to rise**

Vietnam - Vietnamese tuna exports to the EU have continued to benefit from the decrease in tariffs on tuna products due to the EU-Vietnam Free Trade Agreement (EVFTA), which entered into force on August 1, 2020. In the second quarter of 2021, Vietnam shipped 9,360 tonnes of tuna to the EU bringing in US$45.05 million, up 43.9% in volume and 59.3% in value from the previous quarter.

According to the Ministry of Transport, Vietnamese tuna was sold in the EU at an average of US$4.62 per kg in the first six months of the year, down 0.27% from the previous year. Global tuna prices declined as demand for canned tuna products declined during this period.

Vietnamese tuna was sold in the EU at an average of US$4.62 per kg in the first six months of the year, down 0.27% from the previous year. Global tuna prices declined as demand for canned tuna products declined during this period.

The biggest increases were seen for Poland, where imports of Vietnamese tuna rose by 989% in volume and 608.6% in value, followed by Bulgaria at 289% and 229%, respectively. Meanwhile, the European Statistical Office (Eurostat) reported that Vietnam was the eighth largest external supplier of tuna to the EU in the first four months of 2021, accounting for almost 5% of total EU tuna imports, up from 4% in the same period last year.

However, there is ongoing concern in Vietnam over the EU’s yellow card that was issued in October 2017, and which has not been lifted as long as the EU is not satisfied with the country’s activities to end illegal fishing. In September, Prime Minister Pham Minh Chinh set a deadline to stop illegal fishing by the end of this year to avoid the risk of fines or a ‘red card’ from the EU.

**First shipments of fresh Norwegian saba to Japan**

Japan/Norway – In the last week of September, fresh Norwegian mackerel was flown into Japan for the first time. Usually, the mackerel (or ‘saba’ as it is called in Japan) is imported in frozen form. Marketed as “saba nouveau”, the fresh mackerel was imported by trading house Jalux Inc., a group company of Japan Airlines.

According to Jalux, some of the imported fish will be salt-grilled and served as a first-class inflight meal on JAL’s domestic flights to and from Haneda airport. Others will be sold at supermarkets in the Tokyo metropolitan area. Jalux said it carefully selects Norwegian mackerel that weighs 500 grams or more and has a fat content of about 30%.

**Salmon producer to buy cargo plane**

Faroe Islands - In a first for the industry, Global Salmon Initiative (GSI) member Bakkafrost is buying its own cargo plane to deliver product direct to the market. Bakkafrost is the biggest salmon farmer in the Faroe Islands and owner of the
Scottish Salmon Company. The decision to buy its own aircraft was made to overcome the logistical challenge of sending fresh salmon to parts of the world including its biggest market, the US. Currently, Faroese salmon has to be exported by sea to the UK mainland or Denmark before being put on flights to the US.

In the meantime, Bakkafrost is taking a number of measures to improve its Scottish operations, including investments in larger smolt, automation and processing facilities.

**Re-launch of Norwegian whitefish campaign in Asda stores**

**UK** - In September 2019, Asda stores (UK) announced a partnership with the Norwegian Seafood Council (NSC) in which line-caught Norwegian cod and haddock was placed on its shelves and sold under its house brand. Now, two years later, the “Seafood from Norway” campaign has been re-launched by the NSC and Asda. According to a press release, the NSC and Asda will also grow customer awareness through advertising and social media. With stronger demand for white fish in Nottingham and Leeds, campaign activity will be amplified in these areas, featuring direct mail to 13,000 households. Hans Frode Kielland Asmyhr, UK Director of the Norwegian Seafood Council says: “The consumer has spoken: our research revealed that sustainable fish is important to 87% of UK consumers”.

The UK is Norway’s most important export market for whitefish. Cod and haddock are two of the UK’s most popular species for domestic consumption, but British waters are only able to provide for about a quarter of the demand.

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Nestlé announces plant-based shrimp alternative

Switzerland - Nestlé has expanded its plant-based seafood offerings with the Garden Gourmet Vrimp, the company said in its press release in October. The shrimp alternative is vegan and made from a combination of seaweed, peas and konjac root. Nestlé says that it also has the authentic texture and flavour of succulent shrimps, is perfect for complimenting salads and poke bowls and can be used in stir fried dishes, pasta dishes or as topping for pizzas.

The Garden Gourmet Vrimp follows the launch of Garden Gourmet Vuna which is now available in Switzerland, Germany, Italy and the Netherlands. Vuna is made from pea protein, wheat gluten, rapeseed oil, and a natural flavour blend.

WTO members continue discussion on subsidies

WTO members resumed negotiations on fisheries subsidies under an intensified programme of meetings beginning on 1 September. The chair of the negotiations, Ambassador Santiago Wills of Colombia, said the objective, as affirmed by ministers at the 15 July virtual meeting, will be to produce a clean text of fisheries subsidy rules ahead of the 12th Ministerial Conference. Thus far, there have been consultations, bilateral discussions, small groups, and meetings of the entire membership on key issues where views remain divergent. As at the time of publication of this issue, the negotiations were still ongoing and suggestions are being put forward, such as India’s suggestion that existing leading distant-water nations should pick up the tab for damage done to global fishing stocks and ecological systems. Under this “polluter pays” principle, other developing nations without a distant-water fleet would get a 25-year exemption from subsidy prohibitions.

Under the mandate from the WTO’s 11th Ministerial Conference held in Buenos Aires in 2017 and the UN Sustainable Development Goal Target 14.6, negotiators have been given the task of securing agreement on disciplines to eliminate subsidies for illegal, unreported and unregulated fishing and to prohibit certain forms of fisheries subsidies that contribute to overcapacity and overfishing, with special and differential treatment being an integral part of the negotiations.

Shanghai Declaration adopted at GCA+20

Under the theme of “Aquaculture for Food and Sustainable Development”, the Global Conference on Aquaculture Millennium +20 (GCA +20) was held in September. It was organised by the FAO, the Network of Aquaculture Centres in Asia-Pacific (NACA), and the Chinese Ministry of Agriculture and Rural Affairs. The Shanghai Declaration (http://www.aquaculture2020.org/declaration/) was adopted at this Conference, representing a road map to optimise the role that aquaculture can play in achieving the 2030 Agenda and meeting the pledge of “leaving no one behind”.

Speaking at the Opening, Director-General QU Dongyu stressed that aquaculture plays an important role in FAO’s new Strategic Framework 2022-2031 through its Blue Transformation priority programme, with the objective of supporting 35 to 40 percent growth in global aquaculture by 2030. “FAO’s Strategic Framework is based on the principles of the Four Betters: better production, better nutrition, a better environment and a better life for all - leaving no one behind,” he said. “The Shanghai Declaration is a call for global action.”
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MARKETING AND PROMOTION OF ARTISANAL GROPER FARMING IN THE MALDIVES

By Ahmed Rashid

As the Maldives is surrounded by the ocean, the fisheries sector and the food that comes from the sea are of great significance to its population. In line with its vision of maintaining the fisheries sector as being one of the greenest in the world, the government is further developing its blue economy through the establishment of a grouper farming project at Adh. Atoll. The results have been encouraging; however, the author recommends increased focus on the marketing and promotional aspects in order for the beneficiaries of the project to fully realise the viability of grouper farming.

The Maldives economy is structured along two main economies: tourism and fisheries. These two sectors are highly impacted upon by changes in global trade and business as can be clearly observed in the current situation that has been happening in the world economy. In order to enhance resilience within the fisheries sector, the government’s renewed focus is on developing other areas such as artisanal fisheries/grouper farming.

The first artisanal grouper farming project in the Maldives was introduced in Alif Dhaalu atoll in 2019, when seven household farmers from Mahibadhoo successfully grew market-sized brown marbled groupers. The auction of these fish in August 2020 follows years of research and development in mariculture by a dedicated team at the Maldives Marine Research Institute (MMRI). Cultured using standard mariculture feed, the groupers in this ongoing project are being introduced to a newly established market.

A similar grouper farming pilot project has been set up at Adh. Atoll, where a total of 19 beneficiaries have been assigned 19 cages of 8 compartments for each beneficiary to produce
groupers. This article dwells on the marketing and promotion of the fish in local and international markets, which are key elements of the development of any industry.

## Challenges and opportunities

The challenges that are faced by artisanal fisheries in the Maldives when trading in the international or domestic arena are lack of finance, low productivity, burden of regulations, limitations in human capital development, environmental issues, competition from large scale fisheries, and high cost because of diseconomies of scale (Rashid, 2020)\(^1\). A good business strategy can change challenges into opportunities as governments are usually interested in developing its economy by encouraging more entrepreneurs to carry out economical activities. Providing financial support, capital and other incentives to these entrepreneurs can be seen as opportunities for artisanal fisheries. Banik, S (2018)\(^2\) stated that small scale industries trigger the equitable distribution of wealth and income within societies in ways that are economically positive and without being politically turbulent. In general, societies are chiefly categorised by more concentration of income and wealth in the organised sector, leaving the unorganised sector under-developed.

To develop artisanal grouper farming in the Maldives, the Government has been providing financial support and training to island communities and encouraging youth and women to participate in relevant programmes and economic activities. There has been substantial growth in mariculture as a result of these endeavours and strategies.

### A conceptual framework for the marketing and promotion of grouper farming

To expand artisanal fisheries, especially in developing countries like the Maldives, certain factors must be in existence. For example, Maldivian grouper farming depends solely on imports of raw material, whether it is feed or juveniles (eggs) for the growth of grouper or any other species. Therefore in order to ensure continuity, it is vital to have an arrangement to import or produce raw material in-house for use in business operations/artisanal fisheries without any halt. Access to training, having an interest in the field of business, and other parameters which are necessary for success, are detailed in the theoretical framework shown in Figure 1.

The Government’s role is vital in providing support for mariculture to develop as an industry, as currently, Maldivian artisanal fisheries is in the initial stages of economic activity. In this regard the Government, in collaboration with the World Bank, has configured loan funds for the development of mariculture. Using this loan, a grouper grow-out pilot project was established at Adh. Atoll to demonstrate the feasibility of farming the species. Training on marketing and promotion as well as business management are part of the project, while funds and capital have been distributed to the beneficiaries to bring the mariculture industry to another level. As one of the objectives of this mariculture project is to reduce poverty in the Maldives, it is designed to be replicated on other atolls.

In these early stages of this initiative, there is a need for the Government to guide the beneficiaries on how to promote their grouper output in order to obtain high returns from their investment. Since the initial investment may not be sufficient for the development of the project, further financial support should be provided to the beneficiaries in order to sustain the industry. As production is expected to increase, further steps should be taken to identify the distribution channels for the products on a regular basis. How to raise operational funds is usually a great obstacle for fishers working to enhance their livelihoods, most having hardly been able to accumulate their own capital for investment in a new venture. Another constraint for altering livelihoods is a lack of market information (Zamroni and Masahiro, 2011).

Figure 2 depicts a concept developed by the author, which identifies the independent and dependent variables to be considered in promoting and marketing grouper farming in the Maldives. The conceptual framework begins with activities on marketing and promotion, while the independent variables for artisanal fisheries/mariculture are those related to promotional and marketing activities.

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\(^3\) Zamroni A, and Masahiro Y, (2011), Assessment of the Socio-Economic Impact of the Small-Scale Natural Resources Management Program (SNRM) in Indonesia: Case Study in Two Fishing Communities of South Sulawesi, Graduate School of Biosphere Science, Hiroshima University.
Figure 2: Conceptual framework for artisanal fisheries/mariculture in the Maldives

Figure 2 shows that increasing the unit of production, growth rate of grouper, setting a reasonable price and enhancing the quality of the packaging may lead to high business performance, high return on investment (ROI), increasing profits and sales. The independent variables (promotional and marketing activities) will result in better performance of the dependent variables.

Pilot project on artisanal fisheries

Research was conducted on a pilot project in the Maldives in order to ascertain the project beneficiaries’ view on marketing and promotion for the grouper which they grow out in their respective cages. There are 19 beneficiaries in this project so this will be regarded as the population size, and since 18 of them took part in the survey, so the sample size is 18. Three of the 19 beneficiaries are women, which indicates that the project furnishes opportunities for empowering women. It also provides financial assistance to the beneficiaries, as well as training on how to grow out groupers, start up a business, finance and accounting, marketing and promotion. The expectation is that this kind of project will reduce poverty in Ari Atholhu Dheknuburi (Alifu Dhaalu Atoll) as well as build capacity in this field.

Table 1: A snapshot of beneficiaries

<table>
<thead>
<tr>
<th>Project island</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Dh. Mahibadhoo</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>A.Dh. Omadhoo</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>A.Dh. Dhangethi</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>A.Dh. Dhigurah</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The research findings are given in the following sections.

There are 19 cages in this project, each cage of nine square feet containing eight compartments (Figure 3). It is estimated that each cage can hold 72 groupers, which makes the total production of grouper as 1368 units. Each beneficiary is designated a cage and it is his/her responsibility to oversee them. If the selling price is US$6.50 per unit of production, the estimated revenue from this project is US$8,892 for every production cycle.
Weather conditions could be a challenge due to rough seas and high velocity winds which may cause damage to the cages; careful observation and regular monitoring of weather conditions is therefore important. Theft could be another challenge for farmers, and it might be difficult for them to arrange for security to monitor what is happening to the cages 24 hours a day. This is a limitation for the beneficiaries as they have to hire workers to work as security guards to protect the cages from thieves. Although the initial investment is high, this challenge can be eliminated by installing security cameras or monitoring surveillance systems on the cages. In the long term it will be more beneficial financially.

Figure 4: Making and preparation of cages

Figure 5: Installation of cages at sea

Marketing and promotion of artisanal fisheries

Promotion of artisanal fisheries is a fundamental activity which needs to be carried out to obtain high returns in profit or sales for the artisanal fisheries business holders. The United Nations also considers artisanal fisheries to be a worthwhile economic activity with implications for development in developing countries. In a measure of the importance of artisanal fisheries, the United Nations General Assembly in its Seventy-second session in December 2017 declared 2022 the “International Year of Artisanal Fisheries and Aquaculture”.
Under the sustainable fisheries resource development project (SFRDP) funded by the World Bank, a pilot project has been established in Adh. Atoll for the mariculture of grouper by four communities/islands in this atoll. In the survey which was conducted by the author especially for this article, all the respondents strongly agreed with the importance of marketing and promoting of the business in which they are involved through this project.

**Figure 6: Survey on the importance of promoting artisanal fisheries**

Even though promotional activities incur cost to the business, it brings high returns as well. The survey confirms the view that promotion and marketing of economic activities result in high returns in sales or profits for the business.

**Figure 7: Respondents strongly agree that promotion brings high returns to the business**

When the beneficiaries were asked on the type of promotional activities that they think should be implemented, there was a clear preference for a special video on the grouper farming in order to promote their products. Hence some 77.8% agreed to make a video for this project, followed by 62.1% in favour of participating in international fairs. Equal importance was given to brochures and other promotional activities, as indicated in Figure 8.

**Figure 8: Beneficiaries’ responses on promotional activities on a scale of 0 to 15**

### Social and economic benefits

The grouper farming project in Adh. Atoll has brought social and economic benefits to the island and to the Maldives as a whole. Marketing and promotion have been instrumental in this process. Due to this project, new employment has been created, gross domestic product (GDP) will be increasing in the near future, the involvement of youth and women is high in this project, and there has been some poverty reduction due to the project generating income for the community. Furthermore, the whole project gives high visibility to Adh. Atoll, serving as a good demonstration of what could be possible for other atolls. New economic activities have been created such as the supplying of cage materials; also, since the cages are some distance away from the islands and located on the lagoon, small crafts may be required to travel between island to cages.

### What’s next….. ???

Any new process or activity should be given time to develop. It is recommended to take heed of the challenges experienced by the project beneficiaries at Adh. Atoll, and to move forward to other atolls, utilising the experience and knowledge gained. One key challenge was that not much attention was given to marketing and promoting the
Ahmed Rashid has a dual position in the Ministry of Fisheries and Agriculture as senior research officer, and Secretariat of the Maldives Fisheries Promotion Board. Conducting training and providing awareness programmes for students and island communities are part of his role as senior research officer. As Secretariat of the Board, his responsibilities include promoting and marketing Maldives fishery and seafood products.

Beneficiaries of the grouper farming project hard at work

In summary, the grouper farming project at Adh. Atoll contributes to reduction of poverty in the community on the Atoll. However, the study, especially designed for this grouper farming project, shows that the beneficiaries are in considerable need of assistance for marketing and promotion, which are the key components in raising awareness of the project internationally and locally.
The Thirty-fourth Session of the INFOFISH Technical and Advisory Board (TAB) Meeting was held from 13-14 October 2021. It was the second time that the TAB meeting was organised through a virtual platform. Representatives from 11 Member Countries: Bangladesh, Cambodia, Fiji, Republic of Maldives, Malaysia, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka and Thailand, and Observers from FAO, World Sustainability Organization (WSO) and Network of Aquaculture Centres in Asia-Pacific (NACA) attended the session. INFOFISH TAB advises the Governing Council on all technical and economic aspects of INFOFISH activities.

Mr Rizwan Ahmed, Federal Secretary for the Ministry of Maritime Affairs, Pakistan, and current Chairman of INFOFISH, stressed the role that UN FAO and INFOFISH have to play in overcoming the depletion of fish stocks around the world. He congratulated INFOFISH on its 40th anniversary this year and expressed his assurance of continuous support from Pakistan towards INFOFISH and other Member Countries. He noted that INFOFISH has expanded its activities over the years, now covering fish technology, handling, processing, aquaculture etc and hoped that the activities planned out by INFOFISH could further improve the fisheries and aquaculture sectors of Member Countries.

The Secretariat presented an overview of the progress made during the review period while highlighting that the organisation has been adept and flexible in adapting to the new circumstances to ensure minimum interruption to its services to Member Countries.

The mid-term market review presented on trade and markets, the production of fisheries and aquaculture globally in Asia and INFOFISH Member Countries, as well as the impact of Covid-19 on the sector. The presentation also discussed developments on commonly traded fishery products as well as the key challenges in terms of market access, ways to facilitate these challenges, and gave an overview of the impact of the Covid-19 pandemic on the seafood industry.

The presentation on “Technological Developments and Innovations in Aquaculture” by the Secretariat highlighted that disruptive technologies are the key to achieving greater global food security as well as making a difference in establishing responsible and transparent fishery value chains. The presentation also provided comprehensive updates on innovations in aquaculture, describing its brief history, traditional vs smart farming, current technological interventions, importance of sustainable intensification, collaboration, and partnerships.
Representatives from ten (10) Member Countries: Bangladesh, Cambodia, Fiji, Republic of Maldives, Malaysia, Pakistan, Papua New Guinea, Philippines, Sri Lanka and Thailand and Observers from FAO attended the 35th Session of the INFOFISH Governing Council Meeting (GCM) recently. The GCM was held for the first time through a virtual platform from 20-21 October 2021. The main functions of the Governing Council (GC) are to determine the policy of INFOFISH and approve its programme of work and its budget for the upcoming year, giving due consideration to the conclusions and recommendations of the Technical and Advisory Board.

The 35th session was hosted by the Ministry of Maritime Affairs, Pakistan, as Chair of INFOFISH. The GCM was graced by His Excellency Ali H Zaidi, Federal Minister of Maritime Affairs, Pakistan. In his keynote address, the Honorable Minister shared his views on some initiatives being implemented by the Government of Pakistan in relation to fisheries and aquaculture, among them being the Kamyab Jawan (Successful Youth) programme. This programme offers low or zero interest across the sector specifically for youth who are interested to start a venture or expand their existing businesses. While congratulating INFOFISH on its expanding range of services over the last years, he added that the series of webinars conducted by INFOFISH were very useful for the Member Countries and hoped that physical activities could be held soon across the Countries. He pointed to two areas of possible cooperation between Member Countries, i.e., that they collectively work to (i) attract positive media attention towards the fisheries sector; and (ii) address pollution of the oceans and improper solid waste management affecting the livelihoods of fishers.

The Chairmanship for INFOFISH for the year 2022 was handed over to the representative from Papua New Guinea. The 36th INFOFISH GCM will be hosted by Papua New Guinea in 2022.
INFOFISH 40TH Anniversary Celebration

To mark INFOFISH’s 40 years of service to the fisheries industry, we reached out to people who have, over many years, made the organisation what it is today. Below is a collection of reminiscences from some of them.

Erik Hempel
Marketing Information Officer (1981 – 1983)
Editor, INFOFISH International (1981 – 1985)
Director (1983 – 1985)

It seems incredible that it is already 40 years since I stepped off the Qantas flight from Rome at the old Subang airport outside Kuala Lumpur to join INFOFISH. My colleagues Wolfgang Krone and Jochen Nierentz were there to greet me and my family, and to take us to our hotel, the Merlin Hotel just off Ampang Road.

INFOFISH was started during the summer of 1981, with generous funding from Norway and executed by the FAO. Consequently most of the senior staff was recruited from the FAO and I myself was part of the start-up team, which consisted of four European experts. The fourth member of our group, Hinko Lisac, arrived a few months later. Dr. Krone was Chief of a section in the Fisheries Department in Rome before he became the first Director of INFOFISH (the title in the beginning was “Project Manager”); Hinko Lisac came from a position at headquarters in Rome; Jochen Nierentz was recruited from a position as Junior Professional at INFOPESCA, but spent some time in Rome preparing for INFOFISH before coming to KL; and I was recruited from the private sector in Norway, but I had done a consulting project for INFOPESCA back in 1979.

The Malaysian government provided a number of office staff, as well as office space in Wisma Batik in the centre of Kuala Lumpur. The office staff were seconded from the Fisheries Development Authority of Malaysia (LKIM, which was then known as MAUJIKAN), but they were in the dark about what INFOFISH would be. They soon learned and some of them stayed on with INFOFISH for years. In fact, one, Zainah Abbas, is still there!

When we started preparing for becoming an inter-governmental organisation towards the end of my time at INFOFISH, in 1984, FAO sent two legal experts to start work on the legal framework for the IGO.

INFOFISH information services

Southeast Asia is a great area to work in because the region is permeated by business, including in the fisheries sector. Therefore, it was relatively easy to get in touch with the private sector as long as we had something to offer them: market information.

At that time, market information was not so readily available. Admittedly, the commercial operators knew a lot about the markets in which they were active, but they knew very little about alternative markets, where they could sell their products at higher prices and ensure better profits. By putting these companies in touch with new markets, INFOFISH helped to improve the results for many, and we also contributed to both market development and product development in the region.

INFOFISH launched two major regular publications right from the start. “INFOFISH International” (which was called the “INFOFISH Marketing Digest” at that time) was a bi-monthly magazine with articles of interest to the industry in the region.

The other publication was the fortnightly “INFOFISH Trade News” (ITN), providing pricing information for hundreds of products. This publication had much more up-to-date information than the magazine, so we played around with various appearances to give the impression of urgency. In those days we were using telex, and telex messages were always in capital letters, so we tried to emulate telex by writing everything in capitals. But we soon found that it was hard to read text in only capital letters, so the other option was to give it the appearance of being an airmail letter. In those days airmail envelopes had some stripes along the edges of the envelope and that was a universal sign of urgency. So I cut some stripes from an airmail envelope and glued them on to the side of the pages. Thus was the appearance of the ITN born, and it is still the same today.
Dr. Krone was very strict about meeting deadlines and about improving our performance all the time. For the distribution of our two publications, we had to meet these deadlines, and we did, sometimes with difficulty. As Editor of the INFOFISH International, I was under great pressure as the deadline approached, and I found that I had to lock my door and put up a sign that said “Please do not disturb. Deadline approaching”. Only once was the publication of the magazine one day late, but Dr. Krone accepted the delay because the printshop we used had burnt down!

One external consultant who helped us a great deal in the beginning, and who also helped when we established INFOPÊCHE in 1985, was Ron Baynes from Canada. Ron was a superb teacher when it came to editing, and for the more difficult articles and reports he introduced the term “major surgery”.

**Technology and communications**

Distribution was a problem at the time, because we had neither e-mail nor affordable telephone services. We did not even have fax. Therefore, the information went out by airmail, which admittedly could be somewhat slow. Later, we experimented with computer transmissions, an early form of e-mail. But we had to connect our own personal computer (PC) with another PC at the other end through normal telephone lines - transmission was slow and consequently the cost was enormous. When telefax was introduced, the speed of communication increased dramatically, but telefax was an interim solution until e-mail came on line.

Back in 1981, PCs were not at all common. In fact, the first ones were introduced that year. We were keen to use the latest technology, and at that time, there was something called word processors, a kind of electronic precursor for PCs. We found that they were very effective for sending out letters and writing reports etc. that could easily be corrected on screen rather than typing the whole document over again. So we bought a Philips word processor, a huge thing that came with its own desk and used floppy disks for storage. A little later, we also bought a PC, an Apple II, with an external hard disk that had an enormous capacity. It was a big box that could store no less than 5 MB!

With these machines we were able to pour out thousands of letters to the industry in the whole region. We introduced INFOFISH and asked for information about their products etc so that we could establish our own database of producers and exporters in the region.

**Conferences – the first tuna conference**

One day in 1984, Sjef van Eijs (who had taken over as Trade Expert after Jochen Nierentz), our National Liaison Officer from Thailand, and I were discussing the possibility of organising a conference. We thought that tuna was an interesting topic and discussed where we could hold such a conference. “The conference must be in Bangkok. First of all, we have a very important tuna industry there, including the largest tuna canning plant in the world”, said our Thai friend. And so, Bangkok it has been ever since for all INFOFISH tuna conferences.

The first tuna conference in February 1985 was a great success - to our delight, the entire global tuna industry lined up with its top executives, several hundreds of them. INFOFISH’s market conferences now also include shrimp and tilapia.

**Recruitment of regional personnel**

At the outset, we aimed at replacing all the international experts - that is ourselves - with local and regional experts within five years of operation. Our first recruitments were for four junior professionals from member countries: Virginia Kwong from Fiji, Edward Lai from Macao, Jojo Poblete from the Philippines, and Fatima Ferdouse from Bangladesh. While Edward and Jojo went back to their home countries after a year or two, Virginia stayed in touch and helped me during the establishment of our sister organisation INFOPÊCHE in Abidjan. Fatima continued at INFOFISH, was promoted to senior trade promotion officer and stayed with the organisation for the rest of her professional career.

When Dr. Krone was called back to Rome to fill a senior position there (as Director of Fisheries Industries Division) in 1983, he tried to recruit his replacement as Director from the region, but had to settle for me instead. But when I left to start INFOPÊCHE in 1985, we managed to recruit Henri de Saram from Sri Lanka to take over as Director.

**Why has INFOFISH survived for 40 years?**

As mentioned, INFOFISH started as a Norwegian-funded project. But as the years went by, we built up a separate income from conferences, sales of publications, and sales of consulting services. When Norway withdrew from the project in 1987, it was transformed into an inter-governmental organisation with close cooperation with the FAO; since then, the organisation has stood on its own feet. It is true that there is some support in the form of office space from the Malaysian government and membership fees from the member countries, but most of the budget is based on own revenues. In this respect, INFOFISH is a fairly unique project that has survived for 40 years. The usual situation for such donor-funded projects is that when the funding from the donor is phased out, the organisation quickly dies.

One of the reasons why INFOFISH still exists is that when the FAO entered into this project, the goal was to replace all
international experts within about five years with local experts, i.e. from the member countries. The emphasis was therefore on training local and regional people who could eventually take over when the donor withdrew, and at INFOFISH, we succeeded in doing this. Some of those we recruited in the mid-1980s are today regarded as international experts.

Another important decision that was made was that companies in member countries had to pay for the services of INFOFISH. In order for private companies in developing countries to be able to assert themselves in competition with companies in the developed countries, they must learn to function under the same conditions.

A model for other export promotion agencies

One very important result of INFOFISH came about because a young student from Norway wrote to me one day and asked if he could study INFOFISH. Dag Eivind Opstad came to Kuala Lumpur in 1984, did his study and wrote his thesis for the Fisheries Department at Tromsø University about how INFOFISH was serving the industry in multiple countries in the region with market information and technical advice.

A few years later he was employed by the Ministry of Fisheries in Oslo, where he became central in the re-structuring of the export promotion organisation in Norway. At the time, there were 13 different export councils for seafood in the country. Opstad proposed to close them all down and establish one central organisation covering all seafood. This was supported by Parliament, and in 1991 the Norwegian Seafood Export Council (NSEC) was established in Tromsø, with Opstad as the first CEO. Since then, the NSEC, which has now changed its name to the Norwegian Seafood Council (NSC), has been extremely successful in promoting seafood from Norway, now the second largest exporter of seafood in the world, after China.

Dear INFOFISH friends,

FAO has always had a close and special relationship with INFOFISH, starting from its inception as a FAO project and later as an Intergovernmental Organization. During these past 40 years, thanks to its competent and highly motivated staff, INFOFISH has provided important services to its Member Countries and industry on a range of issues, but in particular on upgrading institutional, technical and managerial capacity to access international markets for fish and fishery products. Working closely with Members and with industry associations and companies, INFOFISH has contributed to remarkable economic and social advancements in the Asia-Pacific region, by raising food quality and safety standards and making fisheries and aquaculture value-chains more efficient and productive.

Your achievements are fully recognized by industry worldwide and participation in your commodity conferences such as for tuna has become a must for operators. Your ability to act as a forum for discussions among stakeholders including academia and NGOs is also much appreciated by all.

There are many organizations operating within the fisheries and aquaculture sector but almost all focus on primary production and resource management. INFOFISH is one of very few with a focus on the value chain, on markets and trade, on product development, distribution and consumer needs. Also for this reason, the work of INFOFISH is of crucial importance for truly sustainable development of the sector.

Personally I have great memories from participating in many INFOFISH activities, ranging from being a speaker at tuna and shrimp conferences, as a contributor to the INFOFISH International magazine, on project missions to Thailand, Malaysia, Cambodia and Sri Lanka, and more recently in a number of webinars on various topics, all organized professionally and with great competence.

Congratulations on your first 40 years of successfully providing technical assistance and support to INFOFISH Member Countries, industry associations and companies.

Marcio Castro de Souza
FAO Senior Fishery Officer (International Trade), Also Secretary of the FAO Sub-Committee on Fish Trade and FAO GLOBEFISH Coordinator

When INFOFISH was created, the world was different. Information was hard to obtain and access. Since then, INFOFISH has played a vital role in disseminating information associated with markets for fisheries and aquaculture products, particularly for the geographic region of its Member Countries. During all these years, INFOFISH was able to follow the information revolution and reposition itself in a modern world where information can be readily available but where huge gaps still exist in understanding and properly managing it.

INFOFISH became an independent intergovernmental organization that is also a key partner for FAO, although it originated from it. INFOFISH has been an active unit of the Fish Info Network, coordinated by FAO GLOBEFISH.
All participating units of the network have benefited from the excellent analytical tools and products developed by INFOFISH, creating excellent examples to be followed by others in supporting and providing technical assistance to countries. Congratulations INFOFISH!

Looking back, I feel so lucky to have been a party to INFOFISH’s success, at least in a small way. My stay in hospitable Malaysia, which I consider my “second home”, among its warm, friendly people was a memorable one. I still miss the exquisite cuisine it offered— **roti canai, nasi lemak, teh tarik**…..

I have no doubt, helped by a dynamic staff, INFOFISH will scale greater heights in the coming years. Good luck!

It is my pleasure to convey my best wishes to INFOFISH on its 40th anniversary. The organisation has played a key role in the development of marketing of fish and fisheries in Asia-Pacific countries. My three years’ tenure at INFOFISH was a very fruitful experience which took me to several member countries. We were able to successfully implement fish processing, certification, fisheries development and marketing information projects, funded by FAO, CFC, Member Countries, and others. A new dimension was added when, for the first time, INFOFISH won an Asian Development Bank funded project, through open competition and bidding in Pakistan. I believe that INFOFISH should continue to work on these lines and explore new avenues of getting resources and helping Member Countries in the fisheries sector.

I would like to mention that the human resources at INFOFISH were very dedicated and knowledgeable, with Shirlene Maria Anthonysamy being one of the highly professional staff who worked in my team. I am glad that currently she is ably leading the organisation as Director. My best wishes to all the team at INFOFISH at this important juncture of the 40th anniversary. I hope after the coronavirus pandemic subsides, that INFOFISH will organise a technical meeting, inviting former staff.

After retiring as Director General, Fisheries, currently I am working as Fisheries Expert with IUCN, and as Senior Visiting Faculty at GC University, Lahore. Please feel free to contact me, if I can be of any service to INFOFISH.

INFOFISH opened the door to the world of fisheries to me and words alone cannot describe the wealth of experience I have gained and the knowledge I have acquired. I am grateful for my “teachers” Fatima Ferdouse and Sudari Pawiro at the
Trade Promotion Division where I spent most of my earlier years at INFOFISH for all the support and knowledge they have shared. A special note of thanks to Dr Subasinghe, Director, INFOFISH (1991-2011) for the opportunities to grow - INFOFISH is an awesome organisation to learn, contribute and share for fisheries. I have gained great mentors in the process, valuable friends and colleagues.

A salute to all former colleagues, the bedrock of INFOFISH and who were instrumental in what we are today. Also, a big thank you to FAO for the unwavering support till this day, and not forgetting all the regional and international organisations, authorities, industry leaders, and other stakeholders for their collaboration too. With this collective support, INFOFISH has, and continues to live up to its mission and mandate to provide marketing and technical advisory support for its Member Countries and the region at large.

INFOFISH: You are still rocking at 40! Happy birthday!

It is a pleasure to write this message on the 40th anniversary of INFOFISH. My association with INFOFISH began in 1990 and spanned a period of some 23 years in the final stage of my active working life.

Working at INFOFISH was professionally fulfilling and often fun. There was a wide range of activities including industry conferences, projects, consultancies and training and dissemination activities. The portfolio of INFOFISH industry conferences has grown significantly from the original shrimp and tuna meetings to include a number of new species and topics such as aquatechnology, tilapia, catfish and organic aquaculture. There were also some interesting consultancy projects such as the three-year CFC-funded Organic Aquaculture project implemented in Malaysia, Myanmar and Thailand. The bimonthly magazine, INFOFISH International, continues to provide up to date information to the industry through interesting articles, updates and other regular features.

Congratulations and best wishes to all staff, past and present, for their good work to make INFOFISH what it is today.

Spending half of my career in fisheries with INFOFISH means a lot, both professionally and personally. Over 18 years of work as Trade Promotion Officer at INFOFISH has given me priceless opportunities to learn and understand various aspects of the global fisheries industry and its issues, establish networking with fisheries professionals and practitioners all over the world and earn valuable experiences from working in many countries as an INFOFISH consultant. All this exposure at the international level during my time at INFOFISH has been very useful, particularly now in my current position as the Chief Technical Advisor for the fisheries programme in Indonesia jointly implemented by the UN Industrial Development Organization (UNIDO) and the Ministry of Marine Affairs and Fisheries since June 2014. In this regard I consider myself lucky to have had the golden opportunity to work with excellent professional teams in an established organisation like INFOFISH.

On a personal level, Malaysia is like our family’s second home where we always miss it and want to visit as so many good memories are left behind. I am also happy to still be in contact with old friends and have good collaboration with colleagues at INFOFISH. Hence I take this opportunity to congratulate INFOFISH on its 40th anniversary and hope that it continues to successfully provide excellent services to the fisheries industry not only in the Asia Pacific but also all over the world.

Commemorating 40 years of INFOFISH service to the seafood industry, I would like to say that my eight years of association with INFOFISH as Coordinator Consultancy Services (2000-2008) was a never-before experience which strengthened my expertise in post-harvest techniques and I got to deepen my knowledge of the seafood industry in the
Asia Pacific region and beyond. I was also fortunate to have been involved in global food security programmes within the framework of national, regional, and inter-regional development projects, and enjoyed wholehearted support from my colleagues and senior officers at INFOFISH, while networking with fisheries experts from INFOFISH member countries.

My first encounter with INFOFISH was in 1983 when I attended a regional training course in Fish Handling, Processing & Quality Control in Penang. There, I met Hinko Lisac, Technical Adviser at INFOFISH, a soft spoken, meticulous, diligent gentleman from Eastern Europe. Born out of this course was a Handling, Processing and Quality control training kit, which sold well in the industry and was used through the many regional training courses that INFOFISH organised and conducted. In 1984, I joined the Technical Division of INFOFISH. I was awestruck by the level of modern, up to date information exchange done on a regional and global scale.

The Technical Division, as it still does today, contributed technical information, articles, training courses, conferences, publication booklets, and the Fish Inspector – the brainchild of Carlos Lima dos Santos (Technical Adviser after Hinko Lisac). This newsletter addressed quality control issues in the industry, and was also translated and circulated through the INFOPESCA, INFOPECHE and INFSAMAK regions. Technical articles were also published in the INFOFISH International (then called the INFOFISH Marketing Digest), the organisation’s proud flagship which was disseminated worldwide.

I also recall a delightful first for us! Erik Hempel, then Director, installed a fax machine in our Wisma Batik office. Lo and behold, the very first faxed letter from a vendor arrived at the ring of the phone! So, the fax joined the ever-punctuating telex machine with fish trade prices, marketing, supply and demand information for the fortnightly newsletter, the INFOFISH Trade News.

Then, as now, INFOFISH organised many conferences for the trade, especially shrimp and tuna. A resounding first was the Shrimp Conference in Bangkok in 1988, so popular that tradespeople were flocking to register long after its opening. It was a boon to the industry, and an unexpectedly huge success for INFOFISH. Such was the foresight for which I will remember INFOFISH. It was a truly satisfying work experience there.

The INFOFISH that I know has always worked hard to be a valued source of information on the fisheries industry, throughout the supply chain. I look back on those years during my first stint with the organisation as being among the most professionally and personally fulfilling times in my life. Driven by a palpable sense of camaraderie, we were always looking at how we could supply information faster, or work with stakeholders in developing countries on building better technical and marketing capacity - all this while keeping our finger on the pulse of the global industry.

I left INFOFISH in 1989 to live overseas and then went on to work in other international organisations for about 15 years. However, as the Hotel California song goes, “you can check out anytime you like but you can never leave” so when I was asked to come back to INFOFISH in 2018 as Editor of the INFOFISH International, I immediately accepted. The organisation will always be close to my heart and I congratulate all former and current staff of INFOFISH over the past 40 years for having contributed to its enduring success.

INFOFISH - the star of UN-FAO’s info-network, has successfully served the regional fisheries industries and beyond for 40 years, supported by FAO, the member countries, and most of all, the stakeholders in the region.

The dream of Dr. Wolfgang Krone, the Founder Director/Project Manager of INFOFISH, has been materialised through the efforts of the successive Directors as well as the many national and international professionals and staff who worked with heart and mind to realise the organisation’s mandate and mission. INFOFISH has benefitted from the dedication and hard work of its people through the years and until today.

On a personal note, I am grateful to Dr. Krone, my “guru” Mr. Sjef van Eijs, Mr. Erik Hempel, and all my former colleagues for the opportunities to work together, learn and love this organisation for 32 years.

Happy Birthday INFOFISH!
Congratulations to INFOFISH on its 40th Anniversary Celebration.

Being a pioneer of INFOFISH since its inception in 1981, it gives me great pleasure and pride to witness its 40 years of existence, and today still providing excellent services to the fishery industry globally.

Credit goes to Dr Wolfgang Krone who, with his passion and dedication, set up this organisation with a few key people. Now we see many good staff, not only in number but also in expertise and creativity, under the stewardship of Shirlene Anthonysamy, the present Director.

My 31 years of journey with INFOFISH were memorable and dear to my heart because of the strong sense of dedication and teamwork spirit of my colleagues - we worked together as a family and watched INFOFISH grow from strength to strength. Bravo to all the current staff as well for your great work and achievements, today.

Happy Anniversary and all the best for more success to come!

I am so proud to still call INFOFISH my ‘second home’ since Sept 1981, two months after its establishment as a FAO project.

As a pioneer employee, I was able to gain many experiences and saw INFOFISH move on from ‘old’ communication technologies such as manual printing machines, word processors, and telex machines.

Being my first time in the working world, everything was new in my life, including working with foreigners. It was like being in a family - Dr. Wolfgang Krone (Project Manager), Mr. J H Nierentz (Trade Promotion Officer), Mr. Erik Hempel (Marketing Information Officer) and several others, and also the local staff, treated me like a younger sister. The sweetest experience that I recall was when an officer from FAO who at that time was probably between 55-60 years old, gave grandfatherly guidance on the operation of the library.

I was supposed to retire on 20 June 2021, having served INFOFISH for 39 years 10 months, but my contract has been extended until 19 May 2022. I have spent more than half of my life with INFOFISH. I walked in at a very young age (“baby” of INFOFISH) and soon I will leave this organisation that I love as a grandmother. Congratulations to INFOFISH on its 40th year - it is my hope that it will continue its legacy forever.

Twenty-five amazing years, under four amazing Directors, alongside a group of all-round amazing coworkers: Fatima, Pauline, Lai Lai, VK Dey, Sudari, Anil, Krish, Paul, Tarlo - my experience at INFOFISH is indescribable. The exposure and knowledge I gained under the professional guidance were beyond one’s expectation. The working environment and the bonding formed among us have made us a family and a home to many. I will cherish all the good memories that we share. Regardless of who you are, INFOFISH will forever be home to me, and everyone I’ve worked with, family to me. Keep up the spirit and here’s wishing INFOFISH, under the leadership of our dedicated Director, Shirlene Maria, a happy 40th anniversary celebration. You can go further and beyond! Make us proud to bring INFOFISH to a higher level.

During the three years of my association with INFOFISH from 2009 to 2012, working on the editorial aspects of INFOFISH International was a daily part of my job which I used to enjoy very much. This included identifying authors, searching for articles and communicating with the authors, as well as discussing the layout and the content with my colleagues. Interactions with my senior colleagues in INFOFISH improved and fine-tuned my editorial skills and scientific knowledge on fisheries, and at the same time, enhanced the bonding and relationships with all my colleagues. Thank you everyone for the support you had given.
TRADE PROMOTION OFFICER

Working under the overall supervision of the Acting Director/Director, INFOFISH, the Trade Promotion Officer shall be responsible for the following:

- Monitor and review fishery trade in the Asia Pacific region and beyond;
- Collect and analyse price and market information on specific fishery products for the ‘INFOFISH Trade News’, a fortnightly bulletin;
- Attend to queries on supply, marketing and trade of fishery products worldwide;
- Work on identification and export promotion of fishery products from the region;
- Maintain regular contact with institutions, market news correspondents and organisations relevant to the fish marketing information network;
- Write and review articles pertaining to marketing and international trade of fishery products for the INFOFISH International magazine and other publications;
- Undertake other activities as assigned by the Supervisor or the Acting Director/Director

Qualifications:

- Post graduate degree from a reputable university in Fisheries / Fisheries Economics / Economics / Marketing / Trade/Business Management or related fields;
- Experience in international trade and marketing;
- Excellent writing and communication skills in English;
- National of a Member Country* of INFOFISH

Duty station

These positions are based in Kuala Lumpur, Malaysia. Applicants must be prepared to travel if required to do so.

Age limit

40 years; might be extended in the case of highly qualified and experienced candidates or government employees/nominees from Member Countries.

Emoluments

Salary will commensurate with qualifications/experience.

Applications stating the position applied for and containing full curriculum vitae and recent passport size photograph should be sent to the following, preferably through the INFOFISH National Liaison Office in each Member Country* of INFOFISH.

The Director
INFOFISH, 1st Floor, Wisma LKIM, Jalan Desaria, Pulau Meranti, 47120 Puchong, Selangor Darul Ehsan, Malaysia
Email: info@infofish.org

Closing date: 28 February 2022
for the receipt of application at INFOFISH.
Only short-listed candidates will be notified.

*Bangladesh, Cambodia, Fiji, Iran, Malaysia, Maldives, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka and Thailand.

Please visit our website www.infofish.org for contact details of INFOFISH National Liaison Officers in the respective Member countries.
The tenth TARS 2021 (The Aquaculture Roundtable Series 2021) was held virtually for three days from 18-20 August 2021 with some 300 participants from Europe, America, Asia Pacific and Latin America. ‘Markets, Margins and Productivity’ was the theme of this year’s TARS.

The event was organised by Aquaculture Asia Pacific Magazine and Corporate Media Services in collaboration with industry sponsors including DSM Nutritional Products, INVE Aquaculture, Biomin, Corbion, BASF, Adisseo, Jefo Nutrition, Diana Aqua, and Grobest. Dr. Zuridah Merican, Chair of the TARS 2021 and Editor of the Aquaculture Asia Pacific Magazine, opened the session by saying that COVID-19 taught us the lesson of demand-led production. For instance, farmers are facing challenges like diseases and higher production costs and as well as lower margins. She explained that in this event, consumer preferences would be discussed; and feed millers, business leaders and functional additive suppliers will answer questions such as why a trust deficit exists for farmers regarding functional feeds. Further, groups can meet through the breakout sessions to talk on improving the supply chain and traceability and how to develop sustainable Asian shrimp. She also paid a vote of thanks to the nine sponsors for making the event possible.

Presentations on Day 1 featured three Sessions: State of the Industry- Understanding Markets and Consumers, sustainability-Building Consumer Confidence and SWOT Analysis on the Asian Model. During his presentation entitled ‘A close look at the EU 27 market: Is there a future for Asian Shrimp?’ Mr Willem van der Pijl, Shrimp Insights, The Netherlands, said that he strongly believes that Asian shrimp can compete with South American suppliers in the European market in terms of quality and sustainability, and it is high time for Asian shrimp producers, processors, and feed millers to work together to create value for their products. The moderators for the day were Mr Ronnie Tan, Advisory Board member, Calysta and Dr Patrick Sorgeloos, Emeritus Professor of Aquaculture, Ghent University, Belgium.

On Day 2, there were nine presentations under three Sessions: Margin Optimization, Managing Productivity- Survival Rate and Disease Control and Weak Links in the Supply Chain. The moderators were Dr Romi Novriadi, Senior Researcher, Directorate General of Aquaculture, Indonesia; Dr Olivier Decamp, Group Technical Director, Grobest Thailand; and Mr Ravi Kumar Yellanki, Managing Director, Vaisakhi Bio-resources Pvt. Ltd, India respectively. During his presentation entitled ‘Optimisation of Feed Margins: Extracting Value Out of Feed Proteins’ Mr Herve Lucien-Brun, Jefo Nutrition, Inc., Canada explained that in the early stages of COVID-19 there was a sudden drop in product prices which had repercussions on ex-farm prices and subsequently a sharp rise in prices of key raw materials used in feed, particularly protein sources. Feed contributes the highest in total cost of production (Ecuador 53% and Vietnam 67%). Optimising the rate of crude protein in feed to decrease the non-digestible protein; looking at Protein Retention Efficiency Ratio (PRE) and feed formulation; lowering the content of marine meal in the feed; and reducing nitrogenous wastes in ponds and/or effluent can help in margin optimisation, he added.

Day 3 highlighted Future Growth Needs, Investments and Big Data. There were three presentations from Mr Alexander Farthing, Alune Aquaculture, Singapore; Ms Chelsea Andrews, XpertSea, Canada; and Mr Aryo Wiriyawan, JALA Tech, Indonesia. In his presentation entitled ‘Unlocking Investment: Consistency, Record Keeping and Risk Mitigation’ Alex Farthing underlined that investment is needed to create consistency in biosecurity and infrastructure development. The Session was moderated by Dr Anton Immink, CEO, ThinkAqua, Scotland.

The last Session started with several hard hitting questions, including: ‘Why is there a trust deficit among Asian farmers on functional feeds?’ On the panel were Mr Samson Li, CEO, Grobest Group Holdings Ltd., Hong Kong; Mr Guntur Mallarangeng, CEO, Dewi Laut Aquaculture, Indonesia and Mr Peter Coutteau, Business Unit Director, Adisseo, Belgium. Peter Coutteau opined that all stakeholders (feedmillers, feed additive suppliers and farmers) need to collaborate to find solutions. Samson Li said that functional feeds is not a silver bullet - in shrimp farming, success depends on the input. We need to bridge the trust gap between farmers and feedmillers. Guntur Mallarangeng replied that functional feed is not the panacea and that most farmers are unwilling to change to functional feeds due to price sensitivity of the shrimp and also, they are used to their own protocols.

The 10th TARS ended with a breakout session on building alliances to improve the supply chain and traceability and how to develop sustainable Asian shrimp.
Food and Agriculture Organisation (FAO), World Organisation for Animal Health (OIE) and Norwegian Veterinary Institute (NVI) jointly organized the Fish-Vet Dialogue entitled Exploring Collaboration on Managing Health of Aquatic Organisms that was held virtually during June 7-9 June 2021. It brought together competent authorities with mandates on fisheries/aquaculture, biosecurity and health management of aquatic organisms. Representatives and delegates from thirty-three invited countries from five regions (i.e., Africa; the Americas; Asia and the Pacific; Europe and Central Asia; and Near East and North Africa) responsible for national aquaculture management policies (including managing the health of aquatic organisms); as well as the private sector and/or academia/research, participated in the event.

The dialogue started with the welcome and opening remarks by Dr. Manuel Barange, Director of the FAO Fisheries and Aquaculture Division (NFI); Ms. Jorun Nossum, Deputy Director of NORAD and Dr Gillian Mylrea, Deputy Director of OIE. Dr. Melba Reantaso (FAO NFI) explained the objectives of the Dialogue: (i) to provide a platform to inform of respective mandates, (ii) to share experiences and (iii) to identify areas for collaboration concerning aquaculture biosecurity, health management of aquatic organisms and/or trade-related matters.

On the opening day, Dr. Ramesh Perera (FAO Consultant) made the plenary presentation entitled Review of organizational arrangements of the country competent authority responsible for managing the health of aquatic organisms and aquaculture biosecurity: Survey Synthesis by providing a brief analysis of the responses received from the survey. He highlighted the national authorities’ primary responsibility role, inter-agency relationships, policy and planning i.e., the country’s commitment to aquatic health and biosecurity, funding issues, Public-Private Partnerships (PPPs), stakeholder communications, regulating aquaculture and compliance. The session continued with the Plenary Country...
Presentations from five countries (China, Peru, United Kingdom, Vietnam and Zambia). The session ended with a discussion, facilitated by Dr. Ramesh Perera and Day 1 ended with a wrap-up by Dr. Rohana Subasinghe (International Consultant). A total of 143 participants from 37 countries were present, seventy nine (79) participants were from several government agencies: fisheries/agriculture (61), veterinary (5), food safety (13) and other competent authorities (5). There were also 13 representatives from intergovernmental organisations, 20 from academia and four from the production sector.

On Day 2, there were a total of 130 participants from 38 countries. D. Melba Reantaso started the day off with guidelines for the break-out session which was the main activity for the day. Participating countries were divided into five groups to discuss on disease investigation or emergency response related to specific diseases including the biosecurity and control measures taken by their respective countries. Discussions in each group started off with a 10-min scenario-setting presentation from a selected country. The selected countries were Chile, Ghana, Norway, Saudi Arabia and Thailand. After the break-out session, the programme continued with the group presentations followed by the plenary discussion led by Dr. Nigel Gibbens (International Consultant). Day 2 ended with a wrap-up by Dr. Rohana Subasinghe.

On the closing day, there were a total of 117 people from 33 countries. The session kickstarted with a plenary presentation and discussion on observations from Day 1 and Day 2. The plenary session was led by Dr Stian Johnsen (OIE) and Dr Ramesh Perera aimed at sharing of experiences on the challenges due to the COVID-19 pandemic in terms of trade of aquatic organisms and their products. The next plenary session, facilitated by Dr. Sophie St-Hilaire (Professor, City University of Hong Kong) and Mr. Ruggero Urbani (FAO Consultant), focused on the COVID-19 impact on aquaculture. This was followed by the plenary on learnings and challenges from the pandemic, facilitated by Dr. Sophie St-Hilaire. The discussion continued with the final plenary session facilitated by Dr. Nigel Gibbens and Dr. Rohana Subasinghe, which covered the opportunities for on-going Fish-Vet collaboration and discussions on the way forward. Dr. Melba Reantaso then took the floor and delivered the findings for the three-day event. The Fish-Vet Dialogue ended with closing remarks by Dr. Gillian Mylrea, Deputy Director of OIE and Dr. Keith Sumption, the Chief Veterinary Officer of FAO.
TECHNOLOGICAL TRENDS AND INNOVATIONS IN AQUACULTURE: AN UPDATE

By Sujit Krishna Das

Unlocking the immense potential of disruptive technologies is the key to achieving greater global food security as well as making the difference in establishing responsible and transparent fishery value chains. This article will provide comprehensive updates on innovations in aquaculture, describing in brief its history, current technological interventions, traditional vs smart farming, importance of sustainable intensification, collaboration and partnerships. It will also take a peek into the future, focusing on ‘sustainability-focused’ innovations and attempt to chart the way forward.

The larvae of black soldier fly (Hermetia illucens) can be a good source of alternative protein for use in aquafeeds.

Global aquaculture production attained an all-time record high of 114.5 million metric tonnes (MMT) in live weight during 2018 with a total farmgate sale value of USD 263.6 billion, where Asia contributed significantly (66%).

To meet the increasing demand for cost-effective and nutrient enriched protein to feed the global population, farmers need to produce more aquatic animals and plants. As highlighted in the Blue Food Assessment report published by the Nature journal, ‘aquatic food systems (sometimes called blue foods) can help to end hunger and accelerate the creation of a truly sustainable global food system’.

It has been acknowledged that the potential of aquaculture for further growth can be achieved through innovative practices that support environmental stewardship. In this regard, the 34th session of COFI, FAO (February 2021) recognised the need for strengthening the scientific basis in support of fisheries and aquaculture management decisions through the use of new technology. Furthermore, the landmark ‘Shanghai Declaration’ arising from the 4th Global Conference on Aquaculture Millennium +20, recommended five overarching commitments and identified 10 strategic priorities to accelerate sustainable aquaculture development and its contribution to the SDGs. Investment in aquaculture innovation, research and development have been prominently highlighted in the Declaration. Unlocking the immense potential of technologies is therefore crucial in the quest to nourish more starving people, and undoubtedly, innovative technologies will be the key driver to grow, process and market responsible seafood and establish transparency throughout aquatic food systems.

There are some limitations and risks in traditional farming which can be minimised with the help of these technologies. While comparing between traditional and smartly managed farms, one should consider the stocking density, growth, disease, labour intensity, feed management and utilisation of trophic levels. Whereas traditional farms are less aware about transparency, environmental concerns, sustainability, women’s empowerment, and fish welfare, these parameters are addressed in smart farming systems. The younger generation of farmers in particular, are usually excited to experiment with them such as having the ability to operate aqua farms remotely and precisely. Success ultimately depends on the economic returns, Feed Conversion Ratio (FCR), Feed Efficiency Rate (FER), the species being cultured, market demand and consumer expectations in both farming systems.

2 Harness the world’s aquatic ‘blue’ food systems to help end hunger. The Nature Journal, 15 September 2021.
3 Report of the 34th session of the Committee on Fisheries, 1-5 February 2021, Rome, Italy.
4 The Shanghai Declaration: Aquaculture for food and sustainable development, Conference on Aquaculture Millennium +20, 22-25 September 2021, Shanghai, China.
A brief history of aquaculture innovation

The history of aquaculture dates back centuries, with every innovation coming on the back of various scientific research, development of novel materials, float and net technologies etc. The chronology given below is the summary of an article published in the Hakai Magazine on 24 August 2020:

<table>
<thead>
<tr>
<th>Year</th>
<th>Technological developments</th>
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<tbody>
<tr>
<td>1833</td>
<td>International Fisheries Exhibition, London, UK: growing interest in culturing salmon, trout and oysters</td>
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<tr>
<td>1899</td>
<td>Establishment of marine laboratories and fish hatcheries through ICES</td>
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<tr>
<td>1924</td>
<td>Tilapia “The Aquatic Chicken” was first cultured (Kenya)</td>
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<td>1927</td>
<td>Vertical floating raft culture (hanging method) developed for oysters (Japan)</td>
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<tr>
<td>1933</td>
<td>Brine shrimp artemia as an excellent food source for fish larvae (USA)</td>
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<tr>
<td>1950</td>
<td>Revolutionary use of plastics in design and manufacture of aquaculture items</td>
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<tr>
<td>1954</td>
<td>Development of fish feed in a moist and soft pellet by Oregon Fish Commission, USA</td>
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<tr>
<td>1958</td>
<td>Artificial spawning and hatching of kuruma shrimp by Japanese scientist Motosaku Fujinaga</td>
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<tr>
<td>1959</td>
<td>Floating wooden cage with suspended net for Atlantic salmon culture</td>
</tr>
<tr>
<td>1963</td>
<td>Artificial propagation and spawning of bivalves by Victor Loosanoff and his colleagues at Milford Lab, USA</td>
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<tr>
<td>1970</td>
<td>World’s first commercial salmon farm developed by Karstein and Olav Vik brothers in Norway</td>
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<tr>
<td>1971</td>
<td>World’s first family-based breeding programme developed for salmon</td>
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<tr>
<td>1980</td>
<td>RAS technology introduced in Denmark with a view to commercial culture of European eel</td>
</tr>
<tr>
<td>1999</td>
<td>Acoustic technology to monitor fish swimming behaviour. In fact, this is the beginning of computer vision technology by using underwater camera and algorithms to monitor fish size and sea lice infestation</td>
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<tr>
<td>2017</td>
<td>World’s first offshore fish farm developed (SalMar, Norway)</td>
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<tr>
<td>2018</td>
<td>World’s first deep sea fish farm developed (Chile)</td>
</tr>
<tr>
<td>2020</td>
<td>Cermaq’s iFarm project to monitor not only cages but also individual fish</td>
</tr>
<tr>
<td>2021</td>
<td>Genome edited sea bream (Japan)</td>
</tr>
</tbody>
</table>

Also noteworthy in Asia, innovation in shrimp aquaculture started with the successful artificial propagation of black tiger shrimp by Professor Dr. Chiu Liao, National Taiwan University (1968).

Innovative technology development in aquaculture is a collaborative process which depends on the scale and mode of operation, implementation site, target species, existing environmental conditions, available resources, scope of commercialisation, as well as regulatory and funding support. Broadly we can categorise aquaculture innovations as those that are problem-oriented (e.g., disease, growth) and demand-oriented (e.g., traceability, value added product).

Recirculating Aquaculture System (RAS): In RAS, water is purified and reused continuously. The purified water is subsequently saturated with oxygen and returned to the fish tanks. Through recirculation, the water and energy requirements are limited to an absolute minimum. The produced wastes - solids, ammonium and CO₂ - are either removed or converted into non-toxic products by the system processes. The non-degradable wastes must be removed, and evaporated water must be replaced.

Biofloc Technology (BFT): ‘Biofloc’ (biological floc) refers to a group of bacteria and other microorganisms suspended in the water column. In BFT, two groups of bacteria build up biofloc in the culture system i.e., autotrophic (nitrogen cycle bacteria that convert nitrogenous wastes to ammonia, nitrite and nitrate) and heterotrophic bacteria (such as lactobacillus and yeast that use up nitrates upon addition of a carbohydrate such as molasses). The BFT provides a stable culture medium where the toxic materials are neutralised, the floc is eaten by shrimp and fish, FCR is improved, and zero water discharge.

Innovations boost up production, generate employment, reduce the burden of energy, water, spaces and labour intensity, and address environmental issues including climate change. They offer consumers a wider range of products from diversified species while establishing transparent and trustworthy value chains with the help of disruptive technologies. Technologies also enable market access by ensuring compliance.

Land based innovations

To address major risks and ensure more aquatic foods, sustainable intensification is the way forward. There have been remarkable advancements in land based or inshore aquaculture production systems in the past decade. Some ‘sustainability focused’ innovations are listed below:

Recirculating Aquaculture System (RAS): In RAS, water is purified and reused continuously. The purified water is subsequently saturated with oxygen and returned to the fish tanks. Through recirculation, the water and energy requirements are limited to an absolute minimum. The produced wastes - solids, ammonium and CO₂ - are either removed or converted into non-toxic products by the system processes. The non-degradable wastes must be removed, and evaporated water must be replaced.

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Also noteworthy in Asia, innovation in shrimp aquaculture started with the successful artificial propagation of black tiger shrimp by Professor Dr. Chiu Liao, National Taiwan University (1968).

Innovation is essential to resolve the existing production risks and transform the sector towards sustainable intensification.

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gained. The BFT can be done in tanks (indoors: 5 m³ - 300 m³) and ponds (outdoors: 1000 m³ - 5000 m³) at a stocking density of 300-600 juveniles/m³.

**In-Pond Raceway System (IPRS):** An effective, intensive aquaculture system for regions with high water consumption and limited land resources. Water flow and dissolved oxygen (DO) are important for sustainable aquaculture, which are the key outputs from IPRS. China uses a modified IPRS by adding an APFD (Aeration Plug Flow Device) within the system.

**The Mixotrophic™ System:** Modulates environmental factors such as pH, Oxygen Reduction Potential (ORP), and the Carbon:Nitrogen (C:N) and Nitrogen:Phosphorus (N:P) ratios. The result is an increase in carrying capacity, which is defined as the measure of the biomass of any species that a particular environment can support. Optimising the balance of nutrients by providing the required amount of feed, minerals and bacteria will create a stable environment for high density farming. This technology, developed and patented by Blue Aqua International Group, Singapore, combines RAS and BFT to maximise the stocking density and carrying capacity in ‘intensive’ and ‘super intensive’ farming.

**Integrated Aquaculture**

- **Rice-fish** farming started more than 1500 years in India and more than 2400 years in China. It is now recognised as a ‘Globally Important Agriculture Heritage System’. There is a wide range of Integrated Agri-Aqua systems (IAA) in Asia, Africa, Europe, South America and Central America. Small scale IAA has great potential in meeting the nutritional needs of the poor, being an income source with minimum risk. The level of skills is fairly low, unlike pond management.

- **Aquaponics** combines aquaculture (culture of fish) and hydroponics (culture of plants) in one integrated system. It is cost-effective, run by solar power and is particularly useful to ensure food security among urban and rural communities. It is an excellent example of vertical integration where water, space and energy are used efficiently. The Philippines’ Bureau of Fisheries and Aquatic Resources (BFAR) introduced 16 different models of aquaponics systems during COVID-19 for communities to take control of their own food security and augmenting incomes.

- **Photovoltaic (PV) System** refers to solar-generated electric power known as photovoltaics (PV) to meet the power demand in land based and offshore aquaculture operations. Both static and floating photovoltaics can be used to aerate water, pump the water through raceways, tanks and ponds, replace water loss due to evaporation and seepage, and remove fish wastes. This renewable technology is extremely promising as it addresses space limitations and power supply in remote areas. It also helps in increasing resilience to climate change impacts especially for the small-scale sector.

**Offshore innovations**

More countries are moving towards offshore farming to explore its huge potential and ensure sustainable blue economy harvests. Offshore farming generally consists of different systems (e.g., cages, net-pens, long-line arrays etc) which can be floating, semi-submersible and submersible based on mode and scale of operations. Developed countries from Europe (Norway), Central America (USA), South America (Chile), and Australia take the lead, with the Asian exception being China. High value species like salmon, cod, flounder, halibut, cobia, tuna, seabass, snapper, grouper etc are being cultured in offshore facilities around the world due to ready markets, short culture duration and availability of feed.

**Precision farming system**

Precision aquaculture is founded on a set of disparate, interconnected sensors deployed within the aquatic environment to monitor, analyse, interpret and provide decision support for farm operations. The overarching aims

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of precision aquaculture are: (i) Improve accuracy, precision and repeatability in farming operations; (ii) Facilitate more autonomous and continuous biomass/animal monitoring; (iii) Provide more reliable decision support; and (iv) Reduce dependency on manual labour.

Internet of Things (IoTs), real-time sensors, hardware associated data platforms, sensor based demand feeders, Real time Fish Appetite Index using machine learning, Artificial Intelligence based on growth platforms, blockchain-based traceability, virtual reality to monitor sea lice infestation, high resolution satellite data to forecast ocean parameters such as Harmful Algal Bloom (HABs), robots for cleaning tanks and cages, drones for monitoring aqua farms and Marine Protected Areas (MPAs) are some examples of precision farming.

IoTs, sensors and data platforms: IoTs or sensor-based devices consist of water quality monitoring stations which are linked to a wireless sensor network (WSN), meteorological station, water quality control station, on-site and remote monitoring centre and a central cloud processing platform. Jala Tech8 is providing this kind of service to monitor water quality parameters. Other equipment which are being used to manage feed efficiently are the Automatic Feeder by e-Fishery9, and the sensor-based demand feeder produced by Umitron, Singapore10.

Machine Learning and Artificial Intelligence, AI: Machine learning has been used to detect the real time feed appetite of a school of fishes. AI-based mobile apps (XpertSea, Canada11) can track water quality matrices, oversee meals and feeding rates, as well as forecast the growth and health quality of the organisms. Meanwhile, a Japanese start-up called TUNASCOPEx2 offers AI-based tuna certification.

Blockchain-based traceability: Blockchain technology provides item-level traceability to each participant in the food supply chain from source to store and farm. It allows anyone to trace and track products back to their original source. Some award-winning start-ups are Wholechain.com, Rfider, and atma.io, which provide low-cost traceability solutions throughout the supply chain.

Smart genetics

Smart genetics or modern breeding techniques will continue to contribute significantly to aquaculture production and disease resistance. Marker Assisted Selection (MAS), gene editing (CRISPR- Cas 9) or bio-engineering, Sex Reversal Technology (SRT) to produce all male tilapia, and biotechnology for unisex giant freshwater prawn juvenile production are also being used. So far, TiLV resistant and salinity tolerant tilapia, SPF, SPR and APE shrimp broodstock, genetically engineered salmon13 and bioengineered red sea bream14 (20% more meat) production have been successful. Genetic selection can also be done for climate change resilience.

Biosecurity and fish health management

There are quite a lot of developments in improving fish health and biosecurity of aquaculture farms/reproduction facilities. Vaccination, bacteriophage, quorum sensing, advanced Point-of-Care diagnostic facilities and alternative ways to reduce the burden of antibiotic use, are some of them.

8 https://jala.tech/
9 efishery.com
10 https://umitron.com/en/
11 https://xpertsea.com/
13 https://en.wikipedia.org/wiki/AquAdvantage_salmon
14 https://twitter.com/NHKWORLD_News/status/1440204012050022412
**Vaccination** is an effective way to prevent bacterial and viral diseases. It also contributes to the environmental, social and economic sustainability of the industry. However, progress in aquaculture vaccine development is slower compared to livestock. The key challenge in vaccine application is that a limited number of commercially available fish vaccine companies are present, and some farmers assume that it adds on to their work burden.

**Bacteriophage** is a promising alternative to control bacterial diseases. Proteonpharma\(^\text{15}\), a Poland based start-up, has applied this technology to prevent and eliminate *Pseudomonas* and *Aeromonas* infections in commercial aquaculture, while stimulating the immune system of fish.

**Quorum Sensing** inhibitors not only inhibit the expression of virulence associated genes but also attenuate the virulence of aquaculture pathogens. This is a potential strategy for preventing infectious disease outbreaks in aquaculture. Nutriad-Adisseo\(^\text{16}\), a European company, has developed feed additives for aquaculture by using this technology.

**Advance pathogen detection:** Point-of-Care diagnosis of aquaculture pathogens facilitates quick decisions at farm level. Shrimp Multipath Xtra\(^\text{17}\), PCR, Dot Blot, Gene Chip, Underwater Virtual Reality (VR) and LAMP (Loop Mediated Isothermal Amplification) technology has been used for pathogen detection.

**Alternative to antibiotics:** Anti-Microbial Resistance (AMR) and reducing the burden of antibiotic applications in aquaculture are widely discussed issues. China and Indonesia have made some advances in the prevention of whitespot disease and reducing antibiotic application.

### Alternative proteins

Single cell proteins (algae, bacteria, yeast, filamentous fungi), insect-based protein (black soldier fly *Hermetia illucens*, housefly *Musca domestica*, mealworm *Tenebrio molitor*, litter beetle *Alphitobius diaperinus*, house cricket *Acheta domesticus*, tropical house cricket *Gryllodes sigillatus*, Jamaican field cricket *Gryllus assimilis*), and Antarctic krill *Euphausia superba* can be good sources of alternative protein. The world’s largest black soldier fly production facility (Nutrition Technologies\(^\text{18}\)) with a capacity of 1200 MT/year is located in Asia (Malaysia).

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\(^\text{15}\) [https://www.proteonpharma.com/]
\(^\text{16}\) [https://www.adisseo.com/en/nutriad/]
\(^\text{17}\) [https://www.genics.com.au/]
\(^\text{18}\) [https://www.nutrition-technologies.com/]

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**Smart business management**

**e-commerce platform and post-harvest management:** In one example, the e-commerce platform Aruna\(^\text{19}\) connects fishermen directly to the customers to sell their daily catch. Having a solar dryer with LPG back up\(^\text{20}\) and improved cold chain management can reduce post-harvest losses significantly.

**Value added seafood products:** Market specific seafood products are being developed, giving priority to consumer preference and innovation. Examples of these products are sardine cakes, jellyfish stir fry, algae and seaweed-based products like algae milk, algae chicken and algae shrimp, seaweed brownies, vegan shrimp, cell-based seafood, and fish-less/meat-less seafood.

**Biodegradable packaging and new mode of processing:** Consumers are increasingly aware about the negative impacts of plastic pollution, giving room for growth of bioplastic packaging made from seaweeds and other ocean materials. In the area of processing, new software-driven bone detection technology (SensorX Fish by Marel)\(^\text{21}\) is being used to optimise the process while enhancing traceability and quality assurance. Collaborative Robots (Cobots)\(^\text{22}\) and highly intelligent machines capable of making decisions and complex movements are also being incorporated into seafood processing lines by the Danish Technological Institute (DTI).

**Responsible Supply Chain Management:** With the help of blockchain technology, people can source seafood products, and trace and track their origin. It ensures that the supply chains of aquatic food systems are responsible and traceable.

**X-ray fluorescence machine to prevent food fraud:** Due to increasing seafood demand, the occurrence of food fraud is also rising. To prevent this malpractice, the Micro-X-ray fluorescence (ITRAX)\(^\text{23}\) appears to be a useful tool.

\(^\text{19}\) [https://aruna.id/]
\(^\text{20}\) [https://cift.res.in/solar-dryer-with-lpg-back-up]
\(^\text{21}\) [https://marel.com/en/products/sensorx-fish]
\(^\text{22}\) [https://www.dti.dk/collaborative-robots/39701]
\(^\text{23}\) [https://www.foodnavigator-asia.com/Article/2020/09/01/X-ray-]
Conclusion and way forward

Technology development is a continuous and collaborative process. There are some innovation platforms (Aquaspark, HATCH) and funding agencies such as Rabobank that support fisheries and aquaculture in order to accelerate growth. To ensure sustainable intensification of aquaculture as well as to establish transparent and responsible aquatic food production, we need to adopt a holistic ‘ship to supermarket, farm to fork’ approach. Some strategic approaches include:

- Promotion of national, regional and international cooperation to set up more innovation platforms
- More Public-Private-Partnerships (PPPs), which are required for consistent funding and development of new technologies;
- Benchmarking of aquaculture technologies by an international apex body such as FAO/GSSI;
- More training and outreach programmes which are needed to transfer new technologies among farmers, especially the small-scale sector; and
- Sustainable intensification, which can only be achieved through equal and effective participation of all stakeholders, backed by strong political will and effective aquaculture governance.
ENHANCING GOVERNANCE IN ASIAN SMALL-SCALE FISHERIES VALUE CHAINS

By Firoza Buranudeen

The small-scale fisheries sector in Asia is still lagging behind and those involved in its value chains remain mired in poverty as well as suffer inadequate access to basic human rights. One major reason for this is a lack of significant representation in national decision-making processes, resulting in poor governance and regulatory frameworks, and which in turn perpetuate inequity throughout the value chains. Understanding how small-scale communities function and adopting a collaborative, participatory approach may help in efforts to enhance governance in this sector.

The Food and Agriculture Organization of the United Nations (FAO) defines small-scale fisheries (SSF) as: “artisanal, or small-scale fisheries are traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, and mainly for local consumption.” Other characteristics may include: (i) an inshore fishery which provides mainly for food security but which also sells to local markets; (ii) non-mechanised/low technology; (iii) workers comprise family members; (iv) at risk to external factors such as climate change, natural disasters, and competition with commercial fisheries. Almost all (about 95%) of landings are destined for local consumption, which has implications for livelihoods and food security.

Small-scale fisheries value chains include all the activities from pre-harvesting through harvesting to consumption. As useful indicators of their importance, FAO states that more than 90% of the approximately 120 million full time or part time workers worldwide who are directly dependent on fisheries for their livelihoods, work at different stages in these value chains. In addition, about half the number of workers comprise women.

Importance of SSF value chains

The FAO’s Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF Guidelines) recognise post-harvest and other activities as crucial components for sustainable small-scale fisheries value chains. They highlight the need to involve the sector in decision-making processes, invite support for associations of fishers and fish workers, and stress the key role that women play in post-harvest activities. The SSF Guidelines also suggest improvements to the post-harvest sector through appropriate infrastructure and technology investments, value-addition activities, and post-harvest loss and waste reduction.
On matters of trade, the SSF Guidelines call for market access for small-scale fisheries, including a consideration of the impact of international trade of small-scale fisheries, ensuring that benefits are fairly distributed and that market-driven over-exploitation is prevented. Small-scale fish workers and their communities also need to be provided with timely and accurate market and trade information that allows them to adjust to changing market conditions.

Improvements to the post-harvest sector will ensure that more people can benefit from its activities.

**Structure of the value chain**

Usually value chains are fairly long and they typically involve a number of intermediate stages and actors. Most, if not all, will be men, with women mainly to be found as labour force in the processing and small retail sub-sectors.

In addition to gender, an interesting feature about small-scale communities is the existence of social and power differentials, which will have an effect on who benefits from programmes and polices meant to improve governance of the sector. For example, if a transparent pricing system were to be set up, the normal expectation is that the fisher will try to obtain the best offer from traders and processors, and will walk away if that price is not forthcoming. In reality, the situation may be more complex. Small communities often operate based on familial ties and friendship, and fishers may stick with a trader out of a desire to preserve harmony rather than satisfaction with the buying price.

Governance programmes will have a higher chance of success if they are based on an understanding of the socio-cultural dynamics as well as through engaging with government, private sector and NGOs, and strengthening cooperation among key stakeholders.

**Challenges associated with the value chain**

The issues that led to the formulation of the FAO’s SSF Guidelines, as outlined in the previous section, remain relevant and of continued concern.

For a start, “the development and implementation of socially, economically and environmentaly sustainable small-scale fisheries policies, legislation and legal frameworks” mentioned in the SSF Guidelines remains a major challenge throughout Asian small-scale fishing communities. Not only are their specific problems seldom explicitly considered in regional fisheries management (compared to commercial fisheries), these SSF workers are largely absent from economic and political decision-making at national level. Not surprisingly, most remain mired in poverty - according to the FAO, 5.8 million small-scale fishers live on less than US$1 per day - and are dependent on the active support from government-linked agencies and NGOs.

Part of the problem could be that small-scale fisheries and their catches are not fully accounted for, or are under-represented in the fisheries statistics of many developing countries, and therefore their scale is under-estimated. This is amply demonstrated in a ground-breaking study called “Hidden Harvest: The Global Contribution of Capture Fisheries” published by the FAO, the World Bank and WorldFish, which stated that millions of metric tons of fish from the small-scale fisheries sector are hidden (unreported).

The other SSF challenges stated in the Guidelines can be noted throughout supply chains, starting from fishers’ equitable access to sustainable resources to provide for income generation as well as to feed their families, right up to obtaining fair prices for their efforts. With regard to the latter point, several analyses have shown that small-scale fishers and fish farmers receive the smallest economic benefits in the value chain, with processors and retail markets benefitting the most owing to their stronger bargaining power. In order to safeguard their interests, one study’s recommendations included an increase in governmental, NGO and private-sector support, improved organisation, consistent and transparent pricing methods, the sustainable expansion of small-scale fish farming, an increased focus on promotion and marketing, and the exploration of new markets – all this within an overarching governance framework focusing on sustainable resource management and better regulatory framework practices.

With the advent of the COVID-19 pandemic, greater and unusual stresses have been placed on the SSF sector, further exposing their vulnerability.

In an analysis of the impacts and responses to COVID-19 of small-scale fisheries in Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam, the major underlying issues of poverty, lack of market and financial access, and gender inequity were exacerbated by poor/delayed access

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Examples in Asia where the SSF sector is supported through e-commerce

The interesting feature in Asia is that no other region is as ‘wired’, albeit still mainly in the urbanised areas. In 2019, smartphones accounted for over 60% of all retail website visits worldwide. M-commerce is particularly popular across Asia, with countries like South Korea generating up to 65% of their total online transaction volume via mobile traffic. The country with the fastest growth rate of e-commerce is China.

With lockdowns and disruptions in transport systems (which caused traders to raise their own profit margins), small-scale fishers were faced with the choice of taking a break from fishing or adapting to this new online market environment. In several Asian countries, this adaptation process has been made easier by the involvement of partners and collaborators. Examples include:

**Indonesia:** An aquaculture start-up company, eFishery, which collaborated in 2018 with the Ministry of Fisheries and Marine Affairs, and the West Java Provincial Government to establish a ‘digital fishery village’ in Losarang, Indramayu (West Java). The village, which applies NB-IoT (narrowband internet of things), is the first to use integrated automatic feeding technology and technical assistance to improve fish farming and market access for catfish farmers. The digital fishery village programme also helps farmers to obtain quality fish feed at lower prices as well as develop their business plan and access funding to grow their business. To date, the eFishery Fund has supported hundreds of farmers and deployed an online marketing platform called eFisheryFresh.

**India** - The e-Santa app, described as an electronic marketplace to export seafood, allows producers and exporters who are registered with The Marine Products Export Development Authority (MPEDA) to connect directly with buyers, thus fetching better prices by cutting out middlemen. Using the platform, farmers must enter the details of their upcoming harvests (e.g. species, estimated volume, and scheduled date of harvest). Buyers are able to contact and negotiate directly with the farmers on prices and other factors, after which they have to make a 25% online payment before any delivery is made. MPEDA is working with the National Centre for Sustainable Aquaculture (NaCSA) to ensure that the process is smooth.

**Myanmar** – The Shwe Ngar (Golden Fish) mobile phone app, developed by WorldFish and partners with funding from USAID, provides fish farming families in Myanmar with information on how to stock and feed fish, fish health, and aquaculture technologies, as well as nutrition, water, sanitation, and hygiene practices. The app also connects fish farmers to suppliers, traders, and others in order to strengthen the country’s fisheries value chains. Launched in October 2020, it is available in English and Burmese, where local farmers can access all modules in Burmese.

**Malaysia** – In an example of a public-private initiative, the Fisheries Development Authority of Malaysia (LKIM) is helping fishers registered with Fishermen’s Associations (NEKMAT) throughout the country, to sell their products online on the NEKMATBIZ platform.

**The Philippines** - An app called Aquabiz presents information to new and potential investors in aquaculture that is relevant, up-to-date, and easy to digest. It also provides technical guidance, especially in feed management, and the monitoring of feed performance through metrics such as feed conversion ratios (FCRs) and average daily gain (ADG).
as an opportunity to transform the food system to be more green, inclusive, and resilient.

In addition to the above, a recently acknowledged challenge is that the SSF sector is poorly prepared to deal with the surge of digitalisation and e-commerce in the changing marketplace. Those who have survived were those who understood how to use digital platforms such as websites, Facebook or WhatsApp as a means to connect with consumers and buyers. There are also logistical problems related to the fact that the products are perishable and need timely transit and proper handling.

The role of women

FAO estimates that women make up an estimated 47% of those involved in small-scale fisheries, accounting for around 56 million jobs along the fisheries supply chain, mostly in processing and trade. Apart from cleaning and casting nets from the shoreline, women are rarely the ones doing the actual fishing; nevertheless, their contribution to the landed value globally is around US$5.6 billion. Their involvement has been poorly documented until recent years, notably by international organisations such as FAO (the Too Big to Ignore’s women and gender cluster), the Asian Fisheries Society (Gender in Aquaculture and Fisheries section), and NGOs such as the International Association for Women in the Seafood Industry (WSI).

A woman carries fish from the shore in Maharashtra, India

Some of the particular challenges that women in small-scale fisheries face are: (i) discrimination due to prevailing (restrictive) cultural norms; (ii) unequal perceptions of power by men (including the traders, who are usually male); (iii) lack of facilities in markets and landing centres; (iv) poor access to credit; (v) men are given preference in training opportunities, healthcare, and sanitation; and (vi) they may become the target of sexual and other forms of harassment. As they are often not recognised as workers, they are poorly represented in decision-making processes within the family, in the community and in governance as a whole.

However as many individual case studies have shown, when women are given the support that they need and they become successful, the balance of power within their family and social environment shifts. What is needed therefore is equal participation of women in decision-making processes, access to technologies and knowledge (for example, better smoking technology or how to use digital platforms), and mainstreaming of gender equity into policies and legislation in accordance with relevant international human rights law.

Development of good governance practices

As mentioned above, there is a great need to involve the small-scale sector in decision-making processes as well as to re-double efforts of stakeholders to ensure equity for all, increased access to basic human rights, and generate improvements in the post-harvest sector. These ideals are mentioned not only in the SSF Guidelines, but also in other cross-cutting policy documents from regional and international organisations. In a word, the key is ‘governance’.

Because of the complexities inherent in small-scale communities, the most appropriate step to take in formulating policies to enhance governance would seem to be through a holistic, inclusive, and participatory lens. One such method is by applying the Ecosystem Approach to Fisheries (EAF) which looks at how fisheries affect and interact with society, economy, culture, and environment. In other words, human well-being and ecosystem health are linked to one another. As stated by the FAO, small-scale fishing communities can play an important role in managing, restoring, conserving and protecting aquatic resources and ecosystems. States and government institutions can empower and support fishing communities to engage in such participatory management – also called co-management – of fisheries resources together with government institutions and other groups. The aim is to bring together coastal groups, industry, government policymakers, and NGOs for dialogues that expand policy boundaries for environmentally sustainable, socially, and economically just coastal aquaculture. As in any other participatory approach, stakeholders are more likely to comply with regulations and policies if they had had a hand in the decision-making process. Through similar co-management and inclusive approaches, good governance frameworks can be formulated, and capacity built within SSF communities to ensure equity, respect for human rights, and resilience.
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:
- INFOSAMAK Magazine
- EUROFISH Magazine
- INFOPESCA Internacional
- INFOPÊCHE

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 http://www.fao.org/in-action/globefish/background/fishinfonetwork/en/

EVENTS

International webinars discuss the fisheries and aquaculture sector in five countries

Over three consecutive weeks in September and October, Eurofish and the FAO Sub-regional Office for Central Asia organised three workshops addressing the fisheries and aquaculture sector in five countries, Albania, Armenia, Georgia, Serbia, and Ukraine. The objective of the webinars was to gain an understanding of fisheries and aquaculture in the countries, exchange experiences, highlight the challenges and opportunities, and foster a dialogue between stakeholders. The sector in the five countries has many similarities, for example, everywhere it makes a significant contribution to economic and nutritional security particularly in more remote inland and coastal communities where it was often the only source of jobs. But there were also significant differences. Of the five, Armenia and Serbia are landlocked and only farm fish in fresh water, while of the three coastal states only Albania has a marine aquaculture industry. All agreed that closer cooperation between administrative authorities and the industry was important for the further development of the sector. Each webinar comprised an overview of the sector followed by a presentation about the industry, the opportunities to be exploited and the challenges it faced. The discussions following the interventions were lively and interesting and highlighted efforts by administrations to develop the sector. Albania, for example, has incentives such as low tax rates and no red tape when establishing an aquaculture or fish processing company. Representatives from industry also had the opportunity to offer their perceptions of some of the measures and legislation they had to deal with and to compare the policies of other countries with those of their own. The webinars underscored the need for regular occasions when stakeholders’ concerns can be discussed—and hopefully acted upon—for the good of the sector as a whole.

Regional consultation on fish traceability

INFOFISH and the Food and Agriculture Organization of the United Nations (FAO) organised a virtual regional consultation on traceability to review the draft guidance document titled "Advancing End-to-End Traceability: Critical Tracking Events (CTEs) and Key Data Elements (KDEs) along the capture fisheries and aquaculture value chains". The document was developed by FAO in 2020 and 2021 and underwent an online public consultation in March-April 2021. Comments and feedback were received from a wide range of stakeholders from 42 countries. The document is based on reviews from literature and from existing initiatives, as well as traceability standards, that identified KDEs (as well as traceability standards) documented by both FAO as well as those developed by different industries, non-governmental organisations (NGOs), and non-regulatory standards.

The event was held from September 14 to 16, 2021 and representatives from fourteen countries in the region (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Panama, Peru, Dominican Republic, Uruguay and Venezuela), members of two Regional Fisheries Management Organizations (IATTC, COPESCALC), as well as experts, technicians and FAO representatives all took part in the meeting. The objective was to discuss with the FAO member countries the draft of the guidance document which compiles the information needs for traceability and its verification for both capture fisheries and aquaculture. Traceability is a valuable tool to assist countries in the fight against fishing fraud and illegal, unreported and unregulated (IUU) fishing. The event was aimed at technical experts and government officials with relevant experience in aquaculture traceability.

Investors interested in establishing a fish farming or processing company in Albania can look forward to a welcoming business environment and low taxes.
Plastic-free reef cubes

A start-up called ARC Marine looked at the important role that undersea concrete mats play in protecting the base of offshore installations like wind farms from strong tides, but they noted that often, these mats contain plastic. They also recognised the value of reefs in providing a habitat for plants and creatures in the sea. Combining the two, they came up with artificial plastic-free reef cubes made from recycled aggregate and sand that is a byproduct of the quarrying industry. The company says this reduces carbon emissions by 90% compared to the processes used to make common types of cement.

The cubes interlock, leaving larger living spaces for fish, crabs and lobsters, and their porous surface is designed to allow marine plants to establish easily and grow. The aim is for these alternative reefs to protect vital offshore installations from storms and erosion while also encouraging marine biodiversity.

Tom Birbeck, CEO and founder of ARC Marine, calls the reef cubes “building blocks for the ocean” and says they were inspired by the belief that every offshore and coastal project can have a positive impact on ocean health.

Large-scale offshore kelp cultivation

Kelp helps to draw down carbon dioxide from the atmosphere, reduce acidification of marine waters, boost marine biodiversity, provide nursery grounds and shelter to hundreds of species, and create jobs in coastal communities. However, current seaweed farming practices are small-scale and seasonal, driven by nutrient availability, species selection and the reliance on wild harvesting on near-shore areas or sheltered bays.

Dutch company Kelp Blue has developed techniques to grow giant kelp forests, involving:

- Cultivating offshore (5-10km) in order not to compete with coastal ecosystems
- Choosing a species not requiring annual re-planting
- Only harvesting the canopy of the macroalgae, allowing for a harvest of multiple times per year while leaving the bulk of the organism to support a healthy and thriving marine biosystem.

The forests grow off a floating platform made of a series of arrays and placed at 20-40m below sea surface. The kelp is used for sustainable agri-foods and bio-stimulants which in turn can displace environmentally damaging alternatives such as chemical fertilisers and non-organic supplements.
Seaweed biofilters for the Great Barrier Reef

The Australian Seaweed Institute is conducting some very interesting research aimed at protecting the iconic Great Barrier Reef. Quoting from its website, it says that every year thousands of tonnes of excess nutrients run off the land and out to the reef, causing higher microalgal growth, leading to reduced light and smothered corals. The water quality also compromises Reef-dependent industries such as tourism, fishing, recreation, research and education; and the nitrogen run-off has been linked to outbreaks of crown-of-thorns starfish - a significant contributor to the loss of coral cover on the Great Barrier Reef. Meanwhile, the carbon dioxide assimilation in the ocean increases the acidity of the water, which impacts ecosystems and coral growth.

The Institute has installed a network of native seaweed biofilters in targeted locations across the Great Barrier Reef catchment that will remove the nitrogen and carbon dioxide loads. The harvested seaweed is then sold as a beneficial ingredient for use in bioproducts such as animal feed and fertiliser thereby generating a return.

Shellfish and seaweed polyculture

Regenerative ocean farming is the key focus of Thimble Island Ocean Farm, situated off the coast of Connecticut (USA) and its non-profit arm, GreenWave. In its polyculture farming system, GreenWave showcases a mix of seaweeds and shellfish which sit vertically below the surface, producing high yields with a small footprint. The products are sold to consumer markets while non-food grade seaweed is turned into straws, paper, and bioplastic packaging as a cost-effective, viable alternative to fossil-fueled based plastic packaging.
Recapture hides and feed for cleaner fish

Lumpfish (*Cyclopterus lumpus*) and ballan wrasse (*Labrus bergylta*), the two main species of cleaner fish used in the salmon industry, need a place to hide from the salmon whenever they need to rest and to feel safe. As wrasse are territorial, they require a different hide set-up than that used for lumpfish. To remove the cleaner fish safely and with less stress to the fish, specially-made ‘recapture’ hides can be used. One type of recapture hide is produced by AquaSolutions AS, using treated PVC, each measuring six metres long and weighing 33kg. Another type, also made of PVC, is manufactured by Nordic Cover and is marketed as recyclable as the hides can be broken down into roofing tiles after about three years of usage.

Meanwhile, World Feeds Limited (UK) is marketing cleaner fish feed blocks which are tailored to wrasse and lumpfish. The blocks (which are supplied individually foil wrapped within an easily carried and fully recyclable bucket) can be stored in a cool, dry place requiring no refrigeration. They have a two-year shelf-life, require no mixing or preparation, and can simply be loaded onto the bespoke MLD (Manual Line Deployment) feeding station in-situ at the side of the pen, directly out of the pack. The MLD itself is also far more practical, efficient and quicker to use than the net bags that might otherwise be employed. Each unit is supplied with 11 metres of polysteel rope, allowing feeding versatility as stations can be strategically placed at various positions and depths around the pen. This is designed to disperse the cleaner fish among the salmon, reducing aggression during feeding while significantly increasing their range and exposure to the sea lice. The feed blocks are designed to promote and facilitate natural grazing behaviour throughout the day and once a block has been consumed, the bright yellow float indicator is designed to float to the surface, enabling staff to easily keep track of when the feed needs restocking.

For further information: AquaSolutions AS, Norway (https://aquasolutions.no); Nordic Cover (info@nordiccover.no); World Feeds Limited UK (info@worldfeeds.uk)

Humane slaughter of fish and crustaceans

The Optimar electrical stunner for shrimp was developed by Hilton Seafoods (HSF), resulting in winning the best innovation category of Compassion in World Farming’s Good Farm Animal Welfare Awards which were presented in June 2021. HSF is one of the largest distributors of fresh seafood in the UK, supplying over 100 million shrimp a year to Tesco stores. Shrimp are traditionally slaughtered using ice slurry.

Stunning machines for lobster, crayfish and crab are also now on the market. One such equipment called the Crustastun interrupts the nerve function of the animal within half a second, meaning the shellfish cannot feel pain. The animal is also killed in under 10 seconds, as compared to a few minutes in the case of a lobster placed into boiling water.

The animal is placed belly down on a sprung tray in the unit. As the lid is closed, the shellfish and tray are pushed down by the electrode sponge into the saline solution. The operator then presses one of
the stun buttons on the front of the machine and a current passes through the 13 brain centres of a lobster, or the two brain centres of a crab.

Electrical stunning equipment for fish have also been developed by several companies to reduce stress to the animals. The electrical fish stunning machine manufactured by Ace Aquatec Ltd is said to be able to stun fish fully unconscious in less than one second, without being removed from the water. When the fish exits the machine, workers can then quickly process it.

For further information: Hilton Seafood, UK (www.Hiltonfoodgroupplc.com); Mitchell & Cooper, UK (www.mitchellcooper.co.uk); Ace Aquatec Limited, UK (https://aceaquatec.com).

Reducing stress during handling and transport

Globally, nets are the most common method of catching fish and shrimp for harvest or transport to markets, or when juveniles need to be transferred to grow-out sites such as from inland nursing facilities to cages in the sea. Not only does this cause stress to the animals, the nets can cause abrasions and damage to the skin, scales, fins, and mucous lining of the skin. Other methods such as using highly-oxygenated purpose-built water tanks, are better; nevertheless, there remains some form of stress through physical interaction with other animals or in collisions with the tank walls.


Live seafood transport

The patented FishPac is said to be the world’s only IATA-approved air freight live seafood transport system providing an average of less than 1% mortality rate across 30 or more hours of transport. The central focus of the FishPac system is its dual stage regulator which supplies a continuous flow of oxygen. Together with the live fish transport bin called the StackPac bin, it is possible to safely transport up to 600 kg of live seafood cargo. With a change of the regulator and a few minor modifications, the StackPac can also be used for land and sea transport purposes.

For further information: Floatpac Pty Ltd, Australia (info@floatpac.com)

Counting of early-stage live fish and shrimp

For inventory assessment and quality analysis of early-stage aquatic populations without handling them, there is a portable, smart option called the XperCount. This is a waterproof battery operated device with a touchscreen interface, capable of counting, sizing and imaging millions of live aquatic organisms within seconds. It has been tested for crustacean, fish, shellfish, and echinoderm eggs, larvae, or juveniles; as well as for live feed (artemia, copepods, rotifers) and microalgae.

For further information: XpertSea Solutions Inc (https://xpertsea.com)

Readers may be interested in a Guide published by WorldFish on improving live fish transportation with special attention to the COVID-19 pandemic in Bangladesh and other tropical developing countries. The main objective of this guide is to improve human safety during the COVID-19 pandemic in relation to harvesting and transporting live fish. Other objectives include (i) providing safer methods for handling and transportation, (ii) improving animal welfare, (iii) reducing road safety hazards, and (iv) detailing methods to reduce the cost of live fish transportation.

Guide to improving live fish transportation with special attention to the COVID-19 pandemic

For further information: WorldFish, Malaysia (worldfishcenter@cgiar.org)
GUIDANCE FOR PREVENTING TRANSMISSION OF COVID-19 WITHIN FOOD BUSINESSES: UPDATED GUIDANCE
Published by the Food and Agriculture Organization (FAO), August 2021.

This guidance should be read in conjunction with the guidelines and advice from national and local public health authorities. Updated with new evidence, this Food and Agriculture Organization of the United Nations (FAO) guidance replaces the FAO/WHO interim guidance, COVID-19 and food safety: guidance for food businesses: Interim guidance (dated 7 April 2020). Note: This is a condensed version. The full text is available from: https://doi.org/10.4060/cb6030en.

For the purpose of this guidance, food workers include all people working in the food business who touch food or food contact surfaces. This includes explicitly also all people who are physically present in the vicinity where food is processed, packaged, or handled. The term can therefore apply as well to managers, cleaners, maintenance contractors, delivery workers, food inspectors and others. In addition to this document, food businesses also need to keep up-to-date with food regulations and any additional advice from competent authorities on other measures that must be implemented as a result of the pandemic. These efforts are essential to maintain trust and consumer confidence in the safety and availability of food.

Unlikely transmission of COVID-19 through food

It is highly unlikely that people can contract COVID-19 from food or food packaging (Goldman, 2020; ICMSF, 2020; NZFSSRC, 2020). COVID-19 is primarily transmitted during close contact among people through respiratory droplets and aerosols generated by activities such as coughing, sneezing, shouting, singing and speaking (WHO, 2020a). Alternatively, some respiratory droplets may land on surfaces surrounding the infected person. Coronaviruses cannot multiply in food or on inanimate surfaces; they can only multiply in humans and certain animals. Once in the environment, viruses degrade and becomes less infectious.

Several research reports have described the persistence of the SARS-CoV-2 on different surfaces, for instance documenting that the virus can remain viable for up to 72 hours on plastic and stainless steel, up to four hours on copper, and up to 24 hours on cardboard (van Doremalen, Bushmaker et al., 2020). Other studies have investigated the stability of the virus on surfaces kept at different temperatures or varying other parameters (Kumar, Singh et al., 2021). While all these investigations add to our understanding of the persistence and survivability of the virus, they have typically been conducted under laboratory conditions, with controlled relative humidity, temperature and other factors, and should therefore be interpreted with caution when considering virus stability under actual conditions of the often cool (or freezing) and humid food processing and transportation environment. It is important to note that, although the detection of virus or viral ribonucleic acid (RNA) remnants on foods and food packaging provides evidence of previous contamination and is not disputed, there is no confirmation of SARS-CoV-2, or any other respiratory illness-causing virus, being transmitted by food or food packaging and causing illnesses in people who touch the contaminated food products or packaging.

The virus responsible for COVID-19 is susceptible to most commonly used disinfectants and sanitizing agents used in the food processing environment. Standard cleaning and sanitizing procedures, as outlined in the food business operator’s (FBO) food safety management system (FSMS), should therefore be effective at disinfecting the food processing environment. Alcohol-based sanitizers/surface disinfectants should be used as per manufacturers’ instructions for cleaning purposes. In general, alcohol-based disinfectants (ethanol, propan-2-ol, propan-1-ol) have been shown to significantly reduce infectivity of enveloped viruses like SARS-CoV-2. WHO recommends sanitizers with greater than 70 percent alcohol with sufficient contact time for decontamination (WHO, 2020b). Common disinfectants with active ingredients based on quaternary ammonium compounds and chlorine also have virucidal properties. Whilst microbiological environmental sampling has a role in verifying sanitation protocols, the testing for SARS-CoV-2 in food processing facilities or on food packaging is costly, time consuming and does not aid in risk-based decision-making processes for consumer protection and is therefore not recommended.

Role of food business operators and food workers

All FBOs are expected to establish corporate measures that aim at the safety of their products and the protection of its workers. FBOs should have food safety management systems based on the hazard analysis and critical control points (HACCP) principles in place to manage food safety risks and prevent food contamination. While not designed specifically for prevention of COVID-19 transmissions, FSMS are underpinned by prerequisite programmes that include good hygiene practices, cleaning and sanitation, zoning of processing areas, supplier control, storage, distribution and transport, personal hygiene and fit for work assessments – all the basic conditions and activities necessary to maintain a hygienic food processing environment. If a food business
has a FSMS and/or HACCP team established, the members of these groups need to be included in relevant discussions and training to ensure that new measures or interventions aimed at minimizing any person-to-person spread of COVID-19 do not compromise the integrity of the FSMS or of the effectiveness of HACCP measures. Several functions in food businesses (e.g., occupational health; human resources) will be responsible for selecting and implementing appropriate measures and, where necessary, gather advice from public health authorities. In addition, the Codex General Principles of Food Hygiene lay down a firm foundation for implementing key hygiene controls at each stage of the food processing, manufacture and marketing chain for the prevention of food contamination (WHO, 2009).

Every FBO should have appropriate plans in place to prevent disease transmission within their operations and to ensure compliance with these measures to protect workers from contracting COVID-19 and to prevent exposure to or transmission of the virus. Such plans will typically include policies that encourage workers to stay home when ill, the introduction of operational and structural controls to increase physical distancing between workers, provide separation or barriers between workstations, and compliance with stringent hygiene and sanitation measures to promote frequent and effective handwashing, mask wearing, and sanitation at each stage of food processing, manufacturing and marketing (LeJeune and Grooters, 2021). These strategies are particularly important in food businesses with operating environments conducive to viral transmission between workers, for example, those with limited ventilation or air filtration, noise (requiring shouting to communicate), and close spacing for long periods (greater than 15 minutes).

Intervention and prevention strategies should be applied, to the extent possible, across the entire food production chain, not only on processing lines, but also in other areas where workers may congregate, such as in meeting rooms, locker or break rooms, dining areas, as well as in employee housing and group transportation provided by the FBO and in primary production. The implementation of measures should be risk-based and proportionate to the level of expected food business worker exposure: Food safety practices outlined in effective FSMS may be adequate to protect food business workers when there are no community cases of COVID-19. In contrast, the requirement for additional intervention and prevention measures should be increased with increasing prevalence of human COVID-19 cases in the local community.

General principles of worker protection

Physical distancing

Physical distancing is very important to help slow the spread of COVID-19. The probability of COVID-19 transmission decreases as distance between individuals increases. Where there is intracommunity spread, all food businesses should follow physical distancing guidance as far as reasonably possible. WHO maintains the distance between workers should be at least one meter (circa three feet). Country guidelines or regulations may require greater distances and these should be complied with. Where the food production environment makes it difficult to do so, employers need to consider what additional measures can be put in place to protect employees.

Personal hygiene

Vaccinations have proven to be effective to lower the severity of COVID-19 and can reduce the risk of transmitting the disease. Where possible and available, FBOs should encourage and enable all food workers to become vaccinated, for example, by providing the necessary flexibility in shift scheduling.

Good personal hygiene is the cornerstone of both communicable disease prevention and food safety. Food businesses need to ensure that adequate sanitary facilities are provided and ensure that food workers thoroughly and frequently wash their hands. Normal soap and warm running water are adequate for handwashing. Hand sanitizers may be used as an additional measure; however, hand sanitizers do not replace handwashing.

Protective equipment

The most effective prevention against spreading of respiratory droplets and aerosols is the wearing of sufficiently effective face coverings or masks. Food business operators should provide suitable face coverings/masks and instructions for their appropriate use according to WHO guidelines (WHO, 2020c).

Gloves are not essential for the management of COVID-19 in food: handwashing is a greater protective barrier to infection than wearing disposable gloves. Disposable gloves should not be used in the food work environment as a substitute for handwashing. Viruses and bacteria can contaminate disposable gloves in the same way they get onto workers’ hands. Removal of disposable gloves can lead to contamination of hands. Wearing disposable gloves can also give a false sense of security and may result in staff not washing hands as frequently as required. Non-touch alternatives may be implemented instead of those currently requiring use of gloves.

Food workers: COVID-19 illness in the workplace

The occupational safety and general public health protection programmes of a food business operation should be applied to all staff, contractors, visitors, and maintenance and service personnel. These programmes should include guidelines for reporting and managing staff sickness in food premises, tracking and tracing worker health in line with local governmental privacy policies, as well as policies for return.
to work when staff recover from illness. Staff working in food premises should be provided with written instructions and training on how to prevent the spread of COVID-19, both at and outside of work. Normal routine fit for work procedures employed by food businesses, as part of their occupational safety and general health procedures, should ensure that confirmed or suspected infected workers are excluded from food premises.

Staff who are unwell or who have symptoms of COVID-19 should not work in food businesses. Prerequisite programmes and other occupational safety and general health programmes must ensure that COVID-19 infected (symptomatic individuals and confirmed asymptomatic carriers) workers and their contacts (those with exposure to confirmed cases) are excluded from food premises until sufficient time has passed or specific testing has occurred to confirm they are no longer infectious. A procedure to allow staff to report illness by phone (or email) or app should be established, so that workers with early stages of COVID-19 can be recognized and receive reliable information and be quickly excluded from work environments. This is imperative because an infected worker can infect co-workers, may contaminate the food production and processing environments, and may contaminate food or food materials (e.g. packaging, etc.), that may potentially precipitate unjustified trade restrictions, even though it is not a safety hazard.

However, it is important to recognize that infected individuals may be pre-symptomatic or remain completely asymptomatic and may not be aware that they are contagious and capable of spreading the virus (Pan, Chen et al., 2020; Tong, Tang et al., 2020). This underscores the need for all personnel, regardless of their apparent health status, to use appropriate equipment and practices to prevent disease transmission. As tools to identify potentially affected workers or asymptomatic workers (such as temperature monitoring, rapid PCR or antigen tests) become more widely available, they may be used to aid in the detection and exclusion of infected individuals from the workplace.

**Primary production**

Common food producing animals (cattle, swine, sheep, goats, poultry, etc.) and fish do not naturally become infected with SARS-CoV-2 and contact with these species, either as live animals, or from their derived food products, is not considered a risk factor in acquiring COVID-19. However, some wild animal species (e.g. certain bats, monkeys, shrews and pangolins) and some domestic animals (cats, dogs and mink) can become infected with SARS-CoV-2. Transmission of COVID-19 from susceptible species to humans is possible. As such, individuals should protect themselves from potential inoculation with aerosols or droplets generated by these animals or their environment by the use of masks, other protective equipment, and by practicing good personal hygiene. As with any other stage of production, the largest concern in primary production is person-to-person transmission and any activity in primary production of animals or vegetables that requires or results in close proximity to other workers (transplanting, weeding, harvesting of vegetables, indoor congregation in milking parlour, or breakrooms) requires risk reduction strategies as described below.

**Food processing**

Raw agricultural food products and packaged foods are unlikely sources of SARS-CoV-2 exposure to workers in food processing. Instead, like other areas of the food value chain, the largest risk for COVID-19 acquisition is through contact with infected co-workers. Food processing establishments are particularly likely to serve as a superspreader sites as workers often work long hours in very close proximity to others under cool and humid conditions (LeJeune and Grooters, 2021). Indeed, clusters of COVID-19 have been linked to processing facilities for meat, poultry, fish, fruits and vegetables, and even pet food. Specific prevention strategies are those listed above with emphasis on physical distancing, the use of masks, and personal hygiene.

**Food transport**

As part of effective FSMS based on HACCP principles, many food businesses already have measures in place to control the delivery and transport of products to and from the facility as part of food safety assurance plan. The primary focus of any additional COVID-19 control measures involving hygiene and sanitation measures implemented by food businesses is on keeping the COVID-19 virus out of their business premises. It is most likely that the main route for the virus to enter business premises is via an infected person (staff, contractor, visitor, etc.) that enters the premises.

All non-employees, including delivery drivers, contractors and visitors, entering the premises of an FBO, should strictly adhere to all other COVID-19 control measures before and during their entering the facility. For example, drivers delivering to food premises should be aware of the potential risks involved in person-to-person as well as contact transmission of COVID-19.

The FBO should inform and instruct people accordingly prior to arrival, post appropriate signage, and provide the necessary support. Where intracommunity spread is occurring, enhanced measures, including physical distancing, mask use and personal hygiene are critical.

A surface contamination of items brought into a facility may also be possible, but unlikely, route of introduction when an infected person contaminates items immediately before they are brought into the premises (Lewis, 2021). Although the risk of acquiring COVID-19 through surface contamination is very small, it is prudent that all non-employees, including delivery drivers, thoroughly wash hands, sanitize or use a
hand sanitizer before entering premises and, for instance, passing delivery documents to food premises staff. All non-employees (including delivery drivers) need to be given easily accessible and near-by access to handwashing facilities, an alcohol-based hand sanitizer, or a disinfectant, and disposable paper towels. Disposable containers and packaging are best used to avoid the need for cleaning of any returns. In the case of reusable containers, appropriate hygiene and sanitation protocols should be implemented. A mechanism for dealing with all used disposable materials in a dedicated way should be in place to avoid unnecessary exposures. To further avoid any potential additional transmission risks, increased sanitation of frequently-touched surfaces such as steering wheels, door handles, mobile devices, etc., and proper hand hygiene, may be advisable.

Food retail
During the COVID-19 pandemic, the food retail sector has been facing significant challenges in maintaining the highest standards of hygiene, protecting staff and customers from the risk of infection, maintaining physical distancing when dealing with large numbers of customers, remaining open, and ensuring that adequate supplies of foods are available daily. Although some customers may believe that there is a risk of COVID-19 infection resulting from open food displays, there is currently no scientific evidence confirming that food or food packaging is associated with transmission of the COVID-19. To ensure general food hygiene around open food areas, all workers and consumers need to follow strict measures designed to control person-to-person transmission of the virus causing COVID-19 between workers and customers, as well as to observe good hygiene practices.

Food workers in retail premises should not report to work when sick. Retail food workers, like those in food processing, need to be aware of symptoms of COVID-19 and inform their employer and seek medical advice if they think they have symptoms of the disease. All retail food workers should follow standard, good personal hygiene practices that can help reduce the risk of transmission of other foodborne illnesses. Where intracommunity spread of COVID-19 is occurring, food workers need to adhere to the necessary specific additional COVID-19 measures prescribed by local or regional authorities such as physical distancing and mask wearing. FBOs should stress to employees and customers the importance of avoiding crowds, especially in confined or indoor spaces, physical distancing, mask wearing, frequent handwashing and maintaining good hygiene practices, and of frequent cleaning and disinfecting surfaces that are touched regularly.

Food services and restaurants
Recommendations for food service providers such as restaurants and institutional cafeterias should also apply to food take-away providers, delis, and workplace canteens in essential frontline businesses, such as food processing and food retailing establishments. Key recommendations for COVID-19 prevention in this sector include the following:

- Food service workers should not report to work when sick.
- Food service workers need to be aware of symptoms of COVID-19 and inform their employer and seek medical advice if they think they have symptoms of the disease.
- Provide information to patrons of the premises’ COVID-19 mitigation policies, such as adequate hygiene, physical separation and proper face mask wearing.
- Train food preparation and waiting staff in strict personal hygiene, physical distancing, mask wearing and applicable sanitizing practices.
- Train waiting staff in patron interaction and recognizing signs of illness.
- Require wait staff to frequently clean and sanitize contact surfaces, including counters, frequently-touched points, serving utensils and condiment containers.
- Make available hand sanitizer for customers on their way in and out of the food premises.
- Introduce no-touch ordering and payment for patrons.
- Use floor markings inside and outside the retail store to facilitate compliance with the physical distancing requirements.
- Wash and frequently sanitize items such as ladles, tongs, and condiment holders.
- Maintain a low density of patrons and staff, e.g. through pre-ordering, seating time slots, restriction of party size.
- Introduce physical barriers in seating area and offer outside seating where possible.
- Ensure adequate ventilation and use externally sourced fresh air for air conditioning.
- Deal with disposable equipment (masks, gloves, etc.) and other materials in a dedicated way.
- Stagger staff work and break times to reduce staff numbers in a canteen at any one time or by having extended hours of operation.
- Post visible notices promoting hand hygiene and physical distancing for staff and customers.
- Cleaning and disinfection procedures for frequently-touched contact surfaces, such as handles, doorknobs, equipment, common water and beverage dispensers, shared utensils and displays, as well as all necessary precautions for the delivery of foods need to be suitably incorporated in the FSMS of the FBO and appropriately enforced.
2021

NOVEMBER
3 - 5
Busan International Seafood & Fisheries Expo
Busan, South Korea
http://www.bisfe.com/

8 - 10
Japan International Seafood & Technology Expo
Tokyo, Japan
http://www.exhibitiontech.com/seafood/e_index.html

10 - 13
SEAFOOD SHOW ASIA EXPO
Jakarta - Indonesia
https://seafoodshowasia.com/

15-19
Seafood Expo Asia (RECONNECT)
Virtual event
asia@seafoodexpo.com

26 - 28
Aquaculture Philippines
Pasay, Philippines
https://www.aquafisheriesexpo.com/philippines

DECEMBER
2 - 4
Taiwan International Fisheries & Seafood Show (Virtual)
Taipei, Taiwan

2022

FEBRUARY
13 - 15
Fish International
Bremen, Germany
https://fishinternational.de/en/

MARCH
13 - 15
Seafood Expo North America
Boston, USA
https://www.seafoodexpo.com/north-america/

APRIL
26 - 28
Seafood Expo Global
Barcelona, Spain
https://www.seafoodexpo.com/global/

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Aquaculture UK
Aviemore, Scotland
https://aquacultureuk.com/

24 - 27
World Aquaculture 2021
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