I Crystal Clear

Mike Berthet

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Global Seafood ALLIANCE

Market innovation: Food and Beyond

- Clear as mud! Why Seaweed?
- !…endless possibilities !
- Shrimp Farming in Lincolnshire!
- What is *Business* critical?
- How can we add transparent trust & integrity in our healthy, nutritious products through third party benchmarked certification?

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Crystal Clear

Leanne Cullen-Unsworth, UK
Marine scientist

Leanne Cullen-Unsworth, UK
Marine scientist

Seagrass is known for its ability to store carbon and provide nurseries for fish, but some underwater habitats have been devastated.

Leanne Cullen-Unsworth is one of the founders and current CEO of Project Seagrass, the UK's first seagrass restoration scheme at a meaningful scale.

The project makes the process easier by using a remote-control robot to plant seeds, and could create a blueprint to help other countries restore their underwater meadows.

An interdisciplinary scientist with more than 20 years of experience in marine research, Cullen-Unsworth is devoted to science-based conservation and restoration.

> “There is too much to do for anyone to achieve things alone, but people are working together and sharing knowledge. For my own small part, I know we can revive a vital habitat, protect it and restore it for all of the benefits it provides our planet and society.

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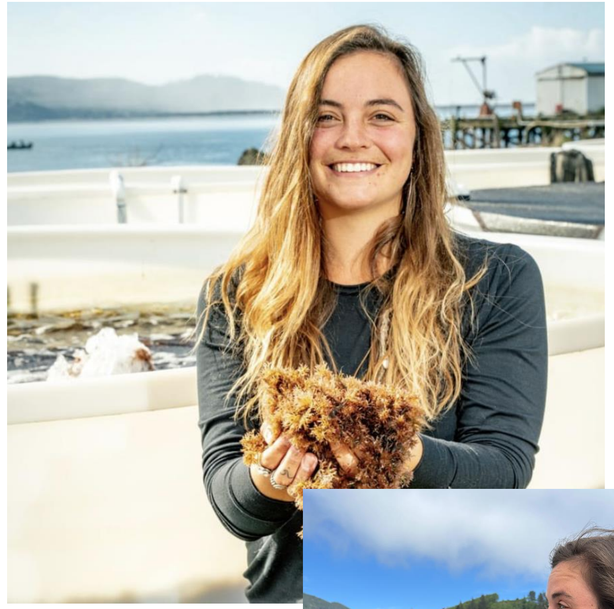
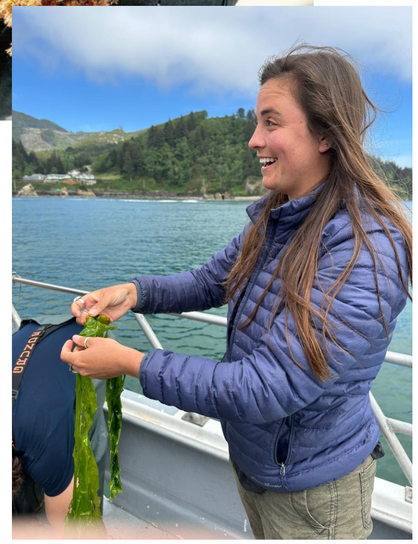
Market Entrepreneurs - Alanna Keiffer





Based in Garibaldi on the Oregon Coast she works as a seaweed farmer for Oregon Seaweed, a new land-based seaweed farm. Much of her time is now spent educating the public about regenerative aquaculture and the story of seaweed as a “climate cuisine”. Alanna has worked in conjunction with the tides and crazy conditions of the oceans for much of her life and loves nothing more than sharing it with others!

It’s Crystal Clear why Seaweed!

Why seaweed?

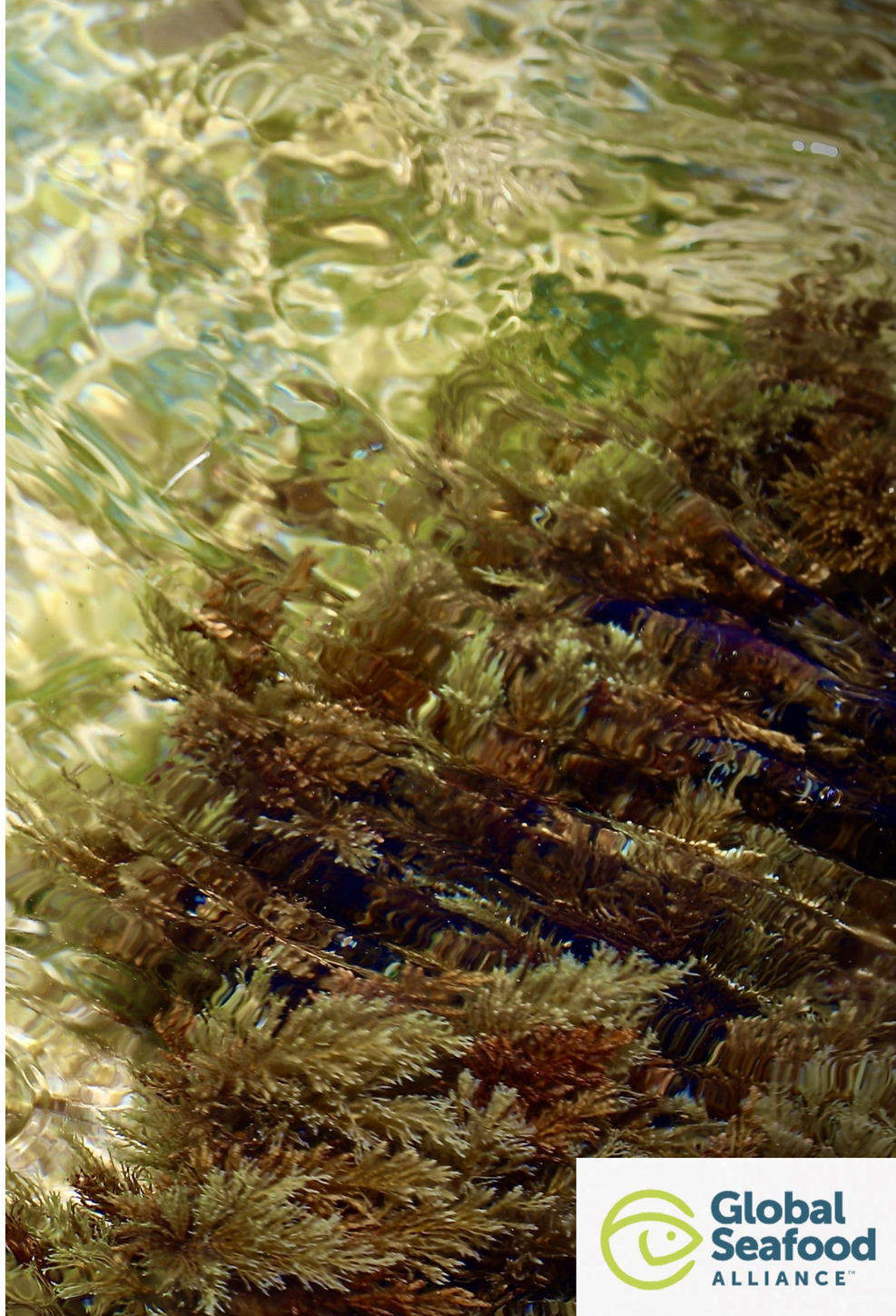
The green gold

Seaweed is considered the new green gold and many scientists agree that this little green plant can save our planet!

Those magical ocean greens

What comes from the sea, grows on sunlight, and belongs to one of the most powerful plants on this planet? Right; seaweed! These ocean greens are an essential addition to plant-based gastronomy, due to their high-quality proteins, omega acids and minerals.

Seaweed is considered the new green gold and many scientists agree that this little green plant can save our planet. It is a high-quality source of protein, its cultivation doesn’t take up any agricultural land, and hardly uses fresh water. We believe that we have to work with the sources that are available and that the best utilisation of food is to use it directly for human consumption. Our seaweed grows in National Park Oosterschelde.



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https://dutchweedburger.com/en/about-us/seaweed/seaweed-farm-zeewaar/

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Climate friendly + Healthy & Nutritious

Seaweed offers a variety of potential benefits for the future, spanning environmental, nutritional, and industrial applications. Some of these benefits include:

1. **Climate Change Mitigation:**

- **Carbon Sequestration:** Seaweeds have the ability to absorb and store carbon dioxide from the atmosphere, helping mitigate climate change by acting as a carbon sink.

- **Ocean Acidification:** Seaweeds can help counteract ocean acidification by absorbing carbon dioxide and reducing its impact on marine ecosystems.

2. **Renewable Biofuel Source:**

- Some species of seaweed can be used as a source of biofuel, offering a renewable and sustainable alternative to traditional fossil fuels.

3. **Nutritional Value:**

- Seaweeds are rich in vitamins, minerals, and other nutrients. They can be a valuable addition to diets, providing essential elements like iodine, iron, and omega-3 fatty acids.

4. **Aquaculture and Fisheries:**

- Seaweeds can play a role in sustainable aquaculture practices by providing habitat and food for marine organisms, supporting fishery ecosystems.

Diverse

5. **Bioremediation:**

- Certain species of seaweed have the ability to absorb and accumulate heavy metals and other pollutants from the water, contributing to water purification and environment

6. **Agrochemical Reduction:**

- Seaweeds can be used in agriculture to enhance soil fertility and reduce the need for synthetic fertilizers. They contain natural growth-promoting substances and can act a

7. **Industrial Applications:**

- Seaweed extracts are used in various industrial processes, including the production of food additives, cosmetics, and pharmaceuticals.

8. **Erosion Control:**

- Seaweeds can help prevent coastal erosion by stabilizing sediments and providing a barrier against wave action.

Versatile

9. **Alternative Materials:**

- Seaweeds can be used to produce sustainable materials, such as biodegradable plastics, reducing reliance on traditional plastic derived from fossil fuels.

10. **Biodiversity Support:**

- Seaweeds provide habitats for a diverse range of marine species, contributing to overall marine biodiversity.

11. **Water Purification:**

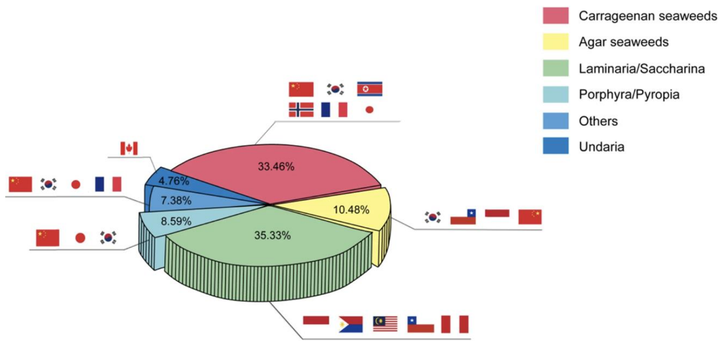
- Seaweeds can help improve water quality by absorbing nutrients, reducing the risk of harmful algal blooms and maintaining a healthier aquatic ecosystem.

nvironmentally friendly practices, addressing some of the challenges we face in the future. However, it's important to note that large-scale implementation may require careful conside

- **Nori (Porphyra):** Often used to wrap sushi rolls.
- **Kelp (Laminaria):** Used in various Asian cuisines and sometimes as a source of iodine.
- **Dulse (Palmaria palmata):** A red seaweed consumed in Northern Europe and Atlantic Canada.
- **Wakame (Undaria pinnatifida):** Widely used in Japanese miso soup and salads.
- **Hijiki (Hizikia fusiformis):** A brown seaweed often used in Japanese and Korean dishes.

From: Global seaweed farming and processing in the past 20 years

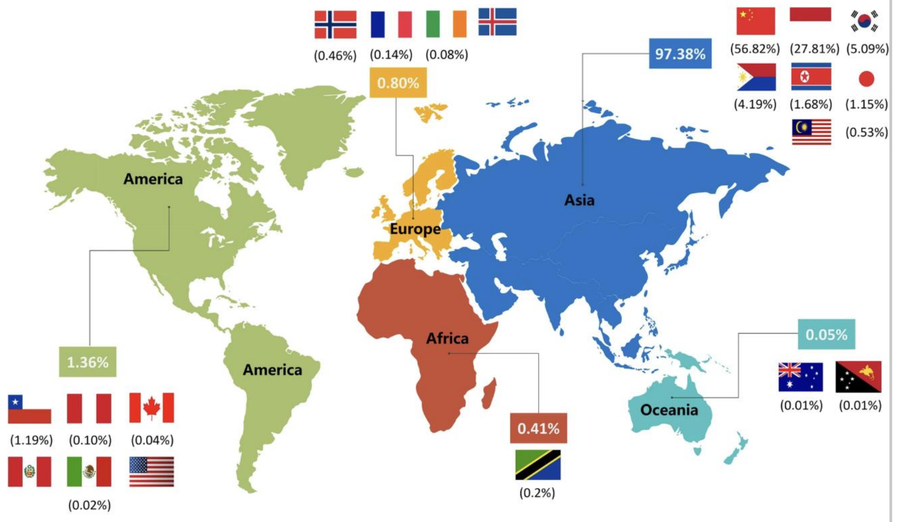
Fig. 3



Percent seaweed aquaculture production per species and countries in the year 2019 (FAO 2021)

From: Global seaweed farming and processing in the past 20 years

Fig. 2



Seaweed production in the year 2019 (FAO 2021)

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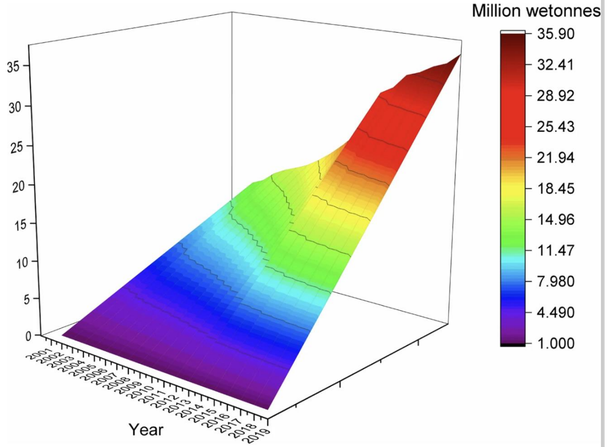
From: Global seaweed farming and processing in the past 20 years

Fig. 1



Status and trends of world algal production from 2001 to 2019 (FAO 2021)

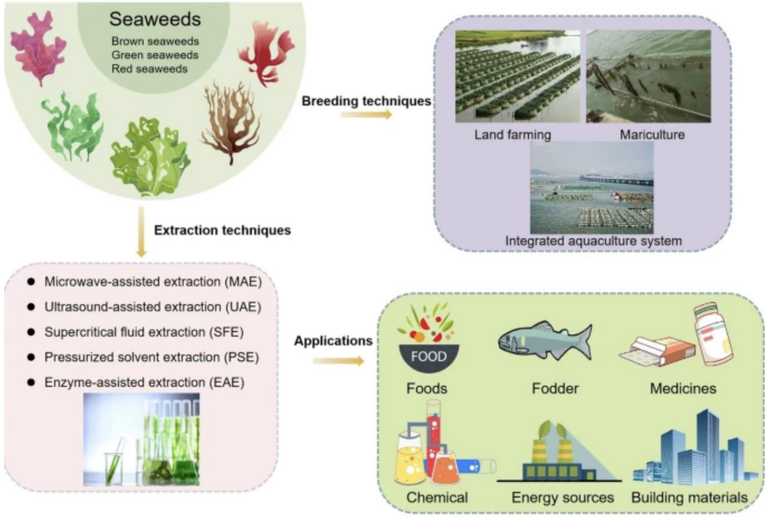
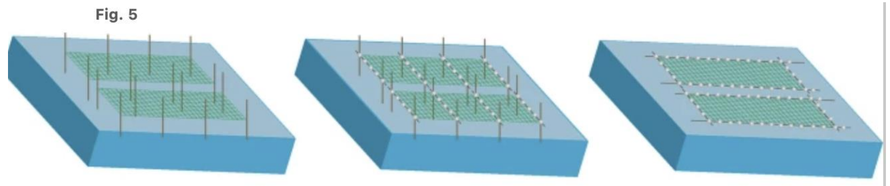


Fig. 5



Three farming techniques of seaweed. A: pillar type; B: Semi floating raft: C: full floating raft composed of long rope and floating ball

https://fppn.biomedcentral.com/articles/10.1186/s43014-022-00103-2#Fig1

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Global production 2019

Table 1: Global seaweed production, 2019

Country/area	Total seaweed production (farmed and wild)		Seaweed cultivation	
	Tonnes (wet weight)	Share of world production (%)	Tonnes (wet weight)	Share in farmed and wild production (%)
World	**35 762 504**	**100.00**	**34 679 134**	**96.97**
Asia	**34 826 750**	**97.38**	**34 513 223**	**99.10**
1. China	*20 296 592*	*56.75*	*20 122 142*	*99.14*
2. Indonesia	*9 962 900*	*27.86*	*9 918 400*	*99.55*
3. Republic of Korea	*1 821 475*	*5.09*	*1 812 765*	*99.52*
4. Philippines	*1 500 326*	*4.20*	*1 499 961*	*99.98*
5. Democratic People's Republic of Korea	*603 000*	*1.69*	*603 000*	*100.00*
7. Japan	*412 300*	*1.15*	*345 500*	*83.80*
8. Malaysia	*188 110*	*0.53*	*188 110*	*100.00*
Rest of Asia (7 countries/territories)	42 047	0.12	23 344	55.52
Americas	**487 241**	**1.36**	**22 856**	**4.69**
6. Chile	*426 605*	*1.19*	*21 679*	*5.08*
Peru	36 348	0.10	-	-
Canada	12 655	0.04	-	-
Mexico	7 336	0.02	10	0.14
United States of America	3 394	0.01	263	7.75
Rest of the Americas (6 countries)	904	0.00	904	100.00
Europe	**287 033**	**0.80**	**11 125**	**3.88**
9. Norway	*163 197*	*0.46*	*117*	*0.07*
France	51 476	0.14	176	0.34
Ireland	29 542	0.08	42	0.14
Russian Federation	19 544	0.05	10 573	54.10
Iceland	17 533	0.05	-	-
Rest of Europe (5 countries)	5 741	0.02	217	3.78
Africa	**144 909**	**0.41**	**117 791**	**81.29**
10. United Republic of Tanzania	*106 069*	*0.30*	*106 069*	*100.00*
Zanzibar	104 620	0.29	104 620	100.00
Tanzania (mainland)	1 449	0.00	1 449	100.00
Morocco	17 591	0.05	273	1.55
South Africa	11 155	0.03	2 155	19.32
Madagascar	9 665	0.03	8 865	91.72
Rest of Africa (2 countries)	430	0.00	430	100.00
Oceania	**16 572**	**0.05**	**14 140**	**85.32**
Solomon Islands	5 600	0.02	5 600	100.00
Papua New Guinea	4 300	0.01	4 300	100.00
Kiribati	3 650	0.01	3 650	100.00
Australia	1 923	0.01	-	-
Rest of Oceania (3 countries)	1 099	0.00	590	53.66

Source: FAO. 2021c. Fishery and Aquaculture Statistics. Global production by production source 1950–2019 (FishStatJ).
Notes: The top 10 seaweed producing countries are indexed. "-" indicates zero or no data.

- Wild 1.1 mil ton
- Farmed 34.7 mil ton

Representing 30% of global Aquaculture at 'wet weight'

Kelp/Kombu…12,469,664 mt

Wakame…2,810,435 mt

Sea Moss/Guso 1,625,164 mt

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(PDF) Global Seafood Alliance - Seaweed Farm Standard Best Aquaculture Practices Certification Standard (researchgate.net)

epseafoods.com.au

AUSTRALIA'S LARGEST PRODUCER OF PREMIUM MUSSELS

PHONE (08) 8682 3091

HOW TO COOK MUSSELS

EYRE PENINSULA seafoods

ABOUT OUR BRANDS RECIPES

WHERE TO BUY INFO CONTACT

What is BAP certification?

Best Aquaculture Practices (BAP) is the only certification program in the world that endorses every step of the production chain… and we are the only Australian mussel farmers to hold this certification.

Certification by BAP illustrates EP Seafoods' commitment to the four pillars of sustainability:

- Environmental responsibility
- Animal health and welfare
- Food safety
- Social accountability.

Best Aquaculture Practices
Processor
CERT # P10952
bapcertification.org

Responsible seafood production is a global effort to keep fish in our future. BAP certification is transforming the seafood industry in 39 countries and EP Seafoods is proud to lead the way in the Australian market.

The investments we have made in our sustainable farming practices and state-of-the-art processing facilities ensure we remain Australia's leading farming and processing operation for the finest quality Australian grown mussels.

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PacificSeafood

Certified to offer the First and Only BAP Four-Star Oysters in the World!

October 16, 2018

New BAP Seaweed Standard about to be launched

Proposed Work Program
FOR GSA STANDARD SETTING AND REVISION

Global Seafood ALLIANCE

UPDATED AS OF OCTOBER 2023	Publication date	Operational or in preparation?	Public review process status	Newly adopted* or established?	Next tasks
PROCESSING PLANT					
SEAFOOD PROCESSING STANDARD (SPS)					
SPS Issue 5.1	16 November 2020	■	Complete	Established	Maintain program until full launch of Issue 6.0
SPS Issue 6.0	N/A	In Preparation	Complete	Established	Achieve SOC approval
VESSEL					
RESPONSIBLE FISHING VESSEL STANDARD (RFVS)					
RFVS Issue 2.1	30 January 2023	■	Complete	Established	Maintain until next review
FARM					
Farm Standard Issue 3.1	7 February 2023	■	Complete	Established	Maintain until next review
Salmon Farm Standard Issue 2.4	7 February 2023	■	Complete	Established	Maintain program until full launch of Issue 3.0
Salmon Farm Standard Issue 3.0	N/A	In Preparation	Not Yet Conducted	Established	Finalize Technical Committee draft for Public Comment
Mollusk Farm Standard Issue 1.2	7 February 2023	■	Complete	Established	Maintain until next review
Seaweed Farm Standard Issue 1.0	N/A	In Preparation	Complete	Newly Adopted	Approved by GSA BOD in August 2023 - prepring for implementation and publication
HATCHERY					
FINFISH, CRUSTACEAN & MOLLUSK HATCHERIES AND NURSERIES					
Hatchery Standard Issue 2.1	30 January 2023	■	Complete	Established	Maintain until next review
FEED MILL					
Feed Mill Standard Issue 3.1	31 May 2022	■	Complete	Established	Maintain until next review
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Climate Action and Sourcing Standard Issue 1.0	N/A	In Preparation	Complete	Newly Adopted	Achieve SOC approval

October 2023

Newly adopted: in the six months preceding SOC meeting

Best Aquaculture Practices

Global Seafood ALLIANCE

Shellfish….raised on water from 20,000 years ago….now that is Crystal Clear!

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FloGroFresh

RAS King Prawn Farm … Peterborough!

What are the essential needs for RAS to succeed

- A market requirement
- An ideal RAS Project team and their ‘providers’
- An ideal site location
- A Council which really understands the ‘why’
- A Council with a top flight team who understand the ‘what’
- Planning team that understand the ‘when’
- Talented local People
- Water sometimes Fresh and Saline
- Green Energy
- Local infrastructure which can support the proposal
- United Nations SDG’s
- Fully third party accredited Farm and Processing plant

Regulated and transparent

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Will every businesses be…..Crystal Clear ?

The Future: Responsible ethical farming

Are we Crystal Clear about our transparency!

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Our Responsible Journey Continues

- Climate Change & The Environment
- Social Issues - Worker Voice
- Micro Plastics - How to exclude from the Seafood Chain
- Antimicrobial Resistance - N… unambiguous regulatio…
- Feed Ingredient… …stainable and incorporat… …eeds
- Ani… …e - Electro stunning of …

Third party accredited?

Greta Thunberg, a 16 year old, strikes in front of the Swedish parliament and starts a global movement.

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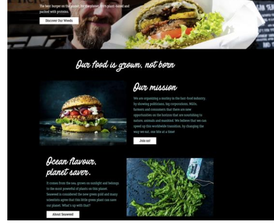
Once proof of concept goes live will operations be…..Crystal Clear to our market ?



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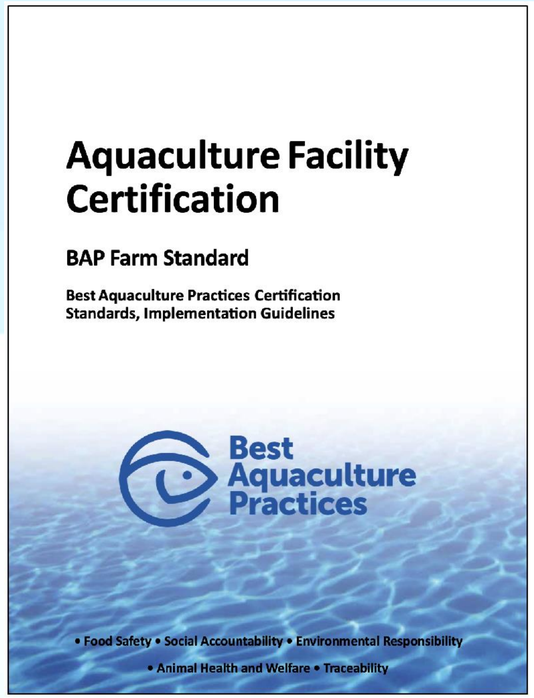
***Newly adopted:** in the six months preceding SOC meeting

Certification to the Best Aquaculture Practices can be an integral part of the offering to the Market Place



"In this fast moving World of today, consumer's expectations rise ever higher. Whether that be for innovation, instant gratification or the best that money can buy, the security of 'trust' both in the product and in the Brand cannot be over emphasised.

People want their view of a brand's worthiness to be trusted unconditionally and interrogated and supported by a Third 'Independent' Party, as this demonstrates the company's complete faith in their systems, their personnel, their product and their Brand and this in the end…helps sell more product."

BAP® CERTIFIED

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Thank you!

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ADDENDUM SLIDES

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Standards

Seaweed standard

Community

- Property Rights and Regulatory compliance
- Community Relations
- Work Safety and Employee Relations

Environment

- Carrying Capacity
- Stocking Sources: Preservation of Wild Stocks, Genetic Diversity and Non-Native Species
- Biosecurity and Disease / Pest Management
- Cultivation Site Interactions and Other Selected Organisms / Wildlife Interactions
- Storage and Waste Disposal

Food Safety

- Control of food safety hazards

Seaweed standard

Expert panel and reviewers

Chair: Dr. Alan T. Critchley, Canada

Mr. Erick Ask, USA

Prof. Thierry Chopin, Canada

Prof. Delin Duan, China

Prof. Elizabeth Cottier-Cook, UK

Prof. Leila Hayashi, Brazil

Prof. Jang Kyun Kim, South Korea

Dr. Stefan Kraan, Ireland

Prof. Phaik Eem Lim, Malaysia

Dr. Valeria Montelscot, France

Dr. Flower E. Msuya, Tanzania

Dr. Iain Neish, Indonesia

Dr. Céline Rebours, Norway

Prof. Michael Roleda, Philippines

Dr. Loretta Roberson, USA

Dr. Craig Sanderson, Australia

Dr. Yoichi Sato, Japan

Prof. Charles Yarish, USA

Initial draft: Andrew Fitzgerald and Dr Andrew Woolmer, UK.

Breeding and Technology - Driving Performance Gains

- Growth
- Multi-pathogen resistance
- Reproductive performance
- Soy tolerance
- Disease exclusion: Biosecure ponds with waste treatment, RAS, and ionic b
- Efficient feeding systems
- Sensors and remote controls
- RAS systems
- Nutraceuticals

RAS

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Market innovation: Food and Beyond

5.2 Market demand as driving force

Market demand has been a key driving force behind algae sector development. The kelp boom in Scotland during the eighteenth century, an industry which employed over 100 000 people at peak time, was driven by demand for raw materials to produce soda (sodium carbonate) and potash (potassium carbonate) (Kenicer, Bridgewater and Milliken, 2000).

Demand for raw materials to produce carrageenan created the Irish moss (*Chondrus crispus*) boom in Canada, starting around 1950 and lasting through the mid-1970s (Craigie, Cornish and Deveau, 2019), and later also fuelled the *Kappaphycus*/*Eucheuma* booms in the Philippines (from the mid-1970s to the early 2010s) and in Indonesia (from around 2000 to the mid-2010s) (Bixler and Porse, 2011).

Demand for healthy and tasty aquatic food has been the primary driving force behind the kelp boom in Eastern Asia, primarily China and the Republic of Korea, from the 1950s to the present day. The boom has been sustained or reinforced along the way by other market forces, such as the demand for brown seaweed extracts (iodine, alginate, mannitol, fucoidan, etc.) and the demand for fresh seaweeds to feed abalone (Hwang, Ha and Park, 2017; Zhang, 2018).

Nutritious, eco-friendly and versatile algae have great potential in a variety of food and non-food applications, yet the potential may not turn into immediate market demand because of a variety of constraints, such as low consumer exposure or preference, high production costs, market competition and stringent regulations. One example is the lack of commercial success in algae-based biofuel production (primarily because of high production costs and low fossil fuel price) in spite of much interest and substantial investments in the sector from the private and public sectors (van Iersel and Flammini, 2010; Lam and Lee, 2012; Chen *et al.*, 2015).

Though attracting attention, many potential contributions of algae (e.g. health contributions, environmental benefits and ecosystem services) may not automatically lead to immediate market demand or subsequent business opportunities to attract profit-seeking private investments in the sector. Similarly, the valuable global externalities of seaweeds and microalgae (e.g. mitigating climate change through carbon sequestration) may not give local governments enough incentive to prioritize algae in development planning.

Therefore, market-based mechanisms, including carbon credits, nitrogen credits, blue bonds and green finance, among others, could be established to facilitate internalization of the positive externalities of algae (Jones, 2021). Coordinated support from governments, donors, civil societies and international organizations is crucial to facilitating algae sector development and integration into global food systems.

Another crucial lesson learned from the history of global algae development is that over-reliance on a narrow range of applications (particularly industrial commodities) can be risky or unsustainable. For instance, the aforementioned kelp boom in Scotland went into a speedy decline in the early 1800s, as more economic ways to produce soda and potash were discovered (Kenicer, Bridgewater and Milliken, 2000). The rapid expansion of *Kappaphycus*/*Eucheuma* cultivation in tropical areas, which supplies much cheaper raw materials for carrageenan production, has rendered the Irish moss industry in Canada a similar boom-bust experience, and the decline of the industry (starting in the mid-1970s) has caused significant socio-economic repercussions (Eamer, 2016).

Utilization of algae (especially seaweeds) as human foods, particularly for local consumption, tends to be the most stable market force that can serve as a stabilizer for algae sector development. However, the inertia of dietary habits and consumer behaviours poses a major challenge to the development of markets for algae food products, especially in places with little algae production, consumption and

5. LESSONS LEARNED AND WAY FORWARD

5.1 Governance as foundation

Science- and evidence-based laws, regulations and guidelines (environmental regulations, spatial planning, food safety standards, occupational health requirements, technical guidelines and good aquaculture practices, among others) on seaweeds and microalgae are essential to laying a solid foundation for the sector's sustainable development.

While it is usually the jurisdiction of individual countries to establish or adopt these criteria according to their socio-economic and environmental conditions and developmental priorities, the international and scientific communities can help generate and share global knowledge and experiences to facilitate informed decision-making in the process.

Governments, civil societies, international organizations and/or the industry can establish or facilitate community-based management (e.g. farmer groups) and market-based schemes (e.g. certification), which can become equally or more effective governing mechanisms in certain areas (e.g. fostering good practices, such as adopting proper stocking density, avoiding the littering of cultivation materials in the ocean, and not adding impurities during the post-harvest handling).

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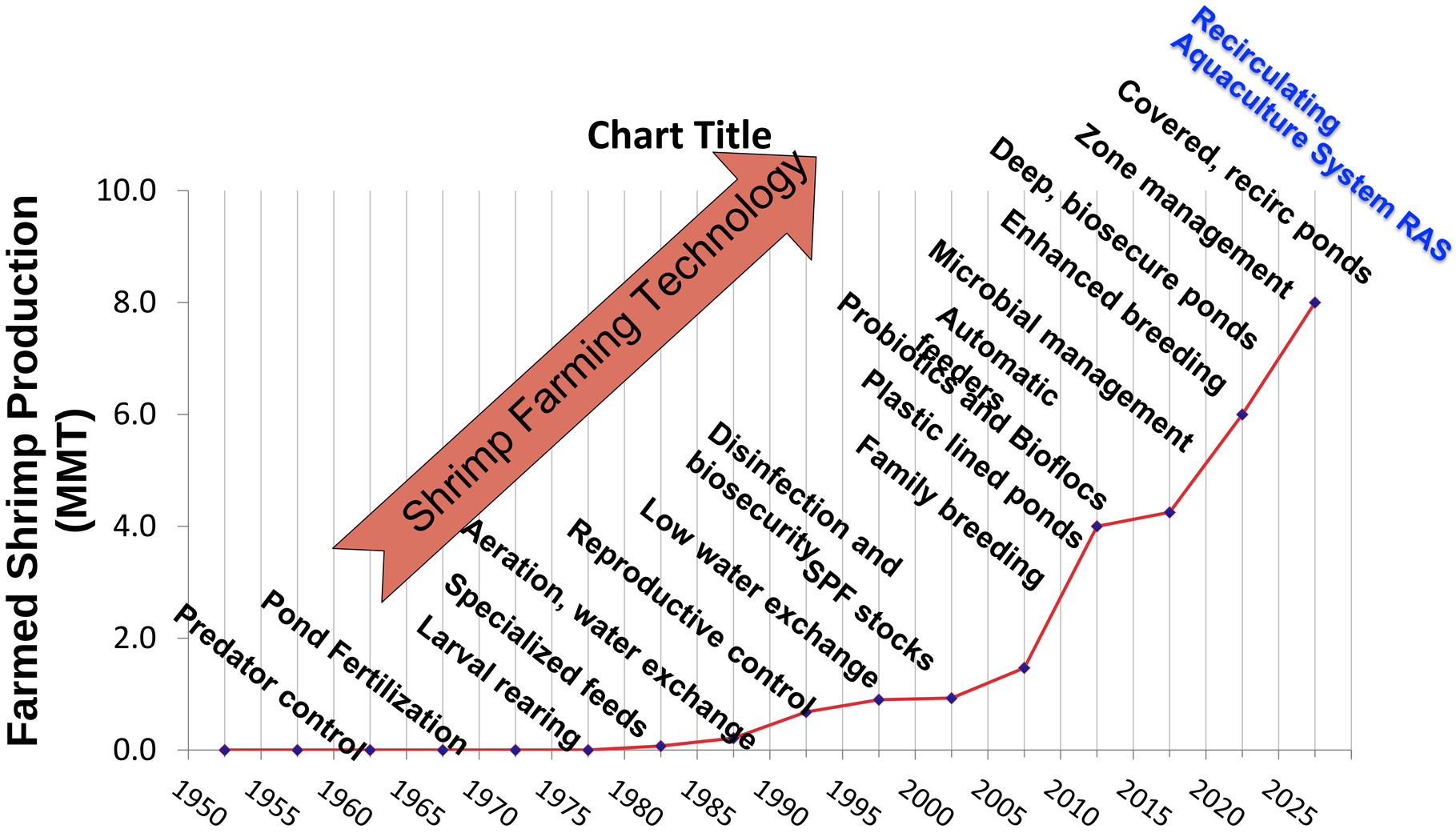
Shrimp Farming: Growth through Innovation



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