GreenCoLab

Cultivation

Market Trends

2026

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I3-4 SEAWEED

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Introduction

Seaweed aquaculture, which accounts for 97% of the total global production, is a rapidly expanding and vital part of the global blue economy. According to FAO, the worldwide production of algae reached 36.5 million tonnes (wet weight) in 2022, worth USD 17 billion [1]. While Asia overwhelmingly dominates the global seaweed production, cultivation is emerging in Western regions. Farmed seaweed is cultivated in both land-based and sea-based (near-shore and offshore) systems, including Integrated Multi-Trophic Aquaculture (IMTA) systems, free-flowing tanks, raceway systems, as well as the use of seeded ropes and direct seeding in marine environments. In the North Atlantic, the main cultivated commercial species include brown kelp (*Sacharina latissima*, *Alaria esculenta*), red (*Gracilaria* sp., *Palmaria palmata, Chondrus crispus*) and green algae (*Ulva* sp.). This follows a global trend of seaweed valorisation for food, a segment that absorbs around 30–38% of world production, but also for emerging markets like biostimulants, feed additives, nutraceuticals and biomaterials [2], [3].

Currently, the western market for farmed seaweed is characterised by elevated pricing and insufficient production volumes. These factors represent key constraints that prevent wider adoption and limit the industry's ability to enter larger, mainstream markets. Rather than competing on volume, Western application trends prioritise high-value, functional ingredients and sustainable solutions. For this reason, cultivation is viewed as an essential strategy to guarantee a reliable supply of high-quality raw materials with a consistent, tailored chemical profile. This shift drives investment toward high-margin applications where purity and traceability are key differentiators. Cultivation offers a technological advantage by allowing for strain selection and optimising growth conditions to boost specific, high-value compounds (e.g., increase protein and pigments), directly increasing the value of the biomass across the entire value chain. Moreover, cultivation provides genetic certainty for seaweed raw materials, as molecular tools (e.g. DNA barcoding and sequencing) can be employed to validate the specific strains/cultivars being used in production. This level of genetic specificity is a critical consideration for the industry, as regulatory compliance is often species-specific. For instance, the approval of seaweed as an ingredient may be governed by the EU Novel Food Regulation, meanwhile its use in cosmetics must align with permitted entries in the CosIng database for cosmetic ingredients [4].

1. Challenges & Opportunities

Current seaweed aquaculture practices show strong sustainability potential and can have positive environmental impacts, especially compared to other aquaculture and agricultural systems. Across both land-based and sea-based systems, seaweed farming typically avoids the use of fertilisers, pesticides, and freshwater, thereby minimising resource inputs and pollution risks. Many producers prioritise the reduction of energy consumption, reuse of materials and adoption of zero-waste approaches, such as repurposing processing co-products and using seawater for washing instead of potable water. These practices align with circular economy principles and contribute to the preservation of both terrestrial and marine resources. In the Roadmap for the Blue Bioeconomy, recommendations to overcome bottlenecks in the development of the algae sector were provided within four categories: science, technology and innovation; policy, environment and regulations; finance and business development; and consumers and value chains [5].

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1.1 Science, Technology & Innovation

The seaweed cultivation industry faces significant hurdles, starting with infrastructure and design challenges in sea-based systems. For example, ensuring reliable and scalable rig design is complicated by issues like cultivation lines sinking too deeply, which ultimately reduces yields. Seaweeds' limited shelf life, texture, flavour and moisture content require specific handling and immediate, energy-intensive post-harvest processing, which significantly increase the risk of product loss before market entry. This inherent difficulty is further compounded by the lack of automation across key operational phases, including seeding, harvesting, and post-harvest handling. This leads directly to high operational costs and restricted scalability. Furthermore, open water systems are highly vulnerable to environmental variability, depending heavily on seasonal fluctuations in temperature, light, and water quality, making consistent, year-round production difficult. Both land- and sea-based operations must also contend with contamination and biosecurity risks. Biofouling and general contamination can negatively affect product quality. In addition, specific diseases and pests—such as ice-ice disease and fungal infections—pose serious challenges, particularly in the absence of strong biosecurity measures. Beyond operational risks, the sector faces long-term resilience concerns due to a reliance on wild seedstock, which limits the genetic diversity for disease resistance. The rapid expansion of large-scale operations raises environmental risks of operations, including marine pollution from lost gear and entanglement risks for marine megafauna. Finally, the absence of a European biobanking strategy; persistent knowledge gaps on species domestication, breeding, and the cumulative and long-term impacts of large cultivation, call for increased investment in research.

1.2 Policy, Environment & Regulations

The future of seaweed farming is threatened by the direct effects of climate change vulnerability, where ocean warming, acidification, altered salinity, and shorter growing seasons collectively reduce yields and increase disease susceptibility. This climate threat is amplified by extreme events such as storms and marine heatwaves, which cause significant physical damage to infrastructure and result in substantial biomass loss. Seaweed farming is considered beneficial for the environment, particularly small to medium-scale cultivation, which, if sited responsibly, is unlikely to cause significant ecological harm and can even improve water quality and support local biodiversity [6], [7]. However, large-scale deployment should proceed with caution to avoid shading effects and habitat disruption. Overall, current best practices and ongoing innovation in seaweed aquaculture have strong evidence supporting its environmental benefits, positioning the sector as a model for sustainable blue economy development.

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Ensuring quality consistency and meeting regulatory food safety regulations, such as HACCP, ISO 22000, HALAL, and organic certification, are critical aspects. Seaweeds can accumulate harmful elements, including contaminants like heavy metals (such as inorganic arsenic and cadmium), microbial hazards (like *Salmonella* spp.), and potentially high iodine levels (especially in brown seaweeds), depending on species and cultivation practices. Operationally, farms, particularly those located in natural areas, face economic loss from the grazing of marine fauna, particularly macroinvertebrates which also contribute to shellfish allergens [4], [8]. The challenge of meeting specific quality requirements is exacerbated by the inconsistent biochemical profile resulting from variations in species, growth, or harvesting techniques. This difficulty is severely compounded by regulatory complexity, which differs between countries. The ability to scale the industry is conditioned by the slow, time-consuming nature of licensing and regulatory frameworks, coupled with limited access to necessary funding and investment, which collectively act as significant bottlenecks for expansion.

1.3 Finance Business & Development

The seaweed cultivation sector faces significant economic and social challenges that hinder its mainstream adoption and scaling. From a farmers' perspective, scaling the industry requires substantial investments, which are currently jeopardised by a lack of early-stage revenue, making it difficult to secure the necessary funding for expansion. The most pressing economic issue is the high production costs, leading to a price per tonne of farmed seaweed that can be up to 100 times higher than that of comparative crops like corn. This is driven by substantial expenses related to labour, energy, infrastructure, and specialised equipment costs. Specifically, high energy costs associated with post-harvest activities, particularly drying and processing, severely impact overall profitability [2], [9].

Furthermore, the reliance on manual labour for key tasks means the industry requires highly skilled labour. This reliance not only inflates operational costs but also requires a specialised workforce that can often be scarce. The seasonal nature of some cultivation systems also creates job insecurity for workers, leading to periods of underemployment. Socially, the expanding sector must address community conflict and licensing issues. New farms must navigate potential conflicts with established marine users, such as fisheries and tourism operators. Gaining a social license to operate requires transparency and the demonstration of clear local benefits. Additionally, operational complexity is increased by concerns over worker health and safety. Finally, market-side uncertainties act as a major bottleneck. The limited market demand, especially outside of traditional seaweed-consuming regions, results in fluctuating demand, which discourages necessary investment and hinders the ability to secure long-term contracts for producers.

1.4 Consumers & Value Chain

The final set of challenges for the seaweed industry centres on market development and economic viability. Lack of established distribution channels makes it challenging for seaweed farmers to efficiently reach food processors and other commercial buyers. A major factor is low consumer awareness and acceptability related to an unfamiliar or unpleasant flavour and texture. Limited public knowledge, and demand for seaweed products restrict opportunities for local economic growth and community participation. This market is exacerbated by supply chain gaps. The overall market development is hindered by insufficient product standardisation and a lack of established supply chains. This results in low availability of raw biomass with neither predictable volumes nor consistent quality at affordable prices. Overall, to succeed in the seaweed-based market sectors, the key interventions needed are that the industry must either establish seaweed as a premium, high-value product that justifies a higher price, or it must find ways to reduce the cost of seaweed products [2]. Cost reduction can be achieved through efficiency gains (such as increased automation and better farm design) or by introducing long-term subsidies and incentives for seaweed farming, as is done in Asian countries.

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1.5 Opportunities

Innovation is positioning the seaweed aquaculture sector for significant growth and stability. Companies are implementing practices such as modular land-based cultivation systems and customised protocols, which offer the opportunity for more stable and diversified, year-round production. Furthermore, the establishment of biobanks creates valuable resources for genetic research and strain selection, enhancing disease resistance and long-term crop resilience [10], [11]. The development of direct seeding methods presents an opportunity to significantly reduce labour costs and increase scalability if reliability issues are resolved.

The sustainable advancement of the seaweed aquaculture sector relies heavily on international cooperation and policy alignment. Through multi-country policy dialogues and platforms, the industry is establishing shared national strategies, which are vital for closing policy gaps, securing coordinated support, and unlocking global market potential [12], [13].

2. Market Size and Potential

The global seaweed market was estimated to be worth around USD 18.4 billion in 2024 and is expected to grow at a Compound Annual Growth Rate (CAGR) of approximately 9–12%, reaching USD 34.56 billion by 2032 [14]. While this scale is overwhelmingly dominated by Southeast Asia aquaculture, western regions with current limited seaweed farming, such as Europe and America, are emerging as a strategic move to develop new, high-value markets and secure local, sustainable and traceable seaweed sourcing [15]. In Europe, the current market is worth over EUR 1 billion and is projected to experience an annual growth rate of 8–10%, supported by EU-driven sustainability and circular economy policies, reaching EUR 2–3 billion by 2030. New and emerging seaweed applications represent the greatest market opportunities outside established sectors [16]. Seaweeds' nutritional and bioactive properties make them attractive alternatives to conventional products, driven by consumer awareness and demand for sustainably sourced biostimulants, alternative proteins, cosmetics, personal care and health products. However, despite seaweed's recent rise in popularity, its market entry and product introduction rates have fallen short of these optimistic expectations.

According to the World Bank Seaweed Markets report, biostimulants, animal feed additives, and pet food were considered the most promising short-term markets for seaweed, projected to reach USD 4.4 billion by 2030. In these markets, seaweed-based products offer competitive value and low processing complexity [2]. Currently, seaweed biostimulants are worth around USD 1 billion and involve 250,000 to 500,000 tons of biomass per year, however, they are primarily sourced through wild harvesting. Projected to grow at a rate of 13% annually, this market could be worth USD 2.5 billion in 2030, with approximately 1% of global farmland treated, but also sought for in other markets such as sports fields [17], [18], [19]. This market segment is followed by nutraceuticals, alternative proteins, biomaterials and textiles in the medium-term. The nutraceuticals market is projected to reach USD 6 billion by 2030; however, due to significant challenges related to production costs, pricing, and functionality, these markets must drastically improve the cost-effectiveness and seaweed supply, or have their future use restricted to niche applications [2], [20]. Lastly, pharmaceuticals and construction materials were considered a long-term market opportunity for seaweeds. Data on the value of seaweed-based pharmaceuticals is scarce and unreliable, and there are significant barriers including the production costs and regulatory challenges in this market segment. The market for seaweed derived construction materials is estimated at $1.4 billion in 2030. However, this will likely be achieved either by serving a specialised, niche market or by using waste products from seaweed processed for other purposes [2].

In Europe, the commercial species with the most potential, based on their nutritional profiles, industrial versatility and ecological advantages, are listed below (Table *1*). Brown kelp species, such as *Saccharina latissima, Alaria esculenta* and *Laminaria digitata*, have a strong potential for cold-water farming. They are nutritionally rich (vitamins, iodine, dietary fibre, antioxidants) and suitable for human

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consumption, pharmaceuticals, cosmetics, feed, biostimulants and biodegradable packaging. *Ulva* sp., commonly known as sea lettuce, is considered a model organism in European seaweed cultivation. It is a fast-growing green seaweed that is protein-rich, ideal for sustainable plant-based diets and integrated aquaculture [21]. *Ulva* has been recently highlighted in the SEAWHEAT cost action (https://seawheatcost.haifa.ac.il/), whose main mission was to contribute towards a green economy based on its mass production and utilisation within the European community and beyond [22]. Other emerging species, such as *Palmaria palmata and Porphyra* spp. *(P. dioica, P. umbilicalis)* are valuable red seaweed with a high protein content, omega 3 fatty acids, vitamins including B12 and unique compounds such as phycobiliproteins and mycosporine-like amino acids with promising applications in pharmaceutical and cosmetic industries.

Table 1. Main European commercial seaweed species and their applications.

Species	Common name	Main Applications
Saccharina latissima	Sugar kelp	Human consumption, Hydrocolloids (Alginates), biostimulants
Alaria esculenta	Atlantic wakame	Human consumption, biostimulants
Ulva sp.	sea lettuce	Animal feed, human consumption, biostimulants
Porphyra spp.	Atlantic-nori	Human consumption, nutraceuticals & cosmeceuticals
Palmaria palmata	Dulse	Human consumption, nutraceuticals
Codium tomentosum	Spongeweed	Human consumption, cosmetics
Gracilaria gracilis	Ogonori	Human consumption, Hydrocolloids (Agar)
Laminaria digitata	Kombu royal	Human consumption, Hydrocolloids (Alginates), biostimulants

3. Key Stakeholders

The PhyCo Seaweed and Companies Explorer tool available online (http://www.phyco.ulpgc.es/) was developed within the I3-4-Seaweed project. Stakeholder/companies working with certain species can be found as well as detailed information about their activities, between seaweed production, processing or valorisation, specifically within Europe. More than 500 enterprises have already been identified across the seaweed value chain.

Additionally, there are other available online tools that provide information on the global seaweed industry such as the Phyconomy company database and research depository (www.phyconomy.com), which includes detailed information on the developmental stage, scale and investments of stakeholders. The "European Atlas of the Seas" platform (https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/) launched by the European Commission maps Europe's marine environment. In the "food from the Ocean map" seaweed production facilities both aquaculture (land-based and sea-based) and harvested (manual and/or mechanical) are mapped [23]. According to this tool, there are European aquaculture seaweed farming sites located in Denmark, the Faroe Islands, France, Ireland, Norway, Portugal, Spain, Sweden, The Netherlands, and the UK.

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4. Applications and Products on the Market

4.1 Industrial Additives

The largest revenue segment for global seaweed biomass centres on the extraction of hydrocolloids used as additives. They are used as emulsifying, thickening, gelling, stabilising ingredients and excipients for industrial manufacturing in the food, pharmaceutical and nutraceutical markets (alginates: E400-E404; agar: E406; and carrageenan: E407). While Europe and North America have significant markets, the sourcing methods for the required seaweed species vary by hydrocolloid. Alginates are primarily extracted from wild-harvested brown seaweed, with a small fraction being sourced from farmed *Sacharina latissima* and *Alaria esculenta*. Agar is extracted from wild-harvested *Gelidium* but also from cultivated *Gracilaria* spp. Lastly, carrageenans are predominantly sourced from Southeast Asia, where large-scale cultivation of *Kappaphycus alvarezzi* and *Eucheuma denticulatum* provides the consistent volume needed by multinational ingredient industries (e.g., Cargill, DuPont) for standardising extracts [24].

4.2 Food and Food Supplements

The western food market focuses on high-value, whole seaweed products and specialty ingredients, often driven by a demand for organic-certified and traceable biomass. Cultivated seaweeds are consumed fresh as "sea vegetables" or included as ingredients either frozen or dried (flakes, powders) in premium products [25], [26]. Some of the seaweed-based products sold in western markets include fermented seaweed [27], tartares and guacamoles [28], dried flakes for seasoning [29], [30], condiments [30], [31], sauces such as mayonnaise, where seaweed inclusion allows for salt replacement [32], salads [28], [33], snacks [29] croquettes [34] plant-based burgers and beverages [35], [36]. Examples are represented in **Error! Reference source not found.**.

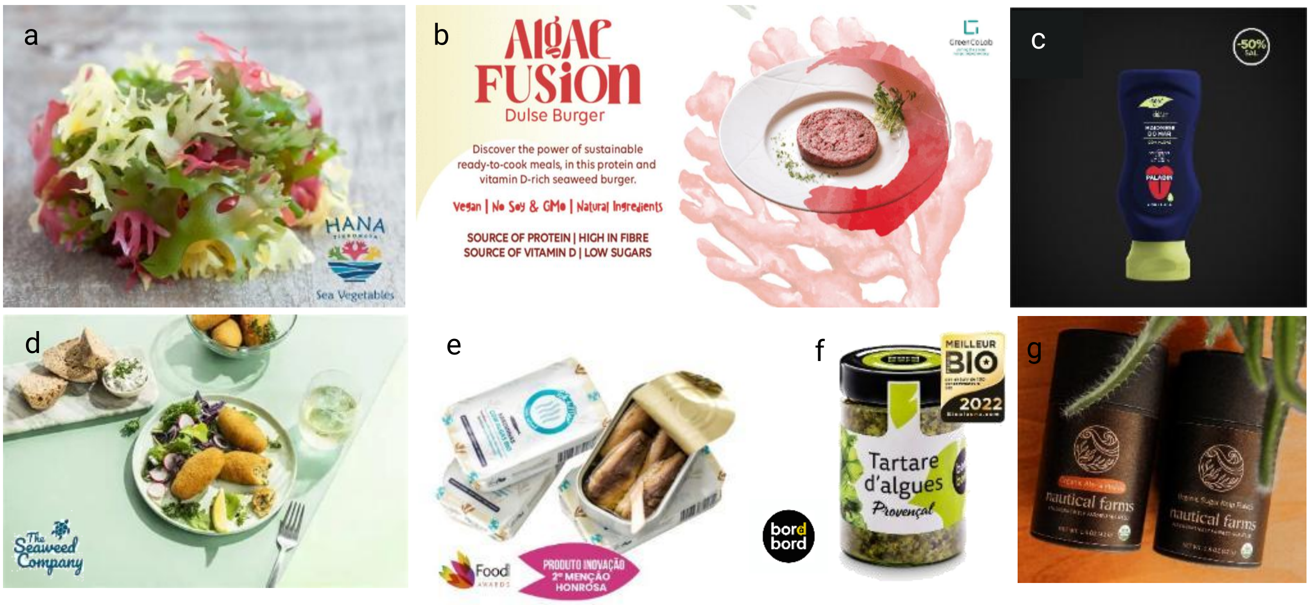

Figure 1. Overview of seaweed-based food products. a) Hana Tsunomata® Sea Vegetables with colourful farmed Irish Moss; b) Algae Fusion Dulse Burger by GreenCoLab; c) Sea mayonnaise by Palladin, salt reduction up to 50% given the inclusion of farmed sea lettuce flakes, d) Nomet seaweed Croquette by The Seaweed Company; e) Canned sardines with farmed sea lettuce and bladderwrack, by Tok de Mar; f) Seaweed tartare "Provençal" by Bord a Bord with Sea lettuce, Sea spaghetti, Dulse and Wakame; g) Organic Alaria and Sugar kelp Flakes for seasoning by Nautical farms. Images retrieved from: [28], [31], [32], [33], [34], [73], [74].

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Dietary inadequacies in vitamins and minerals are globally widespread. Seaweed-based supplementation can not only source vitamins (A, C, E, K, B12) and minerals (iodine, potassium iodide and calcium) but also bioactive compounds (omega-3 fatty acids, pigments) to improve human health and contribute to the prevention and treatment of diseases. The European market includes a range of nutraceutical products with distinct targets to prevent oxidative stress [37], support skin, hair, and nail health [38], supplement iodine deficiencies or regulate thyroid function [39], as well as pre-natal pregnancy vitamins, particularly using calcified *Phymatolithon calcareum (=Lithothamnion calcareum)* [40], [41], [42]. Some examples are represented in **Error! Reference source not found.**.

Figure 2. Nutraceutical products with seaweed-based ingredients a) Pregnancy multivitamin supplements Grossesse by boome with Lithothamnium thallus powder and organic Ascophyllum powder; b) Oxybiane Cell Protect by PiLeJe with a Porphyra umbilicalis extract; c) ALGAESSENCE, an organic powder algae blend made of cultivated microalgae and seaweed; d) Ocean Iodine tabs by ezyleaf nutrition, with Sea Kelp, Irish Sea Moss, Bladderwrack, potassium iodide and iodine; e) Pure Ocean pure beauty food supplement with Dulse (Palmaria palmata), Sugar Kelp (Saccharina latissima), Lithothamnion calcareum complex (AQUAMIN). Images retrieved from: [37], [38], [39], [41], [75].

4.3 Pharmaceuticals and Cosmeceuticals

The pharmaceutical and cosmeceutical sectors are premium markets where the integrity of the raw material is crucial. A cultivated, predictable, traceable, organic-certified, "green" ingredient source is highly desirable, offering the guaranteed purity essential for meeting regulations and certifications (eg. Cosmos and China approved ingredients) [43]. Seaweed extracts with scientific and clinical research backing up their specific action mechanisms are sought for, such as the ingredient InAlgae® AOX by Inclita Seaweed Solutions, with a potent defence against oxidative stress [44]. Cultivation can also maximize single, high-value components, for example the French company CODIF, cultivates *Jania rubens* (a red alga) in photobioreactors for plant-based taurine production (*EARLY BOOST*), while *PANTODIUM CICA* is an organic-certified fermented extract sourced from farmed *Codium tomentosum*, to deliver natural Vitamin B5 precursors ([45], [46]). Mycosporine-like amino acids from red seaweed are also extremely sought for in the cosmetic industry as they can replace UV-protecting chemicals [47], [48]. Personal care products with seaweed-based ingredients include luxury regenerative and moisturizing creams [49], [50], sunscreens [47], serums [51], soap [30] and therapeutic spa products (thalassotherapy) [31], examples seen in **Error! Reference source not found.**.

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Figure 3. Overview of seaweed-based cosmeceuticals: a) Seaweed Serum Facial Sensitive by AlgaMar; b) La mer moisturizing cream; c) Bam and Boo Regenerative overnight cream using InAlgae®AOX ingredient from a Fucus vesiculosus extract; d) Algosun by Algotherm using an anti-UVA Porphyra umbilicalis algae extract; e) Thalassotherapy kit with farmed sea lettuce by Sea Originals.Images retrieved from: [31], [50], [51], [76].

4.4 Biostimulants and Biopesticides

The agricultural sector is a major consumer of seaweed extracts, driven by European policy and consumer demand for eco-friendly farming. Policies, such as the EU's Farm to Fork Strategy, are explicitly pushing for the reduction of chemical fertilizers and pesticides which generate more carbon emissions per application [17]. The importance of biostimulants in the European agricultural market is set out in Regulation (EU) 2019/1009 [52]. Seaweed extracts are rich in micronutrients, phytohormones, and bioactive compounds, activating the plant's natural defence mechanisms against abiotic stresses (like drought and salinity) and pathogens and promote efficient nutrient uptake, soil quality and overall plant growth. While the Western seaweed industry is strategically scaling up cultivation, the most widely used raw material for biostimulants is currently obtained through commercially managed wild harvest, primarily from *Ascophyllum nodosum* [53]. However, cultivated species are increasingly utilized across the agricultural sector, particularly those that offer a reliable, consistent supply of specific compounds, including brown *Fucus* spp., *Laminaria* spp. and the red and green seaweeds *Kappaphycus* spp. and *Ulva* spp. [54], [55].

Figure 4. Seaweed-based biostimulants in the market: a) TerraMare by ficosterra with a Laminaria extract; b) EliteSea™ by BASF based on Ascophyllum nodosum; c) BlackFort by BioAtlantis with an Ascophyllum nodosum extract. Images retrieved from: [56], [57], [58].

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4.5 Animal Feed (additives) & Pet Food

One of the most impactful emerging seaweed-based ingredients application is in the ruminant livestock sector, addressing global climate goals. There are major scaling efforts by climate-tech companies to provide commercial, cultivated supply chain for specific red algae (*Asparagopsis spp.*). These supplements have been scientifically proven to reduce methane emissions from ruminant livestock by up to 90% [59], [60], [61]. However, given the technical and ecological challenges of large-scale cultivation of *Asparagopsis* spp., novel approaches are emerging, for instance recent research focusing on the enhancement of bromoform synthesis in *Pyropia* microscopic stages, through genetic engineering [62]. Additional markets include the pet food sector, equine and aquafeeds [60], [61], [63], [64]. Research promoting the inclusion of seaweed ingredients in aquafeeds to increase immune defence at larval and juvenile stages is also being implemented [65], [66], [67].

a

b

Figure 5. Overview of animal feed products with seaweed-based ingredients: a) OceanFeed products use a blend of brown, green and red seaweeds with products ranging from equine, poultry, swine feeds to aquafeeds; b) SeaFeed™ with Asparagopsis bioactives for ruminant livestock. Images retrieved from: [64]

4.6 Biomaterials

The biomaterials segment represents a long-term, systemic goal of the "Blue Bioeconomy" concept, by utilizing seaweed as a renewable, non-food source to produce high-volume sustainable alternatives to fossil-fuel-based products [68]. It is fundamentally driven by the EU Green Deal and its associated strategies (e.g., the Circular Economy Action Plan), which aim to make the EU climate-neutral by 2050 [12]. In 2019, Notpla replaced single-use plastic cups at the London Marathon for the edible pouch "Ooho", widely recognized for its revolutionary impact on the perception and application of seaweed-based biomaterials. Ooho can be applied to encapsulate liquids such as energy gels for athletes on the move, honey and sauces for food service, yogurts, condiments, frozen treats and desserts [69]. Seaweed-based biopolymers are being used to create biodegradable packaging materials such as lids, caps, containers, sachets and bottles for cosmetic, food and other applications, as well as rigid cutlery, gel pods and paper [69], [70]. Seaweed-coating materials can also be applied in flexible films and takeaway boxes, replacing plastic or PFAS linings [69]. Seaweed fibres and dyes are also emerging as novel natural alternatives to synthetic materials in the textile and fashion industries [2], [16], [20], [71], [72]. For instance, the company Zeefier supplies seaweed-based dyes to textile manufacturers across Europe, sourced from green, brown and red seaweed from local farms, industry by-products, and natural beach wash-ups [72].

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Figure 6. Overview of seaweed-based biomaterials: a-c) Notpla packaging, cutlery and Ooho capsule; d-f) B'ZEOS pellets transformed into thermoformed packaging, bottles and flexible films; g) SeaCell cotton yarn from Katia; h) Zeefieer seaweed-based dyes. Images retrieved from: [70], [72], [77], [78].

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Table 2. Global Seaweed Market Analysis: Cultivated Species, Product Applications, and Key Drivers

Market	Key Cultivated Species	Product Form & Application	Western Market Driver
Food Additives	Carrageenophytes (*Kappaphycus/Eucheuma*), Agarophytes (*Gracilaria*), Alginates (Kelp)	Hydrocolloids: Carrageenan (E407), Agar (E406), Alginates (E400-E404) used for gelling, thickening, and stabilizing especially in the dairy-free and plant-based sectors.	Clean Label & Functionality
Food & Food ingredients	Sugar Kelp (Saccharina latissima), Atlantic wakame (*Alaria esculenta*), Dulse (*Palmaria palmata*), Sea Lettuce (*Ulva* spp.), Atlantic-nori (*Porphyra* spp.), Irish Moss (*Chondrus crispus*)	Fresh/Salt Brine/Frozen/Dried (whole flakes or powders). Bread, Pasta, Fermented Foods, Dried Seasoning Flakes. Used as a sustainable, low-sodium salt replacer.	Local & Sustainable Sourcing
Nutraceuticals & Health	Brown Kelps (*Laminaria* spp.), Sea lettuce (*Ulva* spp.), Atlantic Nori (*Porphyra* spp..)	High-Purity Extracts (e.g. Fucoidan, Laminarin) for supplements, concentrates, and specialized functional ingredients promoting gut and immune health.	High grade, certification & tailored bioactive composition
Cosmeceuticals & Personal Care	Sugar Kelp (Saccharina latissima), Atlantic wakame (*Alaria esculenta*), Dulse (*Palmaria palmata*), Sea Lettuce (*Ulva* spp.), Atlantic-nori (*Porphyra* umbilicalis), *Jania rubens*	Algal Extracts and purified compounds used in anti-aging, moisturizing, and thalassotherapy.	Purity, High-grade certification, Research-based bioactive ingredients;
Biostimulants & Biopesticides	Kelp species (*Laminaria* spp.), Kappaphycus and Sea Lettuce (*Ulva* spp.)	Liquid Extracts & Biofertilizer Powder: Used to promote plant growth, enhance nutrient uptake, and increase crop resistance to environmental stress.	Sustainability Mandate
Animal Feed Additives	Specific Red Algae (*Asparagopsis* spp., *Gracilaria* sp.); Kelps (*Saccharina latissima*); Sea Lettuce (Ulva spp.)	Pelleted Feed Supplement (low-inclusion rate) for cattle to achieve up to 90% methane reduction.	Climate-Driven; alternatives to fishmeal
Biomaterials	Brown Kelp (*Saccharina latissima*), Sea lettuce (*Ulva* spp.)	Bio-Packaging Films, Biodegradable Plastics, Chemical Feedstock (non-food fraction).	Replace single-use packaging; Circular Economy

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5. Target audience

The commercial seaweed market is driven by a duality of demand: large-scale volumes required by industrial supply chains and the high-value needs of conscious consumers. This dynamic means that the target audience varies greatly across the different sectors. For example, shifting the selling point from cost efficiency (for industrial hydrocolloids) to traceability and purity (for direct-to-consumer sea vegetables). A primary driver of consumer demand is the global shift toward plant-based diets, where seaweed is valued as an essential source of protein, minerals (like iodine and calcium), vitamins (including bioavailable Vit B_{12}) and omega-3 fatty acids. Furthermore, the macrobiotic community forms a high-loyalty sub-segment, having long relied on sea vegetables (Kombu, Nori, Wakame, Arame, Hijiki) as a foundational staple food for daily health. The following table provides a detailed breakdown of specific buyers and their motivations across the sector's major applications.

Table 3. Target Audience and Motivational Drivers Across Key Seaweed Market Sectors

Market	Typical Product Focus	Target Audience Profile	Key Drivers & Psychographics
Food Additives (Hydrocolloids)	B2B Application: Carrageenan (E407), Agar (E406), Alginates (E400-E404)	R&D and Procurement Managers at large Multinational Food & Beverage Corporations (e.g., dairy, confectionery, vegan protein analogue companies).	**Functionality & Cost**: need reliable supply, quality consistent functionality (gelling/stabilizing) and competitive pricing. **Regulatory Compliance**: need suppliers who meet global food safety standards (e.g., organic-certified, non-GMO, kosher, halal).
Food (Sea vegetables & Functional Foods)	Premium seaweed dried snacks, gourmet seasonings (e.g., Dulse flakes, Kelp crisps, nori sheets), pesto, burgers	Conscious consumers (25–45, urban/coastal, high disposable income); Millennials and Gen Z actively seeking healthy, globally inspired, and nutrient-dense alternatives to traditional snacks.	**Clean Label**: desire for organic-certified, natural, sustainable foods. **Health**: Focus on plant-based protein sources, mineral composition (Iodine, Calcium), natural vitamins (B_{12}) and omega-3 fatty acids and their associated bioactive properties.
Biostimulants & Biopesticides	Kelp-based Biostimulants (liquid extracts and biofertilizer powders) (B2B Application)	Commercial growers/farm managers and agricultural distributors specializing in organic, regenerative, or high-value crops (e.g., vineyards, orchards, organic vegetables); plant wellness enthusiasts for home gardening	**Sustainability & Yield**: need for products that improve crop resilience, boost nutrient uptake and protect against pests while simultaneously being approved for organic certification. Aiming for higher yield and quality with reduced chemical use.
Nutraceuticals & Health	Iodine/Fucoidan, bioactive ingredients in Supplements (capsules, powders)	Active seniors (55+ with chronic conditions), wellness enthusiasts (35–55, high income, proactive in health) and pregnant women (25-40). Buyers: Seek functional benefits (immune support, thyroid health, anti-	**Functional properties**: Seek science-backed ingredients. **Proactive Health**: use supplements to manage or prevent age-related issues or diet deficiencies.

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		inflammatory).	
Cosmeceuticals & Personal Care	Premium Skincare (e.g., Anti-aging serums, moisturizing regenerative creams, Thalassotherapy products	Affluent Women (30–60, mid-to-high income). Buyers: Value natural luxury and are willing to pay premium prices for clean-beauty, traceable ingredients with proven efficacy (e.g. anti-aging, hydration).	**Purity**: Demand for toxin-free, "green" and organic-certified ingredients (especially in Europe). **Efficacy**: evidence-based marine bioactive compounds (antioxidant, anti-inflammatory properties) for superior skin repair, skin conditioning and anti-aging.
Animal Feed (Additives & Pet Food)	Methane-Reducing ingredients (Asparagopsis), aquafeeds for larval/juvenile stages (B2B Application)	Corporate Executives (Sustainability/Supply Chain Leads) at large Dairy and Beef Producers, Pet Food and Feed Formulation Companies.	**Regulatory and Climate Risk**: Driven by the need to meet ESG (Environmental, Social, and Governance) targets, comply with potential future climate regulations, and demonstrate a sustainable supply chain to consumers and retailers.
Biomaterials, (Packaging, Construction & Textiles)	Alginate/Cellulose-Based Packaging/Fibers/dyes (B2B Application)	Packaging innovation managers and Sustainability/R&D directors at large retailers, fast moving consumer goods, construction companies, or textile manufacturers.	**Circular Economy**: Need novel, non-fossil-fuel based materials that are biodegradable or compostable to meet corporate and government zero-plastic waste targets.
Pharmaceuticals	Medical Hydrogels, Excipients, Drug Leads (R&D) & Microbiological Agar Media	R&D Directors/Scientists at major pharmaceutical companies; Chief Medical Officers at specialized biotech firms; Lab Managers/Procurement Teams buying high-purity biopolymers and Bacteriological Grade Media (Agar).	**Efficacy & Regulation**: Need compounds that meet grade standards; Agar must meet quality control and bacteriological grade purity for microbiological plating; compliance with drug safety regulations.

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Conclusion

High-Value Strategy Dominates Western Market Focus

While Asia overwhelmingly dominates global seaweed production, the western market, characterised by elevated pricing and insufficient production volumes, is strategically focused on high-value, functional ingredients rather than competing on volume. Cultivation is seen as an essential strategy to guarantee a reliable supply of high-quality raw materials with a consistent, tailored chemical profile, allowing producers to boost specific, high-value compounds (e.g., protein, pigments) and ensure genetic certainty for regulatory compliance.

Significant Market Growth Potential

The global seaweed market is projected to reach USD 34.56 billion by 2032 (growing at an approximate 9–12% CAGR). Europe's market is expected to grow from over EUR 1 billion to EUR 2–3 billion by 2030. The most promising short-term markets are biostimulants and animal feed additives.

Investment in Technology, Cost Reduction and Market Standardisation

To realise its full potential, the western seaweed industry must address core economic and technological challenges. This requires key interventions to either establish seaweed as a premium, high-value product that justifies its higher price, or drastically reduce the cost of seaweed products through efficiency gains (e.g., automation, better farm design) and long-term subsidies or incentives. Additionally, the sector needs increased investment in research to close knowledge gaps (species domestication, breeding), establish greater product standardisation and more robust supply chains to support predictable volumes and consistent quality.

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