


Project title: Mediterranean Innovation Alliance for sustainable blue economy

Acronym: BLUE BIO MED

Priority Axis 4: Enhancing Mediterranean Governance

4.1: To support the process of strengthening and developing multilateral coordination frameworks in the Mediterranean for joint responses to common challenges

<https://blue-bio-med.interreg-med.eu/>

Deliverable 3.2.3	Technology and market forecast
Description	<p>The report highlights the technology and market future trends for the different sectors pertaining the blue bioeconomy and their linkages with the Sustainable Development Goals. The deliverable is structured into different sections:</p> <ol style="list-style-type: none"> 1. <i>Introduction</i> 2. <i>How to read this document</i> 3. <i>Technology forecast and importance of SDGs in Blue Bioeconomy</i> 4. <i>Complete report on patent and NPL analysis</i> <ul style="list-style-type: none"> - <i>Part I: Fishery and Aquaculture</i> - <i>Part II: Blue Biotechnology</i> - <i>Part III: Blue Sustainable Development</i> 5. <i>Key points on Patent and NPL</i> 6. <i>Final remarks</i>
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Due date of Delivery/Actual date of Delivery (if different)	October, 2021
Status (draft, version, final)	Final
Language	English
Delivery Date:	December, 2021
Distribution	Public

6. Final remarks

Table 1 synthesizes the relationship between each BlueBioMed analyzed sector/subsector with the SDGs most likely corresponding. For each sub-sector the perceived qualitative degree of contribution to the SDGs is shown (in qualitative raking as negligible, weak or strong), as resulting from the analysis performed in the report dedicated to the technology forecast. The rightmost columns report the trends arguable from the number of patent applications filed in most cases during the last 20 years and from the market data.

The Table 1 allows to synthetically grasp the contribution of each sector and subsector investigated to the SDGs (as identified in the Technology and Market Forecast report). As expected, the BlueBioMed sectors considered altogether do contribute primarily to the SDG 14 (life below water), being the contribution of SDG 9 on Industry Innovation and related infrastructure relevant as well. To some extent, the Blue Biotechnology sectors also contribute to SDG 3 (Good health and well-being) and SDG 6 (Clean water and sanitation) while covering at lesser extent the topic and actions of SDGs 2 (zero hunger), 12 (responsible production and consumption) and 13 (climate action)¹.

For instance, the widespread contribution of fishery and aquaculture sectors to all SDGs analyzed, except the SDG3 and the SDG 6, can be noticed. Yet, such two goals (SDG 3- Good Health and Well-being and SDG 6- Clear water and Sanitation, respectively) are only in part covered by some of the Blue Biotechnology sectors, such as the soil fertilization and the seawater purification and remediation, mainly because the SDG 6 is focusing on inland waters and thus it may be not completely overlapping the marine sectors identified in the analysis.

It is worth noting the contribution of certain fisheries' subsectors, either industrial or artisanal, as well as the methodologies focusing on the Monitoring and Observing systems for Marine Environment which appear relevant to SDG13 (climate action). The former is resulting from the actions for increasing a sustainable exploitation of the marine resources that will determine an increase of the resilience of the marine ecosystems to the climatic changes. The latter is resulting from actions for increasing capability of monitoring and mapping the marine environment that allows to better understand the effects of the climate changes. In both cases the information is crucial for supporting those initiatives aimed at the climate change mitigation.

Although both the fisheries and the aquaculture subsectors appear significantly connected to the SDG 14, as might be expected, the table highlights fields of this SDG in which the contribution of aquaculture appears rather weak as it is the case of the SDG 14.7 which is related to the impact on the development of the pool of SIDS (Small Island Developing States). Our data provide evidence that the commitment toward the commercial sustainability of small-scale fisheries is consistent (SDG 14.b) and compliant with the regulatory framework and guidelines for using the world's oceans and seas so as to use and conserve marine resources and to ensure the preservation and protection of all the living beings of the sea (SDG 14.c, based on the United Nations Convention for the Law of the Sea - UNCLOS). Consistently, the implementation of new devices based on several smart technologies can efficiently support most of the SDG 14 requisites. The aquaculture sector, moreover, reveals the strong contribution that can be given to the improvement of the quality of life of people (SDG8) and to the industrial innovation in general, either considering the production trends (e.g., the information arguable as far as new feeds and precision aquaculture are concerned), or the retail chain that could undoubtedly benefit of technological applications aimed at improving the sales' rate.

¹ The SDGs and the targets mention in the passage are reported in Table 2.



In addition, the table highlights the presence of technical improvements accordingly with the trends arguable from the patent application' filing events and from the market demand, respectively. Not surprisingly, the fishery sector (both at artisanal and industrial level) appears characterized by a steady number of patent applications and a consistent market demand, despite a natural limit in sea wild productivity being widely recognized. Conversely, hydroponics and precision aquaculture relevance are mirrored by an increasing trend of patent applications that, thanks to an increase of the commercialization opportunities, fits well the trend resulting from our market scenario. Notably, the fish feed sector demonstrates an increasing market trend apparently in contrast with the trend resulting from the patent applications. One explanation could be the presence of few major industrial entities involved in this sector. Furthermore, even excluding the quite recent introduction of insects' derivatives as alternative products to fish oil, since several decades complementary products (for example based on soybean, poultry, corn, etc.) are conceived and developed, yet the implementation potential of the technologies underlying such kind of production seems very limited despite the great demand. Cutting edge technical solutions could boost the commercialization of such products.

The patent and the market trends in the Blue Biotechnology sector reveal significant discrepancies. This sector is to some extent made up of subsectors that had been creating innovative technologies in the past decades (as resulting from the patents' trends) but the adaptation of the technical fundamentals to the marine environment and to the marine resources occurred only later, especially as consequence of the widening of the demand of commodities such as the cosmetics, the pharmaceuticals, or the nutraceuticals. The growth of the biofuel market appears emblematic since the patent applications' filing rate is slowing down in recent years. The biofuels represent in fact an interesting alternative to the fossil counterpart, and consistent R&D effort has been made. However, since a minor yield is expected because of lower content of lipids and salt interference in the case of seawater resources, a decreasing patent trend ascribed to the use of marine photosynthetic resources is plausible, being freshwater algae preferable as alternative fuel resources. Likewise, the 'Sea Organism Genetics' subsector is experiencing an academic bloom, although it is mostly dependent on nucleic acid-based technologies that had been developed decades ago and have been so far utilized essentially for developing new biomedical applications.

The Blue Sustainable Development sector encompasses a smaller number of SDGs, yet some targets such as 3.9, 9.5, and additional ones included in the SDG 14, appear significantly related to several subsectors identified in our survey. In contrast to what has been observed in the case of the Blue Biotechnology fields, the patent applications, and the market trends in the case of the Blue Sustainable Development are positive and fairly in agreement. The products generated in this sector are generally intended for a niche market that nonetheless entails substantial technological innovations. For example, the implementation of technologies dealing with the marine mapping, the maritime surveillance, the underwater unmanned vehicles and the seawater sensors are considered of utmost importance by the governmental organizations and the private entities, by the research institutions and the highly specialized companies, each of them requiring an improvement of the accuracy of the measurements in order to constantly increase the reliability of the information delivered. Development of autonomous or remote controls, of higher elaboration capability of datasets characterized by growing complexity, and of instruments aimed at facilitating the virtual experiences and the remote sampling are all aspects that explain well the increasing trend observed following the analysis of several sectors of the blue technologies.

Moreover, due to the persistent problem of microplastics at sea, it is not surprising the both the technological development and the commercialization potential of solutions dedicated to the removal of plastic particles or to the development of substitute biodegradable materials (bioplastic) display an increasing or, at least, a stable trend.



Table 1 Final Remarks. The heatmap shows the contribution of the investigated technologies to the achievement of the Sustainable Development Goals (SDGs) by virtue of the patent and market trends. The impact is represented by colour intensity (light colour indicates a weak impact on the SDGs; dark colour indicates a strong impact on the SDGs). The trends are represented as: increasing trend (↑), decreasing trend (↓), steady trend (→) and emerging trend (●). Such scheme and the complete documents' collection is available at the following URL: [BLUE BIO MED - Pagina iniziale \(sharepoint.com\)](https://bluebio.med.unipi.it/Pagina_iniziale)



Technologies investigated in the TF	2.1	2.3	2.4	3.8	3.9	6.1	6.3	8.2	8.3	8.4	9.3	9.4	9.5	9.b	12.2	12.3	12.4	12.7	12.8	12.a	13.1	14.1	14.2	14.4	14.7	14.b	14.c	Patent trends	Market trends
Aquaculture																												↑	↑
Fishery_SS																												↓	→
Fish derivatives																												→	↑
Fish feed																												↓	↑
Fishery_LS																												↓	→
Soil fertilization																												↓	↑
Biofuels																												↓	↑
Bioplastics																												↑	↑
Cosmetics																												↓	↑
Marine mapping																												→	→
Maritime surveillance																												↑	→
Microplastics																												→	→
Nutraceuticals																												→	↑
Pharmaceutics																												→	↑
Precision aquaculture																												↑	↑
Remediation																												→	●
Sea Organisms Genetics																												→	●
Seawater purification																												→	●
Seawater sensors																												↑	→
UUV																												↑	↑



Table 2 SDGs and Targets relevant to the blue bioeconomy

SDGs	Targets
2 ZERO HUNGER 	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round
	2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
3 GOOD HEALTH AND WELL-BEING 	3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all
	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
6 CLEAN WATER AND SANITATION 	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all
	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
8 DECENT WORK AND ECONOMIC GROWTH 	8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors
	8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
	8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 	9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets
	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
	9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
	9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities
12 RESPONSIBLE CONSUMPTION AND PRODUCTION 	12.2 By 2030, achieve the sustainable management and efficient use of natural resources
	12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
	12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities
	12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature



	12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
13 CLIMATE ACTION 	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
14 LIFE BELOW WATER 	14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
	14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
	14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
	14.7 By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism
	14.b Provide access for small-scale artisanal fishers to marine resources and markets
	14.c Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of “The future we want”

