Project title: Mediterranean Innovation Alliance for sustainable blue economy
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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	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: 1. *Introduction* 2. *How to read this document* 3. *Technology forecast and importance of SDGs in Blue Bioeconomy* **4. *Complete report on patent and NPL analysis*** - ***Part I: Fishery and Aquaculture*** - *Part II: Blue Biotechnology* - *Part III: Blue Sustainable Development* 5. *Key points on Patent and NPL* 6. *Final remarks*
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Index

4. Complete report on patent and NPL analysis

Part I: Fishery and Aquaculture

1 FISHERY AND AQUACULTURE: MARKET SCENARIO

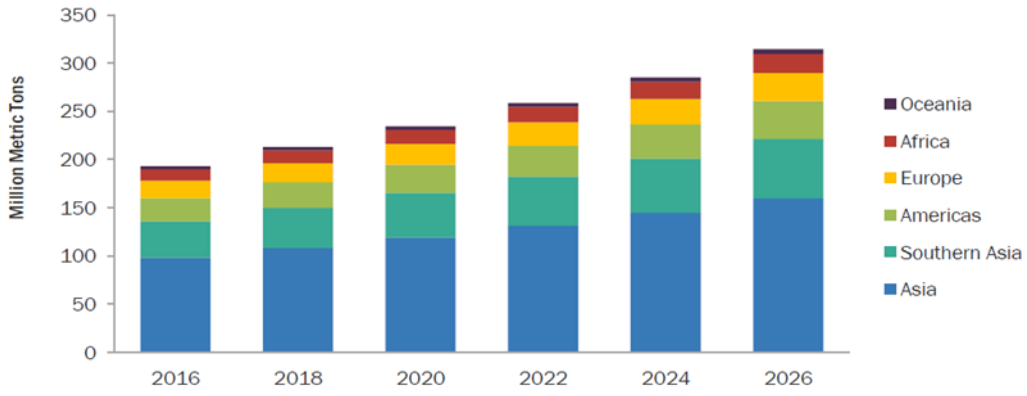
a) Fishery: Pelagic and Demersal Large-Scale Fisheries (LSF) and Distant Water Fleet (DWF) and Small-scale Fisheries (SSF)

Globally, **fisheries** have been over-exploited. As a result, wild fish stocks have declined. With capture fishery unable to meet future demand, it will be a challenge for the sector to maintain current growth rates. The global market for fish has two sources of production: **wild capture** and **aquaculture**. In recent years, aquaculture has become another major source used to meet the global demand for fish and seafood.

Through aquaculture, the natural stock is balanced simultaneously meeting global demand. In the developing countries, aquaculture is being practiced by both **small-scale fish farmers** and big companies.

Global fish production has reached about 179 million tonnes in 2018. Among them, 156 million tonnes were used for human consumption while the remaining 22 million tonnes were destinated to non-food uses such as fishmeal and fish oil. About 300 million metric tons of global fisheries production are expected by 2026 [1].

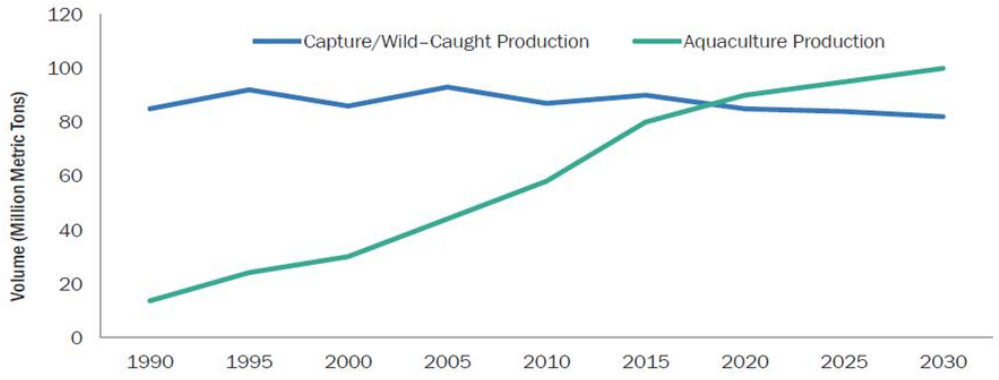
Figure 1 Global Production of Fisheries, 2016–2026 (Million Metric Tons)



Overall, **capture fishery** and **aquaculture** accounted, respectively, for 54% and 46% of the total marine organisms consumed in 2018. Specifically, during 2018, the global capture fishery was estimated around 96.4 million tonnes with an increase of 5.4 percent of the average of the previous three years [2]. According to the FAO, the top 5 fish producers in the world currently are **Asian countries**: China, India, Japan, Indonesia, Vietnam, and Bangladesh. The Asia-

Pacific region is followed by **North America** and **Europe** in the global fish production. In the last 10 years, Indonesia, Vietnam and Myanmar have increased their marine fishing and have traded it in the global market and is increasing the global production of fish and seafood. **Africa** has been working to improve its position in the global production of fish. Asia Pacific is currently the leading producer of fish in the world and the largest market in this sector.
The global aquaculture production is expected to surpass wild-caught fish production by 2024 [1].

Figure 2 Seafood production by 2030



In the **Mediterranean area**, the seafood is still dominated by wild fishing products covering 80% of the total production [3] with an average landing estimated at 787 900 tonnes for the 2016-2018 period. In this area, Italy is the main producer, holding the 22.7% of the total landings, followed by Algeria (13.1%), Tunisia (12.2%), Spain (10%), Greece (9.3%) and Croatia (8.9%) [4].
The **global market of wild fisheries** is expected to reach about 91 Mtons in 2030 but during the last two decades is facing a stagnation affecting the overall production [5]. This lack of growth in wild fisheries products is related to the depletion of the natural fish stock due to decades of overfishing, mismanagements of the marine resources, climate change and other anthropogenic impacts on marine resources [2].
Regarding the global production, the Asian Pacific region (represented mostly by China), scores the highest production, followed by Europe and North America. **Europe** is the continent with the greatest fishing region, and the European countries which mainly contributes to fishery industries are France, Spain, and Italy [6].
In 2019, fisheries in the Mediterranean Sea registered a fishing fleet of approximately 82 000 vessels, with ships ranging from under 6 to over 75 metres, and overall reported landings which oscillate around 800 000 tonnes, mostly concentred in the western Mediterranean and the Adriatic Sea. Greece scores the highest number of vessels with a total of 14934 boats, followed by Italy (12060 vessels), Spain (8886 vessels), Portugal (7791 vessels), Croatia (7605 vessels) and France (6262 vessels) [7]. Among them, almost 82% of the total European fleet are small-scale vessels.
Small-Scale Coastal Fleet (SSF) are vessels of less than 12 meters in length over all (LOA), which work in a short distance from the home port, use quite diversified range of passive gears and not towed gears, sell their products within local market directly to the consumers and are owned by family-based companies with none or few employees. This type of fishery is widespread in the **Mediterranean Sea** especially in Greece, Italy, Portugal, and Croatia, and generally operates in lagoons and the coastal area of the continental shelf [8]. SSF have generally lower impact on nature and are seasonally diverse in terms of species, fishing ground and gears allowing to respect the biological and migratory cycles of different species. Moreover, SSF demonstrated to be highly adaptable to climatic changes and to the future changes of species composition.

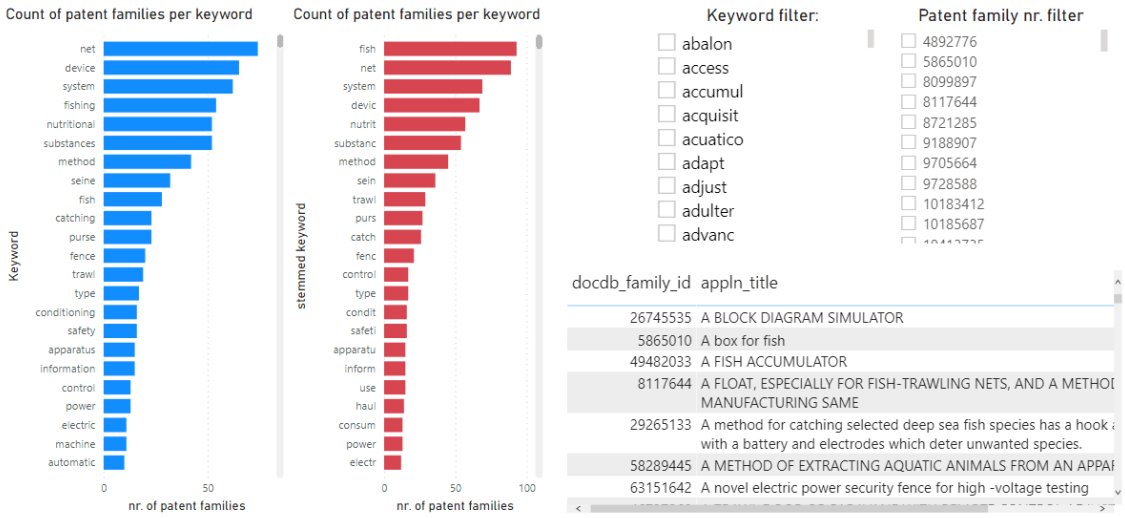
In the Mediterranean Sea, the SSF sector encompasses over 84% of the fishing vessels and provide a significant opportunity for employment. However, SSF represent only 22.6% of the total landings from fishery, demonstrating the small contribution to fishing capacity and production [9].
The remaining 20% of the European Mediterranean fishing vessels are represented by **Pelagic and Demersal Large-Scale Fisheries (LSF)** and **Distant Water Fleet (DWF)** which include larger vessels (usually much larger than 12 meters LOA). The Mediterranean large-scale fisheries are mainly made up of vessels using active gears, i.e., gears that are towed (in the case of demersal ad pelagic trawlers) or used to circle the flock (purse seiners). Usually, the large-scale fisheries are highly dependent on a small number of species [3].

Figure 3 Small-scale in comparison to non small-scale in Europe (Source: Small-Scale Coastal Fleet in EU. European Commission)

Overall, Mediterranean catches cover fish, crustaceans, molluscs, other aquatic animals, and aquatic plants that are taken for all purposes, covering a wide range of marine areas such as high-sea fishing areas, offshore, inshore, or brackish water areas. The main species caught by Mediterranean EU fleets are finfish such as European anchovy (*Engraulis encrasicolus*), European pilchard (*Sardina pilchardus*), European hake (M*erluccius merluccius*), red mullet (*Mullus barbatus*), but also invertebrates such as venus clam (*Chamelea gallina*), deep water rose shrimp (*Parapenaeus longirostris*), common cuttlefish (*Sepia officinalis*).

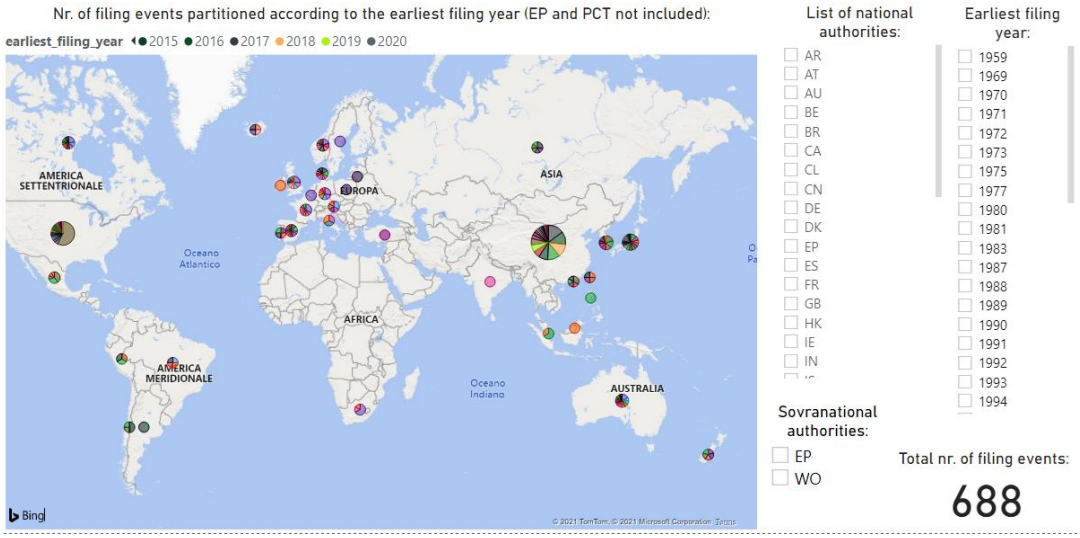
From the perspective of the patent analysis, a dataset consisting of **357 non-duplicated patent families** corresponding to **688 patent applications** has been analyzed. No limitation is assumed concerning the applications' filing timeframe. The main topic regarding this sector may be argued considering the frequency of citations of specific keywords present in the patent titles' as shown in Figure 4.

Figure 4 Fisheries: keywords' frequency



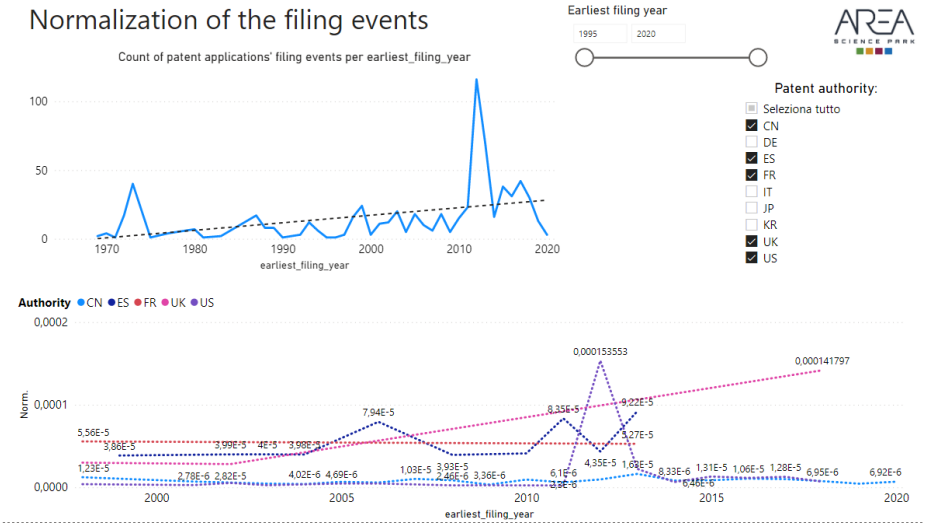
As already observed and mentioned in "*Technology forecast and importance of SDGs in Blue Bioeconomy"*, during the first two decades of the century, the filing events regarding technical innovations in the fishery field are mainly involving the Asian Pacific region, followed by the USPTO and several European patent authorities. The map (Figure 5) does not include the applications filed to the EPO (30) nor the PCT applications (49).

Figure 5 Fisheries: Map of national/supranational patent authorities



As can be noticed in Figure 6, an overall increase of the total number of patent applications, though at relatively modest pace, can be noticed during the last fifty years. The figure concerning the normalization of the data shows that only when focusing on specific patent authorities a relatively significant increase of the applications can be noticed the benchmark being the number of patent applications filed to the same patent authorities yet regardless from the technical sector.

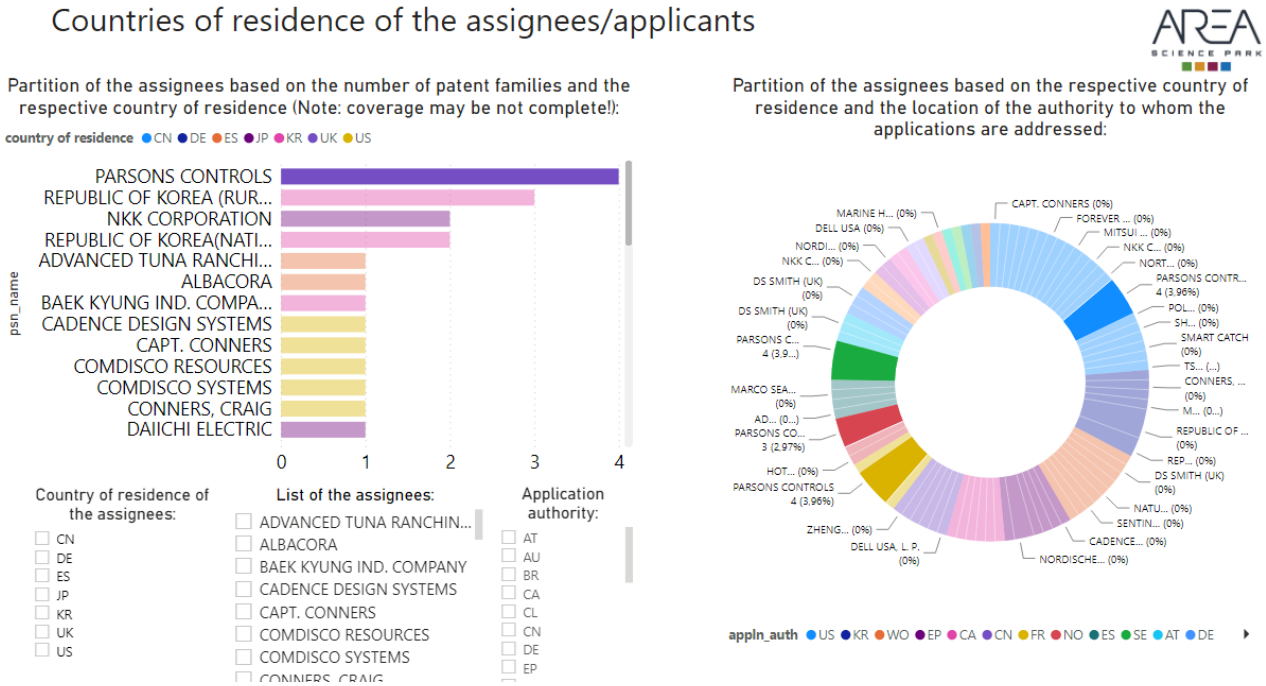
Figure 6 Fisheries: Normalization of patent applications



Considering the French and Spanish national authorities, for example, there has been a significant filing activity until about ten years ago and since then the number of French or Spanish applicants do not seem relevant any longer. As will be further assessed, the possibility exists that the coverage of these potential markets is rather demanded to the nationalization in France or Spain of several patent applications initially filed to supranational authorities, such as the EPO or the WIPO.

There is a relevant distinction to bear in mind, concerning the country of residence of a specific applicant and the countries hosting the national authorities to whom the patent applications are filed by the specific applicant. The focus on one of the applicants shown in the dashboard of Figure 7 allows to draw information concerning the legal protection strategy conceived by that specific applicant (PARSONS CONTROLS is taken as example). The leftmost bar diagram highlights the country (UK) where the residence or where the premise of the applicant is located, while in the rightmost pie diagram are highlighted the national authorities to whom the patent applications have been filed, and in the case of PARSONS CONTROL, including the USPTO, the French, the Swedish and the Norwegian patent authorities. Even if the data coverage may be scarce sometimes, similar information may be argued for each of the applicants selectable from the menu “List of the assignees”.

Figure 7 Fisheries: Legal protection strategy (specifically regarding PARSONS CONTROLS)



Such information allows to characterize each applicant depending on the territorial extent of the legal protection, thus providing an indication about the commitment of each applicant toward the exploitation of his invention, being plausible that the expenses will increase as the number of countries designated for the legal protection becomes greater.

Further data about the patents/patent applications of a specific applicants may be drawn from a specific dashboard (where the publication numbers of the patent documents owned by a specific applicant may be easily identified Figure 8).

Figure 8 Fisheries: additional bibliographic data specifically referring to the player PARSONS CONTROLS

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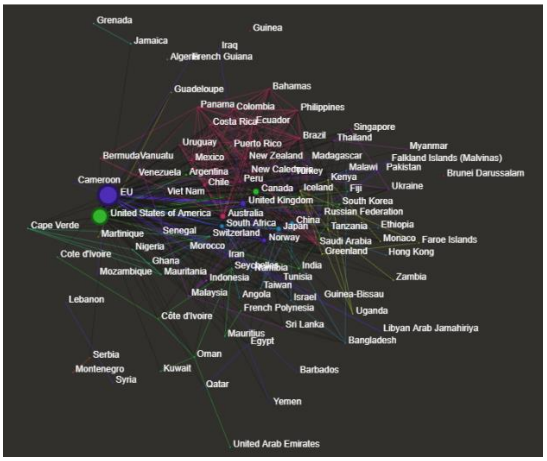
Despite following the analysis of the patent data a relevant impact on the commercialization of innovative technical solutions especially in territories such as the USA or China (Figure 5) may be usually argued, basic research activities, monitored by analyzing other divulgation modalities, such as the scientific publications, the books, the reviews,

the conference proceeding and the EU funded projects, appear ongoing worldwide, a relevant proportion being concentrated in the EU countries, as evident from Figure 9.

Figure 9 Fisheries: NPL data worldwide



b) Aquaculture: Marine Finfish aquaculture (MFA) and Shellfish aquaculture (SA)

Aquaculture is the process of rearing aquatic plants and animals in water environments for commercial and domestic uses. The Food and Agriculture Organization (FAO), defines aquaculture as “the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants”. The FAO reported that aquaculture is probably the fastest growing food-producing sector which accounts for 50 percent of the world's consumed fish [1]. Aquaculture is one of the major drivers of the food industry worldwide. The rise of this sector is primarily driven by the following factors:

- The growing demand for seafood products both for human consumption and non-food commodities;
- The increasing seafood trade between countries;
- The decline of natural fish stocks and decreasing catches of wild capture fisheries due to overfishing environmental pollutions and habitat disturbance;
- The growing number of Blue economy initiatives focused on the improvement of aquaculture infrastructures.

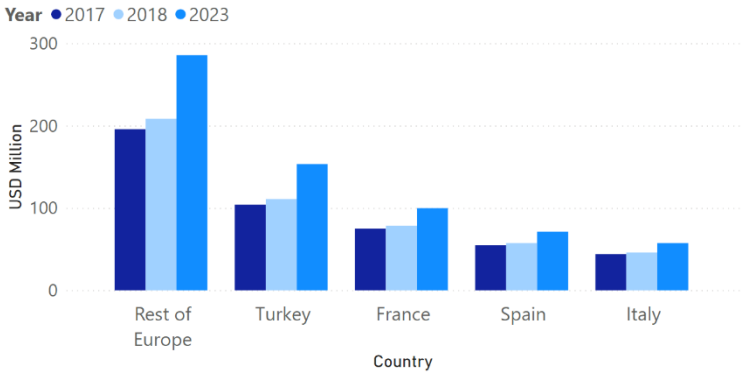
However, major farmed species appreciated in western markets (e.g., salmon, seabream, seabass) are carnivores and need fish derived material (i.e., from wild catches) in the feed. This limits the potential growth of aquaculture and restrict sustainable aquaculture to only a part of the farmed species, I.e., the herbivores such as mussel and clams [6]. **Aquaculture** is necessary for the cultivation of food that is rich in essential **nutrients**. Aquaculture ensures the recycling of organic waste of human and livestock origin. From a macro-economic point of view, aquaculture utilizes land and aquatic resources, which benefit the whole society.

Aquaculture is practiced in both **inland** and **marine** and **coastal** environments and occurs at multiple scales, from small-scale to medium and large-scale production. Aquaculture is the preferred option for many rural coastal communities whose traditional means of producing income has been through selling fish, which has been adversely affected due to over-exploitation. **Small-scale aquaculture** thus improves the social and economic conditions of such communities and thus helps the development of rural areas.

Small-scale producers are the largest source of aquaculture products; this production type segment is projected to reach USD 38,502.2 million by 2023, at a Compound Annual Growth Rate (CAGR) of 7.2% during the forecast period. The

medium and large-scale segment is projected to grow at a CAGR of 6.9% from 2018, to reach a value of USD 4,037.2 million by 2023 [2].
Globally, the **aquaculture market** is dominated by the Asian Pacific region, followed by South America and Europe. In **Europe**, the aquaculture market value is projected to reach USD 1,847.0 billion by 2023 with a CAGR of 6.5% from 2018 to 2013 [3]. The major countries engaged in the production of aquaculture in the Mediterranean region are Turkey, France, Spain, Italy, while among the rest of Europe segment there are Croatia and Greece [4].

Figure 10 Aquaculture Market in EU, by main competitors, in the period 2017-2023 valued in United States Dollar (USD)



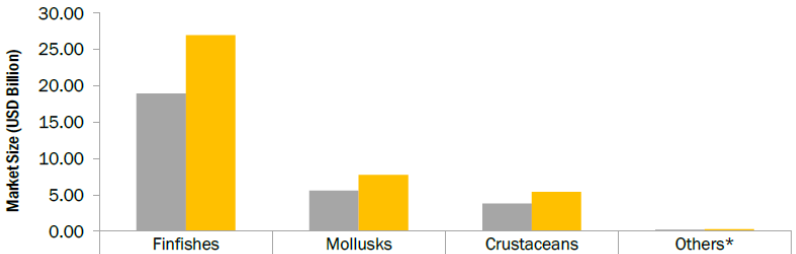
In **Italy**, aquaculture has developed into an industry of national importance, especially for the farming of molluscs (mussels, *Mytilus galloprovincialis*, and Manila clams, *Ruditapes philippinarum*).. However, this sector is not fully developed yet and most of the farmers still used traditional extensive aquaculture [3].
Considering the trade of aquaculture products, the **EU**, including both imports and exports with third countries, totalled EUR 33,37 billion in 2019, making the EU the second largest trader of these products in the world following China. Imports, which accounted for around 80% of the total, amounted to EUR 27,21 billion to cover domestic consumption [4].
The process of aquaculture can be done in three types of habitats: **marine water**, **fresh water** and **brackish water**. Based on rearing facilities, the desired products can be reared in earthen ponds, concrete tanks, plastic tanks, wooden troughs or vats and rearing cages. Based on production technology, the products can be cultured and the farming approach used in an extensive culture system, a semi-intensive culture system or an intensive culture system. Based on the number of species cultivated and the farming approach used, it can be considered the monoculture (culture of single species of fish), the polyculture (culture of two or more species of fishes), the integrated multi-trophic aquaculture (IMTA) (culture of fishes in systems similar to natural ecosystems), the mariculture (culture in seas) and aquaponics (a blend of aquaculture and hydroponics).

Regarding the aquaculture market, the preferred rearing system is the **marine culture** which employs either fish cages or substrates for molluscs and seaweed such as stakes, ropes, and rafts. This type of farming is projected to rise significantly at a growth rate of 7.5% during the forecast period ranging from 2018 to 2023.
The main **farmed animal** species are finfish (seabream and seabass) and molluscs (oyster, mussels, Manila clams), and crustaceans (shrimps and crabs). **Finfishes** include tilapia, carp, trout, milkfish, bait minnow, yellowtail, mullet, and catfish, among others. Finfishes can be cultivated in marine and freshwater. Most of the fish farmed in the world (salmon, trout, and sea bass) have different requirements in terms of environment and feed. Hence, water treatment equipment and chemicals along with cleaning are the most commonly and extensively used components in aquaculture. **Crustaceans** include shrimp, lobster, crab, krill, and barnacles. They are a rich source of vitamins, minerals, proteins, and Omega-3

fatty acids. The most sustainable farmed species are usually bivalves (mussles and clams) because they are herbivorous/detritivores filter feeders.

Globally, **finfish farming** is the dominant market sector, and the same trend is observed in Europe whereas finfish production is projected to reach USD 1,103.6 million by 2023 at a CAGR of 6.9% from 2018. Finally, in Europe, the molluscs segment is forecasted to reach USD 411.5 million in 2023 with a projected CAGR of 6.0% from 2018 [2].

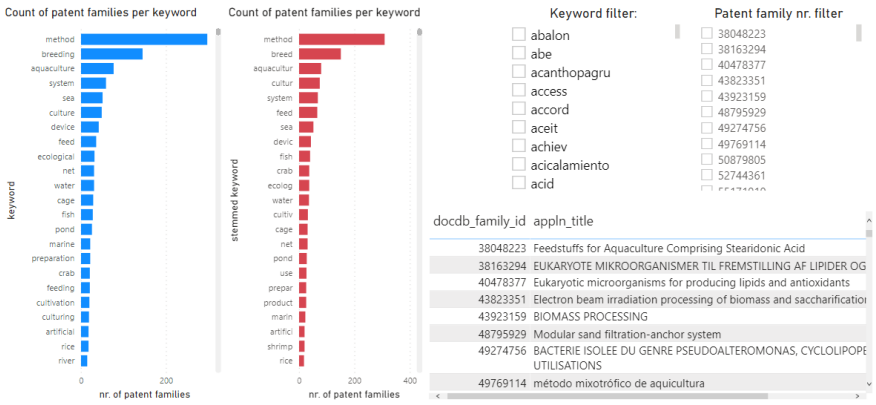
Figure 11 Aquaculture Market, by Aquatic Animal Species, in the Period 2018- 2023 Valued in United States Dollar (USD). e – Estimated; p – Projected *Others include sea bream, sea brass, and frogs



	Finfishes	Mollusks	Crustaceans	Others*
2018-e	18.97	5.61	3.81	0.24
2023-p	27.00	7.78	5.44	0.30
CAGR (2018-2023)	7.3%	6.8%	7.4%	5.0%

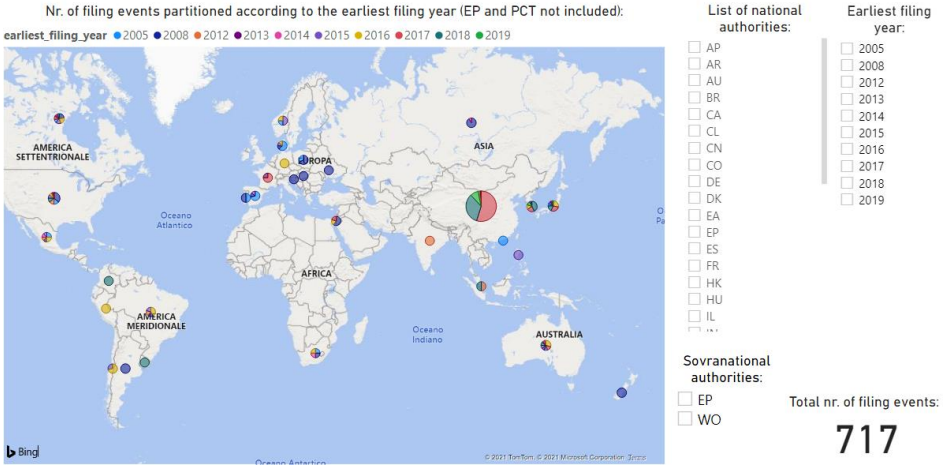
From the perspective of the patent analysis, a dataset consisting of **467 non-duplicated patent families** corresponding to **717 patent applications** has been analyzed. Applications' filing timeframe: priority year 2017 → oct. 2020. The main topic regarding this sector may be argued considering the frequency of citations of specific keywords present in the patent titles' as shown in Figure 12.

Figure 12 Aquaculture: keywords' frequency



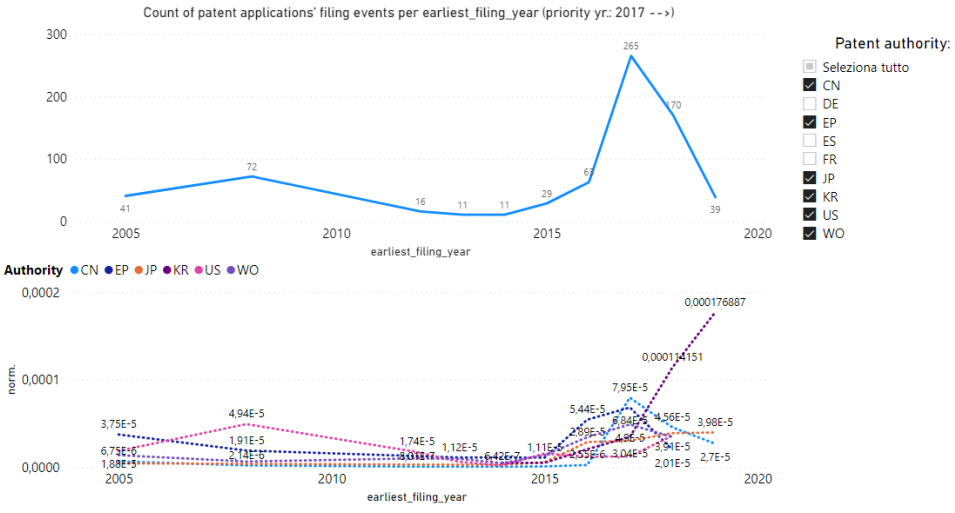
As already observed and mentioned in the "*Technology forecast and importance of SDGs in Blue Bioeconomy*", the analysis has been focused on the most recently filed patent applications. Technical innovations are rising in the aquaculture industry, especially in the Asian Pacific region, followed by the United States of America and Europe as demonstrated by the high number of patent filings registered by the patent authorities located in those regions. The map (Figure 13) does not include the applications filed to the EPO (24) nor the PCT applications (36).

Figure 13 Aquaculture: Map of national/supranational patent authorities



As can be noticed in Figure 14, the increase of the total number of patent applications seems consistent in the most recent years, however it is worth reminding that the analysis is in fact focusing on the most recent filing events. The trend concerning the normalization of the data (Figure 14) shows that there is a quite consistent relevance for the topic according to the pace of the PCT applications filing procedures, thus indicating that despite a higher absolute value of patent applications filed to CNIPA, there interest worldwide in the coming years might be consistent.

Figure 14 Aquaculture: Normalization of patent applications

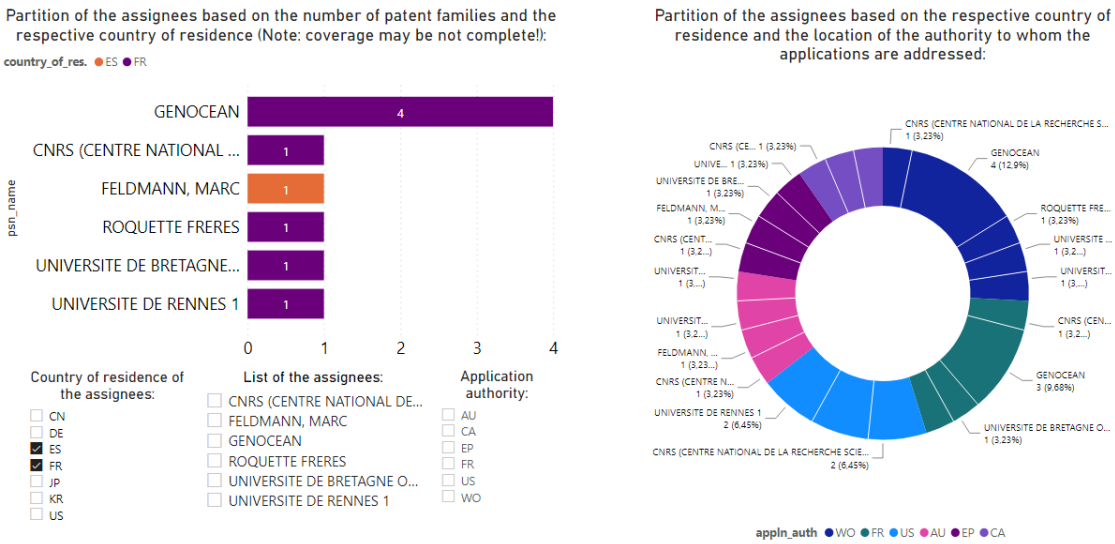


Considering the French and the Spanish national authorities, like in the specific sub-sector regarding the fisheries, a significant filing activity until few years ago could be observed and since then the number of French or Spanish applications do not seem relevant any longer. As will be further assessed, the possibility exists that the coverage of these potential markets is rather demanded to the nationalization - in France or Spain - of several patent applications initially filed to supranational authorities, most likely filed to the WIPO.

As far as the territorial distribution of the applicants' premises is concerned, **differently from the case of the fishery**, **few applicants located in France or Spain might be retrieved**. In the former case, apart from one enterprise (GENOCEAN), few academic institutions (CNRS, Université del Bretagne Occidentale, Université de Rennes 1) are

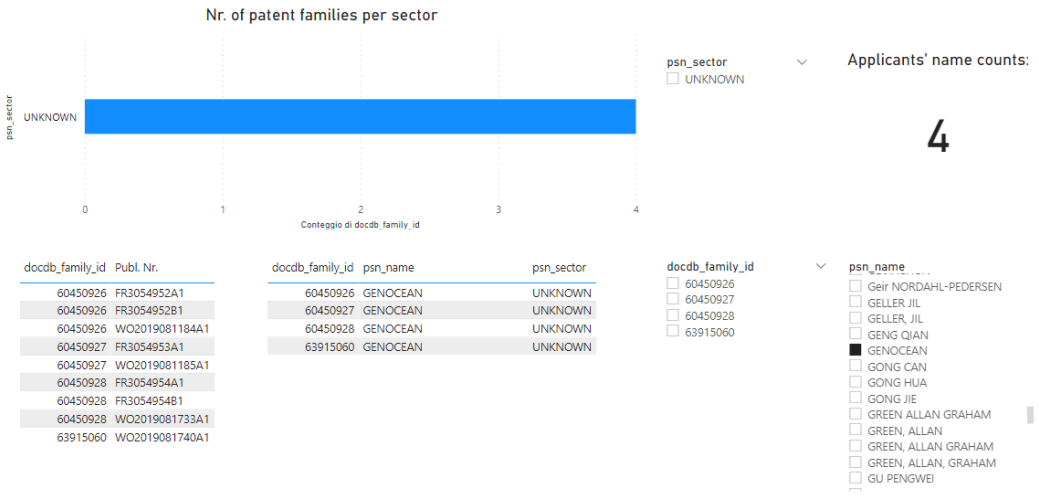
active in the field, while in the latter case one individual applicant can be selected. The rightmost pie diagram of Figure 15 provides valuable information regarding the protection strategies, confirming that the French/Spanish applicants take in due consideration the possibility of filing applications to the EPO or the WIPO.

Figure 15 Aquaculture: Legal protection strategy (specifically regarding French and Spanish applicants)



Further data about the granted patents/patent applications owned/filed by specific applicants may be drawn from a dedicated dashboard (the example of GENOCEAN is shown in Figure 16, where the publication numbers of the patent documents owned by that specific applicant may be easily identified).

Figure 16 Aquaculture: additional bibliographic data (specifically referring to the player GENOCEAN)



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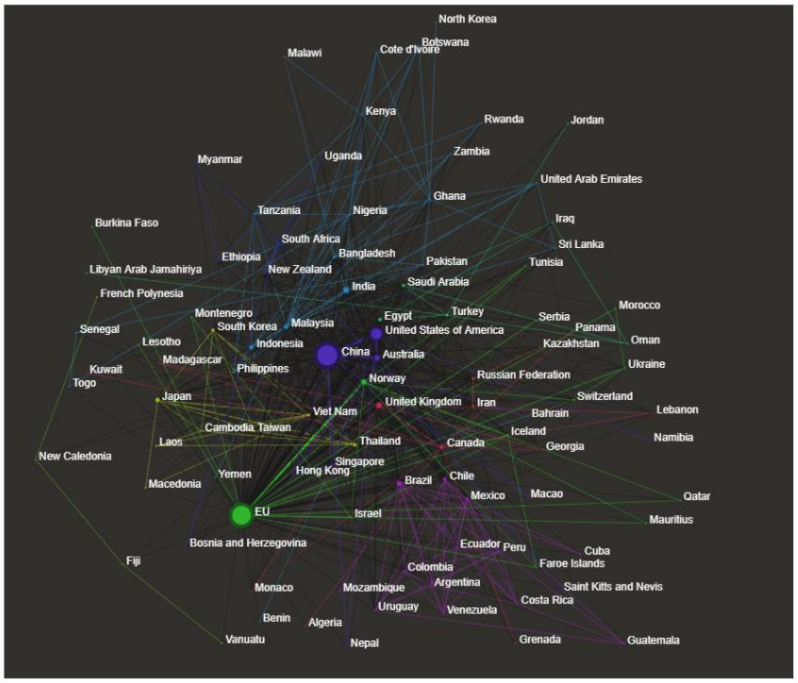
Despite following the analysis of the patent data a relevant impact on the commercialization of innovative technical solutions especially in territories such as the USA or China (Figure 13) may be usually argued, basic research activities, monitored by analyzing other divulgation modalities, such as the scientific publications, the books, the reviews,

the conference proceeding and the EU funded projects, appear ongoing worldwide, a relevant proportion being concentrated in the EU countries, China and United States of America as evident from **Errore. L'origine riferimento non è stata trovata.**.

Figure 17 Aquaculture: NPL data worldwide



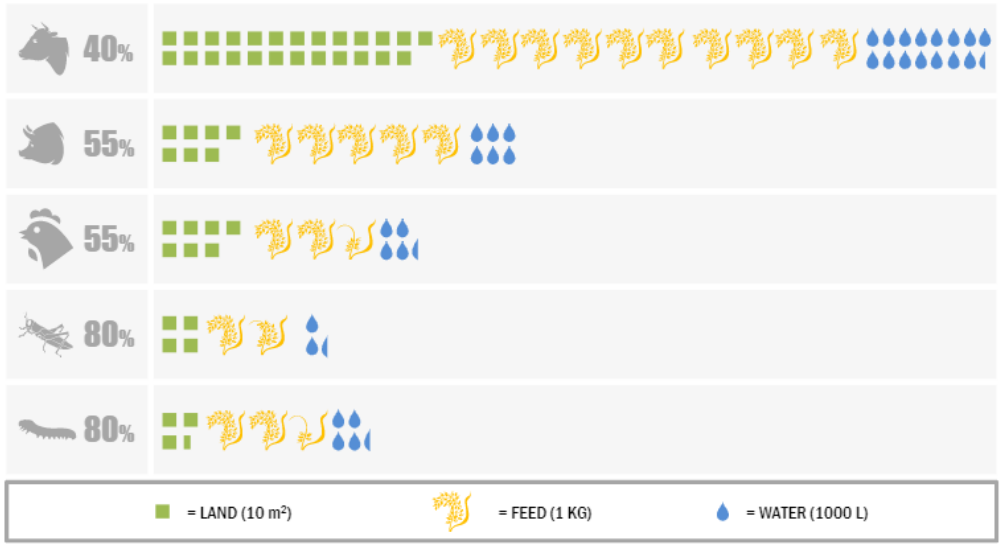
c) Fish meal

In the last decades, one of the main challenges in aquaculture is the production of **fish meal**. Marine fish farming requires feed to grow the animals and some of the species farmed are carnivores, thus they need fish-derived proteins in the feed; 25% of total fish production worldwide is transformed into feed for fish farms. This represents a major issue for aquaculture sustainability because wild fish stocks are overexploited and because farming carnivorous fish is ecologically inefficient. Since the transformation of proteins in the feed into body protein always imply a loss, in fact, the feeding farmed species with feeds containing wild caught fish derivates is ecologically unsustainable Therefore, an important sector regards the **fish feed** industry and their innovations including the increase of feed conversion ratio, the reduction of fish protein in the feed and the substitution with alternative protein sources. This implies looking for new formulations, including alternative mixtures of fish feed or other products aiming to reduce the content of fish derived proteins and lipids in the feed and to increase the alternative sources (e.g., insects, vegetables, discards from the meat industry).

Usually, aquafeed encompasses one or more artificial and/or natural feedstuffs in the form of pellets or extruded bits for aquatic animals. Overall, the **global aquafeed market** is expected worth USD 71 million by 2025, growing at CAGR of 7.2% from 2020 to 2025. The most common alternative ingredients used in the aquafeed industries are soybean, corn, fishmeal, fish oil and additives [5]. However, in recent years novel alternative sources of fish meal are explored due to the increasing demand of sustainable solutions for the growing industry of aquaculture products. The sustainability of aquaculture depends significantly on the nature and quality of the feed used, for such reason new sources such as insect proteins are increasingly gaining attention in the aquafeed industry.

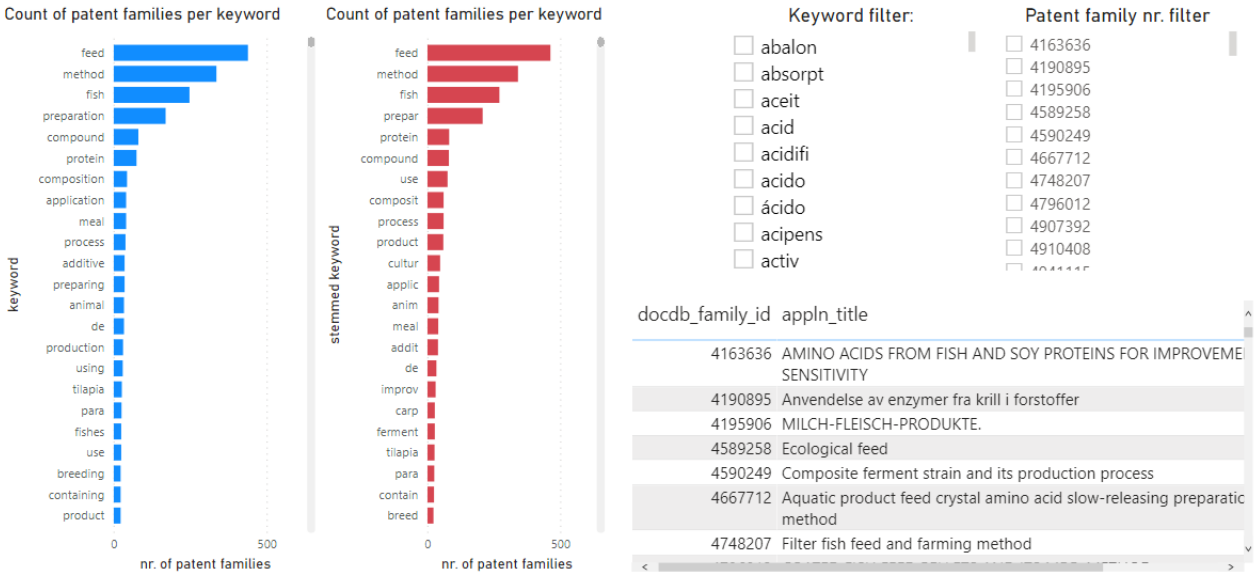
Insect meals could be a great replacement of traditional fishmeal, firstly insects are part of the natural diet of fishes, particularly in the juvenile stage. Moreover, insects are a great source of protein, amino acids, minerals, and vitamins. Furthermore, several insect species have a broad trophic spectrum and scavenger habit and thus their growth can be based on very simple and cheap substrates. Overall, the global market for insect meals in aquaculture in estimated at USD 44 million in 2019 and is projected to reach USD 380 million in 2025 with a CAGR of 43% in the forecasted period [6].

Figure 18 Environmental benefits of using insects for food and feed [5]



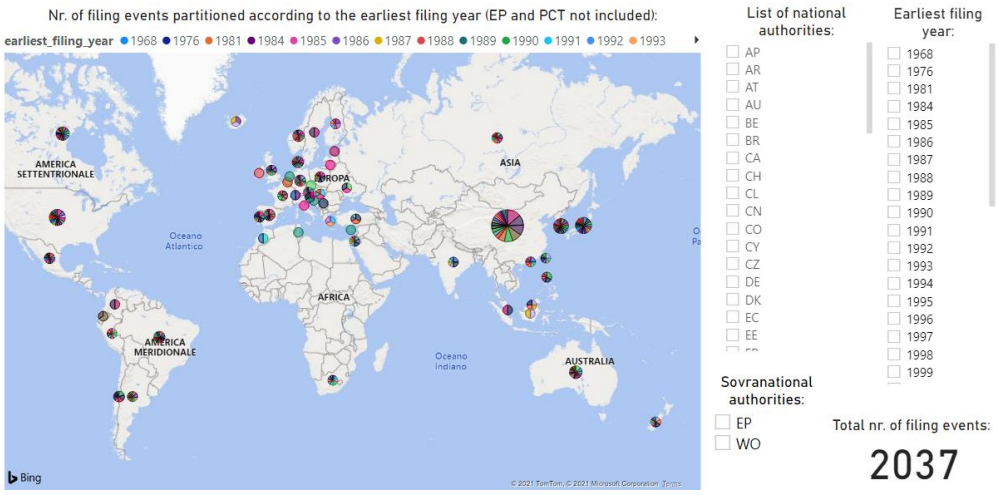
From the perspective of the patent analysis, a dataset consisting of analysis of **809 non-duplicated patent families** corresponding to **2037 patent applications** has been analyzed. No limitation is assumed concerning the applications' filing timeframe. The main topic regarding this sector may be argued considering the frequency of citations of specific keywords present in the patent titles' as shown in Figure 19.

Figure 19 Fish meal: keywords' frequency



As already observed and mentioned in "*Technology forecast and importance of SDGs in Blue Bioeconomy*", the analysis has been focused on the legal protection of technical innovation regarding the feeding of fishes. The patent authorities located in the Asian Pacific region, especially in China, score the highest numbers of filing events. Within the Mediterranean region, the Spanish patent authority registered the highest number of filing events during the last two decades, yet occasional filing events occurred in several countries bordering the Mediterranean Sea (Figure 20). Looking at the number of patent applications filed to the EPO (138) and WIPO (156), respectively, the data suggests that several inventors consider the possibility to protect their technical innovation in a multiplicity of territories by means of harmonized filing procedures.

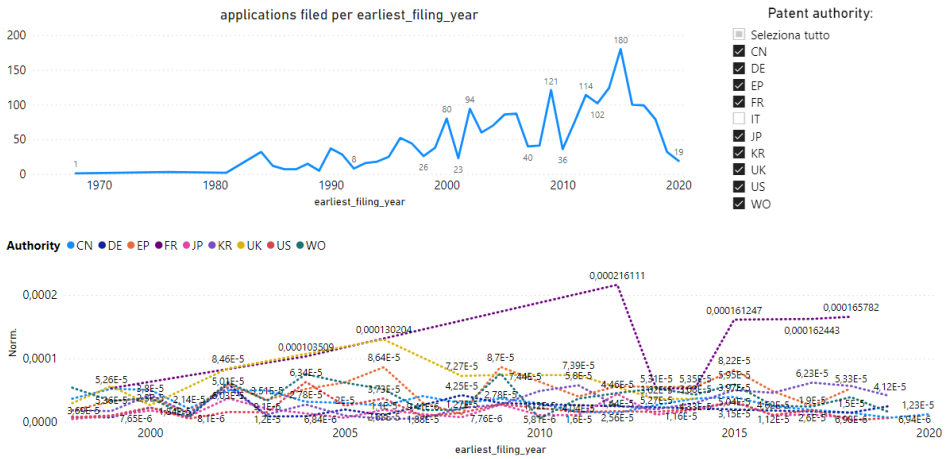
Figure 20 Fish meal: Map of national/supranational patent authorities



As can be noticed in Figure 20, the increase of the total number of patent applications seems consistent when analyzing the most recent years. The figure concerning the normalization of the data (Figure 21) shows that there is a

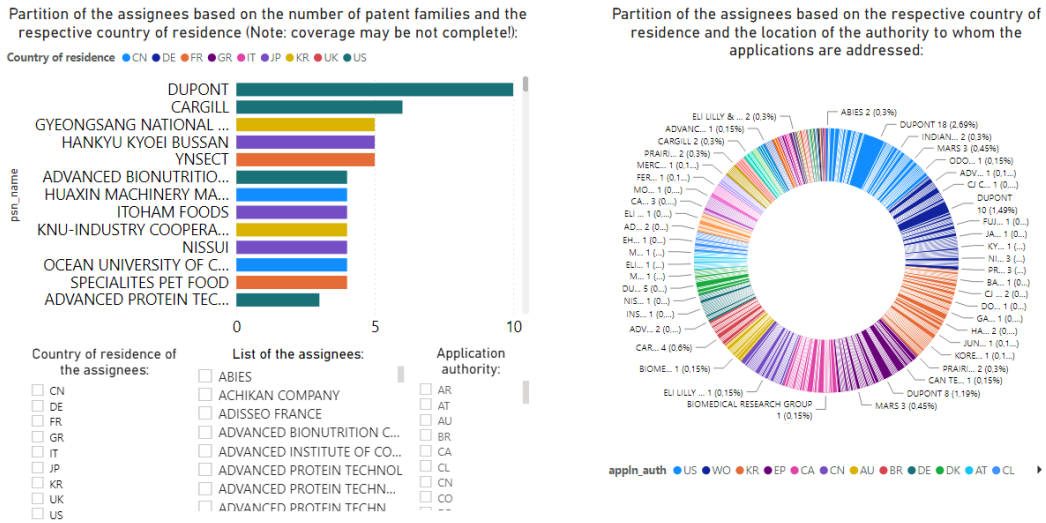
quite consistent relevance for the topic according to the pace of the patent applications filed to the French authority (including the PCT applications filed to such national authority), thus indicating that despite a higher absolute value of patent applications filed to the Asian patent authorities, there might be a growing interest worldwide in the coming years.

Figure 21 Fish meal: Normalization of patent applications



As far as the territorial distribution of the applicants' premises is concerned, several **applicants located in France may be identified** while few others may be retrieved in Greece and Italy, respectively. The rightmost pie diagram of Figure 22 provides valuable information regarding the protection strategies, confirming that the French applicants, and to minor extent the Greek and Italian applicants, take in due consideration the possibility of filing applications either to the EPO or to the WIPO.

Figure 22 Fish meal: Legal protection strategy



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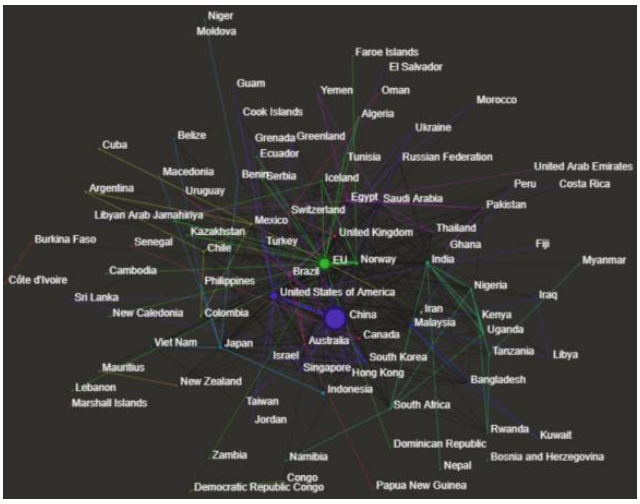
Despite following the analysis of the patent data a relevant impact on the commercialization of innovative technical solutions especially in territories such as the USA or China may be usually argued, basic research activities, monitored by analyzing other divulgation modalities, such as the scientific publications, the books, the reviews,

the conference proceedings and the EU funded projects appear ongoing worldwide, a relevant proportion being concentrated in China, as evident from Figure 23.

The contribution of USA and EU institutions is smaller, but the respective proportions appear substantially equivalent.

Figure 23 Fish meal: NPL data worldwide



d) Seafood processing and trade

The **processing of seafood** adds value to the production of fisherman and small fish farmers, diversifying the sources of income of coastal communities and reduces the seasonality mainly linked to the biological cycles of exploited resources (mainly wild but also farmed) fisheries. The seafood processing sector includes:

- The preparation and preservation of fish, crustacean and molluscs: freezing, deep-freezing, drying, smoking, salting, immersing in brine, canning, preserved in modified atmosphere, etc.;
- The production of fish, crustacean and mollusc products: cooked fish, fish fillets, roes, caviar, caviar substitutes, etc.;
- The production of processed fish dishes ready to cook or ready to eat;
- The production of fish meal for animal feed;
- The activities of vessels only engaged in the processing and preserving of fish.

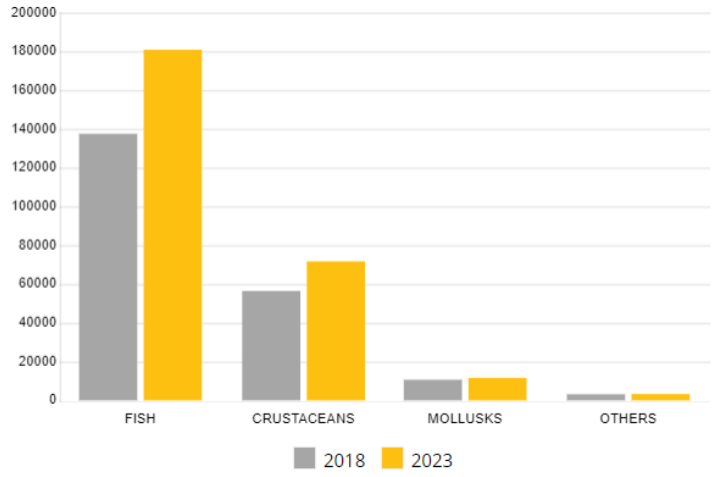
Several factors are currently driving the growth of this sector, such as the need to process, packaging and storage perishable commodities, the growing of the aquaculture industry, the rising demand for seafood products, the globalization process and the increase of trading, mechanization, and robot-driven operations [3]. Therefore, the seafood processing sector is being rapidly transformed into a high-volume industry.

As anticipated, **Seafood products** are perishable commodities, and their transportation and storage must be regulated. For this reason, the processing of seafood products industries relies on advanced technologies and materials that can face the challenges of the delicate handling of those products. The introduction of robotics and state-of-art automated equipment have increased product efficiency and consistency ensuring the production of high volume and better quality of the products. Moreover, manufacturers are providing more efficient food packaging solutions using new materials such as environmentally friendly paper boxes, polyethylene-terephthalate-laminated containers, super lightweight plastic film and sterilized cans to ensure a longer product shelf-life.

The **global processed seafood market** is expected to reach the total value of USD 267,231 million by 2023, at a CAGR of 5.2% in the period 2018 – 2023 [1].

Globally, Asia Pacific and Europe encompass a large part of the market where **Europe** is expected to reach the market value of USD 36,075 million by 2023. In the EU the seafood processing sector contributes positively to the blue economy adding around 45% of the Gross Value Added (GVA) and generating employment, particularly in the form of jobs for women.
Analysing the market by product type, **fish** are the main processed food produced, followed by **crustacean** and **molluscs** [3]. Those products are processed using different manufacturing methods. Specifically, the frozen seafood segment is dominating the market, followed by the dried seafood, smoked and canned segments [3]. As the EU demand for fish products greatly exceeds the supply that fish catching and aquaculture sectors can deliver, the international trade for processed fish products is increasing. Therefore, the processing industry is highly dependent on international developments including prices, exchange rates, trade agreements, tariffs, and geopolitical aspects.
In Italy, the fish processing industries included almost 800 companies and employed up to 6000 in 2015. A high concentration of industries is observed in Lombardy region. Looking at the processed species, tuna represents around 54% of the total turnover of the processing industries. Italy is thus confirmed as one of the most important markets in the world for the consumption of canned food [2].

Figure 24 Processes Seafood Market Size, by type, in the period 2016- 2023 valued in United States Dollar (USD). *Others include turtles and sea urchins.



The **trade** of fish and aquaculture products plays an integral role in boosting fish consumption and achieving a global market for aquaculture products, by connecting various international suppliers and manufacturers. According to the FAO, aquaculture trade exceeds about 40% of the total value of merchandise trade in Greenland, Iceland, or the Maldives in 2016. Globally, the trade of fish and fish products accounts for over 9% of total agricultural exports, and 1% of the world merchandise trade in value terms in the same year. The top exporter countries of fish and fish products in 2016 were China (total value of USD 20.1 million, with a share of 14.1%), Norway, Vietnam, Thailand and US. The main importers in the same year were US (total value of USD 20.5 million, share of 15.1%), Japan, China, Spain and France.

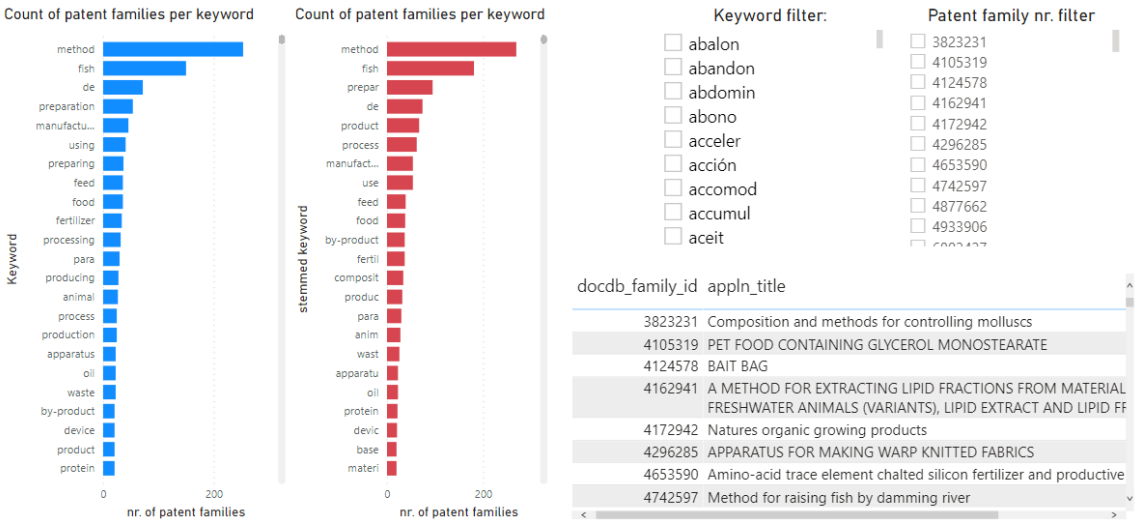
According to the FAO, **seafood** is among the most heavily traded food commodities. Developing countries are well established in the global seafood trade, with more than 54% of all fishery exports by value and more than 60% by quantity (in live weight equivalent) being generated by these countries. Seafood demand from China, the single largest

market for seafood, has grown substantially, and its influence on the global fish market has further led to trade intensification. China's per capita fish consumption is expected to grow to 47.2 kg (104.05 pounds) per year by 2022, at an annual rate of 6% to 8% between 1990 and 2022. Particularly due to this growth in aquaculture production, fish production in China has also kept pace with the growth in the country's consumption and income.

Aquaculture continues to increase its contribution to the world's seafood supply. This growth in the trade of seafood is further expected to boost the entry of several processed seafood manufacturers, to tap into a growing demand for aquaculture products among various developing countries [3].

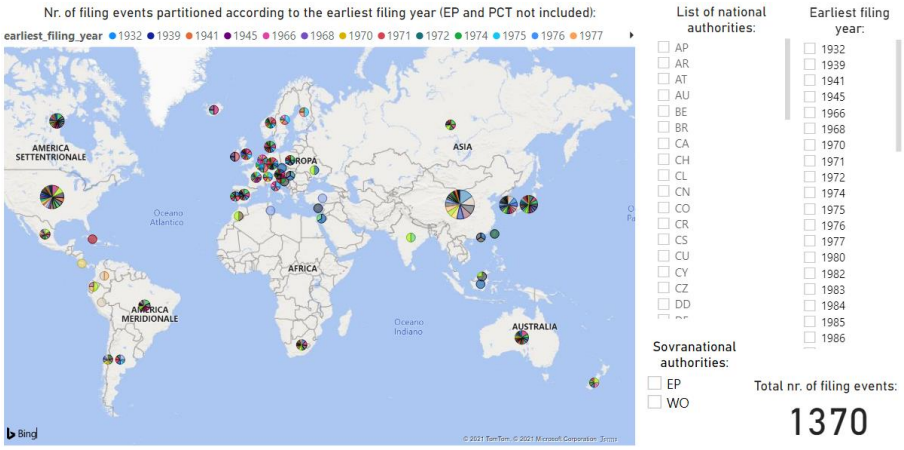
From the perspective of the patent analysis, a dataset consisting of analysis of **563 non-duplicated patent families** corresponding to **1370 patent applications** has been analyzed. No limitation is assumed concerning the applications' filing timeframe. The main topic regarding this sector may be argued considering the frequency of citations of specific keywords present in the patent titles' as shown in Figure 25.

Figure 25 Seafood processing and trade: keywords' frequency



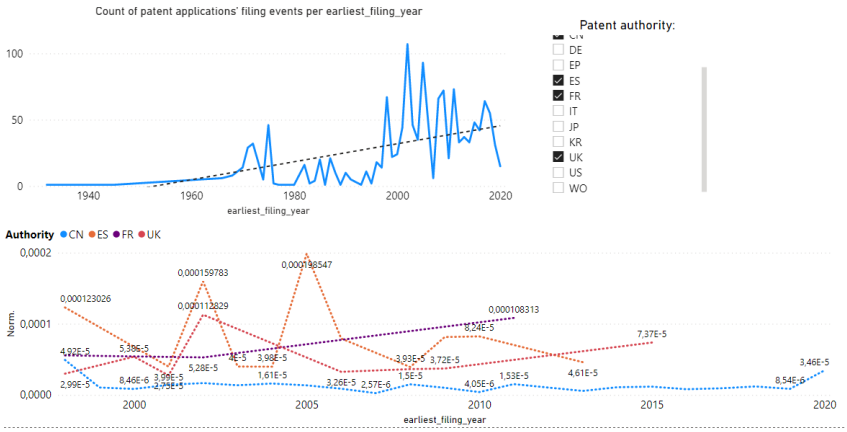
As already observed and mentioned in "*Technology forecast and importance of SDGs in Blue Bioeconomy*", the analysis has been focused on the legal protection of technical innovation regarding the preparation of seafoods mainly based on fish discards. The patent authorities located in the Asian Pacific region, especially in China, as well as the USPTO score the highest numbers of filing events (Figure 26). In the Mediterranean region, the Spanish patent authority registered the highest number of filing events during the last two decades, followed by Portugal and Slovenia. Looking at the number of patent applications registered by EPO (76) and WIPO (95), the data suggests that several inventors consider the possibility to protect their technical innovation in a multiplicity of territories by means of harmonized filing procedures.

Figure 26 Seafood processing: Map of national/supranational patent authorities



As can be noticed in the increase of the total number of patent applications seems remarkable after yr. 1960. The figure concerning the normalization of the data (Figure 27) shows that there is a quite consistent consideration for the topic of interest, at least according to the fraction of patent applications filed to certain national patent authorities (the normalized data regarding especially patent authorities located in European countries, such as Spain, France and UK). Even if the absolute number of patent applications filed to the CNIPA seems prevailing, the normalized values indicate that certain European countries deserved attention for the exploitation of the inventions dealing with the seafood processing. After the yr. 2015, the continuation of the filing events is essentially ascribed to the harmonized procedure involving the EPO or the WIPO, respectively.

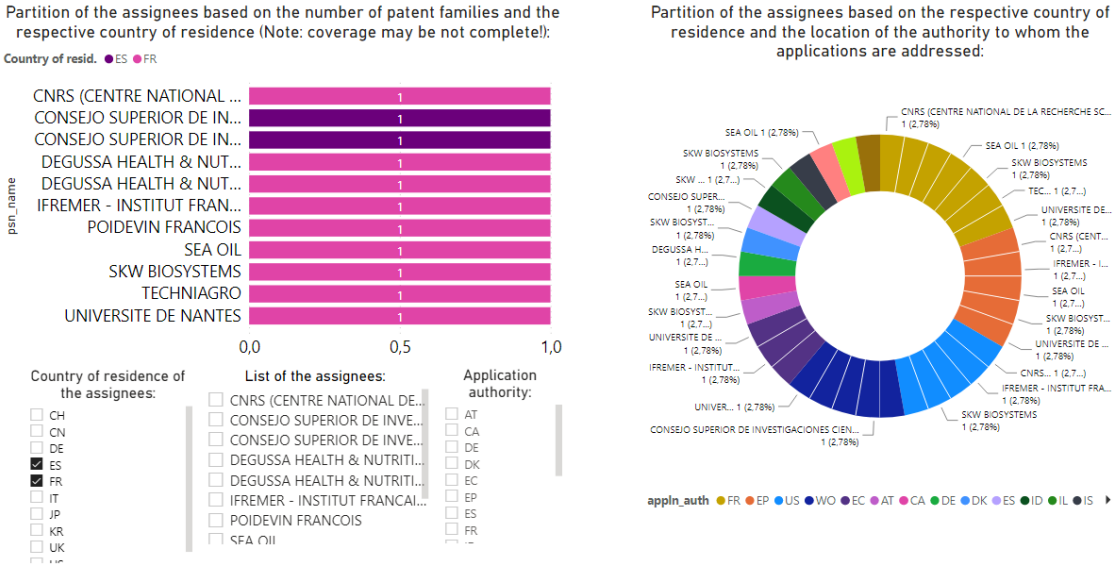
Figure 27 Seafood processing: Normalization of patent applications



As far as the territorial distribution of the applicants' premises is concerned, differently from the case of the fishery and similarly to the case of the aquaculture, few applicants located in France or Spain might be retrieved. In the former case, industrial and academic players may be identified, while in the latter case one academic institution may be detected. The rightmost pie diagram of Figure 28 provides valuable information regarding the protection strategies, confirming that the

French/Spanish applicants take in due consideration the possibility of filing applications either to the EPO or to the WIPO.

Figure 28 Seafood processing: Legal protection strategy (specifically concerning the residents of Spain and France)



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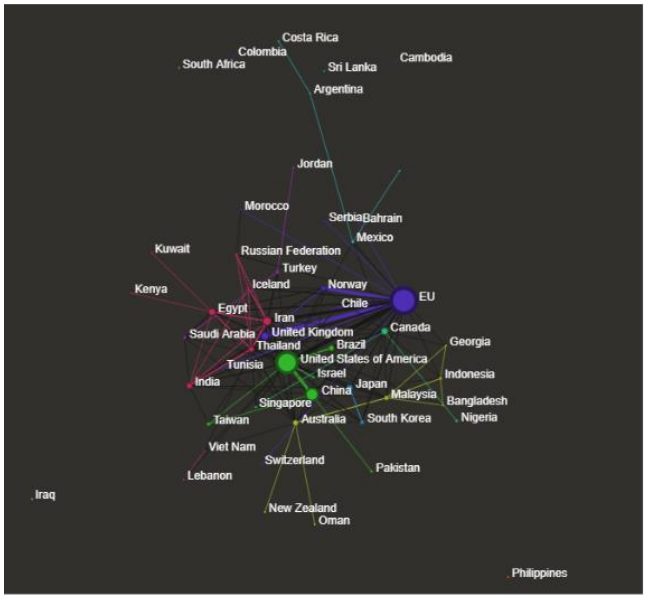
Despite following the analysis of the patent data a relevant impact on the commercialization of innovative technical solutions especially in territories such as the USA or China (Figure 26) may be usually argued, basic research activities, monitored by analyzing other divulgation modalities, such as the scientific publications, the books, the reviews, the conference proceedings and the EU funded projects, appear ongoing worldwide, a relevant proportion being concentrated in the EU countries, as evident from (Figure 29).

Figure 29 Seafood processing: NPL data worldwide



2 KEYPOINTS

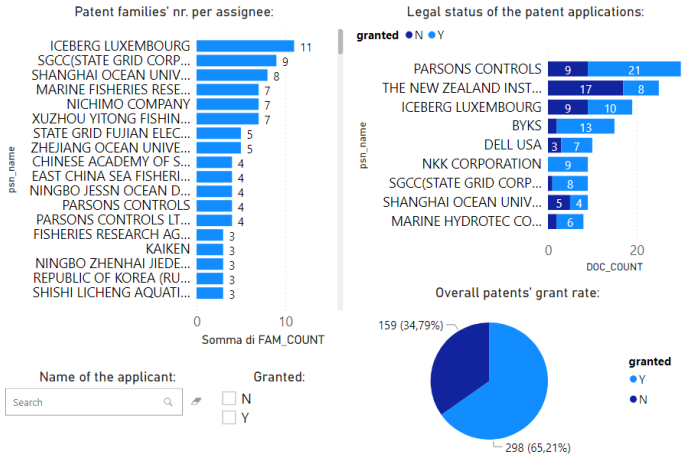
- The increment of the patent filing events is quite impressive when analyzing the trends of the most recent years, especially as far as the sectors “Fish meal” and “Seafood processing” are concerned.
- When focusing on overlapping timeframes referred to individual sub-sectors, it can be noticed that several initiatives related to basic research are concentrated within the EU, whereas the exploitation of the results demanded to the legal protection of the inventions seems quite uncertain in general, and not easily predictable, in particular as far as the countries bordering the Mediterranean Sea are concerned.
- Upon analyzing the situation of the countries bordering the Mediterranean Sea, it may be worth of consideration the trend of the patent applications’ numbers filed to the French and Spanish patent authorities, respectively, however such trends may appear discontinuous. Other European patent authorities, despite hosted in countries not bordering the Mediterranean Sea (for example Switzerland, Germany or the UK) receive a quite consistent number of patent applications, likely because worldwide notorious players, especially those relevant as far as the food sector is concerned, are headquartered in the European countries mentioned above.

3 FISHERY AND AQUACULTURE: THE LEGAL INFORMATION ARGUABLE FROM THE PATENTS’ DATASETS

a) Fishery: Pelagic and Demersal Large-Scale Fisheries (LSF) and Distant Water Fleet (DWF) and Small-scale Fisheries (SSF)

Although the number of the patent owners can be estimated on the order of one hundred, a selection of the top players is displayed in Figure 30. The top players may be ranked according to the respective amount of patent families owned (as shown in the leftmost bar diagram) or, alternatively, selected upon combining the patent applications to the granted patents for each ranked applicant (rightmost bar diagram). The pie diagram includes aggregated data useful to estimate the average grant rate which is slightly above 1/3.

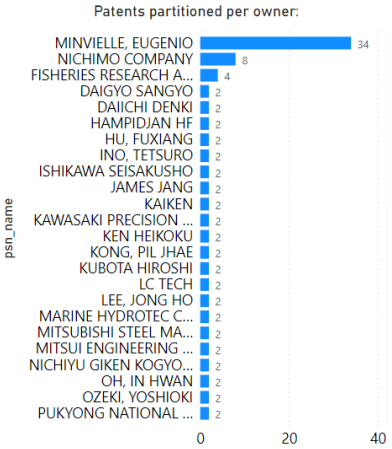
Figure 30 Fishery: Ranking of the applicants based on the patent application number and grant rate



Irrespectively from the ranking, there may be other players worth of consideration since the expected lifespan of the respective patents is still considerably long. The possibility of analyzing in detail the patent documents of a specific applicant has been already anticipated. A more synthetic indication reflecting the expected lifespan of the granted patents might be argued from the following Figure 31.

Figure 31 Fishery: Residual validity of granted patents (data from EP Register)

psn_name	Publication_Nr	EXPIRY_days	fee_renewal_year
FOREVER OCEANS CORPORATION	EP3255981	5110	5
MINVIELLE, EUGENIO	FR3004569	4431	3
LANKHORST EURONETE PORTUGAL	EP2781650	4411	7
THE NEW ZEALAND INSTITUTE FOR PLANT AND FOOD RESEARCH	EP2967018	4404	7
JAMES JANG	KR101414139	4211	5
JAMES JANG	KR20140030628	4211	5
RICARDO JANG	KR101414139	4211	5
RICARDO JANG	KR20140030628	4211	5
MINVIELLE, EUGENIO	US2013273222	4071	4
MINVIELLE, EUGENIO	US2013275318	4071	4
MINVIELLE, EUGENIO	US2013275477	4071	4
MINVIELLE, EUGENIO	US2013276644	4071	4

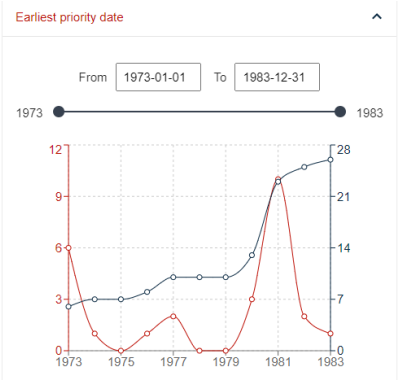


The degree of innovation of the technology claimed in the patent documents listed in the table may be evaluated considering the residual validity (i.e. the number of days left before the patent expires) and/or the information regarding the number of annual fees. Although it was found that PARSONS CONTROLS is the enterprise scoring the highest number of granted patents, a deeper analysis of this applicant performed upon consulting Espacenet[1] allows to argue that the technologies/products may be not much 'up-to-date', as arguable from Figure 32 revealing that the most recent

[1] EPO - Espacenet: patent database with over 120 million documents

applications have been filed prior to yr. 1983. Since the name of each applicant included in the dataset is known, this assessment can be easily reproduced to evaluate other applicants.

Figure 32 Fishery: Trend of the patent applications of PARSONS CONTROLS

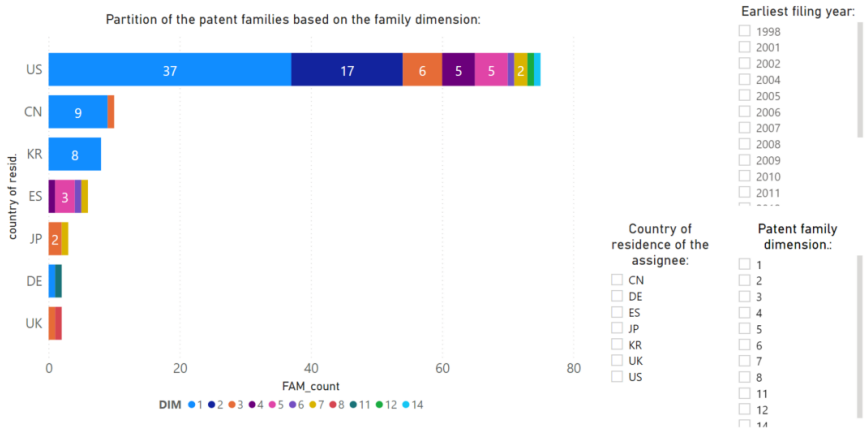


An additional tool useful for monitoring the commitment of a specific assignee/applicant is based on the assessment of the so-called triadic families. Such proxy is an indicator of the commitment of each player toward ensuring the protection of the invention in countries acknowledged as relevant markets by OECD, likely because the technical content is relevant. Even if the results may be affected by some 'contaminating' data (a possibility due to the downloading procedure permitted by Orbit Intelligence), three triadic families emerge, namely:

Publication number	Applicant/Assignee	Patent title
EP1592296A1	BYKS AS [NO]	SUBMERSIBLE NETPEN
EP1220605A1	JENSSEN INGE HENNING [NO]	EQUIPMENT FOR STORAGE AND TRANSPORT OF LIVING FISH
EP2967018A1	THE NEW ZEALAND INSTITUTE FOR PLANT AND FOOD RESEARCH LIMITED	APPARATUS AND METHOD FOR HARVESTING AQUATIC ANIMALS

Legal implications may also depend on the dimension of the patent families, which is another indicator of the commitment of a specific assignee/applicant toward ensuring the exclusivity of the Intellectual Property Rights (IPRs) in a multiplicity of countries. The diagram displayed in Figure 33 takes in consideration the applicants aggregated because of a common location of the respective premises (the country of residence). Although some relevant information may be missing, especially as far as some eastern countries are considered, quite often the patent families corresponding to patent applications filed to the CNIPA consist of one member only (cases of utility models are not included in the analysis), being equivalent patent applications seldom filed to foreigner patent authorities. On the other hand, the patent families of the applicants located in Western countries include several members corresponding to applications filed to a multiplicity of patent authorities and this option is particularly evident as far as the US applicants are concerned.

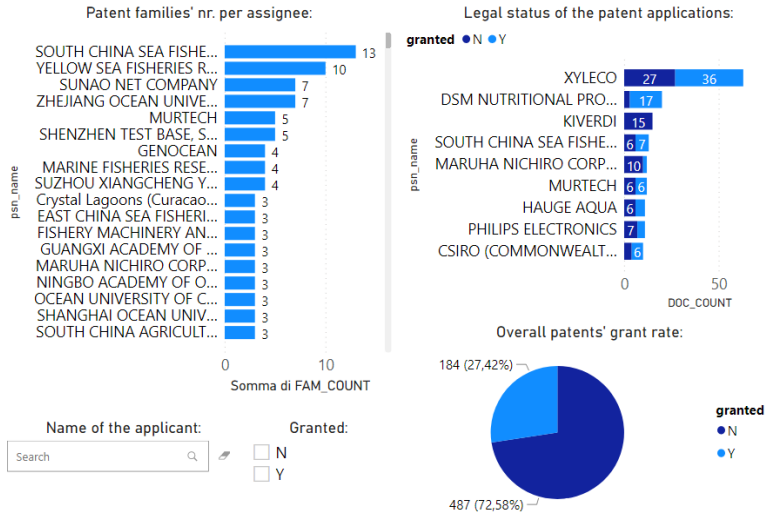
Figure 33 Fishery: Ranking of the country of residence of the players based on the patent family dimension



b) Aquaculture: Marine Finfish aquaculture (MFA) and Shellfish aquaculture (SA)

Like in the case of the preceding topic (fisheries) also in this case the number of the patent owners can be estimated on the order of few hundreds, a selection of the top players being displayed in Figure 34.

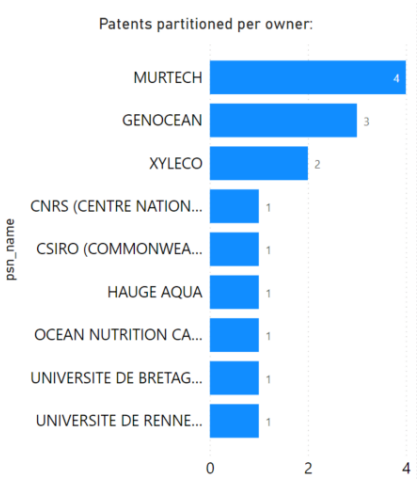
Figure 34 Aquaculture: Ranking of the applicants based on the patent application number and grant rate



Being the average grant rate slightly lower than 1/3, a synthetic indication reflecting the expected lifespan of the granted patents might be argued from the following Figure 35. As can be argued from the residual validity, the French player GENOCEAN has recently filed several patent applications all referring to breeding devices to be used in aquaculture applications (**FR3054952**, FR3054953, **FR3054954**) followed by the decision to grant the patent in two of the three cases. Another recently filed patent application (**EP3285570A1**: FLOATING AND SUBMERSIBLE CLOSED-CONTAINED FISH REARING TANK, AND METHOD OF REARING FISH) followed by the decision to grant the patent concerns a closed-contained floating, and submersible system for farming and storage of finfish and other aquatic species.

Figure 35 Aquaculture: Residual validity of granted patents (data from EP Register)

psn_name	Publication_Nr	EXPIRY_days	fee_renewal_year
GENOCEAN	FR3054952	6221	3
GENOCEAN	FR3054953	6221	3
GENOCEAN	FR3054954	6221	3
HAUGE AQUA	EP3285570	5414	4
CNRS (CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE)	FR3005963	4604	6
UNIVERSITE DE BRETAGNE OCCIDENTALE	FR3005963	4604	6
UNIVERSITE DE RENNES 1	FR3005963	4604	6
MURTECH	US2014008306	4281	4
MURTECH	US2014158624	4281	4
MURTECH	US8778176	4281	4
MURTECH	US8784653	4281	4
XYLECO	EP2276795	2754	11
XYLECO	EP2963060	2754	11



Some results of the assessment of the triadic families are shown in

Figure 36.

Figure 36 Aquaculture: the Triadic families

PUB	psn_name	person_ctry_code
EP3017069	CNRS (CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE)	FR
EP2447356	DSM NUTRITIONAL PRODUCTS	CH
EP2468847	DSM NUTRITIONAL PRODUCTS	CH
EP3238543	DSM NUTRITIONAL PRODUCTS	CH
EP3467096	DSM NUTRITIONAL PRODUCTS	CH
EP3285570	HAUGE AQUA	NO
EP1899453	OCEAN NUTRITION CANADA	CA
EP3160661	PHILIPS ELECTRONICS	NL
EP3017069	UNIVERSITE DE BRETAGNE OCCIDENTALE	FR
EP3017069	UNIVERSITE DE RENNES 1	FR
EP3370745	WISCONSIN ALUMNI RESEARCH FOUNDATION	US

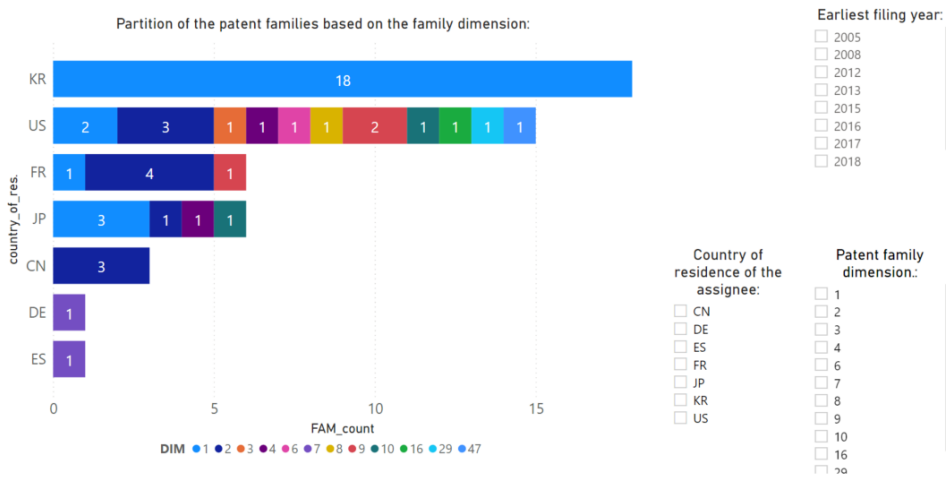
Documents worth of consideration may include the CNRS patent (EP3017069) claiming that the use of probiotics from healthy wild animals is part of a natural bio-protection strategy for aquaculture species. Unmet needs involve also the culture of eukaryotic microorganisms, aimed at increasing the production of fatty acids such as DHA and anti-oxidants, beneficial for the human health (pls. refer to DSM NUTRITIONAL PRODUCTS). The aim is that of integrating, or even, replacing the traditional marine resources mostly depending on the fish proliferation. A similar goal has been already highlighted as in the case of the invention claimed by XYLECO Inc. (EP2276795A2).

On the other hand, the need may be that of developing technologies for controlling and limiting the growth of marine organisms with the aim of preventing the biofouling (EP3160661 PHILIPS). The establishment of exclusive rights based on such products/technologies should be expected in the coming years.

Legal implications may also depend on the dimension of the patent families, which is another indicator of the commitment of a specific assignee/applicant toward ensuring the exclusivity of the IPRs in a multiplicity of countries. As far as the specific topic (aquaculture) is concerned, once again the trend observed in the case of the fishery is replicated

by the applicants with premises located in the Eastern countries, in particular the presence of patent families essentially implying exclusive rights confined within the national boundaries. The legal protection of the US applicants appears relying on totally different perspectives, as evident from Figure 37.

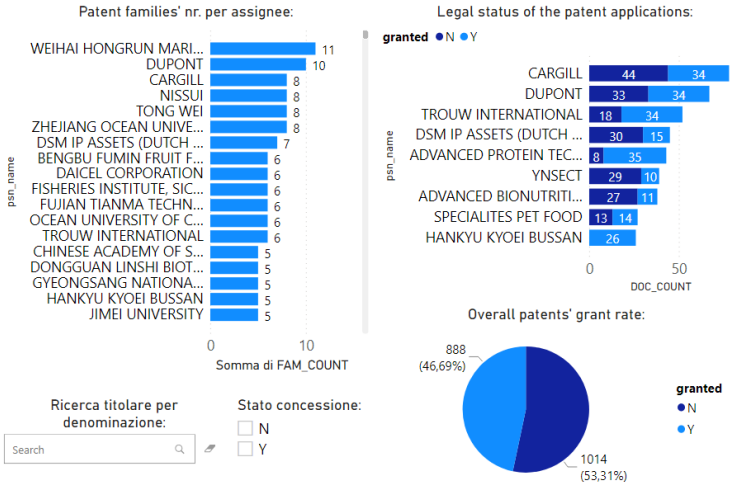
Figure 37 Aquaculture: Ranking of the country of residence of the players based on the patent family dimension



c) Fish meal

Like in the case of the preceding topics (fisheries and aquaculture, respectively) also in this case the number of the patent owners can be estimated on the order of few hundreds, a selection of the top players being displayed in Figure 38.

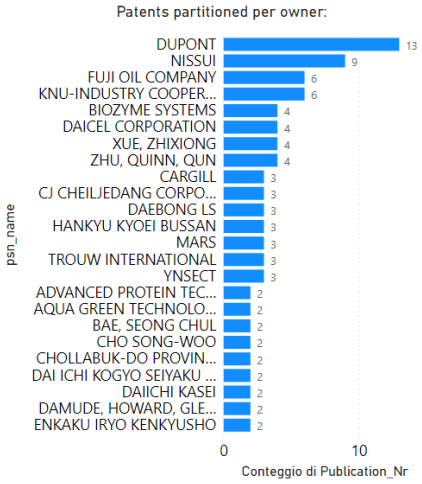
Figure 38 Fish meal: Ranking of the applicants based on the patent application number and grant rate



Considering the overall patents' grant rate, it can be noticed that in the case of the "fish meal" sector as well as in the subsequent "seafood processing", **the decision to grant the patent concerns almost half of the patent documents analyzed**. As can be argued from the residual validity (Figure 39), a couple French players (**YNSECT** and **FERMENTALG**) have recently filed several patent applications referring to substances helpful to reinforce the fish skeleton, or to vitamins to be used in aquaculture applications (**FR3087092**, **FR3042387**) or to the use of microalgae for animal feed production **(FR3038913)**, each followed by the decision to grant the patent.

Figure 39 Fish meal: Residual validity of granted patents (data from EP Register)

psn_name	Publication_Nr	fee_renewal_year	EXPIRY_days
YNSECT	FR3087092	3	6332
CALLEJA PIERRE	FR3065862	4	5806
YNSECT	FR3042387	6	5244
ADISSEO FRANCE	FR3038913	6	5149
FERMENTALG	FR3038913	6	5149
FIXED PHAGE	EP3285787	5	5061
YNSECT	EP3240905	6	4951
JEJU NATIONAL UNIVERSITY INDUSTRY-ACADEMIC COOPERATION FOUNDATION	KR101465233	6	4733
REPIATEC COMPANY	KR101465233	6	4733
DUPONT NUTRITION BIOSCIENCES (DANISCO)	EP3099793	6	4617
CJ CHEILJEDANG CORPORATION	KR101517326	6	4614
JUNWON GBI COMPANY	KR101604223	4	4561



The results of the assessment of the triadic families are shown in Figure 40.

Figure 40 Fish meal: some of the Triadic families

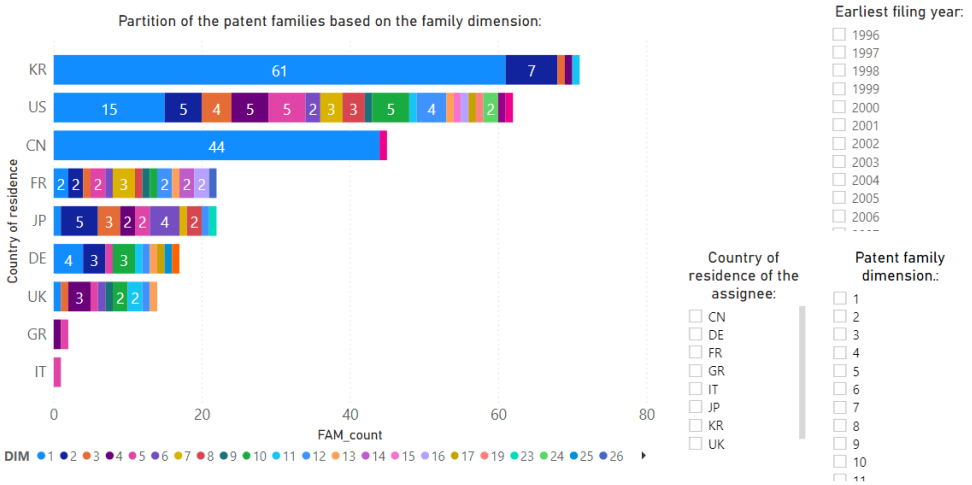
psn_name	person_ctry_code	PUB	Conteggio di Famiglie
ADVANCED BIONUTRITION CORPORATION	US	EP2117354	1
ADVANCED BIONUTRITION CORPORATION	US	EP3383999	1
ADVANCED PROTEIN TECHNOLOGIES	US	EP0848911	1
ADVANCED PROTEIN TECHNOLOGIES	US	EP1019433	1
APOTHEKERNES LABORATORIUM	NO	EP0412125	1
BIOMEDICAL RESEARCH GROUP	JP	EP1676908	1
BIOMEDICAL RESEARCH GROUP	JP	EP2444480	1
CJ CHEILJEDANG CORPORATION	KR	EP3101136	1
DEINOVE	FR	EP2793607	1
DIVERSA CORPORATION	US	EP1180152	1
DSM IP ASSETS (DUTCH STATE MINES IP ASSETS)	NL	EP1474388	1
DSM IP ASSETS (DUTCH STATE MINES IP ASSETS)	NL	EP3229604	1
DUPONT	US	EP1320579	1
DUPONT	US	EP1807525	1
DUPONT	US	EP1807526	1
DUPONT	US	EP1807527	1
DUPONT	US	EP1809756	1

There may be several patent documents worth of consideration in the list above. For example, patents owned by the ADVANCED BIONUTRITION CORP. (such as the EP2117354) claim the production of food encompassing any consumable matter of either plant or animal origin or of synthetic sources that contain a body of nutrients such as a carbohydrate, protein, fat vitamin, mineral, etc. The product is intended for the consumption by humans or by animals, in the latter case including fish (for example salmon) and crustaceans (for example shrimp). Unmet needs may concern not only the feeding but also the oral administration of medicaments, such as in the case of the EP0412125 patent owned by the Norwegian company APOTHEKERNES LABORATORIUM (now ALPHARMA Inc.). When considering the patent triadic families regarding the fish feeding products, another representative European company is NUTRECO. In Nutreco patent EP1981352 it is mentioned that the aquaculture industry and especially the fish feed industry have predicted for several years that there will be a shortage of both fish meal and fish oil in the future. Therefore, other animal protein sources are also used for dry fish feed. Thus, **it is known the use of blood meal, bone meal, feather meal and other types of meal produced from other slaughterhouse waste, for example chicken meal**. These are typically cheaper than fish meal and fish oil. **However, in some geographic regions, such as Europe, there has been a prohibition against using such raw materials in**

the production of feeds for food-producing animals and fish. It is also known to use vegetable protein such as wheat gluten, maize (corn) gluten, soya protein, lupin meal, pea meal, bean meal, rape meal, sunflower meal and rice flour. Considering the issues mentioned above, **the production of fish feed which leads to good (high) SGR[2] and good (low) biological and/or economic FCR[3] is considered as a priority**.

Legal implications may also depend on the dimension of the patent families, which is another indicator of the commitment of a specific assignee/applicant toward ensuring the exclusivity of the IPRs in a multiplicity of countries. As far as the specific topic (fish meal) is concerned, once again the trend already observed in the case of the fishery and aquaculture sectors is replicated by the applicants with premises located in the Eastern countries, in particular the presence of patent families essentially implying exclusive rights confined within the national boundaries. The legal protection of the US and several European applicants appears relying on totally different perspectives, as evident from Figure 41.

Figure 41 Fish meal: Ranking of the country of residence of the players based on the patent family dimension

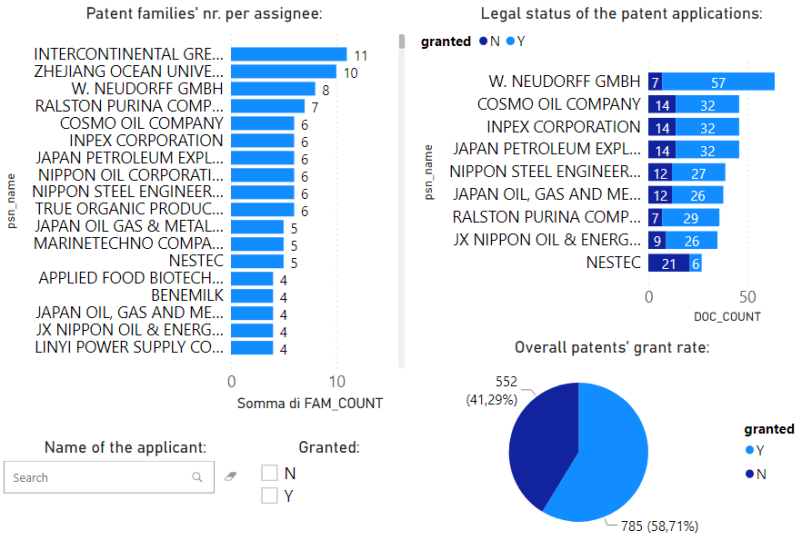


d) Seafood processing and trade

Like in the case of the preceding topics (fisheries and aquaculture), also in this dataset the number of the patent owners can be estimated on the order of few hundreds, a selection of the top players being displayed in Figure 42.

[2] SGR = Specific Growth Rate
[3] FCR = Feed Conversion Ratio

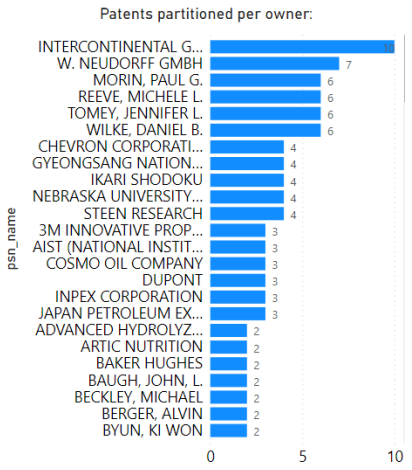
Figure 42 Seafood processing: Ranking of the applicants based on the patent application number and grant rate



Being the average grant rate slightly higher than 1/3, a synthetic indication reflecting the expected lifespan of the granted patents might be argued from the following Figure 43. Differently from the equivalent indicator regarding the fishery and the aquaculture, in the case of the nutrients extracted as fish derivatives the number of granted patents (552) is significantly higher. Therefore, the evaluation of the expected lifespan implies the assessment of many results. There may be opposite situations regarding the residual patent validity, as shown in Figure 43 and in Figure 44, respectively. In one case there may be innovative technologies or products legally protected.

Figure 43 Seafood processiong: Residual validity of granted patents (data from EP Register)

psn_name	Publication_Nr	EXPIRY_days	fee_renewal_year
UNIVERSITY OF LATVIA	EP3098302	5292	6
WANG, YOUNG SONG	KR101575549	5140	5
HWANG, JAE HO	KR101341721	4630	7
EMPIRE TECHNOLOGY DEVELOPMENT	EP3013367	4596	6
HWANG, JAE HO	KR101341704	4539	7
KIM, KI CHUL	KR101562294	4538	5
KIM, KI CHUL	KR20140130585	4538	5
KIM, YOUNG YUK	KR101562294	4538	5
KIM, YOUNG YUK	KR20140130585	4538	5
GUETARI, SAMI	EP2950667	4446	7
HILL'S PET NUTRITION	EP2931061	4400	8
MILAE RESOURCES ML. COMPANY	KR101493466	4393	6
MILAE RESOURCES ML. COMPANY	KR20140074082	4393	6



There are many cases where the technologies/products claimed may be obsolete, as in case of “Expiry days” defined by means of negative numbers, referring to several IPR titles already expired since relatively long time (Figure 44).

Figure 44 Seafood processing: Residual validity of granted patents expressed by means of negative numbers (referring to patents already expired)

psn_name	Publication_Nr	EXPIRY_days	fee_renewal_year
MEINKE; WILMON W.	US4361586	-7320	12
AGRICULTURE	US4921696	-6822	12
THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF	US4921696	-6822	12
THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF	US5177107	-6822	12
HER MAJESTY THE QUEEN IN RIGHT OF CANADA, AS REPRESENTED BY THE PROVINCE	US4563832	-6495	8
ADVANCED HYDROLYZING SYSTEMS	US5053234	-6055	12
ADVANCED HYDROLYZING SYSTEMS	US5113755	-6055	8

Having already alerted about the possibility of some 'noisy' information that can be filtered out directly from the MS Power BI dashboard, the results of the assessment of the triadic families are shown in Figure 45.

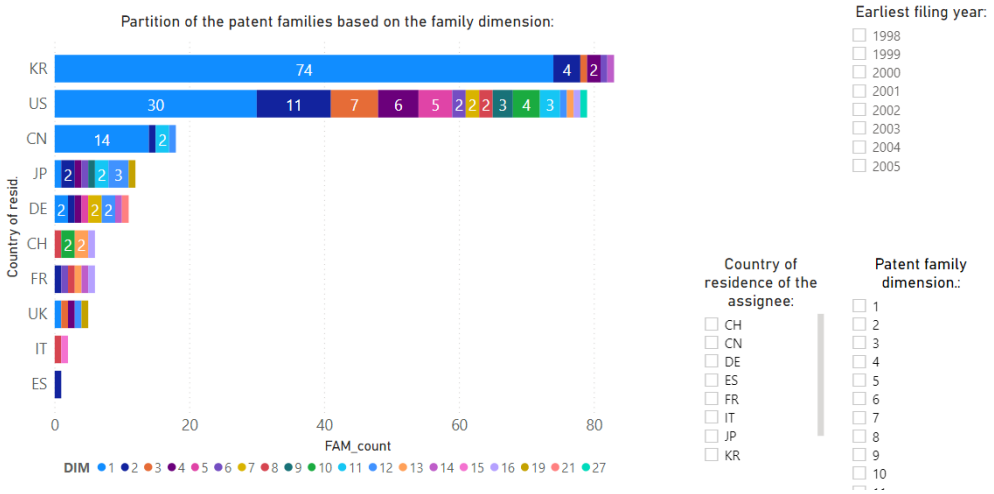
Figure 45 Seafood processing: some of the Triadic families

psn_name	person_ctry_code	PUB
3M INNOVATIVE PROPERTIES COMPANY (MINNESOTA MINING AND MANUFACTURING INNOVATIVE PROPERTIES COMPANY)	US	EP1648225
ADVANCED HYDROLYZING SYSTEMS	US	EP0535135
APPLIED FOOD BIOTECHNOLOGY	US	EP2983507
DUPONT	US	EP0282170
GAS TECHNOLOGY INSTITUTE	US	EP2699642
GAS TECHNOLOGY INSTITUTE	US	EP3190165
INNOSPEC	GB	EP2389065
LIGNOTECH USA	US	EP2124618
MORINDA	US	EP1505996
NEBRASKA UNIVERSITY - LINCOLN	US	EP0283969
NESTEC	CH	EP2156744
NESTEC	CH	EP2312954
NESTLE	CH	EP1329163
NESTLE	CH	EP1469748

Documents worth of consideration may include the EP0535135A1, claiming about the possibility of producing a particulate proteinaceous product and methods for producing the same from waste raw animal parts, as well as the EP0282170A2, concerning a nutrient for feeding shrimps, the nutrient being based on fish meal, powdered fish, crab or other crustaceans. Likewise, the production of feeding for animals is claimed in the EP0283969A2. Several patent documents describe and claim procedures for extracting long-chain fatty acids from fish by-products (e.g. EP2156744A1, EP2312954) for food stuff, nutritional supplement, cosmetic or pharmaceutical composition.

Legal implications may also depend on the dimension of the patent families, which is another indicator of the commitment of a specific assignee/applicant toward ensuring the exclusivity of the IPRs in a multiplicity of countries.

Figure 46 Seafood processing: Ranking of the country of residence of the players based on the patent family dimension



As can be noticed in Figure 46, differently from the case of implementations specifically dealing with the fishery and the aquaculture sectors, as far as the seafood processing is concerned there is an almost equally relevant number of patent families corresponding to US residents and to Korean applicants, respectively. The main difference concerns the strategy on which the legal protection relies because, as often noticeable in the case of applicants of Eastern countries, the attitude toward legal protection outside the national South Korean boundaries remains scarce. To the contrary, for the US applicants it may be considered crucial protecting the inventions either in the USA or abroad. A similar trend is reflected by the attitude of several European applicants, although the number of patent families owned by the European players is usually modest.

3 KEYPOINTS

- Despite the number of applicants appears comparable in each subsector of the Fishery & Aquaculture field, the dimension of the patents' datasets concerning the fish meal products and the seafood processing are significantly larger than the dimension of each of the other two datasets (fishery and aquaculture, respectively). It can be argued that for the time being the legal protection of innovative elements concerning both the fish meal administration and the seafood processing is considered strategically relevant for potentially increasing efficiency of transformation, reduction of costs, reduction of ecological costs and thus increasing sustainability fo fish farming.
- For each sub-sector analyzed it can be noticed that the number of patent applications filed to the CNIPA is higher than the number of patent applications filed to any other authority, either national or supranational. Nonetheless, the attitude toward extending the legal protection outside the national boundaries is usually scarce in the case of applicants headquartered or resident in Eastern countries. Instead, the legal protection strategy adopted by players located in Western countries is aimed at establishing an IPRs exclusivity in a multiplicity of countries, thus implying a consistent economic effort for maintaining the exclusive rights alive in a quite large market. As consequence the commitment of the players appears significant, thus suggesting that the know-how implemented in the Western countries might positively affect the competitiveness of such region.
- In general, when the number of patent families owned by applicants located in countries bordering the Mediterranean Sea (mainly northern shores) is evaluated, the commitment of such players toward the legal protection appears scarce. However, at least in the case of the fish meal and seafood processing sub-sectors, there may be European corporates (headquartered in the Northern Europe in several cases) that base their

profit on the transformation of the fish by-products into edible matter, while - on the other hand – the elaboration of the fish by-products for farming applications, for example with the purpose of preventing or limiting the pest proliferation, may deserve attention as well.

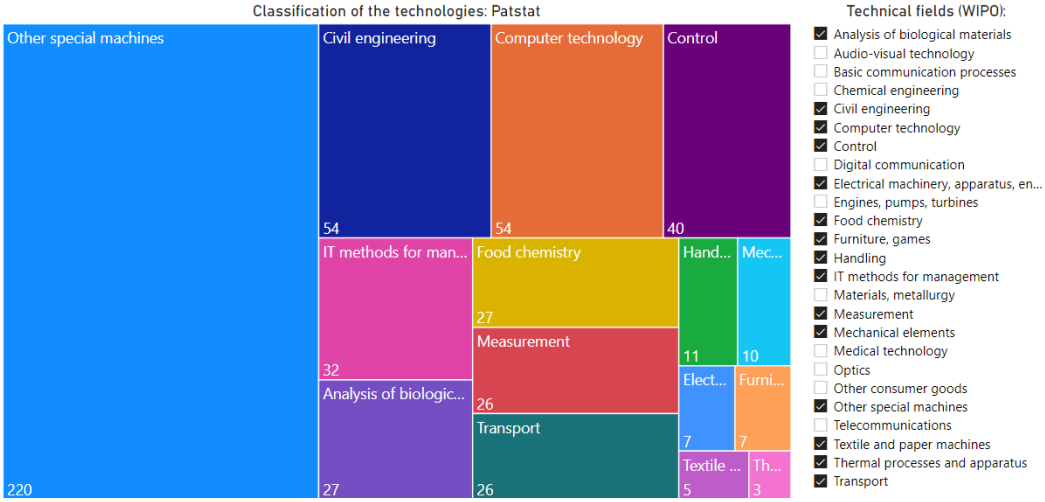
- As far as the fish feeding products are concerned, in Europe and therefore also in the countries bordering the Mediterranean Sea awareness **of the prohibition[4] of the use of blood meal, bone meal, feather meal and other types of meal produced from other slaughterhouse waste, for example chicken meal in the production of feeds for food-producing animals and fish** seems an important incentive for conceiving fish meals based on the availability of alternative sources, usually vegetable based products. This might also answer to a request of market for more sustainable products also from aquaculture and thus the pressure for producing feeds less dependent on fish-products and potentially more ecologically efficient.

4 FISHERY AND AQUACULTURE: THE TECHNICAL INFORMATION

a) Fishery: Pelagic and Demersal Large-Scale Fisheries (LSF) and Distant Water Fleet (DWF) and Small-scale Fisheries (SSF)

The simplest scheme allowing to visualize the distribution of the technical fields among the patent families is shown in Figure 47.

Figure 47 Fisheries: Map of the technology fields defined by WIPO

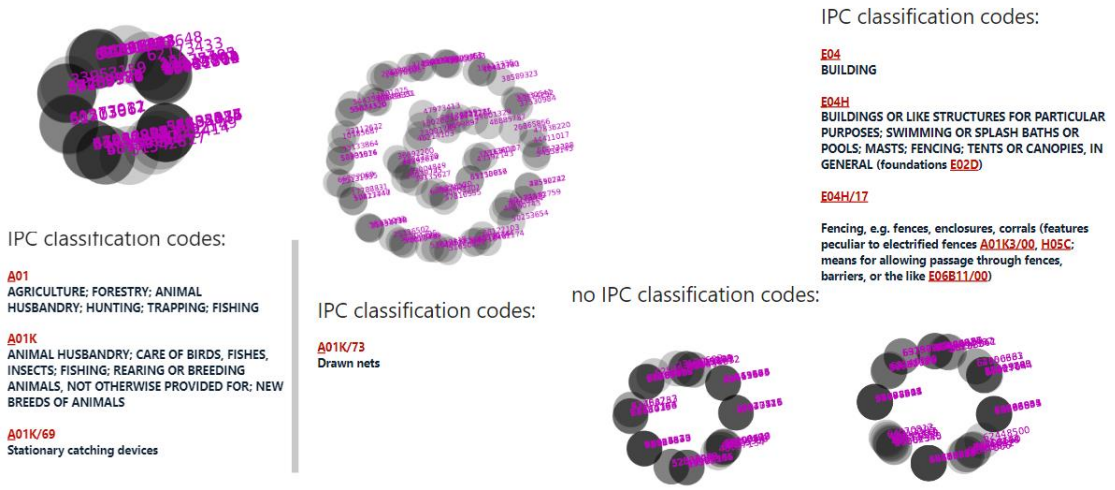


The clustering of the patent documents according to patterns defined by one or more technical fields does not produce a meaningful information because the definition encompassing the "other special machines" is not contradictory but quite generical, in other words it is not possible to identify technologies specifically dealing with the sub-sector. However, the clustering of the same documents may be based on the classification codes, either IPC or CPC. The following figures (Figure 48 and

Figure 49, respectively) are dealing with patterns of IPC/CPC classification codes:

[4] **EP1981352A1**

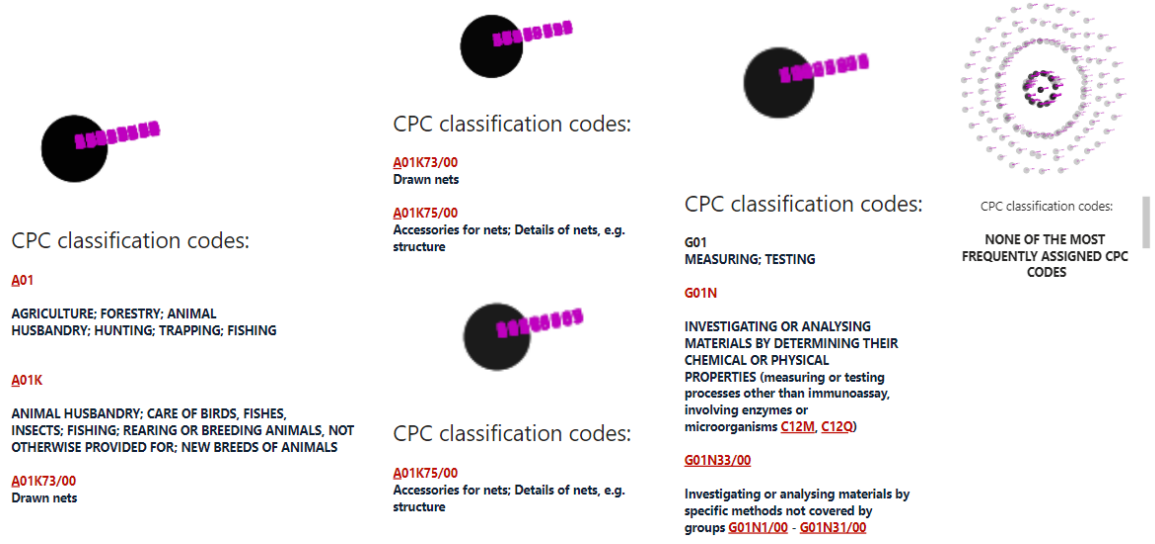
Figure 48 Fisheries: clustering of the patent families based on the identification of patterns of IPC classification codes



Excluding the documents not identifiable by means of IPC classification codes, the majority may be included in patterns characterized by just one IPC code, namely:
A01K/69, referring to **Stationary catching devices.**
A01K/73, referring to **Drawn nets.**
E04H/17, referring to **Fencing, e.g. fences, enclosures, corrals**

Likewise, if excluding the documents not identifiable by means of the CPC classification, meaningful CPC classification codes include:
A01K73/00, referring to **Drawn nets.**
A01K75/00, referring to **Accessories for nets; Details of nets, e.g. structure.**

Figure 49 Fisheries: clustering of the patent families based on the identification of patterns of CPC classification codes



The co-occurrence of two IPC or CPC classification codes identifying single patent families may be not meaningful considering that the dataset includes 357 non duplicated patent families whereas, as shown in Figure 50s', the co-occurrence of two classification codes involves at most 14 patent families (IPC) and 13 patent families (CPC) respectively. Codes such as G09B19 (Teaching not covered by other main groups of this subclass), G06F17 (Digital computing or data processing equipment or methods, specially adapted for specific functions), A23P10 (Shaping or working of foodstuffs characterised by the products) and Y02A90/10 (Information and communication technologies [ICT] supporting adaptation to climate change, e.g. for weather forecasting or climate simulation) appear scarcely representative of the fishery subsector.

Figure 50 Fisheries: Co-occurrence of IPC classification codes (leftmost table) and CPC classification codes (rightmost table)

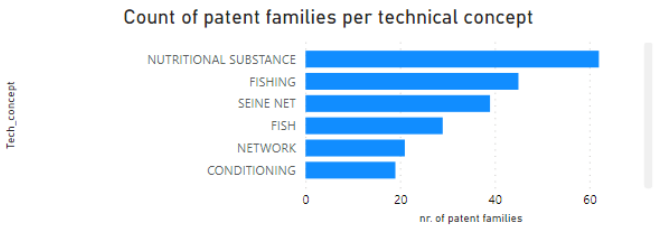
NumberOfFamilies	ipc_class_symbol_1	ipc_class_symbol_2
14	G09B 19/00	G06F 17/00
13	G09B 19/00	G06F 17/30
12	G09B 19/00	G01N 33/02
9	G01N 33/02	A23L 3/00
9	G06F 17/30	G06F 17/00

NumberOfFamilies	cpc_class_symbol_1	cpc_class_symbol_2
13	G09B 19/0092	A23P 10/00
11	Y02A 90/10	G16H 20/60
10	G09B 19/0092	G01N 33/02
10	G16H 20/60	G09B 19/0092
9	G01N 33/02	A23P 10/00

A meaningful piece of information about the technical concepts characterizing single patent's families may be argued from the following Figure 51.

Figure 51 Fisheries: List of technical concepts associated to each patent family of the dataset and ranking

docdb_family_id	appln_title
4892776	SAFETY ENCLOSED FENCE
5865010	A box for fish
8099897	Fishing equipment
8117644	A FLOAT, ESPECIALLY FOR FISH-TRAWLING NETS, AND A METHOD OF M SAME
8721285	Improvements in and relating to deep-sea trawlers
9188907	Measuring length of deep sea trawl line - using counter driven from trav wheel
9705664	DEEP-SEA TRAWLING CHAIN CONNECTOR
9728588	DEEP-SEA TRAWLING CHAIN CONNECTOR
10183412	WHIP AERIALS

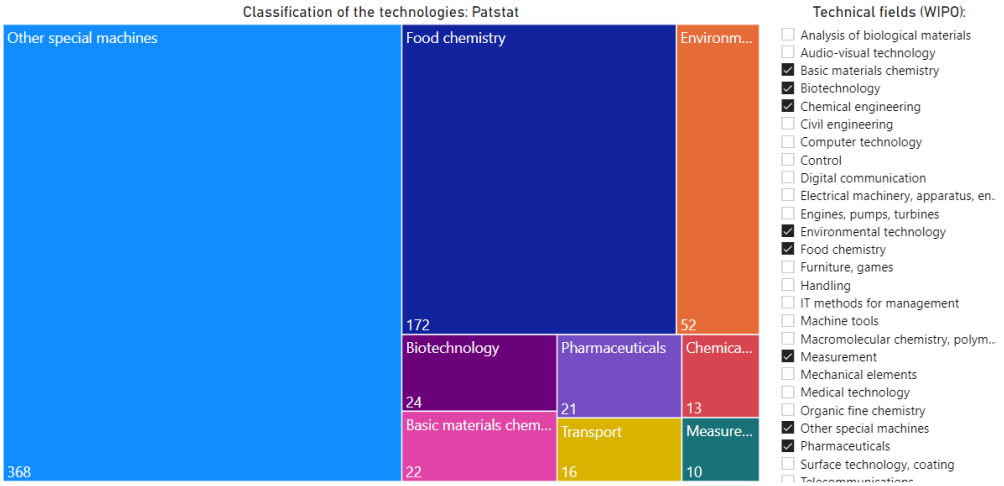


docdb_family_id	Tech_concept #1	Tech_concept #2	Tech_concept #3	Tech_concept #4	Tech_concept #5	Tech_concept #6	Tech_concept #7	Tech_concept #8	Tech_concept #9
1557355	BOAT HULL	FISHING JOB	WORKING CHAMBER	FISHING SERVE	LIGHTENING	SHELL CONSTRUCTION	WORK LOCAL SEPARATION	CHA	FISH
4892776	ENCLOSED SAFETY	CNU	SEINE NET	SUPPORT ROD	CIRCULAR HOLE	UPPER	BAR	FENCE	LOW CURVED CHAOPSTI
5865010	FISH BOX	IMPREGNATED CORRUGATED CARDBOARD	STORAGE	FISH TRANSPORTATION	NON RETURNABLE CONTAINER	INWARDLY DIRECTED FLAP	CONTENT DETERIORATION	RELIABLE PROTECTION	WATER INGRESS
8099897	SORTING	CATCH BAG	NET	FISHING TACKLE	PANEL	SORTING NET FORM	KIND FISHING TRAWL	TOWING DIRECTION RUN	TRAWL CATCH BAG
8117644	FLOAT	FISH TRAWLING NET	ELASTICITY MODULUS	KIND FLOAT	HALF TUBE	STRESS CONCENTRATION	HOLLOW BODY WALL	SLEEVE PROTRUSION	SLEEVE EDGE
8721285	TRAWLING TRAWLER								

b) Aquaculture: Marine Finfish aquaculture (MFA) and Shellfish aquaculture (SA)

As far as the WIPO technology fields are concerned, as in the case of the subsector dealing with fishery most patent families are associated to the technology field named “Other special machines” which is not very informative (Figure 52).

Figure 52 Aquaculture: Map of the technology fields defined by WIPO



The clustering of the patent families based on the IPC classification codes is more informative. These data are shown in Figure 53 and in Figure 54, respectively.

Figure 53 Aquaculture: clustering of the patent families based on the identification of patterns of IPC classification codes

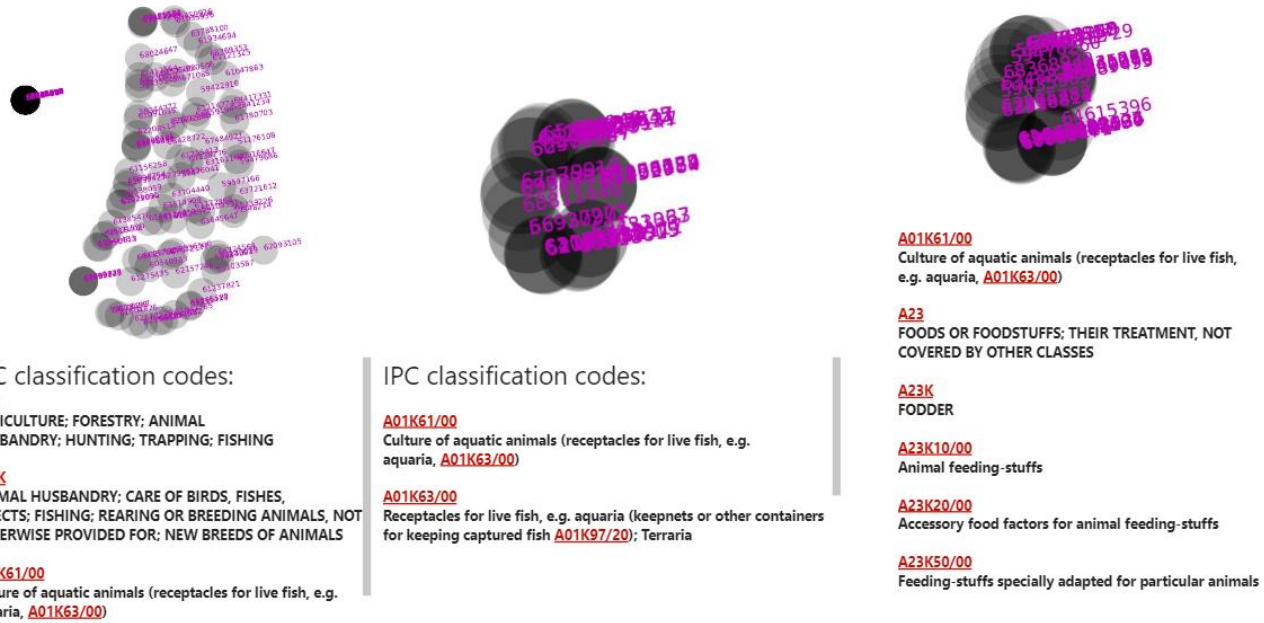
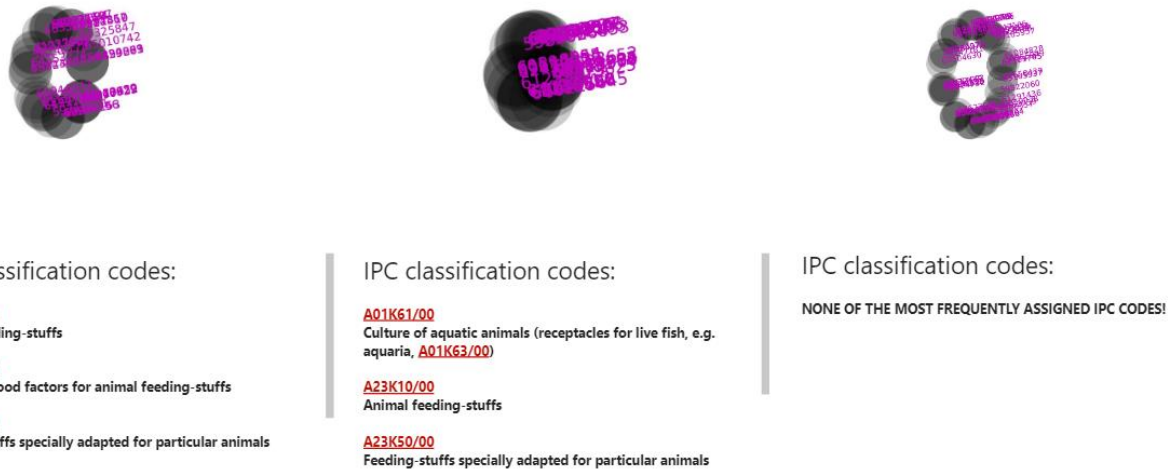


Figure 54 Aquaculture: clustering of the patent families based on the identification of patterns of CPC classification codes



Excluding the documents not identifiable by means of IPC classification codes, the majority may be included in patterns characterized by one or more IPC codes.

In most cases the classification code **A01K61/00** (**Culture of aquatic animals** (receptacles for live fish, e.g. aquaria, A01K63/00)) is present either alone, or in combination with other IPC classification codes, namely one or more of those included in the following list:

- **A01K63/00** referring to **Receptacles for live fish, e.g. aquaria.**
- **A23K10/00** referring to **Animal feeding-stuffs.**
- **A23K20/00** referring to **Accessory food factors for animal feeding-stuffs.**
- **A23K50/00** referring to **Feeding-stuffs specially adapted for particular animals.**

The co-occurrence of two IPC or CPC classification codes identifying single patents' families confirms what already observed about the classification codes mentioned above. In addition, the co-occurrence of CPC classification codes, for example **Y02A40/818** (**Alternative feeds for fish, e.g. in aquacultures**) in combination with one of the aforementioned codes, is meaningful considering the assignment to a consistent number of patent families (60) and bearing in mind that the dataset includes 467 non duplicated patent families. Other relevant combinations might be argued from Figure 55.

Figure 55 Aquaculture: Co-occurrence of IPC classification codes (leftmost table) and CPC classification codes (rightmost table)

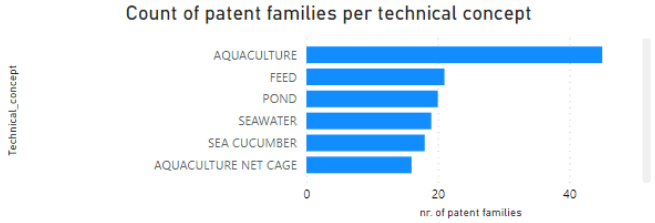
NumberOfFamilies	ipc_class_symbol_1	ipc_class_symbol_2
89	A23K 50/80	A23K 10/30
68	A23K 10/37	A23K 10/30
64	A23K 50/80	A23K 10/22
63	A23K 50/80	A23K 10/37
55	A23K 10/30	A23K 10/22

NumberOfFamilies	cpc_class_symbol_1	cpc_class_symbol_2
72	A23K 50/80	A23K 10/30
61	Y02A 40/824	A01K 61/59
60	Y02A 40/818	A23K 50/80
57	A23K 50/80	A23K 10/37
56	A23K 10/37	A23K 10/30

A meaningful piece of information about the technical concepts characterizing single patents' families may be argued from the following Figure 56.

Figure 56 Aquaculture: List of technical concepts associated to each patent family of the dataset and ranking

docdb_family_id	appln_title
55171910	HIDRATOS DE CARBONO
56920901	An egg-shaped fish rearing tank and a method of rearing fish
57227158	Composiciones que contienen aceite de acicalamiento y procedimientos
58240178	A COMPOSITION AND/OR COMBINATION FOR AQUACULTURE
58266580	SEMI-SUBMERSIBLE FISH FARMING SYSTEM
58489518	NET FOR AQUACULTURE
58586331	Autonomous vessel-mounted aquatic product culture zone water tempe device and method
58668552	Damping plate sand filtration system and wave energy water desalinatio methods of using potable water produced by wave energy desalination
58829203	Foraging feed of special compound feed for breeding stichopus japonic

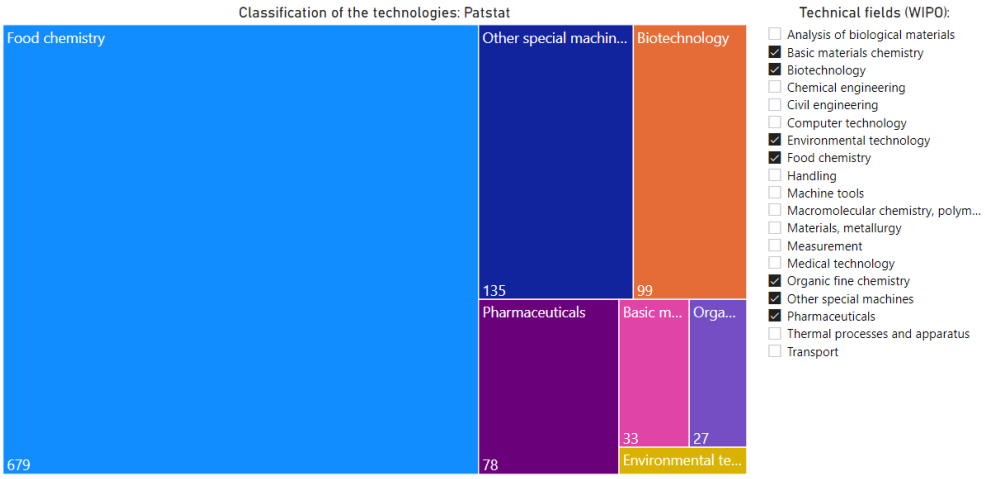


docdb_family_id	Tech_concept #1	Tech_concept #2	Tech_concept #3	Tech_concept #4	Tech_concept #5	Tech_concept #6	Tech_concept #7	Tech_concept #8	Tech_concept #9
			AVAILABILITY			CONSUMPTION			
56920901	CLOSE CONTAINED AQUACULTURE FARMING	REARING FISH	(AU)	FISH REARING TANK	REARING FISH	SUBMERSIBLE	CLOSE CONTAINED AQUACULTURE FARMING	FLOATING	FISH GRID
57227158	PREEN OIL	FISH	AQUACULTURE	GROWING FISH	FEED	FOOD	CHRONIC JOINT INFLAMMATION	ORGANISM	HYPOXIA RISK
58240178	AQUATIC SPECIES	ADMINISTRATION	AQUACULTURE	CLAY MINERAL	AQUATIC ANIMAL	ARMORED SUCKERMOUTH CATFISH	BONNEVILLE CUTTHROAT TROUT	LONGFIN INSHORE SQUID	ADHESIVE AGENT
58266580	FISH PEN	SEMISUBMERSIBLE FISH FARMING	BALLASTING	DEBALLASTING	SEMI SUBMERGED POSITION	FISH REPELLENT NET ROOF	REPELLENT NET ROOF	NET CAGE	NET ROOF
58489518	POLYMERIC RESIN	AQUACULTURE	NET MESH	MICROORGANISM UNDESIRABLE	CORD	ETHYLENE COPOLYMER	FISH FARMING	YARN	FISH FARMING CONS

c) Fish meal

As far as the WIPO technology fields are concerned, in the case of the fish meal sector and in the seafood processing sector, the prevalent technology field is dealing with the food chemistry (Figure 57), therefore being likely that certain technical elements may be shared by these two sectors.

Figure 57 Fish meal: Map of the technology fields defined by WIPO



The clustering of the patent families based on the IPC and CPC classification codes' assignment corroborate the finding based on the WIPO technologies, although a relevant fraction of patent families does not appear associated with any of the most frequently assigned IPC or with any of the most frequently assigned CPC classification codes. These data are shown in

Figure 58 and Figure 59 respectively.

Figure 58 Fish meal: clustering of the patent families based on the identification of patterns of IPC classification codes

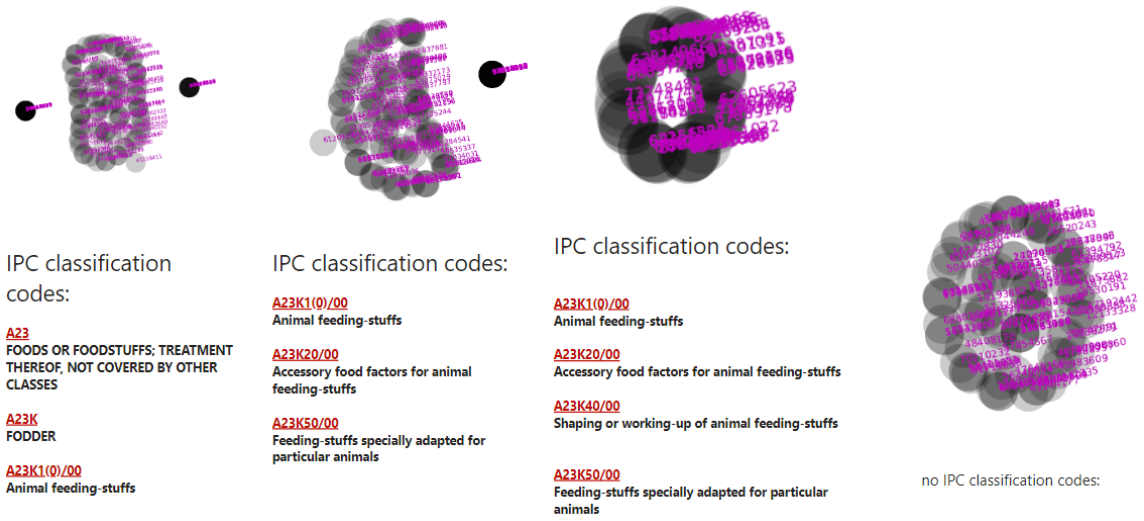
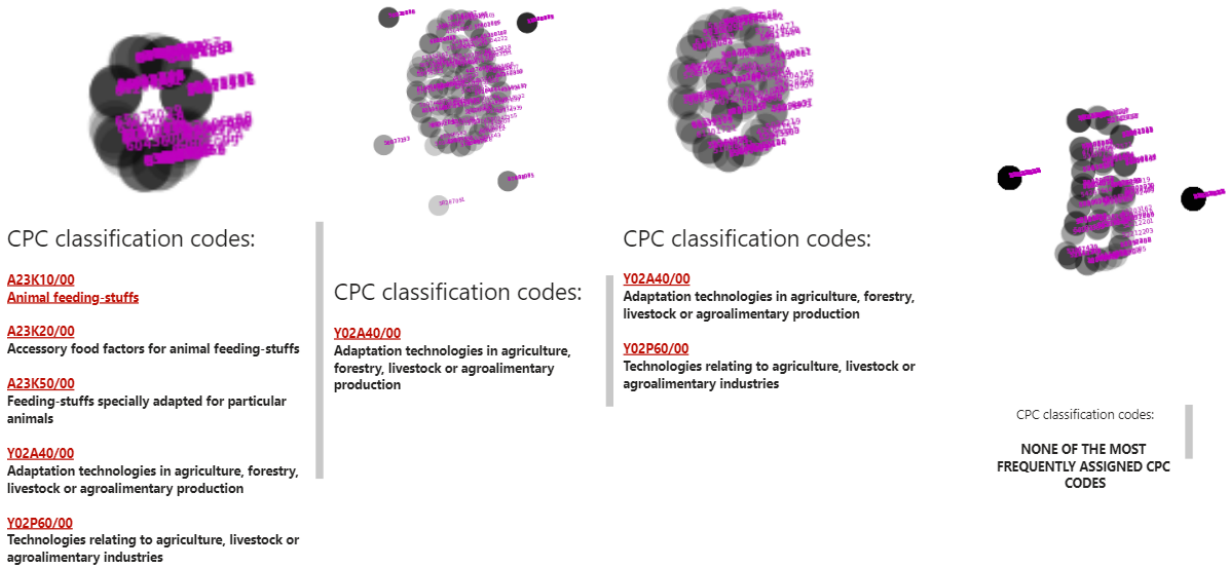


Figure 59 Fish meal: clustering of the patent families based on the identification of patterns of CPC classification codes



In most cases the classification, either based on the IPC or on the CPC codes, relies on the assignment of the main class **A23** (**FOODS OR FOODSTUFFS; TREATMENT THEREOF, NOT COVERED BY OTHER CLASSES**). The "Y" section of the CPC classification does not add meaningful information, **although the main groups "Y02A40/00" and "Y02P60/00" refer both to technologies dealing with the agro-alimenatary industry**. However, differently from the subsequent analysis regarding the assignment of the IPC/CPC classification codes to the seafood processing patent applications, in the case of the inventions dealing with fish meal elaboration no evidence appears concerning the assignment of classification codes identifying the diet supplements (for example the CPC A23L33/00 - *Modifying nutritive qualities of foods; Dietetic products; Preparation or treatment thereof*, or the CPC A23V2002/00 - *Food compositions, function of food*

ingredients or processes for food or foodstuffs) being the A23K subclass prevalent in the sector regarding the fish meal, as can be also argued from the schemes (Figure 60) showing the co-occurrence of the classification codes.

Figure 60 Fish meal: Co-occurrence of IPC classification codes (leftmost table) and CPC classification codes (rightmost table)

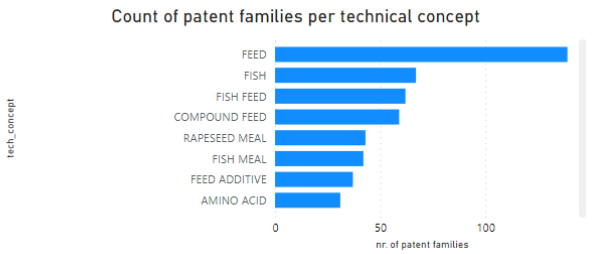
NumberOfFamilies	ipc_class_symbol_1	ipc_class_symbol_2
218	A23K 50/80	A23K 10/30
168	A23K 50/80	A23K 10/22
143	A23K 10/30	A23K 10/22
138	A23K 50/80	A23K 10/37
137	A23K 50/80	A23K 20/147
131	A23K 50/80	A23K 20/158
130	A23K 1/18	A23K 1/16
130	A23K 50/80	A23K 20/174
122	A23K 10/37	A23K 10/30

NumberOfFamilies	cpc_class_symbol_1	cpc_class_symbol_2
150	Y02A 40/818	A23K 50/80
148	Y02P 60/87	Y02A 40/818
122	A23K 50/80	A23K 10/30
104	A23K 50/80	A23K 20/147
95	A23K 50/80	A23K 10/22
90	A23K 50/80	A23K 20/158
90	Y02A 40/818	A23K 10/30
89	Y02P 60/87	A23K 50/80
83	A23K 50/80	A23K 10/37

A meaningful piece of information about the technical concepts characterizing single patents' families may be argued from the following Figure 61.

Figure 61 Fish meal: List of technical concepts associated to each patent family of the dataset and ranking

docdb_family_id	appln_title
4163636	AMINO ACIDS FROM FISH AND SOY PROTEINS FOR IMPROVEMENT OF
4190895	Anvendelse av enzymer fra krill i forstoffer
4195906	MILCH-FLEISCH-PRODUKTE.
4589258	Ecological feed
4590249	Composite ferment strain and its production process
4667712	Aquatic product feed crystal amino acid slow-releasing preparation and
4748207	Filter fish feed and farming method
4796012	COATED FISH FEED PELLETS AND ITS MFG. METHOD
4907392	One-step process of mono-cell protein made from raw starch
4910408	EFFECTIVE ANIMAL PROTEIN FEED

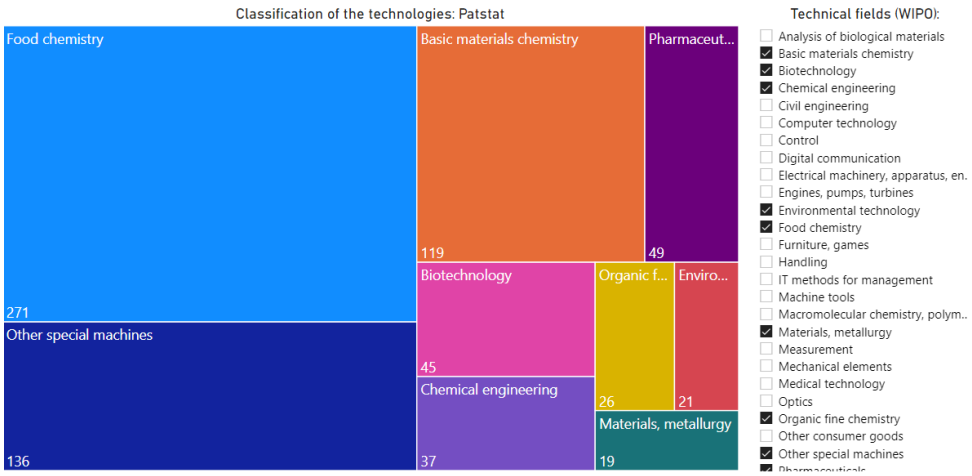


docdb_family_id	tech_concept #1	tech_concept #2	tech_concept #3	tech_concept #4	tech_concept #5	tech_concept #6	tech_concept #7	tech_concept #8	tech_concept #9
4163636	AMINO ACID	INSULIN SENSITIVITY	SOY PROTEIN	CA	AMINO ACID	SOY PROTEIN	INSULIN SENSITIVITY	HUMAN	HYDROLYZED FISH PROTEIN
4190895	ENZYME	FEED	KRILL ENZYME	ENZYME FEED ADDITIVE	AQUATIC ANIMAL	AQUATIC ANIMAL FOOD	METHYLPROP ENOIC ACID	AQUATIC ANIMAL FOOD METHACRYLATE	BEAUTY FEED
4195906	MILK	US	MILK	FOOD PRODUCT	COMMINUTED FROZEN EMULSION PARTICLE	EMULSION PARTICLE	KNIFE FOOD CUTTER	MILCHSAEURE BACTERIUM STARTER CULTURE	INGREDIENT IDENTIFICATION
4589258	ECOLOGICAL FEED	SPIRULINA SEAWEED	ECOLOGICAL FEED CAROTENOID	FISH IMMUNITY	PREMIX FEED	FISH QUICK GROWTH	FOOD CALLING CAPABILITY	SPIRULINA POWDER	COMPREHENSIVE NUTRIENT
4590249	ENZYME	CELLULOSE DECOMPOSING	COMPOSITE FERMENT STRAIN	ENZYME COMBINATION	ENZYME COMBINATION	PRODUCING SPECIES	DECOMPOSING BACTERIA	SPECIES SACCHAROMYCES	BACTERIAL SPAWN

d) Seafood processing and trade

As far as the WIPO technology fields are concerned, differently from the cases seen before, in which most patent families appear associated to the technology field named "Other special machines" which is not very informative, in the case of the seafood processing sector, the prevalent technology field is dealing with the food chemistry (Figure 62).

Figure 62 Seafood processing: Map of the technology fields defined by WIPO



The clustering of the patent families based on the IPC and CPC classification codes' assignment corroborate the finding based on the WIPO technologies, although a relevant fraction of patent families does not appear associated with any of the most frequently assigned IPC and especially with any of the most frequently assigned CPC classification codes. These data are shown in Figure 63 and Figure 64, respectively.

Figure 63 Seafood processing: clustering of the patent families based on the identification of patterns of IPC classification codes

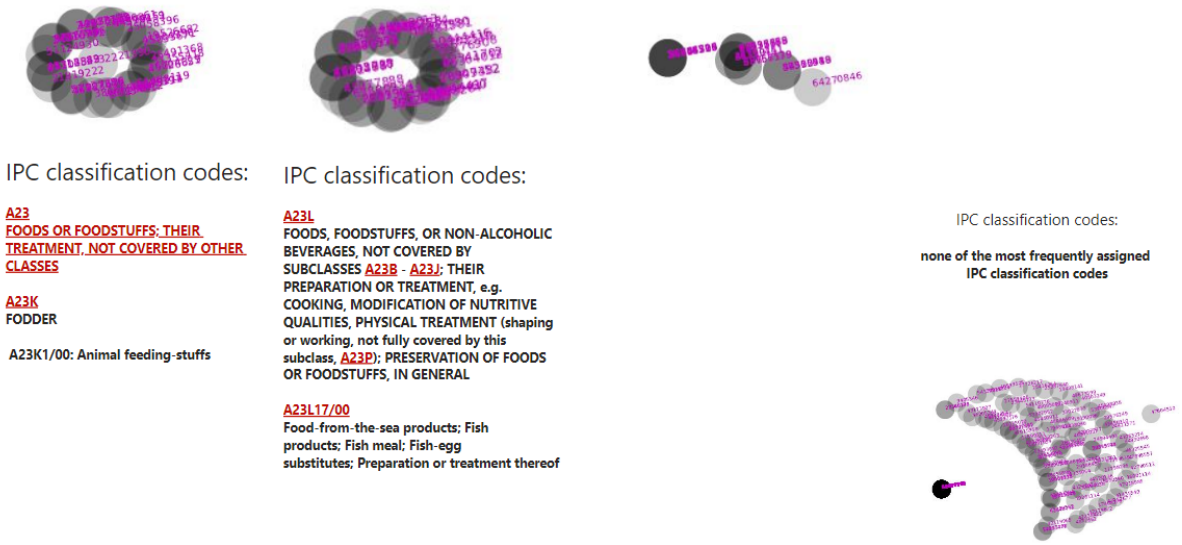
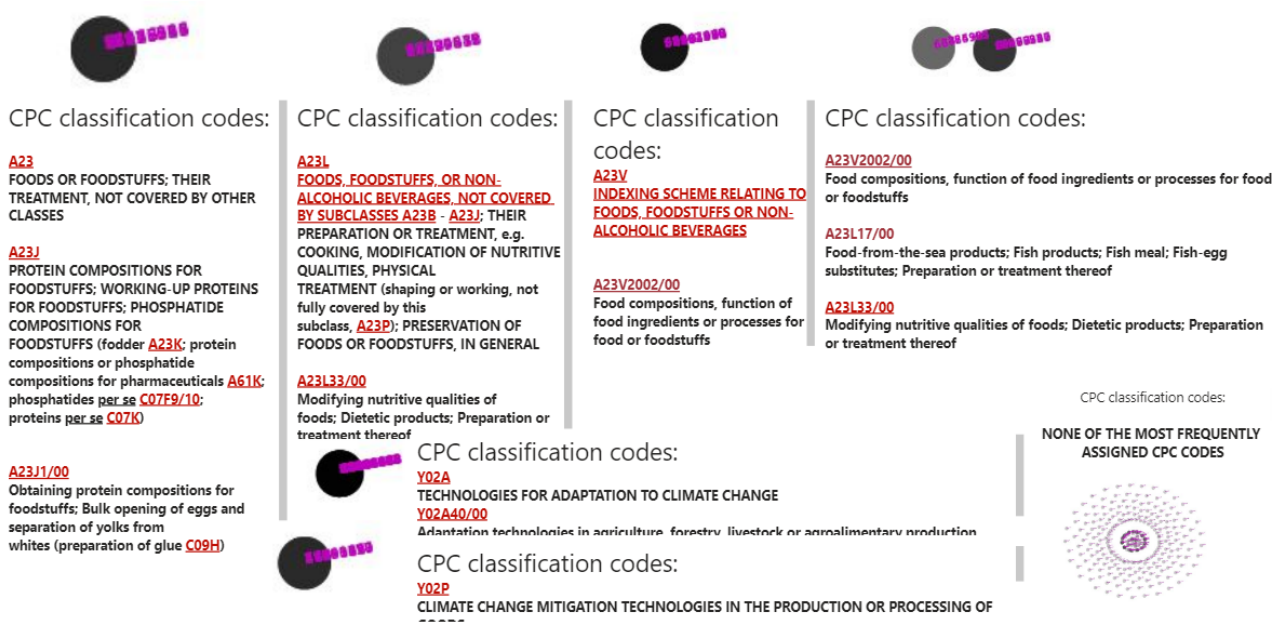


Figure 64 Seafood processing: clustering of the patent families based on the identification of patterns of CPC classification codes



In most cases the classification, either based on the IPC or on the CPC codes, relies on the assignment of the main class **A23** (**FOODS OR FOODSTUFFS; TREATMENT THEREOF, NOT COVERED BY OTHER CLASSES**). The "Y" section of the CPC classification does not add meaningful information, **although the main groups "Y02A40/00" and "Y02P60/00" refer both to technologies dealing with the agro-alimenatary industry**. Further detail about the subgroups of the CPC classification codes may be argued by the schemes (Figure 65), showing the co-occurrence of the classification codes.

Figure 65 Seafood processing: Co-occurrence of IPC classification codes (leftmost table) and CPC classification codes (rightmost table)

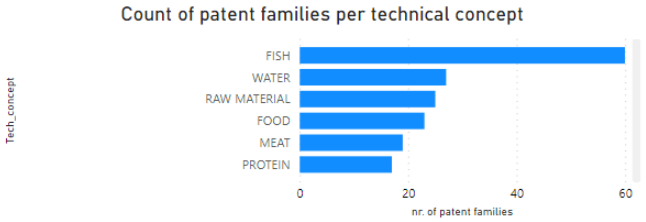
NumberOfFamilies	ipc_class_symbol_1	ipc_class_symbol_2
27	A23K 1/18	A23K 1/16
21	A23K 1/18	A23K 1/00
18	A23K 1/18	A23K 1/10
15	A23K 1/16	A23K 1/10
13	A23K 1/14	A23K 1/10
12	A23K 1/10	A23K 1/00

NumberOfFamilies	cpc_class_symbol_1	cpc_class_symbol_2
16	Y02P 60/87	A23K 10/37
15	Y02A 40/818	A23K 50/80
14	Y02A 40/20	C05F 1/002
14	Y02W 30/40	Y02A 40/20
13	A23K 10/30	A23K 10/20
13	Y02P 60/87	A23K 10/20

A meaningful piece of information about the technical concepts characterizing single patents' families may be argued from the following Figure 66.

Figure 66 Seafood processing: List of technical concepts associated to each patent family of the dataset and ranking

docdb_family_id	appln_title
3823231	Composition and methods for controlling molluscs
4105319	PET FOOD CONTAINING GLYCEROL MONOSTEARATE
4124578	BAIT BAG
4162941	A METHOD FOR EXTRACTING LIPID FRACTIONS FROM MATERIAL OF M/ FRESHWATER ANIMALS (VARIANTS), LIPID EXTRACT AND LIPID FRACTIC
4172942	Natures organic growing products
4296285	APPARATUS FOR MAKING WARP KNITTED FABRICS
4653590	Amino-acid trace element chalted silicon fertilizer and productive methc
4742597	Method for raising fish by damming river
4877662	METHOD FOR PREPARATION OF RICE-BEAN ICE CREAM
4933906	CLEANER FOR FISH GLOBE



docdb_family_id	Tech_concept #1	Tech_concept #2	Tech_concept #3	Tech_concept #4	Tech_concept #5	Tech_concept #6	Tech_concept #7	Tech_concept #8	Tech_concept #9
3823231	MOLLUSK	TERRESTRIAL MOLLUSK	INGESTABLE POISON	ACTIVE INGREDIENT	MOLLUSK BAIT	LETHAL DOSE	DAMP PREMIX	LETTUCE PLANT	FORMULATION ADDITIVE ENH
4105319	PET FOOD	GLYCERYL STEARATE	FLAVORED CEREAL CHUNK	CANNED PET FOOD	PET FOOD MANUFACTURER	CHEESE FLAVORING AGENT	MEAT BROTH	CEREAL CHUNK INGREDIENT	FLAVORED CEREAL PRODUCT
4124578	BAIT	CONTAINER	APERTURE	BAIT CONTAINER	APERTURED SIDEWALL	CRUSTACEAN	BAIT CONTROLLED RELEASE	TRAP FISHING	EXTENDED PERIOD OF TIME
4162941	LIPID	LIPID FRACTION	MARINE	FRESH WATER PRODUCTION	PHOSPHOLIPID	RAW MATERIAL	FRESH WATER	ANIMAL TISSUE	ANIMAL ORIGIN RAW MATERI/
4172942	RENEWABLE INGREDIENT OFFERIN	FOREST SETTIN	HAY STRAW	FERTILIZER PH MODIFIE	LEAF MOLD	PLA GROWTH	HOST VEGETATION	ROCK PHOSPHATE	FEDERAL GOVERNMENT OTTA\
4296285	HIGHLY	MAJESTY	PROTEIN	TREATING	LIPID	PHENOL	PL TICAL	PROTEIN	DNA MOLECULE

5 KEYPOINTS

- As far as the fishery sector is concerned, little information about the technologies may be argued considering the technology fields defined by WIPO, since most patent families are classified as “Other special machines”. However, the IPC/CPC classification codes allow to argue additional details regarding the protected products/technologies, in most cases dealing with stationary catching devices, drawn nets or fences, enclosures, corrals, etc. A relatively small fraction of the results concerns implementations achieved by including digital computing or data processing equipment or methods. Therefore, consistently with a relatively low growth rate of the patent applications filed to national/supranational authorities, the innovativeness of the techniques legally protected seems limited.
- When considering the aquaculture sector, like in the case of fishery, little information about the technologies may beinterferred considering the technology fields defined by WIPO, since most patent families are classified as “Other special machines”. However, a consistent fraction of the patent families deals with food chemistry. Consistently, several patent families may be identified by patterns of IPC/CPC classification codes identifying the feeding devices. Moreover, a not negligible fraction of the results corresponds to classification codes identifying the receptacles for live fish, e.g., aquaria.
- As in the sector regarding the fish meal inventions, the kind of WIPO technology fields or the IPC/CPC classification codes seems not clearly distinguishable from the classification concerning the seafood processing sector. However, in the case of fish meal little or no use of the IPC/CPC classification codes identifying the diet supplements is made, moreover, the frequency of assignment of the A23K subclass (fodder) is significantly higher than in the case of the seafood processing sector.
- The technology field “food chemistry” is prevalent as far as the patent documents dealing with the seafood processing and with the fish meal subsectors are concerned, however the technical context of both such fields might differ from that specifically regarding the aquaculture sector, because, especially in the seafood processing case a relevant fraction of IPC/CPC classification codes might refer to the food compositions and to the agro-alimentary sector.
- To better differentiate each subsector from the others (excluding the fishery) from the technical point of view, it may be advisable to inspect the individual documents of each dataset considering the

corresponding list of technical concepts extracted from Orbit Intelligence. It may be worth reminding that for the purpose of the present report each patent family is displayed in association with only 9 technical concepts however longer lists of technical concepts associated to each patent family may be delivered upon request.

6 FISHERY AND AQUACULTURE: THE NPL DIVULGATION FOCUSING ON THE COUNTRIES LOCATED ALONG THE MEDITERRANEAN SEA

a) Fishery: Pelagic and Demersal Large-Scale Fisheries (LSF) and Distant Water Fleet (DWF) and Small-scale Fisheries (SSF)

Although the quantification of the patent applications filed by the European residents is limited to few French or Spanish applicants, it is worth considering that the divulgation of technical aspects through alternative means (Non-Patent Literature) may be preferred by organizations, either enterprises or academics, hosted within the European countries bordering the Mediterranean Sea. This trend emerging from the analysis of the publications of the last two decades is particularly evident for Italy, France and Spain, as evidenced from Figure 67 to Figure 69, being there evidence of the national and also the trans-national collaborations between the institutes/enterprises located in each of the countries mentioned above, as well as the research institutes playing main role in each country (e.g., CNR for Italy, CNRS for France, IEO, CSIC in Spain) .

Figure 67 Fisheries: data showing the national and trans-national collaborations (NPL research focusing on Italy)

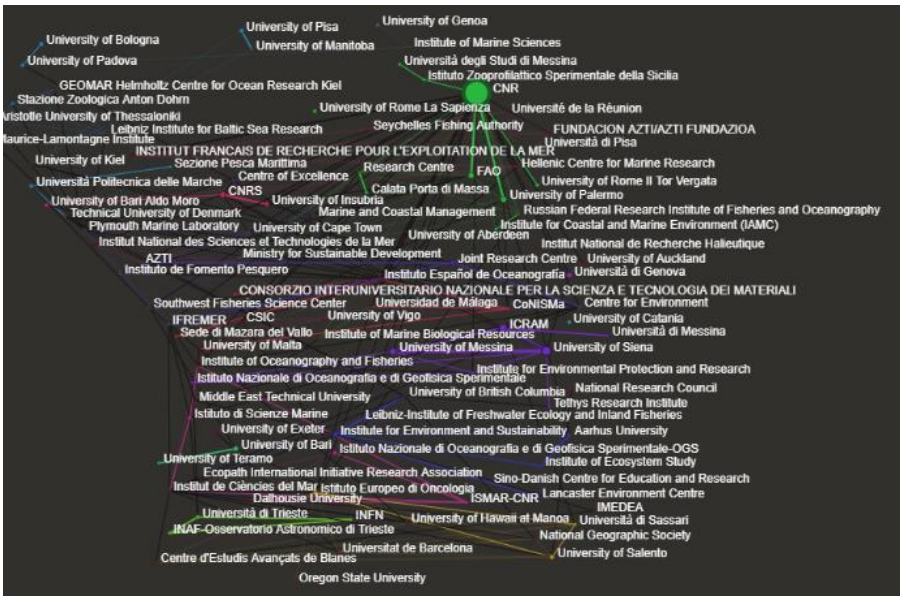


Figure 68 Fisheries: data showing the national and trans-national collaborations (NPL research focusing on France)

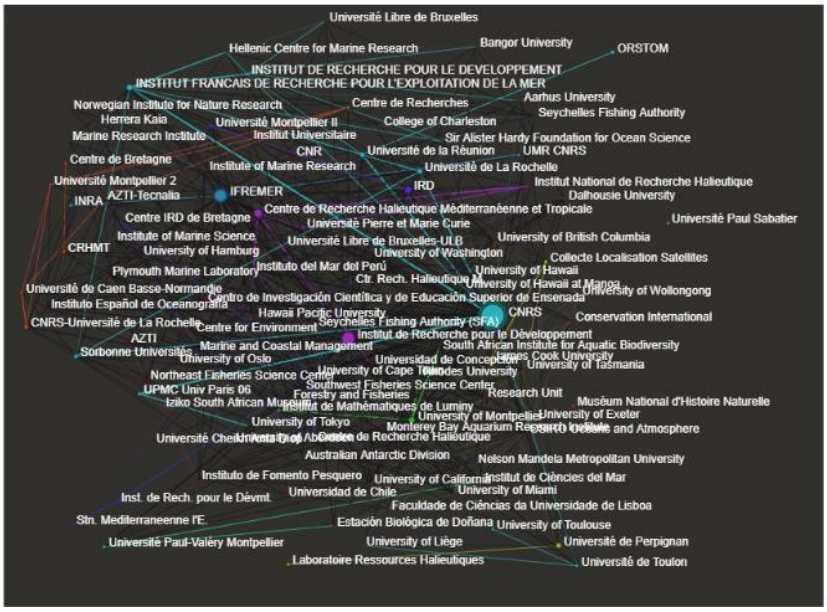
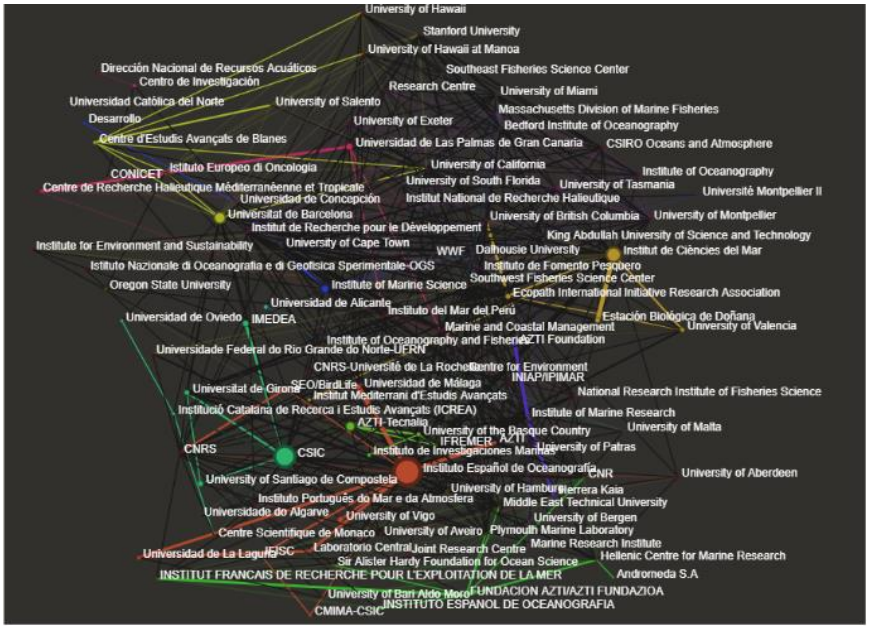


Figure 69 Fisheries: data showing the national and trans-national collaborations (NPL research focusing on Spain)



Similar diagrams are available as far as other European countries located along the Mediterranean Sea are concerned, namely: Greece, Croatia, Slovenia, Turkey and Israel. For each of the countries mentioned above the analysis of the divulgation modalities confirms that, apart from the little number of patent applications filed by French or Spanish residents, in the remaining countries the preferred forms of divulgation do not rely on the filing of patent applications.

Figure 70 to Figure 72 provide such evidence and also highlight the technical elements addressed by the publications. The main topics regarding the fishery may be described through clusters of technical concepts, each cluster being evidenced by a different color on each map.

Figure 70 Fisheries: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Italy)

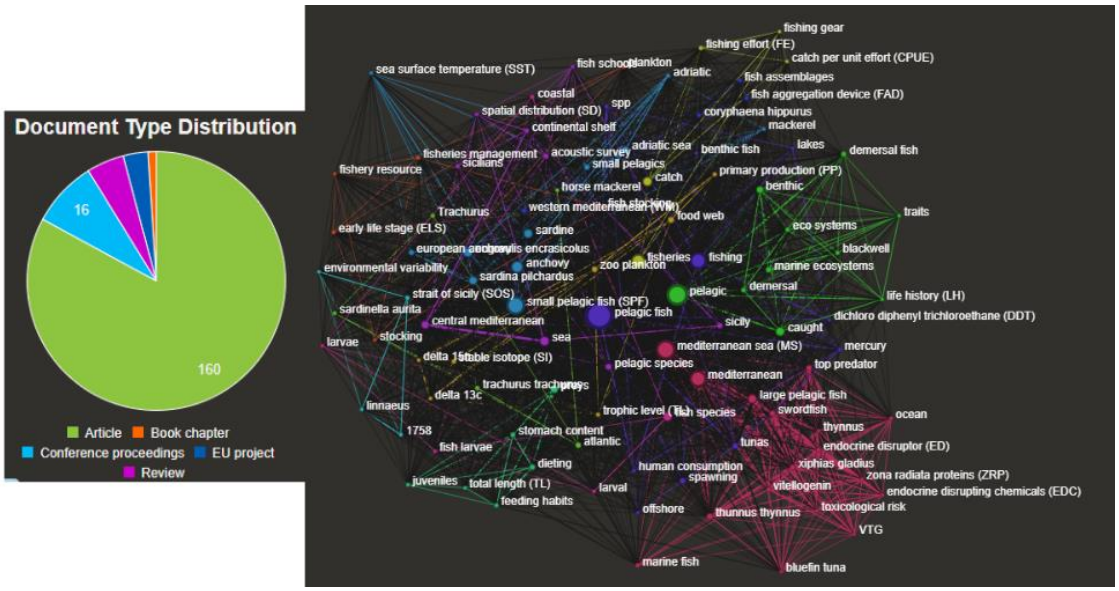


Figure 71 Fisheries: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on France)

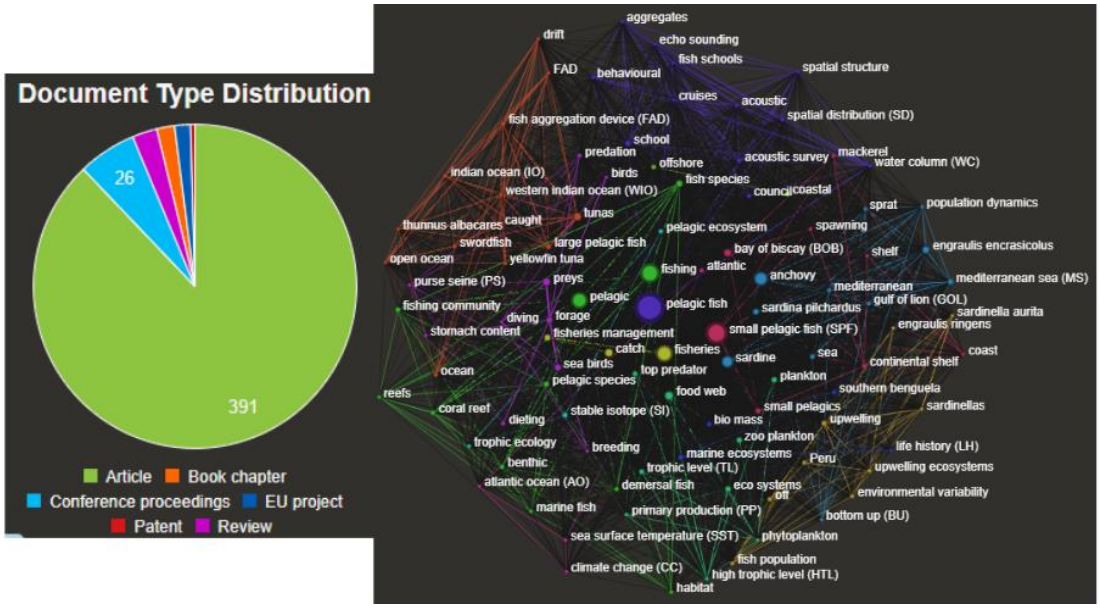
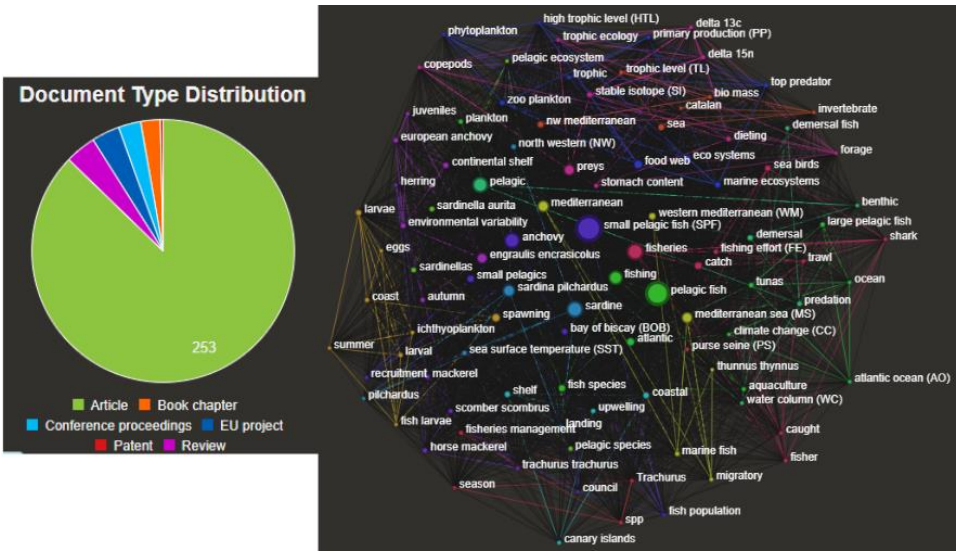


Figure 72 Fisheries: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Spain)



Similar diagrams are available as far as other European countries bordering the Mediterranean Sea are concerned, namely: Greece, Croatia, Slovenia, Turkey and Israel.

The countries showing the highest publication rate are **France, Spain and Italy**. Greece, Turkey, Croatia, Israel and Slovenia follow being listed in decreasing order considering the respective amount of NPL publications.

b) Aquaculture: Marine Finfish aquaculture (MFA) and Shellfish aquaculture (SA)

The amount of NPL publications of the last two decades ascribed to each of the countries analyzed is high when the aquaculture sector is considered. Data of the most representative countries provide evidence about the higher commitment of institutions hosted in France, Italy, Spain, Turkey and Egypt. As far the national/international collaborations in 2021 are concerned, the situation for each of the leader countries is depicted from Figure 73 to Figure 77.

Figure 73 Aquaculture: data showing the national and trans-national collaborations (NPL research focusing on Italy)

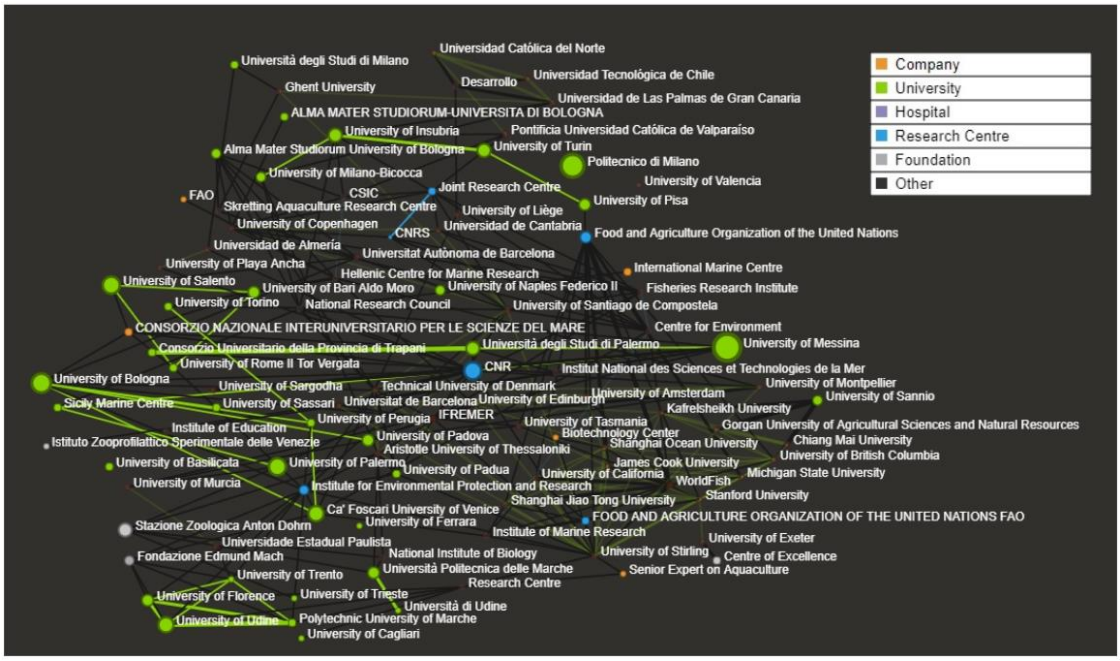


Figure 74 Aquaculture: data showing the national and trans-national collaborations (NPL research focusing on France)

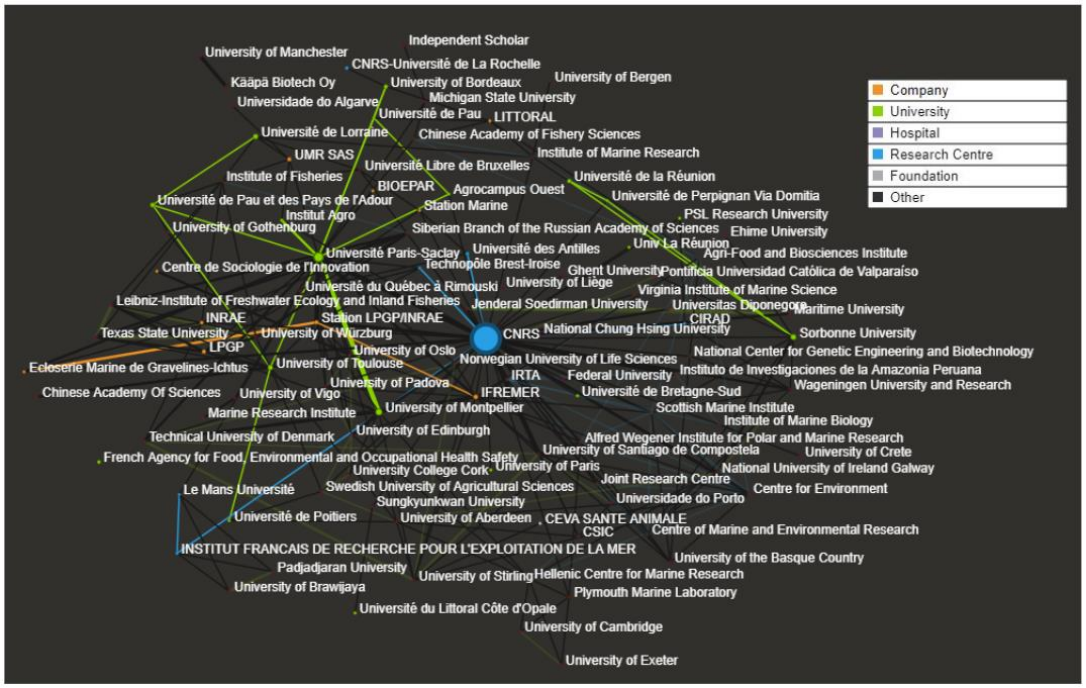


Figure 75 Aquaculture: data showing the national and trans-national collaborations (NPL research focusing on Spain)

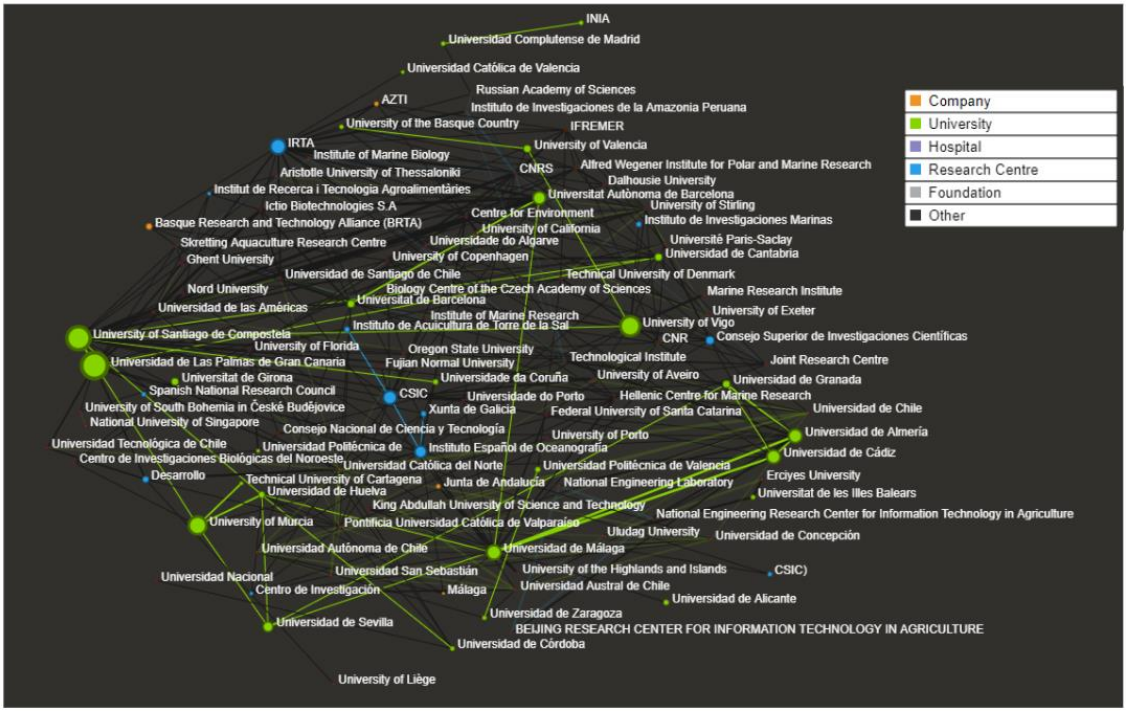


Figure 76 Aquaculture: data showing the national and trans-national collaborations (NPL research focusing on Turkey)

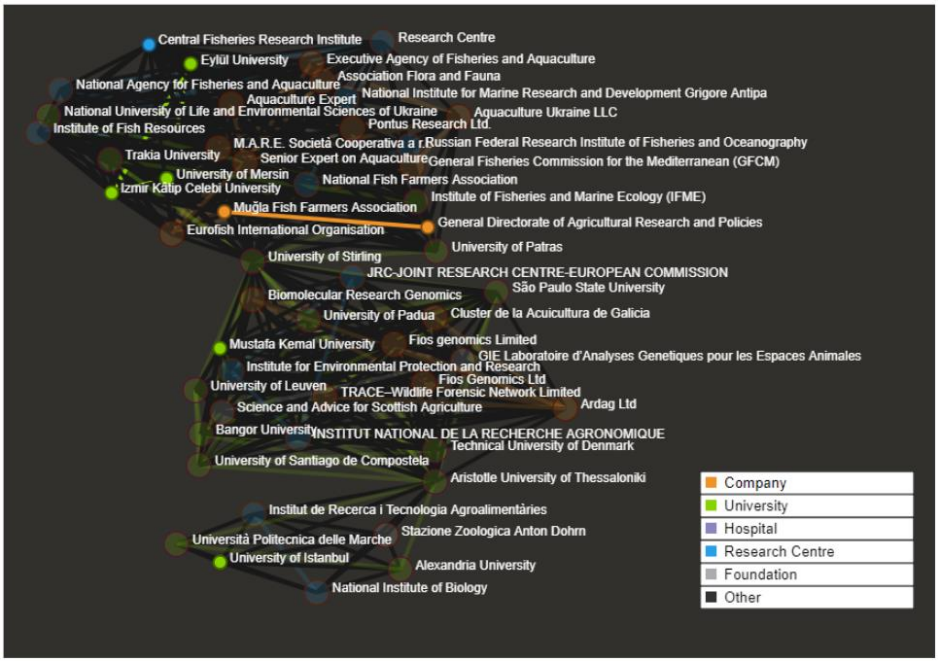
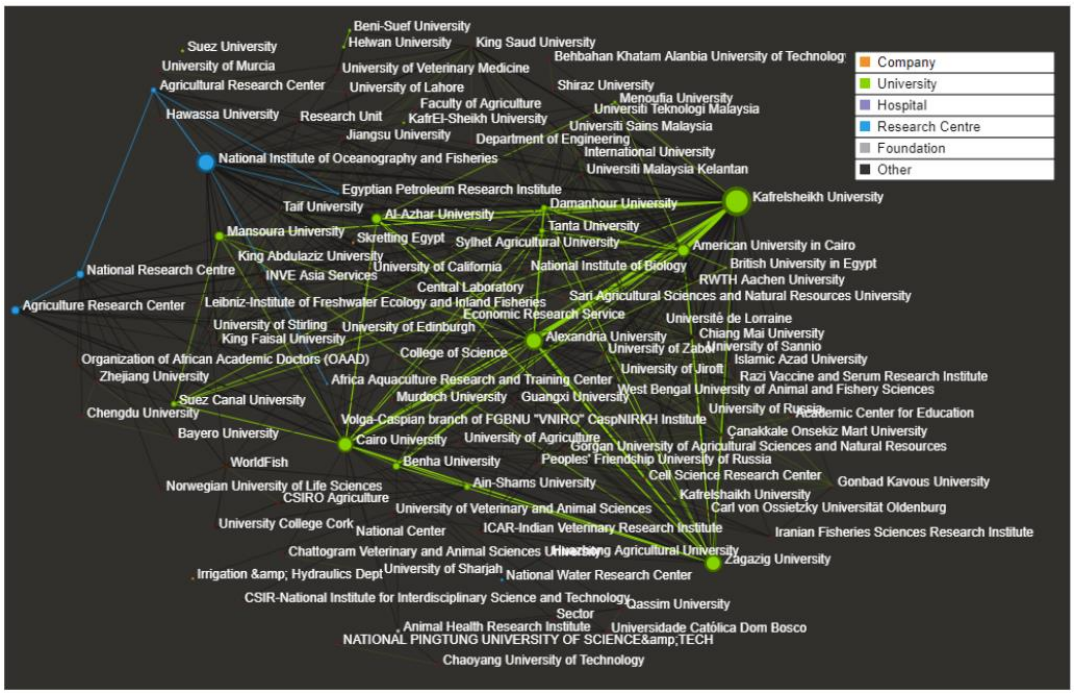


Figure 77 Aquaculture: data showing the national and trans-national collaborations (NPL research focusing on Egypt)



Similar diagrams are also available for Greece and Croatia which also invest in the Aquaculture sector. For each country mentioned above the analysis of the divulgation confirms that, apart for the small number of patent filings in France and Spain, in the remaining countries the preferred forms of divulgation do not rely on the filings of patent application.

Figure 78 to Figure 82 provide such evidence also highlighting the technical elements addressed in the publications. The main topics regarding the aquaculture sector may be identified by clustering the technical concepts, each cluster being evidenced by means of a specific color.

Figure 78 Aquaculture: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Italy)

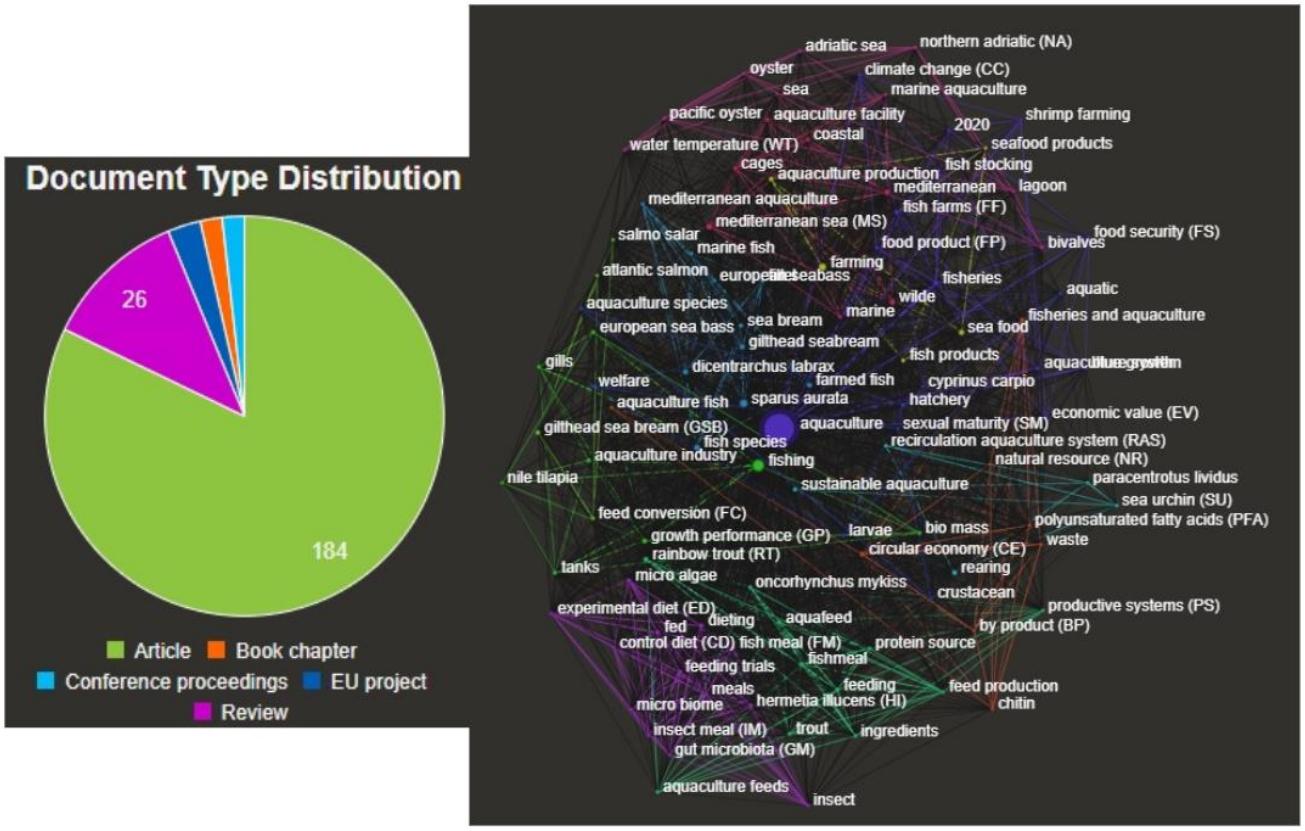


Figure 79 Aquaculture: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on France)

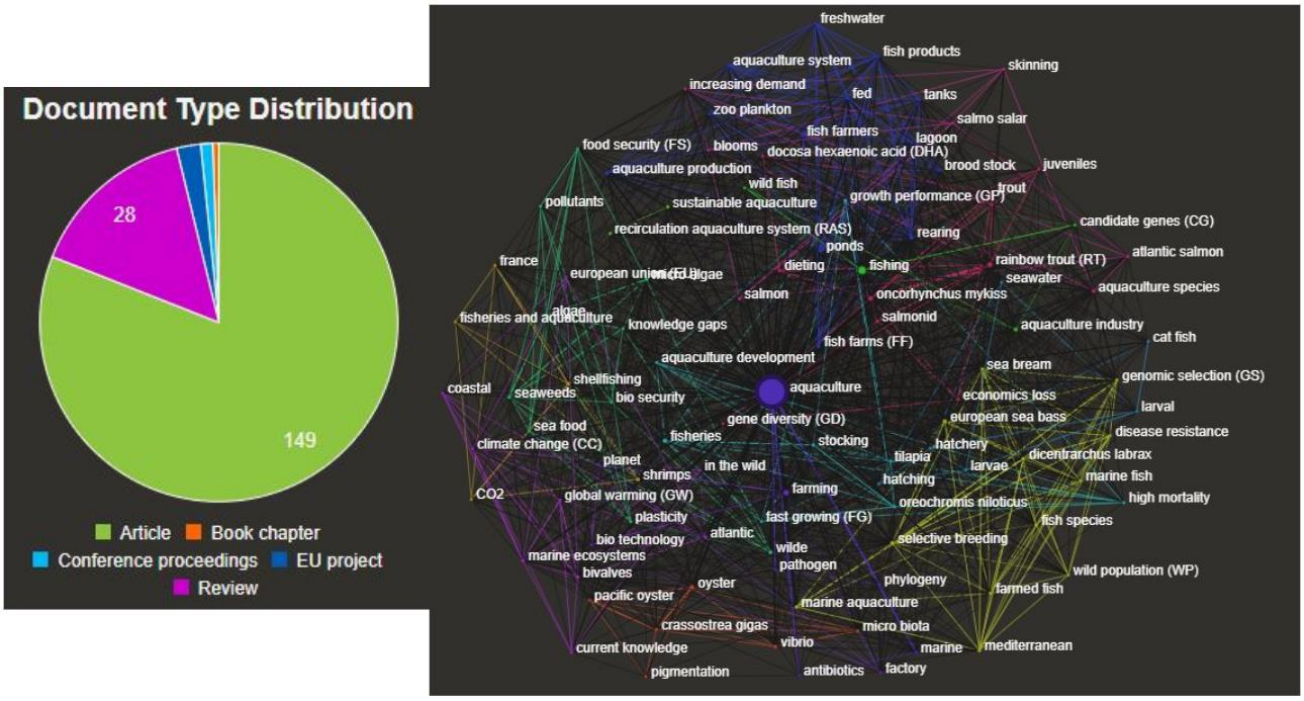


Figure 80 Aquaculture: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Spain)

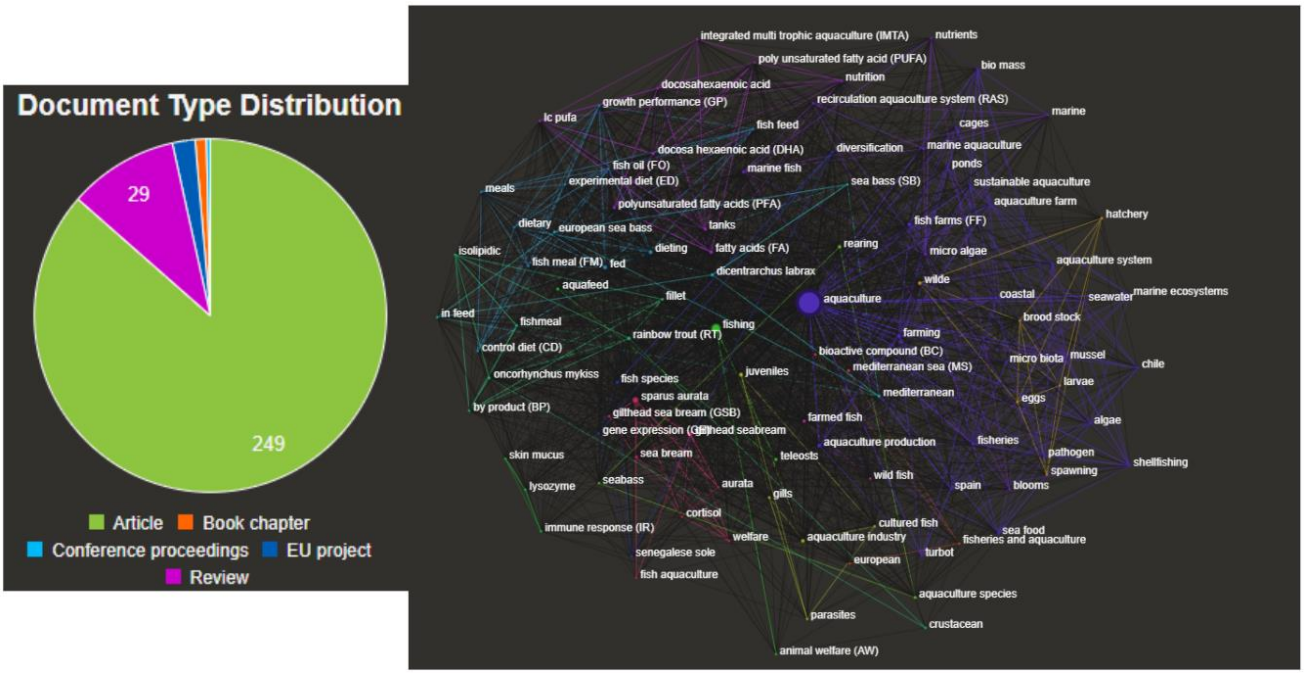


Figure 81 Aquaculture: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Turkey)

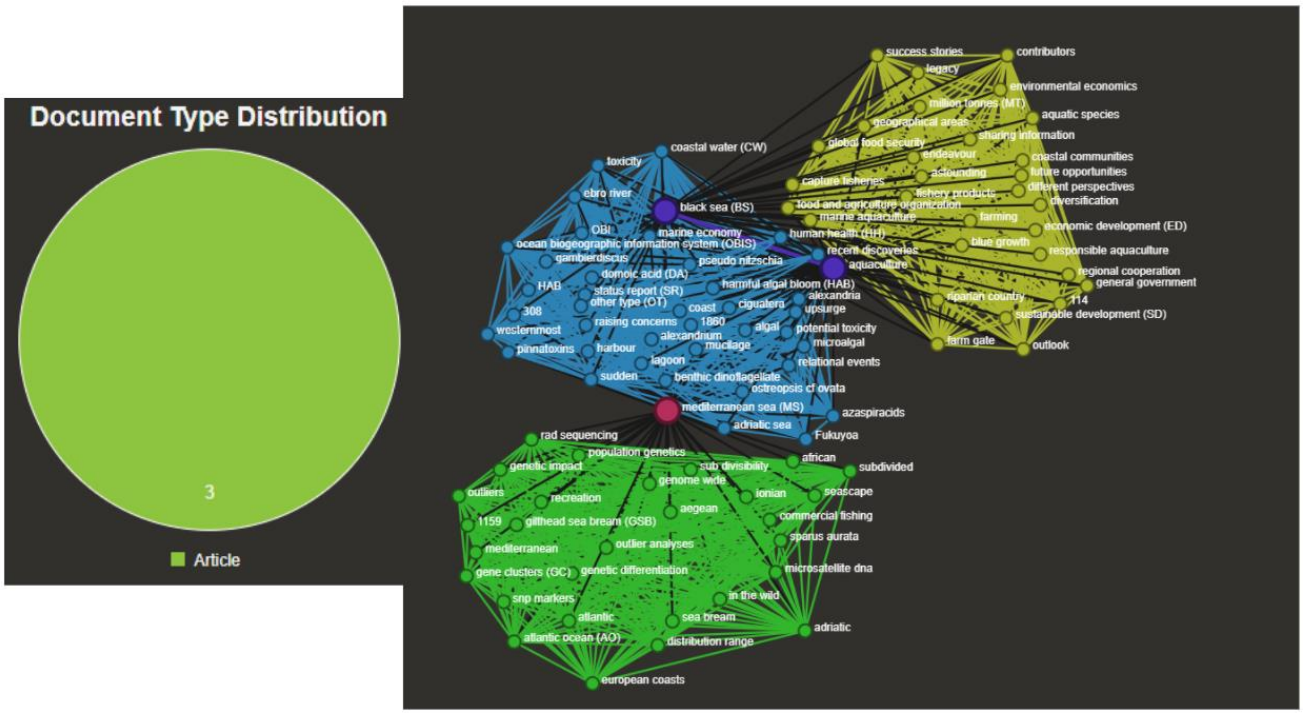
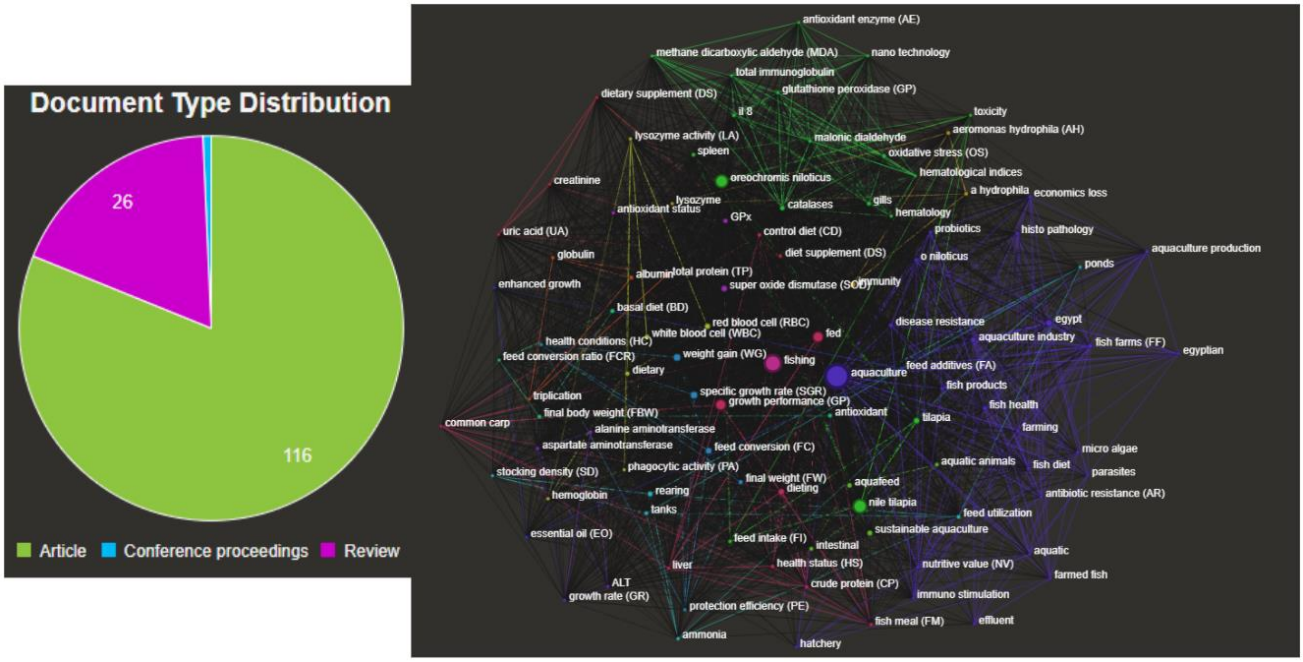


Figure 82 Aquaculture: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Egypt)



c) Fish meal

Differently from the cases of the other subsectors, **the amount of NPL publications is limited to the last four years since the data of the last two decades exceeded the number of results that can be analyzed by means of TIM**. Data of the most representative countries provide evidence about the **higher commitment of institutions hosted in France, Italy** and **Spain**, whereas the roles of other countries, such as Greece, Slovenia and Croatia appear more marginal. As far the national/international collaborations are concerned, the situation for each of the leader countries is depicted in Figure 83 to Figure 85.

Figure 83 Fish meal: data showing the national and trans-national collaborations (NPL research focusing on Italy)

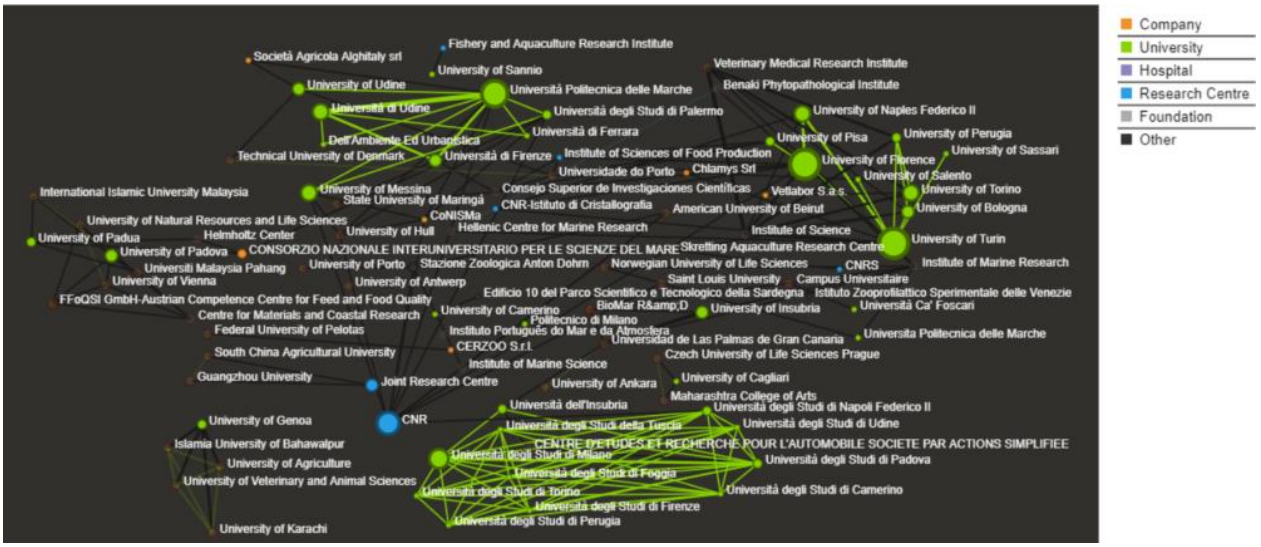


Figure 84 Fish meal: data showing the national and trans-national collaborations (NPL research focusing on France)

Figure 85 Fish meal: data showing the national and trans-national collaborations (NPL research focusing on Spain)

For each of the countries mentioned above the analysis of the divulgation tools confirms that, apart from the little number of patent applications filed by French or Spanish residents, in the remaining countries the preferred forms of divulgation do rely on the patent applications. Data of figures from Figure 86 to Figure 88 corroborate such statement and highlight the technical elements specifically addressed by the publications. The main topics regarding the fish meal sector may be identified by clustering the technical concepts, each cluster being evidenced by means of a specific color.

Figure 86 Fish meal: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Italy)

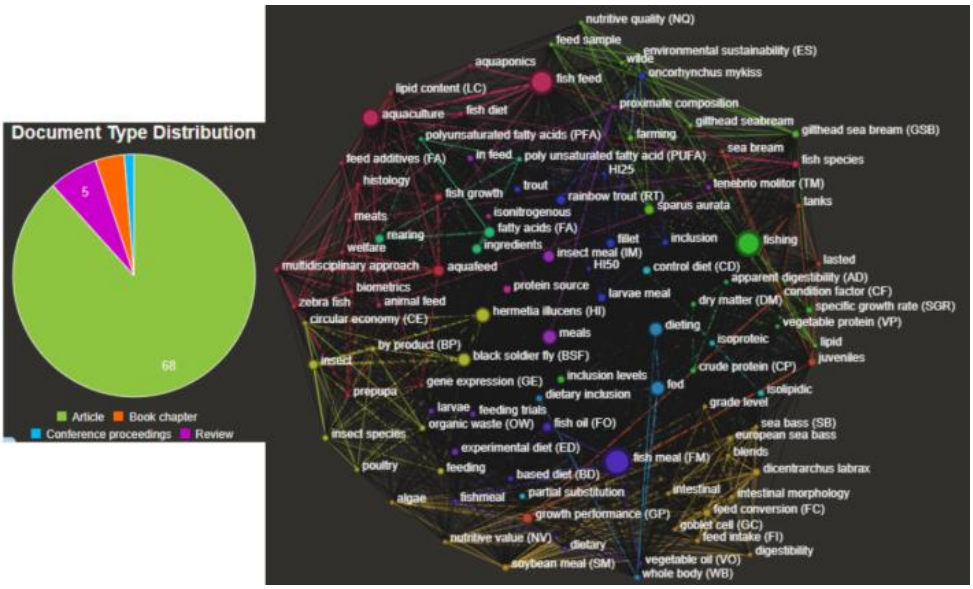


Figure 87 Fish meal: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on France)

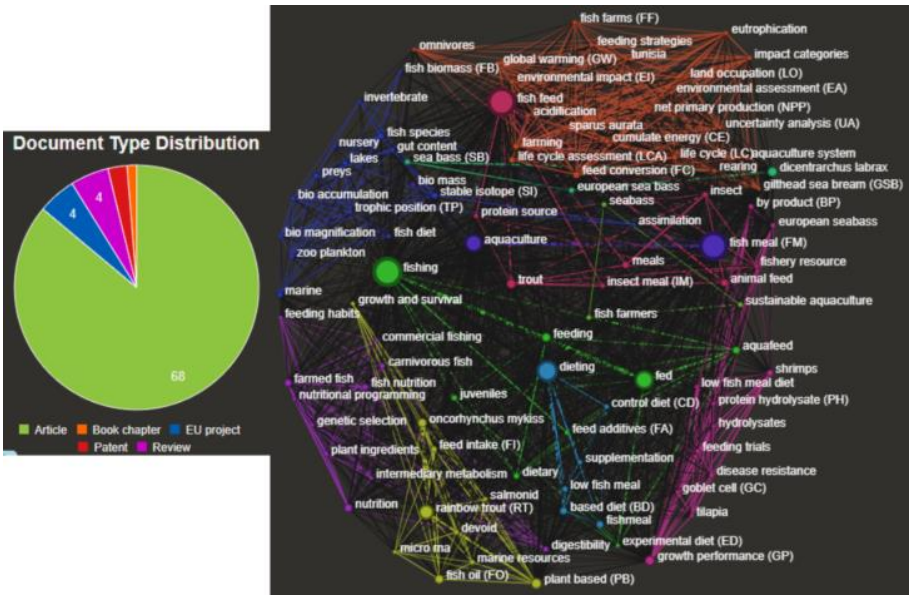
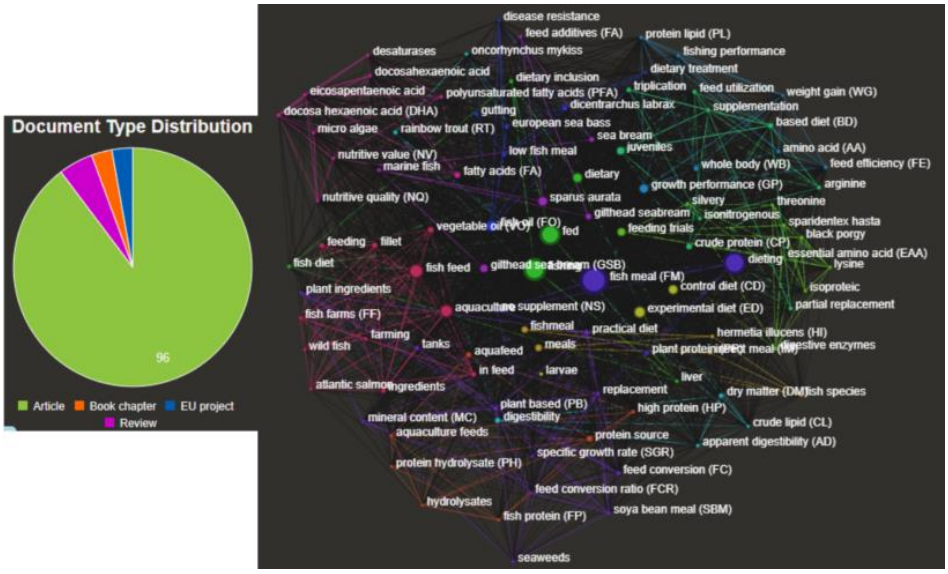


Figure 88 Fish meal: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Spain)



d) Seafood processing and trade

While the consistency of the patents' dataset regarding this specific sub-sector appears more relevant if compared to the patents' datasets specific for the fishery and the aquaculture respectively, the rate of NPL publications ascribed to authors resident in the European countries located along the Mediterranean Sea appears equivalent to that regarding the aquaculture sector and both rates appear modest when compared to the NPL publications specifically dealing with the fishery sector. As countries such as **Spain and Egypt are characterized by the highest number of publications**

produced during the last two decades, Figure 89 and Figure 90 show that the national and international collaborations are quite intensive in both cases.

Figure 89 Seafood processing: data showing the national and trans-national collaborations (NPL research focusing on Spain)

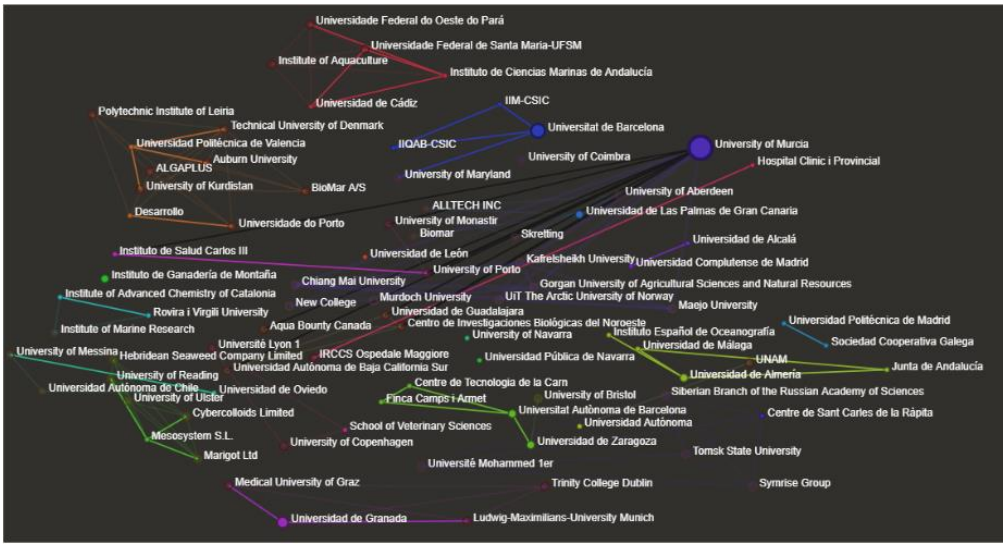
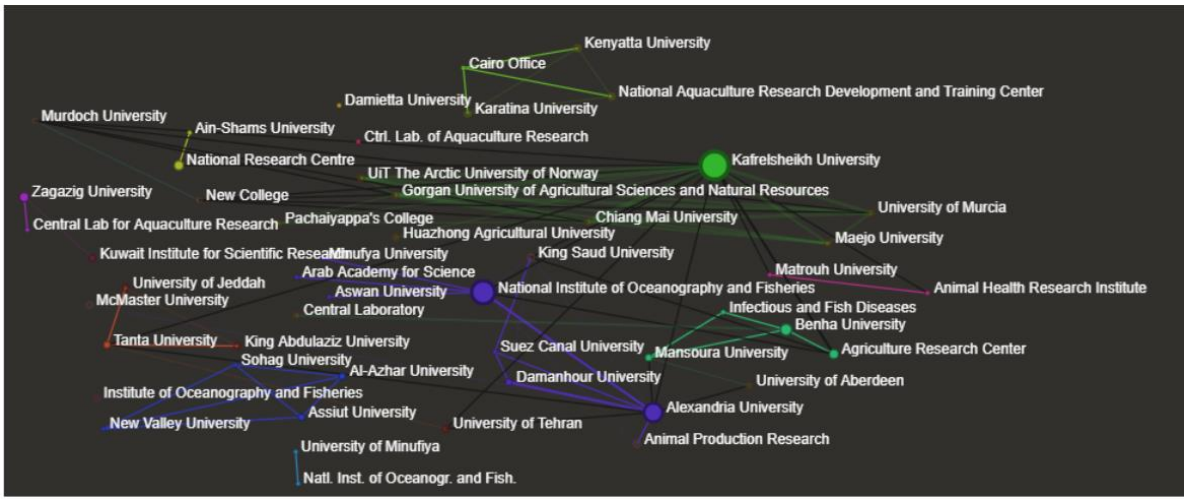


Figure 90 Seafood processing: data showing the national and trans-national collaborations (NPL research focusing on Egypt)



Countries characterized by relevant, though less consistent activities, include Italy, France, and Greece, while relatively smaller commitment may be ascertained as far as Turkey, Croatia and Israel are concerned.

Excluding the patent applications filed from players located in European countries, such as Germany and Switzerland, as already observed in the case of the fishery and the aquaculture sectors, the legal protection obtained through the filing of patent applications is seldom considered in the countries bordering the Mediterranean Sea. Data of Figure 91 and Figure 92, respectively, confirm that NPL divulgation is preferred both in Spain and in Egypt.

Figure 91 Seafood processing: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Spain)

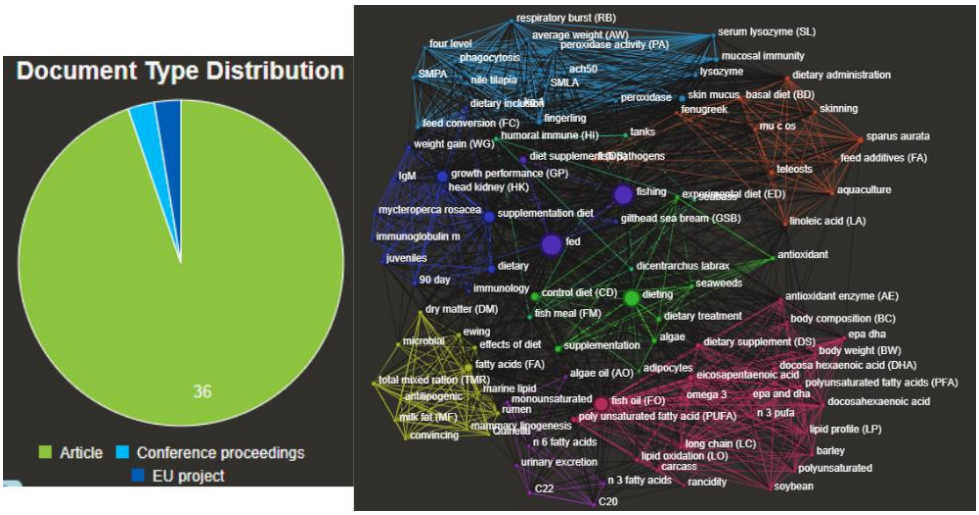
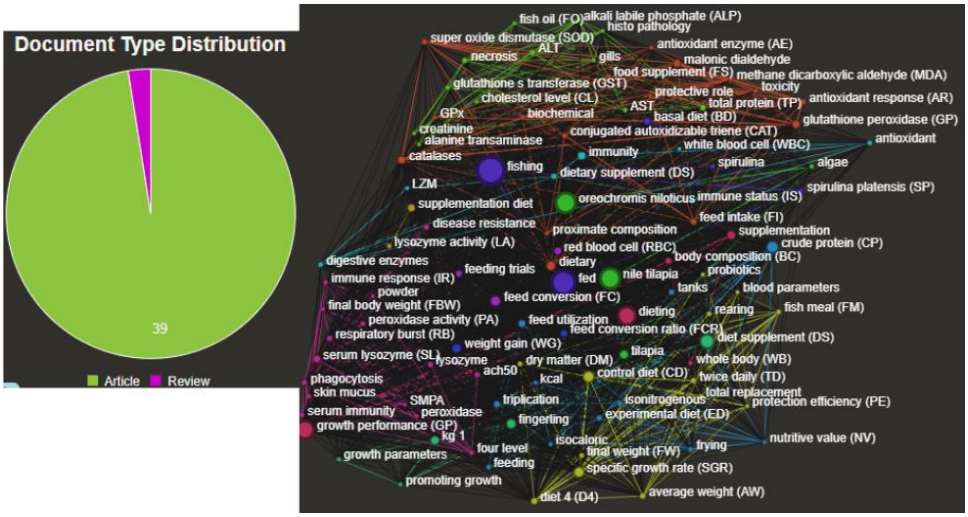


Figure 92 Seafood processing: data showing the partition of the publication kind (left) and the relationships between the automatic keywords (NPL research focusing on Egypt)



7 KEYPOINTS

- Among the European countries bordering the Mediterranean Sea, France and Spain host the players who have recently filed patent applications, though the number of patent applications is generally marginal. Quite consistently those are the countries where the highest number of NPL publications have been produced in the last two decades, with few exceptional cases.
- The number of NPL publications produced as far as the fishery and aquaculture sectors are prevalent if compared to each of the other sectors and the role played by Italy, France and Spain appears quite consistent.
- It is noteworthy that the number of publications regarding the seafood processing sector is quite modest, to the contrary the number of patent applications is consistent. Such trends suggest that there may be a relevant margin for implementing the number of initiatives involving the European players, especially those residents along the Mediterranean Sea.

8 PLAYERS TO BE MONITORED AND EU FUNDED PROJECTS

A list of the players whose activity, based on the evaluation of the legal protection propensity in one or more sub-sectors, may be worth of consideration and periodical monitoring follows:

- **BYKS** (BYKS AS - OceanGlobe)
- **THE NEW ZEALAND INSTITUTE FOR PLANT AND FOOD RESEARCH** (Seafood Technologies: Plant & Food Research (plantandfood.co.nz))
- **XYLECO** (https://www.xyleco.com/impacts/)
- **DSM NUTRITIONAL PRODUCTS** (https://www.dsm.com/corporate/about/businesses/dsm-nutritional-products.html)
- **KIVERDI, Inc.** (https://www.kiverdi.com/)
- **HAUGE AQUA** (https://haugeaqua.com/)
- **GENOCEAN** (https://opencorporates.com/companies/fr/518466305)
- **KRAFT FOODS** (https://www.kraftheinzcompany.com/)
- **TRUE ORGANIC PRODUCTS Inc.** (https://true.ag/)
- **MARINE TECHNO** (https://marinetechno.tradekorea.com/main.do;JSESSIONID_TK=8Uhw6vu8rUdNcBeZ69A0fVM2saYIcu5o-nCmEkic_0057K206CRk!-798423004!1742867100)
- **NESTEC** (https://www.eitfood.eu/partners/partner/nestec)
- **YNSECT** (Ynsect, Premium Natural Feed)
- **ADISSEO** (Nutrition animale | Adisseo)
- **FERMENTALG** (Home - Fermentalg - Algae you can trust)
- **NIREUS AQUACULTURE** (Homepage | NIREUS AQUACULTURE)

RELETED EU FUNDED PROJECTS:

Fisheries

1) **A Holistic Opto-Acoustic System for Monitoring Marine Biodiversities (SYMBIOSIS).** We present the SYMBIOSIS project to provide a mature, cost effective autonomous optico-acoustic prototype for the characterization, classification, and biomass evaluation of six target pelagic fish that are important to the fishery industry and that reflect on the health of the environment. The processing will be made in a real-time fashion onsite, and the results will be sent to a shore station.
Grant agreement ID: 773753
https://cordis.europa.eu/project/id/773753

2) **Paradigm for Novel Dynamic Oceanic Resource Assessments (PANDORA).** The Blue Growth of European fisheries is at risk due to over-exploitation, unforeseen changes in stock productivity, loss of markets for capture fisheries due to aquaculture, future trade agreements opening European markets to external fleets, and fluctuations in the price of oil and other business costs. All of these risks need to be considered when providing advice needed to sustainably maximize profits for the diverse array of fisheries operating in European waters and to help safeguard the benefits this sector provides to the social coherence of local, coastal communities.
(Grant agreement ID: 773713)
https://cordis.europa.eu/project/id/773713

Aquaculture

1) **Sustainable innovation of microbiome applications in food system (SIMBA).** The objective of SIMBA project is to harness complex soil and marine microbial communities (microbiomes) for the sustainable production of food. SIMBA will focus on two interconnected food chains, i.e. crop production, aquaculture....Microbiome-tailored interventions will be specifically developed including soil, plant, fish, aquaculture and food/feed processing towards optimal layout as defined in the modelling step, as follows: i) Identified optimal microbiome consortia will be designed and tested in lab, pot and field trials to improve plant productivity and health; ii) Marine microbiomes will be applied to facilitate sustainable aqua and agriculture; iii) Optimal microbe/microbe consortia will be used to convert raw-materials and residuals to high quality food, feed or finally to energy.
Grant agreement ID: 81843
https://cordis.europa.eu/project/id/818431

2) **Mediterranean Aquaculture Integrated Development (MedAID)**. Production and productivity of Mediterranean marine fish aquaculture, mainly seabass and seabream, are stagnating or growing slowly as a result of multiple and interrelated causes. To accomplish the objective of improving its competitiveness and sustainability, MedAID is structured in a first interdisciplinary WP to assess technical, environmental, market, socioeconomic and governance weaknesses, and in several specialized WPs exploring innovative solutions, followed by an integrating WP, which will provide codes of practice and innovative tool-boxes throughout the value chain to enhance the sector performance holistically. Biological performance (nutrition, health and genetics) will be scrutinized to identify and quantify the relevant components to improve Key Performance Indicators (KPIs: growth rates, mortality and feed efficiency), thus contributing to increase production efficiency.
Grant agreement ID: 727315.
https://cordis.europa.eu/project/id/727315

Seafood processing

1) **Convenience Food Enriched with Marine based Raw Materials (ENRICHMAR).** Recent process improvements have created new possibilities for the use of marine based ingredients in functional foods. Consumers tend to favour functional foods over supplementary pills as means to prevent diseases. The market for these types of products is one of the fastest growing markets in the world. By adding marine-based bioactive ingredients from low value by-products and underutilised raw material to foods they obtain added value, both economical, for health and more sustainable use of resources. Few natural food antioxidants are commercially available on the market. Due to strong market demand and very positive preliminary tests it is believed that seaweed food antioxidant extracts can be highly competitive on the market and find various uses in food. A unique new tasteless omega-3 powder ingredient is new on the market with the ability to both regulate and maintain the body's omega-6/omega-3 fatty acid balance while simultaneously safeguarding the daily need for omega-3 from fish and protective biological antioxidants from olives (flavonoids). The aim is to increase the value of convenience food by enriching seafood, cereal and dairy products with bioactive compounds; powder of fish oil and seaweed extracts with confirmed bioavailability. The functional properties of the enriched products will be studied via dietary intervention
(Grant agreement ID: 606023).
https://cordis.europa.eu/project/id/606023

Fish meal

1) **Sustainable management of mesopelagic resources (SUMMER)**. The SUMMER project will explore recent findings that suggest that the mesopelagic zone of oceans contains 90 % of the planet's fish biomass. Even if a fraction of this is correct, the exploitation potential in fishmeal production, nutraceuticals and pharmaceuticals is enormous. However, as the role of mesopelagic fish is not understood in terms of the ecosystem, it is first necessary to establish tools to accurately

estimate their biomass and the interspecies impact at that level. Using eDNA[5], acoustics and gut analysis among other tools, SUMMER will also investigate the environmental repercussions of such exploitation. The resulting outcome will provide a better idea of the mesopelagic commercial potential and its impact on ecosystem balances.
Grant agreement ID: 875429
https://cordis.europa.eu/project/id/817806

2) **Intelligent Fish feeding through Integration of ENabling technologies and Circular principle (iFishIENCi)**. iFishIENCi will deliver breakthrough innovations supporting sustainable aquaculture, based on enabling technologies and circular principles, thereby providing the European aquaculture industry with the competitive advantage and growth stimulation needed to be a mover in revolutionizing global efficiency in fish production and meet society's needs for food from the ocean.
Grant agreement ID: 818036
https://cordis.europa.eu/project/id/818036

3) **INSECTS FOR A SUSTAINABLE AQUACULTURE 2 (IFASA 2)**. Fish feed manufacturers and fish farmers are seeking innovative ways to increase the nutritional value of their products while reducing the environmental impact of their supply chain. Insect protein stands out as one of the best solution to address this need and drive the development of sustainable aquaculture. Insect protein has demonstrated excellent nutritional performance with less pollutants than fishmeal (heavy metals, pesticides residues, PCBs, dioxins), restoring a natural diet for farmed fish that eat insects in the wild (e.g. salmon, trout, seabass). InnovaFeed's insect protein is an alternative source of quality protein that will address the fish feed challenge and support the aquaculture sector's growth.
Grant agreement ID: 823566
https://cordis.europa.eu/project/id/823566

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9 Methodology in Brief

The selection of the patent documents has been performed using the database Orbit Intelligence (see also the chapter "References"). The queries are listed in the following table:

The FamPat collection of Orbit Intelligence implies a comprehensive family coverage of worldwide patent publications published by more than 100 patent authorities. In Fampat, a single-family record combines together all publication stages of each family member. Questel has developed a family definition which incorporates the EPO's strict family rule with additional rules to take into account the links between EP and PCT publications and links between US provisional applications and US published applications. Fampat's family definitions also incorporate different patenting authorities' definitions of an invention, particularly useful with Japanese publication searching. As far as details regarding the coverage of the FamPat collection are concerned, pls. refer to: Orbit data coverage.

[5] The theme was also addressed in the section "Industrial Processes and Manufacturing" of the Blue biotechnology section.

	Dataset	Orbit query (FamPat collection)	ND Patent families	Applications
Fishery and Aquaculture	**Fishery**	(SEINE_NET+)/TI/AB/CLMS/OBJ/ICLM/KEYW ((DEMERS+ OR BENTHO+) 2D TRAWL+)/TI/AB/CLMS/OBJ/ICLM/KEYW OR (((SEA+ 2D (DEEP+ OR DEPTH)) 2D TRAWL+)/TI/AB/ICLM/CLMS/OBJ/KEYW) (E04H-017 OR A01K-073 OR A01K-069 OR G06F- 017)/IPC/CPC 1 AND 3 (SEA+ OR MARIN+ OR MARIT+)/TI/AB/CLMS/OBJ/ICLM/KEYW 4 AND 5 2 OR 6	357	688
	Aquaculture	((AQUACULTURE) AND (SEA OR MARIT+))/TI/CLMS/ICLM (FEED+ OR NUTRIT+)/TI/CLMS/ICLM 1 AND 2 PRD=2017-01-01:2020-10-13 3 AND 4	467	717
	Fish feed	((((ANIMAL OR INSECT+ OR VEGETABLE)) 2W PROTEIN) NOT (INSECTICIDAL OR INSECT_RESIST+ OR ANIMAL_PROTEIN_FREE))/TI/AB/CLMS/OBJ/ADB/ICLM/KEYW AND (FISH 1W FEED)/TI/AB/CLMS/OBJ/ADB/ICLM/KEYW	809	2037
	Seafood processing	(FISH+ 2D (DISCARD+ OR (BY 0W PRODUCT+)))/TI/AB/CLMS/OBJ/ICLM	563	1370
			2196	**4812**

The results of each dataset have been subsequently elaborated by means of the Python programming language and further analysed using the Autumn 2020 or the Spring 2021 edition of Patstat online (EPO - PATSTAT. Worldwide Patent Statistical Database). Data extracted from Patstat online were elaborated using the tSNE[6] algorithm in order to produce the clusters based on the classification codes (either IPC or CPC) or to cluster the patent families according to the definition of technical fields provided by WIPO (PRH - Patents - Applications per field of technology).

Elaboration of the NPL data has been performed by interrogation of TIM (Tools for Innovation Monitoring quick_start_tim_open_access.pdf (europa.eu)). The data in TIM comes from Scopus for scientific publications, from Patstat for patents, from the EU data portal for cordis publications. There are also other data available from various sources, like Semantic Scholar, US Patent Office, arXiv (coming soon). Further information about the documents' sources may be retrieved at this URL: 5. Data Sources — TimDocs 0.3 documentation (timanalytics.eu).

For more **information** regarding the **methodology** please see the ***"2. How to read this document"*** report.

10 Online visualizations

For each sector analysed in this report, you can access to the online dashboards realized by means of the MS software Power BI at the following links:

	Sub-Sector	Link

[6] *https://scikit-learn.org/stable/modules/manifold.html#t-sne*

Fishery and Aquaculture	AQUACULTURE	https://app.powerbi.com/view?r=eyJrIjoiNGM3OWUzN2MtMmY1OC00YWQ5LWFmYTctNjQwOWU3N2QwMzdlIiwidCI6ImQ0YWFmY2E2LWJmMzUtNDUxNS1iMDZhLTQ5NzNjZGZiYmVkMyIsImMiOjh9
	FISH MEAL	https://app.powerbi.com/view?r=eyJrIjoiMDA2ZWNmZTEtZjY2My00ODM5LThkYjYtMzVmYmM0Mzc4OGMzIiwidCI6ImQ0YWFmY2E2LWJmMzUtNDUxNS1iMDZhLTQ5NzNjZGZiYmVkMyIsImMiOjh9
	SEAFOOD DERIVATE AND PROCESSING	https://app.powerbi.com/view?r=eyJrIjoiNDFkYmFkZDMtNDg5MC00NWE4LThlYzEtMWU1YmZhZWMyOGQ4IiwidCI6ImQ0YWFmY2E2LWJmMzUtNDUxNS1iMDZhLTQ5NzNjZGZiYmVkMyIsImMiOjh9
	FISHERY	https://app.powerbi.com/view?r=eyJrIjoiYjUxMzliNzMtNTQ2ZC00ZDJlLTkzNzctYzkwMmNlODYxYTgwIiwidCI6ImQ0YWFmY2E2LWJmMzUtNDUxNS1iMDZhLTQ5NzNjZGZiYmVkMyIsImMiOjh9

11 References

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[2] FAO 2020; The State of World Fisheries and Aquaculture (SOFIA): http://www.fao.org/3/ca9229en/ca9229en.pdf

[3] Francocci F., Paifelman E., Ciappi E., Cedre A., Le Corff C., Ruel C., Efstratiou C., Falini G., Giannakourou A.,Solano-Lopez J.M., Strogyloudi E., Raddadi N., Pistocchi R., Valentini S. and Barbanti A., 2019. MISTRAL Blue Growth Book. State of the art assessment and overview on the most relevant drivers and opportunities in the Mediterranean Blue Economy. MISTRAL project, Deliverable D3.1.2; DOI 10.5281/zenodo.3242281.

[4] FAO. 2020. The State of Mediterranean and Black Sea Fisheries 2020. General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cb2429en

[5] FAO. 2018. The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome. 172 pp. Licence: CC BY-NC-SA 3.0 IGO.

[6] MarketsandMarkets Knowledge Store (https://www.mnmks.com/)[7] report "Aquaculture Market - Global Forecast To 2023", August 2018;

[7] Facts and Figures on the Common Fisheries Policy. Basic statistical data-2020 edition. European Commission

[8] Small-Scale Coastal Fleet in the EU. European commission

[7] *© MarketsandMarkets (MnM) 2021. All rights reserved. The MnM Report represent data, research opinions, and/or viewpoints published as a part of a service by MnM and are not representations of fact. The MnM Reports are relevant only as to their original date of publication, and not of the date of this document, and the viewpoints and/or opinions expressed in the original MnM Report(s) are subject to change without notice.*

[9] Penca, J., Said, A., Cavallé, M., Libralato, S., & Pita, C. (2020). Market opportunities for artisanal and small-scale fisheries products for sustainability of the Mediterranean Sea: Towards an innovative labelling scheme. Euro-Mediterranean University.

b) Aquaculture: Marine Finfish aquaculture (MFA) and Shellfish aquaculture (SA)

[1] Aquaculture. (2021). Food and Agriculture Organization of the United Nations. http://www.fao.org/aquaculture/en/

[2] BCC Research (https://www.bccresearch.com/): "Global Markets for Aquaculture Products", April 2018.

[3] MarketsandMarkets Knowledge Store (https://www.mnmks.com/) report "Aquaculture Market - Global Forecast To 2023", August 2018;

[4] THE EU FISH MARKET 2020 EDITION. EUMOFA European Market Observatory for Fisheries and Aquaculture Products;

c) Fish meal

[5] MarketsandMarkets Knowledge Store (https://www.mnmks.com/) report "Aquafeed Market - Global Forecast to 2025", June 2020;

[6] MarketsandMarkets Knowledge Store (https://www.mnmks.com/) report "Insect Protein Market– Global Forecast to 2025", July 2019.

d) Seafood processing and trade

[1] 7BCC Research (https://www.bccresearch.com/) report "Global Markets for Food Processing and Food Packaging Equipment", January 2019.

[2] 8The EU fish processing industry: An economic analysis. European commission.

[3] 9MarketsandMarkets Knowledge Store (https://www.mnmks.com/) report "Processed seafood & seafood processing equipment - Global Forecast to 2023", April 2019.

Patent Landscape datasets

- **Derwent Innovation™** e **Derwent World Patents Index™ (DWPI)** - Patent database provided by Clarivate Analytics. DWPI covers more than 32.5 million inventions (patent deposits and families) for a total of more than 70 million patent documents (December 1, 2016). The experts in Derwent's editorial team manually analyze, summarize and index each patent record, making it easier and faster for analysts to find the information. Time coverage: from 1963 to the present. https://clarivate.com/derwent/about-derwent/).
- **Orbit Intelligence.** Patent database provided by Questel. It is a daily updated system that includes over 54 million patent families and 100 million patent documents with worldwide coverage. Further details can be found at URL: https://www.questel.com/data-coverage/.
- **Patstat Online.** The PATSTAT product line consists of two individual databases. They are available as a bulk data set or via PATSTAT Online (https://data.epo.org/expert-services/index.html), a web-based interface to the databases. PATSTAT Global contains bibliographical data relating to more than 100 million patent documents from leading industrialised and developing countries. It also includes the legal event data from more than 40 patent authorities contained in the EPO worldwide legal event data (INPADOC). Patstat EP Register contains bibliographic and legal event data on published European and Euro-PCT patent applications. For the present analysis the Spring 2020 edition has been consulted.
- **Espacenet:** An instrument developed by the European Patent Office (EPO) and the member states of the European Patent Organisation, which contains more than 110 million patents from the 19th century to the present

day, belonging to more than 90 patent authorities. The system is updated daily and is freely accessible (https://www.epo.org/searching-for-patents/technical/espacenet.html).

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LIST OF FIGURES: