WP3 - Deliverable 3.1.3 - MAPPING INNOVATION NEEDS - REPORT

INDEX

TABLE OF ACRONYMS

T2I	Technology Transfer and Innovation S.C.A R.L.
IDA	Istrian Development Agency Ltd.
AGRRA	Agencija Za Ruralni Razvoj Zadarske Županije
INVESTINFISH	Boosting INVESTments in INnovation of SMEs along the entire FISHery and aquaculture value chain
F&A	Fisheries&aquaculture
FLAG	Fisheries Local Action Groups

EXECUTIVE SUMMARY

This report deals with the results achieved in the framework of the INVESTINFISH project, regarding the mapping of the innovation needs in F&A sectors in the five territories of the project: Veneto, Marche, Puglia, Istria and Zadar.

In the first part of this report the theme of innovation needs useful to the fishing and aquaculture sector is generally introduced. Reference is made not only to the needs relating to technology and methodology but also to those relating to a more sustainable fishing activity from an environmental and social perspective.

This is followed by a methodological note explaining how the procedure for creating the database containing the innovation needs expressed by the organizations belonging to the INVESTINFISH project target was managed.

Finally, in the last paragraph, an overview of the results obtained through the mapping is provided, both from the Italian and from the Croatian side, to be used as a basis for future meetings that will be outputs of the deliverable 3.2.4 of the project.

INVESTINFISH PROJECT

INVESTINFISH - “Boosting INVESTments in INnovation of SMEs along the entire FISHery and aquaculture value chain” is a project funded by the Italy – Croatia CBC Programme under the Priority Axis 1 “Blue Innovation”, Specific Objective 1.1 (S.O.1.1) “Enhance the framework conditions for innovation in the relevant sectors of the blue economy within the cooperation area”.

INVESTINFISH sees the cooperation of n. 6 Partners from 5 Different Regions: T2I (LP – Italy – Veneto), Sviluppo Marche (PP1 – Italy – Marche), D.A.Re. Puglia (PP2 – Italy – Puglia), Punto Confindustria (PP3 – Italy – Veneto), Istrian Development Agency (PP4 – Croatia – Istria), Zadar County Rural Development Agency (PP5 – Croatia – Zadar).

INVESTINFISH main objective is strengthening of competitiveness of F&A production system through promotion of investment programs aimed at acquisition of innovation services. INVESTINFISH implements pilot actions providing some IT-HR F&A SMEs with a roadmap to innovation instruments & services, boosting creation of marketable innovative products and/or processes that will improve the SMEs potential market positioning.

Expected benefits for enterprises are: accelerate time to market, increase linkages with innovators, increase F&A enterprises R&D expenditures in new & greener components/technologies/services, to boost HR-IT competitiveness. INVESTINFISH intends also to offer to the F&A sector to substitute the value chain concept with value network, proposing a shift from traditional value chains towards more collaborative value networks.

FRAMEWORK ANALYSIS OF INNOVATION IN F&A

The 2030 Agenda for Sustainable Development (2030 Agenda for short) offers a vision of a fairer, more peaceful world in which no one is left behind. The 2030 Agenda also sets aims for the contribution and conduct of fisheries and aquaculture towards food security and nutrition, and the sector's use of natural resources, in a way that ensures sustainable development in economic, social and environmental terms, within the context of the FAO Code of Conduct for Responsible Fisheries (FAO, 1995)1

Global fish production peaked at about 171 million tons in 2016, with aquaculture representing 47% of the total (FAO, 2018). The total first sale value of fisheries and aquaculture production in 2016 was estimated at USD 362 billion, of which USD 232 billion was from aquaculture production.

EU production of fishery and aquaculture products, instead, amounted to 6,3 million tons in 2016 (a 2% decline from 2015). Moreover, in 2016, world production of fisheries and aquaculture products decreased by 5% compared with 2015, dropping from 212 million tons to 200 million.

Also, according to the FAO estimates, the average annual consumption of fish per capita worldwide has gone from 9 kg in 1961 to 20.5 kg in 2017, with a demand, in 2016, of 171 million tons, which cannot to be satisfied by fishing alone.

FISHERY

Global capture fisheries production was 90.9 million tons in 2016, a small decrease in comparison to the two previous years. Fisheries in marine and inland waters provided 87.2 and 12.8 percent of the global total, respectively.

[1] FAO "The State of WORLD FISHERIES AND AQUACULTURE – Meeting the sustainable development goals" (2018)

World total marine catch was 79.3 million tons in 2016, representing a decrease of almost 2 million tons from the 81.2 million tons in 2015. **Moreover, the state of marine fishery resources, based on FAO's monitoring of assessed marine fish stocks, has indeed continued to decline.**

The fraction of marine fish stocks fished within biologically sustainable levels has exhibited a decreasing trend, from 90.0% in 1974 to 66.9% in 2015. In contrast, the percentage of stocks fished at biologically unsustainable levels increased from 10% in 1974 to 33.1% in 2015, with the largest increases in the late 1970s and 1980s.

Moreover, fishing pressure, changes in freshwater flow regimes that affect the productivity of coastal waters, nutrient enrichment and consequent anoxia and harmful algal blooms and coastal habitat destruction, combined with other anthropogenic impacts, such as climate change, has imperiled many aquatic species and related ecosystems (Harley et al. 2006; Worm et al. 2009).

To improve this negative trend innovation action were implemented: one of them was the **implementation of the ecosystem approach to fisheries management** as well as improving the **selectivity of gears**, **employing genetics and stock boundaries**, together with **novel fishing techniques** (such as gear selectivity and bottom-impact-reduction) **to mitigate the interaction with protected species as well as bycatch.**

ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT (EAF)

According to FAO, the ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

Generally speaking, *the purpose of an ecosystem approach to fisheries (EAF) is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems.*

Moreover, *an EAF strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.*

To fulfil this purpose, an EAF should address components of ecosystems within a geographic area in a more holistic manner than is used in the current target-oriented approach to management. Doing so will require identifying exploited ecosystems (in their geographic context) and recognizing and addressing their complex nature.

In brief, according to FAO Technical guideline for responsible fisheries, recognizing that fisheries have the potential to alter the structure, biodiversity and productivity of marine ecosystems, and that natural resources should not be allowed to decrease below their level of maximum productivity, fisheries management under EAF should respect the following principles:

- fisheries should be managed to limit their impact on the ecosystem to the extent possible;
- ecological relationships between harvested, dependent and associated species should be maintained;
- management measures should be compatible across the entire distribution of the resource (across jurisdictions and management plans);

- the precautionary approach should be applied because the knowledge on ecosystems is incomplete;
- governance should ensure both human and ecosystem well-being and equity.

To make this EAF operational the principles underpinning this approach need to be “translated” first into policy goals and then into operational objectives that can be achieved by applying management measures.

Policy goals will usually reflect the overarching principles outlined in relevant domestic legislation, regional agreements and international agreements of various kinds. Translation of policy into **action** is more important, but it is probably the most difficult step in the implementation of principles; a way to succeed in this transformation is to:

- identifying broad objectives relevant to the fishery (or area) in question;
- further breaking these objectives down into smaller priority issues and sub issues that can be addressed by management measures;
- setting operational objectives;
- developing indicators and reference points;
- developing decision rules on how the management measures are to be applied;
- monitoring and evaluating performance.

Without this translation, EAF will remain an important, but largely unachievable, concept.

SELECTIVITY OF GEARS

The phrases "fishing gear selectivity", "selective fishing", and "selection of fish" by a fishing gear are widely and sometimes interchangeably used in fisheries science and management.

However, they are poorly defined, causing confusion even among professionals on the subject. We can define "selective fishing" as the ability to target and capture specific types of marine organisms, allowing unwanted sizes and species to evade or escape capture.

Through size selectivity is possible to control the impact of fishing on juveniles through the regulation of coded mesh sizes or other devices and designs; moreover, with size selective fishing, the age at first capture is typically increased to increase total yield from the stock.

Size selectivity also can be described as the ability of fishing gears to target and retain certain sizes of organism typical of a certain species and less so for other species. Methods that improve species selectivity allow fishers to catch and retain desired target species more efficiently, while reduce the amount of non-target species, often called bycatch species. Species selectivity can be achieved through a range of modification in gear design and operation; the knowledge of fish behavior is often fundamental in this development.

Finally, thanks to its small scale, high manageability and good understanding make it a convenient instrument to reach management objectives at large scales. Selectivity can serve to manage what is extracted from the ecosystem and thus what can be used, and/or to manage what is left in the ecosystem and how fishing impacts it.

GENETICS AND STOCK BOUNDARIES

The concept of stock has long been discussed by many authors (Carvalho & Hauser,1994; Waples & Gaggiotti, 2006; Cadrinet al., 2014), but according to Ward (2000),the most commonly quoted biological definition of a stock is that proposed by Ihssenet al.(1981): "*a stock is an intraspecific group of randomly mating individuals with temporal and spatial integrity*".

However, the Common Fisheries Policy (CFP), in its Article 4.14 (E.U.,2013), defined stock as "a marine biological resource that occurs in a given management area". Moreover, this definition corresponds to what is termed by Smithet al. (1990) as a "fishery stock": a group of fishes exploited in a specific area or by a specific method.

In fisheries science and ecology, stock assessment is an important tool in fisheries management. In particular, to ensure continued, healthy, fish stocks, measurements of the Spawning Stock Biomass (the stock population capable of reproducing) allows sensible conservation strategies to be developed and maintained through the application of sustainable fishing quotas.

In practice, it is not easy to identify stocks because the delimitation of adjacent populations involves many difficulties, in the sea where there are no clear geographical barriers. Different methods have been used for stock identification such as morphometry, parasites and genetics (Cadrin et al. 2005).

Through genetics applied to fishery, indeed, is possible to provide, using DNA methods, unprecedented knowledge of population genetic structure. According to Hauser and Carvalho (2008) and Reiss (2009) using this approach many independent stocks and management units within fisheries have been identified. Moreover, there are also examples of genetic methods being implemented in the active regulation of fisheries (Nielsen et al., 2001; Ogden, 2008; Glover, 2010; Glover et al., 2012; Flannery et al., 2010).

A second but equally important and priority theme under which genetics can inform fisheries assessment and management is in resolving issues associated with mixed-stock fisheries (Theme III from Ovendenet al., 2015).

It is possible to relate to mixed-stock fisheries when two or more stocks, that are morphologically very similar or identical and thus impossible to differentiate in the fishery, overlap in time and space. In such cases, according to Allendorf (2008), one of the potentially risk is the under-exploitation and/or the over-exploitation of the separate components of the fishery. To resolve this problem usually a genetic mixed-stock analysis has been applied.

Moreover, genetics can improve other fisheries activities as:

- **seafood traceability**
  In these cases, genetics can be used to create a process by which DNA is extracted from the tissue of each sample and, after a series of steps in the laboratory, the sample DNA is sequenced to produce a pattern similar to a barcode. This process can help to reduce cases of illegal and unregulated fishing

- **designing of marine reserves**
  Through genetics, indeed, is possible to designing no-take zones and define populations and understanding the spatial scale (this is critical especially for define the different strategies required to effectively manage one large population compared to multiple populations). Moreover, genetics generate information about the level of connectivity within and between populations: indeed, it’s important that protected areas are connected with fishing grounds so that, in addition to the conservation of resources, fishers and coastal communities receive benefits.

AQUACULTURE

Unlike the negative trend in fishing, aquaculture has been experiencing a positive trend in recent years. According to FAO, indeed, aquaculture continues to grow faster than other major food production sectors although it no longer enjoys the high annual growth rates of the 1980s and 1990s (11.3 and 10.0 percent, excluding aquatic plants).

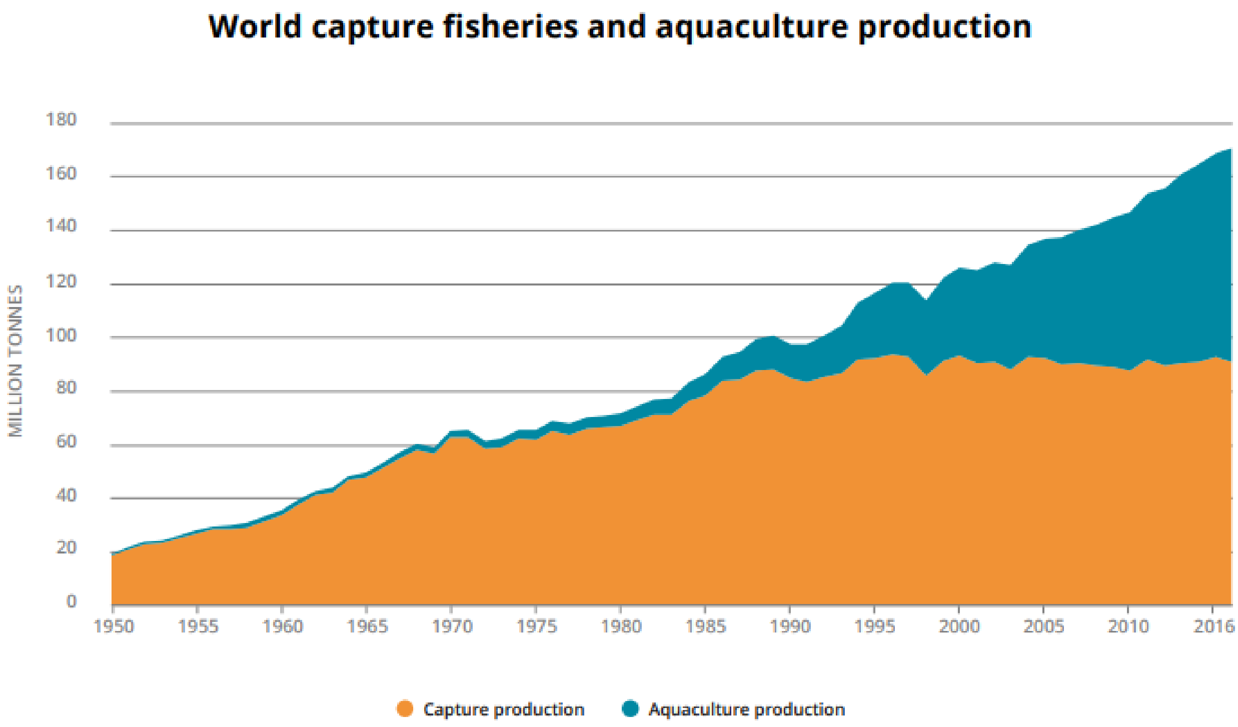

Figure 1 - Word Capture F&A production by FAO

Average annual growth declined to 5.8 percent during the period 2000–2016, although double-digit growth still occurred in a small number of individual countries, particularly in Africa from 2006 to 2010. Global aquaculture production in 2016 included 80.0 million tonnes of food fish and 30.1 million tonnes of aquatic plants, as well as 37 900 tonnes of non-food products.

Farmed food fish production included 54.1 million tonnes of finfish, 17.1 million tonnes of molluscs, 7.9 million tonnes of crustaceans and 938 500 tonnes of other aquatic animals.

The **current challenge in aquaculture innovation** is represented by:

- the **improvement of the nutrition of species and the development of specific species diets,**
- the **sustainability of fish feed production in fish farming**,
- the development of a **health management,**
- the **measures to reduce the impact of aquaculture on the environment** (as reduction of inputs of water & energy and reduction of waste outputs).

NUTRITION & DIETS

Fish nutrition is the study of nutrients and energy sources essential for fish health, growth and reproduction. Aquaculture requires optimization of nutrition to efficiently raise fish for the purpose of food production.

With the world's rapidly expanding population, it is important, indeed, to provide safe and nutritious fish; however, there are many issues related to fish nutrition that need to be considered in order to achieve balance in food production and sustainability.

Moreover, certain issues related to fish nutrition have become controversial due to their impact on the environment and/or their affect on the final product for consumption.

An example of these issues is the feed and nutrient efficiency, the overfeeding and waste and the unsustainable feed ingredients.

Diets of fish should be based on essential nutrients as amino acids, fatty acids, vitamins, minerals and energy-yielding macronutrients (protein, lipid and carbohydrate) to supply all essential nutrients and energy required to meet the physiological needs of growing animals.

In this case, biotechnology research and applications can be a great help to aquaculture industry for developing a more sustainable and efficient aquaculture feeds.

According to various research, indeed, today the most common protein source for many fish diets is fish meal. Fish meal aby-product of fish processing is used because of its high quality and high protein content. However, it has some disadvantages: the first one is represented by its high cost (according to Billington and Hebert (1991), this fish meal sells for about N520.000,00/tone) also fishmeal comes from byproducts of wild fish, but world fish stocks are declining.

Another problem of this meal is that its use in aquaculture causes environmental problems: it contains levels of phosphorous far above the requirement for optimal growth in fish. The excess phosphorus goes into the water, causing problems such as eutrophication or excess algal growth.

As a result of these concerns with fish meal, researchers are using biotechnology to produce alternative plant-based protein source (Adelizi, 1998). Plant protein, indeed, has the potential to reduce the problem of phosphorus pollution.

Sustainable fish feeds are on the rise and substituting plant proteins for fishmeal in feeds is also becoming more prevalent.

HEALTH MANAGEMENT

Biotechnology can also be useful for the treatment and prevention of diseases in the aquaculture environment: disease in aquaculture, indeed, are mostly connected to environmental factors because farmed aquatic animals are much more sensitive to their immediate environment than land animals.

According to Mandany (1996) the water, in which they depend for oxygen and a range of other important chemicals, also takes up their waste products and may carry pollution from the nearby environment.

For this reason, biotechnology focus part of its study on **bio-remediatio**: this refers to the use of friendly bacteria or 'probiotics' to treat water or feeds and by natural processes, discourages the development of 'unfriendly' bacteria that potentially would cause disease (Verschuere et al., 2000)

Also, concerning the **fish health management**, a great number of vaccines against bacteria and viruses have been developed: the old ones have been focused on conventional vaccines consisting of killed microorganism, while the newest are focusing on a protein subunit vaccine genetically engineered and DNA vaccine.

Biotechnological tools such as molecular diagnostic methods, use of vaccines and immunostimulants are gaining popularity for improving the disease resistance in fish and shellfish species world over for viral diseases. However, in this context there is a need to rapid method for detection of the pathogen. **Biotechnological tools such as gene probes and polymerase chain reaction (PCR) are showing great potential in this area** (especially for fish and shrimp - Karunasagar, 1999).

Moreover scientists, are investigating genes that will increase production of natural fish growth factors as well as the natural defense compounds marine organisms use to fight microbial infections.

MEASURES TO REDUCE THE IMPACT OF AQUACULTURE ON THE ENVIRONMENT

According to FAO 2016, the aquaculture industry is the world's fastest-growing food production sector and only with a sustainable aquaculture growth will be possible to easing pressure on wild fish stocks, which are globally under stress as a result of overfishing. For this growth to be sustainable in terms of environmental impacts, the industry must grapple with issues arising from interactions between aquaculture activities and the natural environment and develop solutions to minimize negative effects on wildlife (and vice versa).

The first step should be to assess the state of knowledge on these issues and identify the most severe effects. A recent study conducted by Luke t-Barret, Stephen E.Sewarer and Tim Dempster (2018) has revealed that wild fish generally do not interact directly with stock.

Of more concern is the role that wild populations play as reservoirs for pathogens and parasites, facilitating reinfection of farms (Uglem et al. 2014). Unfortunately, this risk is inevitable for farming in open systems but, accorded to Samsing (2016) research is underway to lower infection rates by minimizing spatiotemporal overlap between stock and zones of high infection risk. Moreover, also post-infection treatments are in a development state to minimize the role that farms play as amplifiers of pathogen and parasite populations.

Moving away from a negative point of view of this interaction, we must recognize that wild fish can provide ecosystem services to aquaculture operations by increasing animal welfare and reducing local environmental impacts of farming. Invertivores fish that are small enough to gain access to sea cages can act as cleaner fish and significantly reduce parasite loads on stock.

Moreover, it has to be recognized that with aquaculture, farmed fish are closely monitored in comparison to wild fish and farmers have more control over variables. This can positively impact the environment and the fish. Farmed fish are generally free of environmental contaminants like mercury and heavy metals, as they exclusively eat human-processed feed. Fish feed's toxin levels are regulated.

Moreover, the farming of filter-feeders (as shellfish) can improve water quality: these creatures eat excessive nutrients in the water, which, in turn, prevent the buildup of effluent. Filter-feeders are often integrated into the farming of other species, like finfish, to use uneaten feed and fish waste as food, offsetting the farm's environmental impact. This system is called polyculture, or integrated multi-trophic aquaculture (IMTA).

Finally, according to the World Economic Forum have been discovered others ways to minimize aquaculture's environmental footprint and push the industry to be more sustainable as it develops, here are some of them:

1. **Moving aquaculture into land-based recirculating system (RAS)**
   Recirculating aquaculture systems (RAS) are technologies that create suitable conditions for aquaculture using indoor tanks, pumps, aerators and filters; with new developments, they can be designed to attain up to 100% water recycling within the system. Moreover, the possibilities with land-based RAS are endless: they act as a mitigation strategy for traditional aquaculture's environmental impacts and also allow for aquaculture to take place anywhere, including in urban areas and the desert.

2. **Moving offshore**
   These offshore systems are marine net pens that are placed out in the open ocean far from the coastline, and as a result make it a more environmentally

conscious option. Open ocean, indeed, offers deeper water and more powerful currents than in coastal areas that allows offshore aquaculture systems for more efficient dilution of waste produced from the farm system. Also, in offshore waters there are fewer nutrients and less biodiversity than in fragile coastal waters, enabling a faster dispersion of fish waste into the marine food web, with less environmental impact.

3. **Utilizing multi-trophic aquaculture**

   Through this system is possible to reduce nutrient accumulation by using filter feeders as artificial filters: multi-trophic aquaculture involves farming of species like shellfish, seaweed and carp alongside the target farmed species (salmon, trout, or shrimp). The byproducts from the feed that are used for target species becoming the feed sources for the filter feeders. Consequently, this system reduces waste accumulation and helps improve water quality, all while providing additional economic value to the farm.

Aquaculture faces immense challenges in the future. But with the industry simultaneously growing and evolving, the goal of feeding the world in a sustainable manner is certainly attainable.

In this regard it is extremely important to highlight the innovation needs coming directly from the main players of the F&A sector. This was the thinking perspective that led to the birth of the mapping of the innovation needs and the innovation needs database of the INVESTINFISH project.

METHODOLOGY

The innovation needs database was created through a public call research, structured with a Google Form for response mechanism that allowed the partners to have all the data already organized in an excel file, ready to be processed and analyzed.

Partners prepared the call in English and their language and pushed it through the project website, their personal website, social media channels and all other useful media for the purpose.

Google Form was chosen because it allows to include different types of questions (such as short answers, paragraphs, multiple selection, verification boxes, pull-down, linear scale, grid of several options, among others) and is easy to use both for creators and respondents. Moreover, Google Forms allow to share both the editing of the forms and the results with all Partners: everyone can view them at the same time, make edits at the same time and see other people’s edits as they make them.

Finally, through Google Forms is possible to receive results automatically to a Google Sheet (shareable between partners via links) that makes data analysis quicker and easier. Indeed, Google's document sharing abilities are extremely useful when it comes to collaborating with other parties.

The structure of the Google module use for this research was the following:

- ORGANIZATION NAME
- LOCATION
  - Address
  - City
  - Country

- CONTACTS
  - Mail
  - Phone number
- WEBSITE
- LEGAL STATUS
  - Public
  - Private
- TYPE OF ORGANIZATION
  - SME of Fishery Sector
  - Large Company of Fishery Sector
  - SME of Aquaculture Sector
  - Large Company of Aquaculture Sector
  - Association of Fishery Sector
  - Association of Aquaculture Sector
  - Local Public Entity
  - Regional Public Entity
  - National Public Entity
  - Networks
  - Clusters
  - Digital Innovation Hub
  - Universities & Research Centres
  - Competence Centres
  - Scientific Parks
  - Incubators/Accelerators
  - Business Support Organization
  - Innovative SMEs/Start-Ups

- TARGET AREA
    - Local
    - Regional
    - National
    - International

- YEAR OF ESTABLISHMENT

- Brief Description of your Organization in terms of product/services offered in F&A sectors

- Do you think that there are specific innovation needs in the fishing and aquaculture sector?
    - Yes
    - No

- Indicate 3 keywords related to the innovation needs of the fishing and aquaculture sector

- What are the main areas where innovation is needed?
    - Leftovers
    - By-products (second raw material/circular economy)
    - Waste and waste disposal
    - Pollution (engines consumption/efficiency, renewable sources of energy, plastic in the sea)
    - Quality of aquaculture products (virus resistance, water oxygenation)
    - New materials (ecologic materials for the nets and the bags used)
    - New eco-friendly technologies for fresh-water aquaculture and marine-culture
    - Packaging

- New management system for companies
- Improvement of accessibility and connectivity
- Logistic management system
- Improvement of consumer perception and awareness
- Market expansion (national/international level)
- Digitalization (Industry 4.0)
- Coastal/lagoon dredging
- Other____

WP 3 - Del. 3.1.3 - Mapping Innovation Needs

PP	n°	NAME	Address	City	Country	Mail	Phone number	Website	Type of Organization	Legal Status	Targeted Area	Year of establishment	Key services	Do you think that there are specific innovation needs in the fishing and aquaculture sector?	Indicate 3 keywords related to the innovation needs of the fishing and aquaculture sector	What are the main areas where innovation is needed?

Figure 2 - Database example

RESULTS

Below is reported a summary of the priority characteristics of the questionnaires carried out to learn about the innovation needs of the innovative poles and of the actors in the F&A sector. For more information, or detailed research, please refer to the relevant database.

The totality of the interviewees found a strong need for specific innovation needs in the fishing and aquaculture sector. Regards the **Italian part**, a plurality of subjects was consulted, divided between public (39% of the participants in the questionnaire) and private (61%). The **Croatian side,** on the other hand, showed a greater participation of public subjects (53%) than private individuals (47%).

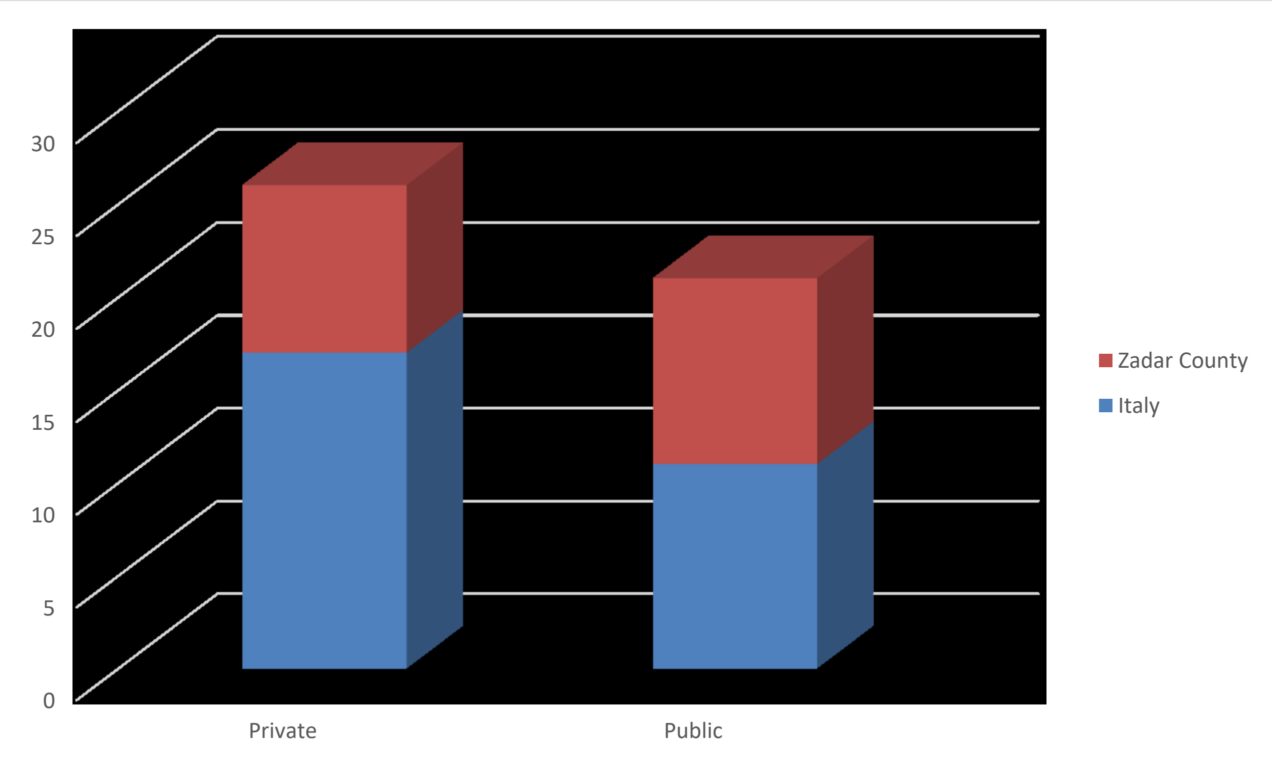

Figure 3 - Italian side - Legal Status

As for the target area, it is evident from the database how, for the **Italian side**, most of the respondents operate mostly in a national context (31%) followed on an equal footing by the regional and international (25%). Only 19% of respondents work locally.

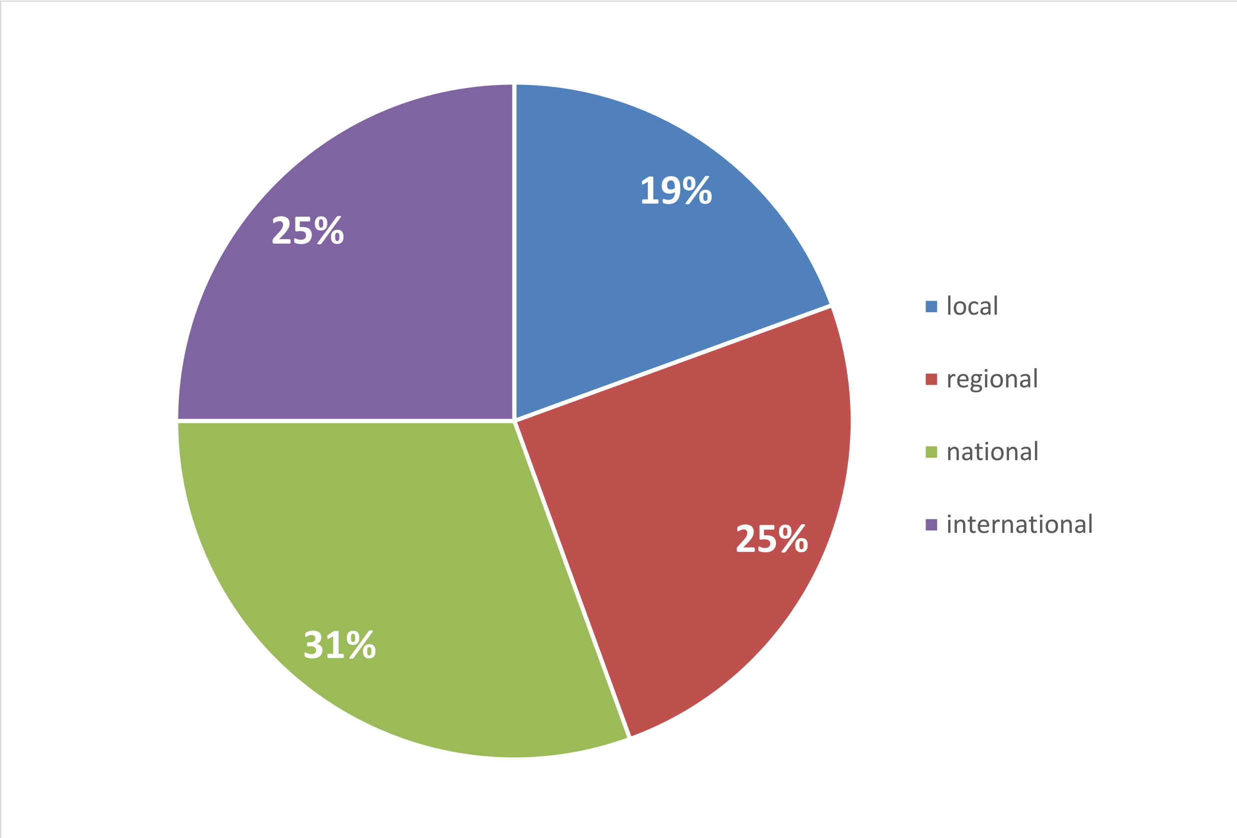

Figure 4 - Italian side - Target Area

On the other hand, as far as the **Croatian side** is concerned, most of the subjects who answered the questionnaire work mostly in the local field (37%). In second place are the subjects operating internationally (26%) while the subjects operating at the regional level are those that have less replied to the questionnaire (18%).

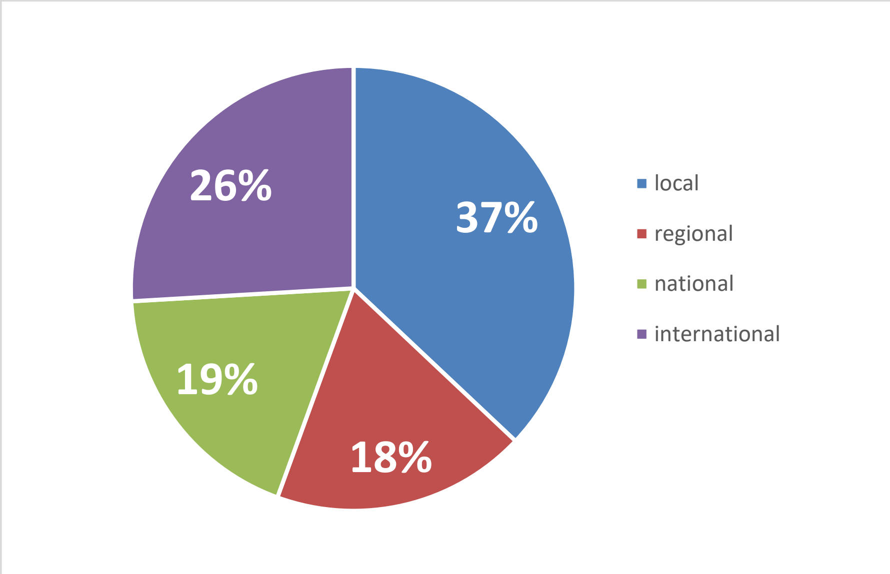

Figure 5 - Croatian side - Target Area

The organizations involved in the **Italian side** were mostly Association (27%), SMEs (23%), University and Research Center (20%) and regional, national and local Public bodies (20%).

It should be specified that Italian side has decided to involve associations formed by a large number of SMEs linked to the fishing and aquaculture sector. This choice was made as we believe that, this union of knowledge belonging to the same sector but coming from different subjects, can develop and spread knowledge and favor the creation of new opportunities for innovation (in a perspective of Open Innovation).

The situation is clearly different in the context of **Croatian responses**: here most of the organizations that responded are mostly SMEs (40%) and Association (25%). They are following by Local, National and Regional Public Entities (15%). In addition, a Large Company of Aquaculture sector and Zadar County Chamber of Trades and Crafts as Business Support Organization also participated in the questionnaire.

With regard to the innovation needs highlighted by companies, on the other hand, we can say that on the Italian side a greater demand is visible in five specific areas: Residues and leftovers not used (13%), Pollution (12%), Quality of aquaculture products (11%), Waste and waste disposal (10%) and New materials (10%)

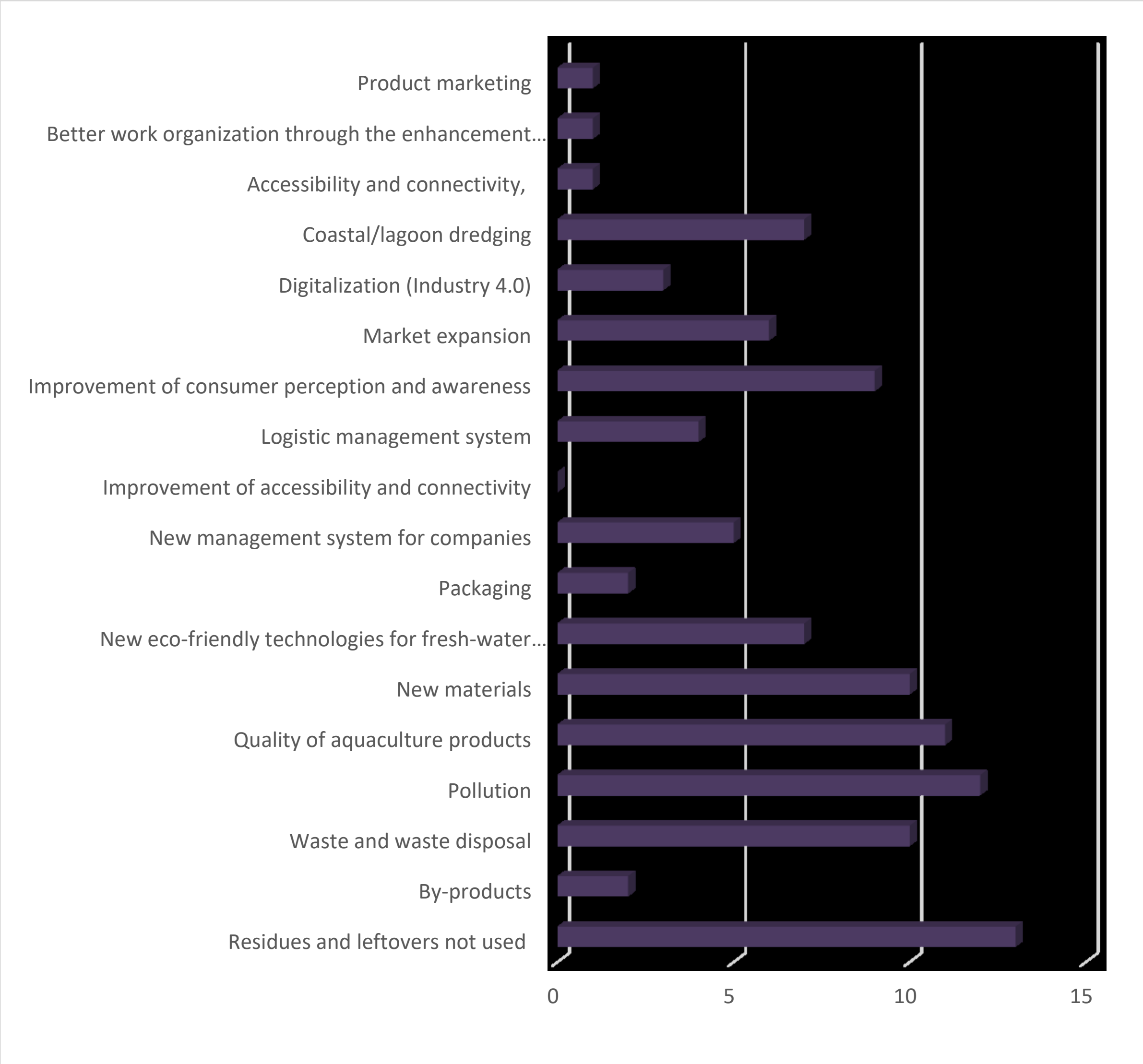

Figure 6 - Italian side - What are the main areas where innovation is needed?

On the **Croatian side**, the organizations with which the INVESTINFISH project came into contact have demonstrated innovation needs that are mostly different from the Italian side, focusing above all on the environmental and environmentally sustainable sector: in fact, as many as 16% of respondents have expressed a strong need for innovation especially in the creation of new eco-friendly technologies both for fresh-water aquaculture and marine-culture. They also highlighted a strong need for new, more ecological materials for the nets and bags used during the activity (14%).

At the same time, the actors on the Croatian side denote the need for a greater opening up of the fish market, demanding an expansion of the market that can satisfy all internal operators (14%) and, at the same time, require better management in the waste and waste disposal and innovative impulses on the side of the reduction of pollution (especially in the field of engines consumption / efficiency, renewable sources of energy and plastic in the sea) which are positioned, both with 12% of the interviewees.

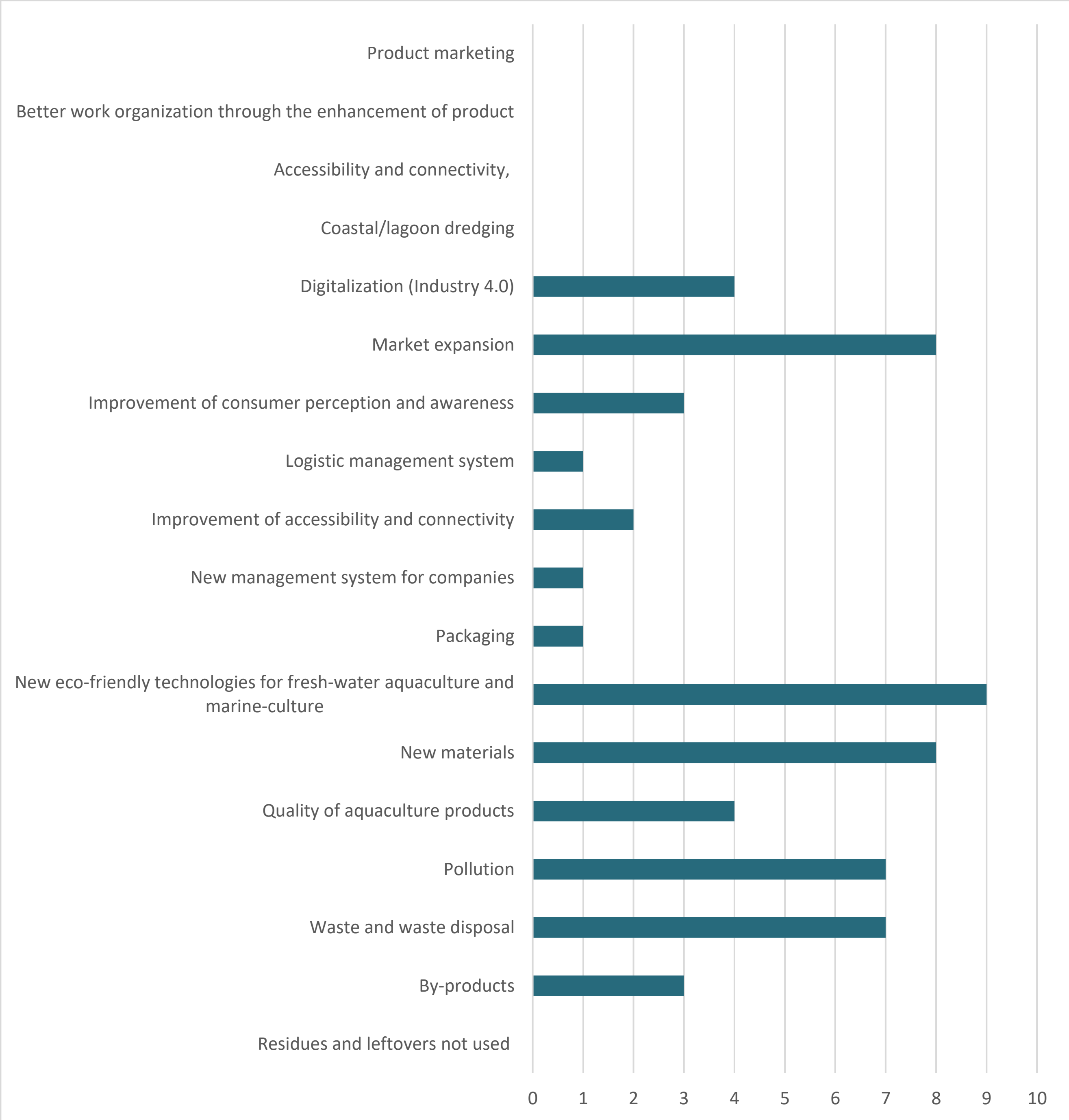

Figure 7 - Croatian side - What are the main areas where innovation is needed?

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