

1. Basic Information

1.1. Title:

Circular economy for food: partnership for sustainable coastal cities in Western Mediterranean

Économie circulaire de l'alimentation: partenariat pour des villes côtières durables en Méditerranée occidentale

1.2. Location:

Italy (Palermo/ Livorno), France (Marseille), Morocco, Portugal, Spain

1.3. Project Partners:

France: Groupement LAVE (Laboratoire d'Adaptation Ville Environnement), Institut Océanographique Paul Ricard; Fondation Veolia; APAM Pêche; Ecocean; Inter-Made; La Cité de l'Agriculture; LICA; Pikaia; Rêves Germés- Le Présage.

Italy: Federpesca, Ciheam, ENEA, ANCI, Milan Food Pact, CNR, Ispra.

Tunisia: Ministère des Affaires Locales et de l'Environnement, Municipalité de Bizerte, Université de Carthage, Faculté des Sciences de Bizerte, Tunisie,; INRAP, Institut National de Recherche et d'Analyse Physico-Chimique; INSTM, l'Institut National des Sciences et Technologies de la Mer.

Marocco:

International: FAO...

2. General relevance

The Mediterranean cities

The Mediterranean cities have come back to the fore as the new centres of regional political, economic, cultural and social dynamics. The Mediterranean, from the Latin *mediterraneus*, "midland", indicates at the same time a passage, a source of culture, a way of life, a liquid bridge, a vision and a belief. We cannot talk about the Mediterranean without talking about its cities. Currently more than 75% of the Mediterranean population lives in urban areas of more than one hundred thousand inhabitants and even more are expected in the next decades. That's why the historian Braudel describes it as "a network of cities holding hands". They are places that change constantly, albeit preserving common and recognizable features, such as social stratification and spontaneous growth in which the historical centres remain poles of attraction.

This super-urbanization process produced, in the last 60 years, the degradation of the territory equilibrium that coexisted with significant effects on the environment and on life quality. Mediterranean cities are now facing with complex reorganization problems that require appropriate tools to cope with the rapid structural change of environment, society and economy. These issues can be addressed only when working with long-term and holistic approach. In this context the challenges caused by the climate change make it even more urgent to strengthen an adaptive capacity to deal with a sustainable future.

Coastal Mediterranean cities are thus a key factor in the transition to a circular economy, sustainable development and wellbeing. At the moment, in fact, it is estimated that 75% of natural resource consumption occurs in cities where 50% of global waste and 60-80% of greenhouse gas emissions are produced. These are the symptoms of the «Take, Make, Dispose» Linear economic model, which is no more sustainable from an economic, ecologic and social perspective.

Agriculture & Fisheries

Agriculture & Fisheries sectors have strong potentials to contribute to the economic diversification of urban and peri-urban areas. At Mediterranean level, the horizons for the sectors are quite ambitious, spacing from food security improvement, climate change adaptation, the enhancement of food quality and safety and health standards, local production promotion through safeguard and support of family farming and economic diversification. The mission for the sectors concerns: food security carried out through provision of basic needs; improvement of food quality and safety and enhancement of human health; demonstration of food authenticity and traceability; optimal exploitation of natural (land and water), financial and human resources; reduction of environmental impact; respect of the ethics of production; proper utilization of modern technology and foreign expertise to support properly private and public sectors. Agriculture & fisheries are also considered a key sector where youngsters may find job opportunities increasing smallholder's self-reliance.

Attention should be given to complete the product cycle "from farm to fork". To achieve such a mission, the aim is to activate and foster the capacity of urban and peri-urban agricultural and fisheries areas to improve the production in terms of quantity and quality. In this dynamic peri-urban farms and fisheries play a key role in peri-urban development. This can provide direct benefits for the peri-urban areas themselves, as well as for the needs of the cities (properly urban areas), in terms of a proper use of natural resource, environmental quality, land conservation and valorisation, protection of water-resources, biodiversity conservation, food quality, improvement of the quality of life of citizens with benefits on both producers and consumers. In this respect, the agri-fisheries sector shall play its role for the stabilization of urban population in a path of resiliency and stability. Furthermore, peri-urban farms and fisheries can benefit of the opportunities offered by the city, such as a very receptive potential market, which requires fresh and quality food products. In particular, the direct product sale and the short chain can help companies and favour the spread of more sustainable production models, as well as promote the distribution and use of traditional – and in case neglected – products.

Strengthening Food Systems in Coastal Cities through a circular economy approach

Taking into consideration this general framework, what is here proposed is to focus on coastal cities as key points for the sustainable development of the West Mediterranean area developing a set of intervention aimed to improve the long term sustainability of urban areas and communities focusing on a circular food production and consumption system. A holistic approach, able to improve the economic, environmental and social performance of the territory while guaranteeing food security in a deeply changing marine and climatic environment, will be applied. The approach will be developed taking into account the peculiarities of Mediterranean coastal cities while not neglecting the differences between North and South coasts that make Mediterranean coasts such a precious resource for commerce, tourism and economy in general.

3. Objectives

3.1. Overall Objective(s):

A framework of actions focused on the improvement of the coastal cities performance, mainly centered on the food production and provisioning are proposed, aiming at the circularity of the process and the reduction of the negative externalities due to non-efficient system.

The main objectives of the project are:

- develop circular ways to guarantee food production and consumption sustainability with a holistic and long term perspective considering the concurrent growing of population, the depletion of natural capital (i.e. sea stocks), the concentration of people in cities and the climate change effect on the Med area;
- favour the production of affordable and nutritious food from local and regional producers with the aim to improve consumer food security;
- change the access to traditional and alternative markets (i.e. farmers' markets, fish markets, community supported agriculture) improving livelihoods of both small-scale and large-scale producers;
- reduce food waste and stabilise livelihoods by means of local and regional food hubs and shorter value chains;

- propose methods to resource, recover and reuse water, nutrients, primary materials and energy;
- define actions and strategies for the climate change effect mitigation and adaptation in the coastal cities;
- contribute to efforts to cut down emissions and climate change by developing decarbonized production ways (switching from cold-chain processes to life-chain processes)
- set up participatory governance structures to include stakeholders from multiple sectors from both urban and peri-urban areas in a given city region.

3.2. Project purpose:

- To identify gaps and priorities based on a pre-identified set of indicators. City workshops will be organized to engage all relevant stakeholders from different sectors to assess missing links among food systems, territorial development and blue economy.
- To share best practices, expertise and research between partners of different countries (France, Italy, Morocco, Tunisia) including the possibility of developing and supporting common research programs in order to find innovative solutions to the emerging common issues
- To establish new or improved productive systems focused on sustainability criteria, reduction of resource consumption, circularity of matters, integrated management of resources and waste (also considering the water resource management and wastewater treatment), improvement/demonstration of food quality, safety and traceability.
- To establish a circular city living lab in selected cities, engaging local residents and key experts to identify local innovative experiences related to food, waste and fisheries and undertake pilot-actions.
- To define overall urban blue food strategy integrated into the territorial development strategy.
- To promote increased linkages between tourism and peri-urban agriculture & fisheries that will generate economic investment opportunities and build resilience of communities and enhance the sustainable development of both the tourism and agriculture & fisheries industries

4. Description

The project is thought with a specific modular framework. Different pilot actions are here proposed and may be considered as single specific activities or in a comprehensive manner to reach a higher level of sustainability. The pilot actions are selected on the basis of the local territorial needs of the project target area. All the actions of the different pilots are aimed at a circular resource and waste valorization in the food P&C system, through the implementation of industrial ecology principles in order to close the resources loop within the single pilot and among the different pilot actions, with an holistic and integrated approach and a long term perspective. In fact all the actions are designed to be resilient to climate change effects and, indeed, aimed at tackling it.

Pilot 1: Improving circularity and sustainability of the fish production chain

Food intake is increasing worldwide and traditional harvesting method is suffering from depletion of natural resources availability. In particularly for marine food provisioning, the ever growingly changing environment of the sea (increased temperature and acidification, deoxygenation as well as change in the sea currents) added to the pressures in the coastal habitats (pollution, depletion of natural capital and modification due to climate change) must be taken into account when addressing the issues of fish stocks exploitation and food security.

Together with the increasing food request, food production is affected by significant rates of food losses that represent a useless resource consumption and contribute significantly to the waste generation.

Marine resources (e.g. finfishes, invertebrates) harvesting and production systems are typically arranged following a linear flow of “production/capture – collection – selling” which is strongly characterized by huge quantities of waste and poor control of the market.

Current fish capture/production is characterized by high percentage of food discards, changing sea chemicals and the over use of the natural resources. Aquaculture system are often based on wild fish feed use, contributing to sea stock depletion as well. This harvesting method imposes great suffering on the ecosystem with negative effect and damage on biodiversity. The current economic system related with the fish industry considers a linear paradigm which is dissociated from what the natural ecosystems would contemplate. Including nature-based solutions, supporting the use of insect-feed in aquaculture and closing the cycles of fish production with the perspective of circular economy can guarantee an optimization of the production, a decrease of food loss and waste, and benefits on marine biodiversity. In

this regard this proposal would support a changing of approach in the direction of the Blue Growth attitude with a high focus on the sustainability of the entire fisheries sector. The actions of this pilot project are aimed at the implementation of a circular fish production and consumption system through the small-scale fisheries participation and their better integration into regional and international fish trade. The process will provide reinforce for institution building and training and compensation of biodiversity and food quality and the access to new markets. Moreover an increase of product diversification; employment within the sector (innovative activities in the traditional fisheries sector and new enterprises); raise of women employment (i.e. actively involved in fish processing) and general positive effects on the regional welfare. All these aspects are expected to raise people awareness about the marine health and to stimulate actions to reduce impact on the environment. People more aware of this relationship will be more motivated to protect the marine system and adopt environmentally sustainable ways with short, medium and long term impact.

The pilot 1 on Fishing activities is planned with a twofold approach focused on the implementation of the sustainability level of:

- a) fishing activities
- b) aquaculture production

Finally, a third part of the Pilot (WP c) is devoted to the setting of an open space for the promotion of “sustainable values” about fishing and food .

WP a: Fishing activities

WP a.1: Promotion of traditional artisanal fishing towards blue growth

Aim of the pilot project is to support the local community of the coastal cities in the Western Mediterranean in converting their approach to circular economy actions and accompanying them in the process. The approach proposed would consider a preliminary assessment and a participatory phase in order to consider the regional and local needs to work synergistically on multilevel aspects. First level could be the support of local fishing communities through the enhancement of artisanal fishing with low biodiversity impact; incentives to stimulate good practices for responsible fishing; implementation of the infrastructures and fish handling methods and also of the local markets (shortening seafood supply chain, promoting cooperatives).

This action is also aimed at reducing and gradually eliminating the current high levels of unwanted catches. This higher level of sustainability of the fishing activities can be reached through the eco-innovation and promotion of the traditional artisanal fisheries and by adding value to less-demanded (although traditional) species through “slow food” strategies.

Moreover the process of innovation of traditional fisheries will facilitate the fish processing industry with high quality standards and the creation of a local brand of sustainable fishing quality and promotion. Final products will be promoted to get a short and integrated supply and consumption chain linking fishermen with local restaurants and shops to exalt the territorial gastronomic heritage “100% local” and “km0” products. This actions are also aimed at a reduction of packaging use in the whole supply chain (primary and secondary packaging) and a substitution of plastic as primary material in packaging in order to have a circular approach to the marine litter issue thanks to a preliminary plastic use reduction in the fish production sector. A label for traceability, quality, respect for the environment will be also created, to guarantee promotion and marketing actions in national and international markets of local and sustainable fish products.

WP a.2: Adding value to fish production chain through industrial symbiosis implementation

This action is aimed at creating added value in the fish production chain through industrial symbiosis strategies implementation for the discard and waste valorization of the fishery sector. The fish processing industry generates, in fact, waste flows which could be valorized with a circular economy approach in other productive sectors: cosmetic and pharmaceutical sector can valorize the waste of fish transformation in high value added products. Moreover fish production industry waste flows can be also exploited in small anaerobic systems for biogas production or reused as additional primary material for the implementation of mitigations systems for the climate change effects (nature-based solutions) in cities marinas or small ports or as support for the restoration of compromised marine environment in the city area, representing the basis for the biodiversity proliferation of the marine ecosystem (mussels shells).

The implementation of an industrial symbiosis system can also stimulate the definition of additional synergies among different productive sector at urban level which can also be represented by the sharing of spaces and competences with a cross-sectorial integration generating economic and environmental gains and capacity building returns. Basically this circular economy strategy implementation helps the waste reduction in the fish sector and favour the creation of economic added value in the fish production and transformation chain.

WP b aquaculture production

WP b.1: Decision support system for the implementation of aquaculture productions

Mariculture is a relatively new activity that is expanding globally and interacts with other coastal uses. Therefore, it is necessary to allocate suitable sites from environmental, economic and social points of view, involving different stakeholders in the decision-making process. In particular, in the Mediterranean Sea, for its environmental characteristics and traditions, fish farming should be further boosted and an accurate marine spatial planning should be developed. A spatial decision support system (SDSS) based on multi-criteria evaluation addressed to identify suitable areas for siting fish farms at the regional scale is here proposed. The SDSS procedure will drive through the selection of sites based on the definition of criteria that take into account environmental, economic, social parameters and the evaluation of climate change effect on the sea level. The procedure, highly adaptable to any coastal system, is expected to identify and rank the suitability of different sites to the implementation of marine aquaculture activities minimizing environmental impacts while maximising economic and logistic benefits. Once the feasibility and sustainability of mariculture systems have been defined, the design of the plant will be aimed at minimizing its environmental pollution and the safeguard of sea natural capital, for example through the substitution of fish-feed with innovative insect-feed solutions.

WP b.2 aquaculture demonstration – 13 Ocean

The project “13 Océan” (Paul Ricard Oceanographic Institute) aims to create a demonstrator of decarbonated urban multitrophic aquaculture based on insect feed to further develop research and export this model and technique to countries facing food security challenges.

This ecosystemic approach has a circular use of trophic chains. This allows to switch from cold chain to life within coastal cities.

Research can improve both the productivity and the quality of aquaculture production, reducing the climate impact and promoting the protection of biodiversity.

The core of the project is the construction of a sample of highly sustainable aquaculture, which could be placed in - or nearby - the Community Lab building (see pilot 2) .

Industrial fisheries and rising demand are placing ever-increasing pressure of fish stocks. Aquaculture can be a viable alternative but it typically relies on fisheries products for fish feed. To make it more sustainable, we need to diversify the species being farmed but mostly feed them differently.

The use of insect meal and integrated multi-trophic aquaculture are among the most effective alternatives to overfishing and the use of fishmeal in aquafarming.

Project “13 Ocean” represents an open showcase of a zero carbon urban food approach focused on urban market gardening and urban aquaculture, with evident synergistic benefits.

WP b.2: Integrated multitrophic aquaculture

Aquaculture, and in particular integrated aquaculture has been proposed as one of a number of farming methods with the potential to mitigate some of the environmental problems associated with mono-specific aquaculture (monoculture) and to increase total production in a given site. Integrated aquaculture (hereinafter we refer specifically to integrated multi-trophic aquaculture - IMTA) is the culture of two or more species of different trophic levels in a single farm or in close enough proximity so that they interact in a way that mimics the energy flow pathways in natural ecosystems. Particularly promising is the combination of finfish culture with lower trophic levels organisms such as detritivores and algae both exploiting finfish waste as food. In this way, waste input into the environment is reduced and added products with a market value are generated.

Experience with IMTA in the Mediterranean Sea is still mainly experimental with few small scale pilot projects (e.g. Neori, Shpigel and Ben-Ezra, 2000; Neori et al., 2004; 2007; Angel et al., 2000a; 2002). Despite these pilot production offered meaningful information on production possibilities and ecological impacts, more reliable indications of business opportunities (investment, operating costs, market risks) have to be gathered outside of the region, in particular in North America, Chile, and the United Kingdom. Here, evidences show that there is potential for significant improvement in the return on investment mainly from increased production in the form of lower trophic taxa without the necessity of augmenting manufactured feed inputs. Moreover, IMTA may have significant advantages in risk management at the business level because it offers diversification of products and access to multiple markets for finfish, shellfish, macroalgae and other seafood directly as well as derivative products. The cost-benefit analysis is even more advantageous if the environmental costs are accounted since, with the very same amount of

resources employed, more products enter the market and lower load in terms of organic content is released in the environment.

The key opportunities for the expansion of IMTA in the Mediterranean region (along Tunisian coast in particular) have much in common with the opportunities for mariculture as a whole (mainly the poor state of wild fish stocks and the increased demand for sea products).

In ecological terms, the lower effluent of IMTA is preferred together with, at the investment level, the higher potential profit. Other opportunities include the potential for aquaculture operations to rejuvenate remote coastal communities, especially those formerly reliant on capture fisheries.

On the other side, the main challenges for the IMTA development in the region are the oligotrophic conditions in much of the Mediterranean Sea. Even with the organic and inorganic effluents from fed species, the low baseline productivity may be insufficient to support the cultivation of other organisms.

Pilot 2: Circular food production and consumption in urban and peri-urban areas

Table 1: FAO Agriculture in Peri Urban areas – Opportunities & Risks

Opportunities	Risks
less need for packaging, storage and transportation of food	environmental and health risks from inappropriate agricultural and aquacultural practices
potential agricultural jobs and incomes	increased competition for land, water, energy, and labour
non-market access to food for poor consumers	reduced environmental capacity for pollution absorption
availability of fresh, perishable food	
proximity to services, including waste treatment facilities	
waste recycling and re-use possibilities	

Strengthening the agricultural sector in peri-urban areas requires a holistic approach along the entire value-chain by;

- Increasing the institutional support with targeted valorization actions (creation and building of the institutional working group on peri urban development policy);
- Increasing the capacity of agricultural technicians to assist small-medium enterprises
- Strengthening knowledge and rational use of water in agriculture, acquiring the proper and sustainable technology and know-how, fitting users' needs and management capacities
- Bringing production closer to the market by following a "from farm to fork" approach.

Territorial Challenge

MED south areas are affected by common problems, namely, the high number of micro and SME's, the weakness of the value chain, the low level of innovation and the lack of connection between production and market. The productive system is heavily fragmented and consists of small family-based businesses that often carry out activities at home which are not in line with food safety standards and product quality. At the same time, these areas are faced with a high level of youth unemployment; a high number of young people with a very good background emigrate towards areas offering more job opportunities, despite the available rich local products with high potentials for marketing. Improving capacity, skills, innovation and internationalization of MSMEs as well as enhancement of agri-food products in terms of quality and food safety are some of the main priorities of the cooperation area. Focusing on health, sustainability and quality product is an important challenge for agri-food and fishery enterprises to provide adequate guarantees to consumers, as well as to ensure innovation and better market positioning

and economic performance for operators. A key factor for the achievement of the previous listed objectives can be represented by the circular economy principles application to agri-food and fishery sectors, since the implementation of closing the loop materials, water and waste management strategies can at the same time reduce pollution and waste production and generate added value for the local communities both in economic and environmental terms.

WP a: Community Lab - Approach

Considering that “projects have to provide concrete solutions to particular needs”; the **Community Laboratory** is the physical point that unites and brings together the actors of the agricultural and fishing sector for an exchange and enhancement of the productions for entering the market. It will be preliminarily characterized by a smallholder and SMEs “innovation need assessment” following a participatory approach that involves family farms, smallholders, SMEs as well as potential entrepreneurs, researchers and local communities. It will be possible to survey enterprises, to identify innovation needs, to establish clusters among MSMEs in the **agri- food and fisheries sectors**, and to favor the exchange of best practices on quality scheme processing and food safety.

The eco-efficient structural and functional recovery of a number of historical buildings, currently disused and abandoned will be appropriately equipped for providing integrated and assistance services/processing to the Agri-food and fishery SMEs, in particular;

- accompany the creation and change of business to improve the quality of typical and traditional products while supporting the innovation of the traditional models reaching a higher level of sustainability without losing their typical and local
- strengthen competitiveness in the cross-border market through the transfer of process and product innovation;
- improve the production chains especially in depressed areas and marginal cross-border areas.

The design of the community lab will be done by involving stakeholders and potential users in the drawing of an executive project (Living Labs) in order to collect preferences, suggestions and recommendations based on local main products and technical specifications of the pilot plant to satisfy their operational and organizational needs.

Incubation services of emerging businesses and redevelopment of unproductive production chains in depressed areas (innovative approach) will be implemented in order to improve the quality of production and make innovation appreciated in the local and cross-border market. Services and assistance will be oriented to favor knowledge transfer with demonstration and pilot initiatives. Capacity building in the cooperation area will complete the project approach by improving the cross-border framework conditions for the agri-food and fisheries competitiveness of start-ups and MSMEs. Accordingly, all these approaches will encourage the use of advanced ITC (Community Lab platform, open databases for traceability of productions), thus fostering, throughout the project, interactions and synergies between public authorities-enterprises-research-consumers and favoring an “open contamination environment”.

Finally, in order to ensure proper governance as well as the sustainability of the community Lab, a management model will be finalized and adopted by a new created “Producers Association” (gender oriented) ensuring even technical assistance by managers trained in the framework of the initiative.

WP b: Mix-use local market

WP c: Sustainable Tourism : “Albergo diffuso”

Agriculture and fisheries sectors have the potential to provide to tourism creative, new, community and farm/port-based products and services as economic diversification to freshen, enhance and expand the tourism product offer, and to create livelihoods for the poor in peri-urban communities, who are in danger of becoming totally marginalized. Linking agriculture & fisheries with tourism therefore provides a win-opportunity to realize the positive impact of both sector economy and to make them more sustainable and competitive.

Expanding the concept of agritourism to the urban and peri-urban communities of fishermen, we can refer to the concept as “Itturismo”, where the farm is replaced by the port, a point of exchange between diversified producers and a wise and sustainable tourism.

Agritourism/ Ittiturismo is being proposed as a strategic economic activity that could engage peri-urban communities in a mix of activities that provide food related products and leisure within the productive property. It suggests a system within that property that transforms the normal farm - port environment by introducing a form of tourism, entertainment, hospitality or related activity that increases the profitability of the enterprise. By definition therefore, it is a location based on a farm-port where some of the products and services also satisfy the standards of the safety and food quality.

For hospitality, the concept of “Albergo diffuso” is being here proposed as receptive-hotel structure divided among various buildings and apartments arranged in a sparse way inside the peri – urban port or farm land. The widespread hotel (Albergo diffuso) presents itself as a great opportunity to create an economic, territorial and cultural exchange between the communities and the responsible tourist.

The implementation of the concepts set out above, will be carried out through the identification of priority services in the area of intervention, execution of training programs aimed at developing products, services, potential for economic diversification, supporting the creation and strengthening the economic activities in the areas.

WP d: Valorization of by products

The enhancement of food waste and recycling of organic food material is a priority in a world that is increasingly moving away from a linear economy scheme. **Circularity in the recycling of waste and by-products** becomes a necessity in the whole Mediterranean area; organic food waste from households, large scale retail trade, foodservice and agricultural & fishery processing, represents a primary resource that can be reused as compost and organic matter to increase the nutritional values of farmers' soils. Capacity building, technological adaptation and technical backstop are the strategy for the systemic activation of individual composting systems in urban and peri-urban households, community composting in the “community lab” where to collect the organic waste of the area for valorisation, recycling of organic matter as a second resource in other industrial sectors (a.i. cosmetic, biomedical, textile).

To limit food waste and loss, there are several approaches that can be implemented. At first there are prevention measures, which avoid the generation of food waste at the source, reduce leftovers, promote Okm food, support farmers and local markets, create local networks and social values even helping people in need, increase awareness about food loss and waste in customers and in all the involved actors in the food chain, like:

- Creation of ethical purchasing groups, consisting in agreements between one or more group of domestic costumers and local farmers creating a local market.
- Creation of agreements between large scale retail trade and local associations with benefic scope for food recovering to donate to people in need.
- Application of best practices in foodservice sector (as instance doggy bag for uneaten food and differentiation of portion).

On the other side, the further step is the recycling process for organic matter from households and non-domestic costumers, community level but also in the food processing industry, to reduce waste intended for landfill disposal, to valorise resources and produce new ones, like:

- Individual composting and community composting, to produce compost for the population.
- Recycling of the organic matter produced from industrial food processing, into other industrial sectors as cosmetic, biomedical and textile field, to create an integrated chain of value.

Food waste worldwide is equal to one third of the total food production and represents a serious loss of resources even before determining the generation of organic waste to be managed and treated, for this reason, acting to fight this criticality have to be a priority at international level.

Pilot 3. Food quality, safety and traceability

The challenge for the agrifood sector is to succeed in producing safe foods, in sufficient quantity to meet the nutritional needs, reducing the consumption of natural resources and the impact on the environment and promoting sustainability, respecting ethics of production, meeting the consumers’ demand and keeping costs low. Environmental, health, social, technical and economic aspects are strictly interlinked. In turn, the sustainability of productions is strictly related to sustainability of consumption. Food safety, innovation and sustainability are closely linked, both in production systems and in food use (preparation

& consumption). Food traceability and safety are key factors to ensure food quality and to protect consumers' and producer's interests and healthy foods and diets are of major importance in the prevention of non-communicable diseases and overweight.

Fish supply chain is particularly vulnerable to fraud, as reported by various lists of the European Commission (second category of products most at risk in the international market) and as shown by a survey conducted by Interpol-Europol in 2015 in 57 different countries. Several risks are also associated with the fish supply chain. In particular, among the marine contaminants for which maximum permitted levels have been established (EC Reg. 1881/2006 cons. March 2018), there are: organochlorine pesticides, organostannic compounds, phthalates, brominated flame retardants, polyfluorinated compounds, polycyclic aromatic hydrocarbons (IPA), dioxins, PCBs (dioxin-like and non-dioxin-like), heavy metals (mercury, cadmium, lead), radionuclides and arsenic. In addition to the risks associated with chemical contaminants for which limit values have been established, risks connected with (micro)biological contaminants and emerging contaminants, such as toxins, pathogens, toxic alien species, biotoxins and microplastics must be considered. EFSA issued several opinions and recommended individual Member States to review national patterns of fish consumption, assessing the risk to different groups of the population that exceed the safety levels of some contaminants (e.g. methylmercury), although enjoying the health benefits of eating fish.

Innovation in agrifood requires a multi-sectorial and interdisciplinary approach with an overall view and is greatly favoured by the digitization of production processes and the possibility to make data FAIR (Findable, Accessible, Interoperable, Reusable). High-quality data on the food chain are of fundamental importance to populate the expanding data technologies with useful contents and, according to the FAIR principles, enable advanced research on food and food metrology.

The enforcement of the metrological infrastructure (in terms of reliability and comparability of measurement results), as well as the implementation of digital technologies to collect, integrate, share and make interoperable analytical data on food production, processing and preparation and for realising an innovative, integrated collaborative traceability system at a territory level, could bring great advantages, enabling: traceability and authenticity control of traditional Mediterranean foods, risk/benefit evaluation all along the food chain, support to food policies, making more informed and conscious all the actors of the value chain.

The proposed action consists in the development of systems to support the quality, safety, authenticity and traceability of fish products and the control of the catch, with the improvement of processes and waste reduction and valorisation of wastes and byproducts in support to sustainability and circular economy.

Actions will be carried out to develop new competitive opportunities so as to enhance the products along the entire supply chain, from primary production (cultivation/capture), to transport, storage, conservation, distribution and sale of fresh and processed products, up to final consumption (domestic preparation and storage included). Fish products from both fishing and aquaculture will be considered, including raw materials, semi-finished and processed products, and particular attention will be paid to local, traditional or engected products and preparations.

The proposed actions concern the development of systems and infrastructures in support to food quality, safety and traceability, with the valorisation of food products, wastes and by-products for promoting circular economy.

WP a – Measurement tools (Analytical methods and Reference Materials)

Development and application of analytical methods and devices (sensors) for the verification and demonstration of the quality and safety of products along the entire supply chain (raw materials, fished, semi-finished and processed products) for the determination of specific parameters and the identification of markers (or patterns) of quality and origin, both off-line and in-situ and on-site (e.g. determination of nutritional and nutraceutical substances, identification of contaminants such as PAH, PCB, PCDDs, As, Cd, Pb, Hg and MeHg, residues of veterinary drugs, polyfluorinated compounds, radionuclide (bio) toxins, microplastics) and the demonstration of traceability, authenticity and sustainability (identification of markers of origin and process, fraud control). Furthermore, feasibility studies for the development of new Reference Materials (RMs) will be performed and lots of new Matrix-RMs of fish products characterised for selected nutritional or nutraceutical substances and/or contaminants and/or traceability markers will be realised. The newly developed measurement tools will be applied to characterise products selected in the area of the pilot study..

WP b – IT platform and integrated traceability systems

An e-platform will be developed for the collection and integration of data on food composition, quality, safety, etc., and data on available metrological tools in support to food analysis (Reference Materials, reference and official methods, proficiency tests). The platform will enable the collection, integration, sharing, analysis and interoperability of data along and between supply chains and territorial systems (eg through barcodes / QRcodes and eventually implemented with a block-based middleware architecture, ESB and data exchange protocols based on the XML format, so as to enable governance models of information and distributed data and development of distributed supply chain and territorial ledgers).

WP c – Systems for sustainability

Tools for improving sustainability of productions, processing and marketing of fish products will be developed, including strategies for waste reduction, and valorisation and re-use of by-products and wastes aimed at implementing a "circular" production model.

WP d – Service development, capacity building and technology transfer

Services addressed to different potential user categories in the Med Countries, but also open to wider users, will be defined planning and organising their provision by involving the network of physical and e-facilities made available by the research partners, and their inter-relations.

Capacity building and technology transfer actions will be carried out in the area(s) interested by the pilot action. The following initiatives will be organized: i) specialized on-site trainings for laboratories; ii) B2R2B missions and bilateral short-term visits; iii) workshops and schools to network and share practices and activities. Existing best practices on food production, trading and consumption will be evaluated and further improvements will be defined based on the feedback obtained from benchmarking analysis and stakeholders outputs (with the involvement of the Stakeholder Forum). A "Job Bank" will be created to hunt investment resources, as repository of employment opportunities related to food traceability specialist and especially oriented to younger audiences.

Furthermore, a new dedicated infrastructure will be realised through the recovery of a disused building in the port area. This infrastructure may include areas dedicated to analytical activities (new laboratories and plants), areas for the development and integration of ICT systems, area for training and new job promotion, educational areas, areas dedicated to interaction with producers and consumers (including tourists), etc.

The newly developed facilities will work in close connection with the European Research Infrastructure METROFOOD-RI (ESFRI - Domain Health and Food), which will act as a bridge between the countries of the southern shore and those of the northern shore of the Mediterranean, will allow a direct link with other facilities (physical and electronic), data and networks and will serve as an opportunity of scale up, exploitation, technology transfer and capacity building. This will favor an integration of activities and services supporting the market, the control system and consumers.

The proposed actions will produce positive, tangible benefits for food producers (companies and small fisheries cooperatives) and consumers. In particular:

- Valorisation of local and sustainable fish production (also through chemical and microbiological characterization, identification of markers, IT codes and local labels)
- Provision of an added value to the Med fish products, especially against the invasion of the tropical fish market
- Collection of information, data and knowledge for waste valorisation in the industrial symbiosis process
- Interoperability with other Med platforms
- Attraction of investments in sustainable local fish production
- Transfer of technologies, implementation of new services accessible to researchers, food business operators and consumers/citizens, new job opportunities
- Recovery and valorisation of a port and / or of specific disused buildings