

Strategies of fishers and fish farmers: a preliminary analysis for Sustainable Fisheries and Aquaculture

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Abstract

Coastal capture fisheries and aquaculture are interconnected resource systems and economic activities, presenting evolving and complex dynamics, constrained by several socio-economic, policy and biophysical factors. Overfishing and climate change are modifying the distribution and productivity of marine species and altering food webs. The general economic situation has worsened, influencing markets, costs and purchase power.

This paper aims to present a preliminary analysis of the multidimensional causal dynamics of key drivers and market factors influencing the decision-making process of Fishers and Fish Farmers, identifying conditions in which primary producers are involved, the related strategies developed to manage those conditions and the consequent performances in terms of profitability and sustainability.

Derived from industrial organization and agrofood value-chain management a research process is proposed for analysing conditions, strategies and performances of primary producers of fisheries and aquaculture.

The analysis in this paper is situated in two specific contexts: inshore fisheries in Cornwall (UK) and coastal fisheries and aquaculture in Tuscany (Italy). Sustainability of fisheries and aquaculture is jeopardised by a set of socioeconomic and biophysical conditions such as habitat degradation, over-exploitation of resources, complex and restrictive regulatory frameworks, increasing illegal competition, rising costs, market concentration and excessive fragmentation of holdings. Response strategies can be found in investing for innovation, regulating catches and capacity of fleets, training of operators, reorganising the supply chain, multifunctionality and diversification, implementing cooperative programmes and supporting sustainable development.

Engaging with stakeholders and experts and accessing qualitative and quantitative information will be key to comprehensively analyse how primary producers develop decision-making process and transformation strategies towards sustainable solutions for fisheries and aquaculture.

1. Introduction

The decline of marketable fish stocks and the increasing fishing pressure has brought a change in fisheries policies and management systems at a global level over the last decades. Overfishing - due to changes in consumption patterns - and climate change are modifying the distribution and productivity of marine and freshwater species and altering food webs. Moreover, the general economic situation, influencing markets, costs and purchase power of consumers, has worsened. Fishers and Fish Farmers (FFF), as primary producers and economic agents, are also deeply affected by the impact of climate change on aquatic ecosystems, through rising sea levels, ecosystem degradation, acidification, droughts and floods. There is evidence too that commercially-important stocks are exploited close to, or beyond, the rate that will deliver Maximum Sustainable Yield, and economic performance of the fleets shows highly variable trends leading to uncertain outcomes. Furthermore, overcapitalization and disproportionate fleet sizes, undervaluation of catch, huge fuel expenses, insufficiently selective gear, unreliable databases, and rising competition between artisanal fishing and a large-scale capital intensive fishing industry (and between fishing and other types of activities such as tourism) has put at risk the long-term sustainability of the fisheries sector (Higgins et al., 2008; Cardinale et al., 2013; Urquhart et al., 2014; Damalas et al., 2015).

2. A conceptual framework applied to fisheries and aquaculture: state of the art

The theoretical approach of this work builds on the conceptual framework of the H2020 Project SUFISA (see appendix 1), and aims at highlighting the relations and processes that connect the conditions in which agro-food primary producers (e.g. fishers and fish farmers) operate with their strategies and the related performances, which in turn affect primary producers' business environments.



Figure 1 – Conditions, Strategies and Performances of primary producers (SUFISA Conceptual Framework, 2015)

"Conditions" refer to the whole business environment, interpreted in a broad sense to cover all the main determinants influencing primary producers' behaviours. The "Strategies" category comprises the range of actions consciously adopted by the primary producers in order to achieve some performances with a noticeable impact on the production development trajectory. "Performances" are the consciously pursued effects of the strategies. The goal is to disentangle primary producers' decision-making processes, analysing the ways in which they interpret their internal (at the firm and household level) and external conditions and use the resources they have access to, in order to pursue their objectives (SUFISA Conceptual Framework, 2015).

The Conditions-Strategies-Performances framework, applied here to fisheries and aquaculture primary producers, builds on the theories of industrial and organisation economics, in particular it can be deemed as a dynamic variant or adaptation of the Structure-Conduct-Performance paradigm from Porter (1981). According to Rastoin and Ghersi (2010), the CSP approach could

be categorised within the *behaviourist thinking* in which strategies are considered key – strongly focusing on the impacts of strategic decisions upon performance level and on producers and stakeholders' capacity to change the structure of an industrial sector – and it would be different from a *structuralist thinking* that emphasises the role of structure as the principal determining factor for strategies and performances, thus giving less importance to the producer and stakeholder role and strategic decisions.

Industrial economics has been a major influence on strategy theory and research and has showed the contribution towards business (Grimm, 2008). Literature from industrial organization, management and economics - including from scholars engaged in food system and value chain analysis - offers a set of frameworks that contribute to develop theories and methods trying to represent structures and functioning of sectors. In particular, within classical industrial economics, the theoretical framework *Structure-Conduct-Performance* (SCP) introduced an approach to the sectorial analysis that builds on the interlinkages between market structure, the strategic behaviour or conduct of firms, and the profitability and sustainability of a specific sector (Porter, 1981; Rastoin and Gherzi, 2010). The theory of Industrial Economics was operationalized by the SCP-Paradigm to emphasize links between market structure and business conduct in determining market performance (Edwards et al., 2006). Therefore, the SCP-paradigm is recognized as one of the most efficient and reliable means by which to analyse an industry or more specifically the market power-profitability relationship within it. The SCP-paradigm consists of three basic elements, all indicated by different variables, which are: structure, conduct (behaviour), and performance (Carlton and Perloff, 2000). This paradigm suggests that a series of basic economic conditions determine market structure (Norman and La Manna, 1992). According to Bain (1968) and Mason (1939) the industry structure shapes the behaviour, the conduct, and thus the strategies of firms that will determine the performance of the firm in its environment, more specifically, in its marketplace. This analyses gives insight into the market structure the firms operates in, the firm's behaviour and strategy (conduct), and the decisions related to that, that suit this structure and in the end it shows what the influence of this conduct is on the firm's performance in terms of profits.

Within the SCP paradigm, the industry *structure* was identified by the presence of the relatively stable economic and technical dimensions of an industry that constitute the context where competition occurs (Bain, 1972; Porter, 1981). Subsequently, the structure explains the *strategy*, or conduct implemented, which represented the application of choices and trade-offs within a number of variables such as price, quality and capacity of production, marketing, Research & Development, contracts etc., and that was deemed essentially as "the economic dimensions of firm strategy" (Porter, 1981, pp. 611). Concomitantly, strategy leads to a number of outcomes, more specifically defined as *performances* that involve profitability, technical efficiency for cost minimization, innovation, employment, technical progress and sustainability of the firm sector over time (Porter, 1981; Rastoin and Gherzi, 2010).

SCP studies a line of causality that runs from structure through conduct to performance (Church and Ware, 2000). Hence, the original SCP-paradigm assumes a one-way relationship. A number of works demonstrated that this dynamic paradigm needed to be further articulated (specified) with feedback loops between its three main elements, since the outcomes of a firm's (performances) can, in turn, influence both the implementation of strategies and the characteristics of the original context structure (Porter, 1980; Porter, 1981; Salop, 1979; Schmalensee, 1978; Spence, 1979; Caves, Porter, & Spence, 1980; Comanor & Wilson, 1974).

The Conditions-Strategies-Performances framework (Figure 2) goes beyond the previous Structure-Conduct-Performances paradigm since – similarly to the Rastoin and Ghersi variant (2010) - it focuses on the agency capacities of the primary producers and their ability to differently interpret the contextual conditions building on their previous experience and background; furthermore, it does not take into account only the structure of the context in which the primary producers operate, but also involves and adds a larger set of dynamic factors occurring and proposes a detailed and extended inventory of potential sets of conditions, considering the intrinsic characteristics of primary producers, their household and firm, including their surrounding biophysical, socioeconomic, institutional and technological contextual factors.¹

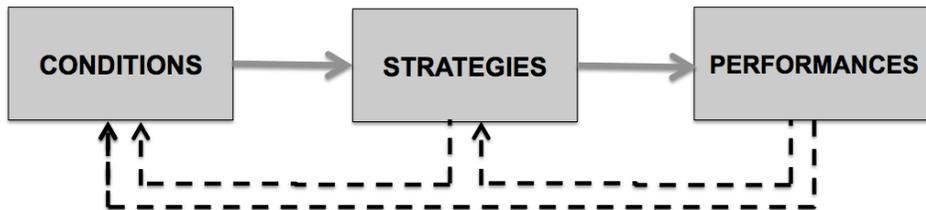


Figure 2 - Conditions-Strategies-Performances Framework for primary producers from SUFISA Project and adapted from Porter, 1981 and Rastoin & Ghersi, 2010.²

2.1 Exploring fishing communities in differing contexts

The several and multifaceted socio-economic, political and geographical contexts - that characterise the surrounding factors where fishing activity is conducted - implies a reflexion about the possibility of different analysis through a “fishing community” approach, or territorial, or even through sectoral approaches. In fact “fishing communities” are generally considered as “*mixed economies [...] always changing and evolving*” (Martindale, 2014; p. 297) which imply “*commitment to an industry, not necessarily entailing actually going to sea, but being part of a network of shared interests and concerns that surrounded the fishing*” (Walton, 2000; p.128), and, more specifically, being “*substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and [...] fish processors that are based in such community.*” (Magnuson-Stevens Fishery Conservation and Management Act, 1996; cited in Clay & Olson, 2007; 2008). However, it is widely acknowledged that fishing activity involves more than landing and processing of catches, including identity and sociocultural aspects also within a urban landscape. Thus, the geographical coexistence and the interactions of the fishing activities with other economic dynamics and sectors do not necessarily imply the dependency of the local economies (e.g. in coastal regions) on the fishery sector, since, such communities may have economically evolved, losing or going beyond their original characteristics linked to catching fish (Gallizioli, 2014). Strategies and performances, within fisheries related economic activities, can thus be interpreted differently depending on the entity identified for the analysis.

¹ A number of studies (Scherer, 1980; De Paula et al. 2003; Carlton & Perloff, 2000; Rastoin & Ghersi 2010) have modified the original SCP paradigm adding “Basic Conditions” as determinants of the “Structure” - meaning mainly conditions of Supply and Demand – and proposing a Basic Conditions-Structure-Conduct-Performances paradigm.

² For the justification of the feedback loop relationships between Conditions, Strategies and Performances, see Porter (1981, p. 616) and Rastoin & Ghersi (2010, p. 137).

Fishing communities in Europe have undergone major structural change over the last 20 years, principally through processes of modernisation, concentration and technological development, leading to a reduction of almost 50% of fishing employment (Symes and Phillipson, 2009). Increased technological innovations have allowed fishing fleets to become considerably more mobile and efficient and, along with an increasing demand for fish for human consumption, contributed to the exploitation and overexploitation of 87% of commercial fish stocks (FAO, 2012). These conditions are jeopardising the viability of many smaller fishing communities over time (Symes and Phillipson, 2009), leading fishers and their families to struggle for regular income and to be vulnerable vis-à-vis a number of uncontrollable risks and uncertainties such as changing seasonality trends, severe weather conditions, market volatility and fish stock variability (Doeksen and Symes, 2015). In addition to biophysical and market conditions, the Common Fisheries Policy's management restrictions against overfishing represent another set of pressure conditions for fishers (Symes and Phillipson, 2009).

Evidences of interactions between socioeconomic and biophysical factors within social-ecological systems and the related need for integrated approaches (Berkes and Folke 1998; Kinzig 2001; Olsson and Folke 2001; Olsson 2003) suggest studying marine fishing as a human activity being an integrated part of ecosystems, connecting the under-sea world and terrestrial coastal communities (Urquhart et al., 2014). Incorporating management and policy issues throughout biological, social and economic dimensions proved to be key in order to achieve sustainable fisheries (FCR 2000; Forst 2009).

Anderson et al. (2015) clearly highlighted how a number of studies in the last two decades prove that for achieving sustainable fisheries it is necessary to keep a sustainable stock, together with social acceptability and continuous business investment. In particular, building on a literature review, the authors stress that the important losses of the potential earnings of the fisheries sector at a global level are not only caused by overfishing but also by disproportionate harvesting costs and low efficiency, product waste, and targeting low value markets (Wilén et al., 2005). In fact, although attention and efforts were mostly oriented towards ecological outcomes and fish stock exploitation management (Gutiérrez et al., 2011) - partially overlooking important social and economic outcomes of fisheries (Smith et al., 2010) - several authors demonstrated that marine systems, as social-ecological systems, need both profitable fisheries business activities and acceptance and support for this sector from people involved and participating in them (Dietz et al., 2003; Halpern et al., 2013; Ehrlich et al., 2012). Thus, it remains crucial to identify how fisheries management sustains and influences a range of socioeconomic outcomes, including community wellbeing (Urquhart et al., 2014; Anderson et al., 2015).

In order to ensure long-term viability of fisheries it is becoming evident that there is a need to address the social and cultural aspects of fisheries management (Symes and Phillipson, 2009; Urquhart et al., 2013, 2011; Carrà et al., 2014). In particular, there is a need for new frameworks to assess progress on social-ecological outcomes with respect to the impact of management strategies on resource, community and market conditions oriented to preserve fish stocks and guarantee socioeconomic community performances (Anderson et al., 2015). Integrating ecological, economic and social dimensions through innovative and structured approaches is then key (Cataudella and Spagnolo, 2011). Furthermore, a comprehensive analysis exploring the potential outcomes of a sustainable management of fisheries, especially for small-scale artisanal fisheries, needs to consider traditional knowledge and the interests of local communities (Potts 2003), accessing information through a stakeholder approach (Urquhart et al., 2014).

3. Methodological approach

Derived from industrial organization and agrofood value-chain management approaches - combined with a literature review at local level - a causal dynamic framework is proposed for analysing conditions, strategies and performances of primary producers of fisheries and aquaculture. This causal dynamic framework is initially applied to two case studies in Europe at NUTS level 2 – Cornwall (UK) and Tuscany (IT) – building on a context-specific literature review to identify the conditions Fishers and Fish Farmers (as primary producers) face and the consequent strategies they are able to develop, as well as the related performances achieved. The "Conditions - Strategies - Performances" (CSP) approach is applied through mapping context-specific conditions, strategies and performances, building on the category inventories identified within the SUFISA project and listed in Appendices 2, 3, 4.

4. Findings

The sustainability of fisheries and aquaculture is generally jeopardised by a set of factors shaping conditions such as habitat degradation, over-exploitation of resources, biodiversity loss and transformation, changing consumption patterns, complex and restrictive regulatory frameworks, increasing illegal competition, reduced catches, rising costs, inefficiencies in terms of supply chain organisation, seasonal bans, export and spill-over, market concentration and excessive fragmentation of holdings, illegal, unreported and unregulated fishing (Higgins et al., 2008; Cardinale et al., 2013; Urquhart et al., 2014; Vindigni et al., 2016).

A number of strategies are implemented through the EU's Common Fisheries Policy, however fishers and fish farmers still need to autonomously adapt strategies to cope with both static and dynamic conditions. Response strategies can be found - among several others - in investing for technological innovation, reduction of catches for targeting high-value species, regulating fishing capacity of fleets, training of operators, reorganising and shortening the supply chain, generation renewal, pluriactivity, multifunctionality and income diversification, transforming and processing products for creating added value, participating in labelling programmes, implementing cooperative programmes and supporting sustainable development (Damalas et al., 2015).

At different EU geographical levels, fisheries and aquaculture present a number of sustainability problems that need to be tackled through context-specific analysis. The analysis in this paper is situated in two specific contexts: inshore fisheries in Cornwall in the south west of England and coastal fisheries and aquaculture production in Tuscany, in west-central Italy.

The above illustrated SUFISA variant of the CSP framework was tested through application in the two case studies. Inputs from a literature review at case study level - Cornwall and Tuscany - helped model the causal dynamics shaping the relationships between the conditions that fishers and fish farmers encounter within their activities, the strategies they implement vis-à-vis specific conditions, and the performances achieved.

4.1 Linking Conditions, Strategies and Performances in Coastal fisheries and aquaculture in Tuscany

Tuscany is a region in west-central Italy and its population is just above 3.8 million people. The city of Florence is the regional capital. Tuscany has a western coastline on the Ligurian Sea (in

the north) and on the Tyrrhenian Sea (in the south), including the Tuscan Archipelago in which the largest island is Elba. The coastline represents an important tourist destination and is varied with mainly extensive sandy beaches and some rugged promontories; three natural protected areas are included in the coastline. The most important port in Tuscany is Livorno, one of the largest Italian and Mediterranean seaports for traffic capacity that is capable of handling all kind of vessels.

Fishing activity in Tuscany is spread among 27 ports (European Parliament, 2008) with 600 vessels registered and 1053 active fishermen (FAO, 2015). In 2012 fishing activity from Tuscany represented 8% of total Italian landings (FAO, 2015) and is mainly led through seine (ca. 50%), trawl (ca. 25%), small-scale (ca. 10%) and few passive polyvalent (FAO, 2015). Livorno and Viareggio are the most important fish markets of the region (ISMEA, 2013).

The fisheries sector in Tuscany is characterised also by a considerable production from aquaculture. Coastal capture fisheries and aquaculture are strongly interconnected resource systems and economic activities, presenting evolving and complex dynamics, constrained by several socio-economic, policy and biophysical factors that intervene and alter behavioural dynamics within the production system (Chuenpagdee et al., 2008). Focusing only on aquafarming of saltwater populations and mariculture, the Tuscany production represents 20% ca. of the national production with mainly 12 aquaculture and 4 mariculture coastal installations farming mostly sea bream and sea bass. Although catches of hake and sardine and production of sea bream, sea bass and juveniles are relevant for the Tuscany fisheries sector at a national level, the region is rather an importer of fish and fish products.

Fisheries and coastal aquaculture in Tuscany are both concerned by the critical conditions affecting the Mediterranean Sea. Together with habitat loss, pollution, eutrophication and incidental introduction of alien species, fishing represents one of the strongest stressors that have led to increased changes in the ecosystem structure and loss of fish stocks and marine biodiversity (Coll et al., 2011; Colloca et al., 2011; Farrugio et al., 1993; Papaconstantinou and Farrugio, 2000; Vasilakopoulos et al., 2014; Piroddi et al., 2015).

Building essentially on a context-specific literature review – including government reports at national (Ferretti, 2011; Gilmozzi, 2011; ISMEA, 2013) and regional (ARPAT, 2008; Regione Toscana, 2005) levels - of the fisheries domain in Tuscany (and on the causal dynamic and the categories of conditions-strategies-performances, see Appendix 1, 2, 3, 4) in the last decade it has been observed that *economic crisis* impacted the local fisheries sector through a change in conditions such as *demand* and *price level and volatility*. In particular the demand for fish, together with fish prices, decreased sensitively (Ferretti, 2011), especially at a local level (Tuscany) in 2012 (ISMEA, 2013: p. 23). The reaction of some fishers in Tuscany has been observed through a number of strategies that have been implemented by the primary producers (table 1):

- This strategic behavioural response can be identified in actions that can be classified in the domain of *rural*³ *development*, in particular with concerns to *diversification and*

³ "Rural" is used here to coherently refer to the SUFISA framework and related strategies (see Appendix 3) since this approach implies the integration of principles from rural studies, rural sociology and agricultural economics; however the fishing enterprises can often be situated in an urban environment instead of a rural one. Moreover, fishing communities can be studied using territorial, "area based" and local development approaches (Budzich-Tabor, 2014) and also considering their extension beyond the shoreline into the sea since, according to Clay & Olson (2007), "the places where people fish and where fishing peoples live are not only different in location but also beyond any jurisdictional boundaries of town or county".

territorial integration, and then strategies such as *vertical integration* and the shift to short food chains. More specifically, in Tuscany, some fishers developed artisanal activities such as transformation and processing of the catches for the production of fish sauces, cured roe and fillets in oil in order to create added value from the fish products (Ferretti, 2011).

- *Diversification and territorial integration* strategies were also observed in Tuscany through the creation of *new market channels*; for instance small-scale fishers demonstrated a preferences for selling to ethical purchasing groups or directly to consumers through a consortium (ISMEA, 2013).
- Other strategies of fishers in Tuscany, vis-à-vis the conditions brought about by the economic crisis (decreasing fish demand and lowering prices), can be identified within the domain of *agro-industrial competitiveness*. In fact, some fishers might further invest in *technological innovation*, such as high tech for management, logistics and mechanization, or in *intensification and upscaling by internationalizing supply and sales market*. For instance, larger-scale semi-industrial fishers tended to invest in innovation, in new vessels, as well as searching for other kinds of consumers beyond the local-scale market channels (ISMEA, 2013).

The *economic crisis* led to a change in the production *factors*, including a considerable increase of the *cost of energy*, in particular higher fuel costs. Fuel represents the main production cost in fisheries activity. This global issue was also observed in a particular time frame (2007-2008) at a local level in Tuscany (ARPAT, 2008) and led to a number of strategies implemented by the primary producers. These strategies mainly belong to the domain of *rural development* strategies (table 1):

- In particular some strategies consisted of *diversification* techniques, thus the shift to *new food products*; in particular some fishers diversified the catches and changed the gear size in order to target larger size and more valuable fish species; this demanded less time spent on the boat, thus lowering the fuel consumption.
- Other strategies consisted of bringing *multifunctionality* to the fishery activity, in particular through implementing *recreational activities*, such as *tourism* on the boat; this allowed using fuel for both fishery and tourism activities (ARPAT, 2008).

With regards to some *factors* influencing the conditions in which fish farmers conduct their activities in Tuscany, increasing *competition from external markets* has been observed. In fact, the regional sector of aquaculture is affected by competition from both national (extra-regional) and foreign markets (Gilmuzzi, 2011). The strategies observed pertain mainly to the domain of *rural development* (table 1):

- Strategies for responding to the competition from external markets were observed in Tuscany and can be classified as strategies of *diversification and territorial integration* through implementing *quality and sustainability standards*. In particular these strategies build on fostering quality and sustainability of the fish products, in order to apply competitive opportunities, using raw materials respectful of the environmental sustainability through the adoption of internal voluntary quality standards and physical, chemical and biological analysis of the water along the whole fish farming process (Regione Toscana, 2005).
- Other strategies of diversification and territorial integration were adopted through *vertical integration, short food chains and local-based networks*; primary producers opted for

- developing the transformation of processed fish products directly or through a consortium of producers (Gilmozzi, 2011).
- Some fish farmers, within the framework of diversification and territorial integration strategies such as the *development of new food products*, started to catch new and more valuable species, improve and valorise the quality of the products, develop marketing actions, prepare and preserve fish (Gilmozzi, 2011).

Regulations and policy are also part of the contextual conditions influencing the strategic behaviour of primary producers of aquaculture. In Tuscany, *local and regional development plans* guided public funding for innovation (Gilmozzi, 2011; Regione Toscana, 2005):

- Fish farmers adopted *rural development* strategies and used the public funding to invest in the introduction of new, higher value and strongly demanded species such as brackish water fish, meagre (or salmon-basse) and mussels (Gilmozzi, 2011; Regione Toscana, 2005).

CONDITIONS FACED	STRATEGIES EMPLOYED	PERFORMANCES EXPECTED ⁴
FISHERIES		
DEMAND Price levels and volatility: Economic crisis of the fisheries sector / Lowering demand and prices (Ferretti, 2011; ISMEA, 2013)	RURAL DEVELOPMENT → Diversification and territorial integration - vertical integration - short food chains: Development of artisanal activities, processing new products (Ferretti, 2011) → Diversification and territorial integration New market channels. Vertical integration - short food chains: Small scale fishers prefer selling to ethical purchasing groups or directly to consumers (ISMEA, 2013) → AGRO-INDUSTRIAL COMPETITIVENESS - Technological innovation: high tech for management and logistics - High tech for mechanization Intensification and upscaling: supply and sales markets Internationalization: Larger-scale semi-industrial fishers invest in innovation, new vessels and look for other kind of consumers beyond the local market channels (ISMEA, 2013).	Business flexibility; Higher revenues; Ethical goals: → - New market opportunities; higher sales prices; increasing products attractiveness → - Consumers see the products as local → Cost reduction; Business flexibility; Higher revenues; Working conditions: - Increasing organisational efficiency
FACTORS Costs for energy: High fuel cost (ARPAT, 2008)	RURAL DEVELOPMENT → Diversification - new food products: Spending less time in the sea targeting larger and more valuable species. → Multifunctionality (Broadening) - recreation activities: Tourism on the boat (ARPAT, 2008).	Cost reduction; Environmental goals; Business flexibility; Higher revenues; Working conditions: → - New market opportunities, higher sales prices and greater visibility of the product; lower impact on resources. - Income support; lower impact on resources.
AQUACULTURE		
DEMAND Competition from external markets: The regional market is exposed to the competition of external markets (Regione Toscana, 2005; Gilmozzi, 2011)	RURAL DEVELOPMENT → Diversification and territorial integration - Quality and sustainability standards: Strategies based on the quality and sustainability of the products and production processes (Regione Toscana, 2005). → Diversification and territorial integration. Vertical integration - short food chains - local-based networks: Processing of products with higher added value (Gilmozzi, 2011). → Diversification and territorial integration. New food products: Targeting new and more valuable species, improving the quality of the products, marketing actions, valorisation of the products (Gilmozzi, 2011).	Environmental goals; Business flexibility; Higher revenues; Productivity: → - Wider and new market opportunities, higher sales prices; increasing attractiveness of products in view of modern consumers; long-term sustainability and further opportunities for new generations in fisheries activity → - Wider and new market opportunities, higher sales prices and greater visibility of the product
REGULATIONS AND POLICY Local and regional development plans: Public funding for innovation (Gilmozzi, 2011; Regione Toscana, 2005).	RURAL DEVELOPMENT → Diversification and territorial integration: Introduction of new and strongly demanded species (Gilmozzi, 2011; Regione Toscana, 2005).	Business flexibility; Higher revenues: → - Wider and new market opportunities, higher sales prices and greater visibility of the product

Table 1 - Conditions, Strategies and Performances observed for primary producers of Fisheries and Aquaculture in Tuscany (Italy).⁴

⁴ The “performances expected” refer to a list of the potential effects - from specific and strategic actions developed - which were inventoried for the fisheries and aquaculture sectors at national level in Italy (ISMEA, 2013; p.76).

4.2 Inshore fisheries in Cornwall

Cornwall forms the westernmost part of the southwest peninsula of the UK. The population of the county is just over 530,000 people, with the city of Truro as its administrative centre. The county is noted for its long and varied coastline, extensive stretches of which are protected as Areas of Outstanding Natural Beauty. The north coast is exposed to the storms of the Atlantic Ocean and is typified by a rugged coastline, although there are also extensive sandy beaches that are important tourist destinations. By contrast, the south coast is more sheltered and there are a number of protected estuaries that have grown up as ports, such as Falmouth, which is the most important port in Cornwall and one of the largest natural harbours in the world. In terms of fish landings and sales, Newlyn is the most important port in Cornwall, followed by Looe. Plymouth, which is just in the neighbouring county of Devon, is also important to Cornish-landed fish.

Phillipson and Symes (2015, p. 349) describe how “Cornwall’s fishing activity is dispersed among some 50 or so ports, harbours and small coves along its long indented coastline with Newlyn hosting the largest concentration and ranked as the UK’s eighth largest port by volume of landings in 2010. With a fleet of 619 registered fishing vessels, of which almost 90 per cent were under 10 m in length, and 898 active fishermen of whom a quarter worked part-time, the sector is diverse and versatile. Fishing activity ranges from beam trawling, scallop dredging, drift netting and long lining, to hand lining, crab and lobster potting. There are two official markets at Newlyn and Looe, though landings at many of the smaller harbours are usually handled by travelling merchants for onward sale or sold direct to local outlets. A high proportion of the Cornish catch is exported to mainland Europe (mainly France and Spain) with little value added locally. Some development of domestic markets has taken place, including several added value initiatives (e.g., hand line caught mackerel, bass and pollack) as well as the supply of high quality fresh fish to high-end restaurants in Cornwall and beyond”.

Cornwall represents one of the key areas in the UK where inshore fishing remains a key part of the rural community both economically and culturally. Fishermen in Cornwall are facing a range of “wicked problems” that are typically faced by primary producers across Europe such as climate change, globalisation and responding to a post-productivist society involving a wide range of user groups with an interest in coastal areas (Symes et al. 2015).

Building essentially on a literature review (that included: Bush et al. 2013; Cornwall IFCA 2015; Fearnley-Whittingstall 2010; Greenpeace and NUTFA 2012; Harris and Harvey 2012; MMO 2015; Phillipson and Symes 2015; Reed et al. 2011; Salmi 2015; Symes and Phillipson 2009; Urquhart et al. 2011) and on the causal dynamic and the categories of conditions-strategies-performances (see Appendix 1, 2, 3, 4), it was possible to identify a set of conditions for the Cornish fisheries sector that necessitated fishers adopting a set of strategies in order sustain their activity (table 2).

In particular, with regards to the conditions concerning *demand* issues – the inshore fleet faces a lack of control over the market for the prices received, in that most of the fish are sold through the three auction markets (Newlyn, Looe and Plymouth), where the prices fluctuate depending on demand, day by day. The response of some fishers in Cornwall has involved the following strategies:

- Within the framework of *rural development* strategies primary producers have responded through *diversification and territorial integration*, primarily in terms of developing *new market channels & vertical integration*. In particular, fishers in Cornwall, especially the inshore fishers, have developed a variety of different market outlets. These include the

harbour markets in Newlyn, Looe and Plymouth, which have the advantage of achieving the best possible price on any given day; some fishers also sell their produce direct to local restaurants, which achieves a higher price but is limited in terms of the quantities that can be sold; and more recently, modern technologies, including Twitter and Facebook have allowed groups of fishers to publicise their catches in real time and sell direct to London restaurants.

Concerning *regulatory and policy* conditions, the Fisheries Local Action Group (FLAG) in Cornwall has had a part to play in developing *local and regional development plans*, in particular through integrating the local fishing sector into the wider food economy:

- This funding from the EU has been made available to fishers through *rural development* strategies for *diversification and territorial integration*, as well as *quality and sustainability standards*: investments were made to improve the quality of locally caught fish (such as through providing ice boxes to fishers), as well as through giving the fish a 'story' and a Cornish seafood brand that is associated with traceability and sustainable fishing practices (Reed et al. 2011).

A key condition – from a *regulation and policy* perspective - for primary producers of fisheries is represented by the management restrictions imposed by the Community Fisheries Policy through licensing and quota restrictions, conceived principally in terms of combating overfishing and conserving natural stocks (Symes and Phillipson 2009):

- Fishers have responded through a number of strategies belonging to *rural development* actions for *diversification and territorial integration*, such as targeting a range of different species (through the deployment of multiple gears). Fishers have also sought to reduce their *risk* exposure by lowering their levels of indebtedness. They also respond by engaging in *pluriactivity* through family members' taking employment that is not related to fishing. In other cases, fishers have responded by adapting their boats so that they can be handled with less people, thereby reducing their crew costs.

Another condition affecting fishing activity is the decline of catches, is the joint effect of a set of drivers (such as overfishing and consequent restrictions, seasonality, weather etc.):

- One adaptive strategy in response to declining catches – belonging to *agro-industrial competitiveness and intensification* strategies - is to fish further from shore and to spend longer at sea. While this may result in greater income, it also involves potentially more danger as well as spending more time away from the family.

CONDITIONS FACED	STRATEGIES EMPLOYED	PERFORMANCES EXPECTED
SMALL-SCALE FISHERIES		
DEMAND Minimal control over prices received	RURAL DEVELOPMENT - Diversification and territorial integration – New market channels & vertical integration: - Developing a variety of different outlets to help even up the prices received	Financial stability: Improvement of the fishermen cash flow (since buyers pay directly to the fishermen)
REGULATIONS AND POLICY Local and regional development plans: Funding from European Fisheries grant for FLAG (Fisheries Local Action Groups)	RURAL DEVELOPMENT - Diversification and territorial integration - Quality and sustainability standards: - Investments made to improve the quality/qualities of local fish caught. - Giving the fish a 'story' and a Cornish seafood brand that is associated with traceability and sustainable fishing practices.	Environmental goals; Business flexibility; Higher revenues; Productivity: - Development of gastronomic tourist destination - Some ports have developed routes into the hospitality trade.
FACTORS Catches decline	AGRO-INDUSTRIAL COMPETITIVENESS - Intensification: - Fishing further from shore and spending longer at sea	Higher revenues; - Increase of the income Working conditions; Increase of the danger for spending longer at the sea. Household's welfare; Spending more time away from the family
REGULATIONS AND POLICY Common Fisheries Policy: Access to quota	RURAL DEVELOPMENT - Diversification and territorial integration. New food products: - Targeting a range of different species (through the deployment of multiple gears), RISK MANAGEMENT: - Lowering levels of indebtedness, PLURIACTIVITY: - Engaging family members' off farm employment, COPING WITH FISHING QUOTA DECLINE - Downsizing/Survival: - Turning to self-employment and reducing crew size.	Business flexibility; Productivity Business survival Business survival

Table 2 - Conditions, Strategies and Performances observed for primary producers of Fisheries in Cornwall (UK).

5. Discussion and perspectives

As a preliminary and explorative analysis, the paper investigates causal mechanisms or inference between conditions, strategies and performances observed only through context-specific literature reviews. Hence the operationalization of the CSP framework proposed in this paper is limited and it is not possible to generalise the results. Moreover, the operationalization proposed takes into account only the linear consequential dynamics of Conditions-Strategies-Performances and does not study yet the feedbacks that are illustrated in figure 2. Combining these preliminary findings with insight from media content analysis, primary producers' surveys and participatory focus groups will enable a more robust analysis. In particular, structured retrieval and analysis of knowledge, information and data - through the involvement and participation of producers and stakeholders - will be key, not only to developing an inventory of the different categories of conditions, strategies and performances, but also to identify the dynamic functioning and the direct feedback interactions between those categories.

An additional context-specific literature review of the observed conditions, likely to influence strategies and performance of fishers and fish farmers in Tuscany and fishers in Cornwall, can provide an idea of the necessity to further investigate the potentially related strategies and outcomes for primary producers through participatory approaches. Tables 3 and 4 illustrate a number of categorised conditions, encountered in context-specific literature, that would need to be further explained through the identification and analysis of the related strategies and the outcomes expected.

CONDITIONS	Regulations & Policy	Ecological	Finance & Risk	Socio-institutional	Factors	Technological	Demand
FISHERIES							
	- Pressure from nautical tourism ⁵	- Low productivity of demersal species in the Tyrrhenian sea ⁴	- Lack of credit and financial services ⁴	- Illegal fisheries undersize fishes ⁵ - Poor coordination between environment management and production activities ⁵	- Crises if distribution channels ⁴ - Lack of labels of production ⁴	- Old vessels ⁵ - Insufficient landing structures and port services ⁵	- Competition between industrial fisheries and artisanal fisheries ⁴
AQUACULTURE							
	- Urban and environmental restrictions limiting the aquaculture activity ⁴	- Damages from piscivorous birds ⁴	- High costs for starting a firm ⁴	- Overly bureaucratic processes and management ⁴	- Increase of costs for fish meal ⁴		- Prejudgement of consumers for aquaculture fish instead of wild fish ⁴ - Strong competition from cheaper Mediterranean fish products ⁴ - Lack of information of consumers concerning areas of origin of fish ⁴

Table 3 – Additional conditions faced by primary producers of Fisheries and Aquaculture in Tuscany observed through context-specific literature review.^{5,6}

⁵ Ferretti (2011)

⁶ Regione Toscana (2005)

CONDITIONS	Regulations & Policy	Ecological	Finance & Risk	Socio-institutional	Factors	Technological	Demand	Socio-demographic
SMALL SCALE FISHERIES								
	<ul style="list-style-type: none"> - Access to quota - Introduction of the Landing Obligation and Discard Ban 	<ul style="list-style-type: none"> - Intensive use of the local ecosystem - Multiple demands of the local ecosystem - Water quality - Seasonality - Weather 	<ul style="list-style-type: none"> - Lack of capital to buy boats, in part because of quota uncertainty 	<ul style="list-style-type: none"> - Some lack of communication between fishers and managing institutions 	<ul style="list-style-type: none"> - Depleted stocks - Lack of sufficient quota - Rising production costs - Pressure of tourism and recreation sectors 	<ul style="list-style-type: none"> - Accurate assessment of local fish stocks, which fluctuate considerably 	<ul style="list-style-type: none"> - Fluctuating prices - Market instability - Low consumer awareness about fish - In general, a lack of fish eating culture in the UK 	<ul style="list-style-type: none"> - Recruitment problems - Ageing of fishers - Increasing housing prices for younger fisher households - The inheritance route into fishing is less common

Table 4 – Additional conditions faced by primary producers of Fisheries in Cornwall observed through context-specific literature review.

The competing interests and concerns among stakeholders and actors involved in a fishing community, in a fishing area, or in fisheries industry, represent further issues that will deserve additional study at local levels.

Competition between actors in fisheries can have negative impacts on income and wealth distribution particularly for small-scale fisheries and traditional fishing modes, especially when fish and seafood imports increase, leading to stronger price pressures (Crona et al., 2016). Often a dualism emerges between small and large-scale fisheries, competing for the same limited fishing resources and markets, and differing for the scale of the activity, the degree of capital intensity and investment, the technology used and employment generation. However, even if there are fixed thresholds at a national or European programme level to define the scale of fisheries (vessel length, KW, GT), there are not clear boundaries that limit the field of activity among the different sectors (artisanal, industrial etc.) of the fishery operations. Also, the different fisheries sectors can respond (or adapt) to diverse pressures (fuel price increase, lowering subsidies etc.), differently depending on the surrounding economic and specific context (Carvalho et al., 2011).

With regards to other competing concerns within actors that will deserve additional study – in particular for the environmental issues related to fisheries - it is acknowledged that the loss of freshwater fish is also caused by acidic precipitation, changes in global precipitation patterns, air and freshwater pollution (Rockstrom, 2009). Actors and stakeholders, from fishermen to environmental non-governmental organisations, play an important role through initiatives aimed at influencing pollution control policies.

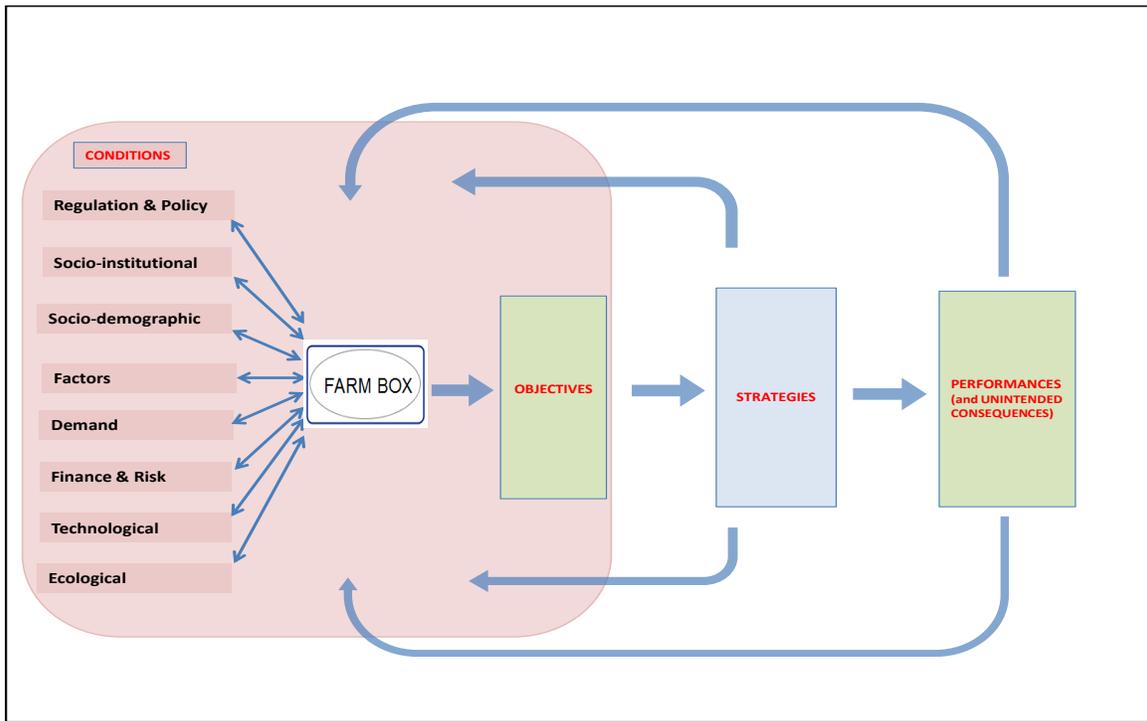
6. Conclusions

Research on fisheries management has been mainly characterised by biophysical approaches and recently several efforts have been implemented to integrate socioeconomic and cultural issues with environmental aspects into fisheries research. However, for many geographical areas, there is a call for developing further research on sustainable fisheries management through participatory approaches in order to explore the crucial issues involved in decision-making and to identify strategic sustainable solutions (Carrà et al., 2014). It is widely acknowledged that moving fisheries towards a more sustainable management perspective needs further analysis of the social dimensions of sustainability (Acott et al., 2016).

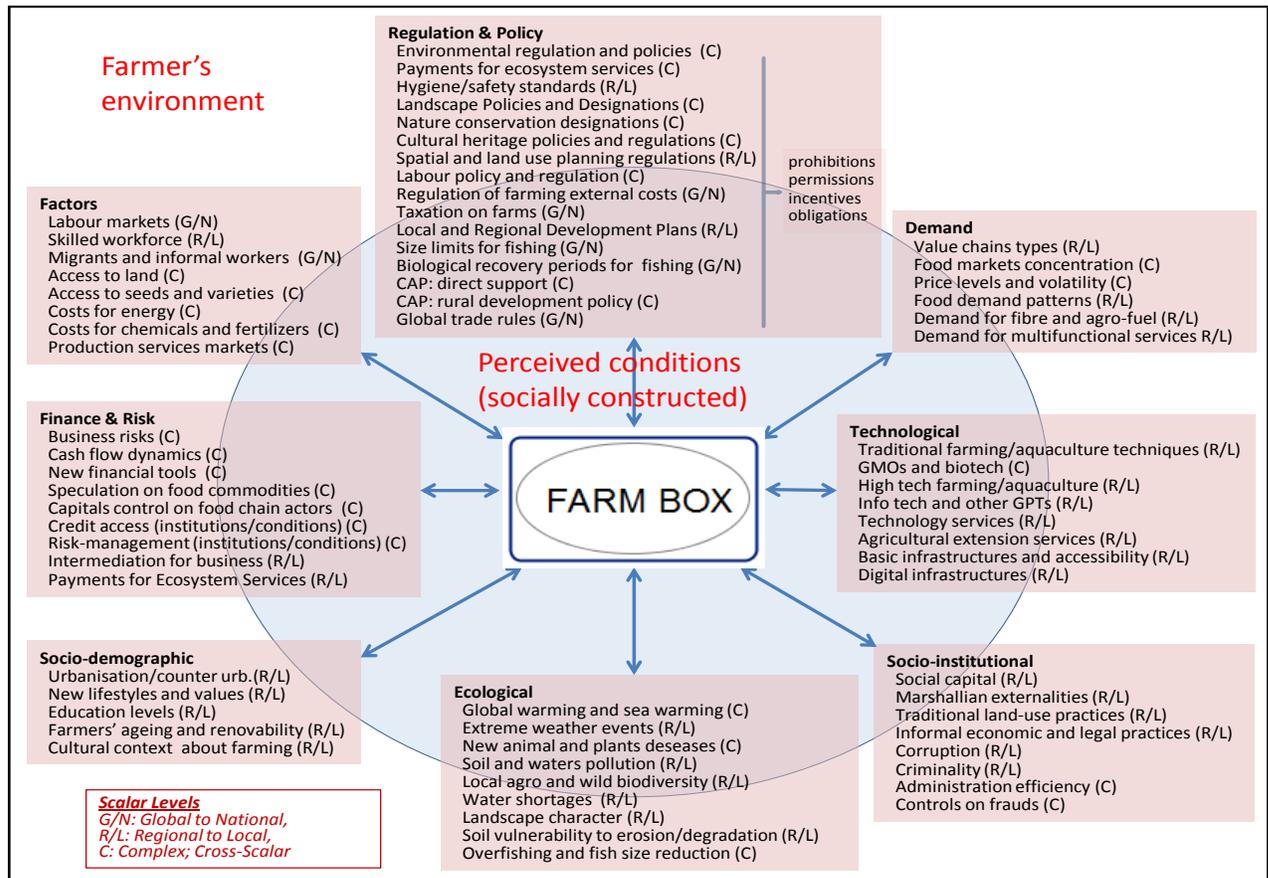
Thus efforts are increasingly being focused on the integration of local knowledge and social values into decision-making frameworks for identifying sustainable strategies for fisheries through balancing the environmental, economic, socio/cultural elements and the related inter-linkages; qualitative data will then be used together with quantitative data (Acott et al., 2016). For instance, incorporation of historical information (i.e. Local Ecological Knowledge and Traditional Ecological Knowledge), about fishing practices or the observed trends of fish stocks, is considered key to implement plans and develop new strategies for fisheries' primary producers such as identifying new fishing grounds, innovative fishing tactics and target different species for new markets (Damalas et al., 2015). The analysis of the information brought from the media, together with interviews with stakeholders and participatory focus-groups can then contribute to a suitable, more informed and systemic application of this framework, avoiding an excessive reductionist approach, and allowing a systemic perspective.

Derived from industrial organization and agrofood value-chain management approaches - combined with an extended literature review (integrating principles from rural studies, rural sociology and agricultural economics), a retrieval of available data, and structured knowledge-based tools and participatory elicitation techniques - a transdisciplinary research process is proposed for analysing and modelling conditions, strategies and performances of primary producers of fisheries and aquaculture in Europe. Engaging with stakeholders and experts, through integrated and structured knowledge-based tools, and accessing qualitative and quantitative information will be key to comprehensively analyse how primary producers develop decision-making process (Eriksson et al., 2016) when they are exposed - and thus potentially vulnerable - to specific stressors and changing conditions, calling for transformation strategies towards sustainable solutions and performances for fisheries and aquaculture.

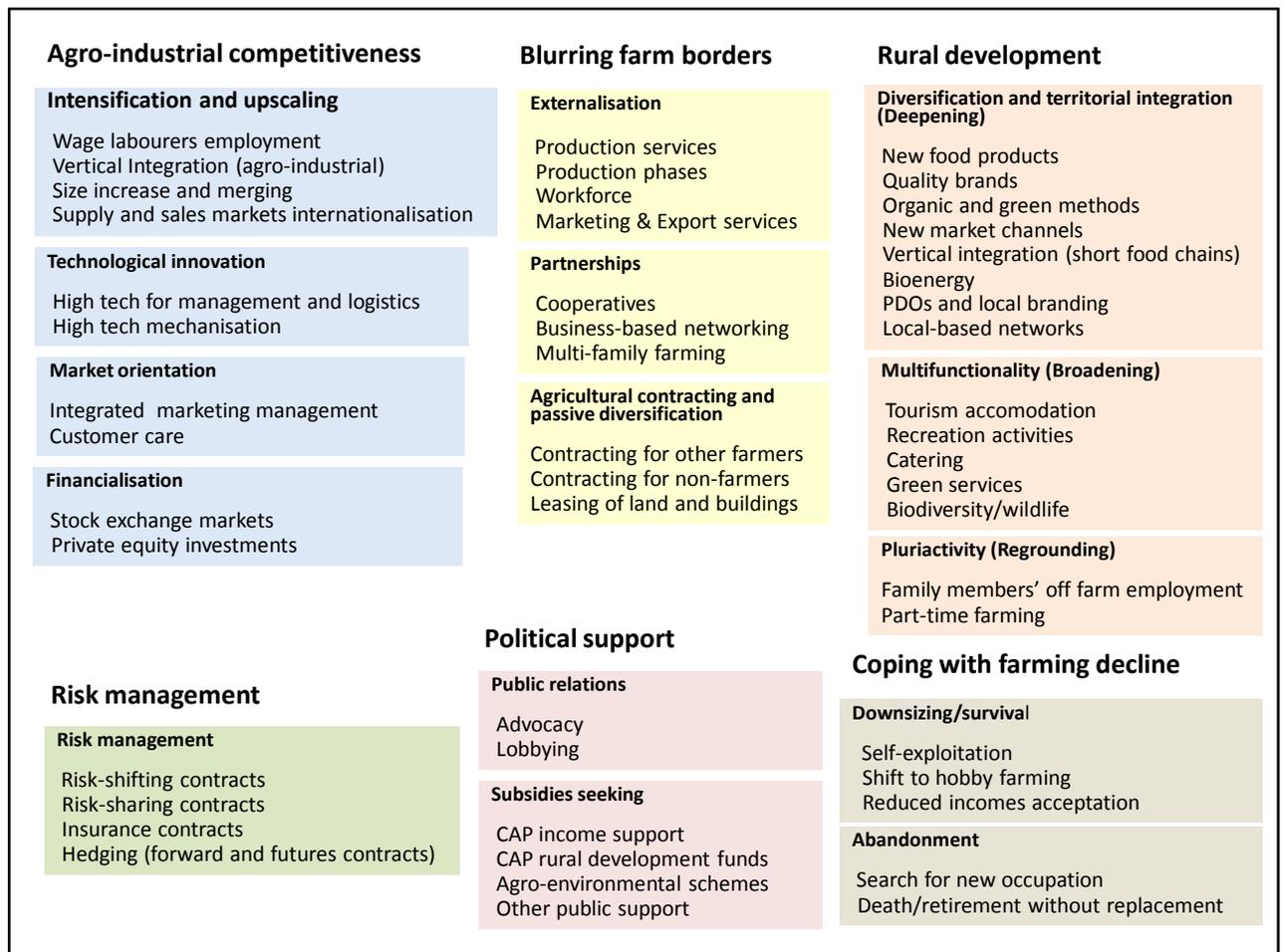
APPENDIX 1: SUFISA Conceptual Framework “Conditions, strategies, performances and feedbacks”



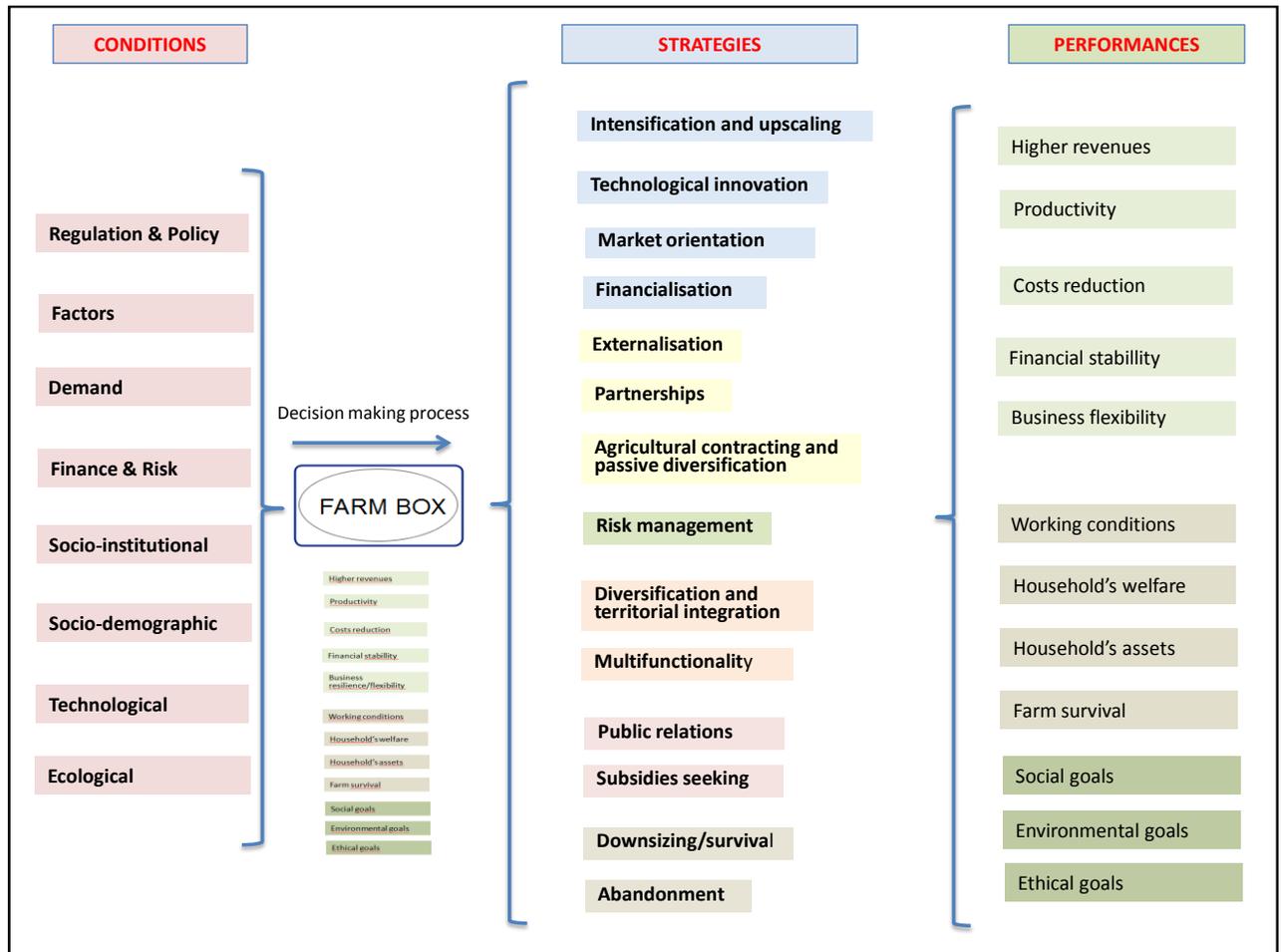
APPENDIX 2: SUFISA Farmers' environment and perceived conditions



APPENDIX 3: SUFISA Farms' strategies map



APPENDIX 4: SUFISA Conditions, Strategies, Performances



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