

The Social Capital for Adriatic small pelagic fish value-enhancing: a network analysis

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1. Introduction

Fishing effort reduction forced by the New Common Fisheries Policy (CFP) in order to achieve sustainable stock levels has caused a fall-off in the incomes of fishermen and coastal communities. Moreover, ineffectiveness in the local supply chain and in supply management contributes to worsening fishermen's income level. These events are particularly dramatic for the small pelagic fish market, which is characterized by low prices, a low level of consumption and poor market penetration. Practical strategies are needed to improve the commercial performance of the product, to foster the general efficiency of the fishery system and workers' profitability as well as customer satisfaction.

Profound changes, such as fast upgrading of production technologies and increasing global competitiveness, boost specialization in production frameworks, increasing evolution and differentiation in consumer demand, and move firms both to establish wider relationships and forms of collaboration

Abstract

Fishing effort reduction forced by the new Common Fisheries Policy (CFP) designed to achieve sustainable stock levels has caused a fall-off in the incomes of fishermen and coastal communities. These events are particularly dramatic for the small pelagic fish market, which is characterized by low prices, a low level of consumption and poor market penetration. This paper evaluates the value of the social capital network as substance of relationships among the Adriatic small pelagic fish (Engraulis encrasicolus anchovies, Sardina pilchardus sardines and Scomber scombrus mackerel) supply chain actors; starting from the definition of each marketplace role and commercial flows, the paper defines the supply chain value-system and the possibility to enhance the fishery's share value, according to increasing relationships. Applied approach of the value chain to different supply chains of the Adriatic fishery system made it possible to estimate value distribution among the phases of the chain and to understand the fishery firms' competitive position. Critical aspects causing fishing firms' low profitability were detected and analyzed through the Social Network Analysis (SNA). Five local small pelagic fishery systems (Manfredonia, Molfetta, Ancona, Martinsicuro and Chioggia) were studied. For each of them, small pelagic fish supply chains were defined with particular reference to the role of local fish marketplaces and operators involved. Analysis of production areas revealed profound differences both in structural aspects (fleet composition, vessels, type and structure of local fish markets, fish ranges and prices) and in the business relations and management of supply chain dealers.

Keywords: Small pelagic fish supply chain, Social network analysis, Value system.

Résumé

La réduction de l'effort de pêche, imposée par la nouvelle Politique commune de la pêche (PCP) afin de parvenir à des niveaux de stock durables, a déterminé une diminution des revenus des pêcheurs et des communautés côtières. Ces effets sont particulièrement dramatiques pour le marché des petits pélagiques, qui se caractérise par des prix bas, un faible niveau de consommation et une pénétration limitée du marché. Dans cet article, nous avons analysé la valeur du réseau du capital social en tant qu'objet des relations entre les acteurs de la chaîne de distribution des petits pélagiques de l'Adriatique (anchois *Engraulis encrasicolus*, sardines *Sardina pilchardus* et maquereaux *Scomber scombrus*). À partir de la définition du rôle de chaque marché et des flux commerciaux, nous avons illustré le système de valeurs de la chaîne de distribution et mis en évidence la possibilité d'améliorer la distribution des valeurs de la pêche, suivant des relations croissantes. Une approche appliquée de la chaîne de valeur à différentes chaînes de distribution du système de pêche de l'Adriatique a permis d'estimer la distribution des valeurs dans les différentes phases de la chaîne et de comprendre la position compétitive des entreprises de pêche. La recherche a identifié et évalué, à travers une Analyse des Réseaux Sociaux (ARS), les causes critiques de la faible rentabilité des entreprises de pêche. A cette fin, on a passé en revue cinq systèmes locaux de pêche (Manfredonia, Molfetta, Ancona, Martinsicuro and Chioggia). Pour chacun, on a défini les chaînes de distribution des petits pélagiques par rapport, en particulier, au rôle des marchés de poisson locaux et des opérateurs impliqués. L'analyse des zones de production a fait ressortir des différences profondes au niveau des aspects structureaux (composition de la flotte, type de bateau, types et structures des marchés du poisson locaux, variétés de poissons et prix) et des relations commerciales et de la gestion des acteurs de la chaîne de distribution.

Mots-clés: Chaîne de distribution des petits pélagiques, Analyse des Réseaux Sociaux, Système de valeurs.

among themselves, with other stakeholders, and with researchers, to find innovative approaches for strategic analysis of the economy. These innovative behaviors set up business networks in which firms can find the most suitable organizational ways to deal with changes in information, which is the key to increasing their competitive advantage (Casieri et al., 2009).

This paper evaluates the value of the social capital network as substance of relationships among the Adriatic small pelagic fish (*Engraulis encrasicolus* anchovies, *Sardina pilchardus* sardines and *Scomber scombrus* mackerel) supply chain actors; starting from the definition of each marketplace role and commercial flows, the paper defines the supply chain value-system and the possibility to enhance the fishery's share value, according to increasing relationships.

2. Theoretical framework

2.1 Social network analysis

The primary resource for the network is social capital (SC), which includes institutions, relationships, attitudes, and values ruling interactions among individuals and/or social groups and which

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contribute to the social and economic development of the territory. A large number of studies have recently underlined the importance of SC, from a scientific definition (Bourdieu, 1980; Scott, 1987; Coleman, 1988, 1990; Castells, 1996; Murdoch, 1995, 2000) to a direct way to assess it (Acciani et al., 2009). According to Grootaert (2001), SC has three different dimensions: the observation, the form and the way in which it may influence socio-economic development. As regards observation, Putnam (1993) identified three different levels: micro, individuals and/or firms, which are able to produce externalities with their relationships and values; meso, the association of individuals/firms, affecting SC with their behavior within and outside them; macro, institutions, with the rules and system of laws governing the economic development of a society. The ways in which SC influences social development are several, starting from sharing of information, strengthening of trust among individuals, and reducing transaction costs (Acciani et al., 2009; Mazzoni, 2005).

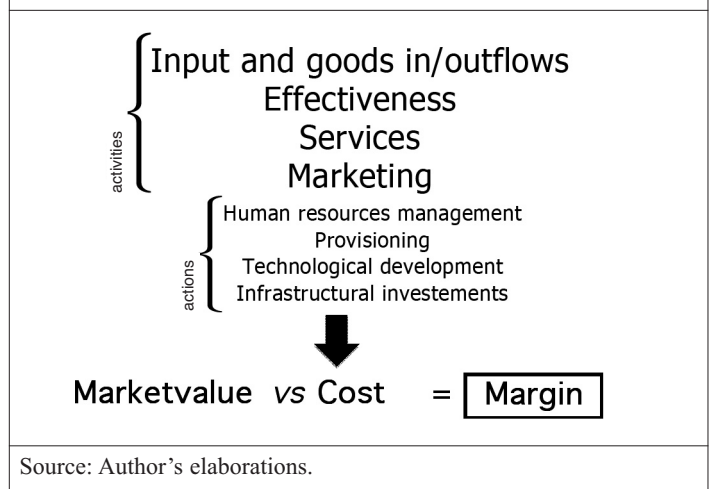
SC theory stresses the network's structure, emphasizing its content as the quality of relationships and, above all, as reciprocal advantages; in this case the network becomes capital in the economic sense, because belonging to it means enjoying a competitive advantage (Fukuyama, 1995; Granovetter, 1985). As described in the literature, SC is the set of durable relational resources useful to pursue individual or collective aims and there are two models: supporting SC, deriving from belonging to a group; and reciprocal SC, related to the amount of individual social relationships established (Putnam, 1993, 1995). Recent network scholarship proposed a multiple level of SC analysis, in which levels are different steps of a subsequent individuals' aggregations: according to Moliterno and Mahony (2011) a system characterized by a dense collaboration may be less interested in setting relationship outside than a node with fewer ties; so that, individuals at an organizational system level influence networks at higher and/or lower levels.

2.2. The value chain

Entrepreneurs perform several diverse activities: control of input and in/out flows of goods; administrative and technical management; product placing on markets. They also implement ways to start up profitable activities, from human resource management to technological and infrastructural upgrading. As shown in the Figure below, the entrepreneur's result (the margin) depends on the comparison between the reference market value of the product (price*amount) and the total production cost (depending on their ability in managing activities and actions).

In a supply chain perspective, all the actors have a similar managerial scheme and target; so that the system value of a product is the sum of each actor's revenues and its dis-

Figure 1 - *The firm's value chain.*



tribution among them depends on their managerial skill: the more they are able to boost their competitiveness, according to their firm's value chain, the bigger system value share they will gain (Porter, 1987).

3. Materials and methods

Applying the approaches of the value chain to different supply chains of the Adriatic fishery system made it possible to estimate the value distribution in the phases of the chain and to understand the fishery firms' competitive position; subsequently, critical aspects causing fishing firms' low profitability were detected and analyzed through Social Network Analysis (SNA) (De Blasi, 2011). In particular, in each area investigated, the value distribution among supply chain phases and the characteristics of networks were analyzed, carrying out a survey of all the official networks in the system under investigation, evaluating the small pelagic fish commercial flows and their critical aspects through direct contact with local stakeholders. As a first step of the study, a literature review and a desk analysis had been carried out on the structural and economic characteristics of the five Adriatic fishery systems. The most up-to-date data were collected from official national info providers concerning quantitative and qualitative characteristics of fleets (vessels number, kind, age...) and marketplaces (kind and structures of local fish markets, fish catches amount, ranges and prices)¹. Then, data concerning each marketplace had been collected during the two years' period through direct in-depth interviews to fishermen and market and Fishermen's Associations managers.

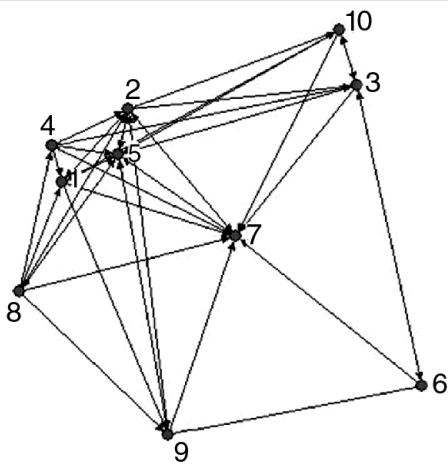
Starting from these considerations, criticalities causing low profitability of fishing firms had been detected and analyzed, using SNA. Regarding the network consistence, an initial survey of production, trading, processing and institutional networks was carried out in each area. A questionnaire was administered to each network to evaluate characteristics, as well as frequency and quality of reciprocal relationships. The results were put in a data matrix that, ac-

¹ particularly from the Italian Institute for Economic Research in Fishery and Aquaculture (Irepa) and from the Italian Institute for Statistics (Istat).

According to graph theory, was the basis to graphically representing the networks of relations and calculate social capital indexes. Graph theory allows a translation of matrix data in a sociogram, which is a way of representing relational matrix data (Fig. 2) (Scott, 1987; Wasserman, 1994; Hanneman et al., 2005) in which nodes are the individual actors within the networks, and ties or links are the relationships between the actors.

According to this topological approach, the local fishery systems were represented as a set of 'points' (nodes) connected by 'paths' (links, ties, or edges). The points represent single networks of fishery, trading, processing, etc; the paths represent the interactional or causal sequences connecting them. The power of a node is proportional to its degree (the number of links connecting it to the network); the power of a network is proportional to the number and strength of its nodes and links.

Figure 2. *Knocke's information exchange network.*



Source: Hanneman and Riddle (2005).

Three indexes were calculated to describe nodes: degree, closeness, and betweenness centrality:

- degree centrality depended on the number of ties or neighbours of a node;
- closeness centrality was the inverse of the sum of all shortest paths to others or the smallest number of ties to go through to reach all the others individually;
- betweenness centrality was the number of the shortest paths on which a node was on (Opsahl, 2010).

These levels of centrality are often associated with the node's power and with the possibility to influence other actors' behavior; thus, at an overall network level of analysis, it is important to evaluate the role of the group of actors with the highest values in the various measures of centrality (Terril et al., 2005). In short, if network degree is the

number of nodes linked by ties to other actors in the network; network or global-level density is the proportion of ties settled relative to the total number possible; a dense network is a network in which the number of links is close to the maximal number of links; on the other hand, a graph with only a few edges is a sparse network; network density depends on the number of nodes carrying out links comparatively to the total number of nodes (inclusivity).

4. Results and discussion

Five local small pelagic fishery systems (Manfredonia, Molfetta, Ancona, Martinsicuro and Chioggia) have been studied. For each of them, small pelagic fish supply chains have been drawn with particular reference to the role of local fish marketplaces and operators involved (Fig. 3). Analysis of production areas revealed profound differences both in structural aspects (fleet composition, vessels, type and structure of local fish markets, fish ranges and prices) and in the business relations and management of supply chain dealers. In the three-year period 2008-2010, Chioggia emerged as the most important local system, with a small pelagic fish catch of about 6,800MT; Ancona small pelagic fishery system, in the same period, had a production of 4,400MT, followed by Martinsicuro (3,600 MT). The Apulian fishery systems of Manfredonia and Molfetta are not so important as regards production, (25 and 500MT, respectively) but are very significant with reference to the well-established small pelagic fish consumption of the region's inhabitants.

Analysis of the five local supply chains shows profound differences among them: first of all for the quite dissimilar shares of catches and, in particular, the better performance observed in the North-Adriatic fish markets. See below for a critical analysis of the 5 different small pelagic fish supply chains, particularly focused on product flows and the role of the marketplaces.

Chioggia is a mixed marketplace² and has an important role in fish supply concentration: about 80% of the total catch is sold through it, fixing an average price of about 2.20€/kg; the remaining part, after health controls and certification by the market, is processed in local handicraft factories, obtaining a price increase up to 10.00€/kg. Currently, more than half of production, fresh and processed, is destined to the Spanish market, but this demand share is clearly bound to decrease because of the recent enlargement of the Spanish fishing zone. The respondents among Chioggia's fishery stakeholders expressed great alarm for the future, mainly because domestic demand for small pelagic fish accounts for less than 1/5 of total supply.

In Ancona, the fishery system had a proper sales organization run by the Fishermen's Association. The presence of this organization, dealing with almost the total amount (99,8%) of catches, has strategic importance not only for its coordination of fishing activity and supply management, but also because this shared management had made it possible to reduce operating costs (administrative and staff management; purchase of ice and crates; net repairs, etc.).

² Fish markets are defined "local market" when only fish caught by the local fleet is commercialized; "mixed market" when fresh or processed fish, from local or other origins, is sold.

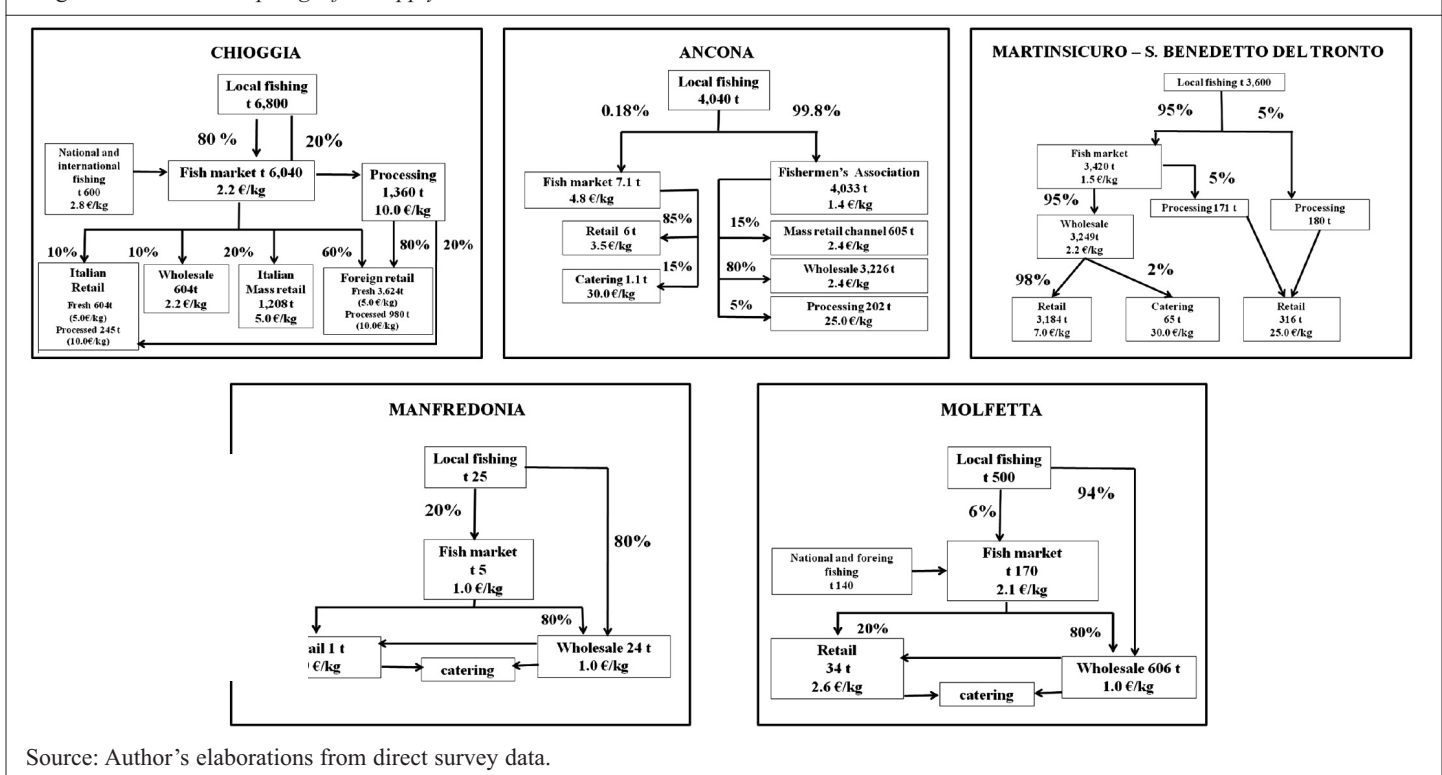
The average price of fish is about 1.4 €/kg, but a complete local supply chain presence is an important characteristic for a fair appreciation of fishery products. Processing and catering phases had an important role in increasing the value of blue fish, the price of which could reach 30.00€/kg.

Also in Martinsicuro fishery system, 90% of catches were sold through the wholesale fish market, in S. Benedetto del Tronto (AP). The average price of small pelagic fish is about 1.5€/kg; the presence of handicraft factories is char-

acteristic of this local chain and makes it possible to increase the value of anchovies, which are processed in many different ways, each having a high value added.

On the contrary, local marketplaces play a subordinate role in the fish trade of the Apulian fishery systems: although both Manfredonia and Molfetta were perfectly equipped for sales by auction, most of the fish is directly and unofficially sold by fishermen on the quay, using the price fixed in market for regular transactions.

Figure 3 - Local small pelagic fish supply chains.



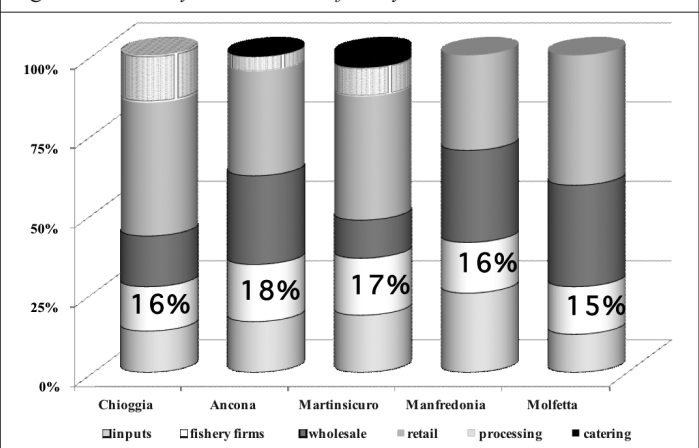
Source: Author's elaborations from direct survey data.

This first phase of the study made it possible to assess production flows and profitability for both marketing and processing phase activities, in relation with each kind of operator in the different fishery systems investigated. According to Porter's Value Chain System theory, each fishery firm's value chain, in the different local production systems, has been considered as a part of a larger system including upstream suppliers (input and raw materials sector, producers, etc.) and downstream operators (processing, trading, customers, etc.). This approach highlighted strong differences among local fishery firms, which differ according to their power to obtain a bigger share of the whole system value produced (Fig. 4) and in developing and maintaining a competitive advantage.

As shown in Figure 4, distribution phases generally earned more than half of the achieved system value, shared between wholesale and retail trading. In every case, local fishery firms show a small (less than 20%) earning capacity. Developed analysis showed better performances for fishery firms in Ancona, which was able to obtain 18% of the total value.

The different levels of performance can be explained by the presence of a well-structured and complete local chain, making product valorization easier; by a high number of

Figure 4 - Value systems in local fishery chains.



Source: Author's elaborations from direct survey data.

workers and stakeholders, setting up frequent and steady relationships, improving social capital value of the area, enabling a reduction in transaction costs and better supply organization, and making it easier to spread information among fishery operators and towards consumers.

From a comparative analysis of registered data, summarized in Table 1, it became clear that all 5 fishery systems analyzed, according to SNA, showed small values both for inclusivity and for density, because of a high share of nodes set at only one tie or completely isolated.

	Chioggia	Ancona	Martinsicuro	Manfredonia	Molfetta
Network size(number)	38	272	70	149	42
Isolated nodes(number)	4	0	3	19	19
Nodes 1 tie(number)	8	0	44	42	20
Inclusivity (%)	89	100	96	78	53
Density (%)	8	11	3	4	5

Source: Author's elaborations from direct survey data.

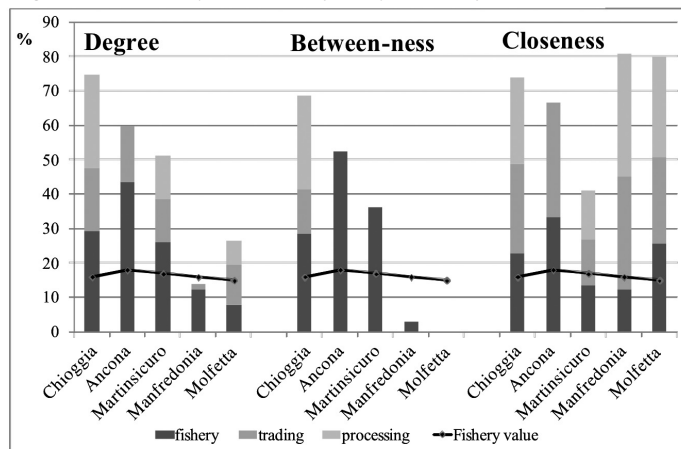
Density value was slightly better in Chioggia and Ancona systems, due to the better performance of fish marketplaces connected to fishery operators. In a second step, network indexes for each node were calculated. Results, clustered for each supply chain phase and standardized on the total value of the network, are represented in Figure 4.

The integrated reading of value system evaluation and network analysis indexes showed relations between value distribution among supply chain operators and their capability to create a strong relations system, useful to improve the profitability of the fishery. In particular, it was important to evaluate fishery network analysis indexes in comparison to other phases of the chain. In Figure 5 network centrality measures are represented by histograms and the fisheries' phases value by lines. Ancona and Chioggia fishery showed the best power in acquiring share of supply chain value (18% and 17% respectively), in accordance with higher performance values of all centrality measures observed. In these two fishery systems, the best scores of centrality indexes were also observed.

The degree centrality of a node refers to the number of links in which it is involved: in Ancona the Small Pelagic Fishermen's Association established good connections among fishery firms (42% of total system's degree score); and in Chioggia (29%) this positive action was performed by one fishermen's association. Betweenness is a measure of the centrality of a node in a network, and it is normally calculated as the fraction of shortest paths between node pairs passing through the node of interest. So it may be a measure of the influence a node has on information spreading through the network (Newmann, 2003). Also in this case Ancona and Chioggia Fishermen's Associations performed a strategic role in connecting fishery firms and in making it easier for them to exchange information and services. Score values of betweenness centrality were respectively 52% and 29%. Closeness centrality is defined as the inverse of farness, as the sum of distances to all other n-

odes. The Fishermen's Associations of Ancona and Chioggia, by taking all decisions about amount and destination of caught blue fish, and supply management, thus actually shorten the distance between fishery firms and wholesalers, and curb prices decreases.

Figure 5 - Centrality scores and fishery shares of value.



Source: Author's elaborations from direct survey data

5. Conclusions

Based on the results of this analysis it has been possible to draw the following conclusions: Network Analysis proved to be a good tool to evaluate small pelagic fish local systems performances, in relation to the amount and quality of relationships established among operators, the shared tools and resources management effects and to the operators' aggregation ability among different supply chains' phases. Network Analysis centrality measures were effective indexes of this capability and their values were directly linked to the possibility to acquire value for fishery firms. Generally, the fishery phase shows poor ability in obtaining a substantial share of the total value generated in the entire supply chain: less than 20% of total value may be referred to the production phase in all the local systems analyzed, but important differences among areas came to light. In particular, these differences were more evident in systems (Ancona and Chioggia) where operators showed greater ability to establish stable and long-term relations, in comparison with systems (Manfredonia and Molfetta) in which analysis revealed a total lack of relationships among operators, both inside the same fishery and in different phases of the supply chain (fishery and trade first of all). Relations between operators in different phases, especially between fishery and processing were of key importance: Martinsicuro system can be considered an example of best practice because of the possibility of increasing value through craft processing of fish in small local firms.

The role of the Fishermen's Associations proved to be of strategic importance and should be stressed not only in market management but also as the central node of a network that can improve social capital value and, in particular, help in the system value shift towards the fishery phase. Fish

marketplaces are fundamental nodes of the network systems but their role needs to be stressed and supported. In this sense, Ancona small pelagic fish market managed by a single producer organization, shows how aggregating capability in shared business management, proves to be particularly useful in increasing income in the fishery phase.

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