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Social networks and seafood sustainability governance: Exploring the relationship between social capital and the performance of fishery improvement projects

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Abstract

1. In the early 2000s, the sustainable seafood movement put forward the concept of fishery improvement projects (FIP), a structured multi-stakeholder approach to address environmental challenges in a fishery and aims to use the power of the market to incentivize change.
2. The intent of the FIP model is to allow fisheries that currently do not meet the MSC standard to maintain market access while working on credible improvements. As such, FIPs have become a widely promoted approach to sustainable fisheries and have proliferated around the globe.
3. Based on recent research assessing the impact of FIPs and testing various FIP attributes and their link to FIP performance, it seems that the FIP model may be delivering on its promise overall. However, the impact of FIP are at best based correlation rather than causation, with only few FIP attributes having been measured consistently over a significant period of time.
4. In this theoretical contribution, we bring attention to one attribute of FIPs: the structure of their social network and its implication for social capital and successful collective action.
5. We start by describing FIPs as projects located at the intersection of environmental governance networks and value chain network governance. Secondly, we demonstrate FIPs as complex social networks and the link between network attributes and FIP progress through the concept of social capital. Thirdly, we present the method of social network analysis and relevant network attributes to understand and characterize how FIPs work better. Finally, we suggest opportunities for further research and integration of this approach in planning and designing FIPs.
6. Through this work, we wish to bring attention to one type of FIP attributes that is currently not explicitly being taken into account to current FIP practitioner and researchers.

KEYWORDS
fishery improvement projects, governance networks, network analysis, private governance, seafood sustainability, social capital, social networks, sustainable seafood movement

1 | INTRODUCTION

The conservation and sustainable use of our oceans, seas and marine resources is one of the 17 goals set by the 2030 Agenda for Sustainable Development adopted by the United Nation in 2015 (UN, 2015). One approach to support this goal is the use of fishery certification and eco-labels that aim to incentivize fisheries to operate according to certain environmental standards using market rewards such as ensured long-term market access and price premiums (Gutiérrez & Morgan, 2015; Ponte, 2012; Roheim, Asche, & Santos, 2011). Today, the most widely used certification and eco-label standard for environmental sustainability of fisheries is the Marine Stewardship Council (MSC) with approximately 12% of worldwide fisheries catch certified (MSC, 2017). Non-governmental organizations (NGOs) have succeeded in getting a large of number of retailers and food service companies in North America and Europe to make timebound commitments to sustainable sourcing based on the MSC standard (Bailey, Packer, Schiller, Tlusty, & Swartz, 2018). These commitments have compelled upstream seafood supply chain actors to act in order to maintain market access and meet the growing market demand for sustainable seafood products. However, for many fisheries around the world, especially in small-scale and developing world fisheries, meeting the MSC standard requires considerable improvements in fishing practices and fisheries management policies (Bush, Toonen, Oosterveer, & Mol, 2013; Tlusty, 2012), with many of those improvement being infeasible or out of the control of the fishery itself (Stoll, Bailey, & Jonell, 2020).

Consequently, the sustainable seafood movement developed the concept of fishery improvement projects (FIP), a structured multi-stakeholder approach to address environmental challenges in a fishery (CASS, 2019). The goal of most FIPs is to achieve a level of performance that meets the MSC standard, whether they wish to pursue certification or not. The intent of the FIP model is to allow fisheries that currently do not meet the MSC standard to maintain market access while working on credible improvements. The Conservation Alliance for Seafood Solutions (CASS) developed a series of guidelines that provide a list of criteria that FIPs should meet in order to be credible and meet market standards (CASS, 2019).

1.1 | What defines FIP performance?

Since 2006, FIPs have become a widely promoted approach to sustainable fisheries and have proliferated around the globe with an estimated 127 active FIPs in place in 2018 (Villeda, 2018). Today, most seafood buyers include products from FIPs in their sourcing policies and commitments, making it an acceptable criterion for sustainability in the market place. However, the credibility and effectiveness of the FIP model has been questioned with the concern that FIPs with limited or no progress are still gaining some market access due in part to limited verification standards and capacity (Sampson et al., 2015). As a result, a web platform (FisheryProgress.org) was developed to catalogue, verify and increase the transparency of FIP performance through self-reporting and independent (desk-based) verification. Through this platform, FIPs must report progress against a set workplan twice a year and are rated from A to E for their performance defined by the extent to which they meet their milestones in a timely manner. Reporting on this web-based platform led to an increasing amount of data available to better understand the FIP model and what elements might contribute to its effectiveness. For instance, recent research used the FisheryProgress database to look at 18 potential FIP attributes and their link to FIP performance and found that only three were significantly linked to FIP performance namely cumulative project time, whether there are regional-level management arrangements in place and, vulnerability of target species (Thomas Travaille, Crowder, Kendrick, & Clifton, 2019). And while it seems that the FIP model may be delivering on its promise (Cannon et al., 2018; Thomas Travaille, Lindley, Kendrick, Crowder, & Clifton, 2019), more research is still needed to understand what makes FIPs work (or not), especially for small-scale fisheries (Barr, Bruner, & Edwards, 2019; Holt, Crona, & Ka, 2019). Better understanding what factors contribute to FIP success would help FIP implementers and funders better design FIPs as an effective approach to sustainable fisheries, and thus a program in support of achieving the 2030 Agenda. However, current databases only collect data on a narrow range of FIP attributes and there has been a lack of attention to developing and evaluating other attributes.

1.2 | Social networks and FIP performance

Fisheries management and achieving sustainable fisheries is an interdisciplinary task which requires the consideration of environmental, social and economic aspects (Phillipson & Symes, 2013). Any intervention that aims to influence how a fishery is managed should therefore consider all aspects of a fishery and how these aspects are interlinked. Moreover, managing fisheries ultimately boils down to managing and governing people and their activities including fishermen (Hilborn, 2007), and increasingly, value chains and markets as well (Jacquet et al., 2010). With the rise in private governance approaches to fisheries management and sustainability (e.g. certification, ratings programs), the number of stakeholders with an interest in fisheries management and seafood sustainability has grown to include local and international NGOs as well as private and public actors. As a result, fisheries governance now consists of coordinating *networks of public and private actors* and managing different interests and levels of influence (Barclay & Miller, 2018; Bush, Oosterveer, Bailey, & Mol, 2015; Gibbs, 2008; Havice & Campling, 2017). Consequently, FIPs should be understood in contributing to fisheries management not only in how they embody improvements in relation to the network of related environmental and socio- economic aspects of fisheries, but also in the ways in which they engage and mobilize the network of actors that affect how fisheries are managed (González-Mon, Bodin, Crona, Nenadovic, & Basurto, 2019). If FIPs are then understood as networks of actors, the analysis of social networks in fisheries and associated supply chains may be a worthwhile exercise when designing an intervention such as a FIP which requires the collective and coordinated action of multiple stakeholders. One resource that arises from a social network and its attributes (e.g. structure, size), that may be of particular relevance to the performance of FIPs is social capital (Figure 1). Social capital typically consists of abstract social resources such as trust, reciprocity, accountability, and a common understanding of collective issues and how these should be resolved and arises from social relationships and how these are organized and structure (Burt, 2003; Scrivens & Smith, 2013). As such, social capital is an important resource to solving complex multi-stakeholder problems such as sustainable fisheries (Grafton, 2005; Gutiérrez, Hilborn, & Defeo, 2011; Nenadovic & Epstein, 2016).

This paper will present the theoretical links between social network attributes, social capital, the governance of FIPs and FIP performance, and explore potential ways to measure those links. The central guiding question is how the social network attributes of FIPs impact their social capital and therefore their performance as a collective effort to improve the sustainability of a fishery. Understanding the relationship between social network structure and FIP performance through the creation and maintenance of social capital could help funders and practitioners in designing, implementing and monitoring FIPs.

In the next section, we will explain in more details how social networks and social capital are relevant to FIP performance. We will then discuss potential social network attributes that may be relevant for measuring social capital in FIPs. Finally, we will make suggestions for future research to further investigate the relevance of social networks and social capital for FIP performance.

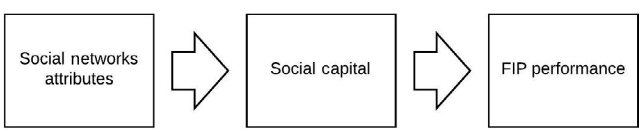

FIGURE 1 The attributes of social networks give rise to different levels of social capital which in turn affects fishery improvement project performance

2 | GOVERNANCE, NETWORKS, AND FIPS

As explained above, FIPs bring together a network of governmental, non-governmental and industry actors to work together towards a common objective: a sustainable fishery. Industry actors drive FIPs in two ways: demanding and preferably sourcing products that come from a fishery engaged in a FIP and/or directly supporting the implementation of FIP activities through in-kind and financial support. As resource manager, the role of government in FIPs is to improve the fishery's management system, for example through policy change or improved implementation of existing policies. Finally, the role of NGO in FIPs is usually that of a mediator and supervisor, coordinating FIP activities and ensuring continuous engagement of industry and government actors. As such, FIPs sit at the intersection between value chain and environmental governance (Figure 2; Havice & Campling, 2017). Therefore, in this section we will present how the concept of networks has been used to study value chains and environmental governance and thereby constructing a conceptual framework that may be relevant to understand FIP governance and performance.

2.1 | Networks and value chain governance: Network governance

The role of social networks in economic organization has been gaining attention, with the term network increasingly replacing the concept of linear supply chain to describe the organization of economic activities, giving rise to new concepts such as netchains (Lazzarini, Chaddad, & Cook, 2001), production networks (Coe, Dicken, & Hess, 2008) and supply network ecosystems (Sloane & O'Reilly, 2013). Where most of the attention in the economics literature had been on vertical supply chain relationships (Gereffi, Humphrey, & Sturgeon, 2005), this reflects a shift towards a growing recognition of the horizontal inter-dependences

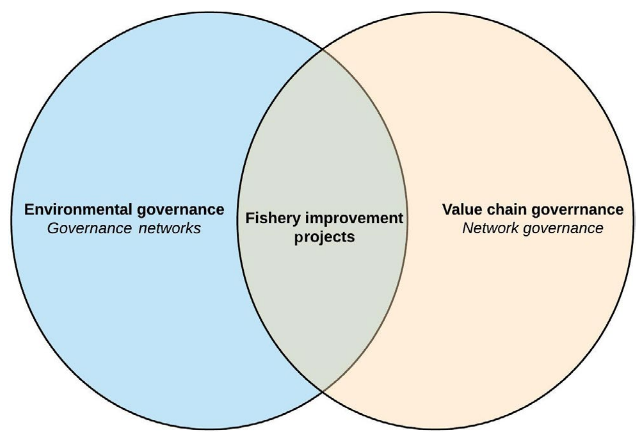

FIGURE 2 Fishery improvement projects sit at the intersection of environmental and value chain governance which means they sit at the intersection of governance networks and network governance

between firms located at the same level of the supply chain (Choi & Kim, 2008). Several studies now recognize the importance of network structure for implementing new practices in supply chains and responding to stakeholder requests (Roy, Nollet, & Beaulieu, 2006; Wathne & Heide, 2004), giving rise to the concept of network governance.

Network governance is a theoretical concept developed to explain certain forms of inter-firm coordination (i.e. value chain governance) that are based on and influenced by social relationships (Jones, Hesterly, & Borgatti, 1997). The idea of network governance came from the observation that as a result of globalization, supply chains have become more fragmented, disaggregated and organized around sub-contracting relationships (Arndt & Kierzkowski, 2001; Feenstra, 1998). Therefore, inter-firm coordination in different global industries (especially those subject to uncertain and competitive environments) are increasingly shaped by political and social relations and thus do not always follow pure hierarchical structures or market logic (Gereffi et al., 2005; Powell, 1990; Uzzi, 1987). As such, network governance is based on the idea that economic transactions are embedded in social relationships, a phenomenon described by the economic sociologist Mark Granovetter (1985) as 'structural embeddedness' to explain why Transaction Costs Economics (TCE) failed to explain certain economic exchanges as it does not take into account the structure and content of network ties. By combining TCE and social network theory Jones et al. (1997) describe network governance as involving 'a select, persistent and structured set of autonomous firms (as well as non-profit agencies) engaged in creating products or services based on implicit and open-ended contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially not legally-binding' (p. 914).

Network governance can be a source of competitive advantage and supply chain efficiency and arises as a response to problems of adaptation, coordination, and safeguarding exchanges more efficiently. The governance of specific product requirements between seafood suppliers and end-buyers, such as certain sustainability attributes for example, is subject to network forms of governance. Indeed, even if sustainability attributes can be codified and standardized (e.g. third-party certification), there is no third-party system for certifying a credible FIP and FIP product. The Fisheryprogress.org platform does provide a certain level of verification, however progress is still self-reported, and it is unclear to what extent, if any, FIP performance scores are used by end-buyers to discriminate between FIPs. Therefore, proving that a product comes from a credible and well-performing FIP still relies on more explicit coordination between first-tier suppliers and buyers using a mix of informal and formal documentation and communication. As a result, inter-firm coordination around the sustainability attributes of FIP products is likely based on trust and mutual dependence. Because FIPs are largely driven by downstream end-buyers (i.e. top-down), their effectiveness is likely partly determined by the relationship between first-tier suppliers and end-buyers and how these actors are involved in the FIP. Further down the supply chain, first-tier suppliers (usually processors and importers) typically work with local supply chains (suppliers and fishermen) to implement improvements. Therefore, maintaining strong and long-term business relationships between importers, local suppliers and fishermen is key to ensure FIP stability and progress and is another example of network governance of fisheries sustainability (Figure 3). In other words, the private governance of fisheries sustainability, and specifically the progress of fisheries improvement, relies on the characteristics of network governance in seafood supply chains.

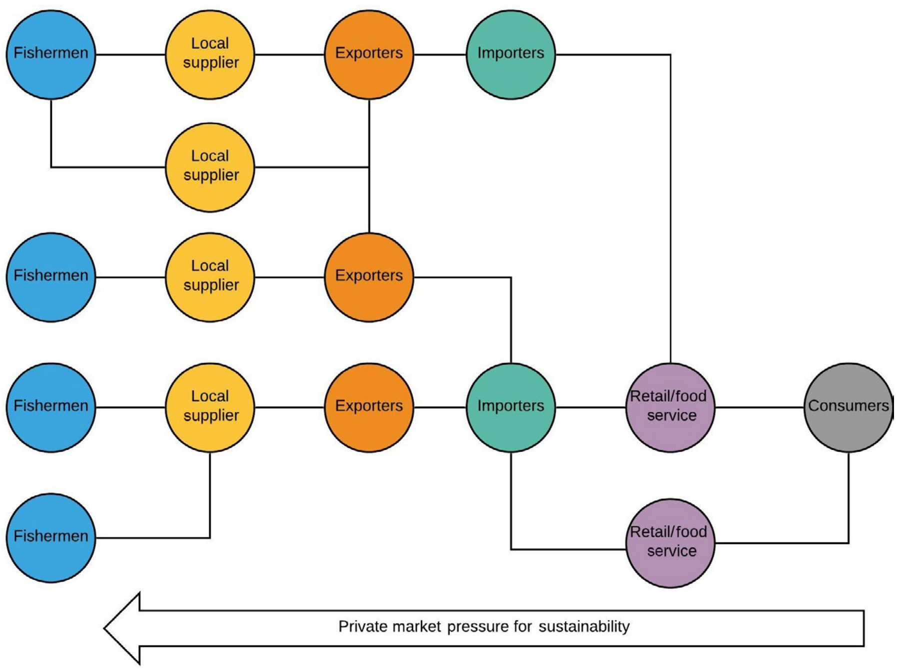

FIGURE 3 Sustainability aspects of seafood production are governed through supply chain networks

2.2 | Networks and environmental governance: Governance networks

At the same time economic sociologists were discussing network governance, political scientists were discussing governance networks. The concept of governance networks was first put forward by political scientists in their study of policy networks to describe new kinds of interactions between public, semi-public, and private actors in governing an increasingly complex and fragmented society (Rhodes, 1997; Sørensen & Torfing, 2005; Stoker, 1998). Rhodes (1997) uses the term governance network to describe the observed shift from state-centered government towards less formal processes based on networks of interdependent public and private actors, the so-called shift from 'government to governance'. Networks differ from markets and hierarchies in that they are not based on contracts, authority and rules of law but on trust and diplomacy (Rhodes, 2007). As such, it is shared norms and values that hold governance networks together (i.e. social capital) and lead to trust-worthy and cooperative behaviour. Governance itself is rooted in the concept of network as it is defined as 'governing with and through networks' and based on the following propositions (Rhodes, 2007):

- Interdependence between organizations (including states and non-state actors).
- Continuing interactions between network members.
- Game-like interactions based on trust and regulated by rules of the game negotiated and agreed by the network participants.
- Autonomy from the states with networks not accountable to the state; although the state can steer networks, networks are largely self-organizing.

Given the shortfall of traditional government-led management, governance networks have also emerged in the fisheries sector (Gibbs, 2008). Indeed, private philanthropic foundations, environmental NGOs and supply chains have become active participants in the governance of fisheries through private approaches such as certification and FIPs. As such, the sustainable seafood movement is governed by a network of actors working together to influence fisheries sustainability, giving rise to a more decentralized and networked form of governance where both public and private actors play, what has been deemed a governance 'concert' (Barclay & Miller, 2018; Gutiérrez & Morgan, 2017). A FIP, as a multi-stakeholder initiative, is one of the governance strategies architectured by the sustainable seafood movement that is based on the collective action and voluntary participation of public and private actors with a common objective of improving the sustainability of a fishery. As such, a FIP can be defined as a type of environmental governance network (Figure 4). Fishery improvements often take time to get implemented and lead to policy and environmental outcomes (FIPs typically last several years) and therefore rely on the continuity and stability of relationships between FIP stakeholders, which in turn relies on long-term commitment, trust, accountability and a mutual understanding of the issues to be resolved and associated solutions. Therefore, these abstract qualities of social relationships between FIP stakeholders, both within and outside supply chains, are key to FIP success.

The role of social networks in environmental management has been the subject of previous academic interest (e.g. Bodin, Crona, & Ernstson, 2006). Indeed, social networks have been identified as an important denominator to effectively deal with natural resource problems by facilitating (a) the generation, acquisition and diffusion of different types of knowledge and information about the systems under management; (b) the mobilization and allocation of key resources for effective governance; (c) commitment to common rules among actors fostering willingness to engage in monitoring and

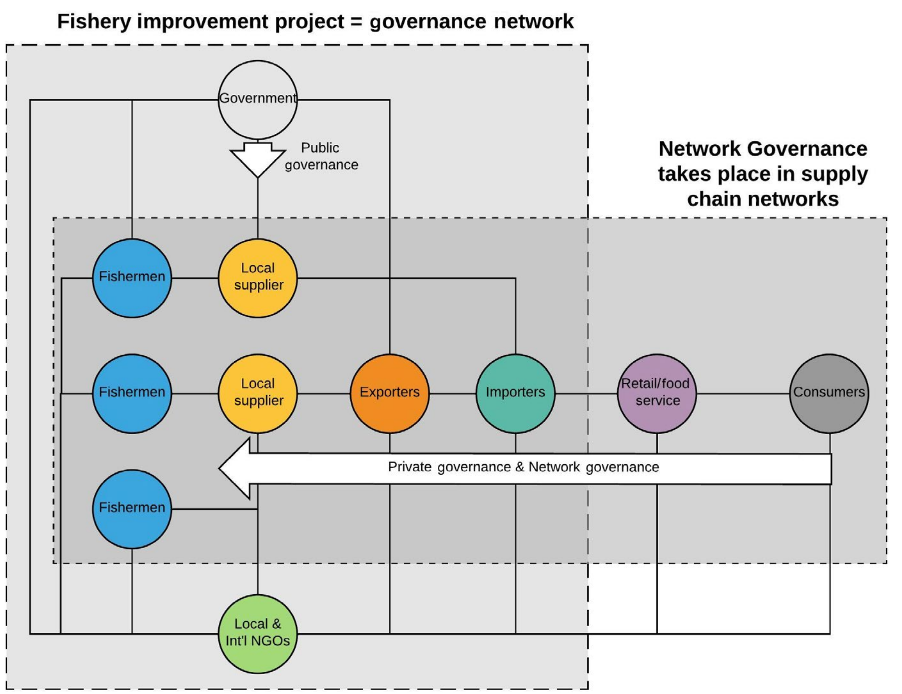

FIGURE 4 A fishery improvement project is a governance network of private and public actors with the collective goal of achieving environmental outcomes for a fishery and overlaps with network governance of value chains

sanctioning programs and (d) the resolution of conflicts (Bodin & Crona, 2009). However, not all social networks are created equal, and the characteristics of a network can affect the ability of that network to govern responsible practices and to manage resources sustainably.

2.3 | Governance of networks, collective action and social capital

How the structure of social networks affects social processes and the governance of networks such as FIPs can be understood through the concept of social capital. Social capital is not a clearly defined concept; however, three distinct representations have been identified in the literature (Grootaert, Narayan, Nyhan Jones, & Woolcock, 2003). The first one is associated with sociologists such as Pierre Bourdieu, Ronald Burt and Nan Lin who define social capital as the resources (such as information and support) individuals can access through their social relationships (Burt, 2003; Lin, 1999). This view emphasizes the importance of network structure as having the most influence on how resources flow. For example, the strategic position of an actor may enable him or her to access resources or leverage certain relationships to gain access to resources (Burt, 1992). This first view of social capital sees it as an individual resource based on four types of resources or capital namely, information, influence, social credentials, and reinforcement (Lin, 2001). The second representation of social capital was largely developed by the political scientist Robert Putnam, who argues that social capital is created through social interactions between individual members of a community and can be translated into shared norms of reciprocity, cooperation, and mutual trust (Putnam, 2000). Therefore, the underlying idea of social capital is that certain network structures and network position facilitate cooperation and lower the 'costs' of working together. As such social capital is a collective resource that is available to all members of the group. A third intermediate representation is one held by James Coleman and was influential in shaping Robert Putnam's work. Coleman sees social capital as both a private and public resource with the actions of individuals having positive (and potentially also negative) externalities for the wider group. As such, individual and collective social capital are co-dependent. These three representations are all valid and interrelated, showing the complex and multi-dimensional nature of social capital. Considering these definitions of social capital, the OECD differentiates between four types of social capital based on four dimensions: network structure and activities, the productive resources made accessible through those structures and, whether the social capital is owned by the individual, or by the collective (Scrivens & Smith, 2013). These lead to four forms of social capital (Table 1). In the case of FIPs and continual improvement of a governance network, the collective forms of social capital (civic engagement and trust and cooperative norms) are the most relevant as it contributes to collective action, as we will discuss further below.

TABLE 1 Four forms of social capital based on four dimensions (Scrivens & Smith, 2013)

	Network structure and activities	Productive resources
Individual	Personal relationships	Social network support
Collective	Civic engagement	Trust and cooperative norms

Governance networks provide opportunities for information sharing and collective action but can also pose challenges in terms of holding network members accountable to meeting network-level goals because participation is mostly voluntary (Provan & Kenis, 2008). Thus, the effectiveness and performance of governance networks rely on social capital to encourage network members to collaborate and ensure they stay engaged and are held accountable for their responsibilities (Sandström & Carlsson, 2008). Indeed, Lubell and Fulton (2008) discuss various social mechanisms whereby governance networks may be vital in effective policy management and implementation, one of them being that social networks 'represent an investment in social capital, important in the case of collective action within a decentralized multi-actor social system'. This builds on the work of Ostrom and others, who argued that social capital is a crucial factor to promote collective action (Ostrom & Ahn, 2003). In that context, social capital refers to the norms and networks that facilitate co-operation (Grafton, 2005). The importance of social capital and social relationships in facilitating cooperative action to solve some of the negative consequences of destructive human behaviours should not be underestimated. Indeed, social capital decreases the transaction costs of working together: people will invest in collective action if they trust others will do so as well and not engage in private actions that damage the common good (Pretty, 2003).

Given that FIPs are collective action projects that rely on the voluntary collaboration of public and private actors and governed through networks formed by informal social relationships between private and public actors, understanding how social capital arises through those relationships is critical. Indeed, social capital and social network are increasingly seen as important components in ensuring successful fisheries governance (Grafton, 2005).

3 | UNDERSTANDING THE PERFORMANCE OF FIPS USING A NETWORK PERSPECTIVE

Now that we have made the case that a FIP is a social network of private and public actors that come together to govern the sustainability of a fishery, and demonstrated the relevance of social network structure to the effectiveness of those governance networks, we will briefly review the method of social network analysis (SNA) and key network metrics that may be relevant for understanding the performance of FIPs.

3.1 | Social network analysis

Social network analysis is a quantitative method to measure network characteristics such as disconnections within the network, relevant actors that should be mobilized, and who is important to work and negotiate with, and to influence and contact in order to achieve common (environmental) objectives (Scott, 2015). Based on graph theory, SNA provides standardized definitions and measures to quantitatively describe relationships, the network structure of those relationships, and the positions of actors within the network. As such, SNA combines the quantitative mathematical approach of graph theory with the qualitative and interpretive approach of sociology to describe and explain individual and collective behaviours based social relationships (Prell, 2012). SNA conceptualizes life in terms of structure of relationships rather than in terms of actor attributes. As such, the method of SNA is based on the paradigm that not only personal attributes influence personal performance, but that one's network position also matters because people influence each other (Borgatti & Li, 2009). In other words, SNA looks for causation in social structures and how individuals are embedded in that structure. For example, two individuals with the same attributes may perform differently due to different network position, and people with the same attributes may behave similarly not because they have the same attributes but also because people with the same attributes tend to occupy similar network positions. Thus, similar network positions give rise to similar opportunities and constraints that in turn shape individual behaviour and performance. Social network characteristics can be viewed not only as affecting the behaviour or outcomes of individuals but also of networks. For example, the question 'how does network structure affect the performance of FIPs?' positions the performance of the FIP as dependent on the network structure.

Stakeholder analysis (SA) or mapping is often used as part of the FIP scoping process to identify most relevant parties to the FIP and determine who needs to become a participant (CASS, 2019; WWF, 2013). SA is a methodology for identifying key stakeholders within a system and for assessing the potential impact that changes to that system might have on the identified stakeholders (Grimble, 1998, p. 1). On the other hand, SNA represents and investigates the relationships and flows between individuals, groups or organizations, using quantitative statistical analysis to characterize the power of those relationships on individuals as well as on the functioning of the network as a whole. Thus SNA is different from SA, but in the FIP context, can be complimentary by bringing in a more quantitative analysis to the qualitative approach of stakeholder analysis. For example, SA usually identifies and categorizes stakeholders subjectively (Prell, Klaus, & Reed, 2009) whereas SNA uses position in the networks to statistically identify types of stakeholders. Moreover, SNA allows to consider the influence of relationships and network structure over the outcome of the network rather than looking at stakeholder influence in isolation. SA and SNA have been combined in a number of fields of study such as natural resource management (Holland, Pinto da Silva, & Wiersma, 2010; Prell, Hubacek, & Reed, 2009), so combining their benefits for understanding FIP performance may be a logical progression.

Over the past decade, there has been a growing interest in studying environmental governance, natural resource management and sustainability from a network perspective using SNA, focusing on understanding which structural network characteristics increase the likelihood of collaboration, collective action, and successful natural resource management (e.g. Bodin et al., 2006; Crona & Bodin, 2006). Five key structural characteristics have been found to affect social processes relevant for the governance of natural resources including (i) number of ties between actors in the network; (ii) network cohesion; (iii) sub-group linkages; (iv) network centralization and (v) actor centrality (Bodin & Crona, 2009). The importance of these structural characteristics have been shown to impact knowledge diffusion, mobilization and allocation of key resources, commitments to common rules, and conflict resolution (Bodin & Crona, 2009; Janssen et al., 2006; Prell, Klaus, et al., 2009). Social capital can also be measured by analysing the presence of three types of ties: bonding, bridging and linking (Table 2; Aldridge, Halpern, & Fitzpatrick, 2002). Bonding social capital arises within a tight group of like-minded individuals who are connected through 'strong ties'. Bridging social capital arises from ties that connect similar but different groups or social networks. Linking social capital stands for ties that connect very different groups usually located at different hierarchies. These structural characteristics and types of ties could serve to help to provide an analytical lens to evaluating FIP performance, eventually perhaps leading to a set of necessary enabling factors required of a FIP network in order to achieve continual improvement.

Here we provide two examples of how network structural characteristics are linked to social capital. First, dense networks, that is, networks in which everyone is connected to each other, means that it is harder to escape the scrutiny of others and increases the likelihood of working together (Burt, 2003). This occurs through two mechanisms. First, social structure affects how information is accessed making it less likely that the information will be altered in denser networks (i.e. contributes to alignment of views and credibility; Coleman, 1990). Second, dense networks facilitate sanctions and therefore make it less risky for network participants to trust each other and work together through the development of common rules and norms (Burt, 2003). Structural holes are another example of how social capital is affected by network structure (Burt, 2004). Structural holes occur when two sub-groups are not strongly or well connected and act as an insulator and keep information from flowing between people. Thus, actors located in between such sub-groups or in those structural holes may be of

TABLE 2 Centrality measure linked to effective collective action, with positive impacts on social capital indicated by '+' and negative impacts indicated by '−'

Type of centrality	Definition	Impact on social capital	References
Degree centrality	The sum of an actor's connections	+ Increases an actor's influence. This influence depends on the strength of those ties. Many ties often mean these are weak therefore influence does not continuously increase with the number of ties; + Central actors can use their position to coordinate activities, execute leadership, and synthesize others' knowledge and opinions, essential for collective sense-making and collaboration; + Central actors can be targeted to motivate a network quickly and diffuse information; − Too many ties can create constraint as these create feelings of obligations to please	Bodin and Crona (2009) Bodin (2017) Prell, Klaus, et al. (2009)
Betweenness centrality	Measures how many times an actor falls on the shortest path between two actors Betweenness centrality can be used to calculate the modularity of a network, i.e. the extent of network cohesion	+ Actors with high betweenness centrality can influence the flow of resources between others and may have access to different kinds of resources and information; + Can act as bridges between disconnected actors (broker) and help provide a holistic view of the issue, a benefit for collective action; + Can support the gathering and diffusion of information from and to the whole network; − May create constraints by being exposed to different positions and opinions; − Having many actors with high betweenness centrality can make a network more vulnerable to fragmentation if these actors disappear, are not willing to play a coordinating role, or if their ties are weakened; − High betweenness centrality may negatively affect the redundancy and buffering in a network, both desirable network attributes for collective action	Burt (2003) Freeman (1979) Granovetter (1973) Prell, Klaus, et al. (2009)
Closeness centrality	Measures how close actors are to each other by measuring the length of the path between actors	+ High closeness is often associated with independence and autonomy. A node with high closeness centrality is freer from actor's influence and is better able to act independently	Freeman (1979)

particular importance, creating a high level of social capital by accessing information from two disconnect groups but also through potential control of information flow. This 'broker' position can be measured though indexes such the network betweenness, developed by Freeman (1977). How the person or organization occupying this broker position uses this social capital (e.g. to facilitate or control) is likely to affect how the network operates, and the likelihood of collective action taking place. These are but two examples of how network structure and position affect the social capital at the individual and network level, which in turn affects a network's ability for collective action for achieving common objectives, which in the case of FIPs is usually continual improvement toward environmental sustainability.

Other network characteristics may affect those two mechanisms as well. For example, if a network is large, it is more likely to have structural holes. If a network is dense, social capital in the form of higher scrutiny and shared norms may be high but social capital in the form of brokered structural holes may be lower (Burt, 2003). Therefore, when looking at issues of cooperation and collective action, it is important to look at both network level and actor level characteristics because collective social capital is linked to both individual and collective social capital. When social capital is high, people have more confidence in investing in collective activities and are less likely to engage in private actions (Pretty, 2003). When seen as social and governance networks, FIPs and their performance can be linked to actor level and network level network characteristics. In this next section, we will present some specific types of network measures that could be used to map and measure social networks within FIPs in an effort to understand relational dynamics that may influence their performance.

3.2 | Actor level measures

3.2.1 | Centrality

Actor centrality was found to significantly affect two features important for adaptive management, namely adaptive capacity and learning (Bodin et al., 2006; Newig, Gunther, & Pahl-Wostl, 2010). The centrality of an individual refers to the extent to which an actor occupies a central position. Centrality can be conceptualized in different ways and can refer to how many ties an actor has (degree centrality), how many times it falls between two other actors (betweenness centrality), how close to all the other actors in the network he/she is (closeness centrality), or how well connected it is to central actors (Eigenvector centrality). Central actors can contact many members of the network quickly, potentially exert influence on them, and are better situated to access valuable information. This can put them at an advantage and therefore it is important that these actors use this position in a way that benefits the collective interest (Bodin & Crona, 2009). Centrality has been shown to be positive for coordinating the process of solving simple tasks because important information can be synthesized and transmitted to a few actors who can make a decision and take action (Bodin et al., 2006).

Central actors may also positively contribute to effective coordination in times of change when resources need to be mobilized to adapt to the new situation. If only a few individuals occupy a central position, there is a risk of centralized decision-making leading to issues of legitimacy and democracy in the way the network is governed (Bodin et al., 2006). This ability to support coordination may be an interesting point of future study given the importance of inter-firm coordination in theories of global value chain governance. Focusing on the implementation of sustainable practices in value chains, Vurro, Russo, and Perrini (2009) explain that network analysis can help us understand the dependencies between supply chain actors and the associated need for mutual trust and collaboration to implement sustainability. Therefore, they link network metrics (density and centrality) to different types of sustainable value chain governance How the different kinds of centrality are linked to network governance in resource management is summarized in Table 2.

3.3 | Network level measures

Network level measures can also provide insights on how network configurations may influence effective natural resource governance. For instance, when a network is characterized by high density of ties, it is likely that more communication is occurring which may mean more mutual trust and the development of knowledge and understanding and more accountability between actors. This leads to higher potential for collective action and collaboration (Bodin et al., 2006; Coleman, 1990; Granovetter, 1985). However, excessive high density can have negative effects such as homogenization of information and knowledge which may limit innovation and adaptability in the network. In the context of FIPs, allowing new knowledge to be integrated and communicated among FIP participants and the ability to adapt to new information is key to ensure that the FIP activities continue to meet the objectives of FIP stakeholders. For instance, the conditions of a fishery may change which may shift interests and ability of participants to take part in the FIP. This is why NGOs recommend FIPs to establish a Steering Committee, clear memorandums of understanding, detailed workplan and regular public reporting (CASS, 2019; WWF, 2013). Network cohesion, which is the tendency to form sub-groups, is another network level measure which may pose a challenge to cooperative action. For instance, the existence of sub-group can create 'tribal' and divisive attitudes. This can sometimes be an issue in FIPs as these bring together actors from different sectors that often operate according to different paradigms or who have not traditionally worked together (Bitzer & Glasbergen, 2015; Future of Fish, 2019). However, if intermediate actors connecting sub-groups (i.e. brokers) are able and willing to coordinate sub-groups, this limitation can be overcome. Other network level measures considered important for collective action include diameter and centralization and are described in Table 3.

3.4 | Examples

In order to illustrate some of the measures we suggest can be used to assess social capital in FIPs, especially collective social capital, we provide four examples of hypothetical FIPs with different network structures and associated network measures (Figure 5; Table 4). Network 1 has a high density with a high number of connections upstream of the value chains, where fishers, processors, a local NGO and governments are well connected with each other, potentially leading to higher levels of cooperation. Moreover, the network is not highly centralized which could suggest that the FIP is a collective effort but might lack leadership. Network 2 is moderately centralized around mid-chain actors (processor and importer) who have hired an independent consultant to manage and advise them on FIP activities. Density is low which means that implementation of FIP activities could be highly dependent on the processor's ability to enroll fishing companies in the FIP activities. Network 3 is fragmented (low modularity) and highly centralized around a fishing association to which fishing companies are members and who has partnered with an international NGO (that is also advising their retail customers) for implementing FIP activities. In this case, the fishing association has ties with the government which could mean that it has influence over government decisions that support the FIP however the performance of the FIP will depend on the strengths of the relationships between the fishing association and the fishing companies. Finally, network 4 is moderately centralized around a processor association and local NGO who together work with fisher groups and an international NGO connected to the end retail customer. The network is denser than the others due to the additional connections between the upstream and downstream ends of the supply chain which could potentially provide additional incentives and pressure to implement FIP activities.

TABLE 3 Network level measures and their impact on effective collective action, with positive impacts on social capital indicated by '+' and negative impacts indicated by '–'

Network level measures	Definition	Impact on network governance	References
Density	The proportion of existing ties compared to all potential ties. Density is also referred to as network closure	+ Higher density usually translates into more communication, reciprocity, and mutual trust which all contribute to knowledge development, development of common norms, and understanding as well as exposure to new ideas; + High density increases mutual trust and trustworthiness; + High density increases social monitoring; + Development of social obligations and expectations; + Lowers the risks for information deterioration; + All of the above contribute to the establishment of collaborative norms – High density reduces heterogeneity and potential for innovation	Bodin and Crona (2009) Granovetter (1973) Robins, Bates, and Pattison (2011) Burt (2003) Crona and Bodin (2006)
Modularity or cohesion	Describes the tendency to form multiple sub-groups. A sub-group, also called a component, clique, or cluster is defined as having significantly more (bonding) ties between its members than it has with non-members	– High modularity often means a fragmented network and thus lead to us versus them mindset. This can limit the capacity for consensus-building. This can be mitigated if actors connecting sub-groups (brokers, usually with high centrality scores) have the capacity and willingness to coordinate sub-groups towards common objectives; + Sub-groups are good for knowledge development within sub-groups and if sub-groups interact in a positive way, they can support the development of comprehensive and diverse knowledge at the network level	Bodin et al. (2006) Wasserman and Faust (1994)
Diameter	The longest path between two actors. Diameter can translate into reachability, i.e. the maximum number of steps needed to reach from one node to any other node	– It is assumed that the higher the diameter, the less cohesive the network. This can affect collaboration, social memory, and adaptive capacity	Crona and Bodin (2006)
Centralization	Describes the extent to which the network is organized around central actors. This measure is complementary to network density. A very dense network usually means it is less centralized	+ High centralization means that most of the ties are organized around one or few actors. High centralization may be useful in the initial phase of a project to form groups and build support for collective action; – On the long term, high centralization can become disadvantageous for long-term planning and problem solving	Provan and Milward (1995) Prell, Klaus, et al. (2009) Crona and Bodin (2006)

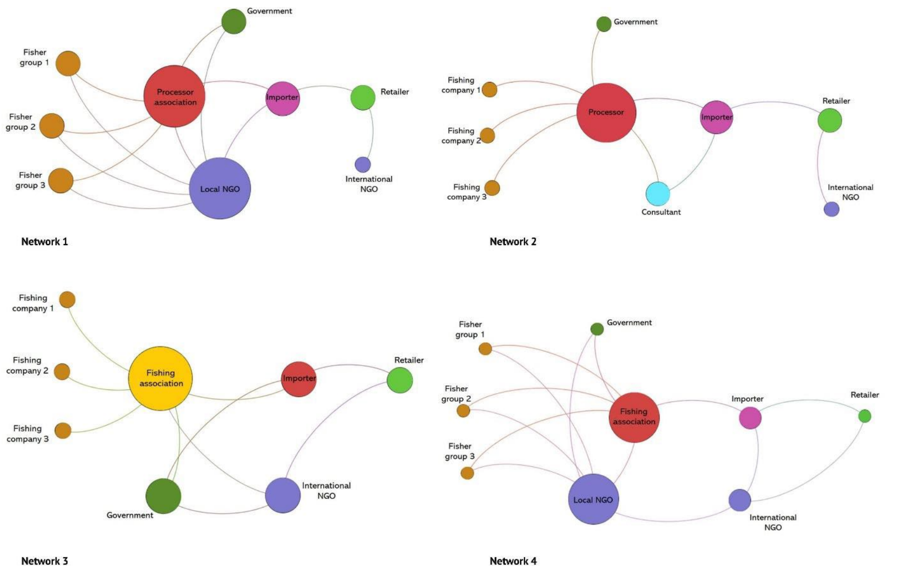

FIGURE 5 Examples of simple fishery improvement project social networks (the size of the nodes are proportionate to the degree centrality of each actor)

TABLE 4 Network level measures

	Network 1	Network 2	Network 3	Network 4
Density	0.361	0.250	0.357	0.389
Modularity	0.201	0.167	0.075	0.265
Diameter	4	4	3	3
Centralization	0.49	0.57	0.61	0.48

4 | FUTURE RESEARCH

Empirical research on FIP performance and effectiveness is still limited to a handful of peer-reviewed and gray literature (Cannon et al., 2018; CEA, 2015; Sampson et al., 2015; Thomas Travaille, Crowder, et al., 2019; Villeda, 2018), none of which take FIP network dynamics, social networks, or social capital into account. This is surprising given the rising number of FIPs as well as the existence of tools for transparently monitoring, evaluating and reporting FIP progress. This is also concerning because it means that the sector is increasingly advocating for the 'FIP model' which has yet to be shown to work across fisheries and contexts (Barr et al., 2019; Stoll et al., 2020). Therefore, more research is urgently needed for developing tools to understand the inside workings and context of individual fisheries, how stakeholders within fisheries and their value chains are connected, how the sector is connected to other related sectors and various markets, and how FIPs impact the network system that is a fishery, its surrounding community and value chains. Combining different tools such as stakeholder analysis and mapping, value chain analysis and SNA, we can better understand how FIPs can support the goal of sustainable fisheries and seafood sustainability. This is especially true as the scope of FIPs is expanding to include social and business improvements.

Social network analysis is but one of the tools that can help better understand how social networks and social capital matter to FIP performance, but it could bring significant insights on the impact of social relationships and social capital for achieving successful collective outcomes. Furthermore, since a FIP is a multi-stakeholder platform for engaging value chain actors in the policy-making process, examining the performance of FIPs from a social network perspective could help gain insights on how FIPs can better contribute to and influence regulators, something that FIPs have struggled with and could significantly increase FIP success. Therefore, we suggest that several aspects should be further investigated. First, key metrics relevant to fisheries and FIPs should be better defined by ground-truthing some of the suggestions made in this article as well as others (Bodin, 2017; Bodin et al., 2019; González-Mon et al., 2019; Grafton, 2005) and develop a methodology including questionnaires to collect information on those key social network metrics. This could use existing methods to measure social capital and social networks (Prell, 2012; Prell, Hubacek, et al., 2009; Siegler, 2014). Another area of research needed to better understand the impact of social networks on FIP performance would be to conduct social network analyses across FIPs and evaluate links between social network metrics and FIP performance using existing FIPs. This could be done first as a snapshot and re-evaluated overtime through longitudinal studies that could understand correlations between exiting and evolving dynamics of social capital and FIP performance. Furthermore, empirical research is also needed to identify strategies that leverage social networks and social capital to accelerate FIP progress and support a model of continual improvement. For instance, the role mid-chain actors may have been underestimated in the past by the sustainable seafood movement and analysing how their bottleneck position connecting markets and producers, importing countries and producing countries may reveal that they hold a key broker position in the network with high social capital. Finally, another potential interesting avenue of research would be to explore how the modelling of FIP networks through SNA could be used as part of Integrated Ecosystem Assessments (IEAs) and explore how the structure of FIP networks, including value chains, would be affected under the different shared socioeconomic pathways (SSPs). For instance, the evolving demand for seafood products in different parts of the world under the various SSPs could affect the network structure of seafood value chains and the extent market-based approaches for sustainability such a FIPs are used and possible.

5 | CONCLUSION

In this article, we aimed to make the first step for considering FIPs as governance networks, essentially social networks of actors including fishermen and their communities, NGOs, industry, philanthropic foundations, governments, scientists and market actors that represent a collective effort to improve the (environmental) sustainability of the fishery. Looking at FIPs from a network perspective potentially allows us to better understand how and why FIP actors and stakeholders interact the way they do and therefore help target interventions to leverage actors in key positions, identify key relationships and actors, and determine how FIP-related activities may impact different actors through the network. Taking a network or system perspective on environmental, social and economic issues is not new and fisheries sustainability is one of those multi-faceted issue which will only be dealt with if we take all aspects into account, including the most central to all, people and relationships.

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CONFLICT OF INTEREST

The authors declare having no conflict of interest.

AUTHORS' CONTRIBUTIONS

H.P. and J.S. co-developed the concept for this paper; H.P. led the research phase with continuous input and feedback from J.S. and M.B.; H.P. led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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