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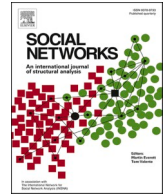
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Reprint of: Participant engagement in environmentally focused social network research

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ABSTRACT

Environmentally focused social network analysis (Env. SNA) has increasingly benefited from engagement, which refers to the process of incorporating the individuals, organizations, actors, stakeholders or other study participants into the research process. Research about engagement in the wider field of environmental management shows that successful engagement often requires significant planning and exchange among researchers and stakeholders. While there is no one size fits all approach, several important guiding principles have been established. To date, this engagement literature has not focused specifically on SNA, even though several examples of engaged SNA exist in the literature and point to some specific challenges to engagement when working with relational data. Drawing upon data from a survey of researchers who have incorporated engagement into Env. SNA, we focus specifically on the goals, scope, effectiveness, benefits and challenges of doing engaged Env. SNA research. We additionally highlight four case studies and demonstrate that researchers and participants find engagement to be a valuable experience with benefits in the researchers' understanding of the context and meaning of their findings. Finally, we provide recommendations to scholars looking to embark on engaged Env. SNA research.

1. Introduction

Social network analysis (SNA) is a highly interdisciplinary field that studies structural patterns of social relationships and how they affect and respond to outcomes of particular interest to different research traditions (Borgatti et al., 2009). Environmental research is one specific domain where SNA has spurred insight into important theoretical questions about how social processes impact environmental and/or management outcomes (see Bodin and Prell, 2011 for a general textbook). Much of the research in this field consists of small networks (actors measured in tens or hundreds) of individuals or organizations involved in managing environmental resources. The typical ties are

information sharing or some form of collaboration, although other relationships are studied as well (see Guererro et al., 2020 and Groce et al., 2019 for reviews). Examples of major themes in the literature include behavioral adaptation (Todo et al., 2014), bridging and bonding capital (Berardo, 2014), brokerage (Hamilton et al., 2020), cooperation (Ostrom, 1990; Jasny et al., 2019), the ecology of games framework (Lubell, 2013), fragmentation (Schneider et al., 2003), governance (Bodin and Crona, 2009; Bodin, 2017), learning ((Paolisso et al., 2019; Teodoro et al., 2020), and scale mis-match (Sayles and Baggio, 2017). While some questions asked by env. SNA scholars and other scholarly groups may be similar (e.g., SNA researchers working on environment and education might both be interested in the role of centrality to

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influence desirable behaviors among network actors), env. SNA often incorporate issues of collective action, complex systems, and geographic scale (Bodin et al., 2019) that might not be the purview of other research groups.

Simultaneously, the field has remained attentive to research implications for practice and policy as researchers commonly focus studies on systems with significant social and/or environmental dilemmas. For example, coastal communities around the globe are already facing impacts from climate change; such as sea-level rise, coastal inundation, and declines in fish stocks (a primary source of food and income); which threaten the livelihoods and well-being of millions of people (Mimura et al., 2007). A recent environmentally-focused SNA (Env. SNA) study demonstrated how social relationships as well as people's relationships with environmental resources underpin responses to these impacts in an affected coastal community, thereby demonstrating how climate adaptation programs (currently receiving billions of dollars in investment funds) could be improved (Barnes et al., 2020). Such research highlights the value of *engagement*, which refers to the process of incorporating the individuals, organizations, actors, stakeholders, or other study participants, into the research process. Within many fields of research, engagement has become popular for a combination of reasons, including producing science that takes advantage of the added experience held by participants, aiding in the dissemination of knowledge, and increasing buy-in to research-led reforms (Hage et al., 2010; Stringer et al., 2006). These practices incorporate a wide range of research approaches and methodologies that focus on the involvement of study participants as stakeholders in the research process.

This paper aims to take stock of participant engagement in Env. SNA to provide guidance for future research. The remainder of Section 1 reviews different literatures to show how engaged Env. SNA incorporates other areas, including research on engagement, interventions, environmental management, and SNA. Section 2 presents four case studies from experts in the field that build upon the themes introduced in the literature review and provide empirical illustrations. Finally, Section 3 presents data from a survey of researchers who have incorporated engagement into Env. SNA. These results show how the themes reflect across a larger sample of current research. We address one overarching research question across all three sections: *what are the goals, scope, effectiveness, benefits and challenges of engaged Env. SNA research?* Most importantly for inclusion in this special issue on data collection, researchers spoke about greater improvements in data quality when participants were included in the planning process. In addition, they added that engagement can aid research by improving the project planning and interpretation processes as well. However, for such participant engagement to be beneficial requires thought, planning, and funding to address problems that are common to all engaged research, SNA, as well as those unique to the combination of the two.

1.1. Engaged research

'Engaged' research means that the participants who provide the data for and context of the research are also involved in the project planning and/or knowledge production (Bäckstrand, 2003). Depending on the types of activities and form of stakeholder involvement, engagement may be characterized as "participatory natural-resource management", "participatory action research", "co-production" and a variety of practices under the umbrella term of "participatory methods" (Reed, 2008) that may include SNA techniques of participatory mapping and participatory modelling. These approaches and methods differ in the *scope* and *types* of models for stakeholder engagement in environmental management and conservation research.

Scope refers to the stages/phases of the research process at which stakeholders are involved. For example, participants are often engaged in the pre-planning stage to facilitate discussions around projects, what questions to ask, who to include as nodes in the network, interpretation, and production of materials from the project. Local partners are

sometimes engaged to help with the data collection process, especially when trust among researchers and participants is a concern (Albright and Crow, 2015).

Type refers to the different degrees of participation on a continuum from passive dissemination of information to interactive participation (Pretty, 1995). Although the number of steps and names vary among typologies, they usually include "collation, co-assessment, and then (rarely) co-production" (Sutherland et al., 2017 p569). Collation is the process of gathering information and perspectives from participants, including methods for eliciting and incorporating traditional ecological knowledge (Paracchini et al., 2018). Co-assessment is the involvement of participants in the interpretation of data. For co-production, research is developed in collaboration with stakeholders from the outset rather than being done for them. Co-production is gaining popularity in transdisciplinary projects (Irwin et al., 2018; Lemos et al., 2018) in which information needs, scope and content of the problem, research questions, methods, and outputs are jointly defined with stakeholders (Beier et al., 2017). Co-production is difficult and often costly (Sutherland et al., 2017), and may not align with the goals of every engagement effort. Rather than adhering to a specific formula (e.g., one that prescribes co-production), the level of engagement should suit the researchers, participants, and the goals of the project (Reed et al., 2018). We adapt Reed et al.'s (2018) 'wheel' approach (Fig. 1) and demonstrate that top-down (dominated by researchers) and bottom-up approaches (more participant dominated) can be applied to all stages of SNA research. Unlike other typologies, this version also emphasizes that there is no one best approach, but rather the type of engagement must fit different sets of circumstances (Reed et al., 2018). We consider any project that uses one or more of these bottom-up approaches to be engaged research.

1.2. Interventions

Network interventions are defined as "purposeful efforts to use... social network data to generate social influence, accelerate behavior change, improve performance, and/or achieve desirable outcomes among individuals, communities, organizations, or populations" (Valente, 2012). However, the use of the word 'purposeful' is not universal in the interventions literature (Seidman, 1983; Soydan, 2015), and the concept of research itself as an intervention advanced in the participatory literature (Buchanan et al., 2007; Robinson, 1993). Here we argue the nature of SNA research means that any engaged research almost necessarily becomes an intervention because, by reporting the structure of the network and individuals' or organizations' roles in it in a communal process, the research itself is changing the network. This overlap between 'engaged' research and 'interventions' is not frequently emphasized in the literature and indeed the distinction between engagement and intervention is noted particularly with the use of the term 'participatory' (Mertens et al., 2012), whereas interventions can require nothing more than the participant's (subject) consent in terms of planning and input. The argument for this latter case is frequently an appeal to 'scientific integrity,' whereas authors show that subject participation in the earlier stages of planning and research can still be consistent with systematic approaches to research (Phillipson et al., 2012). While some network-oriented research that engages stakeholders purposefully aims to intervene in social processes (e.g., to test whether participation in networking events facilitates social learning (Matous and Wang, 2019), research that engages groups of participants inherently constitutes some level of network intervention, regardless of whether researchers explicitly examine its effect. In this sense, engaged network research may be considered to be a form of network intervention that Valente (2012) terms an 'alteration' because the engagement activities may change the composition of people or organizations in the network, or may result in new relationships or in individuals who are part of the data collection process learning more about themselves and others. It becomes very difficult, perhaps impossible, for SNA to engage

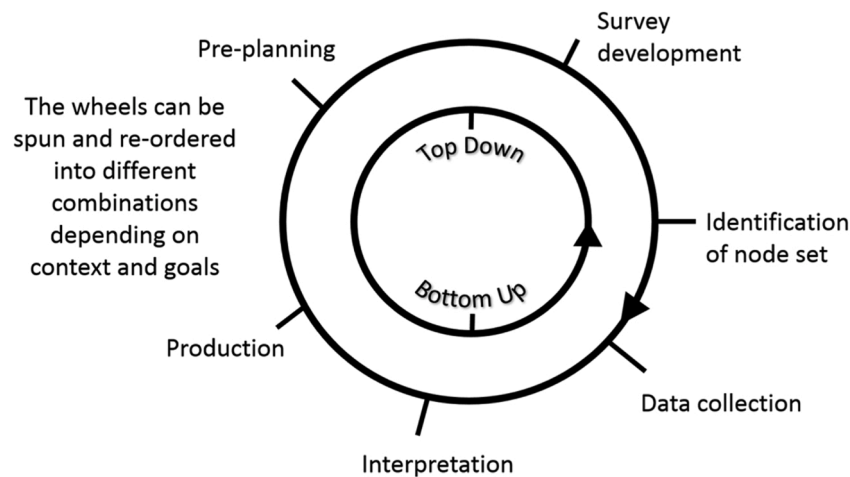


Fig. 1. A ‘wheel’ depiction of engagement approaches for social network survey research (adapted from Reed et al., 2018).

without intervening.

1.3. Engaged environmentally focused social network research

Combining SNA with environmental research presents challenges and opportunities for engagement (Berardo et al., 2016; Groce et al., 2019). Challenges span issues of communication, representation, and logistics. Notwithstanding a few informative examples, (McDavid, 2015; Schröter et al., 2018; Teodoro et al., 2020), limited attention to engagement in the Env. SNA literature suggests that there are significant opportunities to improve the “state of the practice” of engaged research in this domain. Additionally, the wider participant engagement literature is at a crossroads where there is little understanding of “how and why engagement sometimes works, and sometimes fails to achieve objectives or leads to unintended consequences” (Reed et al., 2018 p88), often because these processes are not included in the academic literature (Lenette et al., 2019). Our hope is that our exploratory work here, which draws upon an opportunistic survey of SNA researchers and commissioned case studies by established experts in the field can benefit future work by establishing an agenda for more systematic and causal studies about engagement in Env. SNA and eventually contribute to answering what kinds of engagement work in specific settings.

A key challenge is that mathematical jargon and abstract concepts of SNA can limit its accessibility to environmental practitioners, decision-makers, and other non-researchers (Hauck et al., 2015). Furthermore, dominant approaches for SNA often reduce complex and rich characteristics of social relationships into relatively simple measures (e.g., presence/absence of collaborative interaction between actors), which may not be reflective of how participants themselves perceive these relationships (Sayles et al., 2019). In the context of engaged research, simple representations of relationships that are “ruthlessly abstracted” (Emirbayer and Goodwin, 1994, p. 1427) from richer contexts and narrative may prompt stakeholders to discount insights from SNA.

Another challenge of conducting SNA in engaged research is the time required to collect network data. The relational nature of network data can impose a burden on research participants compared to other types of research (Reed et al., 2009). For example, a classic survey might ask an environmental manager what resource issues they work on, while a network survey is likely to ask who they collaborate with for each issue. If further attributes are gathered about each partnership, such as frequency of interaction or type of information exchanged, the list of questions rapidly multiplies. It’s worth noting, however, that the intensiveness of data collection may not necessarily equate to respondent fatigue during engagement if, for example, data collection can be incorporated into engagement activities, such as collectively diagramming the process by which environmental decisions are made, funded,

and implemented, providing opportunities to integrate data collection with co-interpretation (Etienne et al., 2011; Hogan et al., 2016).

Concerns about anonymity and confidentiality can also present challenges for engaged social network data collection. Participants may be apprehensive about sharing certain relationship information as they may worry that it can be linked back to them (Borgatti and Molina, 2005; Kadushin, 2005). Theoretically, there is some ground for concern as simulation-based studies show that de-identified network data can be re-identified through various means (Ji et al., 2017); however, we are unaware of any real cases where such re-identification has occurred. Confidentiality and anonymity may be particularly sensitive issues in environmental SNA in which studies often have small samples. When actors know one another and are in a small resource-based, cultural, or professional community, it is more likely that they can deduce who each other are if network results (e.g., a visualization) were shared.

Notwithstanding these challenges, several defining features of SNA are uniquely relevant for engaged environmentally focused research. SNA emphasizes relationships and interdependence, which are highly relevant in research on how environmental outcomes hinge on collective problem-solving within complex systems. For example, many environmental systems (e.g., fisheries, forests, irrigation systems) can be classified as “common-pool” resources, where it is costly, and sometimes impossible to exclude people from using them. Moreover, most environmental systems are characterized by numerous stakeholders (resource users, environmental groups, industry), often with competing goals and interests. Finally, many different resources in ecological systems are interdependent because they are linked by ecological processes such as seed dispersal and trophic interactions (who eats who) - thus, human impacts on one ecological resource can spread indirectly to others (Bodin and Tengö, 2012) as well social processes. Thus, outcomes in such systems (e.g., resource abundance and ecological health, as opposed to resource degradation and ecological collapse) depend on whether and how diverse groups of actors can collectively organize to account for these interdependencies and manage environmental resources sustainably (Ostrom, 1999; Barnes et al., 2019).

Indeed, network perspectives have been shown to resonate with environmental stakeholders in some case studies given the central role of relationships and interdependence in collective action problems: working with sustainability organizations in the US, Vance-Borland and Holley reported that many participants appreciated the “bird’s-eye-view” the network diagrams provided (Vance-Borland and Holley, 2011). In this respect, the application of SNA in focus group (or other engagement) settings can prove useful for identifying groups of actors as well as key actors in a particular study system, while ensuring that research participants are representative of the broader community of stakeholders (Foxon et al., 2009). Others highlight the value of network

visualizations as “boundary objects”—products that can be interpreted by people with different perspectives and enable communication and collaboration across distinct communities (Hauck et al., 2015; Etienne et al., 2011). In their application of Net-Map, a participatory approach that emphasizes problem-solving through the creation and discussion of a 3-dimensional network visualization (Schiffer and Hauck, 2010), Hauck et al. (2015) found that research participants readily engaged in knowledge co-production, both with one another as well as with researchers. In work with government agencies in the Upper Blue Nile in Ethiopia, participants selected the questions to be studied. One was “who influences the sustainability of agricultural water management linkages in the study area.” In this example, respondents drew a map as a group with the help of facilitators. They then discussed problems they saw with their empirical findings and how these could be improved. The researchers conclude by writing “As participants discuss and develop a shared map, stakeholders and scientists alike come to understand diverse perspectives on the issue and gain insights into the workings of formal and informal links between the various actors involved in the issue” (Hauck et al., 2015, p408).

Despite the popularity of research that employs network tools and perspectives to assess environmental management and decision-making, and the corresponding growth of engaged research in this field, the application of different engagement approaches has been largely ad-hoc (see Schröter et al., 2018 for a notable exception). This highlights the need to take stock of the range of approaches for engagement in Env. SNA and their utility in different research contexts. Such an assessment may shed light on best practices (as well as common challenges) and provide guidance for future research.

2. Four case studies

We reached out to 4 of the 22 respondents who offered to share their experience and 1) whose work provided diversity in terms of geography and engagement activity and 2) who were leaders in the field (based on publication history) or early career scholars currently engaged in in-depth, on-going engagement activities. The purpose of these accounts was to provide a more in-depth picture to complement the survey results. The four case study authors were subsequently included as co-authors on the manuscript and contributed to its final development. The case studies are written from a first-person perspective to convey the individual authors’ reflections of their experiences.

2.1. Engaging stakeholders to understand wildfire risk management in the western United States (Derric Jacobs)

I work with a research group focused on wildfire risk management. We invite stakeholders into the research process in multiple ways. Our team’s approach to engaging stakeholders includes initial local contacts, workshops, multiple survey waves, and reporting (Fig. 3). The ultimate goal is to reach a collective understanding of the local wildfire risk management system and how to improve it according to the local social, political and economic conditions. Because the funding for these projects aligns with public interests, the inclusion of diverse stakeholders is believed to ensure more transparent and consensus-driven outputs leading to less politically charged policies and actions. The process is intended to maximize our funders’ and stakeholders’ outcomes within the wildfire risk management system, and ensure our professional productivity.

The following case study was conducted in North Central Washington, USA and the Wasatch and Cache regions of Utah, USA. These areas are fire-prone; they have expansions of the wildland-urban interface and large amounts of public land. In both cases, numerous actors are involved in wildfire risk management, including state and private property owners. The state and federal agencies have invested to varying degrees in a participatory and collaborative approach to addressing wildfires.

Our research team always initiates its approach by contacting a local wildfire-related agency. In this first case study, we reached the local Fire District. We built an initial relationship and shared our vision with the Fire District by e-mail and phone conversations. Then we asked the Fire District to summon a diverse audience of stakeholders to a workshop where we launched our initial research survey. We refer to the workshop participants (who include the initial stakeholders who participated in the workshop design) as “seeders” of the survey’s snowball sampling process. These seeders become a critical part of our participant engagement efforts to ensure socio-geographic relevance.

The tone for the rest of the research, analysis and reporting of a project will be set by carefully considering the initial terms of collaboration and by being aware that the stakeholders could lose interest or be joined by other interested parties. We used a two-way learning initiative throughout the process in which the researchers and local stakeholders learn collaboratively (see example in Photo 1). This is a time-intensive process with continuous repetitions and re-thinking as participants work with researchers to plot out the relevant networks. The process produced relevant information for a broad range of audiences, including the scientific community, policy makers, public administrators, agency management and staff, local actors and businesses working within the studied system.

The workshops we ran included federal, state and local agency representatives, non-governmental representatives, and private businesses. The initial group of 12 seeders identified 720 actors in the local wildfire risk management system. The participation of the local Fire District was successful for initiating the workshops, ensuring the survey had local relevance and launching the first survey. However, we faced challenges in maintaining interest in continued stakeholder-researcher collaboration and saw diminishing responsiveness to e-mails and requests for feedback. We suspect enthusiasm waned, in part, because of the slow pace of academic research. However, we observed that the District sustained engagement with another research team studying wildfire risk at the household level. It may be that the more material issues of household risk, as opposed to abstract notions of a risk management network, aligned better with the District’s underlying mission and allowed them to focus on infrastructure and fire suppression.

In our second case study, we opted to collaborate with the State’s Department of Natural Resources (DNR), and with this agency, we ran three workshops instead of one. This update to our collaborative strategy was the result of both the experience gained in our first case study, where many of the initial stakeholders to the workshops operated relatively close to the venue rather than distributed over the research site, but also by the input from local DNR stakeholders who shared demographic, social and cultural considerations to this new region.

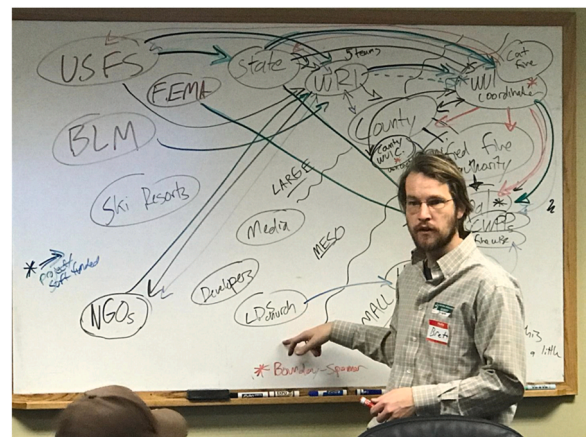


Photo 1. Researcher negotiating explanations of the nature of the complex inter-organizational network of actors and the driving ties with the stakeholders in the workshop, Utah USA 2019.

The second case study's stakeholder participation focused around federal, state and local agencies, a few political actors, and academic representation in one of the three workshops. The number of participants increased from 12 in the first case study to approximately 50 in this case study. Engaging with these participants in the three workshops ensured more participation in diverse social, political and economic regions.

Despite the greater number of stakeholders, there was less diversity in the organization types that participated with a clear dominance of formal agencies over NGOs and citizen groups. From our perspective, the lack of inclusion of non-governmental and private businesses was unfortunate. Yet, through the process, we learned that different from our first case study, these two institutions significantly lack overall participation in the region's collaborative work. In one workshop, we had a single NGO representative. We learned that they were there as observers as the organization is contemplating more engagement and collaboration activities with agencies on wildfire issues. It is still unclear if this is a product of the region's wildfire risk management system or invitational bias. Despite the lower diversity, the workshop discussions picked up distinct variations between the three regions which were articulated in our initial conversations by the State's agency.

The second case study was different from the first – ecologically, socially, culturally and economically – which may explain the lower diversity of workshop participation. The Utah region is socially, culturally, and economically influenced by strong community ties through a centralized Mormon presence. The case study encompassed traditional rural, affluent rural, and suburban to urban communities. There is also a military airbase and a university which differentiates this case from the central Washington study. Furthermore, the Utah case study region is more diverse than the central Washington case study. The Washington region has more desert, shrubland, rangeland and woodlands, and less dense forested areas near the communities.

Overall, the work done through the engagement and collaboration of local stakeholders in the wildfire risk management system seems encouraging. We have been able to use local representation to establish some trust in the research process, as evidenced by stakeholders' willingness to reach out with concerns and questions about the research project. In several phone conversations with stakeholders, we noticed that their questions and concerns about autonomy were followed by an interest in the applicability of the tools to improve their systemic conditions, rather than on the less user-friendly academic outputs. In short, stakeholders wanted deliverables that they could access and use, through organizations and their collaborative efforts. This has ensured that the stakeholders in the case study region have opportunity and voice in the process with reflective dialogue with the stakeholders before and after the analysis is conducted. Finally, it has satisfied the funders' public interests and has shown that the results are not institutionally biased towards one sector.

The rewards were evident as the research team saw and heard how the work adds value to the local stakeholders and how they are thinking of using the research for their initiatives. In our first case study, the local NGO works closely with State agencies to update state policies and initiatives to develop adaptive management strategies. They intend to use the ongoing research to highlight needs that include working within a network governance system to work more collaboratively with diverse stakeholders. In our second case study, despite being early in the process, the state agency participators are already planning on using the research to engage with state and local political agencies to strengthen funding for and participation in more diversified collaborations around addressing wildfire risk management. These efforts would extend more deeply to local communities versus the focused efforts to only address wildfire risks from federal lands.

Researchers working in environmental and natural resources fields should be aware of social network studies' sometimes socially and politically charged nature. Working toward building transparency and trust with at least one local institution is good but recognizing that there

are usually diverse and sometimes competing views, missions and goals within institutions working around problems like wildfire produce a demand for careful considerations for joint ventures between researchers and subjects. The research needs to be well rounded and geographically relevant in ways that the researchers may sometimes be unaware of through multiple stages of the research process (Fig. 2).

2.2. Network mapping to reform the state-owned enterprise sector in Southern Africa (Eva Schiffer)

This case is based on work with a government entity in a country in Southern Africa. To protect participants, the country and supporting donor agency will not be identified. This activity is set in a country with a large number of state-owned companies (e.g. water utilities, mining, telecommunications, an airline, etc.) that cover many different sectors of the economy. The majority of these companies are consistently underperforming, generating less than ideal results for the population and providing ample rent-seeking and exploitation opportunities. The work described was part of a longer term capacity building and strategy development process with a team within the government that had been tasked with state-owned enterprise sector reform. The challenge was that while the team had excellent technical knowledge, they had limited influence in the system and their stakeholder engagement processes mainly relied on the sharing of technical information.

The team was brought together to draw a network map (using the Net-Map method, Schiffer 2010) answering the question: "Who influences the success of state-owned enterprise reform?" They wrote the names of individuals, groups or organizations on post-it notes and distributed them on a large sheet of paper. Then they connected the actors with different colored lines, indicating a number of different kinds of linkages: formal hierarchy, formal money flows, informal money flow, conflict, and one actor's ability to put pressure on another. In addition to drawing this network map, the participants rated each actor as to whether they are positive or negative to the reform and distributed "influence towers" to indicate the level of influence actors have on the result.

Drawing a Net-Map together helped groups explore the different experiences and assumptions they had about their complex system. It is generally true that everyone involved in a social network will have a more detailed picture of those connections close to them than those further away and often the perspective of participants with more or less influence are vastly different. In these cases, the goal is not to figure out whose perception is the "correct" one but rather to bring in different perspectives, explore their tensions and develop a richer understanding of the social realities.

Due to the size of the group (approximately 15 individuals), participants were split into two subgroups. After heated discussions, each group had mapped their understanding of the situation, including ideal conditions as well as current realities and the differences between these two. As the groups shared their maps, this discussion deepened and together, the groups identified the core actors they needed to engage with more to make their vision come true. They also identified "no-go areas" – parts of the system where powerful and well-connected interests would make it impossible for them to succeed and where engagement would be harmful rather than helpful.

To ensure that the insights about the complex social network were transformed into actionable next steps, the group developed strategies to engage and influence core actors. They created stakeholder profiles of these core actors to better characterize their interests and constraints, developed strategies for approaching them and practiced possible conversations in role plays.

In general, drawing a Net-Map starts with steps where everyone's insights are assembled (e.g. naming all actors) and only in later steps the group is asked to agree on a shared perspective (e.g. level of influence of actors), and an example is shown in Photo 2. This sequencing allows the group to develop a shared picture and trust slowly as the process

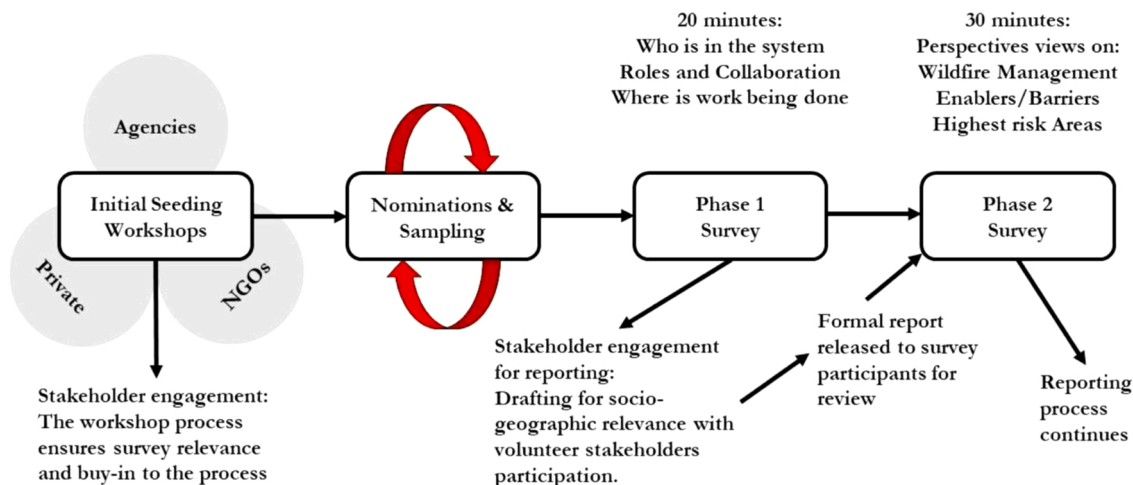


Fig. 2. The research design model, including the stakeholder engagement processes starting from stakeholder workshops for seeding the survey and reporting for socio-geographic relevance.

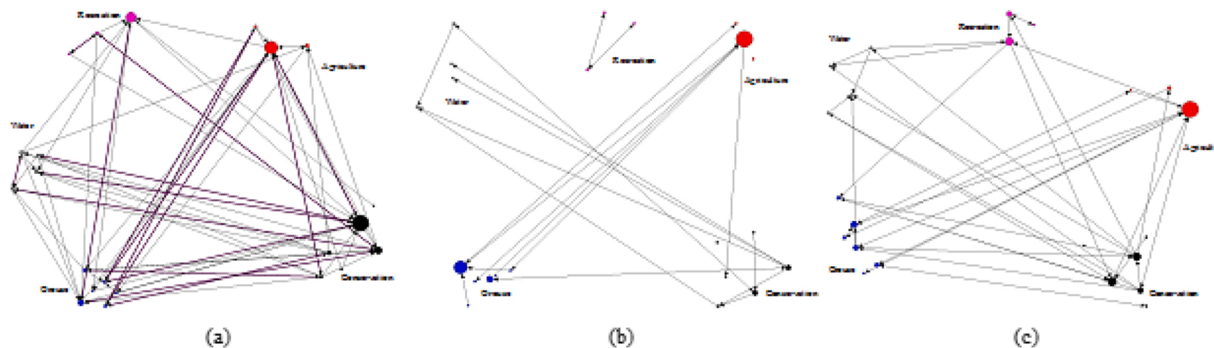


Fig. 3. Graphs used in presentation to stakeholders in the Peak District National Park showing (a) degree centrality in interaction network among stakeholder groups, (b) frequency of interaction, and (c) stakeholders' overlapping views of the management of the park.

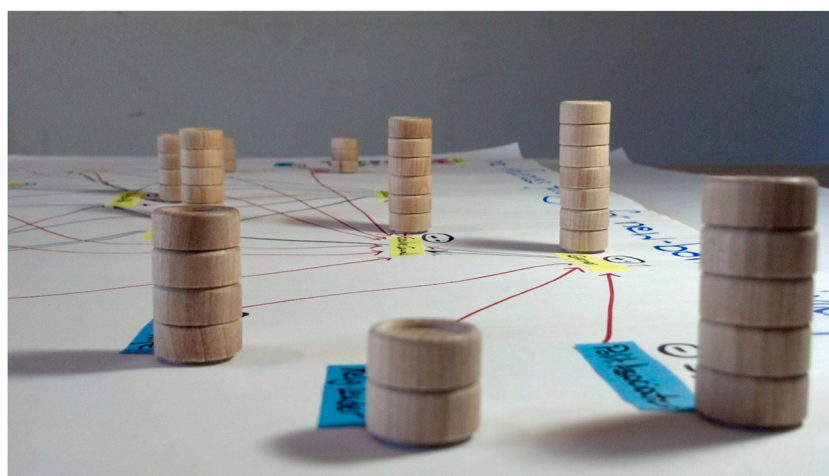


Photo 2. A Network Map showing influence towers next to actor cards.

emerges. Also, it allows the group to move from complexity (all links among all actors) to a certain level of focus (positive and negative high influence actors). This allows for a natural flow from Net-Mapping to strategic planning to engage with key stakeholders in the network. As a result of our participatory session and the open and frank discussions it enabled in a complex and constraining environment, the team developed an engagement plan that went beyond their preferred technical

engagements and explored the political and personal constraints of those they needed to achieve their goals.

Often the most productive and insightful conversations happened in diverse groups that brought together very different perspectives on a social network. Disagreements among participants were often the most fruitful moments in the Net-Map process. It was beneficial for all to slow down the conversation and give each participant with opposing

viewpoints the space to express it clearly, so the group could understand and then discuss the different perspectives. However, in cases where there is a large power difference, or participants do not feel safe, it is recommended to work with more homogeneous groups or even do one-on-one interviews without anyone else from the local context present. As the insights from the Net-Map evolve gradually, in the drawing of the map, the resulting picture can be rather surprising for all around the table – which is part of the power of the tool but may also put participants at risk.

2.3. Engaging Stakeholders for resource management and conservation planning in the Peaks District, UK (Christina Prell)

The Sustainable Uplands project took place from 2005–2009. This was a participatory, social learning project in which scientists and non-scientists engaged in an ongoing series of activities geared towards improving understanding of the UK uplands, in the face of a number of growing uncertainties. These uncertainties ranged from top-down initiated policies pertaining to heather burning, as well as the uncertain impacts of global warming and climate change (“Food Climate Research Network (FCRN) | Knowledge for better food systems,” 2021).

Within the sustainable uplands project, SNA was used both to i) inform stakeholder selection, as well as ii) increase stakeholder awareness of the communication patterns linking them together around land management issues in the Peak District National Park, or PDNP (Prell et al., 2008). With regards to stakeholder selection, identifying the communication network among stakeholders helped the research team identify marginalized groups in the network, as well as the brokers and more central actors linking these groups together. This, in turn, helped the research team make better-informed choices in selecting a sub-group of stakeholders for a series of ‘site-visits’ to key geographical areas in the PDNP. Thus, SNA contributed to stakeholder selection by going beyond identifying ‘diverse’ stakeholders (a key consideration for many participatory projects – see Reed et al., 2009; Schwilch et al., 2012), to also considering which actors in the network tended to be “out of the loop” when discussions pertaining to land management in the PDNP took place. With regards to increasing stakeholder awareness, SNA was used in the context of focus groups and meetings, to collaboratively discuss with stakeholders which actors and groups were more marginalized from the rest of the network, and which ones were more central. In this way, stakeholders were able to brainstorm ways to improve communication processes within the network, and reflect on why some groups were more marginalized than others. To study the communication network, the research team worked closely with a Partnership formed by the Moors for the Future (MFF), a not-for-profit conservation group located in the Peaks. The purpose of the MFF Partnership was to hold regular meetings on a variety of issues pertaining to conservation of the Peak. MFF invited us to use the Partnership as a space for the social learning processes we were developing with stakeholders and scientists. As such, we conducted both one-to-one interviews and focus groups with this Partnership, exploring areas of concern with its members. One topic that was put forward was a commonly shared desire to have site visits to various farms or moors in the PDNP. Such visits were perceived as necessary to bring diverse individuals together in an informal, yet highly informative setting to discuss land management challenges in-depth and witness first-hand some of the land management challenges experienced in the area. The participants of these site visits needed to be small in number, to enable in-depth discussion and facilitate movement in and around each site. As such, the research team decided that, in addition to knowledge about stakeholders’ respective categories, SNA could be a helpful tool for gaining additional information on the social system. In particular, it was important to learn which stakeholders tended to act as brokers, which ones represented more marginal network members, and which ones were in general more central. Such information, we concluded, could help narrow down which stakeholders were key to the network as a whole, and also help make more intelligent choices about

how to include more marginal stakeholders into the site visits and larger project.

Towards these ends, we gathered data on communication ties among our set of stakeholders in the MFF Partnership, asking each stakeholder on our roster about their frequency of communication regarding land management issues in the Peak District. We then conducted basic centrality analyses (i.e. computed individuals’ degree and betweenness centrality scores) on the set of ties reflecting more frequent (and hence stronger) communication. These results were then displayed as digraphs, in which the names of actors were removed (for anonymity purposes), the size of nodes reflected the centralities of individuals, and the color of the nodes reflected different stakeholder categories (e.g. water companies; recreational groups; agriculture; conservationists; land owners and/or managers; tourism-related enterprises; and statutory bodies). These digraphs were then shown to a small number of key stakeholders, who had helped us guide the research approach throughout the project.

Our presentation led to a general conversation among the stakeholders about how to improve communication across the network, and involve more marginal actors. After hearing our presentation, one stakeholder expressed the general concern that identifying central stakeholders would lead to including only central stakeholders in the upcoming site visits. In some ways, including the most central stakeholders made sense, as much network theory supports the idea that central actors tend to be the most well-connected, well-informed, and most able to diffuse new information to the wider network. Yet this stakeholder contended that involving only highly central stakeholders would, essentially, go against one of the main goals of the site visits; namely, to get a wider view and understanding of land management issues among a heterogeneous set of actors. Rather than inviting central actors, this person suggested we create site visits composed of stakeholders who normally had little interaction with each other, i.e. ones on the network periphery. Since these individuals had not engaged with each other before in land management discussions, they might have more to gain from working together.

Hearing these comments, we accepted the need to devise an alternative means of analyzing our network and making recommendations for the site visits. We acknowledged the need to balance a combination of marginal voices with more central ones, and also to try and include a more diverse set of stakeholders and stakeholder categories.

Given these multiple concerns and criteria, our new analysis consisted of a mixed approach, in which the centrality scores of actors, and their stakeholder categories, were combined with their structural positions in the network. Actors with a similar *position* in a network have similar network *patterns*, i.e. they hold the same or similar kinds of ties to the same or similar others. To identify these network positions, we conducted a structural equivalence analysis (Burt, 1976), which measures the extent to which any two actors have the same ties to and from the same others. For our purposes, locating stakeholders who were, more or less, structurally equivalent alerted us to actors who basically performed the same kind of communication role in the network, and thus could be eliminated from our narrower selection of stakeholders (see Prell et al., 2008 for further details). In this way, we were able to identify 9 unique positions in the network. This knowledge of stakeholder’s network position, combined with our knowledge about their stakeholder categories and centrality scores, provided the basis for making a new recommendation of stakeholders for site-visits. In particular, this combined approach attempted to ensure that stakeholders chosen for the site visits would be ones who i) occupied different positions within the network, ii) were still relatively high in terms of their degree and betweenness centrality scores, and iii) who also came from different stakeholder categories.

Through simple SNA techniques and visual digraph of the communication network, our SNA presentation gave stakeholders a visual depiction of their communication patterns, which in some ways confirmed general beliefs held in the network about central versus

marginal voices, and also helped prompt deeper reflection.

The fact that we i) were able to visually capture, through digraphs and simple SNA measures, social processes that many stakeholders already intuitively sensed to be the case, and that we ii) asked stakeholders for their feedback to these digraphs, positively worked towards stakeholders accepting our findings. We believe that stakeholders accepted our research because we approached them, the research, and the presentation of results, in the spirit of having a discussion. Graphs displaying simple measures like centrality and using colors to display different stakeholder categories worked well as visual tools to which stakeholders (or project leaders) could easily respond (see Fig. 3 for an example we used). By listening to their feedback and reactions to these results, we gained a deeper awareness of the social system. In the case of the Sustainable Uplands, the discussion also revealed concerns and needs stakeholders had for including marginal voices. As such, we were able to adapt our SNA approach and develop a new set of analyses, which combined centrality with actors' structural positions and stakeholder categories. This new set of analyses only occurred after stakeholders engaged in the process and offered us feedback on our initial SNA results. In providing a more nuanced analysis of the network via combining these different SNA measures together, we better captured the kinds of stakeholder selection concerns of our participants. We also demonstrated to ourselves that SNA can be done in an interactive way with stakeholders to co-develop a deeper understanding of the stakeholder network, and hence use SNA in a more sensitive way for meeting the needs of the stakeholders and the research project.

2.4. Engaging stakeholders while working for eNGOs and public organizations in Australia and Indonesia (Petr Matous)

I would like to share four general issues that I typically need to deal with when conducting social network research with environmental organizations. The first issue relates to the motivation of environmental organizations to participate in social network research, which is not always completely clear or specific. I have been approached by organizations who wanted to stimulate behavioural change through social networks (such as adopting a recommended conservation practice) or influence social networks among their target population, their stakeholders, or their staff to achieve some desirable outcomes. The idea that “networks are important” has become common in the field of environmental conservation just as in the general discourse, but even if environmental organizations believe that their networks or the network among their targeted populations' matters, they may not know exactly what to expect from network research.

In one case, I was approached by a non-profit organization whose mission was to build networks among farmers in Indonesia to promote sustainable agriculture and to disseminate conservation practices. The director of the program realized that their goal of “building networks” should not be phrased just as metaphor but should also be rigorously measured and was wondering how to do that. In another similar case, an official working for the local government explained to me “if we build a piece of road or social infrastructure, we conduct all kinds of detailed and costly environmental impact assessments but we have no idea whether these projects are making our communities stronger or more inclusive, which is often the reason why they were funded in the first place”. This organization's motivation for partnering with an academic research team was to borrow tools from social network research to assess the social impact of their projects. In another case, an organization leader in Australia felt that there were gaps within the “network” of managers running their diverse programs and wanted to assess where the fractures are and what could be done about it. In this case, social network analysis was applied within their organization to better implement their programs. Another client from the public sector in Australia had heard about “SNA” and approached me because they wanted to learn how their employees could leverage SNA tools to understand and mobilize community networks in participatory programs.

Here, social network research tools were to be applied to better understand the structure of communities that they work with.

In my experience, starting engaged socio-environmental research based on a non-academic partner's need, even if initially vague, often leads to more fruitful collaboration than starting with an academics' need for publication output and access to data. The research can proceed better if the participating organizations care about the result. Moreover, if they pay for the research, they are more likely to listen to the conclusions. However, it should be noted that such participatory development of a research question and collaborative iterative research process is something that external research grant funding institutions are usually not prepared for. If the researchers want to apply for additional grants for such research to major funding institutions, they may need to develop the research plan with the partners first and apply for the grants after the research plan and schedule has been fixed.

The second issue that runs across the initiatives that I have been involved in relates to the strong partners' desire to make a change. Most network studies are not intentionally interventionist and most network experiments are confined to laboratories and online environments. Compared to university researchers, environmental NGOs (eNGOs) are less concerned about how and why networks operate and are more driven to achieve a practical change. Visualizing a network that the partners work with, or are a part of, is interesting for them initially, but usually they have a more substantial objective. When presenting results of network surveys to clients outside of academia, I constantly need to answer questions such as: “Why is it good to know this?” and “How can we change this?” The environmental program managers and policy makers I have dealt with wanted to know how to target their programs and what to do in communities that appear too fragmented to work with, or too centralized around one antagonistic individual, or too disconnected from the external world. Such questions and requests tend to frame network studies in ways that have more practical outcomes. An emphasis on delivering change can also substantially enrich the academic value of network research. From an academic viewpoint, exogenous manipulation of social networks can contribute to clarifying causality behind observed network mechanisms. If the researchers can explain how this can make the programs more sustainable or inclusive, eNGOs may be influenced to alter their existing programs to enable rigorous measurement of changing networks, their drivers, and their consequences.

The third issue relates to which findings should be shared from network research. External partners may support social network research only because they are interested in its practical outcomes but they may be disappointed, for example, when they find their organization on the margin of the collaboration network. When presenting networks back to the partners, it is not generally possible to display everything that they would like to learn without revealing something about others who might not wish to have information shared. It is always safer for the researcher to reveal less. Protecting all gathered information ensures that no harm is caused but that also typically means that only researchers end up benefiting from the study. To manage expectations, researchers should discuss with participants at the beginning of a project to establish clear rules about what can and cannot be shared. This process should ideally be inclusive of all participants but, unfortunately, such consultations may be very difficult when the research targets are large, dispersed, or remote populations or when respondent-driven sampling is used.

In non-academic consulting engagements, there are huge ethical risks when reporting non-anonymized network research findings to the clients, even if the informants formally consented to such use of their data. Looking at a network diagram, the partners may think: this organization is completely dependent on us, let's take advantage of that; or, this farmer is very popular, let's give him more resources; or, how come these two program managers are not talking to each other? Scheduling sufficient time for consultations and explanation of network research from the beginning is really important. It is our responsibility to explain,

for example, that a given organization is an isolate within a given network boundary, but this does not mean that they are not doing valuable work; or that concentrating all development interventions on high-degree individuals may be counterproductive.

In one of my engaged research collaborations with an environmental NGO, both visual and quantitative outputs revealed that the partner organizations' officers were more dominant in local environmental information-sharing networks than they expected and wondered what would happen after their program winds down. In this case, the final deliverable of our first collaboration was a set of recommendations that were used to formulate the brief for the next assignment on how to leverage the local farmers' social networks to enhance the sustainability of the implemented programs.

The final fourth issue relates to balancing incentives towards publication and ethics in practical environmental social research engagements. The common university incentive structure is set in a way that motivates academics to pursue research primarily to produce publications and a combination of engaged impact-oriented research with academic publication-oriented research can be an ethical minefield. The researchers need to ensure that their study with a university logo is not perceived by the participants only as a pure academic endeavour, if the results may in fact have real implications for their lives. The data and topics tackled by external partners might sometimes be too sensitive for open publication, even if the participants and the partners allow that. In my experience, university ethics committees have so far been (for mostly understandable reasons) often more limiting in terms of what kind of data can be used in published research than the partners and informants outside of academia who these data came from.

The focus of academic publications is typically on the generalizable outcomes, not the particularities of each case, and eNGOs and individual informants usually do not mind an anonymized publication. In cases when the results highlight the partners' work in a positive light (e.g. information-sharing networks among farmers were demonstrably strengthened and as a result an uptake of a recommended conservation practice increased), the partners wanted such results to be widely disseminated, but publication might not be possible because of university ethics rules. Fortunately, practical impact-oriented engaged research that does not result in traditional academic publications does seem to be gaining credibility among some academic institutions.

2.5. Survey

To complement the case studies' rich accounts of a limited set of researchers' experiences, we turn to the results of our survey. All questions were either open-ended or categorical. The survey was sent out to 325 email addresses associated with a survey of papers in the Env. SNA field. Key words used in the search were 'network', and either 'ecology', and 'environment' and then 200 papers were found to include

environmental SNA data. We also sent the survey to 5 listservs for environmental, social networks, and Env. SNA memberships. The survey could be forwarded to others and taken anonymously. As such, we are unable to determine how many individuals saw the survey. In total 37 individuals completed it. Individuals were only able to take the survey if they stated they had conducted engagement events in Env. SNA research projects, and therefore the small sample size is understandable due to the small but growing community doing this kind of research. 46 % of survey participants listed publications resulting from their projects; 19 % said such were in progress. Two authors separately reviewed the responses and categorized them as described below. The full survey is presented in Appendix A.

2.5.1. Goals of returning results to participants

Where the case studies were selected because they engaged participants extensively, most survey respondents principally engaged participants to communicate research findings (65 % - see Fig. 4). In some cases, this level of interaction was aimed at "providing participants with information on which to base future decisions and strategies". Communicating results to stakeholders was also a way of supporting the results prior to expanding the research. For example, one survey respondent stated, "my goal was to have the community feedback as a support to my findings. The next step of the project needed the approval of the target population". While they mention a variety of different goals, only one of these include the 'co-production' definition of engaged research. Where this was present in the selected case studies, the absence in the broader survey shows first how comparatively difficult co-production is, and also that we're still in the beginnings of engaged environmental SNA research.

Respondents report that engaging in co-interpretation leads to more meaningful outcomes than if they only used top-down forms of engagement. These respondents, who had a more active engagement (see next section), stated that the participants frequently shed new light on the findings, generate new ideas to push the research forward, and were more prone to owning the results and integrating the new knowledge into their processes.

2.5.2. Activities and facilitation tools

Survey respondents were asked about the types of approaches used to engage stakeholders. An *active* approach refers to engaging directly with participants through tools that can facilitate face to face interactions and bidirectional communication – in other words the participants play a large part in creating the results of the interaction. A *passive* approach refers to indirect engagement with participants through tools that facilitate the dissemination of results – for example, where participants listen to a presentation and ask questions, but are never on the same level as the researchers. Most respondents combined active and passive activities; a small number used only one approach (5 inactive and 4

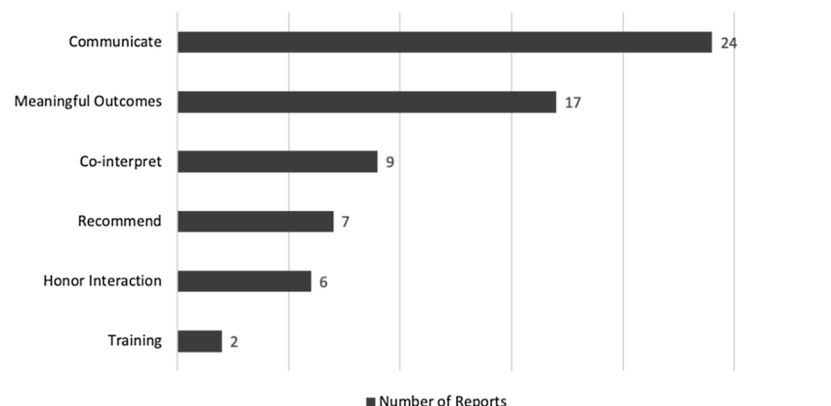


Fig. 4. Goals of researchers in engaged Env. SNA research projects.

active). Methodological tools used to facilitate active and direct interaction with participants included live demonstrations of network mapping surveys, Strengths, Weaknesses, Opportunities, and Threats (SWOT), focus groups, and participatory network mapping (for example the Net-Map tool described in 3.1.2). Support tools facilitated passive activities in which researchers interacted in an indirect way with participants. This category included respondents' use of webinars, online support systems, email communication, expert panels, question and answer sessions. Finally, physical tools are intended to facilitate a passive interaction aimed at disseminating information and communication of results. For this purpose, respondents used reports, posters, handouts, and websites. One respondent explained that the combination of types of approaches engaged different types of participants with different interests and comfort levels. When planning activities, consider the different range of approaches and what might help different types of participants in engaging with the goals of the research.

2.5.3. Analysis of approaches

Respondents were asked about the effective and ineffective aspects of their approach. When designing the research, respondents advocated planning the participation and feedback methodologies from the beginning, aiming at co-interpretation and co-production. Researchers reported it useful to collaborate with local informants or community experts to design the project because they assisted in recruiting participants, and aiding in communication. They stressed that it is also important to consider the optimal format for the engagement activity given the context of the community and the goals of the engagement in advance.

Respondents emphasized the effectiveness of engaging with participants during the preparation phase of the research. They recommended ensuring that participants get enough time to talk about themselves, their community, and their organizations. The preparation phase should also include explaining the aim of the research as well as the conceptual framework of SNA. They also highlighted the importance of designing these activities in ways that take into account local forms of sharing and discussing information. Many respondents said it was important to spend time to determine what participants care about and what they expect to gain from the research, and incorporate these ideas into the project, and wished they had planned even more time for these activities. Researchers also indicated the need to understand what each participant is likely to contribute and possibly define their roles in the engagement activity. Likewise, respondents highlighted the importance of acknowledging co-creators.

Participatory network mapping exercises were considered to be effective tools for communication and data collection. These enable participants to demonstrate their understanding of networks by drawing their own as a precursor to analyzing the network maps produced from the collected data. They are also useful to test alternative methods of network mapping and compare them to the data collection method used in the performed study. Another methodological tool was use of simple figures, diagrams, and real-life examples in combination with the narrative to present fundamental concepts of SNA. According to them, this was effective in helping people understand the outcomes of social network research. Direct communication and deliberation with and among stakeholders also seemed to increase the effectiveness of this sort of outreach. Respondents also reported integrating the use of visual aids in the data collection tool.

Respondents mentioned the value of direct interaction and communication through face-to-face meetings. Following-up with participants was also considered critically important. A timely interaction is also important, though several respondents noted that academic culture does not always lend itself to regular and frequent interactions. One respondent suggested collaborating with a local NGO and having them run the research to ensure timely delivery of results to participants. Respondents recommended sustaining dialogue before, during, and after the engagement to avoid one-way communication activities such as

lectures, isolated events, or top-down communication such as expert panels. Lengthy explanations and webinars were also considered to be problematic or ineffective as participants lost interest or felt they could not comment. Powerpoints, likewise, were generally regarded as ineffective tools; however, some respondents reported having success with short powerpoint presentations with immediate Q&A sessions. Respondents highlighted the value of being upfront and realistic about possible research outcomes and working with stakeholders to ensure that everyone has appropriate expectations of the partnership. They noted the importance of being open-minded, humble, and willing to deal with criticism. It was also suggested that researchers should manage their own expectations as well: "Do not be discouraged if you feel the engagement fell flat," said one participant. "Often the value of [the] information takes time to sink in and become usable." This idea of managing expectations and that productive engagement is a long, sometimes bumpy road is clear in both the survey and the case studies.

Rather than trying to use elaborate methodologies, respondents suggested using low-technology data collection methods as these often were less prone to failure in the field. New purpose-built technologies are also being developed which prioritize the participant's experience and learning. Survey respondents and case studies also emphasised the importance of an interactive preparatory phase to make sure that the stakeholders understand the goals and processes of the engagement activities and that the research topic is relevant to them. The researchers who responded to our survey noted the particular difficulty of determining the level of technical detail sufficient for communicating the goals of engagement and the overall research. Such considerations are especially important when the diversity of participants not only reflects different technical backgrounds, but also levels of resources and power, as is often the case in environmental management contexts (Brandt et al., 2018). In such settings, effective communication of the appropriate scope of technical information is not only necessary for meaningful interaction with research participants, but also for avoiding the marginalization of individuals or groups. Others noted that participants intuitively grasped concepts from the maps themselves including the intended findings and other meaning. Further research is needed to better understand this translation.

2.5.4. Benefits for the researcher and for the participants

According to respondents, engagement provided two general types of benefits. First, engagement enabled better science. For example, respondents noted that participation improves survey designs, promotes the generation of new ideas, provides more information to formulate research questions, helps researchers identify further questions and analysis, and provides opportunities for data and its analysis to be cross-checked; all of which contribute to the robustness of results and the validity of their interpretation (Fig. 5). Second, respondents reported that engagement enabled their research to reach a broader audience, in particular by helping them communicate issues that are important to stakeholder groups and strengthen ties with participants. Both of these findings are consistent with other work in the non-SNA engagement literature (Littell et al., 2017). Respondents discussed that trust was an essential aspect of these relationships and that both groups, researchers and stakeholders, needed to be able to trust one another for many of these benefits to be realized.

Survey respondents and case studies noted that the level of participation of the stakeholders seems to increase the validity, reliability, and utility of the data. This is critically important for SNA, in which measures of interdependence are highly sensitive to missing data or errors, relative to other social science methodological approaches. Engaging with stakeholders from the beginning of the project and maintaining interaction throughout are good practices that ensure better data collection and interpretation. Stakeholders will engage more if they perceive the outlined research responds to their needs, the researcher listens to what they say and they can see an opportunity to use the results of the investigation. If they can perceive their participation as useful and

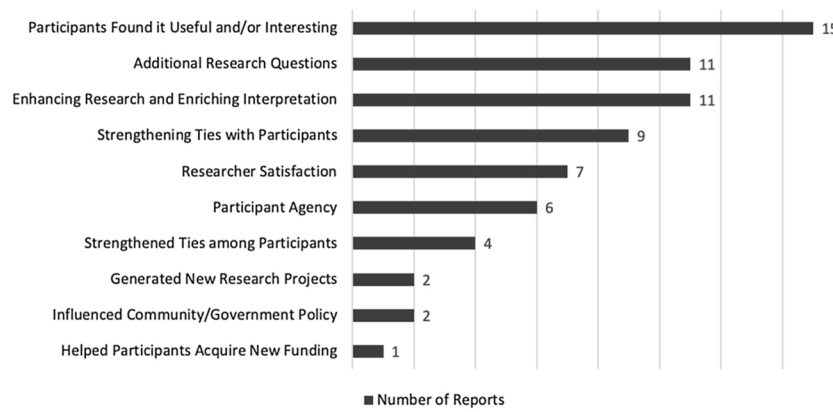


Fig. 5. Benefits of an engaged approach as reported by researcher respondents.

their interaction is built on trust, they will also contribute with honest and thorough responses.

Respondents also described how engagement benefited participants in their research. These benefits broadly relate to capacity building. For example, respondents noted that engaged research enabled the generation and use of applicable knowledge. Likewise, engagement facilitated empowerment by promoting change and social learning, e.g., understanding how interaction structures influence opinions through flows of knowledge. One participant discussed how the engagement helped stakeholders secure continued funding from project sponsors. The engagement activity was not motivated by the goal of securing funding; rather, continued funding resulted from sponsors seeing benefits of the work, which included stakeholder engagement.

Strengthening a network can improve social processes for environment conservation, collaboration, and organisational learning. SNA research can help uncover structural constraints and opportunities that are not seen otherwise. Researchers also emphasized ethical considerations. Some survey participants felt they had a responsibility to give back to participant communities in some way. Some also discussed that SNA could be used to help certain groups gain a voice and make certain social dynamics more transparent.

2.5.5. Barriers/Challenges relating to interaction and communication

Amongst the barriers identified by the respondents, the most common was communicating technical content to a general audience (Fig. 6). One respondent discussed how it could be particularly difficult “to communicate and [translate] content from technical writing to a format that would be more appropriate for a broader audience”. Because SNA can be somewhat technical or jargon-laden, communication challenges were not limited to working with civic groups or local resource users, but also occurred when communicating with environmental

professionals working in management agencies or advocacy organizations. From the case studies, spending time on these materials and working with participants to figure out what is useful knowledge for them and connecting it to the SNA results is a critical part of successfully overcoming this obstacle.

According to respondents, influencing or changing policies and behaviours require long term relationships based on trust. For example, one participant said: “Several of our policy areas have people who are “over contacted” and so if you go in with a rushed attitude and feeling like you are just doing this to check a box on your grant proposal, they will know and react poorly. It takes time and ongoing effort to do engaged scholarship well.”

Another barrier is the use of sensitive data. Researchers need to establish trustworthy relationships, which take time and effort, so that participants will feel comfortable disclosing sensitive information. Researchers must strike a balance between keeping results anonymous and having enough information to understand them. Interestingly, one researcher respondent commented that if they were to do the research again, they might choose to do a content analysis of publicly available data to avoid the barriers associated with keeping information confidential. Publicly available data may come with its own set of ethical implications, however, especially if the analysis brings to light controversial dynamics within the population of interest. Other interaction and communication challenges mentioned in the survey included: creating space for interactions, keeping discussions on topic, dealing with unique place or population specific issues, and sometimes low levels or a complete lack of interest among stakeholders in network analysis.

Respondents highlighted the difficulty of ‘translating’ findings into concrete management or policy recommendations as well as guiding interpretation, particularly when dealing with imperfect data. One respondent commented that a “challenge ... we all face is knowing

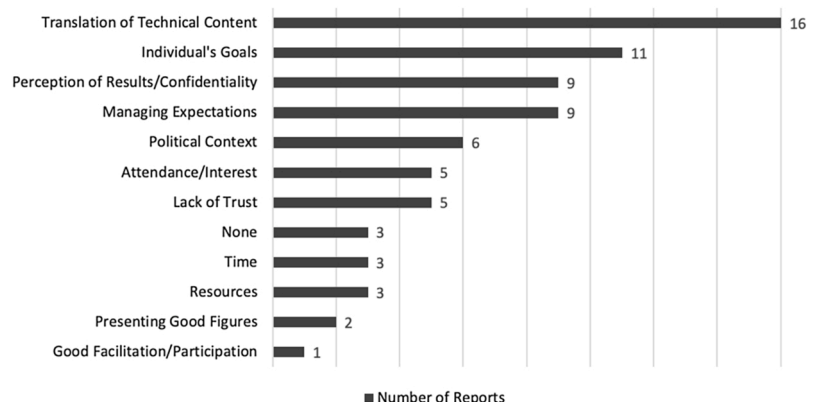


Fig. 6. Barriers each respondent reported with their Env. SNA research projects.

(exactly) what our results mean for conservation and/or resource management ... For example, we still don't know what an "optimal" network structure might look like for achieving conservation and/or resource governance outcomes, and in what context - though we are getting closer. This makes it difficult to translate our findings into concrete management or policy recommendations." The respondent concluded that "asking communities to reflect on our results and deliberate what it means to them can be fruitful for facilitating impact." This was seen as a better approach than just sending them the published paper. Respondents noted that in some contexts, it is important for researchers to guide the process of interpretation, making sure there is no misunderstanding about the scope and reach of the results and that results are not misused.

Contextual barriers included issues such as how participants perceived research and researchers, local politics, and real or perceived costs versus benefits of participation. Some of these contextual barriers seemed to align with specific user groups, country development level, and historical legacies. For example, working with direct-resource harvesters in a local community, one respondent commented that the community was suspicious of outside academics. In another case, working in a developed country with public servants, one respondent said that engagement activities had to adjust for the fact that environmental managers were very busy. Finally, working in South Africa, one respondent commented that legacies of dispossession, marginalization, and colonialism shaped how people interacted in the engagement activities. Respondents also noted that project design can present challenges, including limited resources, complicated logistics, the burden of collecting data over time, and the length of time between data collection and feedback.

3. Discussion and conclusions

Engaged research has become popular among researchers and funding agencies, with some grantmaking institutions opening special funds to incentivise such work (UKRI, 2021). While many Env. SNA researchers have made a practice of engaging stakeholders in their work, these endeavors are often not described in published articles. We've taken the opportunity of this special issue to document current practice, give some recommendations, and reflect on the use of engaged research in our field.

Although out of necessity our sample design makes it impossible to extrapolate what percentage of the Env. SNA community is represented here, our findings clearly illustrate a diversity of motivations, approaches, and outcomes to participant engagement. The majority of survey participants had positive things to say about the engagement activities, which would indicate that, at least from these researchers' perspective, the activity fit the context. While there is a tendency to favor less involved forms of engagement (communication over co-production), more involved levels of engagement were also reported by survey respondents and strongly demonstrated in the vignettes. A substantial portion of the best practices, benefits, opportunities, and challenges revealed in the survey findings and case studies confirm much of what has been written on the topic of engaged research in non-SNA approaches but highlight SNA-specific concerns as well. General concerns include issues related to time commitment (both on the part of the researcher and the participants or stakeholders), establishing interpersonal relationships, thoughtful communication, and concerns over trust, ethics, and confidentiality. SNA-specific concerns included translating SNA jargon, ensuring participants understood the network images, and controversy over the identification of individuals in the network. Drawing recommendations from these results is difficult but we highlight the key takeaways here.

Confidentiality presented as an SNA-specific issue in multiple ways: if individuals were identified in the network, sometimes they didn't like the results, and if they were not identified, participants wanted access to that information. In several examples that we documented, the data

collection process was confidential, but afterwards participants also discussed how the interpretation of the social network was more impactful and meaningful if both researchers and stakeholders can openly access the results. Upfront managing of these expectations was used successfully in the case studies and mentioned as useful in the survey responses. In some cases researchers decided that all identifiable information should be kept from participants and they should instead work with impressions of the network as a whole. In other cases some of the key groups involved in the co-development of the project had more access to information, and in others participants were asked to give permission for others to see their full data. In this last case this was an option in the ethics cover sheet - organizations could give permission for their data to be included in a publicly available data set or restrict it to only be made available to researchers. While in some cases access to information was restricted by funding parameters, in most it was left to the researchers and partnering organizations to decide how much access to grant. Future researchers should carefully think through what information can be revealed and to whom. Experiences here would support having a discussion with participants over confidentiality and the potential consequences to ensure that participants understand what they'll have access to and why. Ideally, these discussions would happen when participants themselves can help decide what the confidentiality policy will be as the best practice is certainly context-dependent and therefore find a workable solution that meets the needs of researchers and participants. Such discussions should also include possible unintended consequences when working through the data, such as findings that make people uncomfortable (i.e., someone is less central than they thought) or that could even be harmful.

Another subset of ethical considerations relates to the tendency for engaged Env. SNA research to effect change, either deliberately or unintentionally. The practice of bringing together groups of stakeholders at different stages in a research project can facilitate new relationships, and may therefore be considered a network intervention. As described in the Australian case study, there are multiple ways in which engaged Env. SNA research can alter social processes, and researchers must strive to anticipate the scope and nature of the implications of research practices. The two most mentioned ways of effecting participants were revealing to the participants their relative positions in the network, and providing ways for more ties to form among participants. The first method is true of any engaged research where participants are able to learn about themselves. Advice here is to try and prepare participants for this eventuality if their identity is to be revealed or if participants will be able to infer their own position from blinded images. This has been done in some studies by having individual meetings with participants to discuss their own ego-networks in relation to the whole rather than revealing the results in a general meeting without the opportunity to process individual results with researchers. The second effect is specific to SNA. While none of the researchers who took part in our survey were concerned about it, and in fact many view it as a positive impact of the research for those who take part, we note potential pitfalls. In terms of the research agenda these kinds of events will certainly skew attempts at longitudinal studies which wish to compare networks over time. Additionally, it might also affect the behavior of participants in other ways if they alter their own network as a result. We cannot move beyond speculation here. While some researchers mentioned that their participants intended to make changes following their studies, to our knowledge no systematic data is presently available. Thus it is left to future research to identify these effects, both positive and negative.

An overarching finding that emerged from both our survey and the case studies was that engagement was considered worthwhile and yielded benefits to participants while improving the research. Notably, certain benefits of engagement—e.g., participants found it useful; it prompted new and compelling research questions—were repeatedly identified. However, our results demonstrate the importance of establishing relationships with research participants, ideally as early as possible. While such a strategy may require a greater upfront investment

in time and resources, our findings highlight how such efforts were perceived by researchers to “pay off” in terms of the higher participation rates and therefore better data quality, greater uptake of research findings by decision-makers, and the possibility of generating novel research questions that emerge from early discussions with stakeholders. Future work could potentially examine some of these same questions but from the perspective of the participants rather than researchers, whose impressions could potentially be quite different.

Finally, our results point to some possible important contextual gradients that may help those wishing to do engaged Env. SNA to prepare. There may be different sets of dynamics when working with direct resource users (e.g., farmers and fishers) versus civic, municipal, and state environmental managers. Development levels also likely play an important role. National development levels might shape certain logistics for engagement, such as financial costs and the availability of technological and other resources. Development contexts may also affect who researchers have access to and in what ways. While not directly discussed by survey respondents, several members of the authorship team have observed that working as a researcher from the Global North can afford certain privileges regarding access to officials and decision-makers in the Global South. Embedded in these kinds of dynamics are issues of gender, socio-economic status, and ethnicity. These issues are not limited to international development contexts and can play a significant role when working in one’s home country, but are often implicit in most international development exchanges.

We conclude by highlighting the need for greater awareness and study of engaged SNA. Research teams bear responsibility for whether these effects are largely positive or negative. Often the planning of these activities is far greater than many initially suppose. We hope our findings will help stimulate discussion and aid future researchers in both thinking through their plans as well as justifying the need for additional resources to ensure their engagement activities are supported. Researchers must guard against potential adverse impacts while increasing the likelihood of positive effects by recognizing the direct and indirect consequences of Env. SNA research on human and natural communities.

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Appendix A

Survey Questions:

1. Have you tried to communicate results back to stakeholders/participants?
2. What were the goals of the feedback, the general approach, and tools or techniques were used to facilitate it? If you’ve run multiple such events, feel free to pick one or describe multiple examples.
3. Where did the feedback or engagement take place, and what kinds of participants were involved (e.g. government, NGO, private citizens, etc.)?
4. What kind of resources did you need to make the effort work (e.g. physical materials, infrastructure, partnerships, etc.)?
5. Were the activities ‘passive’ – meaning results were disseminated, or more ‘active’ (eg workshops, focus groups)? If you’ve run multiple such events, feel free to pick one or describe multiple examples.
6. Were there any barriers that you had to overcome to make the communication/outreach effort work, or can you think of any barriers that others might face if they tried to do similar work? Please comment on general barriers as well as those that might be specific to network methods or data.

7. What aspects of this approach were effective? What aspects of this approach seemed ineffective?
8. How did it help your research? How did it help participants?
9. Would you do it again? Why/Why not?
10. Did any publications (including ‘grey’ lit) result that describe the outreach? If so, either number them or provide references. NOTE: If references are provided, they may be referenced in our work.
11. What advice would you give to researchers who wish to engage participants, but have limited or no experience in such activities?
12. Is there anything else you’d like to describe or explain for the survey?
13. Almost done! We thank you for your time and this is the LAST question! If you would like us to contact you about helping with the article, please enter your email address.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.socnet.2022.01.009>.

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