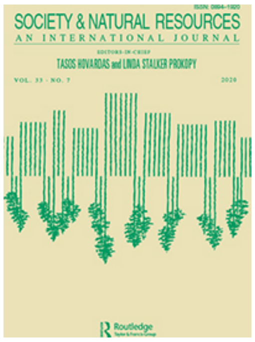

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Identifying Stakeholder Groups in Natural Resource Management: Comparing Quantitative and Qualitative Social Network Approaches

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ABSTRACT

This study compares the efficiency of two analytic approaches—qualitative and quantitative—to social network analysis for identifying stakeholder groups. Social network data were collected from 23 water and agriculture stakeholders in Arizona, USA, and analyzed quantitatively and qualitatively. Analysis of the sample in the original order of data collection found qualitative analysis was more efficient, in that it yielded a stable result—the identification of four stakeholder groups—within 16 interviews. In contrast, the quantitative analysis did not produce a stable result after 23 interviews. Repeated analyses with randomized order and reverse order samples found qualitative approaches yielded more stable results, took about the same number of interviews to yield results, and produced slightly fewer stakeholder groups compared to quantitative approaches. Our findings suggest that, in resource-constrained projects, qualitative social network analysis for identifying stakeholder groups can provide an efficient alternative to conventional quantitative social network analysis.

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Agriculture; mixed-methods; social networks; stakeholder analysis; water

Introduction

Stakeholder analysis is essential to natural resource management and research (Grimble and Wellard 1997). Social network analysis is now part of the core toolkit used for stakeholder analysis (Reed et al. 2009; Prell, Hubacek, and Reed 2009). Qualitative and mixed-methods approaches to social network analysis are gaining traction (Bernard 2014; Domínguez and Hollstein 2014; Herz, Peters, and Truschkat 2015), but are not yet widely applied to stakeholder analysis. The purpose of this paper is to assess the efficiency of quantitative and qualitative social network approaches in identifying stakeholder groups. We apply our approach to a case of water and agriculture

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stakeholders in Arizona, USA. This analysis is the first stage of a larger project to develop and evaluate a collaborative, stakeholder-driven approach to addressing water issues both for, and from, agriculture in the USA.

Stakeholder Analysis, Social Networks, and Natural Resources

Stakeholder analysis is a precursor to stakeholder engagement, which is widely considered critical to natural resource management (Colvin, Bradd Witt, and Lacey 2016). An early review defined stakeholder analysis as a holistic approach for identifying and assessing the interests of natural resource system's key stakeholders (Grimble and Wellard 1997). In natural resource management, "stakeholders" tend to be defined—in contrast to the general population—as actors with a specific interest or shared preference for a focal issue and who are affected by and can affect a decision (Colvin, Bradd Witt, and Lacey 2016; Reed et al. 2009).

Reed et al. (2009) summarized methods utilized in the three stages of stakeholder analysis for natural resource management: (1) identify stakeholders, (2) differentiate among and categorize stakeholders, and (3) examine the relationships among stakeholders. In this paper, we focus on two methods listed among those commonly used in stakeholder analysis: semi-structured interviews and social network analysis. While Reed et al. (2009) conceptualizes these, to some extent, as distinct methods, we take a different approach. We conceptualize the semi-structured interview as a method that can yield qualitative and quantitative data for use in social network analysis.

Social network analysis—a method for which there is a growing literature around applications for natural resource management (e.g., Bodin and Crona 2009)—is useful for categorizing stakeholders and examining relationships between stakeholders. Recent studies have employed social network analysis in research on natural resource stakeholders, and found it to be a rigorous and efficient approach to stakeholder analysis (Floress, Prokopy, and Allred 2011; Krupa et al. 2018; Lienert, Schnetzer, and Ingold 2013; Lubell, Niles, and Hoffman 2014; Mandarano 2009; Paletto, Hamunen, and De Meo 2015). Social network analysis can reveal the structure of stakeholder groups and identify influential stakeholders, but conventional quantitative approaches can be time-consuming, tedious for respondents, and require specialist skills to correctly collect and analyze the data (Reed et al. 2009). If qualitative social network analyses perform equally well in identifying stakeholder groups, they might present an efficient, cost-effective alternative for some phases of stakeholder analysis.

Our goal is to explore the efficiency of two different analysis approaches—qualitative and quantitative—to social network approaches to identifying stakeholder groups. Social network analysts increasingly embrace mixed-methods (Bernard 2014; Domínguez and Hollstein 2014) and qualitative approaches (Heath, Fuller, and Johnston 2009; Herz, Peters, and Truschkat 2015) drawn from analysis of texts (e.g., Verd and Lozares 2014) and drawings (e.g., McCarty et al. 2007). To date, social network analyses in natural resources research have primarily used quantitative and visualization-based approaches. In this paper, we use a mixed-methods approach to stakeholder group identification using social network analysis.

Research Objective

This analysis is designed to compare qualitative and quantitative approaches to analyzing social network data (elicited from the same respondent) to determine which approach is more efficient in identifying stakeholder groups. To do so, we compared the number of interviews it took to identify stakeholder groups in a stable fashion using each analytic method.

Research Methods

Study and Sample

The study sample is comprised of 28 stakeholders involved with water and agriculture issues in the Verde Valley, Arizona. This study is part of the larger USDA-NIFA funded "Water for Agriculture" project, and our first step was to identify informal stakeholder groups to ensure that our efforts at stakeholder engagement included all relevant interests. The Arizona stakeholder sample includes farmers, ranchers, environmentalists, water managers, and government officials from local, county and state agencies. Participants were identified via key informant interviews and by successively asking participants who else they recommend we speak with about water and agriculture issues in the Verde Valley, AZ. In terms of sample size, we aimed to conduct at least 18 interviews, or three times the minimum sample size ($n = 6$) needed to detect themes in a qualitative dataset (Guest, Bunce, and Johnson 2006). We exceeded this minimum bar, as 23 of the 28 interviews yielded usable mixed-methods datasets.

Developing the Social Network Protocol

The social network protocol was designed to identify stakeholder groups in the Verde Valley. To design the protocol, we started by asking four key informants—who each had a broad perspective on the system and wide-ranging network of contacts—to free list individuals and organizations actively involved in water and agriculture issues in the area (Brewer 2002). This list was then reviewed and edited by coauthors Bausch and Porter, who have ethnographic and participatory-research experience with this stakeholder community. This activity produced 53 stakeholder names; this list formed the basis of the social network protocol.

Data Collection

The qualitative and quantitative data were collected in face-to-face interviews conducted with respondents between March and August 2018. Interviews lasted between 1.0–3.5 hours. The study received ethical approval under IRB#STUDY00007549 at the Institutional Review Board Office of Arizona State University. The social network data were elicited at the beginning of the interview. We began with a set of 53 index cards, each containing the name of a stakeholder. During the interview, we asked respondents to sort (i.e., group) the cards (Boster, Johnson, and Weller 1987), based on who works or collaborates together on water and agriculture issues. This activity produced two datasets for each respondent: (1) qualitative data: field notes and verbatim transcripts of the respondent's narration as they sorted the cards, named each group, and discussed the groups and (2) quantitative data: an individual proximity matrix that summarizes whether or not the respondent placed each pair of stakeholders in the same group (Bernard 2012).

Data Analysis

Overview

We conducted two social network analyses: (1) qualitative and (2) quantitative. We began both analyses at $n = 6$ interviews; past research establishes 6 interviews is the minimum for data saturation (Guest, Bunce, and Johnson 2006). After sequentially analyzing 18 datasets (containing $n = 6$ to $n = 23$) qualitatively and quantitatively, we determined how many interviews it took to identify a stable number of stakeholder groups for each method. We defined a "stable" result conservatively, as occurring when the result repeated at least 4 times and remained the same until the end of the sample ($n = 23$).

Interviews were initially analyzed in the order in which we collected them, as we assumed key informants listed more salient stakeholders earlier (Brewer 1995). Since this methodology is sensitive to the ordering of interviews, we reanalyzed the data using three additional sample orders: Randomization 1, Randomization 2, and Reverse Order (following Hagaman and Wutich 2017). For Randomizations 1 and 2, we randomly reordered all interviews in the dataset and reanalyzed the randomly reordered dataset. For Reverse Order, we reordered the observations from last to first and reanalyzed the reverse order dataset. We present all four results in the paper (see Tables 1 and 2), but weigh most heavily the Original Order in our interpretation of the results because Original Order best represents the dynamics of respondent recruitment in stakeholder research.

Qualitative Analysis

Qualitative coding was performed using field notes taken during face-to-face interviews. We used "in-vivo coding" (Bernard et al. 2016) to capture the exact name of each

Table 1. Number of interviews needed to identify a stable number of key stakeholder groups.

Sample	Quantitative analysis	Qualitative analysis
Original order	No stable result	16
Randomization 1	No stable result	20
Randomization 2	16	17
Reverse order	18	19

Table 2. Number of stakeholder groups identified.

Sample	Quantitative analysis	Qualitative analysis
Original order	No stable result	4
Randomization 1	No stable result	4
Randomization 2	6	4
Reverse order	6	4

stakeholder group respondents named to describe that aspect of network structure in their pile sort. These codes were then cross-checked, as needed, against the verbatim interviews. Next, adapting methods from free list cleaning, codes were compared and, as needed, combined to dispense with idiosyncratic naming (Bernard 2012). For example, one respondent listed "groups that work on conservation" while another listed "conservation NGOs;" we combined each of these in-vivo codes and named them "Conservation Groups/NGOs." This process produced a list of twelve codes naming stakeholder groups. We then sequentially counted which stakeholder groups were named in >50% of interviews conducted with the first six respondents ($n = 6$), then the first seven ($n = 7$), all the way through $n = 23$ (completing 18 analyses total). We use >50% as a cutoff as it provides a rough measure of consensus among respondents (Weller 1984).

Quantitative Analysis

Data collected from each respondent's pile sort was converted into a one-mode individual proximity matrix (Bernard 2012) capturing possible ties between every pair of stakeholders. Next, we used individual proximity matrices to create aggregate proximity matrices that represent composite data on stakeholders' ties collected from all respondents (starting with $n = 6$, then adding another respondent so that $n = 7$, all the way to $n = 23$), using Anthropac software (Borgatti 1996). We performed 18 social network analyses—one for each of the aggregate proximity matrices. All social network analyses were performed in UCINET (Borgatti, Everett, and Freeman 2002). We created visualizations of 18 social networks, drawing ties that were reported by >50% of the respondents in each sample, in NetDraw (Borgatti 2002). Here, too, we consider reports of ties from >50% of interviews as a rough measure of consensus about tie existence. In each visualization, we identified components and coded them using the 12 stakeholder group codes developed in the qualitative analysis (e.g., McCarty et al. 2007).

Results

Qualitative Analysis

Using the Original Order sample, qualitative analysis of social network data from our first six respondents yielded mention of just two stakeholder groups that were identified by >50% of respondents. When the qualitative dataset contained between 6 and 14 respondents, the number of stakeholder groups identified by >50% of respondents remained unstable. Once the number of respondents in our qualitative dataset reached 16, we reliably identified four stakeholder groups reported by >50% of the respondents. This result remained stable through the remainder of the interviews (through $n = 23$). In Randomization 1, Randomization 2, and Reverse Order samples, analyses stabilized at 4 groups with $n = 20$, $n = 17$, and $n = 19$ interviews. This result supports Francis and colleagues' (2010) finding that at least 13–17 interviews are needed to reach thematic data saturation, if the definition of saturation includes repetition. Notably, our results also support Guest, Bunce, and Johnson (2006) finding that most themes present in qualitative data can be identified after 6 interviews, as all twelve possible stakeholder groups were mentioned by at least one respondent in our $n = 6$ dataset.

Quantitative Results

Using the Original Order sample, quantitative analysis of social network data from our first six respondents showed six stakeholder groups identified by >50% of the sample. As more respondents were added to the sample, we expected the results to stabilize. However, the number of stakeholder groups identified fluctuated between 5 and 8 with the sequential addition of respondents. In addition, the composition of groups fluctuated across analyses. For example, two major funding organizations appeared as isolates in the $n = 6$ network visualization; joined the conservation NGO subgroup when $n = 15$, but were isolates again in the $n = 23$ network visualization. The most consistency in the number of stakeholder groups occurred at $n = 17$ through $n = 19$, where 8 groups were identified by >50% of respondents. However, from $n = 20$ through $n = 23$, there were 7 groups of stakeholders identified by >50% of respondents. We received similar results with the Randomization 1 sample and found neither yielded stable results. In the Randomization 2 and Reverse Order samples, we identified 6 stable groups at $n = 16$ and $n = 18$.

Discussion and Conclusions

Our analysis was designed to determine if qualitative or quantitative analysis of social network data is more efficient for identifying stakeholder groups. The results indicate that, for the Original Order sample, qualitative analysis was more efficient, in that it yielded a stable result—the identification of four stakeholder groups—within 16 interviews. In contrast, quantitative analysis of the Original Order sample did not produce a stable result after 23 interviews. Repeated analyses with Randomized Order and Reverse Order samples indicate qualitative approaches yielded more stable results, took roughly the same number of interviews to yield results, and produced slightly fewer stakeholder groups compared to quantitative approaches.

A number of limitations should be taken into consideration in interpreting our findings. First, our analysis focused on finding consensus (>50%) in the identification of stakeholder groups, not just presence or salience. Our use of a cutoff at >50% means we did not capture lower-occurrence answers, which may include expert or sensitive knowledge about stakeholder groups. Second, we did not collect data from the whole network of 53 stakeholders. If we had done so, our quantitative social network analysis would have undoubtedly produced a different result. That said, the constraints we faced in composing our stakeholder sample are common in natural resource research. Third, our method of stakeholder elicitation is vulnerable to known patterning in the free recall of network members (Marsden 2005), though the random and reverse order analyses help address this. Fourth, our research focuses only on the identification of stakeholder groups. It does not shed light on the efficacy of qualitative social network approaches for examining other aspects of network structure or dynamics, which may be better served by quantitative approaches. Finally, while efficiency is an important metric in assessing the efficacy of social network analyses for stakeholder identification, other considerations—such as stakeholder buy-in—may also merit further research.

With these limitations in mind, our findings have two possible implications for stakeholder analyses of social network data. First, semi-structured interviews need not be regarded as a technique useful merely for identifying stakeholders; they can also produce nuanced, actionable data about stakeholder groups and, possibly, other aspects of social network structure. Second, our findings suggest that, in resource-constrained projects, qualitative approaches to social network analysis for identifying stakeholder groups may provide an efficient alternative to quantitative approaches to social network analysis.

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