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Look who's talking

Explaining water-related information sharing and demand for action among Ugandan villagers

Abstract

Many national water policies propagate community-based participatory approaches to overcome weaknesses in supply-driven rural water provision, operation and maintenance. Citizen involvement is thought to stimulate bottom-up accountability and broaden the information base, which may enrich design and implementation processes and foster improved water accessibility and sustainability. Practices on the ground, however, are embedded in socio-political realities which mediate possible beneficial effects of participatory approaches. This paper builds on full social network data collected in a Ugandan village to study the social and political reality of two distinct levels of participation, i.e. local information sharing among citizens and a more active appeal to fellow citizens to improve water services. We use Logistic Regression Quadratic Assignment Procedure (LRQAP) to explore what type of actor and network traits influence information sharing and whether the same factors are in play in the demand for action to remedy water-related problems. Whereas social aspects (social support relations) and homophily (using the same water source, the same gender) play an important role in information sharing, it is the educational level, in particular, of the villager who is called upon that is important when villagers demand action. Our findings also demonstrate that those most in need of safe water do not mobilize their information sharing ties to demand for action. This indicates that building local water policies and practice exclusively on locally existing demand for action may fail to capture the needs of the most deprived citizens.

Key-words: information sharing, demand for action, water, social network analysis, Uganda

Introduction

In spite of substantial progress made in water accessibility since the 1990s, the newly adopted 6th sustainable development goal, which calls for universal access to water and sanitation by 2030, is indicative of the fact that people's access to water remains one of the most pressing issues on the international development agenda (UNDP 2015). Over time, it has been increasingly acknowledged that governance problems related to the system of actors, resources, mechanisms and processes that mediate water access are more challenging than the technological constraints (Franks and Cleaver 2007). In order to address various of the governance related problems, there has been a move from state-centric supply systems towards more demand-responsive and participatory approaches in which communities, through a plethora of associations and committees, are encouraged to take a more active stance in the design, operation and maintenance of water supply systems. Proponents assert that citizen involvement fosters ownership and bottom up accountability, thus remedying deficient, top-down accountability mechanisms, while local-level information and knowledge is thought to expand the evidence base. Such a broader exchange of information, which is pivotal to processes of social learning and adaptive management, may enrich the diagnosis and implementation and improve outcomes in terms of accessibility, equity, satisfaction and sustainability (Cook and Manor 1998; Mansuri and Rao 2013).

While the community management model gained international prominence[1] and gradually trickled down to many developing countries' national water policies, it has also come under increased scrutiny (Hutchings et al. 2015). Scholars and practitioners have argued that the realization of participatory benefits is not self-evident but contingent on a number of strong assumptions which are not necessarily borne out in reality. First, the effective participation of citizens in the design, implementation, monitoring and maintenance of water points is still relatively low (Salami et al. 2014), which hints at the fact that communities are not necessarily willing or able to engage in community-based water supply (Das 2014). The limited capacities in terms of knowledge, skills, material resources has led to the realization that community management in the absence of continued external (post construction) support is bound to fail (Baumann 2006; Hutchings et al. 2015; Kleemeier 2000; Schouten et al. 2003). On the ground it has stimulated actors (see e.g. WaterAid 2011) to move towards 'community management *plus*' approaches (Baumann 2006; Hutchings et al. 2015) involving backstopping by governments, NGOs and the private sector in terms of technical assistance, managerial advice and recurrent cost sharing.

Second, various sources have highlighted the importance of making a distinction between different types and levels of participation. Lawrence (2006), for instance, distinguishes between four levels of participation: consultative (information sharing), functional, collaborative, and transformative. In transformative participation local citizens become the key decision-makers driving the process. Similarly, Fliervoet et al. (2016) differentiate between instrumental and normative participation, and break this down into more individual (expertise/voting and direct engagement) and collective activities (lobbying and civil society participation). Whatever specific participatory format is adopted, information exchange is considered a primordial ingredient and this is also the central focus of our study. Building on the aforementioned distinctions, we also distinguish between information sharing among citizens on water related issues (availability, time needed to collect water, functionality and cleanness of water points) and citizens calling more actively upon other citizens (= demand for action) when confronted with water-related problems, as it is particularly the latter which is considered key in triggering a supply side response (Andersson and van Laerhoven 2013).

Third, various scholars have also raised concerns about the inclusiveness of participatory processes and the distribution of its benefits as local communities do not necessarily function as homogeneous entities but are rather structured alongside socio-cultural and political realities (Cleaver and Toner 2006). Mansuri and Rao's 2013 review of participatory approaches highlights that, on average, participants in community based development activities tend to be wealthier, more educated, of higher social status and better connected politically. Additionally, demand-responsive approaches often reflect the preferences of the better off, leading to elite capture and further exclusion of weaker communities (Mansuri and Rao 2013). Echoing this compelling evidence, it is likely that local information sharing and demand-for-action networks are also shaped by these existing local realities. Building local water policies on information and calls for action from local citizens may thus reinforce existing inequalities rather than

[1] The importance attached to community participation is also evident from SDG 6, target 8 which refers to the support and strengthening of local communities' participation in improving water and sanitation (UNDP 2015).

reduce them, while the bias in local knowledge produced may also undermine the sustainability claims of community based water management.

While there is ample evidence regarding the mediating effect of existing local networks on the community management of environmental resources (Sändstrom and Rova 2010), many Sub Saharan African (SSA) governments and donors tend to downplay contextual specificity in the translation of policies into blueprint practice. On the positive side, practitioners on the ground increasingly realize that understanding the functioning of local networks and the socio-political factors at play is critical for the design of effective external support and community backstopping approaches (see e.g. WaterAid 2011).

Our paper aims to feed into this undertaking by unpacking local level information sharing and demand-for-action networks. In this study, we particularly try to answer two main questions:

i) What are the main features of information sharing and demand-for-action networks and is there variation amongst them?

ii) Which factors affect information sharing and are these the same factors that shape demand for action?

In answering these questions, we use social network analysis as it allows us to map and visualize the flow of information and sharpen our understanding by employing formal network analysis measures. In the next section, we provide a brief account of related research which feeds into our own empirical analysis. We build upon this emerging trend of social network application in environmental research while we take it one step further by not merely describing the social networks, but also analyzing underlying social mechanisms structuring the social fabric. We apply Logistic Regression Quadratic Assignment Procedure (LRQAP), something which has, to the best of our knowledge, not often been done before in the context of a rural African village. Section three outlines our methods and the Ugandan study setting in more detail, with our empirical findings presented and discussed in section four.

Unpacking information sharing and demand-for-action networks

Increased awareness of the pivotal role of social networks in the management of local resources has encouraged the application of social network analysis within environmental management studies (Stein et al. 2011). A distinction can be made between network measures describing features of the entire network and those focusing on the position of the individual within the overall network. Table 1 gives an overview of both types of network measures used in our study.

Table 1: Network measures

		Definition
Whole network measures	Density	"The density of a binary network is the proportion of all possible ties that are actually present" (Hanneman and Riddle 2011: 342).
	Degree centralization	"The graph centralization measure expresses the degree of inequality or variance in a network as a percentage of that of a perfect star network of

	(Freeman, 1979)	the same size" (Hanneman and Riddle, 2011). The centralization measure is based on looking at the difference between the number of ties the most central node has and those of all other nodes (Borgatti et al 2013). The measure can vary from 0 (each node is connected to every other node) to 100 (all nodes are connected to only 1 node). The indegree centralization measure is based only on the incoming ties, while outdegree centralization describes variance in outgoing ties among the nodes.
Actor level network measures	Degree centrality (Freeman, 1979)	A local centrality index which measures how many other nodes a node is connected to. We differentiate between the number of incoming ties (indegree centrality) and outgoing ties (outdegree centrality) (Hanneman and Riddle 2005).
	E-I (External-Internal) index	"The E-I index takes the number of ties of group members to outsiders, subtracts the number of ties to other group members and divides by the total number of ties. The resulting index ranges from -1 (all ties are internal to the group) to +1 (all ties are internal to the group). (Hanneman and Riddle 2011:348; Krackhardt and Stern 1988).

Density captures the extent of connectedness or interaction within the network. Dense networks are often associated with solidarity or (a greater stock of) social capital (Bodin et al. 2006; Ward et al. 2011). Denser networks are hypothesized to be conducive to collective action (Sandström and Rova 2010); although not in a linear fashion as groups that are too dense might no longer be efficient (Bodin et al. 2006). This, for instance, holds for information sharing networks where excessive density may lead to a homogenization of information, which may undermine the innovative capacity (Bodin and Norberg 2005). Density might also play out differently for different types of networks. In his research on collective action among Swedish natural resource managers, Sandström (2008, cited in Bodin and Crona 2009), for example, demonstrated that higher density was more important in triggering joint action than for knowledge development while Lauber (2008) pointed out that density proved less important in exerting influence in securing project funds than in exchanging information.

Degree centralization indicates how tightly the network is organized around its most central node (Ward et al. 2011). A highly centralized network proves efficient in solving simple problems as it allows one person (the most central node) to manage communication efficiently, while a more diverse structure is needed to foster experimentation and social learning, which are key in addressing more complex issues (Leavitt 1951; Crona and Bodin 2006). Degree centralization can be further differentiated into indegree (incoming ties) and outdegree (outgoing ties) centralization. A high indegree/outdegree centralization in the information sharing network indicates that few nodes are dominant in receiving/ sending most of the information.

Turning to factors that might explain information sharing and calls for action, we draw upon various streams of literature which we capture in four broad dimensions. In the methods section each of these four dimensions are operationalized taking the local context into account.

A first obvious group of factors is related to local water realities. Various studies (e.g. Lauber 2008; Meizen-Dick and Zwarteveen 1998) discuss the importance of urgency referring to the fact that the more problems citizens face in terms of accessibility to high quality water, the higher the probability that they will make an effort to improve that situation, *inter alia* by sharing information and exerting influence. Another water-related factor that might influence information sharing is membership of water user committees. As water user committees are the responsible unit at the village level, we might assume that being a member of a water user committee influences information sharing and calls for action. The same holds for using the same water source as it implies being confronted with similar problems in terms of water quality, lack of maintenance, etc. while it may also be captured under the next category of social factors.

Second, research from various settings has demonstrated that information sharing is to a large extent dependent on existing social support ties as much information is shared through social interactions (Crona and Bodin 2006; Isaac et al. 2007; Lauber 2008; Trinies et al. 2011). We expect this to hold particularly for water-related information as water practices are to a large extent socially embedded activities involving collective rituals such as fetching water (Mader 2011). Sharing various types of ties among two individuals is obviously not limited to information sharing and social interaction, but a well-known phenomenon which is commonly referred to as 'multiplexity' (Verbrugghe 1979). Another mechanism known to structure social interaction is homophily, i.e. the tendency to form connections (such as exchanging information) with others who are similar in terms of age, gender, education, race, ethnic identity (McPherson et al. 2001). As water provision tends to be a highly gendered practice with water supply responsibilities for household-related and productive activities often neatly divided alongside gender relations, we particularly expect gender homophily to be important in explaining information sharing and demand for action.

Besides social factors, political realities may also have an influence on local level information sharing and calls for action. National politics generally trickle down to the local level, which makes it likely that preference and membership of the same political parties also increases information sharing and action calls. In keeping with the perceived political efficacy literature (Craig et al. 1990), we also expect citizens to share information and contact other citizens whom they consider to be potentially successful in bringing about change. In practice, this boils down to citizens with more individual capacities in terms of education, income as well as citizens with connections to higher level authorities as this increases the likelihood of the system's responsiveness to their claims. This was demonstrated in Lauber (2008) where citizens particularly contacted stakeholders with formal authority as these were considered to be the "legitimate" representatives of the system. A useful network measure in this regard is the E-I index which gives an indication of the degree to which a person is "externally" linked. The value of this has been extensively documented in the (bonding and) bridging literature (Bodin and Crona 2009) which demonstrated that bridging ties among heterogeneous actors are particularly useful in mobilizing external resources (funds, information, knowledge, political and technical support, etc.). Such externally linked citizens are often considered a gateway to the outside world and are as such inclined to receive more information and demands for action from other citizens who want their claims to be heard.

Finally, personal traits may also influence information sharing and calls for action. In her study on community-based water supply in Madhya Pradesh (India), Das (2014) refers to the importance of demographic characteristics such as education, class/caste, age and gender. Similarly, Lauber (2008) showed that higher educated citizens tend to exert more influence, something which was also pointed out earlier by Fukuyama (1996), who related higher education to increased political awareness and higher civic engagement. In keeping with the bonding and bridging literature, we may also assume that villagers with more ties to external actors (from other villages, from supply actors) have more access to sources of information and knowledge outside the village on which they can draw to share more information within the village.

Before translating each of the dimensions into a set of clearly identified variables, the next section provides a brief account of the Ugandan study setting and data collection procedures.

Methods

Setting

Unlike most other SSA countries, Uganda significantly increased its citizens' water accessibility, moving from 40% of the population with access to improved water sources in 1990 to 79%[2] in 2014 (WHO/UNICEF 2015). However, progress within Uganda remains uneven. While some of the districts have almost reached full coverage (95% access[3] to safe water in Pader[4]), in other districts access to safe water remains very low (29% in Mubende) (Ministry of Water and Environment 2015). With regard to other 'Golden Indicators' of water performance, there is also still much room for improvement. In terms of functionality[5], 88% of the rural water sources are considered to be functional, yet still falling short of the 100% functionality target. Water quality[6], on the other hand, seems to be even more problematic. Only 36% of the samples of rural water sources complied with the international standards (Ministry of Water and Environment 2015)

[2] Water performance statistics differ somewhat depending on the source and the definition used. The Uganda Water Supply Atlas reports access to safe water to be around 67 percent, with access to safe water defined as the ratio of people served by a safe water point and piped water supply to the total population. The calculation is based on an estimated number of people per water point type (Water Supply Atlas 2016).

[3] Access is defined as "% of people within 1,000m (rural) and 200m (urban) of an improved water source" (Ministry of Water and Environment 2015: x).

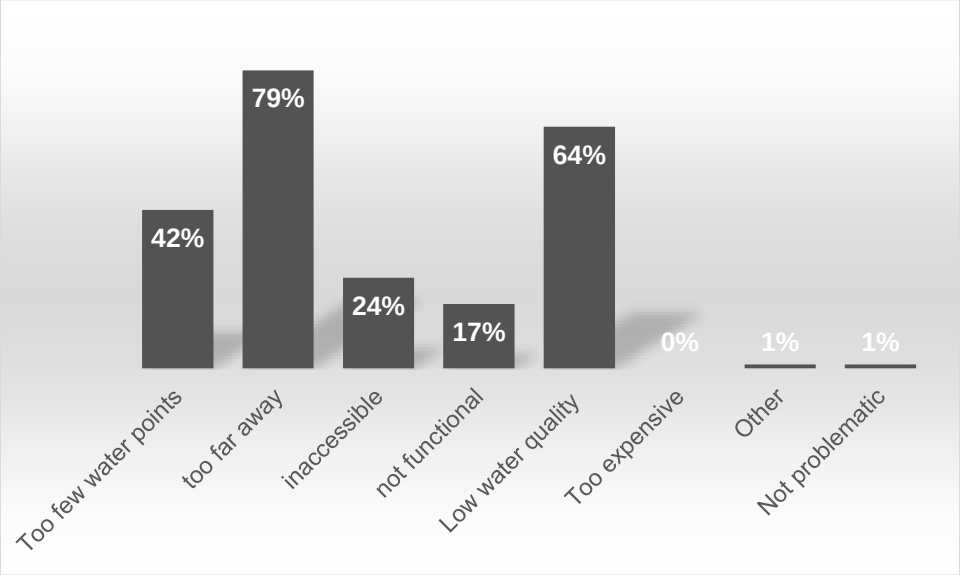
[4] Pader, Kitgum, Moyo, Agagao, Butambala are all capped at 95 percent.

[5] Functionality is defined as "% of improved water sources that are functional at time of spot-check (rural/WfP)" (Ministry of Water and Environment 2015: x).

[6] Calculated as "% of water samples taken at the point of water collection, waste discharge point that comply with national standards." For measuring the quality of the water from rural water sources, the presence of E. Coli (from WQD) is used as an indication of water quality (Ministry of Water and Environment 2015: x).

Our study village is located in sub-county Ruhumuro, which has the lowest access to safe water rate (82 percent) of Bushenyi district. The problematic nature of the village water services is also confirmed by our survey results with villagers mentioning the long distances to the nearest water points, the poor water quality and having too few access points (see Figure 1). More specifically, the average time needed to fetch water for the villagers (one round trip) is 54 minutes, for about 10% of the citizens this daily activity takes about 2 hours while some citizens indicated that they had to spend about 3 hours.[7]
Our survey findings show that 72% of the citizens collect water from a protected spring, 2% from an unprotected shallow well, while 26% use a natural surface water source.

Figure 1: Water-related problems identified by the villagers



Source: Authors' own survey

Uganda is one of the SSA countries which has translated the changes in international water-related conventions into its own policies. The 1999 Water Act (Republic of Uganda, 1999) highlights the importance of citizen participation, which also tallies with Uganda's far-reaching decentralization policy. In Uganda's decentralized five-tier system water provision is mainly the responsibility of district level authorities (LC5) with other levels having mainly support functions. At the village level (LC1), water user committees (WUC) are responsible for the operation and maintenance of water points (Oosterveer and Van Vliet 2010). A WUC is considered functional if it regularly collects O&M funds, holds regular meetings, undertakes minor repairs and maintains adequate sanitation around the water source. At least one of the WUC's formal positions (Chairperson, Vice chairperson, Secretary, Treasurer) should be held by a woman (Ministry of Water and Environment 2015).

[7] The World Health Organization uses 30 minutes total collection time as a maximum threshold for having basic drinking water service.

Progress in water community management of water sources is monitored through one of the Golden Indicators measuring the percentage of rural water points with actively functioning Water & Sanitation Committees. The 2014/2015 target was set at an ambitious 95%, while the actual performance was 77%. To strengthen community management, the sector initiated a number of initiatives, including advocacy meetings at district/ sub-county level and quarterly meetings for extension staff at sub-county level to discuss the current status of community management activities and share best practices and challenges from the field (Ministry of Water and Environment 2015). In Bushenyi district 97% of the water sources reportedly have a functional water committee (Ministry of Water and Environment 2015). While in our study village water user committees indeed used to exist, in reality the committees have been dysfunctional for a couple of years. When villagers were asked about their membership, 98% said they were not a member of a water user committee, whereas only three citizens said they were.

Data collection

Data was collected from September to December 2015 by a team of six researchers, including four local research assistants who could speak the local Runyankole language. Data collection started with key expert interviews with local village leaders and a visit to each of the households in the village to map the entire village population. During this first visit, the research team and topic were introduced while key information on basic background characteristics was also collected. Drawing upon this first round of data collection, we identified from the entire village population those citizens to be included in the subsequent round of data collection. In practice, we excluded villagers below the age of 25 as well as citizens who worked outside the village on an almost permanent basis. The first data collection round was also useful in fine-tuning the survey instrument which was subsequently used during the more in-depth phase of data gathering. Drawing upon face-to-face interviews in the local language, the research team then collected data on socio-economic background characteristics, water-related issues and political attitudes as well as network data related to various types of ties. Table 2 gives an overview of the specific questions that were asked to inquire about social support[8], information sharing and call for action ties. Out of our study population of 131 citizens, 126 participated in the survey (response rate of 96%).

Table 2: Questions used to inquire on social support, information sharing and call for action ties

Social support	From time to time, people discuss important matters with other people. Looking back over the last year, I'd like to know the people you talked to about matters that are important to you.

[8] Social support is a very broad concept which has been defined in various ways (Song et al. 2011). In this article we follow Bodin and Crona (2008) in the use of "the discussion of personal matters network" (Burt 1984) as a tie measuring the social support network in a rural African village.

Information sharing	During the last year, with whom did you share information on water in your community (e.g. availability, quality of water, functionality, time needed to collect water, cleanliness of the well, ...).
Demand for action	During the last year, who did you approach to try to improve water services in your community (e.g. in terms of water quality, functionality, time needed to collect water, cleanness of the well,...).

Variables, descriptive statistics and analysis procedure

Drawing upon the different streams of literature identified above as well as primary data from the exploratory data collection phase, we translated each of the four dimensions considered to have an influence on information sharing and demand-for-action networks into a set of specific variables. Descriptive statistics for each of the variables are summarized in Table 3. The variables discussed below are subsequently entered into our regression models (see Tables 5 and 6). To test the models and predict the likelihood of information being shared and demand-for-action calls, we had to divert to a non-parametric regression technique as the use of social network data violates the assumption of independent observations, which is one of the basic assumptions of parametric regressions (Hanneman and Riddle 2005). More specifically, to test which factors explain information sharing and approach to improve networks[9], we rely upon a Logistic Regression Quadratic Assignment Procedure (LRQAP) (Krackhardt 1988; Dekker et al. 2007). QAP procedures use random permutations of the rows and columns of the network matrix to create a distribution of coefficient estimates based on the random networks. The basic parameters of the random networks (N nodes, N ties) are thus the same as for the network under study. Significance is tested for by comparing the actual estimates to those of the generated distribution of randomly permuted networks (van Duijn and Huisman 2011). UCINET (version 6.598) produces an R square as well as a measure of fit statistic (Borgatti et al. 2002).

The water-related dimension is made operational through a set of six variables. First, 'the average time needed to fetch water' is used as an indication of (limited) access to water. As the village is very hilly with steep slopes, the time needed to fetch water provides us with a better indication of accessibility than distance to the water source. To accommodate for the effect of having poor quality water, we introduced another variable, 'low water quality for consumption', which records whether the respondent has mentioned the poor quality of water as one of the water-related problems in his/her village. Our survey findings highlight that this was the case for 64% of the villagers. To check for the combined effect of distance and poor quality, an indication of how often the household had gone without clean water during the last month is included. The six-item index ranges from never (score=1) to 21-30 times per month (score=6). The median score for villagers without clean water is between 11 to 20 times per month (median = 5 on 6 point scale; mean = 4.33), which means lacking clean water for

[9] In this paper we opted to analyze individual and dyadic level effects on information sharing rather than modeling the underlying social mechanisms beyond the dyadic level (such as transitivity, popularity …) for which Exponential Random Graph Model (ERGM) is the preferred method.

household use about half of the time. All of the variables listed so far were entered into our model (see Tables 5 and 6) as sender effects, meaning that we check whether there is a relation between a citizen (a node) displaying a certain attribute (e.g. long time needed to fetch water) and the propensity of this individual to share water related information.

Table 3: Descriptive statistics

		N		Min	Max	Mean	SD
Water	**Time to fetch water**	126		5	180	53.65	32.8
	Low water quality	126		0	1	0.64	0.48
	Gone without enough clean water	126		1	6	4.33	1.91
	Member of water user committee						
	yes	3 (2.4%)					
	no	122 (97.6%)					
	Which water source do you use	13					
Social	**Gender**						
	male	48 (38.1 %)					
	female	78 (61.9%)					
	Ethnic identity						
	Banyankole	111 (97.4%)					
	Baganda	1 (0.8%)					
	other	2 (1.6%)					
	Religion						
	Roman Catholic	22 (17.5%)					
	Evangelical (Christian)	13 (10.3%)					
	Church of Uganda, Anglican	90 (71.4%)					
	Age	122		25	75	41.15	12.2
	Member of a Community Based Organisation (CBO)						
	yes	90 (72%)					
	no	35 (28%)					
	Social support *(with whom do you discuss important matter**s?**)*						
Political	**Preference for dominant political party**						
	yes	94 (74.6%)					
	no/other	23 (18.3%)					
	Political opportunism	126		1	4	2.01	1.29
	Education						
	some primary schooling	49 (38.9%)					
	primary schooling completed	32 (25.4%)					
	some secondary schooling	15 (11.9%)					
	secondary schooling completed	0					
	post-secondary qualifications	5 (4%)					
	polytechnic or college	0					
	some university training	0					
	university completed	0					
	E-I index	126		-1	+1	-0.83	
Personal	All variables have already been mentioned in the sections above						

Membership of a water user committee (WUC) is used as a variable with both sender and receiver effects as we assume that being member of a WUC leads to more sharing (sender effect) and receiving (receiver effect) of information and demand-for-action calls. Finally, based on the name of the water sources (13 different water sources including protected springs, unprotected shallow wells and natural

surface water sources) where respondents fetch water, we constructed a social network tie capturing whether citizens get water from the same source.

Second, the descriptive statistics in Table 3 also clearly show that overall the village is a fairly homogeneous entity in terms of ethnic composition and religion. As a relatively high proportion of men have migrated semi-permanently, our village population is skewed towards women. Uganda in general has a very young population (median age = 15.5, Index Mundi 2014), but as our study population is restricted to citizens above 25 the average age (41) is substantially higher. In line with the above literature review, we included different types of variations (homophily, sender effects and receiver effects) for all of the variables in our model to explain information sharing and demand for action.

To further account for the social fabric of community life, we included a measure capturing the associational activity within the village. Descriptive statistics in Table 3 hint at a rich associational village life with 72% of all respondents being a member of at least one community based organization. Both a CBO homophily effect (i.e. people that are either both 'in' or both 'outside' CBOs are more likely to share info) as well as a sender effect (persons that are members of CBOs are more likely to share water related information with others) are included in our LRQAP analysis. Finally, we also introduced our social support network tie in the model, capturing to what extent people who have a social support relation are also more likely to share information with each other.

The third dimension covers the more politically-oriented factors. First, we mapped the respondents' political party preferences by asking respondents whether they felt close to a particular political party. Due to the political dominance of the National Resistance Movement (NRM) (75% indicated to feel close to the NRM) as compared to other political parties, we recoded the data as a preference for the dominant political party (*yes = feels close to NRM*) or not *(= feels close to other political parties, does not feel close to any political party or did not want to disclose the political preference*[10]). Based on this variable we introduced in the model a political preference homophily effect (i.e. people that have the same political preference (feeling close or not to NRM) will be more likely to share information). In keeping with the bridging and political efficacy literature discussed in section 2 we also included a receiver effect (i.e. people with an NRM preference will be more (less) likely to receive more information or calls for action).

Along the same lines, a 'political opportunism' variable was introduced, which captures the extent to which the respondent would be inclined to change their vote or other political behavior in exchange for

[10] Given the political sensitivity of the question (particularly during election times), the latter answer category was interpreted as an indication of not having an NRM preference. In countries with restricted political freedom, such as Uganda (Freedom house 2016), there is a real risk of socially desirable answering when probing into political preference. In this case, socially desirable answering would likely result in an overestimation of preference for the NRM ruling party. The 2016 election results highlight that in Bushenyi district 68.7% of the voters support NRM (Electoral Commission 2016). As voters in rural settings (such as our study village) tend to vote more for the incumbent (Harding 2012), the upward bias in our estimate (75%) is likely to be minimal.

material benefits (e.g. better access to services, employment, financial resources, ...). The political opportunism attitude is measured on a four point scale, ranging from 'would never do this' (score= 1) to 'certainly would do this' (score= 4)[11], with about 58% of the respondents stating they would never do this, while 25.4% said they certainly would (average=2; median= 1). In our model, we incorporate receiver effects to check whether someone who behaves more as a political opportunist receives more information or is more called upon to remedy water-related problems. As citizens with a higher educational level are also often perceived as being more capable and effective, we also control for a potential receiver effect of education. Descriptive statistics show that in our study village only a minority of the citizens have studied beyond primary education (about 16%). Finally, to check whether the outward/inward orientation of a person matters for receiving information or being contacted, we included the E-I index (receiver effect). Based on the respondents' answers, there are 257 ties of information sharing recorded in total, out of which 236 were to other villagers[12] and only 21 to external actors. Of those 21, 10 ties were to other citizens living outside the village (to 9 different persons) and 11 to duty bearers (4 different duty bearers mostly at parish and sub-county level). The E-I index varies between -1 (all ties are within the village) and +1 (all ties are outside the village), with 100 villagers having only within group ties and only 2 citizens holding more external than internal ties. In combination with an average E-I index of -0.829 we may safely conclude that villagers are strongly oriented towards their own community.

Fourth, in line with the literature review, we also introduced sender effects related to variables which have previously been discussed (gender, age, education, E-I index) to take into account the potential effects of personal characteristics of the person sharing the information and demanding action.

Findings

The first section describes the most important structural network features of the information sharing and the demand-for-action network. As it is likely that social support relations among citizens also influence the information sharing and demand-for-action network, we also map the social support network. We subsequently analyse what factors explain whether or not citizens share information with each other about water services and whether those factors similarly feed into the action calls.

Describing the networks

The social support, information sharing and demand-for-action networks are displayed in Figures 2a, 2b and 2c respectively, while Table 4 summarizes the most important descriptive network measures. From the graphs differences between the networks become immediately apparent. All networks have 126 nodes (villagers) but, whereas the social support network has very few isolates[13] (N=6), the information sharing network already has some more citizens left out of the network (N=13) while in the demand-for-

[11] Would never do this (=1), would probably not do this (=2), would probably do this (=3), would certainly do this (=4).
[12] This also includes people who are not in the original population (citizens younger than 25).
[13] An isolate is a node which is not connected to any other node from the network.

action network most of the citizens are isolates (N=81). This implies that those citizens never approached anyone from the village to improve water-related problems, nor did anyone else from the village contact them to exert influence in this respect. Two citizens are isolated from all three networks; however, they do have ties to people outside the village.

Figures 2 : Graphic presentation of the (a) Social support network (b) Information sharing network (c) demand-for-action network (without isolates)

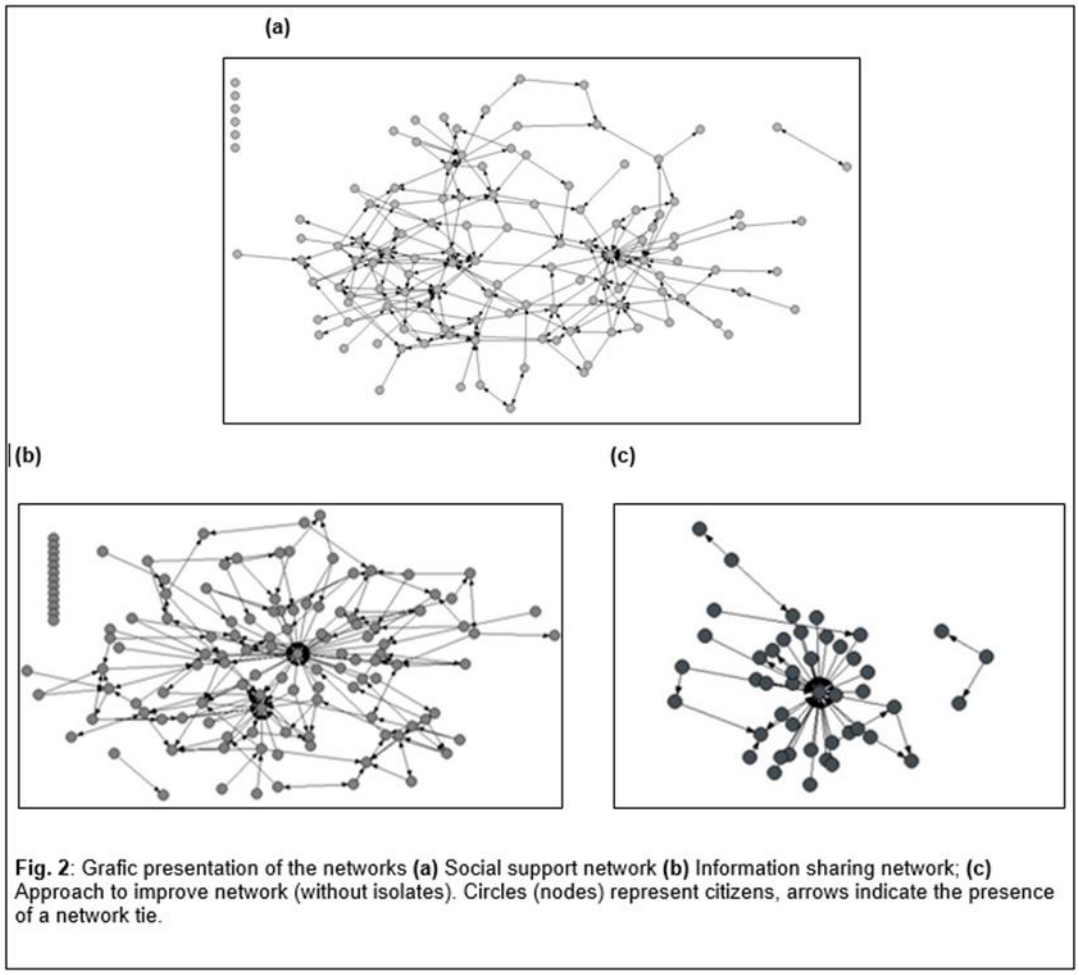


Fig. 2: Grafic presentation of the networks **(a)** Social support network **(b)** Information sharing network; **(c)** Approach to improve network (without isolates). Circles (nodes) represent citizens, arrows indicate the presence of a network tie.

The three network ties are significantly and positively related[14] to each other. While the highest overlap is between the information sharing and demand-for-action networks, significant differences also remain. First, while the social support network and the information sharing network are relatively dense (respectively 14% and 13% of all possible ties actually exist), the demand-for-action network is much more

[14] QAP correlations (5000 permutations): Pearson correlation coefficient demand for action-share info =0.222 (p=0.000); share info - social support = 0.126 (p =0.000); demand for action – social support = 0.098 (p =0.000).

sparsely connected (only 3%)[15]. The results show that citizens have on average fewer ties (0.397) related to demand for action than those based on social support ties (1.778) and information sharing (1.635).

Table 4: Network measures of the three networks

Type of tie	Size (*N isolates*)	Density	Avg Degree	Out-degree Centralization *(without isolates)*	In-degree Centralization *(without isolates)*
Social support	126 (6)	0.014	1.778	0.034 (*0.035*)	0.131 (*0.137*)
Information sharing	126 (13)	0.013	1.635	0.027 (*0.029)*	0.317 (*0.353*)
Demand for action	126 (81)	0.003	0.397	0.013 (*0.021)*	0.279 (*0.754*)

Second, the centralization indices clearly differ among the three ties while differences between in-degree and out-degree centralization indices of the information sharing and the demand-for-action networks are even more pronounced. The in-degree centralization index, i.e. the extent to which some nodes receive most of the information, is high for both the information sharing (0.317) and demand-for-action network (0.279). This indicates that a limited number of individuals receive most of the information or demands for action. Disregarding isolates leads to a particularly high score for the in-degree centralization of the demand-for-action network (0.754), which illustrates that few nodes are contacted while all others call almost exclusively upon these few nodes. The social support network, on the other hand, is far less centralized than the other networks (0.137), meaning that not all citizens lean upon the same few people for social support.

The out-degree centralization index for all three networks is close to zero, indicating that not only a happy few but quite a number of citizens seem to invest in social support ties and information sharing while also trying to exert influence upon other citizens to remedy water related problems.

Who is sharing information? And why?

[15] Using UCINET bootstrap paired sample t-test (5000 subsamples), we tested for statistically significant differences between density of the information sharing and demand-for-action network and between the latter and the social support networks. In both cases, differences are statistically significant at p=0.0002.

An overview of LRQAP regression results[16] is provided in Table 5, which reports the coefficients for each independent variable, their odd ratios and their significance level. Models I to IV[17] first tested the influence of each of the dimensions (i.e. water related factors, social aspects, political aspects and personal attributes of the sender) separately. From these analyses, statistically significant factors were selected and included in a combined fifth model. In line with Borgatti et al. (2013) our discussion mainly focuses on the comparative magnitude of those coefficients, which are significant, rather than the proportion of the total variance explained by the model.

First, comparing among the different separate regression models highlights the fact that the social aspects are particularly important in explaining information sharing. Second, as regards water-related factors, our findings indicate that having gone without clean water increases the odds of sharing water-related information with others. Other factors, such as distance to a water source or perceiving water quality as problematic, were not found to significantly increase the propensity to share information. Being a member of the WUC does not lead to sending or receiving more water-related information, which is counter to what is expected in principle, but in line with evidence from our own household survey and village-level stories about the virtual non-existence of the village water committee.

Conversely, an important significant contribution to explaining information sharing is whether or not citizens use the same water source. More specifically, citizens who use the same water source are almost two times as likely to share information as compared to those who do not use a similar source. This is to a large extent related to the fact that citizens using the same water source are confronted with similar problems of water accessibility and quality, while there might also be a social dimension underneath, since fetching water is a daily activity which is often done by women in a group. The latter is also related to the large effect of gender homophily, which highlights that people of the same sex are 2.2 times more likely to share water-related information. This does not entirely come as a surprise as water provision remains to a large extent a gendered activity, with women fetching water for daily household activities by walking, while men in the village often use bicycles and are more involved in water provision for irrigation.

The importance of being similar for information sharing is also visible from the effect of homophily in terms of religion and age. The larger the age difference between citizens the less likely information sharing becomes. Additionally, older people are more likely to be sent information, which might to some extent relate to their higher social status in the village. However, of all socially related factors, the effect

[16] LRQAP is not frequently used in empirical social network analyses. As Borgatti et al. (2013) state, even though the dependent variable, i.e. information sharing ties (0/1), is binary, the multiple regression QAP (MRQAP) procedure is sometimes used because (unlike OLS) the QAP procedure is based on permutations. Borgatti et al. (2013) indicate that p-values generated for binary dependent variables through MRQAP are valid and interpretable. However, the interpretation of the coefficients is not based on odds, for which they refer to LRQAP (Borgatti et al. 2013). In this paper we present the results of the LRQAP and add findings from the MRQAP in footnotes which allows checking for the robustness of our findings using both procedures.

[17] The `full' model (last column Table 5) using the MRQAP procedure yields an R^2 =0.03413 significant at level p=0.001. The same variables are found to be significant as in LRQAP, except for the E-I index of the receiver.

of having a social support relation is most pronounced: the odds of sharing information increases by a factor of 8.8 if there is a social support tie present.

In contrast to social factors, politically-related dimensions seem to be somewhat less important in explaining information sharing among citizens. A factor which is, somewhat to our surprise, statistically significant is the political opportunism of the receiver, which decreases the propensity of information being shared. In other words, citizens are less inclined to share information with people who are more willing to trade political action for personal benefits. Moreover, the combined model shows that with each additional increase in the education level of the receiver, the likelihood of information being shared with him/her increases by about 55%. Finally, the results for the E-I index are somewhat counter to what is found in the literature. While most of the literature indicates that outward orientation (more external ties than internal ties) is beneficial for information sharing, our findings demonstrate that in our study village citizens who are more outward oriented are less likely to receive info. While descriptive statistics in Table 3 already highlighted that very few people in the village have more external than internal ties, LRQAP results further complete the picture in that those villagers are also not more likely to receive information that could be passed on to the 'outside world'.

Finally, among the personal characteristics, only the level of education of the sender and his/her E-I index influences the propensity to share information. The negative coefficient of the latter is somewhat worrying as it implies that villagers with a more outward orientation are less likely to share information, thereby limiting access to the information and knowledge regarding water-related problems they have learned through their contacts outside the village for the majority of the villagers without such contacts. The positive sender effect for education corroborates the idea that higher educated people are more likely to share information as they understand the benefits of information sharing more easily while it might also be less costly for them to share information. Given the overall low education levels (about 60% did not attend/finish primary school), there could be a (perceived) threshold for sharing information due to low self-esteem regarding one's own 'observation' and 'reporting' skills. However, the receiver effect of education on the propensity to share information is larger than the sender effect, meaning that education is a more influential factor in determining who receives info, than who shares information. It is also worth noting that (in contrast to a gender homophily effect), there is no gender sender effect, i.e. that women are not less or more likely to share information than men.

Table 5: LR QAP regression results for information sharing network

		Water				Social				Political				Personal				COMBINED MODEL			
		Coef	Odds R	T	Sig	Coef	Odds R	T	Sig	Coef	Odds R	T	Sig	Coef	Odds R	T	Sig	Coef	Odds R	T	Sig
	Intercept	-4.871	0.008	-18.87		-7.129	0.001	-11.14		-5.885	0.003	-11.78		-6.005	0.002	-9.413		-13.4	0	-15.42	
water	Time to fetch water	0.003	1.003	1.112	0.111																
	Low water quality	-0.039	0.961	-0.243	0.393																
	Gone without enough clean	0,045	1,046	1,074	0,124													0.08	**1.084**	1.887	0.018
	Member of water user	-0.008	0.992	-0.05	0.462																
	Member of water user	-0.157	0.855	-0.805	0.449																
	Which water source do you	0.861	**2.365**	5.648	0.001													0.887	**2.428**	5.27	0.001
social	Gender (homophily)					0.648	**1.912**	3.467	0.001									0.884	**2.419**	4.971	0.001
	Ethnic identity (homophily)					0.243	1.275	0.569	0.421												
	Religion (homophily)					0,426	1,531	2,329	0,098									0.421	1.523	2.467	0.059
	Age (receiver)					0.044	**1.045**	5.65	0.021									0.079	**1.082**	10.372	0.001
	Age (homophily absolute					-0,043	**0.958**	-4,256	0,001									-0.043	**0.958**	-4.691	0.001
	Member of CBO (sender)					0.129	1.138	0.565	0.276												
	Member of CBO					0.391	1.478	1.897	0.116									0.38	1.462	2.19	0.07
	Social support					2.178	**8.829**	8.898	0.001									1.79	**5.992**	7.139	0.001
political	Preference for dominant									-0.159	0.853	-0.627	0.282								
	Preference for dominant									-0.084	0.919	-0.418	0.329								
	Political opportunism									-0,346	**0.707**	-4,235	0,038					-0.368	**0.692**	-4.372	0.04
	Education (receiver)									0.258	1.294	4.772	0.058					0.436	**1.547**	8.293	0.007
	E-I index (receiver)									-1.486	**0.226**	-3.556	0.016					-1.868	**0.154**	-3.9	0.011
personal	Gender (sender)													0.044	1.045	0.27	0.396				
	Age (sender)													0.007	1.007	0.963	0.15				
	Education (sender)													0.078	**1.082**	1.337	0.061	0.139	**1.15**	2.52	0.004
	E-I index sender													-1.184	0.306	-3.582	0.001	-1.453	**0.234**	-4.032	0.001
R^2		R^2= 0.003 (0.19)				R^2= 0.018 (0.131)				R^2= 0.001 (0.149)				R^2= 0.001 (0.342)				R^2 =0.059 (p = 0.08)			

And what is the difference with demand for action?

In Table 6 using the same combined model to explain demand for action allows us to tease out similarities and differences between factors that are important for understanding information sharing and/or demand for action. The only difference between both models is that in order to study the latter we also introduced information sharing as a tie to represent part of social reality.

First, what is particularly striking and somewhat alarming, is that citizens who frequently go without clean water are more likely to share information but are less likely to approach someone to solve water-related problems. The difference is indicative for thresholds between merely sharing information and the more action oriented contacting of other citizens. It suggests that citizens who are more in need tend to share more information regarding water-related problems while not being able to mobilize these ties when it comes to the more challenging step of approaching someone to improve the situation. Our findings are in line with much of the political participation literature in which poorer people are often found to participate less in various types of political-oriented activities (such as voting, demonstration, strikes, etc.) (Verba et al. 1995).

Another interesting observation is that for the demand-for-action network, the homophily mechanism does not similarly structure interactions as was the case for information sharing. The effect of exchanging more information with those who are similar in terms of age, gender and religion profile as well as going to the same water source completely disappears. Put differently, whereas information sharing often involves people who are similar, when one tries to exert influence, being similar to him/herself is not really a decisive factor.

The most important predictors of the demand-for-action network are the existence of a social support relation and an information sharing tie, which underscores the importance of multiplexity. The effect of the social support relation is smaller than for information sharing, but still very sizeable, with people having a social support relation more than four times more likely to call upon each other for action. Having an information sharing relation increases the odds of approaching them to improve water related issues 8.36 times. These strong multiplex effects which are typical of rural communities where mobility is often lower (Verbrugghe 1979), lend support to the idea that citizens who have ties in some dimensions are likely to mobilize these for other relations (Silvey and Elmhirst 2003).

Political factors do not seem to matter much when contacting citizens to remedy water related problems. The ‘clean hands’ effect of being more likely to share information only with the politically virtuous citizens has disappeared (as political opportunism is no longer statistically significant) while also the inward-oriented bias (E-I index) of the sharing information model has been balanced out. Conversely, the education effects (both sender and receiver effects) have become more prominent with the receiver effect of education still being more outspoken than the sender effect. More specifically, a one level increase in education level increases the likelihood of being called upon for action almost three times, while it only increases the likelihood of contacting someone by 30%.

Table 6: QAP regression results for information sharing and demand-for-action networks

		Share info				Demand for action			
		Coef.	Odds Ratio	T	Sig.	Coef.	Odds Ratio	T	Sig.
	Intercept	-13.395	0	-15.416		-15.171	0	-7.739	
water	Gone without enough clean water	0.08	**1.084**	1.887	0.018	-0.153	**0.858**	-1,692	0,043
	Which water source do you use (homophily)	0.887	**2.428**	5.27	0.001	0.446	1.561	0.886	0.33
social	Gender (homophily)	0.884	**2.419**	4.971	0.001	0.413	1.511	1.089	0.234
	Religion (homophily)	0.421	1.523	2.467	0.059	-1.081	0.339	-2.636	0.204
	Age (receiver)	0.079	**1.082**	10.372	0.001	0.115	1.122	5.288	0.091
	Age (homophily absolute difference)	-0.043	**0.958**	-4.691	0.001	-0.036	0.965	-1.674	0.208
	Member of CBO	0.38	1.462	2.19	0.07				
	Information sharing					2.124	**8.365**	5.09	0.001
	Social support	1.79	**5.992**	7.139	0.001	1.455	**4.284**	2.647	0.01
political	Political opportunism	-0.368	**0.692**	-4.372	0.04	-0.676	0.509	-1.563	0.518
	Education (receiver)	0.436	**1.547**	8.293	0.007	1.047	**2.849**	7.405	0.032
	E-I index (receiver)	-1.868	**0.154**	-3.9	0.011	-0.104	0.901	-0.118	0.761
personal	Education (sender)	0.139	**1.15**	2.52	0.004	0.264	**1.303**	2.109	0.024
	E-I index sender	-1.453	**0.234**	-4.032	0.001	-0.503	0.605	-0.874	0.17
		R^2 =0.059 (p = 0.08)				R^2 = 0.24[18] (p= 0.08)			

(N permutations=1000), significant effects (p <0.05) are shown in bold

Discussion and conclusion

While Uganda has made significant progress in broadening access to safe water, serious drawbacks remain throughout the country. Like many other villages, citizens in our study village face challenges in accessing clean water, with fetching water taking approximately 53 minutes for a round trip. This involves time which is not spent on other productive activities, leisure and education when children are involved in fetching water. Our survey also highlights that safety is often jeopardized, particularly when collecting water takes place in the dark at far-away water points. Similar to many other Ugandan villages, citizens in our study village are also confronted with low water quality and seasonal variation in water availability; they go without clean water about half of the time. It should thus not come as a surprise that water remains one of the key priorities for many Ugandans.

In line with the international prominence of the community management model, Uganda's water policy has been propagating community participation in water provision, operation and maintenance. Built on the premise that local community involvement and integration of local level information and knowledge

[18] The full model for the demand for action ties (second column Table 6) using the MRQAP procedure yields an R^2 = 0.07894 significant at level p=0.001. All variables found significant in the LRQAP model are significant (and same direction) in the MRQAP model.

would foster bottom-up accountability and solve the information asymmetry problem, water community organisations and committees have been established. On the ground, however, many of these associations have proved dysfunctional (Golooba-Mutebi 2012; Terry et al. 2015), as in our study village where only three villagers report that they are a member/leader of the association. This all feeds into citizens expressing strong discontent with the way policy makers are handling water services.

Against this backdrop, this article explores whether citizens themselves address the water problems they are confronted with and if so, what social mechanisms drive those actions. We differentiate between two social network ties related to water services, namely information sharing about water-related issues and actively approaching someone to improve a particular water-related problem. As discussed in Andersson and van Laerhoven (2013), it is particularly the latter, more active use of information that is likely to generate an impact.

First, we compared the overall network structure of the information sharing and demand-for-action networks to the social fabric baseline network of the village, i.e. the social support network. We found that while information sharing, like the social support network, was still relatively inclusive with few isolates, the demand-for-action network was significantly more sparse. Unlike the social support network, we found both the information receiving (incoming ties) and demand-for-action network (incoming ties) to be highly centralized. The centralization of the demand-for-action network was even more pronounced. Although many villagers are sharing information, much of the information, and especially citizens' requests for something to be done about it, reaches relatively few people.

Using LRQAP, the descriptive network analysis was complemented with a more in-depth analysis of the mechanisms driving information sharing and demand for action. Drawing upon different strands of literature and insights from our exploratory field study, we differentiated among four dimensions in the explanatory models, including factors related to the water, social, political realities and personal characteristics. While both ties have various influential factors in common, concurrently, there are also different mechanisms at play. Information sharing seems to build heavily on the homophily mechanism, with citizens of similar gender, age and religion being – ceteris paribus – more likely to share information amongst each other. However, that homophily effect is absent when villagers demand action. The fact that homophily plays out differently for the two different types of ties is in line with the earlier documented difference between 'getting by' and 'getting better/ahead', with the first one relying more on ties with similar others whereas taking action rather necessitates more heterogeneous contacts. The differential effect of urgency further complements the picture with individuals who are more affected by water problems sharing more information, but failing to mobilize these ties to demand for action to remedy the problems. While we have no evidence on the exact reasons behind this, it may hint at coping and survival (getting by) being in the short run the only option for the most vulnerable, leaving little room and energy to exert influence for change.

Counter to our expectations, citizens' outward orientation seems to discourage information sharing rather than the opposite. The latter is actually a missed opportunity, as information sharing with outsiders could bring in new information and knowledge which could potentially benefit many citizens within the village who lack ties to outsiders.

In both networks the baseline social support network is a crucial predictor for information sharing as well as for calls for action, although to a lesser extent. The emergence of multiplexity is consistent with earlier findings hinting at the fact that citizens who have ties in one dimension are likely to mobilize these for other relations (Silvey and Elmhirst 2003). However, particularly those who are most in need fail to draw upon their social support and information sharing ties to get ahead.

Similarly, education plays an important role both for sending and receiving information and for calls for action. The skewing effect is not unimportant in a village where education beyond primary school level is a relatively scarce commodity. The biggest difference between merely sharing information and calling for action is found in the positive effects of higher education profiles and the negative effect of urgency, with those lacking access to clean water being less likely to actively seek support. It is thus not only important to look at who is not talking, but also who is talking but not calling for action.

Our article contributes to the emerging stream of environmental management literature that draws upon social network measures to sharpen our understanding of local social realities, something which is increasingly acknowledged to be vitally important in the search for more equitable and sustainable management of natural resources. Our analysis takes it one step further by combining social network analysis with Logistic Regression Quadratic Assignment Procedure (LRQAP), which allows us to unpack the social mechanisms underlying social network ties and to explore what effect they have on the type of information exchange and demand for action that will materialize.

Our findings are not only theoretically interesting but also policy relevant. While community based organization of water supply is built upon laudable principles, its blueprint translation in the format of water user committees does not necessarily work as it tends to disregard existing local realities. In keeping with institutional economics literature (North, 1990), starting from what locally exists seems to be the only way forward. In fine-tuning such interventions, social network analysis may become an important diagnosis and needs assessment tool as it allows in-depth insights into key features of networks and their driving forces.

In the specific case of the village under study the major strength is the existence of a broad network of citizens sharing information (flat outdegree centralization) with a few central key individuals (high indegree centralization). This should, at least in theory, foster efficient bottom up flows of information. On the downside, however, while biases in information sharing are already pronounced in whose information is likely to be shared, biases in who calls for action are even more pronounced and so simply relying upon existing demands for action is not the ideal recipe as it may reinforce existing inequalities rather than reduce them. The village network is also characterized by strong homophily tendencies in information sharing (same gender, same water source, same age) combined with a very inward oriented village social network (bonding but NOT bridging), largely depriving citizens in this village from new 'outside' information. Additionally, the efficient bottom up information flow is not matched by a similar reverse feedback information stream, while the education receiver effect hints at the fact that the less educated will receive less water-related information. This combination of limited feedback from the central actors, and few alternative entry points of 'new' information suggests little uptake of water-related information. In the current era of experiments with various types of community backstopping

and external support services, our findings underscore the importance of investing in additional feedback mechanisms to remedy for flawed feedback loops and correct for possible exclusionary effects of bottom up information flows.

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