www.water-alternatives.org Volume 10 | Issue 2

McNicholl, D.; McRobie, A. and Cruickshank, H. 2017. Characteristics of stakeholder networks supporting local government performance improvements in rural water supply: Cases from Ghana, Malawi, and Bolivia. Water Alternatives 10(2): 541-561

Characteristics of Stakeholder Networks Supporting Local Government Performance Improvements in Rural Water Supply: Cases from Ghana, Malawi, and Bolivia

Duncan McNicholl

Cambridge University, Department of Engineering, Cambridge, UK; drm60@cam.ac.uk

Allan McRobie

Cambridge University, Department of Engineering, Cambridge, UK; fam@eng.cam.ac.uk

Heather Cruickshank

Independent Consultant; hjcruickshank@gmail.com

ABSTRACT: A study of local governments in Ghana, Malawi, and Bolivia applies social network analysis to identify characteristics of stakeholder networks supporting performance improvements in these institutions. Seven local governments that have demonstrated performance improvements are studied. Network analysis is combined with qualitative analysis of a commentary from primary interviews with stakeholders in these networks to identify characteristics that are observable from a network perspective and perceived as important by stakeholders active in these networks. Three network characteristics are identified in multiple cases as supporting improvements in local government performance. The first network characteristic is multiple information and skill ties between a local government and other local stakeholders including communities and operators. The second network characteristic is strong information and skill ties between a local government and higher levels of sector hierarchy. The third characteristic is coordination between stakeholders at higher levels of sector hierarchy that have strong information and skill ties with a local government. Strong information and skill ties between these support providers can help them to coordinate their efforts to collaboratively support local governments. These three characteristics can be used to analyse other stakeholder networks around local governments to identify where certain relationships that might support institutional development are missing.

KEYWORDS: Social network analysis, local government, institutional development, rural water supply

INTRODUCTION

Institutional development will be an important complement to infrastructure development if the Sustainable Development Goal of universal access to safe water is to be achieved by 2030. Infrastructure is critically important for access to safe water, but sustainability challenges have been a barrier to progress (Carter et al., 1999). In sub-Saharan Africa alone between USD1.2-1.5 billion of investment in water infrastructure is estimated to have been lost over the past 20 years due to breakdowns in infrastructure (Narkevic et al., 2009). Recognition of these sustainability challenges highlights the importance of the institutions such as governments that manage aspects of water services in the long run. Institutions, including local governments, have an essential role to play in achieving universal access to safe water (Walters and Javernick-Will, 2015).

Supporting institutional development in the water sector is therefore a pertinent challenge (Easter and McCann, 2010), and local governments are an important piece because of their permanent mandate in service delivery. Although they do not necessarily manage services directly, they often play important indirect service support roles by providing technical backstopping to operators, regulatory work, and monitoring of services (Lockwood and Smits, 2011). There is a need to understand how to support the development of these local governments so that they can effectively play their role in sustaining long-term service delivery.

Institutional development is challenging, however, because one size does not fit all cases. Institutional roles and structures are strongly influenced by context, and an approach that works in one place might not work elsewhere. The highly contextual nature of institutional development means that prescriptive approaches attempting to create an idealised type of institution are unlikely to succeed (Merrey and Cook, 2012). These idealised designs, often Western in origin, are sometimes adopted by foreign institutions, but research has shown that these institutions may superficially adopt certain reforms to appease donors without achieving the intended function (Andrews et al., 2012). Simply put, institutions cannot be engineered in the way that infrastructure can.

There is therefore a need to understand conditions that support institutional development from the perspective of an enabling environment that supports positive change. This understanding needs to account for the diversity of roles and relationships between organisations and other stakeholders that influence water management (Moss et al., 2009). Institutional development might therefore be considered as an evolutionary process shaped by many factors (Ostrom, 2014). A deeper understanding of conditions that support institutional development could help to identify where certain factors that can support institutional development are missing around particular institutions.

In particular, an investigation of conditions supporting institutional development needs to account for complex environments of stakeholder relationships (Moss et al., 2009). Many relationships can exist simultaneously, and understanding of how institutions exist within broader power dynamics and institutional structures is underdeveloped in water sectors (Whaley and Cleaver, 2017). Because of this, there exists a need for approaches that can rigorously, yet practically, examine the many simultaneous relationships that institutions have.

Social network analysis, with its explicit focus on relationships between actors, has potential to respond to this need. Furthermore, the numerical properties of networks allow some quantitative investigation of social structures (Scott, 2013). Emerging research is beginning to explore this potential in water sectors (see Stein et al., 2011; Navarro-Navarro et al., 2017), but the specific application of social network analysis to understand relationships influencing institutional development is new. With some adaptation of methods and analysis, it is possible that social network analysis might provide insight into factors supporting institutional development by quantitatively describing characteristics of the networks interacting with institutions.

This research explores the potential of social network analysis for identifying characteristics of stakeholder networks that support institutional development in local governments for rural water supply. The study focuses on three countries, Ghana, Malawi, and Bolivia, where specific district governments have demonstrated performance improvements, to answer two questions: what characteristics of stakeholder networks do these local governments have in common; and which network characteristics are perceived by stakeholders in these networks as important for supporting institutional development?

The intended research output is the identification of specific characteristics supporting institutional development in local governments. These findings could inform what to look for from a network perspective when doing similar studies elsewhere, and specifically help to identify where certain network characteristics are missing that might be introduced into networks around institutions to better support performance improvements.

BACKGROUND

Specific cases of local governments that are improving performance are the focus of this research. These case studies were recommended by international organisations that had been monitoring the performance of these local governments over the 3-5 years prior to the time of fieldwork, and were able to provide documentation on how these local governments were developing. Indicators of performance improvement are slightly different for each country because of the different institutional contexts, but all case study local governments show improvements.

Case studies in multiple countries are included to investigate how similar characteristics of stakeholder networks around cases of institutional development might be observed in different contexts. Although the specific types of performance improvements differ depending on the country, patterns might exist in the types of relationships that support positive institutional change. Specific case studies include two local governments in Ghana, two local governments in Malawi, and three rural municipalities in Bolivia.

Ghana

Instances of institutional improvement have been recently documented in certain Ghanaian local governments (District Assemblies) during the Sustainable Services at Scale (Triple-S) initiative, which ran from 2009 to 2014. This initiative, led by The International Water and Sanitation Centre (IRC), and funded by the Bill and Melinda Gates Foundation, supported improvements in rural water supply through learning and piloting new approaches for service delivery (IRC, 2010). Their initiative and associated monitoring provided the basis for selecting Ghana as a case study country.

This research focuses on two district governments involved in the project: Akatsi, and East Gonja (Adank et al., 2013). Tracking of progress included monitoring of these local governments for improvement in their roles as service delivery authorities, and both of these showed improvements as monitored by the Triple-S project (Hydroconseil and Trémolet Consulting, 2015). These successful cases provide the basis for research into the two local governments and the networks surrounding them.

The two districts selected represent different regions, cultures, and distances from the capital. Monitoring of service delivery authorities in these districts was conducted during the Triple-S initiative from 2012 to 2014, and monitoring data have been generously provided by the managing organisation, IRC. These indicators assess the performance of local governments in their roles as institutions for managing aspects of rural water service delivery in their jurisdictions. Each district was assessed annually on six indicators (IRC, 2011):

1. There is a well-resourced District Water and Sanitation Team (DWST), consisting of three well-qualified and experienced staff members, receiving the needed support by the Regional Government Community Water and Sanitation Agency, and District Assemblies.
2. There are efficient monitoring and data flows.
3. The District Water and Sanitation Plan is incorporated into medium-term development plans and budget of the assembly, which is used to guide implementation.
4. The DWST monitors operation and maintenance (O&M) of water facilities in terms of financial, technical and administrative performance, including periodic audits, and provides support where needed.
5. By-laws for the Water and Sanitation Committees and Water and Sanitation Development Boards exist and are enforced effectively.
6. NGOs and CSOs providing water facilities do so in coordination with the District Assemblies.

East Gonja District, located in Ghana's Northern Region is home to a population of approximately 200,000. Most of this population is rural, and agriculture is the chief economic activity (Adank et al.,

2013). East Gonja District Assembly demonstrated improvements in budget allocation and utilisation and in its ability to coordinate NGOs between 2012 and 2014.

Akatsi District, located in Ghana's Volta Region, technically split into two districts midway through the Triple-S initiative, and the project continued assessing both. This research focused on where the main district office resided previously: now Akatsi South. This section of the former district includes the district capital of the same name, Akatsi. Akatsi District Assembly demonstrated performance improvements in the coordination of NGOs and the development of by-laws between 2012 and 2014.

Malawi

Two local governments, Mangochi District Council and Rumphi District Council, were identified in Malawi where performance improvements have been documented between 2012 and 2015. The two districts were identified with the assistance of organisations working with these district governments that have generously provided documentation from their evaluations.

Mangochi is in Malawi's Southern Region, and forms the lower end of Lake Malawi. The national census from 2008 estimated the population at nearly 800,000 and this figure may be approaching 1,000,000 at the time of writing (Mkamanga, 2014). Most of this population are rural. The local economy is largely agricultural, combined with fishing in Lake Malawi and other water sources.

Mangochi District is the sole focus area for the Icelandic International Development Agency (ICEIDA). The ICEIDA programme focuses on health, education, and Water, Sanitation, and Hygiene (WASH) sectors through a multi-year programme that began in 2012. This programme prioritises working through government systems to implement projects, and is based on a tripartite agreement between ICEIDA, Mangochi District Council, and the Ministry of Local Government and Rural Development (Mkamanga, 2014).

The successful management of this programme by Mangochi District Council, particularly in the WASH sector, demonstrates a growing level of capability. The water and sanitation budget for the first two quarters of 2014 showed a 99.6% disbursement of a USD530,203 budget for activities including infrastructure development, as well as increased human resources to strengthen systems for WASH service delivery (Mkamanga, 2014). The successful uptake of the WASH programme provides evidence contrary to a widely held belief amongst donors in the Malawi WASH that Districts do not have management capacity. The experience of the ICEIDA programme suggests otherwise: that local governments can develop their management capacities when given the opportunity. The programme evaluation report finds successful implementation of planned activities (Mkamanga, 2014).

Rumphi District Council is the second case study district. Situated in Northern Malawi, Rumphi is a geographically diverse district that ranges from 400 m in elevation along the northern shore of Lake Malawi, to the highlands of the Nyika Plateau National Park at 2400 m. The 2010 projected population was approximately 175,000. In terms of water access, as of 2010, only 45% of the population was estimated to have access to improved drinking water sources (Rumphi District Council, 2010).

Rumphi District Council was highlighted by WaterAid as an excellent example of a local government strengthening its role as a service authority. WaterAid's engagement with Rumphi District Council does not focus on large financial flows for service implementation, but instead focuses on facilitating dialogue and citizens' engagement to strengthen service delivery arrangements. WaterAid Malawi has generously provided their evaluation reports on their work with Rumphi District Council, which form the basis of its inclusion as a case study. Specifically, the evaluation finds that Rumphi District Council is updating its waterpoint mapping database, updating its District Sector Investment Plan, ensuring that NGO activities align with District priorities, and hosting learning forums and quarterly meetings (Papermate Consulting, 2015).

This success has not gone unnoticed by other stakeholders. Rumphi was mentioned to the researchers by others in Malawi as a good example of local government capacity development, and

there are indications that Rumphi's effectiveness has influenced the decision of the African Development Bank to plan its next project phase to include the district. Other District Councils are now becoming interested in learning best practices from Rumphi (Papermate Consulting, 2015).

Bolivia

The final case study provides a perspective from Latin America. Several municipal governments in the Department of Cochabamba, Bolivia, have developed management units, including hiring specific technical staff, to strengthen their support for local operators and communities. The international NGO, Water for People (WfP) identified the suitability of this case study as one of the best examples of institutional development for service delivery it has observed in its work across nine countries in Latin America.

The Bolivian government is committed to improving access to rural water. President Evo Morales aspired to achieving complete access to safe water across Bolivia by 2020, but this commitment was later downgraded to complete coverage across four departments to match technical and financial capacities of the government (Cambio, 2016). Nevertheless, the political will towards improving access to water remains strong in Bolivia.

In the area of the case study, water supply is managed in rural areas through community operators called CAPyS (*Comité para Agua Potable y Saneamiento*). Municipal governments liaise with these local operators to provide technical support and coordinate new infrastructure investments. Those hierarchically above the municipalities are department officials based in regional capitals. Above them are officials of the ministries at the national level.

Three municipalities that are improving their capacity for supporting water service delivery are studied. These are all in the Department of Cochabamba and contain populations of approximately 30,000. The three municipalities are Villa Rivero, Arani, and Tiraque. All of these case study municipalities have developed management units for responding to water supply issues in their jurisdictions in the recent past, including hiring new staff. These teams are called DMSBs (*Direcciones Municipales de Saneamiento Básico*). This investment in internal capacity represents a clear improvement in each institution's performance in providing support to local communities and operators managing services, and the investment is easily quantified by the financial resources committed to the team from each municipality. All municipalities show an increasing investment in staff and operational expenses of these DMSB teams that directly expand the capacity of the municipalities to perform their service delivery functions (Agua Para el Pueblo Bolivia, 2015).

THEORY

This research studies characteristics of stakeholder networks that support institutional development, specifically in local governments. Although local governments studied do not manage services directly, they play important roles in monitoring services, coordinating activities, and supporting service operators. Local government also has a permanent role in water sectors, making it important even if the specific roles it plays can differ depending on the country.

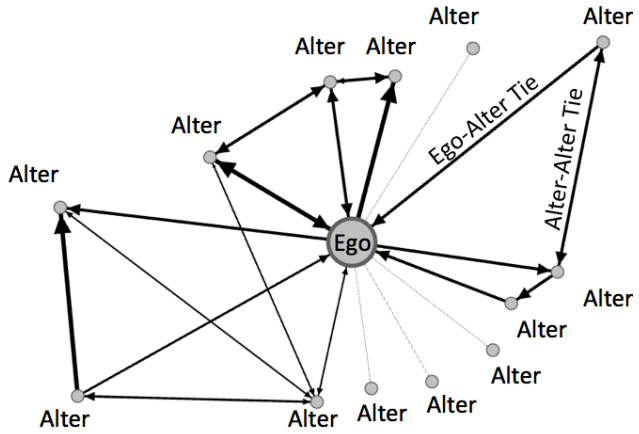
The word 'stakeholder' is a more general term used in this research to describe any organisation, department, or group of individuals that has a vested interest in the rural water service delivery sector. These stakeholders influence or are influenced by outcomes of access to water. Stakeholders include, but are not limited to, NGOs; government departments; private companies; water system operators; bi-lateral or multi-lateral organisations; and civil stakeholders such as communities or water users. Specific stakeholders are identified in this research using a name generator approach during primary interviews, beginning with the case study local governments, allowing interview participants to identify who is relevant to be included in network analysis. This approach is an alternative to conducting interviews

with a pre-specified list of stakeholders, and has been applied in numerous network studies (see Bellotti, 2008; Lubbers et al., 2010).

The networks studied in this research are the relationships between stakeholders and the case study local governments. Networks are made up of 'nodes' – in this case the stakeholders and local governments – that are connected by 'ties' (Scott, 2013). Once data on these relationships are collected, networks can be analysed for quantitative properties.

Specifically, this research applies a network approach called egocentric network analysis (Crossley et al., 2015). The approach is selected because it explicitly considers the network immediately around a node of interest. Applying egocentric network analysis to each case study local government situates it as the 'ego' in the centre of the network, and other stakeholders that it interacts with are called 'alters' (Figure 1).

Figure 1. Ego network example with terms defined.



The ties that define network relationships in this research are derived from a definition of social power. Power is deemed to be the relevant framework for analysis because of the need to identify power dynamics that influence institutional development (Whaley and Cleaver, 2017). The original definition of social power (French and Raven, 1959) is adapted to define four tie types in these networks: information, skills, resources, and authority. Each tie type contains subcategories of different weights for distinguishing between stronger and weaker ties. For example, information ties contain three subcategories that represent progressively stronger ties. The three subcategories, weighted from 1 to 3, respectively, are download, discussion, and dialogue. Each tie is weighted and directional, and multiple tie types can exist in parallel. These ties are used to identify different types of power relationships in stakeholder networks around the case study local governments.

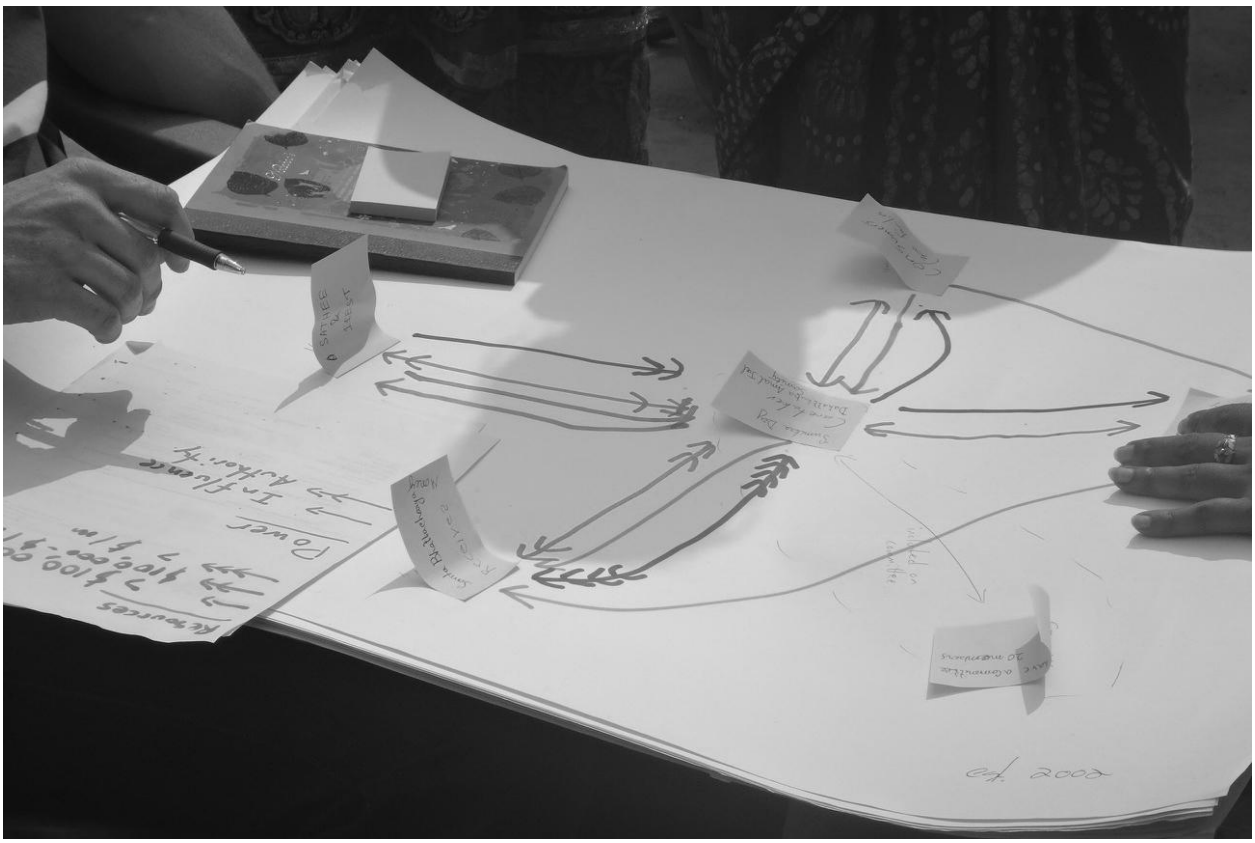
The next theoretical consideration is the source of data. This research employs primary interviews for capturing network data based on the assumption that individual perception is a valid interpretation of reality, and that these perspectives provide the relevant data for this research, as has been the assumption in other studies (see Stein et al., 2011). Conducting in-person interviews with stakeholders individually is designed to allow participants to describe relationships as they are experienced in practice. In this way, participants can share perspectives on reality that may differ from intended institutional structures and power dynamics, and expand on the nuance of particular network relationships. One-on-one interviews provide a space to capture data that might not be officially documented elsewhere.

METHODOLOGY

Individual interviews with stakeholders in each country were the basis of data collection. Each interview included a facilitated network mapping exercise to identify stakeholders and their relationships, followed by participant commentary on network characteristics supporting institutional development. Stakeholders identified during interviews are used to inform whom to follow up with subsequently.

Interviews are inspired by the network mapping approach whereby participants identify stakeholders and draw relationships between the stakeholder that the participant represents and the other stakeholders (Schiffer, 2007). In the first step the name of the stakeholder that the participant represents is written on a post-it note and placed in the centre of a piece of flip chart paper. The participant is then asked to identify who their organisation interacts with in terms of the four tie types. Each stakeholder's name is written on post-it notes and placed in a circle around the edge of the flip chart. The participant next draws arrows to indicate ties between itself and the other names of stakeholders it has identified using coloured markers. Marker colour indicates the tie type, the number of arrowheads indicates the tie strength, and the direction of the arrows indicates if a tie is one-way or two-way. Multiple tie types can exist between the participant and the other stakeholders identified. The result is a drawn network that can easily be converted into data for input into network software (Figure 2).

Figure 2. An egocentric network mapping interview (photo: D. McNicholl).



In the final interview step, participants are asked to describe how network relationships support institutional development. This step is important for capturing qualitative descriptions to know which network characteristics are perceived as significant. Verbal responses from participants are recorded and later coded for analysis. These coded interview quotes are used to verify where multiple

stakeholders commented on similar network characteristics as being important for supporting institutional development.

Stakeholders identified during network mapping interviews then inform whom to contact for subsequent interviews using a snowball sampling method. Interviews begin with case study local governments and expand outwards. These subsequent interviews help to verify data from interviews with the case study local governments, and to capture data on relationships between alters in the local government ego network.

Not every stakeholder identified during interviews is followed up with for a subsequent interview. Criteria for follow-up interviews are included to identify network boundaries and prevent the snowball sampling method from expanding indefinitely. The first boundary groups together multiple stakeholders of identical type, and then one or more specific cases from this stakeholder group are interviewed. For example, it would be impractical to interview every community in a district, but grouping communities together and following up with specific ones can still capture data on network relationships. The second criterion requires the name of a stakeholder to be mentioned in more than one interview before they receive a follow-up interview. Stakeholders at the national level of hierarchy need to be mentioned at least three times because a pilot of methods in Ghana found that national-level stakeholders were otherwise too numerous. After beginning interviews with the case study local governments, and with communities in these jurisdictions, the second boundary criterion ensures that stakeholders only mentioned once do not require a follow-up interview, and therefore the snowball network does not expand indefinitely.

The main ethical responsibility of the research was to ensure that participants could express their views freely during interviews without fear of repercussions. For this reason, participants are anonymous, and the stakeholders shown in network visuals are not named. All participants were presented with a release form that confirmed their willingness to participate in the study, and confirmed that their participation would be anonymous.

Fieldwork was conducted in Ghana from April-May 2015, in Malawi from July-August 2015, and in Bolivia in August 2016. In addition to the case study local governments, 99 other stakeholders were interviewed across the three countries. Table 1 presents a summary of the number of interviews conducted and the number of nodes identified in each country.

Table 1. Number of interviews and network nodes identified by country.

Type of Network Node	Ghana	Malawi	Bolivia
Case study local governments	2	2	3
Others interviewed	41	38	20
Others identified but not interviewed	90	107	65
Total nodes in country case study network	133	147	88

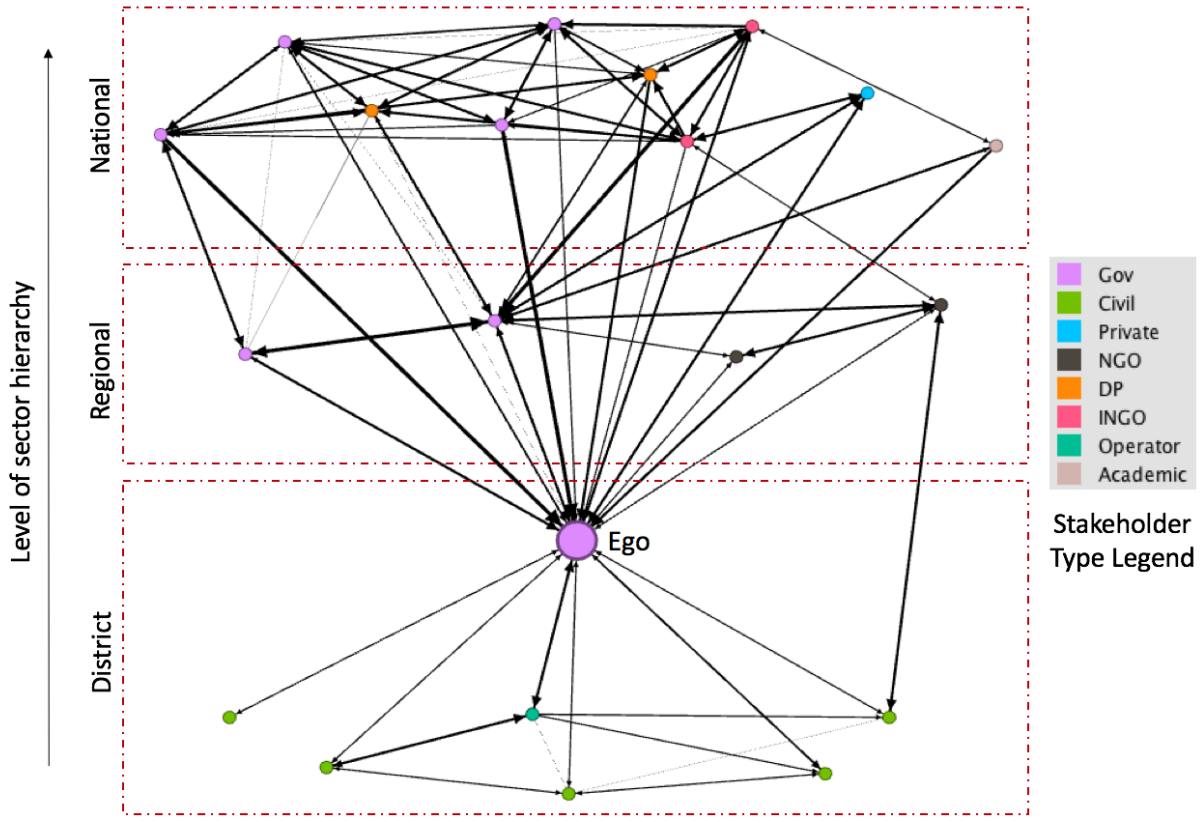
Data from these interviews are combined to produce an ego network around each case study local government for analysis. These networks are visualised using Gephi network software (Bastian et al., 2009), and analysed quantitatively using UCINET (Borgatti et al., 2002). Cases of conflicting tie weights occur where two stakeholders perceive the same relationship differently, and these cases are resolved by taking the average of the tie weight values. The resulting ego network produced therefore shows ties identified by the case study local government, as well as ties identified by other stakeholders interviewed in the ego network.

Network nodes are colour-coded to identify different stakeholder types, and nodes are positioned vertically to indicate level of sector hierarchy. Horizontal node position is random. DP stands for 'Development Partner', including bi-lateral and multi-lateral organisations; NGO stands for 'non-governmental organisation'; and INGO stands for international NGO. Identification of node types is particularly useful for noting whether the case study local government interacts with other stakeholders that are different or similar to itself.

Level of sector hierarchy is also visually represented in **Erreur ! Référence non valide pour un signet.**. All three case study countries have an institutional structure that can be described by the three levels of district, regional, and national. The names in Bolivia differ slightly, and are instead called municipal, department, and national, respectively. Stakeholders are represented on the y-axis the level of sector hierarchy by their jurisdiction and where they are based, and distribution in the x-axis is randomised for visual clarity.

Network data alone are insufficient, however, for understanding the nuance of particular relationships and for identifying influences supporting institutional development. Even seemingly beneficial network properties have been shown to have possible negative effects (Crossley, 2010). Qualitative commentary on the importance of particular relationships is therefore essential for describing the significance of network characteristics.

Figure 3. Ego network of a case study local government in Ghana for all tie types visualised to show levels of sector hierarchy and stakeholder types.



Commentary from stakeholder interviews is compared to identify where different stakeholders independently describe the importance of a similar characteristic in the same part of a network. These methods are inspired by grounded theory (Charmaz, 2006), and adapted to specifically identify

characteristics of stakeholder networks. Qualitative analysis occurs in a three-step manual-coding process. The first step breaks interviews into fragments that are coded according to perceived value (positive/negative/neutral), and identifies the part of the network the comment applies to, if relevant. Macro-economic factors are an example of a commentary that might not relate to network characteristics specifically. The second step confirms that the stakeholder describing a characteristic is able to directly observe this part of the network. This helps to ensure the validity of the observation by requiring the respondent to have first-hand experience with the subject. The third step groups together commentary about similar parts of the network to identify where multiple stakeholders identify a network characteristic as supporting institutional development. The result is a list of verified network characteristics described as supporting institutional development for each case study.

An example from Ghana illustrates this analysis. The first quote is from a case study local government that is describing the support it received from regional government. The language clearly describes a specific part of a network, and identifies this relationship as supportive.

> When it comes to rural water, the [support agency] has the bigger strength. They have the technical know-how, they have the people, they have the institutional structure to be able to deliver water at the rural level. And that kind of understanding is there. And for us, it's working perfectly. And we are doing even better than their colleagues in urban water supply.

A second quote, captured during a separate interview with the regional government stakeholder mentioned, describes this same relationship from their perspective. The quote talks about how, together, they are sharing information to identify opportunities for improvement. The relationship is producing results that the regional government sees as applicable to other district governments.

> With [this district], because the intent of the relationship is to pilot a scaling-up programme, get all the information, see all the areas to improve to be able to scale-up coverage. It has been a very strong relationship and we are hoping to scale-up in all the other districts to be able to do the same.

These two quotes represent an instance of multiple stakeholders independently identifying a similar network characteristic as important for institutional development. From this analysis, specific relationships can be understood in greater detail, and a commentary on important network characteristics can help to highlight what to look for in networks interacting with the case study local governments.

In summary, methods rely on primary interviews to capture data on stakeholder networks and commentary on network characteristics perceived to support institutional development. Data from these interviews are then combined to produce networks of stakeholder interactions around the case study local governments for analysis. Qualitative data are also coded and combined to verify where multiple stakeholders independently perceive similar network characteristics as important for supporting institutional development.

FINDINGS

Findings are presented in two steps. The first looks at quantitative properties of the ego networks around case study local governments using standard types of network analysis. The second step applies qualitative analysis to commentary about networks supporting institutional development, and investigates how these characteristics are apparent from a network perspective. Findings identify three network characteristics in multiple case study locations that are described as positive influences on institutional development.

Quantitative analysis

The ego networks of case study local governments can be analysed using standard numerical network methods. Two are presented in this section: size, and homophily. Size counts the number of alters in an ego network; homophily quantifies the proportion of alters that are different versus similar to the ego. These quantitative methods are a logical starting point to see how quantitative network properties describe the relationships of these institutions.

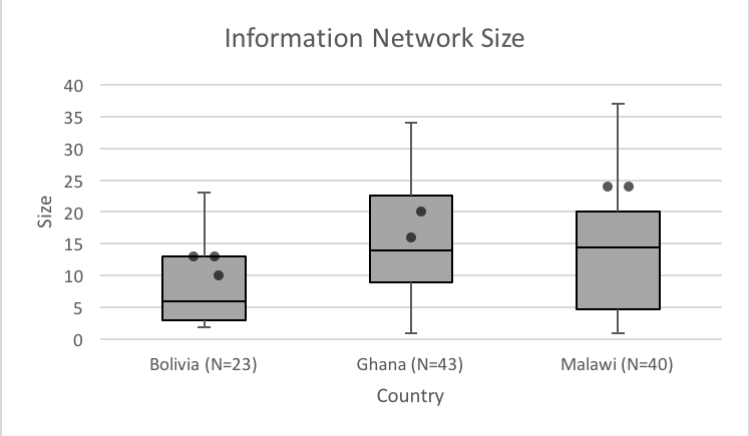
Network size is calculated simply by counting the number of alters in an ego network. In Network nodes are colour-coded to identify different stakeholder types, and nodes are positioned vertically to indicate level of sector hierarchy. Horizontal node position is random. DP stands for 'Development Partner', including bi-lateral and multi-lateral organisations; NGO stands for 'non-governmental organisation'; and INGO stands for international NGO. Identification of node types is particularly useful for noting whether the case study local government interacts with other stakeholders that are different or similar to itself.

Level of sector hierarchy is also visually represented in **Erreur ! Référence non valide pour un signet.**. All three case study countries have an institutional structure that can be described by the three levels of district, regional, and national. The names in Bolivia differ slightly, and are instead called municipal, department, and national, respectively. Stakeholders are represented on the y-axis the level of sector hierarchy by their jurisdiction and where they are based, and distribution in the x-axis is randomised for visual clarity.

Network data alone are insufficient, however, for understanding the nuance of particular relationships and for identifying influences supporting institutional development. Even seemingly beneficial network properties have been shown to have possible negative effects (Crossley, 2010). Qualitative commentary on the importance of particular relationships is therefore essential for describing the significance of network characteristics.

Figure 3 there are twenty nodes, excluding the ego, hence the size of the network is 20. The process is repeated for each case study local government. Network size calculations can also be performed for each stakeholder interviewed in addition to the case study local governments (see Table 1) to provide a perspective on the network sizes of other stakeholders in the same country. Findings are presented in Figure 4 using box plots to represent the maximum, minimum, and median values for other stakeholders interviewed, and values for case study local governments are plotted as points. Figures include values for information ties only because these ties are the most common and are therefore able to represent the key findings.

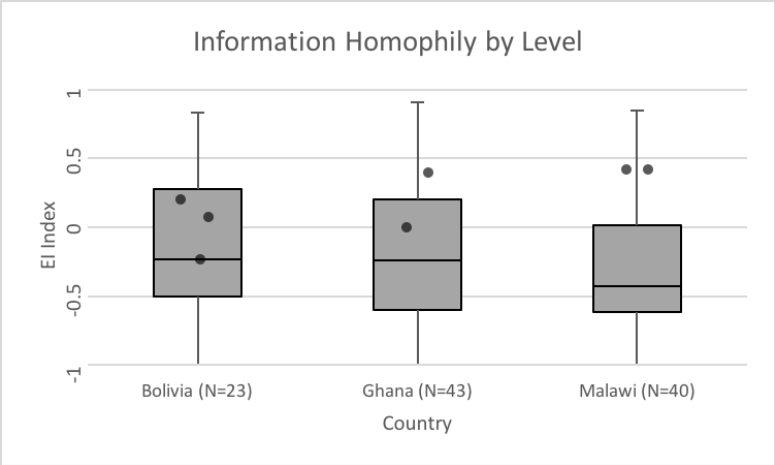
Figure 4**.** Box plots of information network sizes by country. Each box plot includes values for all stakeholders interviewed and case study local governments are plotted as points.



Size analysis finds that all case study local governments have at least 10 information relationships in their networks. Most of these local government information network sizes are also above the median network size value when compared to other stakeholders interviewed in their countries. Without qualitative interpretation, however, the significance of these relatively large information network sizes cannot be confirmed.

Homophily is another standard measure of ego networks that quantifies whether alter attributes are similar or different from an attribute of the ego. This measure, referred to as an EI Index, can be used to quantify the tendency of case study local governments to connect to stakeholders within the same level of sector hierarchy versus those outside of it. Values for the EI index range from -1 to 1. A value of -1 represents exclusively ties to similar stakeholders (homophilic); a value of 1 represents exclusively ties to different stakeholders (heterophilic); and a value of 0 represents an equal number of similar and different stakeholder types in an ego network (Crossley et al., 2015). Analysis finds that all case study local governments have ties to stakeholders both within and outside of their jurisdictions, and most of these ego networks are slightly more heterophilic than those of other stakeholders interviewed (Figure 5).

Figure 5. Box plots of information network homophily by level of sector hierarchy. Each box plot includes values for all stakeholders interviewed and case study local governments are plotted as points.



These quantitative findings provide some general characterisations of the ego networks of the case study local governments, but the effect of these network characteristics cannot be confirmed without qualifying evidence. For this reason, qualitative analysis of commentary from stakeholder interviews is performed next to describe the importance of specific network characteristics. Interpretation of network interactions from the stakeholders that live these relationships helps to identify which network characteristics are perceived as most important.

Qualitative analysis

Analysis of qualitative comments on network characteristics is conducted by identifying where multiple stakeholders interviewed independently identify similar network characteristics as important for supporting institutional development. Analysis is repeated for each case study, and three common network characteristics emerge from multiple locations. These characteristics are independently perceived by multiple stakeholders as important factors supporting institutional development, and these characteristics are observable in the local government ego networks.

Network Characteristic 1 – Information and skill ties with lower levels of hierarchy

The first common network characteristic describes skill and information ties between local governments and other local stakeholders such as communities, the private sector, and operator committees. Commentary from stakeholder interviews identified these ties as important for several reasons, including providing technical support, monitoring services, and receiving feedback on what roles local governments should prioritise. These relationships then help local governments to identify how they might improve their performance. A quote from a case study local government interviewed in Malawi describes how these local relationships provide information that helps the local government prioritise its activities:

> So all these communities are being trained and we also train the [community governance committees], how they can identify the gaps from these areas…. Because the information we get, it's what we use from the communities. So we have got the systems which we have put in place to get this information. As you have seen, we get information from the [community governance committees], and that is our entry point to know where exactly there is need for water supply.

These described relationships are consistent with the quantitative findings on network size and homophily by level. Quantitative values indicate that each case study local government has multiple information and skill ties, and that these ties include relationships with local stakeholders. The quantitative findings are general, and the qualitative descriptions help to better understand the nuance of specific relationships.

The exact nature of these local interactions differs depending on the context, but some of the relationships bear similarities. Case study local governments in Ghana describe performing technical audits of local operators and community waterpoint management committees to identify and provide support where needed. In Malawi, stakeholders commented on the importance of governance structures at the community level, and how interaction with local government helps to strengthen community governance capacity and to strengthen local government ability to identify and act on local priorities. In Bolivia, all local governments studied expanded their human resource capacities to strengthen their relationships with local community water operators. These relationships then provide feedback to the local governments that help them to prioritise efforts and play their role more effectively. Each relationship is slightly different, but the benefit described from these interactions would not be realised if these relationships were absent.

The networks of each case study local government can be visualised to show only ties to lower levels of hierarchy, and graphing these networks identifies how these relationships might be observed from a network perspective. Qualitative interpretation of the relationships is still important, but network visualisation does allow the identification of where relationships exist and where they are absent. Information networks for local relationships are shown for each of the case study local governments and multiple ties are apparent in each network (Figure 6, Figure 7, and Figure Figure 8). The number of stakeholders in each network can differ depending on context, and therefore should not necessarily be compared as a measure of success. Instead, the presence of relationships between a local government and these stakeholders is what should be noted in each network.

Figure 6. Information ties to local stakeholders in ego networks of Ghana case study local governments.

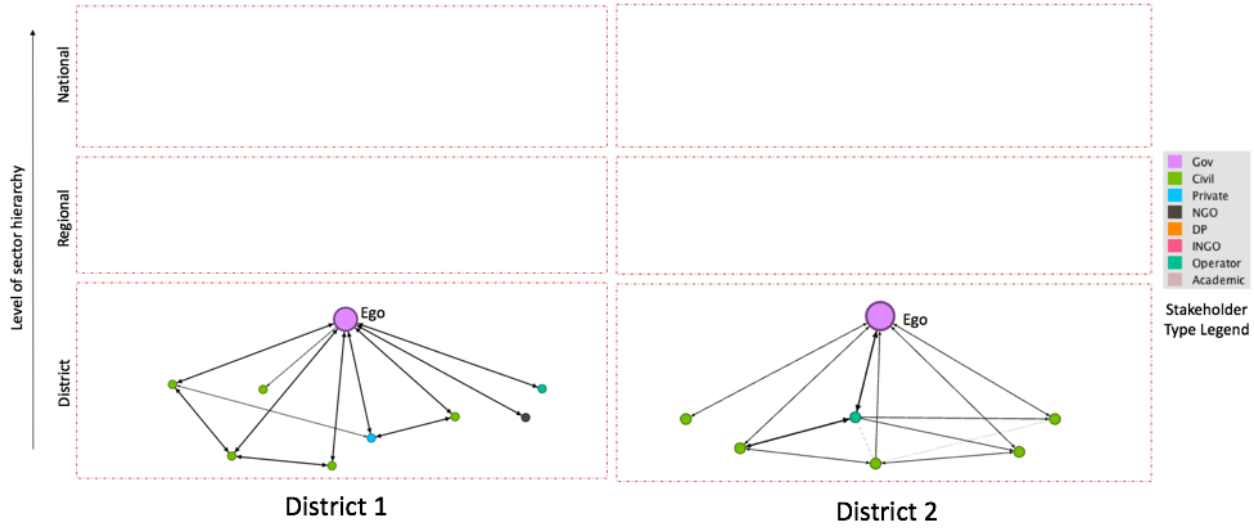


Figure 7. Information ties to local stakeholders in ego networks of Malawi case study local governments.

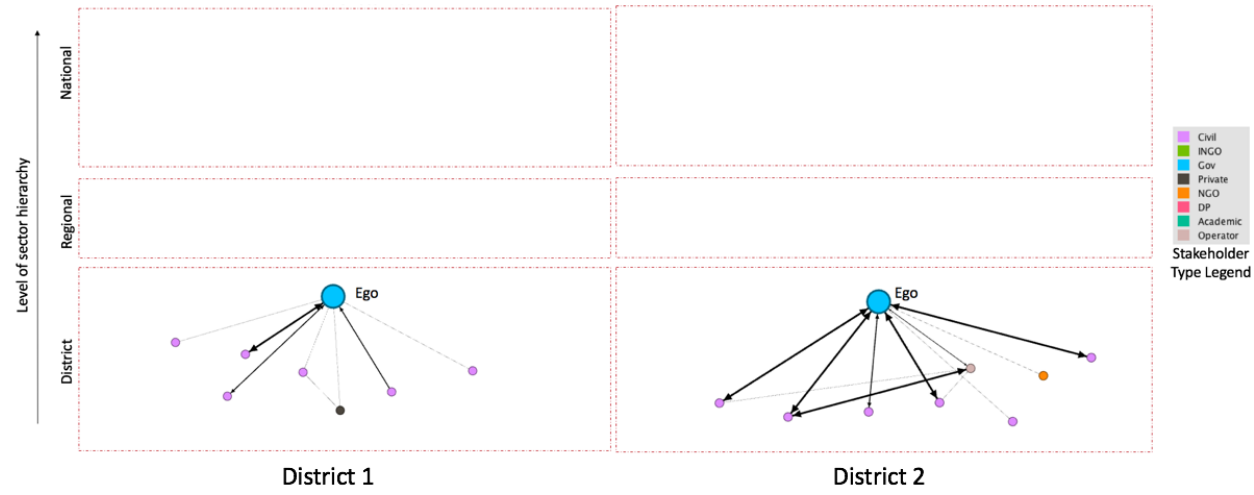
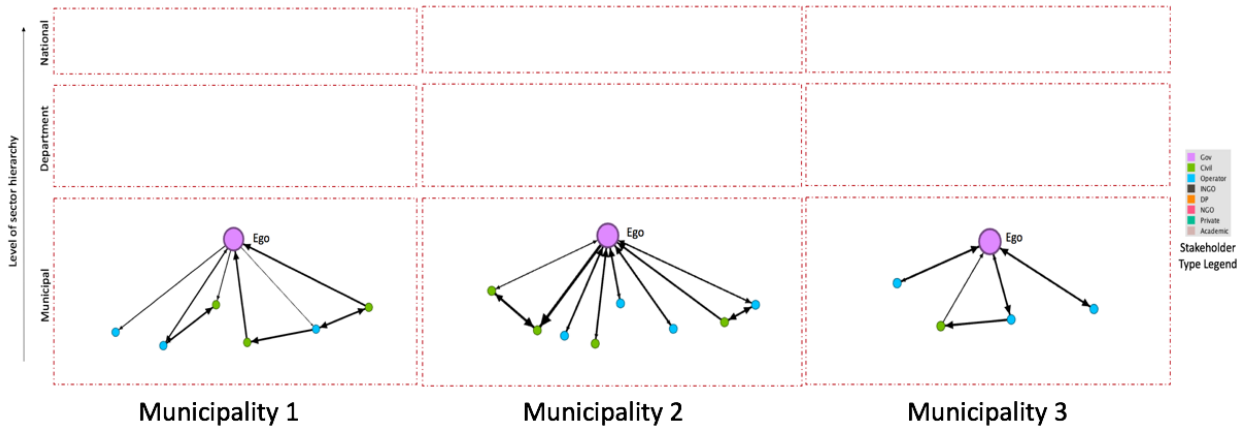


Figure 8. Information ties to local stakeholders in ego networks of Bolivia case study local governments.



Network Characteristic 2 – Information and skill ties with higher levels of hierarchy

The second common network characteristic identified in multiple cases describes the information and skill ties linking to higher levels of sector hierarchy. For local governments, this means ties to regional and national levels. These relationships were described as important for providing technical support to local governments, and for exchanging information that can help to improve the role of local government. An example from Ghana describes how a regional government authority is providing support to a case study local government to help it improve performance:

> Between [a regional authority] and the districts we have come a long way, so there's a lot of coaching, a lot of co-development we are giving the districts and it's helping them to be the implementers of these facilities.

In Bolivia, interview commentary described one stakeholder encouraging municipalities to develop a stronger internal organisational structure for managing service delivery as a precursor to partnership. The idea is that these municipalities can qualify for technical support and investments in infrastructure if they, in turn, invest in developing their internal capacity for managing services. The approach appears to be successfully influencing the case study municipalities to invest in human resources to better engage other local stakeholders.

In general, technical support was described as important, even if the nuance of each relationship differs depending on context, and these relationships can be visually identified in the information ego networks of each case study local government (Figure 9, Figure 10, and Figure 11). The number of stakeholders at higher levels of sector hierarchy differs depending on context because different organisations and even branches of government can engage different areas with different degrees of emphasis.

Figure 9. Information ties to higher levels of sector hierarchy for case study local government ego networks in Ghana.

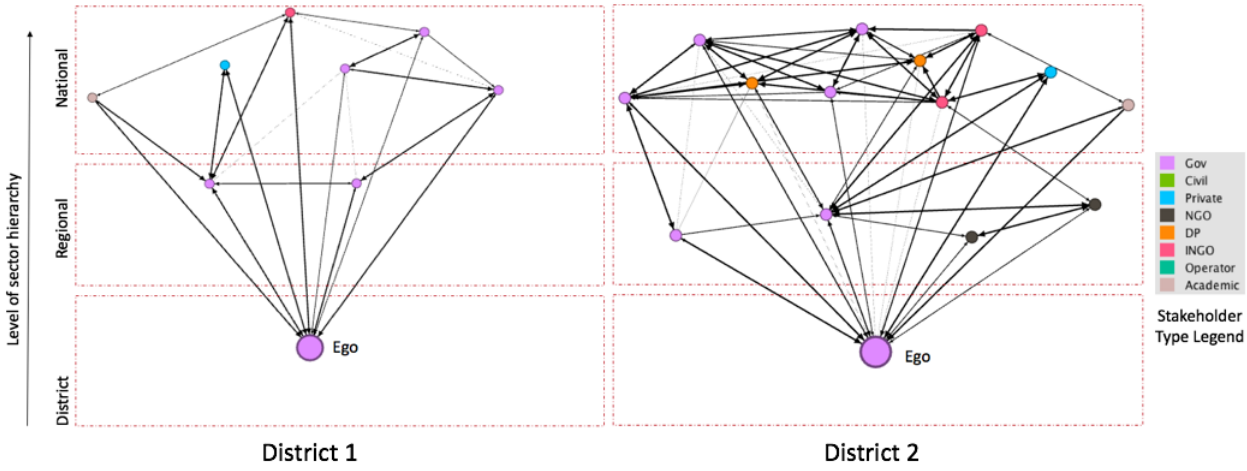


Figure 10. Information ties to higher levels of sector hierarchy for case study local government ego networks in Malawi.

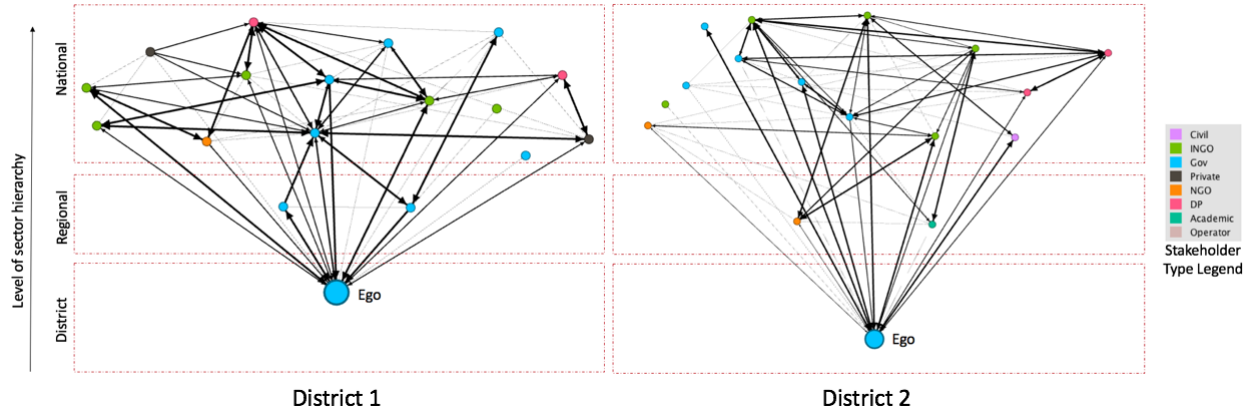
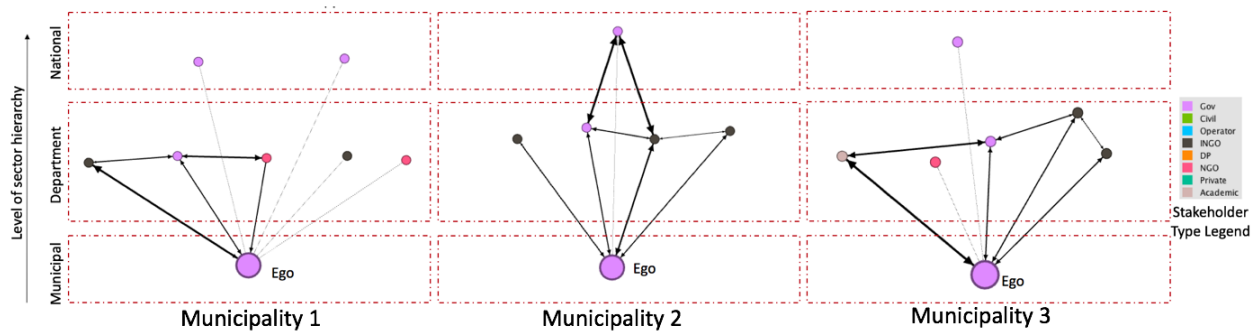


Figure 11. Information ties to higher levels of sector hierarchy for case study local government ego networks in Bolivia.



Network Characteristic 3 – Coordination between higher-level hierarchy stakeholders providing strong information and skill support

The final network characteristic identified in multiple cases of local government performance improvements describes coordination between stakeholders at higher levels of sector hierarchy. These are stakeholders who are both strongly supporting a local government, while also having a strong relationship between themselves. Coordination was a theme mentioned by many stakeholders interviewed, but this term is not specific because not all stakeholders equally engage each other in an ego network. Investigation of coordination in networks is informed by stakeholder commentary on the importance of collaborating with particular stakeholders. Analysis therefore looks at the strongest instances of information and skill support that local governments receive from higher levels of hierarchy, and identifies the strength of the relationship between these stakeholders.

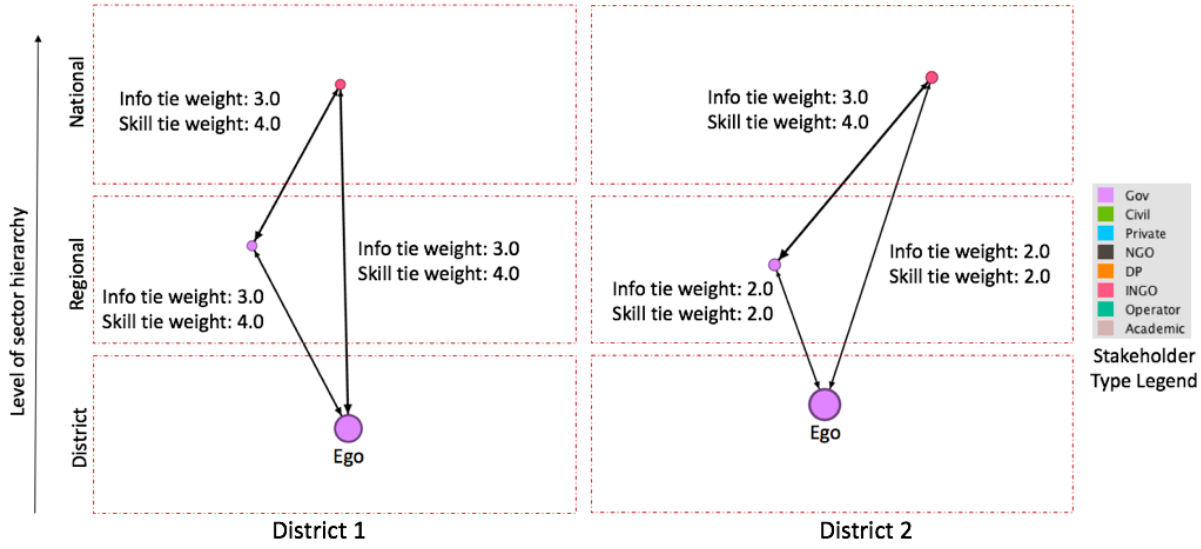
Coordination between stakeholders was described as particularly important in Ghana. Comments describe certain relationships as being stronger than others, and that working together has produced solutions. Commentary indicates that some relationships are particularly strong, and that these might be identified from a network perspective. A quote from an interview in Ghana describes how three stakeholders jointly working together was important for collaboratively developing solutions:

> What we realised from the three [stakeholders] was that sometimes the key challenge is actually that the management teams that are supposed to monitor the systems are defunct. So, once the management teams are not in place then you cannot guarantee the service levels. Depending on how we've worked with our partners, depending on what kind of problems we have found together, then we work out solutions together.

The relationships between three stakeholders described in the quote can be clarified through network visualisation. The following analysis of each district government ego network quantitatively identifies properties of ties between stakeholders engaging districts from higher levels of sector hierarchy. The first step identifies the two alters in the ego network that are the source of the strongest combined inbound information and skill ties from the perspective of the ego. The ego perspective is important because it can define what it perceives as strongest relative to other relationships it has. From the multiple stakeholders engaging a local government, the perspective of the ego can identify which relationships are stronger than the basic level of engagement, and which of these are the strongest two points of support. The next step investigates ties between these two alters. The existence of ties between these two alters would form what is called a triad, and the strength of these alter-to-alter ties is quantified. A triad is considered to be the smallest coalition possible in a network, and analysis of triads has been the basis of extensive sociological research and the development of network theory (Stryke and Psathas, 1960; Simmel, 1964; Caplow, 1968). The triad as a unit of analysis helps to quantify and visualise this described characteristic of coordination between specific stakeholders in ego networks around the case study local governments.

The two alters with the strongest combined information and skill ties to the local government are shown for each Ghanaian case study local government ego network in Figure 12. Also shown are the weights of the information and skill ties between these two alters. Information ties are on a scale from 1 to 3 and skill ties are on a scale from 1 to 4 where higher numbers represent stronger ties. These ties show a triad of strong information and skill ties between all three stakeholders in each case. The y-axis shows level of sector hierarchy and x-axis distribution is random for visual clarity. Filtering the ego network to show the strongest combined information and skill ties finds that the two alters most strongly engaging the districts are also strongly engaging each other.

Figure 12. Visualisation of the network triads in Ghana between case study local governments and the alters with the strongest information and skill ties to the ego.



Other case study countries, by comparison, captured stakeholder commentary on the importance of coordination, but network analysis finds that either few stakeholders are strongly engaging local governments with both information and skill ties, or that these stakeholders are only weakly connected to each other. In these other cases, coordination might therefore be a missed opportunity for further supporting institutional development, or the relatively low number of stakeholders strongly engaging local governments with strong ties might reduce the need for coordination between these alters. Research on more cases would be needed to confirm the independent effect of a lack of coordination between stakeholders strongly supporting a local government.

When present, however, the potential benefit of coordination as a network characteristic is logical. Stakeholders strongly engaging a district government will likely influence it. Multiple stakeholders need to be working towards common outcomes if they are successfully going to influence district performance improvements, and these supporting stakeholders therefore strongly need to engage each other. This engagement could help to coordinate efforts and complement each other's work, whereas the absence of these relationships might lead to redundant or counterproductive efforts. Social network analysis can help to identify where strong relationships exist, and help practitioners to consider if there are missed opportunities for coordination between specific stakeholders that are strongly engaging a local government.

Qualitative analysis summary

Three characteristics described as supporting institutional development can be observed from a social network perspective in multiple local government case studies (Table 2). The first two network characteristics are observed in all cases studied, and the third characteristic was only observed in the cases of two local governments in Ghana.

Table 2. Summary of where common network characteristics were observed.

Country	Network characteristic

(case number)	#1 – Information and skill ties with lower levels of hierarchy	#2 – Information and skill ties with higher levels of hierarchy	#3 – Coordination between higher-level hierarchy stakeholders providing strong information and skill support
Ghana (1)	✓	✓	✓
Ghana (2)	✓	✓	✓
Malawi (1)	✓	✓	
Malawi (2)	✓	✓	
Bolivia (1)	✓	✓	
Bolivia (2)	✓	✓	
Bolivia (3)	✓	✓	

DISCUSSION

This research has used social network analysis in conjunction with qualitative analysis to identify characteristics of stakeholder networks supporting institutional development in local governments in Ghana, Malawi, and Bolivia. These influences are visible from a network perspective, but commentary from stakeholders remains important for understanding the nature of specific relationships and the nuanced effects these have on institutional development. Although social network analysis has some utility for understanding the relationships influencing local governments, network analysis alone cannot identify all factors, nor confirm the importance of specific relationships.

Instead, social network analysis has two main types of value for further understanding of institutional development in water sectors. The first application is the identification of stakeholders and relationships interacting with specific institutions using the methods applied in this research. Once these relationships are identified, the three common network characteristics identified in this research can be used to consider if relationships that can support institutional development are missing. Each application is considered in turn.

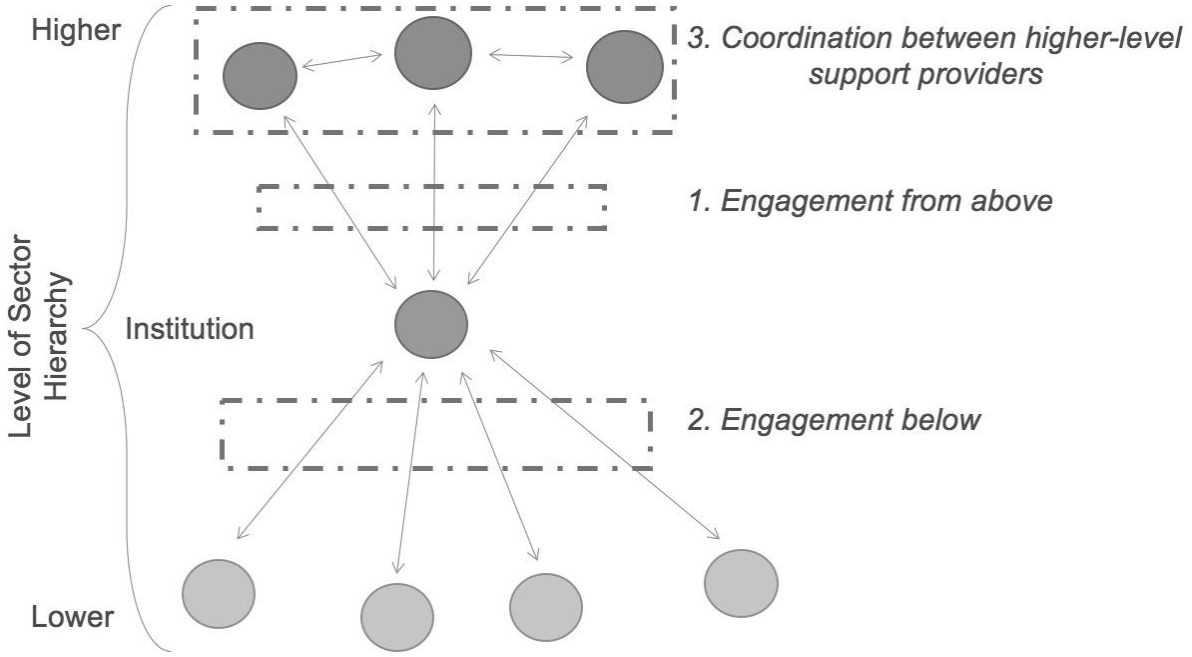
Identifying stakeholder networks has some immediate value for enhancing coordination and understanding sector relationships. Mapping stakeholder networks can help to identify who is involved, what types of ties they have, and where relationships are stronger or weaker. From a practical perspective, mapping networks might identify opportunities for coordination, and these data might also serve as a basis for more academic research that studies how these networks change over time.

Once a stakeholder network around a particular institution is identified, findings from this research can be used to consider if the three common network characteristics are present or absent. The three network characteristics are: engagement with lower-hierarchy stakeholders; engagement with higher-hierarchy stakeholders; and coordination between higher-hierarchy stakeholders that strongly engage the institution. Considering institutional networks in this way is meant to be diagnostic rather than prescriptive, meaning that not every network characteristic need necessarily exist in every network, and even the presence of these characteristics might not guarantee that an institution will develop. Instead, practitioners knowledgeable of the context can use network analysis to consider if characteristics that might support institutional development are missing. Although understanding the nature of specific ties requires qualification, social network analysis can clearly identify where relationships are absent.

The three network characteristics identified in multiple case studies can be visually represented to help practitioners consider network relationships around an institution (Figure 13). The visual

representation is designed to make the key findings more accessible, and these influences on institutional development can be considered around any local government.

Figure 13. Visual representation of key findings showing the three network characteristics identified as supporting institutional development in local government in multiple case studies.



The network characteristics illustrated in Figure 13 are still quite general, however. These characteristics might not apply in all contexts, and their existence does not guarantee that conditions are in place to support local government development. Other characteristics can also influence institutional development depending on the context. From interviews with stakeholders in these networks it is clear that every relationship contains a nuance that needs to be understood in context, and that other non-network factors also influence institutional development in local governments. Future research might therefore benefit from combining social network analysis with the identification of other factors to understand the full range of influences on institutional development in different contexts.

ACKNOWLEDGEMENTS

This research was made possible with funding from the Cambridge Commonwealth Trust, and additional grants from the Cambridge School of Technology, the Smuts Memorial Fund, and Santander. The authors would further like to thank everyone who participated in the research, especially the organisations that kindly hosted the researchers and helped to identify suitable case studies. Thanks to Water for People Bolivia, WaterAid Malawi, Icelandic Aid Malawi, and The International Water and Sanitation Centre (IRC).

REFERENCES

Adank, M.; Kumasi, T.C.; Abbey, E.; Dickinson, N.; Dzansi, P.; Atengdem, J. A.; Chimbar, T.L. and Effah-Appiah, E. 2013. The status of rural water services in Ghana. A synthesis of findings from 3 districts. (April), 85. www.waterservicesthatlast.org/media/publications/the_status_of_rural_water_supply_services_in_ghana

Agua Para el Pueblo Bolivia. 2015. Memoria e Informe Anual 2015. Cochabamba.

Andrews, M.; Pritchett, L. and Woolcock, M. 2012. *Escaping capability traps through problem-driven iterative adaptation* (PDIA). WIDER Working Paper, No. 2012/64.

Bastian, M.; Heymann, S. and Jacomy, M. 2009. Gephi: An open source software for exploring and manipulating networks. International AAAI Conference on Weblogs and Social Media.

Bellotti, E. 2008. What are friends for? Elective communities of single people. *Social Networks* 30(4): 318-329.

Borgatti, S.P.; Everett, M.G. and Freeman, L.C. 2002. *Ucinet for Windows: Software for Social Network Analysis.* Harvard, MA: Analytic Technologies, 2002.

Cambio. 2016. Se Avanza en la Meta de 100% de Agua en 4 Regiones Hasta 2020. Cambio. 15 March 2016, http://cambio.bo/?q=node/2672

Caplow, T. 1968. *Two against one: Coalitions in triads*. Oxford, UK: Prentice-Hall.

Carter, R.C.; Tyrrel, S.F. and Howsam, P. 1999. The impact and sustainability of community water supply and sanitation programmes in developing countries. *Journal of the Chartered Institution of Water and Environmental Management* 13(August): 292-296.

Charmaz, K. 2006. *Constructing grounded theory*. 2nd edition. London: SAGE Publications Ltd.

Crossley, N. 2010. The social world of the network: Combining qualitative and quantitative elements in social network analysis. *Sociologica* 1: 1-34.

Crossley, N.; Bellotti, E. and Edwards, G. 2015. *Social network analysis for ego-nets*. London, UK: SAGE Publications Ltd.

Easter, K.W. and McCann, L.M.J. 2010. *Nested institutions and the need to improve international water institutions*. IWA Publishing 12: 500-516.

French, J.R.P. and Raven, B. 1959. Bases of social power. In Cartwright, D. (Ed), *Studies in social power*, pp. 150-167. Oxford, England: Univer. Michigan.

Trémolet, S. and Valfrey, B. 2015. End of Project Evaluation (EPE) Triple-S – Water Services that Last. January. Chateauneuf-de-Gadagne. France: Hydroconseil and Trémolet Consulting.

IRC: The International Water and Sanitation Centre. 2010. Water services that last. The Hague. www.waterservicesthatlast.org

IRC: The International Water and Sanitation Centre. 2011. Service delivery indicators and monitoring to improve sustainability 1-8. The Hague: IRC.

Lockwood, H. and Smits, S. 2011. *Supporting rural water supply*. Bourton on Dunsmore, Rugby, Warwickshire. UK: Practical Action Publishing.

Lubbers, M.J.; Molina, J.L.; Lerner, J.; Brandes, U.; Ávila, J. and McCarty, C. 2010. Longitudinal analysis of personal networks. The case of Argentinean migrants in Spain. *Social Networks* 32(1): 91-104.

Merrey, D.J. and Cook, S. 2012. Fostering institutional creativity at multiple levels: Towards facilitated institutional Bricolage. *Water Alternatives* 5(1): 1-19.

Mkamanga, G. 2014. Mangochi Basic Services Programme. 2012-2016 Mid-Term Evaluation Final Report Submitted to ICEIDA by September 2014. Lilongwe. www.iceida.is/media/pdf/mbsp-mid-term-evaluation_final.pdf

Moss, T.; Medd, W.; Guy, S. and Marvin, S. 2009. Organising water: The hidden role of intermediary work. *Water Alternatives* 2(1): 16-33.

Narkevic, J.; Harvey, P. and Morgan, P. 2009. Handpump data, selected countries in sub-Saharan Africa. Notes. www.rural-water-supply.net/_ressources/documents/default/203.pdf

Navarro-Navarro, L.A.; Moreno-Vazquez, J.L. and Scott, C.A. 2017. Social networks for management of water scarcity : Evidence from the San Miguel Watershed, Sonora, Mexico. *Water Alternatives* 10(1): 41-64.

Ostrom, E. 2014. Do institutions for collective action evolve? *Journal of Bioeconomics* 16(1): 3-30.

Papermate Consulting. 2015. Mid-term evaluation of the Sector Policy and Governance Project. June. Lilongwe.

Rumphi District Council. 2010. Rumphi District Council District Rural Water, Sanitation & Hygiene District Strategic Investment Plan (DSIP). May 2010. Rumphi.

Schiffer, E. 2007. Manual: Net-map toolbox influence mapping of social networks. Sunbelt conference of the international network of social network analysis (May): 1-6. Corfu, Greece: International Food Policy Research Institute.

Scott, J. 2013. *Social network analysis*. London: SAGE Publications Ltd.

Simmel, G. 1964. *The sociology of Georg Simmel*. 64th edition. New York: The Free Press.

Stein, C.; Ernstson, H. and Barron, J. 2011. A social network approach to analyzing water governance: The case of the Mkindo catchment, Tanzania. *Physics and Chemistry of the Earth* 36: 1085-1092.

Stryke, S. and Psathas, G. 1960. Research on coalitions in the triad: Findings, problems and strategy. *Sociometry* 23(3): 217-230.

Walters, J.P. and Javernick-Will, A.N. 2015. Long-term functionality of rural water services in developing countries: A system dynamics approach to understanding the dynamic interaction of factors. *Environmental Science & Technology* 49(8): 5035-5043.

Whaley, L. and Cleaver, F. 2017. Can 'functionality' save the community management model of rural water supply? *Water Resources and Rural Development* 9: 56-66.

THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS *ATTRIBUTION-NONCOMMERCIAL-SHAREALIKE* LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/LEGALCODE