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Social network analysis reveals a lack of support for greenspace conservation

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Abstract

Retaining urban greenspaces is essential to ensure that cities remain liveable and resilient. However, greenspaces are usually given a low priority by many stakeholders. This means that greenspaces are often converted to other land-uses. Using social networks to understand how stakeholders interact, and influence one another, is increasingly acknowledged as a key tool in conservation and sustainable land management. Nevertheless, social networks are rarely studied in the context of urban greenspace conservation. We carry out a social network analysis of stakeholders affecting greenspace conservation in two fast growing cities in sub-Saharan Africa. We applied the Netmap method, which mixes visual networks with qualitative interviews, and carried out 23 interviews with stakeholders involved in urban planning and/or greenspace management. Although stakeholders such as non-governmental organisations were supportive of greenspace conservation, analyses revealed that no stakeholders actively protect greenspaces while having sufficient influence to change the plans or decision-making of others. Stakeholders thought that government and traditional leaders had negative, or at best, mixed impact on greenspace conservation. Even though some of these stakeholders recognised the multiple benefits that

greenspaces provided, they were strongly influenced by economic pressures to develop land. A lack of support amongst influential stakeholders is undermining the conservation of greenspaces in African cities. To redress this, a better understanding of ways to change perceptions of greenspaces is needed. Additionally, governance structures that support collaboration and coordination should be promoted. Co-developing and communicating a context-specific evidence-base which emphasises the full economic benefits of greenspaces for multiple groups will also be essential to gain the support of influential stakeholders, and thus ensure that rapidly expanding cities in sub-Saharan African conserve greenspaces.

Introduction

Humans play a dominant role in shaping ecosystems and driving the current biodiversity crisis (Díaz et al., 2019). Understanding which stakeholders are responsible for the loss of natural habitats, who is best placed to initiate conservation measures, and how stakeholders interact is crucial (Folke et al., 2005). A key approach is the study of social networks, defined as the relationships enabling the movement of information or influencing the beliefs and behaviours of the individual stakeholders (Groce et al., 2019). How networks are constituted can either help or hinder the sustainable management of natural resources (Groce et al., 2019).

Urbanisation is one of the main threats to biodiversity and ecosystem service provision (Díaz et al., 2019). Urban greenspaces, defined as "all vegetated areas within the urban environment" (Taylor and Hochuli, 2017), mitigate the negative environmental impact of cities through the conservation of specific species (Guenat et al., 2019b; Ives et al., 2016) and the provision of ecosystem services (Gómez-Baggethun et al., 2013). Greenspace conservation has an important role to play in improving the wellbeing of residents (Dean et al., 2011), the resilience of cities to climate change (Demuzere et al., 2014) and in enhancing public appreciation of nature (Soga and Gaston, 2016).

Some of the fastest urban growth is taking place in Africa, threatening biodiversity rich regions (Seto et al., 2012). African urban greenspaces are decreasing drastically (Yao et al., 2019), facing challenges including insufficiently coordinated and collaborative systems of formal government and lack of holistic planning (du Toit et al., 2018). Consequently, understanding how different stakeholders, and their associated social networks, impact greenspaces is key to improving the conservation of urban greenspaces in Africa.

Research on the governance of urban biodiversity and ecosystem services highlights that urban greenspace conservation is mostly government-led, with stakeholders drawn from the planning and environmental management division of the government (Wilkinson et al., 2013). Yet the ability of the government to manage urban greenspaces is limited by a lack of knowledge of ecosystem functioning (Farr et al., 2018), a mismatch between administrative borders and ecologically meaningful units (Dallimer and Strange, 2015), the weakness of the state in some countries (Wilkinson et al., 2013), lack of coordination between different government bodies, and ignoring locally relevant practitioner knowledge (Ernstson et al., 2010). Additionally, incorporation of urban greenspaces in urban planning in sub-Saharan Africa relies, in part, on plans drawn up before independence. It thus lacks local context and fails to incorporate current institutional dynamics (Diko and Palazzo, 2018).

In order to provide positive greenspace conservation outcomes, it is critical to establish a governance structure that relies less on the governmental "command-and-control" mechanism and instead fosters integration, adaptability, and involvement of non-state stakeholders (Bodin and Crona, 2009). Examples of hybrid governance models acknowledged to have potential for urban greenspace conservation by enhancing collaboration between stakeholders include (i) a polycentric governance, which combines a diversity of formerly independent actors and scales (Ostrom, 2009); (ii) a landscape governance, which integrates the natural conditions with the discourses and environmental practices (Buizer and Westerink, 2016); and (iii) a mosaic governance model, which

merges the two preceding models by taking a context-sensitive approach while connecting stakeholders and different governance modes such as government planning and citizens engagements (Buijs et al., 2016). Social networks provide a tool both for the understanding of how the current governance structure works (Hauck et al., 2016) and for preparing the transition towards a new governance model that could then facilitate the implementation of context-specific conservation strategies (Folke et al., 2005). Yet current knowledge on social networks in the context of urban greenspaces is restricted to specific projects (e.g. Ernstson et al., 2010; Farr et al., 2018), meaning their findings are less likely to be generalisable to city-wide greenspace conservation. Additionally, such studies have largely been carried out in the Global North, despite expected regional differences in urbanisation processes (McHale et al., 2013). Consequently, we thus far know nothing of how social networks might impact the conservation, retention or rehabilitation of city-wide networks of greenspaces in Africa, nor of how they can be harnessed to counter-act the decrease of African urban greenspaces.

In this paper, we use a social network approach to explore the governance structure impacting the conservation and management of greenspaces in two cities in sub-Saharan Africa. We identify the stakeholders impacting on and interested in urban greenspaces; describe, through an analysis of stakeholders' interactions and the conflicts arising from differing motivation for greenspace management, the governance structure currently in place and the challenges it poses to greenspace conservation; and which changes in governance would improve greenspace conservation.

Methods

Study setting

African cities are expanding rapidly and thus encroaching on biodiversity hotspots (Seto et al., 2012). Ghana has a higher proportion of urban residents than most African countries (DESA, 2015) and is often praised as an example of stable development (Lenhardt and Rocha Menocal, 2015).

Understanding how to improve greenspace conservation through stakeholders' interactions in Ghana could serve as an example of good practice for other African countries.

Beginning in 1993, Ghana underwent a period of decentralisation which intended to improve public participation in all elements of government decision-making (Government of Ghana, 1992). This resulted in the creation of Assemblies, the highest level of local government authority in a district, and overseen by a Regional Coordinating Council (Government of Ghana, 1993). Local governments are divided into two elements: appointed technocrats, spilt into different departments, and elected assembly members, who approve and budget for decisions made by technocrats. However, despite the decentralisation policy, public participation in decision-making processes in general and in urban planning specifically, including in relation to greenspaces remains low (Mensah et al., 2017). Ghana also has an officially recognised system of traditional leadership in the form of chieftaincy (Government of Ghana, 1992). The office of chief is a life-time position. New chiefs are appointed based both on a hereditary structure and on qualifications, with a higher education increasingly being required (Boafo-Arthur, 2003). Traditionally, there is a hierarchy of chiefs from a paramount chief (or king) who rules over a large area, down to local chiefs who may only control single villages. Historically chiefs exercised decision-making through a council of elders. However, the government Ministry of Chieftaincy and Traditional Affairs encourages chiefs to use formal courts of laws to resolve disputes. Chiefs' roles include upholding customary law, organising traditional ceremonies, protecting and allocating customary land, which covers about 80% of Ghana, and improving the socio-economic situation of their communities (Ubink, 2007). Chiefs also play an advisory role to government and 9% of seats in Assemblies are reserved for them (Commonwealth Local Government Forum, 2018).

This study was carried out in Sunyani and Techiman (Fig. 1), two small-sized cities with a population of 162,765 and 123,973 respectively (Ghana Statistical Services, 2013), putting them on par with the fastest-growing types of cities in sub-Saharan Africa (DESA, 2015). At the time of the

study, both cities were located in the Brong Ahafo region of Ghana and had different status, with Sunyani being the regional capital. However, there was a planned restructuration of the regional structure in Ghana, which led to Techiman being promoted to the capital of the newly-created Bono region in early 2019 (Frempon-Ntiamoah, 2019). Such differences and planned changes in status provides an opportunity for better understanding the influence of governance structures on greenspace conservation. Additionally, Sunyani is often described as an example of a well-planned city (Adu-Gyamerah, 2016), whereas Techiman has been developing fast due to its prominent market. Both cities are split into two administrative districts (Ghana Statistical Services, 2013).

Mapping social networks

We mapped the social networks using Netmap, a visual method that mixes qualitative and quantitative data (Appendix B; Schiffer and Hauck, 2010). Netmap uses three steps to guide participants through drawing social network maps. In the first step, participants identify all stakeholders they think influence the topic. In the second step, participants discuss and draw pre-identified relationships types between the stakeholders. In the third step, they estimate the relative levels of influence of each stakeholder (Schiffer and Hauck, 2010). The method has been designed to minimise the impact of cultural and language differences (Schiffer and Hauck, 2010) and has been used to understand governance of natural resources throughout Africa (e.g. Hauck et al., 2015). Visual network mapping methods provide participants and researchers with a representation of the network on which to base discussion, helping participants to get a holistic perspective on the network, thus providing richer data than matrix-based networks (Hogan et al., 2007). Visual networks also allow for the description of several types of relationships (Schiffer and Hauck, 2010), while most social network studies investigate only communication (Groce et al., 2019) and run the risk of overlooking stakeholders whose influenced is derived from their actions or position in society (Prell et al., 2009).

Participant selection

We carried out 23 interviews, either individually (18 interviews) or in groups of two (5 interviews), amounting to a total of 28 participants. The first participants were recruited through government offices whose official aims were related to greenspaces and/or urban planning. Further participants were identified as part of the first step of the NetMap exercise. All organisations mentioned by more than five participants were contacted. Interviews were carried out with representatives from government departments or institutions (hereafter designated Government Workers (GW), n=12, Appendix A), Chiefs (CH, n=5), members of Non-Governmental Organisations (NGOs, n=4) and Land Developers (LD, n=3). Selection of new participants ceased when data saturation was reached with no new stakeholders or themes emerging from the interviews (Wutich et al., 2020). Additionally, we interviewed representatives of all groups that were mentioned as being influential.

Data collection

Interviews took place in participants' offices or in public spaces familiar to them in October and November 2017. They were carried out in English (n=19) or in Twi (n=4) according to the participants' preference. Participants were asked to identify as many stakeholders, or groups of people, they thought had an impact on urban greenspace conservation and/or management and to describe what this impact was. They were then asked to draw relationships between stakeholders, illustrating the type of relationship (here divided into information sharing, formal authority over, informal influence over, funding, and conflicts) with different coloured lines. Finally, participants were asked to pile up as many tokens as they liked to represent the strength of the impact on greenspaces. All interviews were recorded and transcribed for analysis.

Data analysis

We grouped stakeholders according to their role as given by the participants (Table 1). We qualitatively extracted from interview transcripts the role of each stakeholder both in society and in impacting greenspace conservation. We quantified the strength and recognition of their impact by

normalising the height of the pile of tokens representing the relative impact on greenspaces from zero to one and by recording the number of interviews in which they were mentioned. Relationships between stakeholders were analysed by a centrality analysis with Visone 2.17 (Brandes and Wagner, 2004). In each network, we calculated the in-degree and out-degree centrality and the betweenness centrality for all the stakeholders and all types of relationships except conflicts. As conflicts were described unilaterally, we did not differentiate between indegree out outdegree centrality. The degree centrality is defined as the number of direct ties a stakeholder possesses, and denotes the ability to mobilize (outdegree), or be influenced by (indegree), other stakeholders (Prell et al., 2009). The betweenness centrality, defined as the number of times a stakeholder sits between two otherwise disconnected stakeholders, is critical for long-term management as stakeholders with high betweenness link parts of the network with no other links (Prell et al., 2009). We calculated means across the interviews for all relationship types.

Results

Identified stakeholders and their impact on greenspaces

Sixty organisations were identified as having impact on greenspace conservation. Impacts were positive or negative and could be direct or indirect. Organisations were placed into 10 groups (hereafter stakeholders;

). Some stakeholders were mentioned in all 23 interviews, while others got as few as three mentions (Fig. 2a, Appendix C). The five most frequently acknowledged stakeholders were Local and Central Government, Residents, Chiefs and Industries (including land developers; Fig. 2a). Industries were less frequently mentioned by Government Workers; and Land Developers did not mention Chiefs or members of NGOs as often as other groups. The strength of the impact of each stakeholder on greenspace conservation also varied. Local Government, Central Government and Chiefs had the strongest impact (Fig. 2b).

Local government

Local Government was mentioned by all participants and was identified as having the most influence on greenspace conservation (Fig. 2b). This impact was frequently described as negative. The Physical Planning Department was seen to impact greenspace conservation through the drafting of plans to *"ensure sustainable city development"* (GW08). They were said to create some greenspaces, but also not to *"give [greenspace conservation] the first priority"* (CH01). The Works Department was understood to be responsible for enforcing planning, but was perceived to "*just sit in their office, […] sign and the person starts building"* (GW03). Any planning decision was said to require the approval of the Assembly Members, who did "*not appreciate the fact that these greenspaces must be developed in the built environment."* (GW02).

The Parks and Gardens Department was identified as aiming to implement and maintain greenspaces throughout the city, and were seen to "*nurse these flowers and other species of plants that make the city beautiful naturally"* (GW08). Recent restructuring of the Assemblies was mentioned, including the merger of the Parks and Gardens Department with Physical Planning, and subsequent uncertainty as to its future roles and responsibilities.

Chiefs

The impact of the Chiefs on greenspace conservation was acknowledged and described as important (Fig. 2). This was mainly due to their position as "*custodians of the land"* (NGO04; GW02; GW04), which was seen to give them the final say on any planning activity. Chiefs' vetoes were described as leading to situations of "*development […] at all cost"* (NGO02) at the expense of greenspace conservation. However, some Chiefs were heavily involved in greening activities, spearheading environmental NGOs. Most participants mentioned that all Chiefs, as spiritual leaders, had a strong desire to conserve sacred sites such as traditional cemeteries.

Central government

Three Central Government institutions were acknowledged to impact greenspace conservation: the Land Commission, the Forestry Commission and the Environmental Protection Agency (EPA). The Land Commission was frequently described as critical as they allocate and value land. However, the Commission are sometimes seen to *"add monetary value [to the greenspace] and then protect it"* (GW05) and sometimes to *"collude and […] lease portions of such lands to developers"* (NGO04). The Forestry Commission was said to aim to "*to leave [forests] for future communities […] that are better managed and better valued than we have inherited"* (GW06), by granting permission to fell trees, source seedlings, and initiate education programs. Their role was seen as beneficial for greenspace conservation, but they were criticised for *"watch[ing] people do some indiscriminate felling"* (NGO04). The EPA described their mandate as ensuring that any non-residential project developed in the country is *"environmentally sensitive"* (GW02), a task carried out through impact assessments, allocation of building permits, environmental monitoring and education. They were seen to *"make sure that, if you are putting up a building, [you] have to replant to recover the vegetative cover"* (GW08). The Central Government was described as critical for creating the legal basis for greenspace conservation. Although this was viewed as a positive role, the actual implementation of legislation relies on political will, which was perceived to largely be absent.

Residents

Residents were thought to perceive greenspaces negatively, due to safety concerns linked to poisonous animals and disease vectors and because greenspace was often thought of as being unused land. Residents were also reported to extract resources such as firewood or build without respecting zoning. Conversely, there was a consensus among participants that many Residents included greenspaces on their property and that negative perceptions of greenspaces were changing due to improvements in education. Survey participants acknowledged that Residents' engagement was needed to successfully conserve greenspaces as *"environmental protection is […] a shared*

responsibility" (GW05), and that that some Residents played a critical role in championing greenspaces: *"In this valley here, there is a river, I know of a man […], he did he tree planting along those area, he alone"* (GW08).

Urban farmers were highlighted as a specific subset of Residents impacting greenspaces differently. Farmers were thought to change vegetation structure towards economically valuable species, occasionally enhancing the levels of greenspace provision, or conversely damaging protected greenspaces. Cattle farming in particular was seen negatively, as *"[cattle] eat the grass and the leaves and the crops"* (CH02), with an associated negative influence on the behaviour of other residents who *"do not feel very encouraged to have such backyard gardens"* (NGO04).

Industries

The negative impact of industries, of which land developers were the main subcategory, on greenspace conservation was considered to be important (Fig. 2b). Land developers included building companies and private individuals who *"develop [their] house by [them]selves"* (LD01). Encroachment and bribes for rezoning by developers were seen as a common occurrence, and re-greening as not culturally ingrained. Other industries such as timber extraction and utilities were reported to destroy urban greenspaces to install infrastructure, often without prior consultation.

Media

The role of the Media was described as important (Fig. 2b) because of its ability to transmit information to a wide audience. NGOs reported that media provided free airtime for promoting their work. The Media was described as *"the voice of the voiceless"* (GW02), a way for urban residents with little other opportunities of communicating with government workers.

Religious bodies

Religious bodies were less frequently mentioned as important stakeholders in regards to greenspaces (Fig. 2a). Their roles were perceived as developers of public lands, on which they often

implemented parks and tree planting activities, and as having a strong advocacy power by *"preach[ing] about conservation of nature"* (LD03), sometimes strong enough to *"indirectly […] even influence the chiefs"* (CH02).

NGOs

NGOs were seen to work on aspects that were *"dear to their hearts"* (GW11), such as active tree planting around rivers, seedling production or education programs. Their work was seen to have a positive impact on urban greenspaces. However, the impact of NGOs on greenspaces was not acknowledged by land developers. Although NGOs were mentioned by government workers, specific organisations were often not known and activities were dismissed as *"just some volunteerism"* (GW08).

Educational institutions

Schools were seen to have some impact on greenspaces as teachers were trusted source of knowledge and as schools provided public spaces where active greenspace conservation could be combined with educational activities. Universities were seen to influence policies and mind-sets through their research.

Regional government

The regional government was not mentioned frequently (Fig. 2a), but when mentioned, it was perceived to have a strong impact on greenspaces (Fig. 2c), because of its role as coordinator of local planning: *"Basically we coordinate and also provide technical advice to the districts, if they have any challenge in terms of dispensing their core duties"* (GW08). Participants perceived the regional government as a broker, stepping in mainly when difficult or sensitive issues arose. Its attitude towards greenspaces was unclear to participants.

Interactions between different stakeholder groups

Formal authority

Participants highlighted that the formal authority of the Central Government was mainly exerted in regional capitals or in specific sectors such as in forests and schools, leaving other stakeholders such as the Chiefs or the Industries free reign elsewhere. In contrast, the formal authority of the Local Government was exerted across a wide range of sectors but for their municipalities only. Local Government decision-making often, therefore, led to a lack of overall strategic planning as urban areas can span several municipalities. Representatives of Local Governments reported that, despite the fact that their formal authority has been granted by legislation: *"our problem is how to enforce the laws. The control department is not well resourced: even getting car to go out there is a problem, getting the fuel, the logistics to go out there is a problem so normally you see them in the office. But they are not supposed to be in the office, they are supposed to be on the ground checking to see that people are building according to the plan that the municipality has"* (GW10). Most of our participants also recognised the formal authority of the Chiefs (Fig 3a, Appendix C) and their leadership role in land development: *"For [chief-owned] lands, even if the governments wants a land, they can't just go in and say that, since they are the government, they have right to go in and do whatever. No. […] You can't bypass the chief."* (TR05).

Informal influence

Chiefs had a high relative outdegree of informal influence (Appendix C). They self-described as having a higher authority than that of the Governments because of historical precedence, a view acknowledged by Government Workers, who mentioned that *"our traditional leaders we revere them, they are people who have led exemplary lives, they are leaders"* (GW01). Their role in informal influence was mainly directed towards Local and Central Government (Fig. 3b), trying to shape decisions to fit their agendas. Their informal influence was however used towards all stakeholders except religious bodies (Fig. 3b). For examples, NGOs were supported by chiefs, with most

environmental NGOs identified in Techiman being led by Chiefs. Chiefs had a high betweenness (Appendix C), playing a key role in linking Residents or Industries with Local Governments.

Residents also had a high outdegree of informal influence (Appendix C and D), which they exerted on a wide range of stakeholders (Fig. 3b) through behaviours such as complaints, voting decisions or violence. Both Chiefs and government workers mentioned the need to keep community members satisfied, as they fear that *"[residents] will not even vote for you because you are destroying [their] place of abode"* (GW08).

Funding

Many participants perceived funding to be crucial as *"economic power would outweigh"* (NGO04) any other influences. Industries, including land developers and utility companies, were the main source of funds, followed by the Central and Local Governments (Fig. 3c, Appendix C and D). Central government was described as the main provider of funds for government-led spatial planning. Local Government were perceived to be easily influenced by Central Government, Industries or Chiefs.

Two stakeholders understood to receive funds, from multiple sources including Industries, Governments and Residents, were Chiefs and NGOs (Fig. 3c). How dependent Chiefs are on external funding was likely to affect their approach to greenspace conservation, as they were seen to *"not agree to [greenspace conservation] because they want their money faster"* (NGO03). NGOs' dependence on donors influences their activities, with potential negative impacts on greenspace conservation when NGOs find themselves promoting an industry-led project, even though it is at "*the wrong side of any environmental government advice, [but will be supported by residents] because they will think that the information we are providing is the correct one"* (NGO04).

Information transfer

NGOs, Central and Local Government were perceived as important sources of information, whereas the Chiefs, Industries, Residents and Regional Government were largely receiving information (Fig. 3d). Specialist knowledge was not always welcomed and made use of as it was frequently perceived to come from outsiders: "*some of the public servants are not residents of the area, when they give advice [the residents] don't pick it."* (NGO03).

Conflicts and challenges affecting greenspace conservation

Conflicts mostly exist between Local Government, Central Government and Chiefs. Stakeholders with little impact on greenspaces tended to have fewer disagreement with other groups (Fig. 4; Appendix E). Conflicts and challenges revolved around five main interconnected issues.

Development pressures

Most participants stated that urbanisation is putting pressure on greenspaces, creating conflicts between those wanting to retain greenspaces (e.g. NGOs/Local Government) and Industries such as utility providers (Fig. 4). Such conflicts were exacerbated by the fact that, in Ghana, greenspaces are perceived as vacant land*: "I can consider it as unused land but if you are talking about the greenspace, then it becomes the greenspace. Land bank is a greenspace, greenbelt is a greenspace, all where we have not used becomes a greenspace unless we enter into it"* (GW11), as opposed to buildings whose removal are deemed culturally unacceptable *"with our social background, when the person puts up a building, you cannot destroy the building"* (NGO03). Development pressures were thus perceived as critical challenges facing greenspace conservation: *"You know the number one enemy to the environment is development and I keep saying that there is no development that will not impact on the environment"* (GW05).

Conflicting governing institutions

Competing land uses could be more easily resolved if there was a clear understanding of who was responsible for land allocation and planning. Another issue affecting greenspace conservation that participants identified was a lack of enforcement. Different responsibilities and lack of coordination between Local and Central Government institutions resulted in situations where Local Government allocated land to greenspaces while Central Government institutions authorised its sale to Industries. The emergence of such conflicts was perceived to be closely related to the personality of the officers on duty, with for instance conflicts arising between the Central and Local Governments because *"[they] think I see the officer as too young, so I'm sort of trying to bully the person and tell them that me, I work by the regulations. Fortunately, the [officer working for the other district] works by the regulation, because he is mature"* (GW07). In order to resolve such conflicts, the Regional Government was perceived to be the final judge.

Similar conflicts were also described between Local Government and Chiefs (Fig. 5a). Despite the legal basis of the government authority, perceptions varied on which of Local Government or Chiefs had the most power, particularly when land ownership was contested. This led to situations with uncertainty as to who the main stakeholder responsible for urban greenspaces are, as the Local Government and the Chiefs were perceived to have either *"almost equal powers"* (CH02) or an unbalance in power identified both towards the chiefs, "[*which] take care of the land and they control the land, government don't come in at all. If government want to come in, the only thing he can do is that there should be a mutual understanding between the […] chief and the government"* (CH05) and towards the government: *"when the chief is misbehaving, not going by the scheme that we prepared […] we can take this chief to court to prevent him from doing what he is doing"* (GW10). No resolution mechanism was identified for conflict resolution between the chiefs and the government.

Funding

Local Government participants stated that revenues were mainly received from Central Government, and often, *"there is nothing on the greens on all projects"* (LD03). Systemic lack of funds was generally described as a barrier to the implementation of urban plans as insufficient resources prevent relevant departments from undertaking site visits. This is acknowledged by the Park and Gardens Department who stated *"financial constraint has made the department dormant"* (GW04). Government agencies were perceived to be susceptible to receiving bribes to rezone areas designated as greenspaces, or to issue permits for natural resource extraction, such as timber production. Chiefs also granted permission to build in exchange for part of the plots.

Accountability

Participants mentioned occasions when the ambiguity around governance and accountability led to situations in which no highly influential stakeholder felt accountable for greenspace conservation. Local Government 'technocrats' would be blamed by Chiefs and NGOs for the loss of greenspaces. Conversely, Local Government 'technocrats' blamed greenspace loss on Chiefs. The only stakeholders clearly defending greenspaces, the members of environmental NGOs and the Parks and Gardens Departments, had limited influence and funds as well as being constrained by governance structures.

Discussion

In the context of rapid urbanisation and biodiversity loss in sub-Saharan Africa, our findings show that whether and how greenspaces are conserved depends of an inter-play of relationships between many stakeholders. A relatively small number of stakeholders, including government, land developers, chiefs, residents and the industries, are perceived to have a strong influence on the conservation and management of urban greenspaces. However, those with the most impact on

greenspaces, and influence on others, tended to hold views that threaten greenspace retention and conservation.

Governments are often described as amongst the key stakeholders impacting urban greenspaces and ecosystem services (Wilkinson et al., 2013). Several participants mentioned that legislation to protect greenspaces was in place, however loss of urban vegetation is common across the region (Yao et al., 2019). We highlighted conflicts between different government offices. A lack of collaboration has been exacerbated by recent decentralisation processes, something that was implemented to foster participation and empower Local Government. However, decentralisation also led to a mismatch between urban planning, managed at the local level, and the environmental and land tenure issues, managed centrally. This has created situations in which centralised policies encouraging greenspaces (e.g. Government of Ghana, 2015) are drafted without the input from local governments, which then struggle to implement them. Such conflicts were perceived by participants to hinder both basic greenspace maintenance and proper acquisition of land titles. Key principles to good governance of natural resources include coordination and coherence across sectors and strategies as well as inclusive decision-making (CEESP and GPGR, 2019). Consequently, such conflicts between governing bodies suggest that greenspace retention and conservation is likely to remain a low priority.

Despite the legislation being in place for a typical government-led "command-and-control" governance structure to protect greenspaces, the lack of funding for local governments made policy implementation unfeasible (Yeboah and Obeng-Odoom, 2010). The central government recommends the involvement of the private and civil society sectors to counterbalance the lack of financial resources in local government (Government of Ghana, 2015), thus avoiding the responsibility for greenspace conservation and expressing a preference for economic investment instead (Diko and Palazzo, 2018). We identified industries, including developers, the main source of income, yet they industries did not support the provision of greenspaces. Incentives from the

government such as incorporation of the insurance value of ecosystem services (Dallimer et al., 2020) in regulations or development of compensation policies for conserving greenspaces would be needed to ensure conservation measures are taken by industries (Razzaque and Visseren-Hamakers, 2019).

Both the conflicts between government institutions and the lack of enforcement can explain the failure of the current "command-and-control" governance structure to tackle the decrease in urban greenspaces (Yao et al., 2019). There is thus a need for a governance arrangement that (i) acknowledges alternative stakeholders that can promote the importance of urban greenspaces, (ii) promotes collaboration across different institutions and (iii) shifts the role of government to one of facilitator (Armitage et al., 2012; Bodin and Crona, 2009).

We also showed a lack of community participation in greenspace conservation, consistent with other regions of Ghana (Mensah et al., 2017) but contrary to studies in other contexts where there is greater citizen engagement in decision-making (Dennis and James, 2016). Such lack of community participation can be partly attributed both to the confusion surrounding decentralisation (Fridy and Myers, 2019) and to the fact that some groups of residents perceive few benefits from urban greenspaces (Guenat et al., 2019a). An assumption underlying community involvement in the Global North is that "citizens expect good living conditions, including access to urban greenspaces" (Buijs et al., 2016). Yet in sub-Saharan Africa, where 42.3% of the urban population is living with less than $1.90 a day (The World Bank, 2020), expectations of urban residents regarding their environment are, in the current circumstances, more closely related to affordability and cultural ties (Badmos et al., 2020). Our study emphasizes that the assumption that access to greenspaces is expected from citizens might not be relevant in sub-Saharan Africa, as urban residents were here perceived to have a mostly negative impact on greenspaces. We thus contradict the suggestion that either a polycentric or a mosaic governance model, both promoting active citizen participation (Buijs et al., 2016), might yield positive greenspace conservation outcomes in this context. At present, the wider

population perceives greenspaces to be vacant or unused land that is would be better put to other uses. We therefore highlight the need to change how urban greenspaces are perceived before new models of governance could be implemented to deliver successful outcomes for urban greenspaces.

Urbanisation processes are expected to differ regionally (McHale et al., 2013) and chiefs play critical leadership roles in many African countries (Logan, 2017). Due to the research bias on urban greenspace governance towards the Global North, where such traditional structures do not exist, social network research has not recognised their importance (Wilkinson et al., 2013). Our work illustrates that, in an urban context, chiefs are highly influential in determining if and how conservation proceeds, highlighting the need for a contextualised approach to greenspace governance. However, as chiefs are part of Ghanaian cultural identity (Ubink, 2007), decisions they make are often thought to be above blame and therefore go unchallenged. This lack of accountability, together with the limited support Chiefs have for greenspace conservation, ultimately means that Chiefs mostly have a negative influence on greenspace conservation (Armitage et al., 2012). However, our analyses identified chiefs as both important influencers and linking stakeholders (with high betweenness), in that they have a unique role in binding together networks around urban greenspace management and use. This lack of accountability also increased their influence, as perceived by most participants, meaning that harnessing their role through a change to their approaches to greenspaces could deliver substantial conservation gains.

Altering how greenspaces are viewed by influential chiefs and the wider populations is challenging, but would nevertheless yield long-lasting beneficial consequences for urban sustainability (Abson et al., 2017). Information exchange, and especially targeted information for opinion leaders, is critical for triggering such a change in mindset (de Lange et al., 2019). NGOs are known to play a key role in conservation communication, where they are trusted as experts (Hauck et al., 2015). NGOs could therefore play a critical role in trying to shift how greenspaces are viewed by communities through education about the wider benefits of urban greenspaces. We however

highlight that the influence of NGOs in this study was modest. Instead, their work was largely dismissed due to its voluntary character. Such opinions emphasize the importance of a socially established position for influencing greenspace conservation in sub-Saharan Africa and reiterate the inadequacy of governance models emphasizing citizens' actions in such a context.

A source of information with the potential to shift perceptions are the media. In Ghana, they are known to influence priority-setting by the government through their role in communicating public grievances to mass audiences (Lenhardt and Rocha Menocal, 2015). Here, the media's role was described as being mainly supportive of greenspace conservation, through their support of NGOs. Mass communication through media reaches large audiences but is short-lasting, meaning that any promotion of greenspace conservation would require continued effort (de Lange et al., 2019). However, the media was also described as being an expression of residents' concerns, thus likely to reflect and reinforce the negative perception of greenspaces within the urban population. Indeed, a South African review highlighted that media cover the disservices brought about by urban greenspaces much more regularly than the services (Mclellan and Shackleton, 2019). Potential ways to harness the media for widespread greenspace promotion could be via NGOs and central government, both of whom are the main sources of information for media. For instance, given that greenspaces can contribute to climate change mitigation (Demuzere et al., 2014) and that the need for temperature control in urban Africa is appreciated by residents (Dumenu, 2013; Guenat et al., 2019a), focusing media coverage on this issue could provide a mechanism to alter public opinion.

Retention and implementation of urban greenspaces in fast-growing cities is critical for improving liveability, resilience, and mitigating their impact on biodiversity losses. Here, a social network analysis identified a governance structure in which no adequate instruments or legislation is in place for natural resources managements within cities. The sole defenders of urban greenspaces are stakeholders with limited influence. If the full value of greenspaces for cities is to be realised, a radical shift in opinion across stakeholder is required. The regional context was exemplified by the

identification of chiefs as critical stakeholders whose endorsement is needed for the implementation of city-wide conservation practices, yet who are thus far largely not engaged with, or interested in this process, and by the lack of involvement from residents. Consequently, better understanding ways to change the perception of greenspaces to generate support for greenspaces conservation is critical. Our analyses also showed that the main barriers to implementing greenspace conservation initiatives were a lack of funding for government agencies, impeding planning enforcement. Conversely, industries with little interest in greenspace were the main source of funding for urban development, strongly influencing how chiefs chose to address the socio-economic needs of their communities. This suggests that until the full value of urban greenspaces for society is recognised in land development policies and projects, Africa's urban greenspaces will continue to be lost.

Acknowledgments:

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Tables

Table 2. Stakeholders identified by the participants as having an influence on urban greenspaces, grouped according to societal organisations, and the number of times they were mentioned out of the 23 interviews (where n > 1).

Stakeholders	Organisations	Number of mentions
Local government (Assembly)		23
	Assembly as a whole	20
	Assembly members	3
	Parks and Gardens Department	14
	Physical Planning Department	16
	Roads Department	5
	Works Department	7
Chiefs		19
Central government and state agencies		22
	Central Government as a whole	5
	Electricity companies	5
	Environmental Protection Agency	13
	Forestry Commission	14
	Land Commission	12
	Ministry of Food and Agriculture	3
	National Disaster Management Organisation	2
	Ghana Highway Authority	2
	Ghana National Fire and Rescue Service (GNFRS)	2
	Politicians	2
	Water-related governmental institutions	6
Residents		21
	Urban crop farmers	6
	Livestock farmers	4
	Landowners	8

	Students and young people	6
	Drivers	2
	Residents	16
Industries		19
	Land developers	12
	Timber industry	7
	Hospitals	3
	Hotels and restaurants	2
	Mining companies	3
	Food processing factories	2
Media		9
Religious bodies		5
NGOs		15
	Environmental NGOs	5
	Community-based organisations	3
	Farmer associations	2
	Non-governmental organisations	8
Educational institutions		13
	Research institutions	5
	Schools	10
Regional government		3
	Regional Coordinating Council	3

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Figures

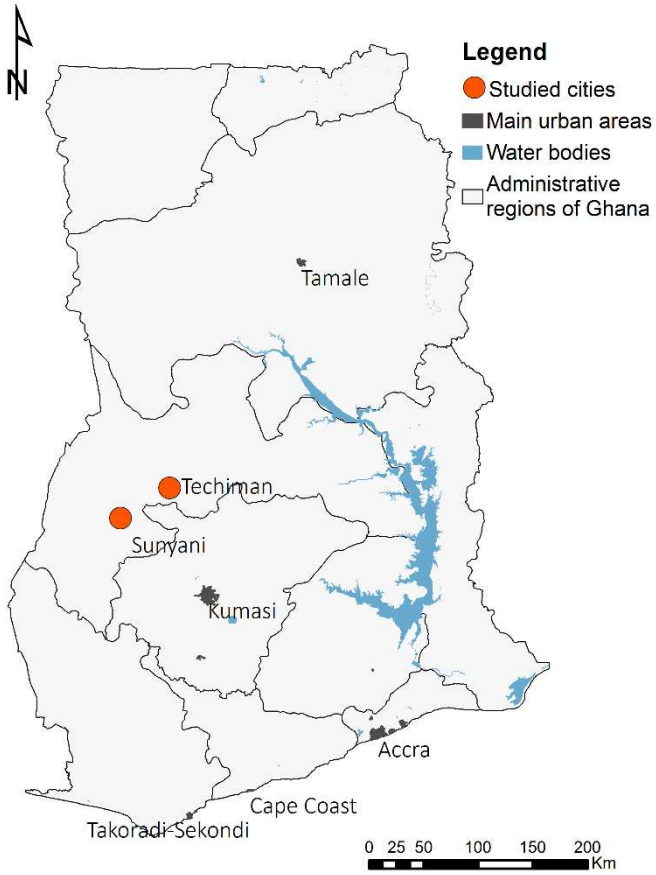


Fig. 1. Study cities within Ghana, including state administrative divisions at the time of data collection. Those divisions were modified in 2019, at which point Techiman was designated the capital of the newly created Bono region.

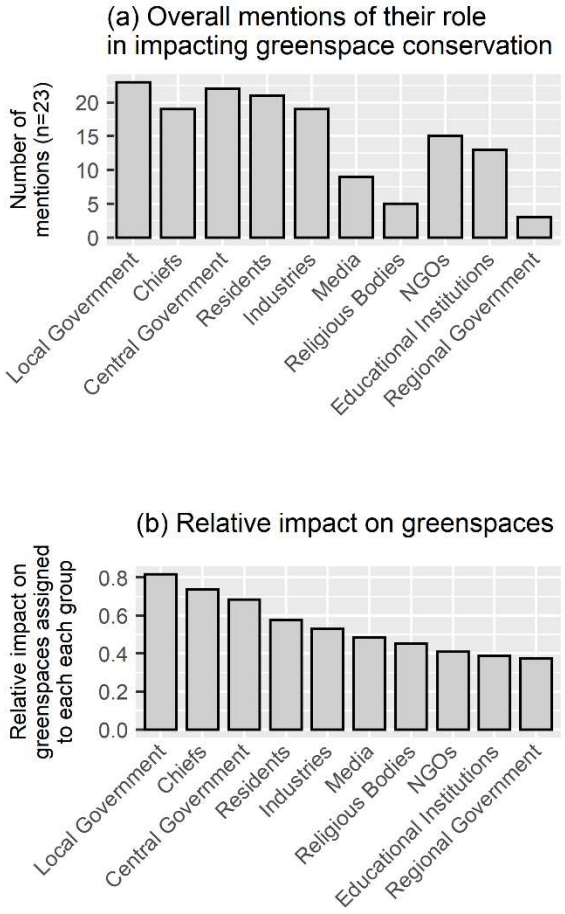


Fig. 2. Importance given to the identified stakeholders: (a) number of mentions of their role in impacting greenspace conservation out of 23 interviews and (b) the relative importance of their perceived impact on greenspace conservation.

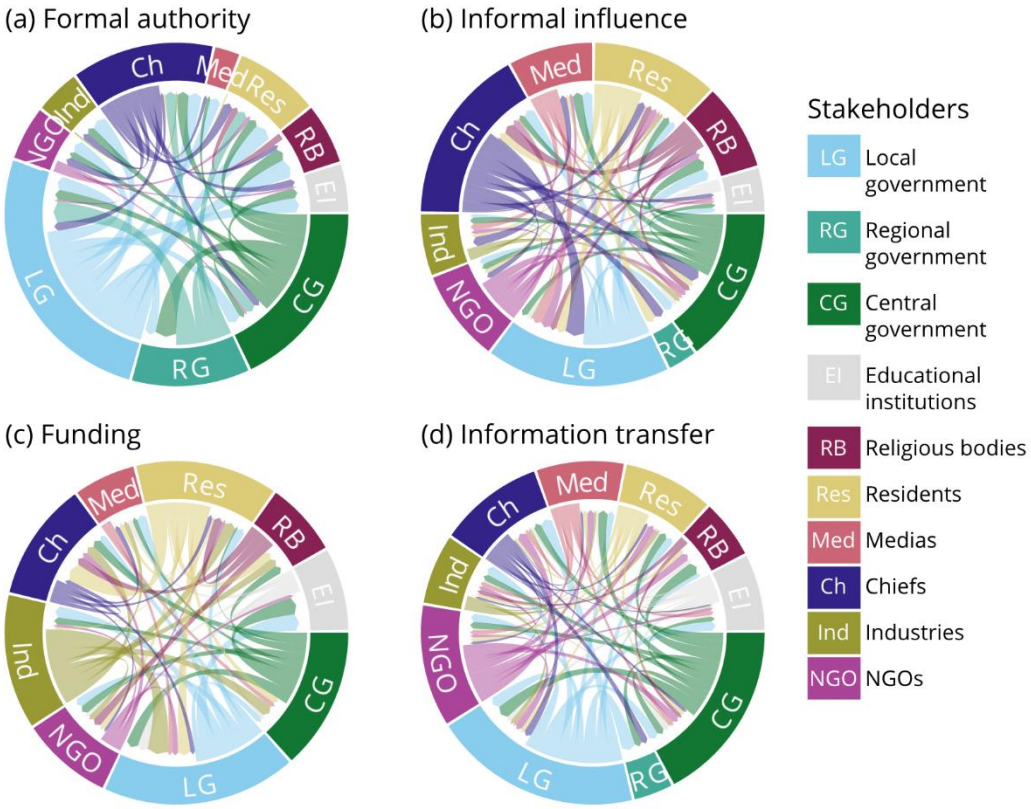


Fig. 3. Different types of interactions between stakeholders: (a) formal authority, (b) informal influence, (c) funding, (d) information. Lines represent the presence of an interaction, with line width weighted by the cumulative number of interactions.

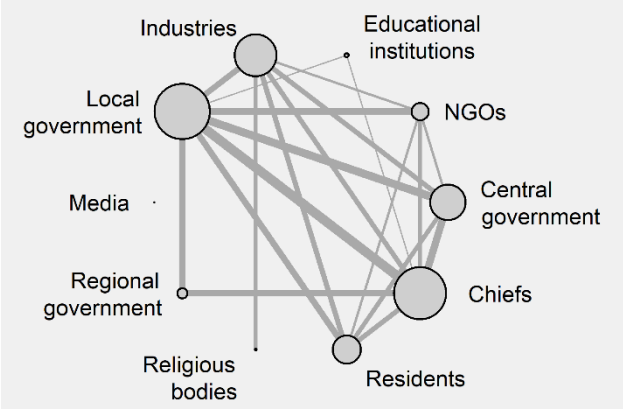


Fig. 4. Graphical representation of the number of recognises conflicts (thicker lines, more conflicts). Circle size is proportionate to the degree centrality of the conflict network for each

stakeholder. This, therefore, indicates the number of conflicts the stakeholder has been identified as being involved in, as a percentage of the total identified conflicts.

List of appendixes

Appendix A. Number of participants per sampling category and city.

Appendix B. Example of a NetMap. The NetMap exercise leading to the creation of such map is split into three steps as follow:

(1) identifying the stakeholders with an impact on greenspaces: each sticky note represents a stakeholder identified by the participant. Participants are free to add stakeholder later during the process if they were forgotten at the initial stage;

(2) identifying interactions between the stakeholders: five types of interactions were draw and color-coded (formal authority in green, informal influence in black, transfer of funds in blue, information sharing in red and conflict in yellow). All interactions except the conflicts (bidirectional) are drawn as arrows representing the direction of the flow (e.g. the community transfer funds to the chiefs). Stakeholders being a source of one type of interaction towards all others were circled.

(3) identifying the relative strength of the impact of each stakeholder on urban greenspaces: tokens were piled up to represent how much impact each stakeholder had on urban greenspaces. Participants were free to choose the height of the towers, whose height relative to each other was normalised from 0 to 1 in the analysis.

Appendix C. Relative importance of each stakeholder as receivers (indegree), providers (outdegree) and intermediaries (betweenness) of (a) formal authority, (b) informal influence, (c) funds and (d) information transfer.

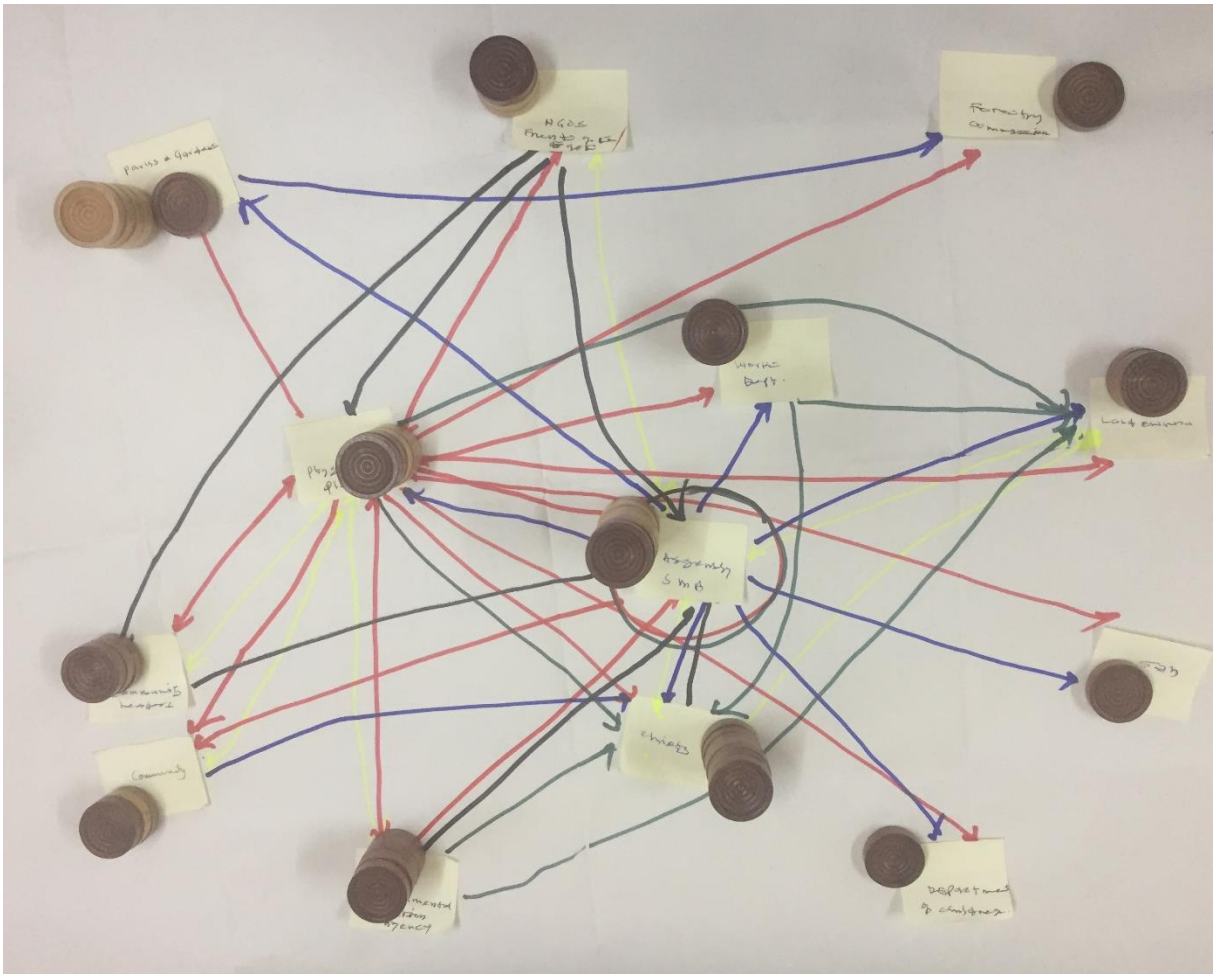
Appendix D. Network metrics measured per stakeholder. Metrics includes the number of mentions (number of times they were mentioned in an interview, out of 23 interviews); the average (+/-SE) of the normalised influence (from 0 to 1) they were given; their in- and out-degree and betweenness centrality for formal authority, informal influence, funds and information transfers; and their degree centrality for conflicts.

Appendix E. Conflicts between the different stakeholders. The values represent the number of times, out of 23.

Appendixes

Appendix A. Number of participants per sampling category and city.

	Sunyani	**Techiman**
Government workers	7	4
Representative of the traditional leaders	3	2
Estate developers	2	1
Members of civil societies	2	2



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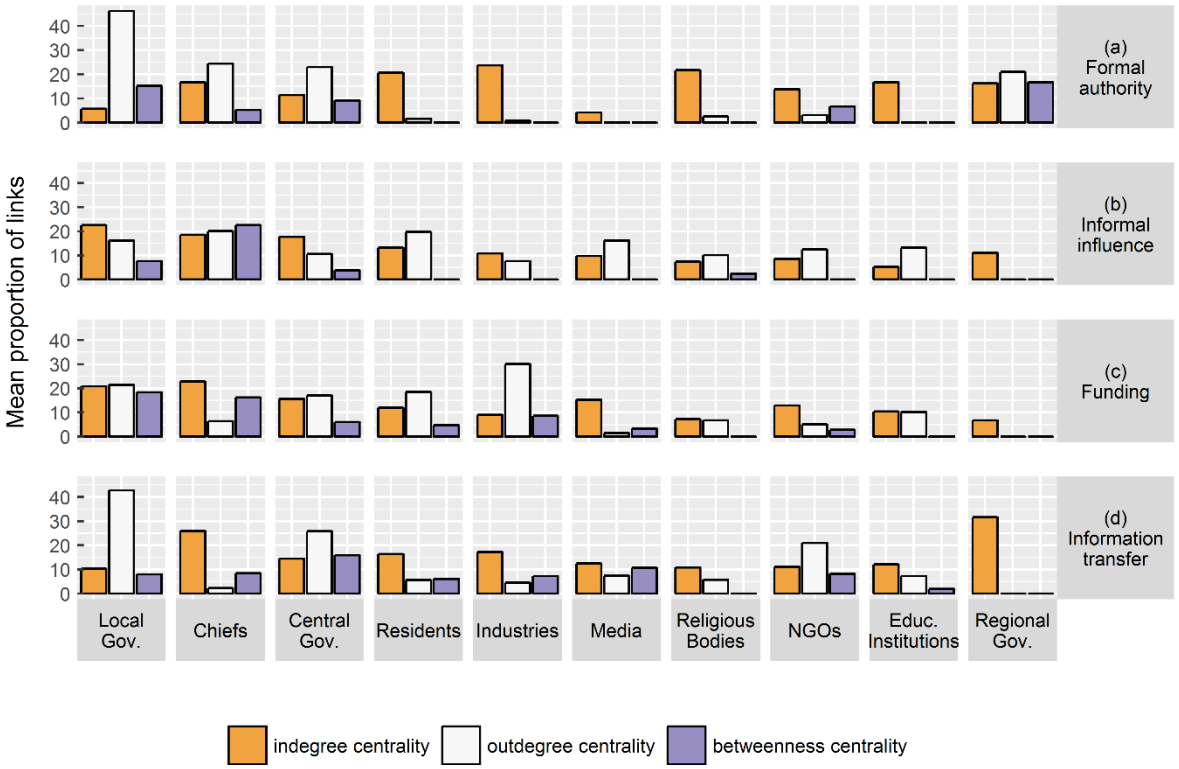

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			Formal authority			Informal influence		
Stakeholders	**Number of mentions**	**Influence (average +/- SE)**	**Indegree (average +/- SE)**	**Outdegree (average +/- SE)**	**Betweenness (average +/- SE)**	**Indegree (average +/- SE)**	**Outdegree (average +/- SE)**	**Betweenness (average +/- SE)**
Local government	23	0.82 +/-0.03	5.70 +/-2.52	46.25 +/-6.41	7.95 +/-7.33	22.61 +/-6.52	16.14 +/-4.49	7.58 +/-4.76
Chiefs	19	0.74 +/-0.06	16.66 +/-5.72	24.36 +/-8.25	5.26 +/-5.26	18.50 +/-4.41	20.04 +/-4.29	22.59 +/-9.53
Central government	22	0.68 +/-0.06	11.34 +/-4.90	23.02 +/-4.64	9.09 +/-6.27	17.73 +/-5.18	10.59 +/-3.25	3.83 +/-2.67
Residents	21	0.58 +/-0.07	20.61 +/-3.29	1.59 +/-1.59	0.00 +/-0.00	13.18 +/-3.35	19.75 +/-6.95	0.00 +/-0.00
Industries	19	0.53 +/-0.07	23.74 +/-6.19	0.66 +/-0.66	0.00 +/-0.00	10.86 +/-3.56	7.64 +/-3.82	0.00 +/-0.00
Media	9	0.48 +/-0.05	4.13 +/-2.26	0.00 +/-0.00	0.00 +/-0.00	9.80 +/-4.10	16.14 +/-8.67	0.00 +/-0.00
Religious bodies	5	0.45 +/-0.16	21.67 +/-11.59	2.50 +/-2.50	0.00 +/-0.00	7.40 +/-3.15	10.10 +/-3.48	2.40 +/-2.40
Civil societies	15	0.41 +/-0.05	13.79 +/-5.11	3.06 +/-2.32	6.67 +/-6.67	8.60 +/-3.49	12.47 +/-4.53	0.00 +/-0.00
Educational institutions	13	0.39 +/-0.08	16.76 +/-4.24	0.00 +/-0.00	0.00 +/-0.00	5.23 +/-1.96	13.25 +/-7.79	0.00 +/-0.00
Regional government	3	0.37 +/-0.24	16.19 +/-1.90	20.95 +/-12.38	16.67 +/-16.67	11.11 +/-11.11	0.00 +/-0.00	0.00 +/-0.00

Appendix D (cc'd). Network metrics measured per stakeholder. Metrics includes the number of mentions (number of times they were mentioned in an interview, out of 23 interviews); the average (+/-SE) of the normalised influence (from 0 to 1) they were given; their in- and out-degree and betweenness centrality for formal authority, informal influence, funds and information transfers; and their degree centrality for conflicts

	Funds			Information			Conflicts
Stakeholders	**Indegree (average +/- SE)**	**Outdegree (average +/- SE)**	**Betweenness (average +/- SE)**	**Indegree (average +/- SE)**	**Outdegree (average +/- SE)**	**Betweenness (average +/- SE)**	**Degree (average +/- SE)**
Local government	20.86 +/-5.25	21.37 +/-5.26	18.33 +/-7.40	10.29 +/-4.52	42.78 +/-6.94	7.95 +/-4.87	25.30 +/-3.71
Chiefs	22.80 +/-4.89	6.40 +/-2.38	16.23 +/-8.56	25.97 +/-5.12	2.21 +/-1.42	8.42 +/-5.99	23.92 +/-3.98
Central government	15.64 +/-3.94	17.00 +/-4.19	6.06 +/-4.72	14.44 +/-4.83	25.82 +/-5.82	15.85 +/-7.04	16.29 +/-3.70
Residents	11.90 +/-3.92	18.49 +/-5.01	4.76 +/-3.28	16.30 +/-2.85	5.55 +/-2.51	6.04 +/-4.78	12.95 +/-2.95
Industries	9.02 +/-4.04	30.08 +/-7.64	8.60 +/-5.74	17.21 +/-3.38	4.53 +/-2.69	7.24 +/-5.35	19.27 +/-4.17
Media	15.28 +/-11.27	1.39 +/-1.39	3.33 +/-3.33	12.39 +/-3.61	7.31 +/-4.02	10.68 +/-7.07	0.00 +/-0.00
Religious bodies	7.17 +/-3.33	6.67 +/-4.22	0.00 +/-0.00	10.74 +/-2.98	5.71 +/-5.71	0.00 +/-0.00	1.05 +/-1.05
Civil societies	12.89 +/-5.42	5.04 +/-2.71	2.78 +/-2.78	11.03 +/-3.57	20.99 +/-7.72	8.21 +/-6.73	8.07 +/-2.86
Educational institutions	10.37 +/-3.74	10.13 +/-7.61	0.13 +/-0.13	12.08 +/-3.36	7.25 +/-4.33	1.92 +/-1.92	2.05 +/- 1.44
Regional government	6.67 +/-6.67	0.00 +/-0.00	0.00 +/-0.00	31.67 +/-22.42	0.00 +/-0.00	0.00 +/-0.00	4.76 +/-4.76

Appendix E. Conflicts between the different stakeholders. The values represent the number of times, out of 23 interviews, that such conflict was mentioned.

	Local government	Chiefs	Central government	Residents	Industries	Media	Religious bodies	Civil societies	Educational institutions	Regional government
Local government	NA	9	9	7	6	0	0	5	1	3
Chiefs		NA	7	5	5	0	0	3	1	1
Central government			NA	5	5	0	0	2	0	0
Residents				NA	5	0	0	2	0	0
Industries					NA	0	1	2	0	0
Media						NA	0	0	0	0
Religious bodies							NA	0	0	0
Civil societies								NA	0	0
Educational institutions									NA	0
Regional government										NA