

# A Social Network Analysis of Collaborative Rangelands Governance: the case of Borana rangelands, Southern Ethiopia

Teferi Tolera (✉ [ttolera2009@gmail.com](mailto:ttolera2009@gmail.com))

Jimma University

Feyera Senbeta

Addis Ababa University

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## Research Article

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# Abstract

Effective natural resources governance plays crucial roles in enhancing the resilience of the Socio-ecological systems (SES) in the face of prevailing environmental changes. It is recognized that the ability to adaptively respond to complex environmental change and manage SES resilience resides in the actors' networks. Network forms of governance facilitate both horizontal and vertical interconnection of actors, bring different perspectives and sources of knowledge, develop shared values and develop innovative solutions to the wicked rangeland problems. However, the structural pattern of the actors' collaborative linkages highly influences how actors actually behave and, hence, impact the deliverance of effective governance. In view of this, by analyzing social networks (SNA), this study aims to identify the structural gaps that result in misfit in the Borana rangelands. As evident from the low level of network density obtained from quantitative SNA, there are very few horizontal and vertical interactions and linkages among actors in the Borana rangelands governance system which considerably blocks flows of knowledge, experiences and other resources indicating inability of the governance system in facilitating the solidification of shared values and joint action. The study further reveals that rangelands governance system in Borana is hampered by absence of adequate network heterogeneity and closure which in turn blocks the building of collaborative visioning and an efficient use of available resources to address complex problem. Thus, this study suggests that policy environment that can create conditions for more collaboration, strength of actors ties, development of trust and social capital and enabling the design of effective collective efforts should be put in place.

## 1. Introduction

For long, natural resource management has been dominated by a mono-centric and hierarchical decision-making approach which has attempted to simplify the complexity of such systems by focusing on a few variables, but that inevitably results in eroded SES resilience (Adger et al., 2005; Folke et al., 2005; Walker et al., 2006; Reid et al., 2014). In the face of apparent failures to govern complex environmental problems by centralized management and reductionist approaches, network forms of governance approaches have emerged which is captured in the concept of collaborative governance (Newig *et al.*, 2010). The SES concept also recognizes that actors' engagement lays a ground to govern SES resilience and sustainability of rangelands as elsewhere in the other SES (Hruska et al., 2017).

The collaborative governance system that involves social networks comprised of various actors including government, non-government and civil society across geographical and jurisdictions governance scales, levels and units is more likely to be effective in responding to the evolving complexity and unpredictability of the environmental problems (Ostrom et al., 2007; Bodin and Crona, 2009; Armitage et al., 2010). Collaborative governance system plays an important role in facilitating collective learning, producing common understanding or shared goals, mobilization of key resources, deliberation of commitment and collective actions and resolution of conflicts (Carlson and Berkes, 2005; Scholz and Wang, 2006; Bodin and Crona, 2009; Newig et al., 2010).

However, the existence and engagement of multiple actors alone are not enough to build effective natural resource governance system (Bodin and Crona, 2009). The types and features of individual actors and networks among actors fundamentally determine whether actors behave in the constructive or destructive manner in governance regimes even more than the existence of formal institutions (Scholz and Wang, 2006; Walker et al., 2006; Bodin and Crona, 2009; Larson et al., 2013) reflecting the critical importance of investigating the characteristics and influence of each individual actors in the network and the overall features of relational ties (Bodin and Crona, 2009). In understanding the effectiveness of a governance networks, investigating the characteristics of network structures or relational patterns among actors is a primary step (Bodin et al. 2006).

Therefore, understanding the existence and structure of social networks of the Borana rangelands governance system, in this case, is important to search the ways in which “collaborative barriers” can be overcome in addressing the complexities in the rangeland resource governance (Bodin and Crona, 2009; Larson et al., 2013). However, to the best of our knowledge, empirical evidence on the effect of social networks on natural resource governance regimes in general and rangelands resources, in particular, is still lacking in the Borana setting. Against this backdrop, this paper attempted to examine the Borana rangeland network governance structures affecting the capacity and effectiveness of the governance system by applying social network analysis.

## 2. Methodology

### 2.1. Study Location

The study was conducted in Borana zone rangelands, southern Ethiopia. The Borana zone is one of 13 administrative zones within Oromia National Regional State. It is located between 3°36 – 6°38’ North latitude and 3°43’- 39°30’ East longitude and borders Kenya in the south, Somali Regional Government in the east, and the Ethiopian highland districts in the north. The Borana rangelands cover an area of about 50,000 km<sup>2</sup> of which 75% consists of lowland, and frequently exposed to droughts. Based on CSA (2017) population census, the Borana administrative zone is currently inhabited by a projected population of about 1.2 million people.

Figure 1: Study location, Source: Tolossa (2018)

The Borana rangelands are characterized by an arid and semi-arid climate, with pockets of sub-humid zones. The average annual rainfall varies between 350 mm and 900 mm with a considerable variability of 21 to 68% among years (Lasage et al., 2010). Rainfall is characterized by bimodal, with 60% of the annual rainfall occurring between March and May (main rainy-season) followed by a minor peak between September and November (small rainy-season). The long-term variability in the quantity and the distribution of the rainfall results in recurrent droughts in the area. In the past, droughts lasting several years occurred approximately once in 20 years and isolated dry years (< 400 mm) once in five years

(Coppock, 1994). Recently, the period between droughts has decreased to 5 years, and the latest drought was observed only 3 years after the previous one (Bekele, 2013).

The topography in the Borana rangelands is distinguished by plain rangelands, intersected with occasional mountain ranges, volcanic cones and depressions, and an altitude between 750 and 1700 m.a.s.l. They are dominated by tropical savannah vegetation, with varying proportions of open grasslands, and perennial herbaceous and woody vegetation (Alemayehu, 2002). Cossins and Upton (1988) classified the Borana rangelands into four ecological zones of different potential grazing capacity; high potential savannah in the northern part, bushlands with high shrub cover in the central area, medium potential grassland in the east and volcanic areas in the west.

Yabello district is one of the representatives of the core of Borana pastoralism system and the cultural sites of the Gada system (Indigenous governance system) which govern the overall rangelands resource use (Ayana and Oba, 2007). Recently, development interventions such as the establishment of ranches, intensification of cropping farm, curtailment of mobility, etc. are intensive in this district. Thus, for the purpose of this study, Yabello district was selected. Yabello district encompasses a total area of 5556.7 square kilometers. The study area is characterized mainly by lowlands and hills. It lies between 1350 and 1800 meter above sea level. Based on current demarcation, the district comprises 18 lowest administrative units called kebele of which 8 kebeles are mainly depended on pastoralism; and the remaining 10 kebeles are characterized by agro-pastoralist.

## **2.2. Social Network boundaries Identification**

In studying social network analysis, identification of the network boundary is the first step. However, the network boundaries are largely arbitrary and subjected to the nature of research questions. The unit of analysis considered for the purpose of the social network analysis for this study was rangeland governance system in Yabello district that can be defined as a group of actors interacting on regular basis and influencing the path to SES resilience. Toward this end, various stakeholders involved directly or indirectly in rangeland management in Yabello district across all governance scales were surveyed.

## **2.3. Actors' identification process and data collection**

Before discussing the process involved in identification of stakeholders'/actors' considered in network analysis, it is worth highlighting the formal institutional setup related to rangeland resource governance in the country. In Ethiopia, generally, the political administration has five tiers: national or federal level, regional states, zones, districts and kebeles. Generally, institutional setup for natural resource management and governance follows the same jurisdictions. Rangeland use is mainly governed by the Federal Democratic Republic of Ethiopia Rural Land Administration and Land Use Proclamation No. 456/2005. The proclamation provides the general framework and power for national and regional governments to set hierarchical organizational structures down to district level to regulate sustainable land use system. However, there are no formal state organizations specifically dealing with rangeland resources management.

At national level, policy issues and development interventions related to rangeland management are coordinated by Ministry of Environment, Forest and Climate Change (recently named as commission), Ministry of Agriculture and Natural Resources, Ministry of Water, Minerals, and Energy, Ministry of Federal Affairs and Ministry of Livestock and Fishery Development (currently, merged to Ministry of Agriculture and Natural Resources). At regional level, rangeland resource governance and management is shared responsibilities of Bureau of Environment, Forest and Climate Change Authority, Bureau of Agriculture and Natural Resources, Bureau of Rural Land Administration and Use, Bureau of Water, Minerals and Energy and Bureau of Livestock and Fishery Development. The institutional structures at Zonal and district levels follow the same lines. Alongside with these state institutions, many organizations such as Research Institutes, Universities, Non-government organizations, State Enterprises and Community Based Organizations and/or customary authorities have interest in rangeland management practices.

The Ministry of Federal affairs is mandated to coordinate the overall pastoral development programs and projects in pastoral areas. However, existing reality shows that there have been poor coordination efforts. In connection with this, many argue that the intention of government is largely motivated by recognition of exerting pressure to control pastoral areas (Abdulahi, 2007). More importantly, as indicated by the key informants from stakeholders, the linkages between stakeholders institutions are quite weak at all levels of scales of management, especially between different lines of management.

To identify active stakeholders/actors involved in rangeland resources management, a combination of purposive and snow ball sampling techniques were employed. Initially, successive consultations were made with major organizations which have direct roles in rangeland governance including Borana Zone Pastoral Development Office, Pastoral Commission and Land Use and Environmental Protection offices to recommend other stakeholders actively involved in rangeland governance system. The snowball sampling method was followed until no new organizations were mentioned. The snowball sampling procedure was started from district level actors. From the local actors, 2 actors were interviewed. To avoid biasedness that may arise from the snowball sampling method in overlooking other stakeholders involved in rangeland management issues, available secondary data, specifically, policy documents were consulted to complement the initial process. Ultimately, a total of 53 actors were included in the social network analysis.

## **2.4. Network data analysis**

To assess the effectiveness of the rangeland resource governance network, analyzing the nature of actors' interactions in a network is a prerequisite (Bodin and Crona, 2009). The network structures (relational pattern) influence the behavior and actions of actors involved in the network and overall effectiveness of the governance system (Sandström and Rova, 2010). These network structural characteristics, which have strong functional implications for the resilience of the network, broadly include: number of social ties, degree of cohesion, subgroup inter-linkages network centralization and actor centrality (Bodin and Crona, 2009).

In shedding light on how each of the network structural characteristics affect the overall performance of natural resource governance, the number of social ties, captured by network density, greatly affect the outcomes of the network governance as the more social ties tend to increase the possibilities of collaboration, mutual trust development and joint action (Sandström and Rova, 2010). The existence of higher network density also facilitate for the co-production of knowledge that are useful in SES resilience building (Bodin and Crona, 2009).

The other important structural characteristic, the level of network cohesiveness, measures to what extent the network is separated into distinguishable subgroups. Looking at its effect on the outcome of the network governance, the existence of subgroups, low cohesion, can possibly pose challenges on collaborative process among subgroups (Hannemann and Riddle, 2011). Generally, less cohesive network exhibit high density in the overall network and produce positive governance outcomes as it facilitates sharing of important resources such as knowledge and information (Bodin and Crona, 2009). It is important to note that if connectivity exists between different subgroups (bridging ties) there would be a high possibility in using external resources which in turn improves the capacity of the network governance (Crona and Hubacek, 2010). In the Borana rangeland governance, for instance, the connections beyond the subgroups potentially promote and create collaborative partnership between various types of the actors including NGOs, government line organizations, higher education and research institutes, community based organizations, and customary authorities.

The relative position and influence of individual actors, covered in the concepts of network centralization and actor's centrality, significantly affect the capacity of the natural resource governance regime in many ways (Bodin and Crona, 2009). The level of centrality deals with the distribution of linkage among actors (nodes) in the network and their structural importance (Bodin et al., 2006). Centrality, the network centrality helps to understand which actors and how they can use their structural position and able to influence the collaborative process and how they are advantageous over the others in accessing important resources (Crona and Hubacek, 2010). Though there are multiple ways to measure network centrality, for the purpose of this study we attempted to measure two metrics: degree and betweenness centrality.

In this way, following related literature (Hanneman and Riddle, 2005; Bodin and Crona, 2009; Sandström and Rova, 2010; Prell, 2012; Scott, 2015) methods of social network analysis were used to map, quantify, and analyze the relational patterns or connection between actors in rangeland governance. Structural properties of networks, the ones described above were measured to analyze the effectiveness of network governance. Brief descriptions of the quantitative network analysis on the selected metrics are highlighted in the subsequent sections.

The network density measures the proportion of all possible ties present in a network and used as proxy of social cohesiveness (Bodin and Crona, 2009). Density is calculated by dividing the number of existing connections in the structure by the maximum number of possible connections (Scott, 2015).

$$D = \frac{l}{n(n-1) / 2}$$

Where:  $D$  denotes density

$l$  = maximum number of links

$n$  = number of actors

The network structures in which all actors are completely connected have a density of 1 reflecting strong cohesiveness in the network structures and effective governance. However, the existence of subgroup in the network may mislead the interpretation of the whole network and the existence of various subsets of actors should be considered (Sandström and Rova, 2010). In our case, the data were clustered into 6 subgroups based on the main organizational goals and governance scales and the density of subgroup structures were examined.

To identify actors' structural position, or coordinating actors that would otherwise have limited or no connections, parameters of the network centrality was analyzed. Network centrality measures how central or well-connected an actor in a network (Sandström and Rova, 2010). It also describes the patterns of power relation and how much an actor has access to the resources in the network (Dkamela *et al.*, 2014; Angst *et al.*, 2018). For the present study, from various versions of centrality parameters, degree centrality and betweenness centrality were considered.

Degree centrality measures the numbers of direct links to and from an actor (Sandström and Rova, 2010). Degree centrality parameter helps to visualize how tightly the network is organized around its most central point or how 'star-like' the network structure is (Bodin and Crona, 2009; Sandström and Rova, 2010; Scott, 2015). A high degree of centrality is interpreted as well-connected network structures (Sandström and Rova, 2010). In related front, to identify potential bridging actors within identified clusters, betweenness centrality scores were calculated for each actor in the network. Betweenness is the number of shortest paths from all nodes (actors) to all others that pass through one specific node (actor) (Dkamela *et al.*, 2014).

Betweenness centrality helps to quantify how much each actor contributes to minimizing the distance between actors in the network (Bodin *et al.*, 2006). It measures an actor bridging position with respect to other two actors in the network. It is the probability of an actor being on the shortest path between two points, reflecting how often a node lies on a shortest path between any two nodes in the network (Angst *et al.*, 2018). To put it another way, betweenness centrality refers the number of times an actor located between two other actors who are disconnected. An actor with high betweenness centrality is considered to have a great influence over the course of interactions, hence affect how rangeland resources governance system delivers governance assets (Hanneman and Riddle, 2005).

To identify actors playing great role in connecting actors out of the clusters, following Vance-Borland and Holley (2011), we calculated brokerage scores. All network metrics used to describe the characteristics of the governance networks were calculated using UCINET version 6.591 (Borgatti *et al.*, 2002). In order to analysis the network structure, the data were transformed into binary network measures (1 for presence

of collaboration and 0 for absence of collaborative relationship). To depict actors' relationship visually, NetDraw software was employed.

### 3. Results And Discussions

In this context, this section presents the results of social network analysis. First, we present the whole network properties of the rangeland governance system. Subsequently, the actor (node)-specific characteristics of the network structures and their likely effects on the deliverance of governance assets were discussed.

#### 3.1. The Structure of Rangelands governance Network

As shown in Fig. 2, the rangeland governance involves a diverse set of actors both NGOs and GOs representing various scales, sectors, and divergent interests. It was identified that 53 network nodes or relevant actors in the rangeland governance system of which NGOs accounts for 28% (n=15), whereas government actors made up of 68% (n=36) and the remaining 4% (n=2) of actors belongs to community-based organizations, customary institutions and private company. As indicated by the key informants, the most common activities that NGOs participate in Borana rangeland management are bush clearing and pond/well construction and maintenance.

Looking at the overall links, theoretically, a density of social network equal to one represents full connections of all nodes, in our case, however, the overall density of social network in rangeland management is very low ( $D=0.076$ ) in that from 2760 possible links, actors only make 207 (7.6%) ties which is poor compared to what other studies for example, Sandström and Rova (2010) recommend. Closely looking at the network links, only about 32% of links were found to be reciprocated. It was also found that government actors exhibited strong hierarchical vertical links across formal governance tiers with very limited horizontal links at all governance scales.

Despite being on the same governance level, having interdependent goals and physically close to one another, there was little horizontal reported collaboration among actors operating at the same governance level. An examination of the network densities shows that the densities of all horizontal networks were low; 0.16 for district scale government actors, 0.056 for zone level, 0.014 for regional level and 0.14. Likewise, the density of networks among non-government organizations was 0.26. The density of the overall government actors ( $D=0.25$ ) at all levels was found to be similar to that of NGOs (0.26). Worth noting, there existed no collaboration between community-based actors and indigenous *Gada* institutions and community-based organizations. Interestingly, it was observed that the tendency of collaborating with customary institutions is increased in these days.

Network governance views that governance for resilient SES demands collaboration among all actors (higher density) which improves the potential for joint actions through facilitating knowledge, resource and experience sharing, foster mutual trusts, solidify shared goals and help to manage potential conflicts (Bodin et al., 2006; Bodin and Crona, 2009; Sandström and Rova, 2010). Network governance with higher

density enables actors with differing knowledge, values, and interests to understand complex problems, agree on solutions and integrate their actions, and hence increase the adaptive capacity of SES (Alexander Steven et al., 2017). As it can be seen from the findings, there were very few overall and horizontal collaborations in the Borana rangeland governance and absence of such interactions potentially undermine the collective action, block communications of knowledge and experience, hinder resource sharing, trigger conflicts of interests and ultimately derives SES vulnerabilities which currently prevailing in the Borana pastoral system. In addition, a low-density network reflects the divergence and competition of perception, goals, and interests which lead to the absence of a common problem definition which hinders the potential to respond adaptively to uncertainties (Crona and Hubacek, 2010).

Sandström and Rova (2010) further elucidate that a well-connected network is assumed to increase the capacity of a co-management network to craft and maintain the rules of the game and the compliance of actors to the set rules. Contrary to the recommendations of existing literature on SES, the Borana rangeland governance system critically lacks sufficient collaborations among actors and hence lacks well-defined common priority process. Even worse, the low level of network cohesiveness appears to have hindered to have a common view on the future of the pastoral system, let alone setting common goals.

On the other hand, it is argued that cross-boundary connections (heterogeneity) increase the effectiveness of adaptive governance through mobilizing diversified resources (Alexander Steven et al., 2017). Effective governance, thus, requires multilevel coordination of actors' interactions across all administrative units involving both policies making bodies and policy implementing actors (Fliervoet et al., 2016). Such a cross-scale and vertical interactions potentially facilitate the sharing of diversified resources. In our case, however, the network has low cross-boundary connections in that there was virtually no direct reported collaboration among stakeholders spanning two levels of governance; actors tend to collaborate with actors who share similar institutional mandate following formal institutional setup, to the nearest level up or down the formal governance hierarchy (Figure 1).

Unfortunately, multi-sectoral and multi-scalar interactions of actors were scarce in the Borana rangeland governance system. For instance, there was no direct collaboration between district and region level actors or between zone and federal level actors out of the formal institutional structures, and thus rangeland governance system failed to synchronize governance assets in responding to the dynamics in SES. In Ethiopia, for more than four decades, the issues of participation and collaboration have been widely discussed and narrated in the policy arena. However, evidently, the issue is practically absent on the ground. In line with this, one of the key informant interviews from the Yabello Drylands Pastoral and Agricultural Research Center saying goes like this:

Now a day it is common to hear the issues of participation of stakeholders and collaboration here and there while designing development and research projects here and there. But I am not sure that we have the technical capacity to do so. We just say it to attract the attention of donors to get funds.

## **3.2. Actors' connecting roles in the network and their importance**

To examine the importance of each actor in decision-making related to rangeland management, degree centrality and *betweenness* centrality were assessed. Table 1 provides the top ten popular actors in the rangeland governance networks. The number of collaboration links reported by a given actor (outdegree) reflects the role of that particular actor in the governance network. In Borana rangeland governance networks, BZEPOAO (Borana Zone Environmental protection and land Administration Office) (13) and SAVE (Save the Children) (13) listed the greatest number of actors to collaborate with (Table 1). Most of the actors who were playing a key role in the network were found to be government organizations. Non-government organizations such as SAVE and GDPI (Gayo Pastoralist Development Initiative) also reported a high level of collaborations indicating they are actively involving in the rangeland governance.

Table 1  
Top ten actors' centrality scores in Borana rangeland governance network

Actor	OutDegree	InDegree	Betweenness
BZEPOAO	13	13	460
SAVE	13	7	351
YADELAO	11	12	353
BZPDO	10	15	373
YDPDO	10	18	429
GPDI	9	8	272
YDCPO	9	10	351
HUP	8	5	43
MEFC	7	4	170
SORDU	6	4	57
Mean of total links	3.96	3.96	102
Network Cent. index	17.7%	27.5%	13.8%
Source: Computed from the network survey, 2016			

Looking at the *indegree* (popularity or visibility of an actor to others), YDPDO (Yabello District Pastoral Development office) (18) received the greatest number of nominations as a collaborator followed by BZPDO (Borana zone Pastoral Development office) (15) (Table 1). An *indegree* score indicates how much an actor is prominent or visible to other actors in the networks (Dkamela *et al.*, 2014). Accordingly, YDPDO was found to be the most powerful and influential of all actors in the network.

Table 1 Top ten actors' centrality scores in Borana rangeland governance network

The perceived dominance of the YDPDO and BZPDO is because, the formal functions in controlling pastoral issues are mainly assumed by these government organizations. Overall, almost all actors from the top ten popular actors belong to government organizations. To visualize each actor's connecting or bridging roles, we analyzed *betweenness* centrality scores for each actor. The *betweenness* centrality measures how frequently an actor situated between two other actors, and high *betweenness* centrality scores reflect that an actor holds a favorable position for facilitating and controlling communication flows which in turn indicate a position of brokerage (Hannemann and Riddle, 2011). In our case, the *beteeownness* centrality index was found to be 14% indicating poor network closure and hence, poor governance outcomes (Sandström and Rova, 2010).

Figure 2 Social Network of Rangeland Governance in Borana, Yabello district

### Note

The red arrow indicates non-reciprocated collaboration and blue arrows stand for reciprocated relationships. Pink Square: NGOs, Black Square regional: GOs, Red square: Zonal level GOs, Green Square: Private organizations, Blue Square: Local Organization, Gray Square: District Level GOs, Light Blue: Federal Level GOs.

Actors such as BZEPOAO, YDPDO, YADELAO, YDCPO and SAVE had higher *betweenness* centrality scores (Table 1), reflecting their role in brokering the connections of different actors who are themselves disconnected. Despite dominant roles of connecting different actors, SAVE, one of the non-government actors, hold a second rank in connecting different actors, indicating the organization is playing a considerable bridging role.

## 4. Conclusions

This section made its departure from the assumption that collaborative governance involving various state and non-state actors is a venue to reverse the current deterioration of SES resilience of the Borana rangelands by addressing the complexity posed by climate and socio-political change. It has become clearer and clearer that as opposed to hierarchical and top-down forms of governance, network forms of governance facilitate both horizontal and vertical interconnection of actors, bring different perspectives and sources of knowledge, develop shared values and develop innovative solutions to the wicked rangeland problems. In view of this, by analyzing social networks, it was attempted to identify the structural gaps that result in misfit in the Borana rangeland SES.

As evident from the low level of network density, there are very few horizontal and vertical interactions and linkages among actors in the Borana rangeland governance. Such a poor linkage considerably blocks flows of knowledge, experiences and other resources indicating inability of the governance system in facilitating the solidification of shared values and joint action. It has been argued that environmental problem is inherently complex issue demanding an integration of scattered resources and capacities distributed across scales, sectors and domains of governance system (Bodin and Crona, 2009).

More importantly, in countries like ours, where problems of limited human and other resources is very common, governance system that enables the integration of scattered fewer resources and coordination of action is essentially recommended. Unfortunately, rangeland governance system in Borana is hampered by absence of adequate network heterogeneity and closure which in turn blocks the building of collaborative visioning and an efficient use of available resources to address complex problem. Thus, this study suggests that policy environment that can create conditions for more collaboration, strength of actors ties, development of trust and social capital and enabling the design of effective collective efforts should be put in place.

The study was also attempted to identify the actors that were playing the most important roles in bridging actors who are not connected otherwise. In the network, one of the government actors, Yabello District Pastoral Development Office (YDODO) was nominated as the most important collaborative actor by other organizations (in-degree value) followed by r followed by the Borana zone Pastoral Development office (BZPDO), reflecting these organizations are more responsible to deal with rangeland management issues and in attempts to enhance of the Borana SES will be more benefited from involving these key organizations. One of the limitations of this investigation was that it only focused on the general collaboration of actors. It failed to look into various relational patterns in the network such as information and other resources flows, policy influence, power relationship, and etc. Further research on the flows of these resources could inform a better design of joint action for adaptive governance of the rangeland SES.

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## Declarations

The authors declare no competing interests.

## Figures

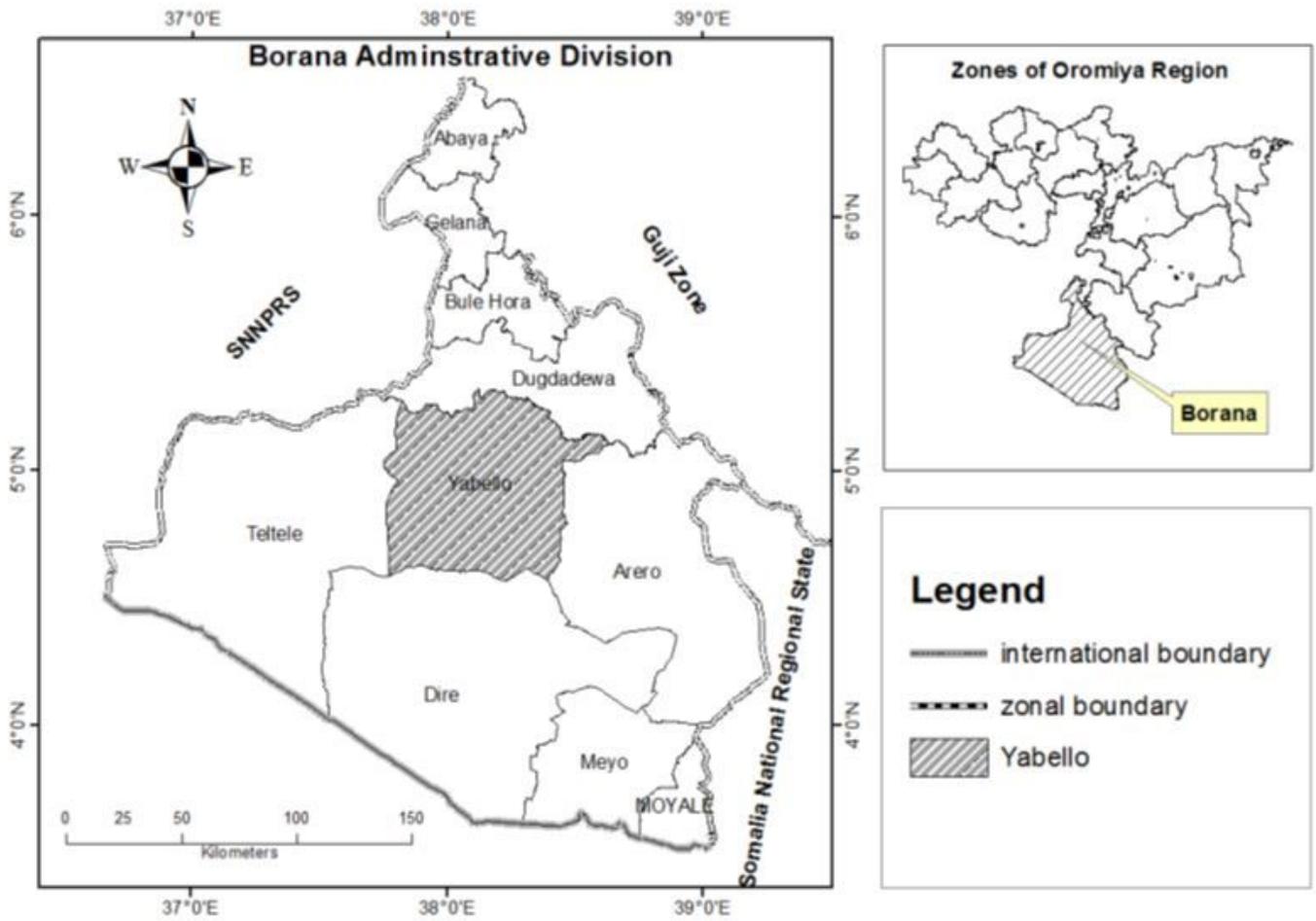
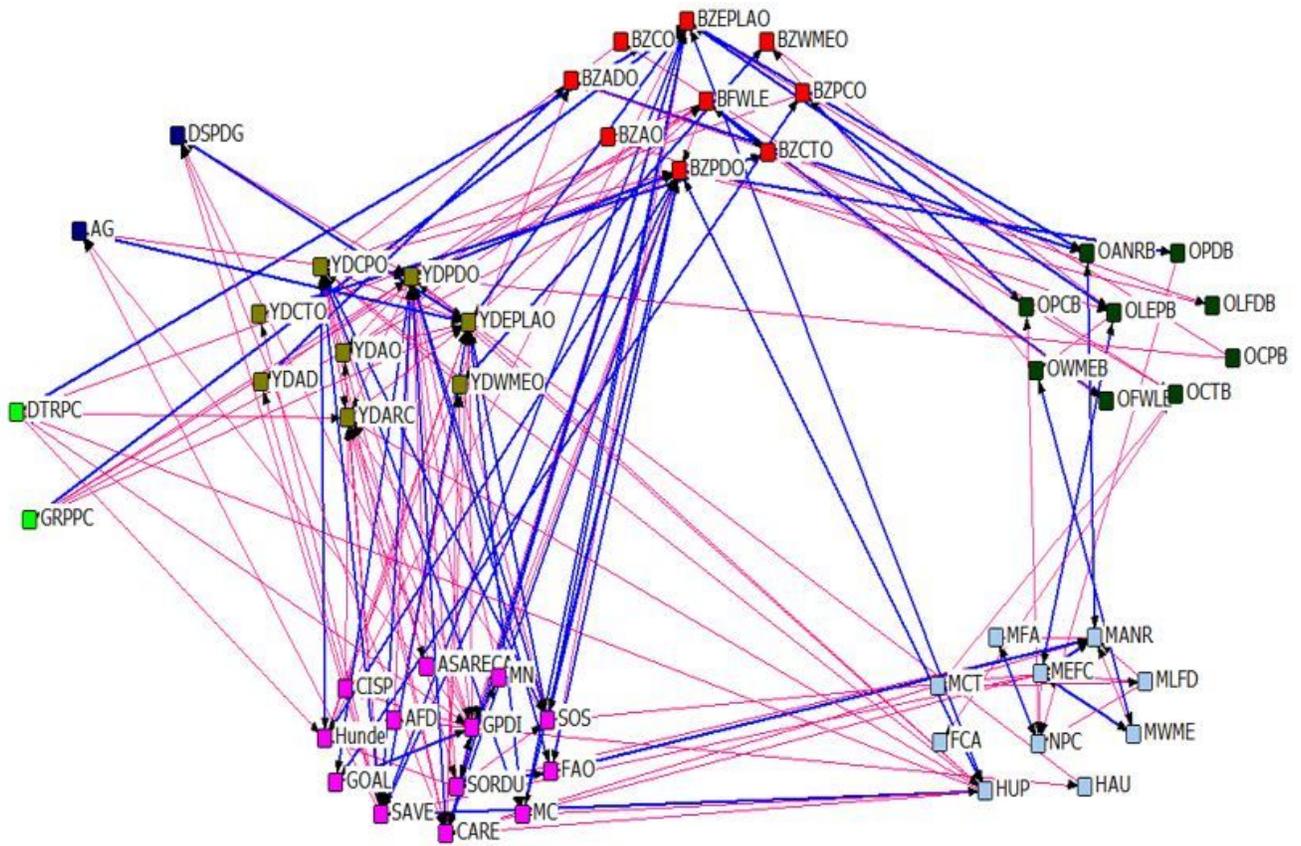


Figure 1

Study location, Source: Tolossa (2018)



**Figure 2**

Social Network of Rangeland Governance in Borana, Yabello district