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Matrilineality, Water Knowledge and Networks, and the Position of Women in Rural Tanzania

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Abstract

This article reports on a study of the effect of matrilineality on a community's social fabric in the Morogoro region of Tanzania. We used water information-sharing networks as a proxy for social interaction, with water accessibility, functionality, and quality being highly problematic in the area under study. This is a situation that particularly affects women, who are generally responsible for household water provision yet are excluded from water management institutions. Drawing on network and survey data and focus group discussions, the differences in inter-gender interaction, inclusiveness, and women's status were explored by comparing a matrilineal and mixed patri-matrilineal community. We found less gender homophily and exclusion of women divorcees in water-related information networks in the matrilineal community. In both villages, chairmen received and shared most water information while women acted as informal information hubs. While there was no clear difference in women's participation in local water decision-making bodies between the two communities, intrahousehold decision-making data showed that women in the matrilineal community made more decisions on their own regarding water investment.

Keywords: Matrilineality, Water information-sharing networks, Social network analysis, Ecofeminism, Ecology, Tanzania

Introduction

While patrilineality is dominant in most societies, the presence of matrilineality (lineage and inheritance passing through the female line) alongside patrilineal communities offers an opportunity to compare the effects of different kinship systems in settings that share similar characteristics. Recently there has been an increasing scholarly interest in exploring associations between kinship systems and gender-based differences in various dimensions of political, economic, and social behavior (see Brulé & Gaikwad, 2021; Gneezy et al., 2009; Gong & Yang, 2012; Gottlieb & Robinson, 2016; Lowes, 2021; Narciso & Henriques, 2020). In their study of Malawi, where 75% of the population is raised in a matrilineal community, Gottlieb and Robinson

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(2016) highlighted that gender gaps in political and civic participation were smaller in matrilineal ethnic groups compared to patrilineal and mixed-descent groups. Similarly, matrilineality has also been associated with higher intrahousehold bargaining power because of its effect on women's independent access to inheritance and maintenance of social networks and support after marriage (De Backer et al., 2021). However, other studies have shown that matrilineality does not make much difference, as decision-making ultimately remains in the hands of men, more specifically in these studies, the maternal uncle (Clark, 2010; Narciso & Henriques, 2020). This also holds for men's dominance in formal positions of state power and authority, such as representation in various layers of state administration (Brulé & Gaikwad, 2021).

Adding to this strand of literature, our inter-university study involving a team of researchers from Mzumbe University (Tanzania) and the University of Antwerp (Belgium) compared the water information-sharing networks of a matrilineal and a mixed patri-matrilineal rural village in Southwestern Tanzania. Water accessibility, functionality, and quality are still problematic in Tanzania; by the end of 2019, almost 30.2% of rural water points were non-functional, with many becoming non-functional within a few years of construction (United Republic of Tanzania, 2020). In 2020, on average, 40% of rural dwellers still relied on unimproved infrastructure and surface water as primary sources of drinking water (WHO & UNICEF, 2021). The problems of water accessibility and quality are even greater in our study villages, where, in 2019, about 70% of households relied on unimproved water sources, and 33% spent more than 30 minutes fetching water. This particularly affects the time and energy of women and children, as they are primarily responsible for managing household water for drinking, cooking, and washing, while remaining largely excluded from water resource management (Coulter et al., 2019).

Over time, the gendered nature of water issues has become more widely acknowledged in international global water and development agendas, such as the 1992 Dublin International Conference on Water and Environment and the SDG Goal 6 on clean water and sanitation (UN, 2019). However, this focus has not been translated adequately into mainstream environmental and ecological studies. Studying the intersection between gender and ecology is at the core of ecofeminist studies. While there are different strands within ecofeminism, the general idea is that access to and control over natural resources (management) is highly gendered (Banford & Froude, 2015; Laplonge, 2016; Mukherjee, 2020). Focusing specifically on water, numerous studies in the context of Sub-Saharan Africa have highlighted that women are heavily involved in collecting water, but they are often excluded from water management, information sharing, and policy and decision-making (Coulter et al., 2019).

Drawing on the observation that women are usually more dependent on and more knowledgeable about water—as they often note changes in water quality and other water-related problems (Andajani-Sutjahjo et al., 2015)—ecofeminism also advocates for greater participation of women in management and decision-making, which might also contribute to sustainable environmental solutions (Parpart, 2000). Over time, there have also been lively debates within ecofeminism and feminist ecology concerning oversimplification and essentialism, in which gendered relations to water (and the environment) are simply linked to the attributes and bodies of men and women. It is argued that a more nuanced gender perspective on the constraints, interests, and opportunities is needed to better understand men's and women's involvement in formal and informal decision-making arenas and networks (Laplonge, 2016; Warren, 2000).

However, exploring the effect of gender norms is not straightforward, as changes in gender relations often take time, which means that disentangling the effect of such changes from other factors is challenging. A compelling alternative is to compare communities that share similar

climatic and environmental characteristics but that differ in kinship systems, which usually involves different gendered power structures. As discussed in Sruthi and Mukherjee (2020), the inclusion of a matrilineal ethnic community, in particular, is interesting from an ecofeminist perspective because of the higher status that women usually have in such communities. This is precisely what we did in our study comparing water information-sharing networks among the matrilineal Luguru and the adjacent mixed patri-matrilineal community.

More specifically, we compared the sharing of water-related information between men and women, the type of actors occupying central positions in the networks, and the extent to which communities excluded or discriminated against certain social profiles when sharing water-related information. We used a comparative case study design (Yin, 2018) drawing on a mix of quantitative and qualitative research methods. We mapped social interaction by collecting and analyzing network data of all members in the community to identify the people with whom they shared information about water. We used Social Network Analysis (SNA) and enriched the results of the SNA with qualitative data from focus group discussions. The use of SNA is also particularly interesting from an ecofeminist perspective. SNA is currently on the rise in ecological studies (Barnes-Mauthe et al., 2015; Stein et al., 2011; Ruzol et al., 2017), as it is particularly apt for studying interactions between humans and nature. However, thus far it has remained underexplored in ecofeminist research, which is surprising given the focus on the interplay between social and environmental inequalities and the call to study and take action on them together (Mallory, 2013).

Water Information Sharing

The importance of access to clean water as a basic human right is evident, above all, from its prominence among the SDGs (UN, 2019). Poor water quality brings water-borne diseases that globally lead to the daily deaths of almost 1,000 children from preventable disease (UN, 2019). Having information on the quality of the water, as well as on how to prevent water-borne diseases, can thus save lives. However, water is not just a basic necessity; it can also play a crucial role in social relations, for example, through the geographical unequal distribution of water (Thompson, 2016). Social relations also have an impact on the information-sharing practices related to water services.

Access to information is also a basic human right (Neuman, 2016). Information and access to it can help people overcome barriers and obstacles to development and create new opportunities (Dewachter et al., 2018; Neuman, 2016; Marcella & Chowdhury, 2018). There are multiple ways to access information, and thus also multiple ways to be excluded and/or discriminated against in gaining such access. There are not only economic barriers to access to information but also social barriers (Chatman, 1996). Particularly when information is shared orally, social barriers such as age, hierarchical power structures, stigma, and culture can constrain access (Lingel & Boyd, 2013; Marcella & Chowdhury, 2018). When researching access to information, it is thus important to keep in mind the social contexts of information-sharing practices and how privilege can shape both information and access to it (Lingel & Boyd, 2013). This politics of information has boundaries, insiders, and outsiders as well as spatial, temporal, and intellectual dimensions (Lingel & Boyd, 2013; Yu et al., 2016). This is in line with how social information-sharing networks work.

Since information on water is socially embedded (Dewachter et al., 2018), it is necessary to look at the interactions between social and ecological systems (Barnes-Mauthe et al., 2015). Moreover, as social roles in relation to water vary for different actors (Sultana, 2009), their access to information on water can also differ. While women often have a water provision and household

management role, men are more often involved at the policy and political levels (Coulter et al., 2019). Additionally, as discussed by Harris and associates (2017), differences in knowledge may further be entrenched through differential participation in water management institutions and water information-sharing networks. In her research on south-eastern Turkey, Harris (2005) showcased how women were often marginalized from water user groups in newly irrigated areas, a situation that excluded women from access to the training, resources, and networking possibilities available through those institutions.

A social network perspective helps in analyzing access to information in social-ecological systems, which has contributed to an increase in the popularity of social network analysis (SNA) in studies of water governance and social-ecological systems (Dewachter & Holvoet, 2017; Dewachter et al., 2018, 2019; Barnes-Mauthe et al., 2015; Holvoet et al., 2016; Stein et al., 2011; Ruzol et al., 2017). This same interplay between (gendered) social structures and ecological processes is at the core of ecofeminism.

Gender, Marital Status, and Matrilineality

As highlighted above, studies that focus on associations between matrilineality and gender gaps in access to and control over different types of resources are on the rise, without, however, coming to an unequivocal conclusion. The different findings might be explained to some extent by the fact that matrilineality is not a uniform category. A distinction is usually made between matrilineal affiliation, matrilineal inheritance, and matrilocal residence. The first refers to kin membership that passes through the mother; the second is related to intergenerational property transmission which also follows the female line (i.e. men's property is inherited by male members of his matrikin instead of his own children, women's property is inherited by her daughters); while the third, matrilocal residence, describes the practice of residence in the wife's natal home or village. Matrilineal kinship systems usually have two of these three features (Narciso & Henriques, 2020).

As actual practices and experiences are often complex and diverge from what is commonly known and expected, case studies which focus on specific communities might be particularly useful for gaining a better understanding of the characteristics and implications of different systems. This study focuses on the Luguru, who live in the Uluguru mountains in the Morogoro district of Tanzania. According to Murdock's *Ethnographic Atlas*, the Luguru/Walguru are matrilineal and practice matrilineal descent, while the inheritance rule for fixed property such as land is matrilineal through sister's sons (Murdock et al., 1999, 2023). Cross-cousin marriage is preferred, and marital residence is matrilocal, with men residing with their wife's kin. Divorce is not difficult and may be initiated by either spouse (Beidelman, 2017, p. 31).

Our own previous research in some Luguru villages (De Backer et al., 2021) has highlighted the importance of women's independent access to land, which increases their social and material security and contributes to a higher intrahousehold bargaining position, particularly regarding children and kinship matters. The latter is also influenced by the fact that women can easily ask for a divorce, while matrilocal residence also increases access to social capital, as it helps women to maintain networks after marriage. However, and in line with Englert (2008) and Hartley and Kaare (2001), we have also noticed that matrilocal practices are declining and evolving towards a patrilineal model, particularly in less mountainous areas, which leads to a patrilineal-matrilineal division being more of a continuum on the ground.

Study Site and Methodology

Comparative Case Study Design

To study associations between different kinship systems and water information networks, our interuniversity team of three researchers and eight students (who were involved in data collection) used a comparative case study approach, which allows the study of social interaction, power, and inclusiveness in depth while taking context into account (Bartlett & Vavrus, 2017). In terms of research paradigm, we adopted a realist position, holding the middle ground between positivism and constructivism (Molteberg & Bergstrøm, 2000). To explore the effect of matrilineality, we selected two villages that were very similar in terms of size, climatic and environmental conditions, and access to water and other facilities. One village belonged to a matrilineal Luguru community, and the other had evolved towards a mixed patri-matri system because of the influx of other ethnic groups. Villages were selected based on an interview (conducted on 3 March 2019) with our key expert, Dr. Elizabeth Lulu Genda, a senior lecturer in Gender Studies at Mzumbe University.

The lead researcher and first author together with our team of eight studentsT visited the villages, introduced the project to the village leaders, and asked for their consent to conduct research in their community. As both villages were quite large, consisting of approximately 459 and 330 households, respectively, one sub-village (hamlet) of approximately 100 households was selected in each village, which allowed the inclusion of the entire hamlet (adults above 18) in our research population and to explore water information networks in depth. To select the hamlets, basic information was gathered through visits to the villages, and a map was drawn with important markers and water points. Based on this information, comparable hamlets were selected, with households having access to basic medical facilities and primary schooling, while access to clean water was limited, with only one water point being functional.

In both settings, women were responsible for fetching water, unpaid care work, and household maintenance in general, while, as expected, differences were observed related to the kinship system. In line with the discussion above, matrilocality was practiced and property passed through female lines in the matrilineal village, while the opposite occurred in the mixed community. Overall, men and women interacted more among the Luguru, from childhood onwards, with boys and girls walking to school together, while in the mixed village, a woman could not be alone with a man with the exception of her husband. Divorce was not considered a problem in the matrilineal community, as our key expert Dr. Genda stated: “You can divorce someone and marry someone else the next day, whereas in a mixed community, people who divorce are ‘punished’ socially, since the community does not want to ‘dilute’ social norms of patrilineality. Divorcees are frowned upon and excluded” (Personal interview, 3 March 2019).

In order to gain an in-depth understanding of the similarities and differences between the two communities in terms of water information networks, our comparative case study drew on and triangulated a combination of qualitative and quantitative data collection methods (Yin, 2018).

Social Network Analysis

Social network analysis (SNA) is a quantitative method that is used to map and analyze relationship ties between people (Faust & Wasserman, 1994). It uses sociograms and graph theory, representing people as nodes and relations as ties, edges, or lines. SNA can analyze the structure of a network as well as the position of a node (actor) in the network. When conducting SNA, it is important to first define the nodes, ties, and boundaries of the network (Borgatti & Halgin, 2011;

Stein et al., 2011). The choice of these three aspects is of crucial importance as they help define the network (Borgatti & Halgin, 2011).

In this study, the nodes were the villagers of the selected hamlets and the ties were the exchange of information related to water services, including quality, functionality, access, budget, and management. Defining the boundary of a network, however, is often a challenging task (Marsden, 2005), especially when there are no clear boundaries to social networks. When important actors in the information flow are not included within the network boundaries, this can significantly change the results of the study and even give rise to misleading results. To accommodate this challenge as much as possible, we selected hamlets that were socially distinct geographically.

Nevertheless, it was not possible to avoid the involvement of actors who were not residing within the network boundaries. In the matrilineal hamlet, 29 people who did not belong to the research population were mentioned in relation to the network question "with whom did you share information about water during the last year?". The mixed patri-matrilineal community had 30 actors who were not within the network boundaries. Some studies deal with this kind of overlap by including these outside actors in the research, so as to have complete network data (Stein et al., 2011). We chose not to do so in our study as none of the outside actors had more than two ties to actors within the boundaries, and thus did not have a central position within the network. However, other actors who did not reside within the geographical boundaries of the network were included in the boundaries set for this research, as they were "duty bearers"who are people with an official responsibility regarding water services. These duty bearers included the village chair, the Village Executive Officer (VEO), Community Owned Water Supply Organisation (COWSO) members, and hamlet leaders, also often called street chairmen.

The software used for the SNA is UCINET (Borgatti et al., 2002) which also comes with a tool to visualize networks, called Netdraw. The software can calculate network properties at different levels of the network (network, group, or node level). All the different network measures relevant to this study are explained in Table 1.

Table 1: Overview of SNA Measures Used in the Study

SNA Measure	Explanation
Density	Density can be used as a measure of group cohesion (Stein et al., 2011, p. 1089). It is calculated by taking the number of ties in a network and dividing it by the total number of possible ties (Borgatti et al. 2018, p. 336).
Average Degree	The average degree is the average number of ties for each node (Borgatti et al., 2018, p. 17). It thus provides insights into how well connected a network is in general, or how well-connected groups are.
Diameter	The diameter of a network is useful in investigating the reach of a network. The diameter is the longest shortest path between any two nodes (Borgatti et al., 2018). It thus indicates how long it maximally takes to reach any node (Hanneman & Riddle, 2005).
Degree Centralization	Degree centralization measures the extent to which the ties are centered on certain actors (Stein et al., 2011, p. 1090). High degree centralization means that most of the ties are centralized around a few actors. Low degree centralization is equivalent to a decentralized network (Borgatti et al., 2018; Hanneman & Riddle, 2005). Degree centralization can be divided into in-degree and out-degree centralization (Freeman, 1978). In-degree centralization represents the incoming ties and out-degree centralization the outgoing ties (Freeman, 1978). Degree centralization is a network-level measurement.
Degree Centrality	Degree centrality is a measure of popularity and structural importance of actors in a network (Freeman, 1978; Borgatti et al., 2009). It measures the number of ties, and the actor with the most direct ties is the most important actor in the network (Borgatti et al., 2018, p. 190). Degree centrality can be divided into in-degree and out-degree, representing incoming and outgoing ties (Borgatti et al., 2018, p. 202).
E-I Index	The External-Internal (E-I) index is a measure of heterophily (Borgatti et al., 2018, p. 337). It is measured as the number of external ties minus the number of internal ties divided by the total number of ties. The resulting value ranges between -1 (all ties are internal to the group, perfect homophily) and +1 (all ties are external to the group, perfect heterophily) (Hanneman & Riddle, 2005; Krackhardt & Stern, 1988).

Data Collection Methods

This research uses both quantitative and qualitative data collection methods as well as primary and secondary data. The latter include academic literature, government policy documents, and reports. Primary data was collected through surveys, focus group discussion (FGD), participant observation, and an expert interview. Between March 18-31 in 2019, survey data was collected in Swahili by eight Mzumbe University students with support from the first author. All respondents received a small amount of compensation for their time. The first part of the questionnaire included demographic data such as gender and marital status; the second part focused on water-related behavior and attitudes.

Social network data was collected in the third section by asking respondents whom they talked to about water. The social network part of the questionnaire allowed respondents to name up to 12 people, but no one filled in all 12 spaces. To ensure the anonymity of the villagers, codes were created for each respondent, which allowed us to identify the hamlet each individual was from and the individuals who belonged to the same household. In total, 121 households with 264 villagers and 90 households with 181 villagers were listed in the matrilineal and patri-matrilineal hamlets, respectively.

In addition to the semi-structured expert interview (interview, March 3, 2019) on Uluguru traditions and practices that also facilitated the selection of villages, focus group discussions

(FGD) were used to better understand the dynamics in the two communities and to validate the results of the questionnaire data and subsequent social network analysis. The gender-segregated FGD were conducted in Swahili on May 7-8, 2019. In the matrilineal village, 11 women (between 18 and 78 years) and 11 men (between 18 and 67) participated in the FGD which were segregated by gender. In the mixed hamlet, the women's focus group had 10 participants (aged between 18 and 54) while the men's FGD had 9 men (aged between 18 and 62). In order to include a broad perspective of opinions and ideas, we selected individuals from diverse age groups and with diverse educational and marital status. However, divorced and widowed women only participated in the women's FGD of the matrilineal community, while in all other FGD only the marital statuses of "never married" and "married" were represented.

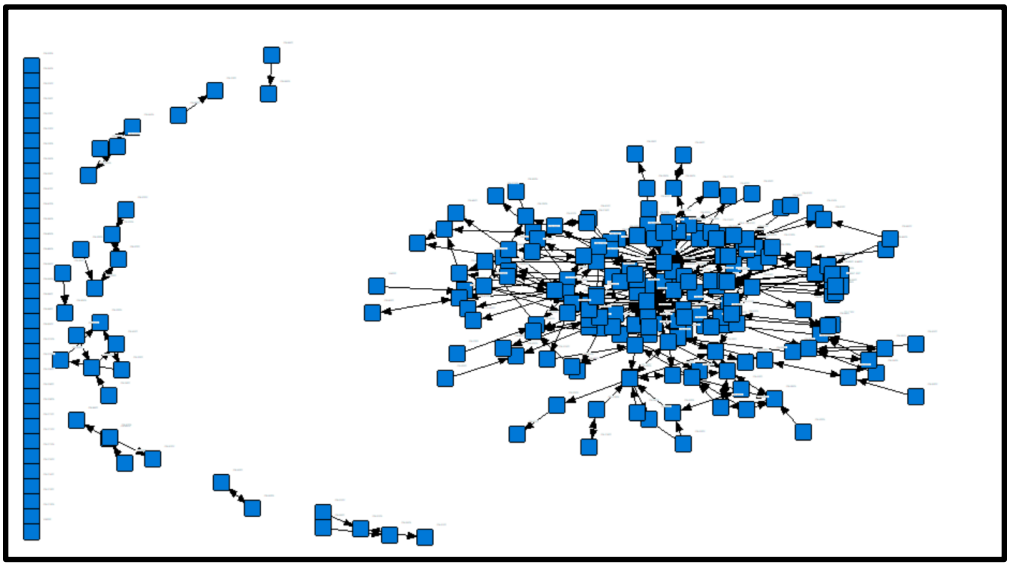
Throughout the primary data collection, and especially during the FGD, participant observation was used. While this methodological tool is influenced by the researcher's personal experiences, at the same time, it also allows the researchers to further enrich and interpret the data. For example, during FGDs, it became clear who was most vocal or if what was said corresponded with actual events. When visiting the hamlets, observation and interaction with the villagers during their daily activities produced additional information and experiences.

Results and Discussion

Describing the Networks

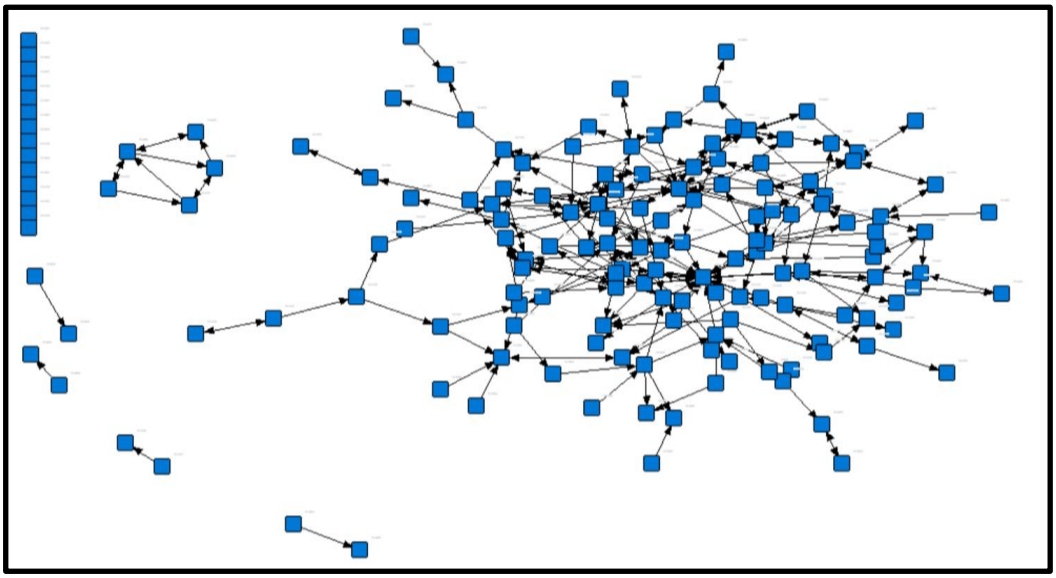
The information sharing networks for the two villages are displayed in Figures 1 and 2. These figures include the isolates and the duty bearers but exclude other people outside the boundaries. Isolates are actors that are not connected to any other actors (Borgatti et al., 2018). In the matrilineal and the mixed hamlet, 29 and 30 people, respectively, who were outside the set boundaries were mentioned.

Figure 1: Information Network Matrilineal Hamlet



Source: Authors' analysis

Figure 2: Information Network Mixed Patrilineal-Matrilineal Hamlet



Source: Authors' analysis

The matrilineal network (Figure 1) consists of 250 nodes and 346 ties, while the mixed network (Figure 2) has 159 nodes and 246 ties. Density measures in Table 2 show that, while the overall density measures are low, the latter network is relatively more dense, at 1% of all possible ties that exist, compared to the matrilineal network where just 0.6% of all possible ties exist.

Table 2: Network Characteristics

	Matrilineal	Mixed
Number of nodes	250	159
Number of ties	346	246
Average Degree	1.384	1.547
Degree Centralization	0.233	0.138
Out-Centralization	0.035	0.016
In-Centralization	0.216	0.137
Density	0.006	0.010
Diameter	13	19

Source: Authors' Data

Additionally, the average degree for the mixed network is higher than for the matrilineal, meaning that, on average, every person shares information about water with 1.55 others in the mixed network compared to 1.38 persons in the matrilineal network Both density and average degree measures show that the mixed hamlet has a slightly more cohesive water-related information network. Regarding the reach of the networks, the diameter is larger for the mixed compared to the matrilineal hamlet, which implies that it takes longer for information to reach the most far node in the mixed hamlet; in other words, the breadth of the network is smaller in the matrilineal community.

The centralization measures clearly differ between the two hamlets. Both the in-degree centralization and out-degree centralization are higher for the matrilineal community. Regarding out-degree centralization, which measures the degree centralization of outgoing ties, both measures (0.035 and 0.016 for the matrilineal and mixed hamlets, respectively) are fairly close to zero, meaning that quite a large number of villagers share information, not just a few. This indicates that water is a topic that is frequently discussed. The in-degree centralization is higher in the matrilineal (0.216) compared to the mixed community (0.137), and both are not as close to zero. This means that a few nodes are receiving more information, which is more pronounced in the matrilineal community, while in the mixed hamlet water-related information is reaching a more diverse group.

However, higher in-degree centralization is not necessarily a disadvantage for an information-sharing network. It has even been shown that highly centralized network structures outperform more decentralized structures as most information is bundled between a few people (Borgatti et al., 2009). These central actors are of crucial importance in an information-sharing network when it comes to wanting to improve the water situation. They can share information with both the villagers and other actors such as the ward and district authorities. When the information is less centralized, it is more difficult to collect it and share it with authorities. However, if most of the information is centralized among fewer people, they hold a relatively powerful position. If they do not use this information appropriately or share it with the right/influential people, the potential positive effect of high centralization may be wasted. Moreover, high centralization may also lead to greater inequality as less people receive the information.

Interaction

In non-matrilineal societies, much social interaction is often intra-gender, meaning women interact mostly with women and men with men, particularly in non-kin networks (D'Exelle & Holvoet, 2011). In line with the discussion above, this widely observed phenomenon of gender homophily is expected to be lower in a matrilineal society where women have a more important status and there is less restriction on women-men interaction beyond the kinship network.

Table 3 shows that in the mixed community, the number of intra-group ties which concern men-to-men and women-to-women interactions (diagonal in the table and highlighted in bold italics) are higher compared to inter-group (men-to-women and women-to-men) interactions. The intragroup densities (diagonal in the table and highlighted in bold italics) are the two highest densities and almost double the inter-group densities. Conversely, in the matrilineal community, the number of women-to-men ties (114) and density (0.007) (highlighted in italics) is highest. Interestingly, the other three densities are similar in size (0.005) and there is no obvious difference between intra-women (women-to-women) or intra-men (men-to-men) interaction compared to interaction between men and women. These results seem to confirm that, in the matrilineal community, the typical dominance of intra-group communication is a little more nuanced than in the mixed community.

Table 3: Inter- and Intra-Group Densities

Community	Number of Ties			Density		
Matrilineal		**Men**	**Women**		**Men**	**Women**
	Men	81	76	**Men**	0.005	0.005
	Women	*114*	75	**Women**	*0.007*	0.005
Mixed		**Men**	**Women**		**Men**	**Women**
	Men	***71***	41	**Men**	***0.012***	0.006
	Women	51	***83***	**Women**	0.008	***0.013***

Source: Authors' Data

The E-I index measures of homophily displayed in Table 4 further complement the analysis. As expected, the internally oriented E-I index (-0.274) in the mixed community confirms the dominance of within-gender information sharing. Overall homophily is found to be statistically significant in the mixed community, while in the matrilineal community the same significant dominance for within-group information sharing was not found. The overall E-I index for the matrilineal community is positive (0.043), meaning there is a slight tendency towards inter-group communication. While the E-I index is not significantly different from what could be expected from randomly distributed ties, it shows that in the matrilineal hamlet women are more outwardly oriented towards men and vice versa than in the mixed village. This is possibly the case due to the higher status and esteem attributed to women within the matrilineal community. Both measurements of homophily thus indicate that the typical intra-group communication is less prominent in the matrilineal community compared to the mixed community.

Table 4: E-I Indexes

Community	Gender	E-I index
Matrilineal	Men	0.003
	Women	0.087
	Overall	0.043
Mixed	Men	-0.25
	Women	-0.297
	Overall	-0.274***
*** E-I Index is significant ($p < 0.05$)		

Source: Authors' Data

Interestingly, findings from the FGD confirmed and complemented the analysis. In the mixed community, homophily was noticeable, with the men sitting together every evening. They explained that during these daily gatherings they discuss their activities and struggles, thus making it more likely they would talk to fellow men about water issues. For the women in the mixed community, the explanation for homophily was two-fold: on the one hand, it is the women who are responsible for fetching water and cooking, thus they understand the importance of water and it is easier for women to talk to each other as their experiences are the same. On the other hand, traditions also have an influence on the homophily among women in the mixed community. One focus group participant explained that men are not allowed to fetch water in their community, and she questioned how, in turn, they could talk to men about these water issues.

In the matrilineal community, the focus group results were, at first sight, less in line with the SNA findings, which also underscores the importance of triangulating among different data sources. Similar to the mixed community, women indicated during the FGDs that it was easier to talk to fellow women as they are responsible for fetching water and cooking. As they face the same challenges, they understand each other better. However, this did not imply that inter-group communication was not prevalent and higher in the matrilineal community. In the FGD, the women highlighted that it was easier to talk to other women, but when asked in the network survey to list all of the people whom they talk to about water, men were listed more often in the matrilineal than in the mixed community.

While our network questionnaire allowed us to capture the presence of inter-gender communication, an important phenomenon of female intra-group interaction would have gone unnoticed without FGDs. In matrilineal culture, young girls are taught to communicate to their mothers first because it is women who make the most important decisions in the family. This gender-based homophily linked to matrilineal culture was not captured through our SNA analysis as we did not include villagers under 18 years in our analysis.

Status, Power, and Influence

As discussed above, in matrilineal communities, women tend to have a higher status, more decision-making power, and a greater influence compared to a mixed community (Hamdani, 2001). It can therefore be expected that women in a matrilineal community will have a more central role in the water-related information network in comparison to a mixed community. This should translate into higher in- and outdegree centrality scores.

As can be seen in Table 5, the overall male indegree centrality (1.59)—that is the number of persons one receives information from—is slightly higher on average than the average indegree centrality (1.19) for women in the matrilineal community. This is even more so without isolates (1.93 for men vs. 1.29 for women). Nevertheless, the average outdegree centrality, i.e. sharing information with others, is slightly higher for women in the matrilineal community (1.49 for women vs. 1.28 for men), although when isolates are removed from the sample the difference becomes smaller (1.62 for women vs. 1.55 for men). In the mixed community, the male and female indegree centrality scores, which concern the number of persons one receives information from, are very similar on average among men and women (1.56 for men vs. 1.53 for women, and without isolates, 1.69 for men vs. 1.70 for women). Regarding outdegree centrality, similar to the matrilineal community, women on average have a higher outdegree centrality score (1.65 for women vs. 1.44 for men, and without isolates, 1.84 for women vs. 1.56 for men).

Table 5: Average Indegree and Outdegree Centrality

Community	Gender	N	Average Outdegree Centrality	Average Outdegree Centrality (without isolates)	Average Indegree Centrality	Average Indegree Centrality (without isolates)
Matrilineal	**Men**	123	1.276	1.554	1.585	1.931
	Women	127	1.488	1.615	1.189	1.291
	Total	250	1.384	1.587	1.384	1.587
Mixed	**Men**	78	1.436	1.556	1.564	1.694
	Women	81	1.654	1.836	1.531	1.699
	Total	159	1.547	1.697	1.547	1.697

Source: Authors' Data

Looking into the centrality scores in more detail (see Table 6), we see that two male duty bearers (namely the village chair and the street chair/hamlet leader) are extremely central in the information-sharing network of the matrilineal community, which could have skewed the results of the above centrality scores. In the matrilineal community, the remainder of the top ten scores for indegree centrality are far less skewed, with all of them having an indegree score of 4 and dominated by women (7 out of 10). In the mixed community, the skewness of the indegree scores by the duty bearers is lower. Although the top two scores also concern the village chair and the street/hamlet leader, the difference and therefore the skewness inducing power is far less.

Table 6: Characteristics of Central Actors

Community	ID	Gender	Marital Status	Indegree centrality
Matrilineal	V08S3P6	Man	Married	55
	V08S1P1	Man	Married	52
	C08H31P01	Man	Never Married	4
	C08H31P02	Woman	Never Married	4
	C08H36P02	Woman	Married	4
	C08H49P03	Woman	Divorced/Widowed	4
	C08H65P02	Woman	Married	4
	C08H78P01	Man	Married	4
	C08H78P02	Woman	Married	4
	C08H85P01	Man	Married	4
	C08H85P02	Woman	Married	4
	C08H95P02	Woman	Married	4
Mixed	V03S1P1	Man	Married	23
	V03S03P6	Man	Married	8
	C03H64P01	Woman	Married	6
	C03H55P01	Man	Married	5
	V03S3P2	Man	Never Married	5
	C03H02P01	Woman	Married	4
	C03H06P01	Man	Married	4
	C03H26P03	Woman	Never Married	4
	C03H33P02	Woman	Married	4
	C03H52P02	Woman	Married	4
	C03H65P01	Woman	Married	4
	C03H66P04	Woman	Divorced/Widowed	4

Source: Authors' Data

Drawing on our key expert interview, the centrality of the male duty bearer might be explained by the fact that in rural areas, and also within matrilineal communities, women are not so much interested in public functions, as it is difficult to combine them with household and agricultural duties. This particularly holds for water, as it is often a difficult topic that leads to considerable discussion about sensitive issues such as the collection of water use fees, and it is also characterized by power struggles between the different entities (such as the village council, COWSO, district) involved in the rural water sector (Holvoet et al., 2015).

Due to the skewness of the results related to the central role of the duty bearers, it is relevant to do an analysis of the dataset omitting the duty bearers. As can be seen in Table 7, after removing the duty bearers, compared to men, women are on average more central, both in outdegree centrality (sharing information with others) and indegree centrality (receiving information), and in both the matrilineal and the mixed community. Based on the focus groups, this makes sense. While women do not have formal decision-making powers regarding water in any of the communities,

they are clearly more knowledgeable about water-related issues and thus function as informal "water information hubs."

Table 7: Average Indegree and Outdegree Centrality without Duty Bearers

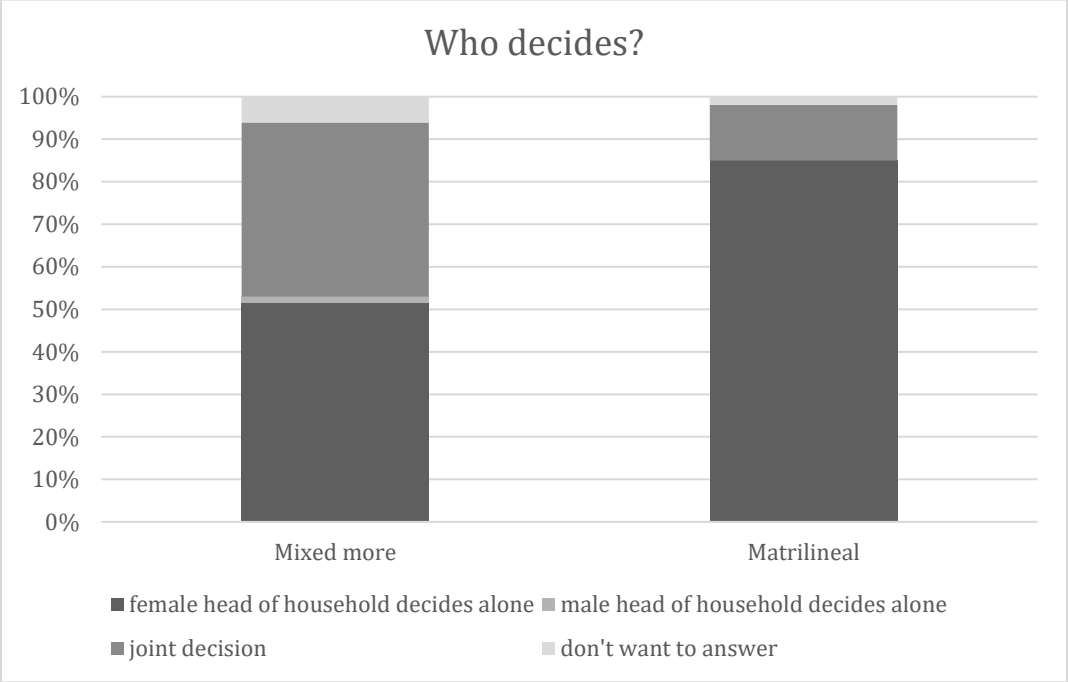
Community	Gender	N	Average Outdegree centrality	Max Outdegree Centrality	Average Indegree Centrality	Max Indegree Centrality	N top 3 Indegree Centrality
Matrilineal	**Men**	117	0.880	4	0.718	4	4
	Women	126	0.968	4	1.119	4	13
	Total	243	0.926	4	0.926	4	17
Mixed	**Men**	73	1.233	4	1.110	5	3
	Women	80	1.4	4	1.513	6	7
	Total	153	1.320	4	1.320	6	10

Source: Authors' Data

While women in the matrilineal community also do not necessarily take central positions in formal decision-making at the community level, it would be interesting to see whether this also held within the household. Overall, and in line with the gendered division of labor, it might be expected that women in all villages make most of the decisions about household water fetching. However, regarding investment in water treatment, the situation might be different, as this is not simply a water question but also a budgetary question (De Backer et al., 2021). Therefore, in a patrilineal society, it would be expected that this decision would not fall entirely under a woman's decision-making power. However, in the Luguru community, although sometimes it is the uncle who has decision-making power to a certain extent, we expect intrahousehold decision-making regarding water investment to be different.

Comparing the findings from the survey, as presented in Figure 3 below, it is apparent that in the matrilineal community, 85% of the women report making these investment decisions alone, compared to just 51.5% in the mixed community. In the latter, 41% stated that, in their household, it is a joint decision, compared to just 13% in the matrilineal community.

Figure 3. Intrahousehold Decision-Making about Water Investments



Source: Author's Data

Based on the results and analysis above, it seems that the hypothesis that women have more status, power, and influence in the matrilinear community needs to be somewhat qualified, as it does not necessarily translate into women taking up more public leadership positions or public offices, which could interfere with other priorities. However, after removing male duty bearers, their centrality increased significantly, which suggests that they do act as a kind of knowledge/information hub in relation to water issues. In line with this, and even more clear from the results, is that at the household level women in the matrilineal community are much more inclined to make investment decisions without consulting their spouse, compared to the mixed community.

Inclusiveness

As discussed above, divorce is perceived differently among the Luguru, as compared to the mixed community. While divorce tends to lead to exclusion in the case of the mixed community, in a matrilineal setting, there was no stigma surrounding divorce and separation. Thus, it was expected that the matrilineal community would be more inclusive than the mixed community in this regard.

To measure inclusiveness, the number of isolates could be used. Isolates are those people who did not share information about water with anyone and were not mentioned as a contact by any other person, and thus are disconnected from the information-sharing network. As can be seen from Table 8 below, the mixed community has fewer isolates compared to the matrilineal hamlet. Even when looking at the number of isolates proportional to the size of the entire network, the conclusion that the mixed community is more inclusive than the matrilineal still holds.

Table 8: Isolates (Disaggregated according to Gender and Marital Status)

Community	N of Isolates	% of Isolates	% of Women Isolates	% of Married Isolates	% of Divorced/Widowed Isolates	% of Single Isolates
Matrilineal	32	13	31	66	3	31
Mixed	14	9	57	50	29	21

Source: Authors' Data

To explore the inclusiveness hypothesis further, we can look at the profiles of the isolates. What is clear, as can be seen in Table 8 above, is that, in the mixed community, women (57%) are overrepresented among isolates, as are divorcees (29%). In the matrilineal community, it is the opposite; only 31% of isolates are women and 3% are divorced, while 66% of isolates are married, compared to 50% in the mixed community. Particularly for divorced women, being disconnected from the water information network is challenging as it is highly unlikely that they are connected through other household members, while it might also indicate isolation from other non-water-related networks.

Conclusion

The aim of this study was to empirically analyze whether there is a difference in women's status, inter-gender interaction, and the degree of inclusiveness between a matrilineal and a mixed matri-patrilineal community. This was done using survey and network data gathered in two rural villages in Tanzania, of which one was matrilineal and the other mixed. The SNA data and analysis was further enriched by information gathered from focus groups, an expert interview and observation. We specifically focused on water information-sharing networks as a proxy for social interaction with water accessibility, functionality and quality being highly problematic in the area under study. This is a situation that particularly affects women and children as they are primarily responsible for household water provision while being often excluded from official water management institutions.

In this study, our three focus points were developed into three hypotheses concerning: the interaction between the community members, the position of women within the communities, and the inclusiveness of these societies. From the analysis, it became clear that there was more intra-gender (women-to-women, men-to-men) interaction in the mixed community compared to the matrilineal community, confirming the hypothesis of more inter-gender interaction in matrilineal communities. Our SNA analysis was further complemented by the findings of the focus group discussions, which highlighted that, although inter-gender interaction, especially women-to-men, was more predominant in the matrilineal community, intra-gender interaction also continued to play a key role. For example, young girls, not included in the social network analysis, are taught to communicate with their mothers first because it is women who make the most important decisions in the family.

The analysis then focused on the status of women within the communities. While literature suggests that women in matrilineal communities are likely to have a higher status, more power, and more influence, the latter can only be cautiously confirmed by our findings. The most central actors in the information network of both communities are the village chair and the hamlet leader, both of whom are men. However, when these duty bearers were left out of the analysis, it became clear that women had a more central role in the information-sharing networks in both villages.

This suggested that they functioned as informal knowledge hubs, although women in the matrilinear villages were not any more central than women in the mixed villages. However, while there did not seem to be a clear difference in female public power among matrilineal and mixed communities, our findings related to intra-household level decision-making suggested a clear difference in the status of women within the household. Survey data on intra-household decision-making highlighted that women in the matrilineal community women made more decisions alone regarding water investment, compared to women in the mixed hamlet.

Finally, to test differences in inclusiveness between the different communities, we first looked at the number of isolates in each network. Based on this, it became clear that the matrilineal hamlet had a higher proportion of persons disconnected from the network. However, when analyzing the profiles of those isolates in more depth, it became clear that, overall among the isolates, women were more overrepresented in the mixed compared to the matrilineal community. Interestingly, while 29% of the isolates in the mixed community were divorcees, this was only 3% in the matrilineal hamlet. These findings are in line with qualitative evidence about the sharply diverging perceptions of divorce in the different communities and also reflected in the marital composition of the women's focus groups.

However, these analyses and conclusions should be interpreted with caution, as there are several limitations to this study. Firstly, SNA data is based on network boundaries, which means findings are affected when people fall outside the network boundary. As our own study highlighted, excluding children below 18 left one important feature of intra-gender interaction between daughters and mothers hidden, which underscores the importance of triangulation with other data sources. Secondly, matrilineality and patrilineality can be interpreted and expressed in different ways in different communities, which puts the external validity of the findings into perspective. To increase the external validity of this study, it would need to be repeated in different villages and even in different countries or areas.

Despite these limitations, this study makes a unique contribution in several areas addressed by the academic literature and could, additionally, be relevant to policymakers or organizations working with water-related issues. Information on water (quality, access, and treatment) is of great importance, due to the nature of water as a necessity for life. The factors that influence the way this information travels, as discussed in this study, may also be relevant in the formulation of water-related policies.

This article clearly illustrates how policy makers could benefit from in-depth community mapping studies before engaging in interventions or public policy-making to know how social interaction is structured, who the key stakeholders are, while also profiling who is (more) isolated within the social fabric and therefore more difficult to reach by their policies and interventions. This type of sociologically fine grained interventions can be more targeted and socially savvy than a one-size-fits-all approach for all communities, contributing in this way to more successfully reaching policy targets. As such, policy makers working in matrilineal communities should take into account the specificity of these communities. The latter does not imply blindly assuming all decision-making power is concentrated among women. Our results nuanced this blunt view by showcasing that public decision making remains mostly concentrated in the hands of a few male duty bearers, while more invisible decision making power, both at the level of the household as well as in the capacity of informal water knowledge hubs, is vested more among female community members. Additionally, the fact that both intra- and intergender interaction are prominent channels for information-sharing, and that divorce is less of a driver for social isolation, can inform more tailormade support mechanisms in matrilineal communities.

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