

Research paper

Assessing nuanced social networks and its implication for climate change adaptation in northwestern Ghana

Rahinatu S. Alare^{a,*}, Elaine T. Lawson^b, Adelina Mensah^b, Armand Yevidé^c, Prosper Adiku^b^a Department of Environmental Science, C. K. Tedam University of Technology and Applied Sciences, Navrongo, Ghana^b Institute for Environment and Sanitation Studies, University of Ghana, P. O. Box LG 209, Legon-Accra, Ghana^c School of Tropical Forestry, National University of Agriculture, Benin

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ABSTRACT

The current uncertainty, frequency and intensity of climate change impacts limits opportunities for climate adaptation among smallholder farmers in developing countries. This paper seeks to critically examine how gendered relations at the household level influence access to social networks for climate change adaptation in northwestern Ghana. By doing so, the study contributes to an improved understanding of how inter-gender dynamics shape adaptive capacities among vulnerable groups. Using semi-structured interviews, focus group discussions and key informant interviews, a total sample size of 156 respondents were studied. The study also employed an intersectional framework and a network analysis to examine the nuanced networks of smallholder farmer households. Findings revealed that the interplay of age, marital status and educational levels influenced access to social networks for support in minimising climate risk. As such, promoting adaptation actions without addressing structural and relational inequalities within vulnerable communities may deepen existing inequalities.

1. Introduction

Climate change and variability impacts manifesting as dry spells, erratic rainfall patterns, floods and increasing temperatures continuously threaten water resources, ecosystems, food security and health of most countries, especially in developing countries (Niang et al., 2014). Africa is expected to be one of the continents affected by climate change and variability due to existing socio-economic challenges and over reliance on climate-sensitive sectors (Boko et al., 2007; Niang et al., 2014). These socio-economic challenges include high poverty rates, underdevelopment, high illiteracy rates, land degradation and policies that restrict agricultural development (Antwi-Agyei et al., 2014; Nyantakyi-Frimpong & Bezner-Kerr, 2015). In West Africa, climate projections indicate increases in temperature and rainfall (until 2100) with uncertainties surrounding precipitation (Riede et al., 2016). Since Ghana attained independence, the mean annual temperature has risen by a degree (1 °C), with Northern Ghana experiencing higher temperatures than the Southern part (Stanturf et al., 2011). However, rainfall trends in the country are highly variable, making it difficult to predict long-term trends (Stanturf et al., 2011). This has implications for many livelihoods, particularly, those that are highly sensitive to climate

change. It is, therefore, imperative to enhance the adaptive capacities of vulnerable groups whose livelihoods and well-being will be most affected by climate impacts.

While adaptation is not a new phenomenon among many African farming households, several studies on climate change have increasingly acknowledged adaptation as the major policy response to the detrimental impacts of climate change and variability among vulnerable populations (Adger et al., 2003; Bendito & Twomlow, 2014; Lahsen et al., 2010). Adaptation refers 'to the process of adjustment to actual or expected climate and its effects' (IPCC, 2014a, pg 118). However, the observed and future impacts of climate change and variability will be experienced disproportionately at scales and by social groups due to differences in exposure and sensitivities (IPCC, 2014b). Also, as the vulnerability of men and women is gendered and mediated through socio-cultural and political structures (Carr & Thompson, 2014), the underlying cultural values in these areas can constrain interventions or actions intended to improve the scope of adaptation (Pelling, 2011). As a result, viewing adaptation as an adjustment reinforces existing risk and its underlying causes rather than contesting it (Pelling et al., 2015). Yet, adaptation has always occurred at various levels (individual, community and government) and it is being motivated by several factors

* Corresponding author at: C. K. Tedam University of Technology and Applied Sciences, P. O. Box, 24, Navrongo, Ghana.

E-mail address: rsidikialare@cktutas.edu.gh (R.S. Alare).<https://doi.org/10.1016/j.wdp.2021.100390>

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(Adger, 2003). Smit and Wandel (2006) also note that adaptation can be reactive or anticipatory. Depending on the degree of spontaneity, it can be autonomous or planned (Smit & Wandel, 2006). For example, it may involve altering agriculture inputs or cycles, diversifying livelihoods, technological innovations or improving institutional structures (Amaru & Chhetri, 2013; Antwi-Agyei, Stringer, & Dougill, 2014; Nyantakyi-Frimpong & Bezner-Kerr, 2015).

In rural Africa, response to climatic and non-climatic stressors have always been carried out as a collective action due to inadequate and untimely external support (Adger, 2003; Yiran, 2016). At the community level, network structures are key elements in collective actions and foster a community's adaptive capacity (Adger, 2003). These network structures are referred to as social capital and often mediated through kinship, acquaintance, formal and informal institutions (Adger, 2003; Dapilah et al., 2020). However, social capital has become a contested concept as it is perceived to be conceptually rooted in an economic analysis which undermines democratic processes (Smith & Kulynych, 2002). Arneil (2006) asserts that social capital may reinforce power asymmetries in the governance of resources and may deny certain individuals or groups from accessing resources. Yet, these resources are vital for many livelihoods and household food security. Studies have also shown that the over-dependence on these resources, particularly, natural resources for livelihoods have implications on the sustainability of ecological systems and may further heighten risk (Dapilah et al., 2020).

Among the various forms of social networks, family connections is increasingly perceived as a key resource in times of distress and disasters (Adger, 2003; Aldrich & Meyer, 2015). However, the vulnerability of women in developing countries has increasingly been recognised in climate change and development discourses not because women are intrinsically vulnerable but as a result of existing gender inequalities and power relations embedded in families and societies (Arora-Jonsson, 2011; Pearse, 2017). As such, Adkins (2005) argues that, whereas the family is perceived as central to the establishment of social capital, social capital theorist often presents a simplified and polarised structure of the family model centred on heterosexual couple and traditional division of labour. Such assumptions reinforce female subordination and ignore the nuanced experiences of many women across the world.

Currently, the uncertainty, frequency and scale of climate change impacts present challenges to the sustainability of socio-ecological systems. However, a number of studies have critiqued the inability of existing literature to explicitly address social processes in the discussions of socio-ecological resilience, especially on the issues of power and agency (Carr, 2019; Nightingale et al., 2020). In addition, recognising that the vulnerabilities and adaptive capacities of men and women are gendered and influenced by socio-cultural, economic and political structures has underscored the importance of considering structural and relational inequalities in adaptation actions (Carr & Thompson, 2014; Ensor et al., 2019; Eriksen et al., 2021). Despite these challenges, fewer studies have explored how social relations shape climate change adaptation (Onta & Resurreccion, 2011). This paper seeks to critically examine how gender relations and structural inequalities at the household level influence adaptation in the context of social networks of farmers in Northern Ghana by using an intersectional framework. Specifically, we identified and mapped social networks in climate adaptation. This was followed by assessing the roles played by these networks in coping or adapting to climate risk. Lastly, we identified the barriers hindering the effectiveness of social networks access for climate change adaptation.

We have structured the article as follows. Section 1 begins with a brief discussion of the links between climate change, adaptation and social networks. This is followed by an overview of the interlinkages between adaptation, social networks and gender relations using an intersectional approach in Section 2. Section 3 gives a brief description of the study area and Section 4 describes the research approach. Section 5 presents the results, which are subsequently discussed in Section 6.

Finally, Section 7 presents the conclusion and policy recommendation.

2. Exploring the adaptation, social networks and gender relations nexus

Social analysis of climate change has increasingly gained traction in academic research and development as the impacts of climate change are known to be mediated through complex social structures and processes (Kaijser & Kronsell, 2014). However, Thompson (2016) notes that, while the framing of vulnerabilities in a single social variable such as gender, socio-economic status, race or ethnicity is important in highlighting unequal power relations, they further undermine and marginalise people who face a myriad of intersecting issues concerning climate impacts. As a result, the uptake of the intersectional framework as an analytical tool has increased in climate research to bring out the nuances in climate vulnerability (Kaijser & Kronsell, 2014; Lawson et al., 2019; Ravera, Martín-Lopez, Pascual, & Drucker, 2016).

Adaptation processes in local settings are often social and involve individuals drawing on collective resources to enhance their adaptive capacity (Adger et al., 2003). In resource-dependent communities, social networks are important sources of climate change information that lead to group innovation (Rotberg, 2013) and livelihood diversification strategies (Antwi-Agyei et al., 2014). In relation to improving agricultural productivity among agrarian communities, social networks are critical in influencing sustainable land management practices (Isaac & Matous, 2017). Whereas the ability of an individual to adapt to climate variability and change depends on the stock of one's social capital resource, such stocks may be unevenly distributed and differentially accessible depending on the social location of the individuals or groups trying to utilise it (Edwards & Foley, 1997). As such, Carr and Thompson (2014) posit that vulnerability and adaptation to climate change are gendered and shaped by socio-cultural structures and processes. Typically, women from developing countries are often portrayed as vulnerable groups in climate change discourses due to their over-dependence on natural resources and the interplay of structural inequalities that limits their capacity to cope (Paavola, 2008). While such studies are important in drawing attention to the challenges encountered by women in successfully adapting to climate change, they often undermine efforts played by women who frequently experience, negotiate and deal with challenges of any kind (Okali & Naess, 2013).

Consequently, feminist political ecologists such as Arora-Jonsson (2011) have questioned the notion of universality among men and women groups and recognise the need to unearth the underlying social factors occurring at the household or geographical area in determining vulnerability. Intersections of age, marital status, educational levels, ethnicity, type of livelihoods or income level and power relations are also known to influence a person's vulnerability (Carr & Thompson, 2014). Additionally, an increasing body of literature has advocated for the need for nuanced gender analysis and research that takes into consideration ways in which inter and intra-gender differences shape adaptive capacities (Rao et al., 2017; Ravera et al., 2016). Although there are several studies on the role of social networks in enhancing agriculture development within the context of climate change adaptation (Abid et al., 2017; Dapilah et al., 2020; Yaméogo, Fonta, & Wünscher, 2018) fewer studies have assessed how the interplay of gender and social network constrains or enhances climate change adaptation.

3. Methodology

3.1. Study area

The study was carried out in the Lawra District of the Upper West Region (1°25' and 2°45' W; 9°30' and 11°N) of Ghana (Fig. 1). The district is bordered to the North by the Nandom District, to the East by Lambussie-Karni District, to the South-West and West by Burkina Faso

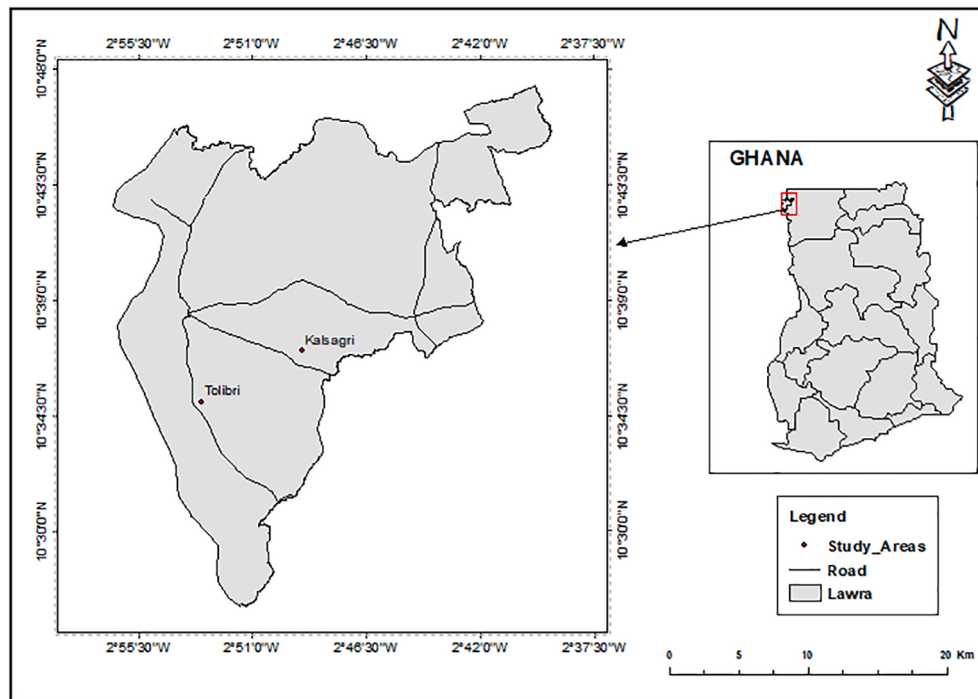


Fig. 1. Map of the study area.

(Fig. 1). The region is semi-arid and has variable rainfall pattern with mean rainfall ranging from 1000 to 1100 mm (MoFA, 2015; Rademacher-Schulz et al., 2014). Additionally, the region is predominantly agrarian and is characterised by high poverty rates, unimodal rainfall pattern, poor infrastructure and limited access to basic services such as water, sanitation, electricity and good housing (Nyantakyi-Frimpong & Bezner-Kerr, 2015). These multi-stressors are further amplified by the impacts of climate variability with cascading impacts on household food security and wellbeing (Ahmed et al., 2016). Being largely a patriarchal society, there are more male-headed households (74.5%) than female-headed households (25.5%) in the District (GSS, 2014a). Household structure within this area depicts an extended family system which has subfamily units consisting of the husband, wife and children living in coexistence and sharing family resources. Structural inequalities also exist, as compared to men, women have limited decision making power as well as access to and control of lands for agricultural activities (Abdul-Korah, 2011).

4. Research approach

Using a case study approach, the Upper West Region was purposely selected because of its recognized vulnerability to both climate and socio-economic stressors (Rademacher-Schulz et al., 2014; Nyantakyi-Frimpong & Bezner-Kerr, 2015). This was followed by the selection of the Lawra District through a simple random sampling out of eleven districts in the region. Two (2) out of fifty-four (54) communities in the Lawra Municipal were randomly selected for the study. The study employed a mixed methods approach and semi-structured interviews in data collection. Overall, a total sample size of 156 respondents were interviewed based on a convenience sampling. Due to constraints in determining the sample frame, the sample was achieved based on the availability and willingness of respondents to participate in the survey (Frey et al., 2000). We also sought to engage younger household members (18–35 years, based on the African Union definition for youth) since there was evidence that different categories of people may experience different opportunities and constraints in accessing social networks as well as coping with climate change impacts.

The respondents were interviewed individually with an average

length of the interview being 30–45 min. Constituting both closed and open-ended questions, respondents were asked the association(s) they belonged to; benefits derived from the associations with relation to climate change adaptation and; who one contacts in case of climate risk (dry spells or floods). Respondents were also asked about the constraints in accessing and utilizing personal relations for support in adapting to climate risk. Questions were asked in the Dagaare language and all interviews were recorded and translated later into English by a field assistant who also acted as an interpreter. The transcribed data were reviewed to ensure that the data was accurate and consistent.

The closed-ended questions which were predominantly socio-economic data were analysed using descriptive statistics in Statistical Package for Social Science (SPSS) version 21. Data on respondents' network were prepared on Microsoft Excel 2016 and exported to Gephi Graph Visualization and Manipulation (GEPHI) 0.9.2 software. A key characteristic of the network analysis is that it focuses on the density of relationships (nodes), degree of centralization and influence (edges). In this analysis, nodes represented the social groups (which emerged from the data) and their networks. On the other hand, edges revealed the relational ties between social groups and their networks. Edges, therefore, described the strength of the connection between the social groups and their networks, which is the number of times a social group solicited assistance from a network to cope with climate risk. Mapping these connections fosters an understanding of the social structures underpinning household networks. A qualitative analysis was done also to identify the challenges constraining access to and utilisation of social networks using the NVIVO software. Different challenges were identified and then broadly categorised into four (4) major themes. Next, different codes were assigned to the four major themes and then aggregated based on which social group experiences most of these challenges.

5. Results

5.1. Characteristics of social groups

The results showed that respondents were socially differentiated and were categorized as: (1) Male-headed household with formal education

(GRP_A); (2) Male-headed household with informal education (GRP_B); (3) Unmarried men with formal education (GRP_C); (4) Unmarried men with informal education; (5) Female-headed household with formal education; (6) Female-headed household with informal education; (7) Unmarried women with formal education and (8) Unmarried women with informal education, (see Table 1).

5.2. Nuanced pathways of networks for climate change adaptation

Fig. 2 illustrates the connections and linkages between the social groups and their source of support in coping with climate risk. Generally, all social groups relied on spouses, family (extended families), neighbours and agricultural extension agents (AEAs) for assistance. From the nuanced social networks between the different social groups (Fig. 3), there were more formally educated males than females. This is evident in the strength of ties when compared to educated female-headed households (GRP_E) and unmarried women (GRP_G).

In terms of access to funds for minimising climate risk, male-headed households with formal education (GRP_A) could access the banks for loans or savings to reduce climate risks, while female-headed households with formal education (GRP_E) relied on credit unions. For informally educated male and female-headed households, village savings and loan schemes (VSLAs) and the sale of livestock or food crops in the markets served as immediate sources of funds. In addition, the strength of tie between female-headed households with formal education (GRP_F) and their spouse was more conspicuous than any other social group. However, single men and women were barely encountered during the time of study, accounting for thin edges observed in GRP_G and GRP_H.

5.3. Benefits of networks and associations in climate change adaptation

As summarised in Table 2, the FGDs reiterated the benefits derived from associations and networks. Key benefits from networks and associations included access to credit, funds, social support, information and climate advisories. In addition faith-based institutions were found to support adaptation actions in study area. Female participants, particularly, noted that the church provided improved mental well-being and communal support for distressed members in times of crises. Another key institution was the traditional governance system. The chiefs and assemblymen/women (i.e. representatives of national government within an electoral area) served as focal points of contacts for most institutions operating in communities and provide information to their community members or facilitate access to external assistance.

5.4. Barriers to accessing and utilising social networks for climate change adaptation

From the FGDs, time constraints, finances, access to productive assets (specifically for land, bicycle and motorcycles) and level of trust emerged as major bottlenecks in accessing and utilising networks. Time constraints were a major barrier to GRPs A, C, D and G. The barriers are summarised in Fig. 4. While there were variations in the responses within intra-group discussions, responses mapped here represent

majority count.

6. Discussion

6.1. Structural and relational inequalities underpinning gender networks

While recognising that gender differences exist in the effects of climate change and related adaptation strategies, six social categories were deduced from the respondents: male-headed household with formal education; male-headed household with informal education; female-headed household with formal education; unmarried women with formal education and unmarried women with informal education. Marital status and level of education were the key social markers influencing one's access to social networks for climate change adaptation.

As highlighted by Pelling & High (2005), bonding, bridging and linking are carried out by people to establish ties that aid in climate change adaptation. In this study, the network analysis showed that respondents depended mostly on bonding (spouse, family, neighbours and friends) and less on bridging social capital considering the strength of ties (church, banks, credit unions, AEAs and farmer groups) to minimise climate risk. This could be attributed to the travel distance required to access these formal institutions which are located in the municipal towns. Respondents also indicated that low literacy rates impeded their networks with formal institutions. This finding is consistent with the widely reported low literacy rates in Northern Ghana (Abu, Osei-Asare, & Wayo, 2014; GSS., 2014b). As a result, interactions are only limited to family and neighbours. This finding mirrors that of Aldrich and Meyer (2015) who assert that people are interdependent on social structures and therefore live and interact with people they know very well.

Despite the claims that horizontal ties (bonding social capital) promote a level playing field and power for collaboration and development of social capital and the reverse true for vertical ties (Putnam, 1993), the findings of this study contradicted these assumptions. In fact, the findings are congruent with Onta & Resurreccion (2011) who assert that in societies where inequities exist such as patriarchal societies, some members of the households are subjected to exploitation and there is over reliance on others for assistance. In point of fact, power relations determine one's ability to adapt to climate change through influencing access to resources, information and the availability of options and choices (Djoudi, Brockhaus, & Locatelli, 2013). Considering that access to land in agrarian communities is very critical for sustainable adaptation and social wellbeing, the limited control and ownership by females in patriarchal societies continues to undermine effective adaptation (Akugre et al., 2021; Lawson et al., 2020). Although female-headed household with informal education showed ties with AEAs, it was revealed in the FGDs that, socio-cultural norms and customs do not permit a widow to be the head of the household. A male successor of the deceased person becomes the head and therefore, has more control and ownership of the land. Therefore, decisions concerning the type of crops to cultivate and contacts with AEAs were done in consultation with the household head. Also, such socio-cultural norms limited their options for diversifying their pool of income and assets to minimise climate risk as revealed by Ferdous & Mallick (2019) in Bangladesh.

In addition, the findings revealed that some households exhibited elements of cooperation and conflicts. The emerging outcome, however, depended on the negotiating power of the members of the household. Factors such as the marital status, educational level and occupation individually or collectively defined the bargaining power used by household members to secure networks. For example, from the FGDs, formally educated and employed single women had the agency to contact other networks for assistance than their informally educated counterparts. Such customs propagate female reliance on male-heads for support even if women had the agency to fall on other networks for support. This is how a 46-year-old informally educated married woman from Kalsagre described the process of accessing funds to support her

Table 1
Characteristics of social groups.

Groups	Characteristics
GRP_A	Male-headed household with formal education
GRP_B	Male-headed household with informal education
GRP_C	Unmarried men with formal education
GRP_D	Unmarried men with informal education
GRP_E	Female-headed household with formal education
GRP_F	Female-headed household with informal education
GRP_G	Unmarried women with formal education
GRP_H	Unmarried women with informal education

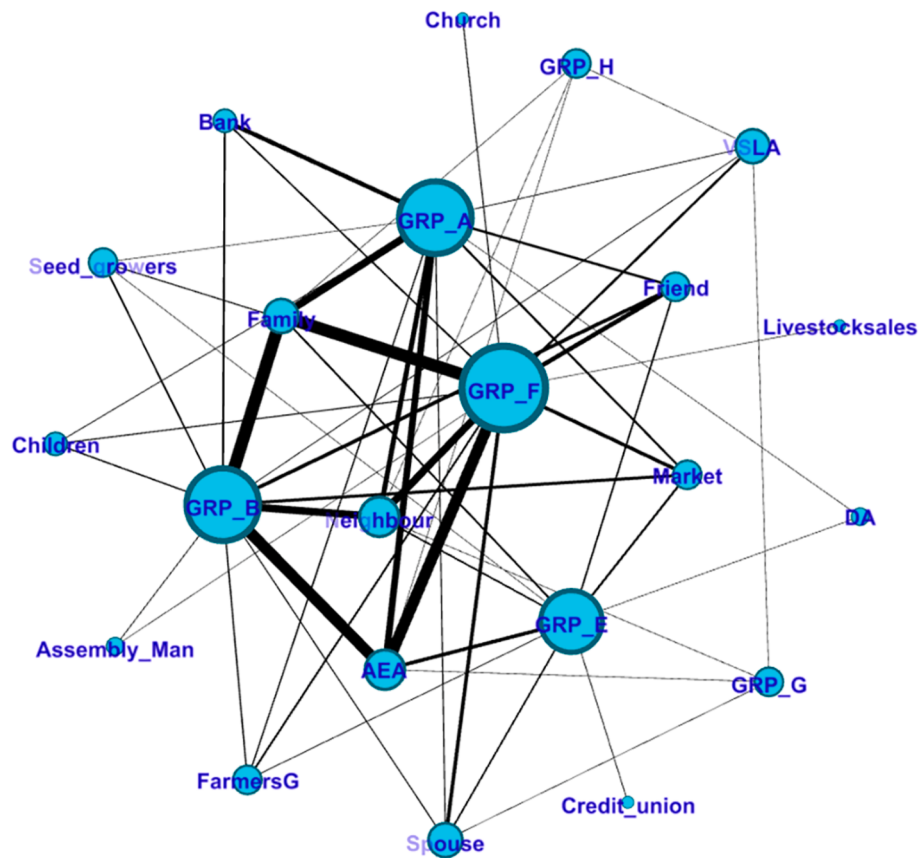


Fig. 2. Social groups and their networks in climate change adaptation.

farming activities

“My husband is the head of the household and if I need anything, I will have to first ask him. If he is not able to provide, then I will ask my sisters for support or from the VSLAs.”

As observed from the network diagrams, the sample did not include unmarried men because unmarried men were not encountered during the survey period. Also, the weaker ties shown between unmarried women and sources of support in times of risk were as a result of fewer unmarried women in the sample size. Marriage is a highly valued social institution in Ghana, and more so in the Lawra Municipal. Therefore, early marriages were rampant among females (GSS, 2014a). However, limited livelihood opportunities in the districts also compelled young men and women to seasonally or permanently migrate to southern Ghana (Rademacher-Schultz et al., 2014). This reveals the pursuit of the youth in non-agricultural activities and the eroding dominance of household heads as family cash-earners. Although migration of young persons from the communities was noted to be depleting the labour force (Britwum & Akorsu, 2016), the mobility of young women in search for improved livelihoods does not only increase their networks but improves their agency to cope or adapt to climate and non-climatic risk (Scheffran et al., 2012; González Ramos & Torrado Martín-Palomino, 2015).

6.2. Benefits from key associations

As reported by Assan et al. (2018), most females relied on the VSLAs as an immediate source of credit to attend to basic household needs. An interview with a woman from Tolibiri noted that:

“With the introduction of VSLA, begging from friends and other households has become a thing of the past. I don’t have to move from house to house to tell friends my predicament before they lend me money. No one now knows what is going on in my household anymore.

When I need money, I meet with the executives and borrow from the group’s savings.”

In some cases, where a husband and a wife belong to VSLAs, the husband prefers the wife borrowing from her group. This describes the hidden forms of male power. In the absence of livestock sale, he will only borrow from his group when there is a need to pay school fees, buy farm inputs or to fulfil a major task at home. This is how a 55-year-old man from Goziri explained that:

“If we need an amount of GHC 200 at home, I will ask my wife to borrow from her group. It is not easy for a man to be seen borrowing all the time. My integrity will be lost when I do that. I will only intervene when my wife is unsuccessful from her group or occasionally borrow from my group if I need to pay my wards fees or to perform other urgent tasks.”

The formation of farmer-based associations has increasingly been promoted by both government and NGOs as the best way for rapid information diffusion and cost-effective extension service delivery to farmers (Asante et al., 2011). Consistent with Mohammed et al. (2013), when farmers participated in the farmer-based associations they increased their networks, served as sources of information exchange, credit access, as well as a source of farm labour. However, the full potential of the association was yet to be maximised as they were often not well developed and strengthened.

Extension agents also served as key sources of support in coping with climate variability. As established earlier, the current uncertainty, frequency and intensity of climate change impacts presents little opportunities for effective adaptation among smallholder farmers. As a result, access to AEAs is critical for providing information, new technologies and enhancing the capacities of farmers to address climate risk (Antwi-Agyei et al., 2021; Dapilah et al., 2020). This, to some extent, accounted for respondents’ contacts with AEAs for assistance. However, farmers’ inadequate access to extension services remains a challenge. A number

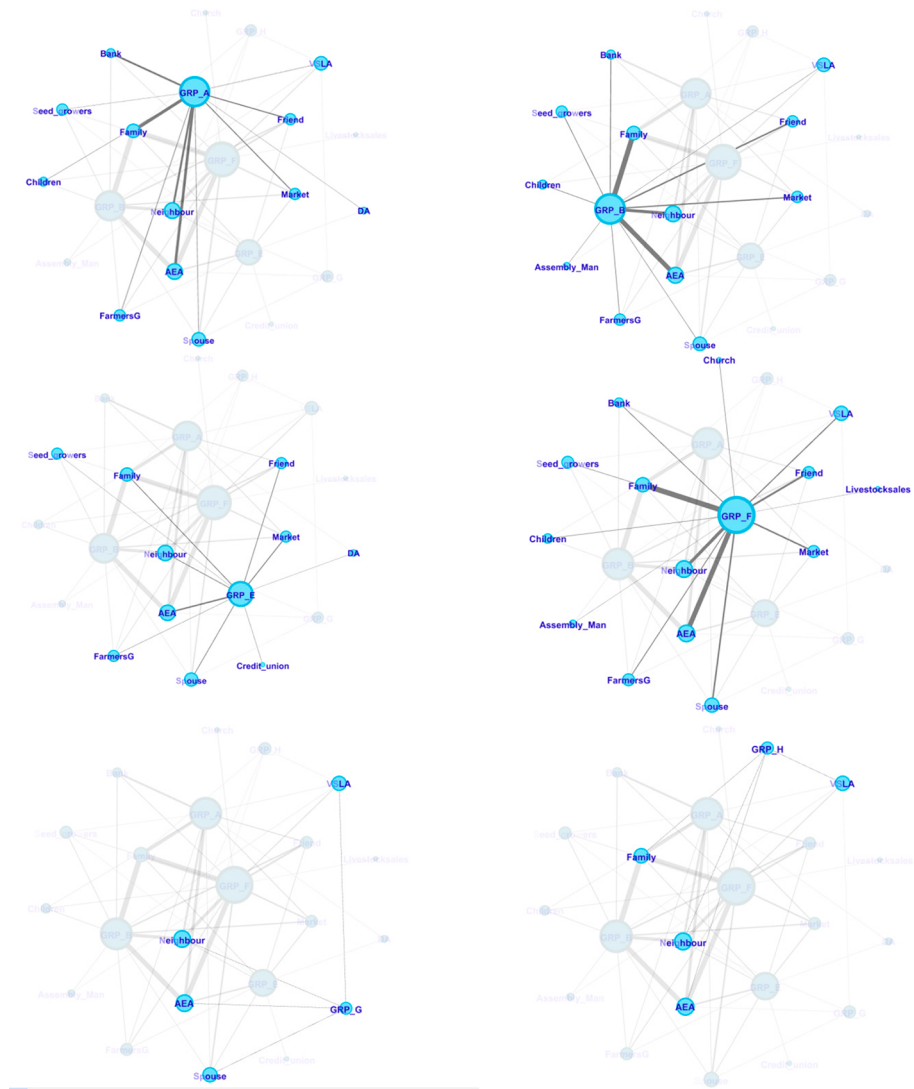


Fig. 3. Nuanced pathways of social groups and their networks.

Table 2
Benefits attained from networks and associations.

Associations/ Networks	Benefits
VSLAs	Immediate source of finance to address basic household needs
Farmers and Fishermen	Information exchange, labour in farms
Credit union/Banks	Access to credit
Agriculture extension agents	New farming strategies and information
Assembly man/woman	Source of information and facilitate external assistance
Family/relatives	Source of labour, finance, care and access to farmlands
Veterinary officers	Treatment of livestock, poultry and small ruminants
Church association	Spiritual renewal and upliftment, peace of mind and communal support in times of crises
Chiefs	Source of information and facilitate external assistance
Neighbours	Farm inputs, money, information, labour

of studies have also established how gender relation constrains women’s access to AEAs and climate advisories (Antwi-Agyei et al., 2021; Mudege et al., 2017; Partey et al., 2020).

While it is well established that relatives, friends and neighbours are the first point of contact for support in an event of risk before state

intervention, faith-based institutions are equally among the first responders and providers of immediate assistance (Bomberg & Hague, 2018; Glaab, 2017; McNaught, Warrick, & Cooper, 2014). With limited psychological services and state intervention in rural areas, most respondents relied on the church for humanitarian assistance. Abdul-Korah (2011) also highlighted the role of catholic missionaries in helping Dagaaba women to overcome traditional socio-cultural norms that subjected them to discrimination and marginalisation during the colonial era. However, faced with a lot of pressures in patriarchal societies, not only did women find female solidarity and support in mitigating these pressures, but they also found spiritual upliftment, healing, hope and new networks for improved wellbeing as reported by Robert (2016). A 40-year-old woman from Ketuo noted that:

‘I find spiritual and emotional upliftment any time I am in the church. There are many occasions my children have asked for money for school fees and other educational supplies and my husband and I were penniless. I got worried and anxious about it, but after going to church, listened to the sermon and prayed, I had a new sense of hope that there was going to be a breakthrough someday.’

6.3. Barriers to accessing and utilising social networks for climate change adaptation

Insights from the study revealed that the traditional social structure

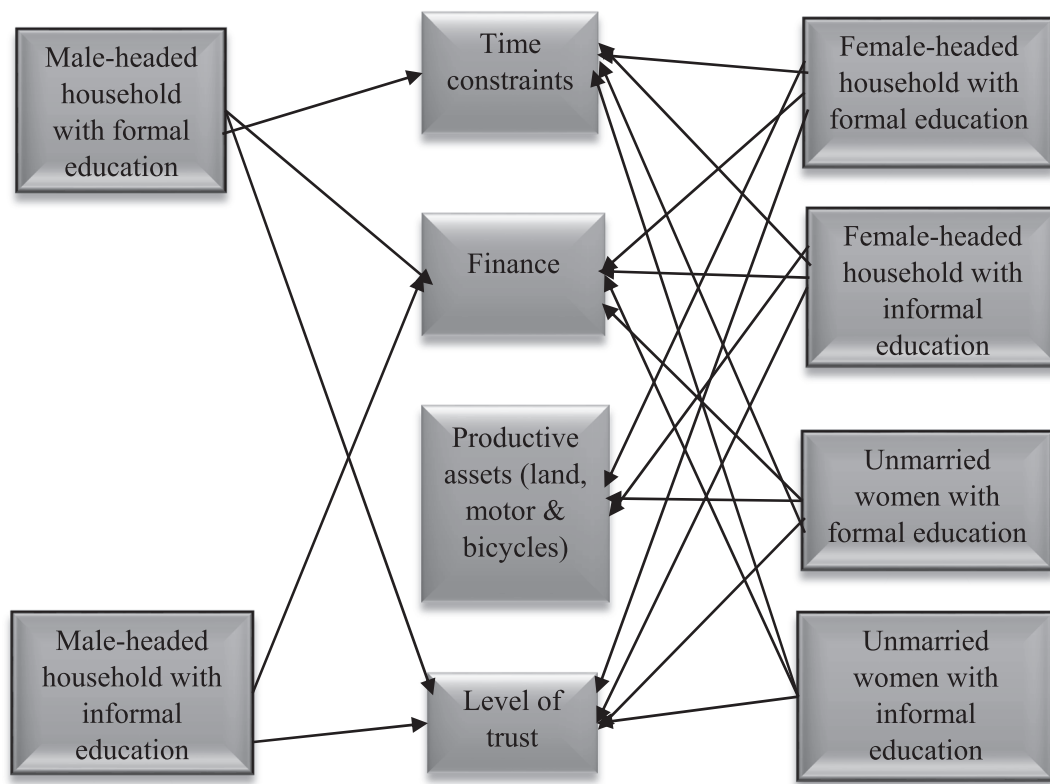


Fig. 4. Barriers in accessing and maintaining social networks.

of respondents was largely patriarchal which favoured extended families, due in part to the labour requirements for agriculture production (GSS, 2014a). In such societies, authority was primarily a male entitlement, while females played supporting roles. Additionally, many livelihoods were agrarian with females having no entitlements to land ownerships (Lawson et al., 2019). Notwithstanding the existing nuances, it is not surprising to see weaker ties between females and institutions such as banks, credit facilities and extension agents. This is because accessing money from bank and credit institutions often require collateral and because access to land is often restricted to usufruct rights only; women cannot provide collateral for credit. They often do not have legal ownership of tangible assets. According to Britwum and Akorsu (2016), women's main access to land in northern Ghana was dependent on "their relations with male relatives, their fathers through whom they claim membership to their natal lineage, and husbands who can cede land from their landholding groups to wives to cultivate crops for the household cooking pot" (p. 11). Since most female study participants also did not have access to productive resources, they resorted to the VSLAs.

There were also cases of declining trustworthiness among families and friends as found in Paul et al. (2016). While some respondents noted that trust had gotten better, others believed that it had gotten worse. However, some participants were of the view that family members and neighbours were either poorer or in the same condition as themselves and therefore, they could not ask for assistance, especially requesting for farm inputs. As a result, a few respondents reported to have accessed farm inputs by directly buying from the markets, seed growers or either selling livestock to buy from the markets.

Female respondents noted time constraints as a hindrance to building networks. Multiple roles such as reproduction, caretaking, domestic chores as well as contributing to household income leave little time for most married women to build and maintain networks. This finding resonates with women's workload as a barrier to climate change adaptation in existing literature (Hinton & Earnest, 2010; Bhattarai et al.,

2015).

As indicated earlier, mobility was done mostly by young men and women than the older ones. Limited livelihoods and the impact of climate stressors on agricultural productivity were drivers of youth migration to southern Ghana. Mobility in this study also encompassed transport networks. Motorcycles and bicycles were the cheapest forms of transport and were often owned by young and older men. This aided movement of men to events in neighbouring communities or urban areas to access information, meet and interact with new networks, compared to older women especially, who moved by foot. This is also embedded in who controls and has access to productive resources. Most males could afford these bicycles as they had access and control of land and farm produce (Lawson et al., 2019; Rivers III et al., 2017).

7. Conclusion and recommendations

The paper highlighted variations and inter-gender dynamics among social groups in accessing support from networks in the event of climate risk. The study found that intersections such as marital status, educational level and occupation individually or collectively influenced one's access to networks. For example, the social networks of married women with no formal education was constrained as a result of social norms which subjected them to the decision making and leadership roles of their husbands. On the other hand, there was flexibility in accessing social networks, particularly, informal ones among female-headed households. Additionally, other factors such as time constraints, mobility and level of trust hindered an individual's access to social networks. These revealed that households, smallholder farmers, men or women were not homogenous groups and there was the need to recognise the diversity.

In addition, with the upsurge of urbanisation and nuclearisation of most families, collective actions from social capital are increasingly dwindling. Bryceson (2000, pg 4) argues that, 'as the returns from peasant agricultural production deteriorates, internal exchange

relations within families are being transformed, producing ambiguity and tension about individual members' rights and responsibilities." Findings of this study resonate with Bryceson (2000) which indicates the need to focus on human development in the long term rather on social networks. In addition, the novel coronavirus has disrupted the livelihoods of many including smallholder farmers through the social and physical distancing protocols aimed at reducing its spread. As a result, it may reinforce homophily (Smith, McPherson, & Smith-Lovin, 2014) as vulnerable smallholder farmers tend to form networks with people who are similar to themselves. This has implication on climate change adaptation since successful adaptation strategies requires the integration of different stakeholders and perspectives (Newman & Dale, 2007).

Lastly, VSLA has become an increasingly widespread intervention aimed at improving local access to credit. Most female respondents, particularly females with informal education, relied on VSLA to support household food security and to other basic needs at the household level. However, Dapilah et al. (2020) note that poor members who could not contribute weekly were excluded from such groups, thereby having implications on social cohesion. Increase in transparency and trust can effectively sustain the operation of VSLAs in the community.

In this regard, development partners and state institutions should take into consideration the diversity of social groups produced by relational structures when designing and implementing interventions that have an impact on social capital.

A limitation to the study is that the findings here are from one case, and in order to test the transferability of our inference, it would be necessary to extend the empirical evidence base. However, they do raise important considerations for practitioners in the context of gender and climate change adaptation.

CRedit authorship contribution statement

Rahinatu S. Alare: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft. **Elaine T. Lawson:** Writing – review & editing, Supervision, Funding acquisition. **Adelina Mensah:** Writing – review & editing, Resources, Supervision. **Armand Yevide:** Formal analysis, Visualization. **Prosper Adiku:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Abdul-Korah, G. B. (2011). 'Now If You Have Only Sons You Are Dead': Migration, gender, and family economy in twentieth century Northwestern Ghana. *Journal of Asian and African Studies*, 46(4), 390–403. <https://doi.org/10.1177/0021909611400016>
- Abid, M., Ngaruiya, G., Scheffran, J., & Zulfiqar, F. (2017). The role of social networks in agricultural adaptation to climate change: Implications for sustainable agriculture in Pakistan. *Climate*, 5(4), 85. <https://doi.org/10.3390/cli5040085>
- Abu, B. M., Osei-Asare, Y. B., & Wayo, S. (2014). Market participation of smallholder maize farmers in the upper west region of Ghana. *African Journal of Agricultural Research*, 9(31), 2427–2435. <https://doi.org/10.5897/ajar2014.8545>
- Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change: social capital, collective action, and adaptation to climate change. *Economic Geography*, 4(79), 387–404. <https://doi.org/10.1111/j.1944-8287.2003.tb00220.x>
- Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies*, 3(3), 179–195. <https://doi.org/10.1191/1464993403ps0600a>
- Adkins, L. (2005). Social capital: The anatomy of a troubled concept. *Feminist Theory*, 6(2), 195–211. <https://doi.org/10.1177/1464700105053694>
- Ahmed, A., Lawson, E. T., Mensah, A., Gordon, C., & Padgham, J. (2016). Adaptation to climate change or non-climatic stressors in semi-arid regions? Evidence of gender differentiation in three agrarian districts of Ghana. *Environmental Development*, 20, 45–58. <https://doi.org/10.1016/j.envdev.2016.08.002>
- Akugre, F. A., Owusu, K., Wrigley-Asante, C., & Lawson, E. T. (2021). How do land tenure arrangements influence adaptive responses of farmers? A study of crop farmers from semi-arid Ghana. *GeoJournal*. <https://doi.org/10.1007/s10708-021-10372-y>
- Aldrich, D. P., & Meyer, M. A. (2015). Social capital and community resilience. *American Behavioral Scientist*, 59(2), 254–269. <https://doi.org/10.1177/0002764214550299>
- Amaru, S., & Chhetri, N. B. (2013). Climate adaptation: Institutional response to environmental constraints, and the need for increased flexibility, participation, and integration of approaches. *Applied Geography*, 39, 128–139. <https://doi.org/10.1016/j.apgeog.2012.12.006>
- Antwi-Agyei, P., Amanor, K., Hogarth, J. N., & Dougill, A. J. (2021). Predictors of access to and willingness to pay for climate information services in north-eastern Ghana: A gendered perspective. *Environmental Development*, 37(September 2020). <https://doi.org/10.1016/j.envdev.2020.100580>
- Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: Insights from farming households in Ghana. *Regional Environmental Change*, 14(4), 1615–1626. <https://doi.org/10.1007/s10113-014-0597-9>
- Arneil, B. (2006). *Diverse communities: the problem with social capital*. New York: Cambridge University Press.
- Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change*, 21(2), 744–751. <https://doi.org/10.1016/j.gloenvcha.2011.01.005>
- Asante, B. O., Afari-Sefa, V., & Sarpong, D. B. (2011). Determinants of small scale farmers' decision to join farmer based organizations in Ghana. *African Journal of Agricultural Research*, 6(10), 2273–2279. <https://doi.org/10.5897/AJAR10.979>
- Assan, E., Suvedi, M., Schmitt Olabisi, L., & Allen, A. (2018). Coping with and adapting to climate change: A gender perspective from smallholder farming in Ghana. *Environments*, 5(8), 86. <https://doi.org/10.3390/environments5080086>
- Bendito, A., & Twomlow, S. (2014). Promoting climate smart approaches to post-harvest challenges in Rwanda. *International Journal of Agricultural Sustainability*, 37–41. <https://doi.org/10.1080/14735903.2014.959329>
- Bhattarai, B., Beilin, R., & Ford, R. (2015). Gender, agrobiodiversity, and climate change: A study of adaptation practices in the Nepal Himalayas. *World Development*, 70, 122–132. <https://doi.org/10.1016/j.worlddev.2015.01.003>
- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., ... Yanda, P. (2007). *Africa. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson (Eds.), Climate change 2007: Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the inter-governmental panel on climate change* (pp. 433–467). 10.2134/jeq2008.0015br.
- Bomberg, E., & Hague, A. (2018). Faith-based climate action in the Christian congregations: Mobilisation and spiritual resources. *Local Environment*, 23(5), 582–596. <https://doi.org/10.1080/103549839.2018.1449822>
- Britwum, A. O., & Akorsu, A. D. (2016). *Qualitative gender evaluation of agricultural intensification practices in northern Ghana*. Retrieved from <http://africa-rising.net/>.
- Bryceson, D. (2000). *Rural Africa at the crossroads: Livelihood practices and policies*. London, UK: Natural Resource Perspective.
- Carr, E. R. (2019). Properties and projects: Reconciling resilience and transformation for adaptation and development. *World Development*, 122, 70–84. <https://doi.org/10.1016/j.worlddev.2019.05.011>
- Carr, E. R., & Thompson, M. C. (2014). Gender and climate change adaptation in agrarian settings. *Geography Compass*, 8/3(October), 182–197. <https://doi.org/10.1111/gec3.12121>
- Dapilah, F., Nielsen, J. Ø., & Friis, C. (2020). The role of social networks in building adaptive capacity and resilience to climate change: A case study from northern Ghana. *Climate and Development*, 12(1), 42–56. <https://doi.org/10.1080/17565529.2019.1596063>
- Djoudi, H., Brockhaus, M., & Locatelli, B. (2013). Once there was a lake: Vulnerability to environmental changes in northern Mali. *Regional Environmental Change*, 13(3), 493–508. <https://doi.org/10.1007/s10113-011-0262-5>
- Edwards, B., & Foley, W. M. (1997). from the SAGE social science collections. All Rights. *American Behavioral Scientist*, 40(5), 669–678.
- Ensor, J. E., Wennström, P., Bhattarai, A., Nightingale, A. J., Eriksen, S., & Sillmann, J. (2019). Asking the right questions in adaptation research and practice: Seeing beyond climate impacts in rural Nepal. *Environmental Science and Policy*, 94 (January), 227–236. <https://doi.org/10.1016/j.envsci.2019.01.013>
- Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., ... West, J. J. (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? *World Development*, 141, Article 105383. <https://doi.org/10.1016/j.worlddev.2020.105383>
- Ferdous, J., & Mallick, D. (2019). Norms, practices, and gendered vulnerabilities in the lower Teesta basin, Bangladesh. *Environmental Development*, 31(June 2018), 88–96. <https://doi.org/10.1016/j.envdev.2018.10.003>
- Frey, L. R., Carl, H. B., & Gary, L. K. (2000). *Investigating communication: An introduction to research methods* (2nd ed.). Boston: Allyn and Bacon.
- Glaab, K. (2017). A climate for justice? Faith-based advocacy on climate change at the United Nations. *Globalizations*, 14(7), 1110–1124. <https://doi.org/10.1080/14747731.2017.1308060>

- González Ramos, A. M., & Torrado Martín-Palomino, E. (2015). Addressing women's agency on international mobility. *Women's Studies International Forum*, 49, 1–11. <https://doi.org/10.1016/j.wsif.2014.12.004>
- GSS. (2014a). *2010 population and housing census: District analytical report, Lawra district. Ghana: Accra.*
- GSS. (2014b). *Ghana Living Standards Survey Round 6.* <https://doi.org/10.1007/s13398-014-0173-7.2>
- Hinton, R., & Earnest, J. (2010). Stressors, coping, and social support among women in Papua New Guinea. *Qualitative Health Research*, 20(2), 224–238. <https://doi.org/10.1177/1049732309357572>
- IPCC. (2014a). Annex II: Glosarry. In K. J. Mach, S. Planto, & von S. C (Eds.), *Climate change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)] (p. 117). Geneva, Switzerland: IPCC.
- IPCC. (2014b). *Climate change 2014: Impacts, Adaptation, and Vulnerability. A Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* (C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White, eds.). Geneva.
- Isaac, M. E., & Matous, P. (2017). Social network ties predict land use diversity and land use change: A case study in Ghana. *Regional Environmental Change*, 17(6), 1823–1833. <https://doi.org/10.1007/s10113-017-1151-3>
- Kaijser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality. *Environmental Politics*, 23(3), 417–433. <https://doi.org/10.1080/09644016.2013.835203>
- Lahsen, M., Sanchez-rodriguez, R., Lankao, P. R., Dube, P., Leemans, R., Gaffney, O., ... Smith, M. S. (2010). Impacts, adaptation and vulnerability to global environmental change : Challenges and pathways for an action-oriented research agenda for middle-income and low-income countries. *Current Opinion in Environmental Sustainability*, 2(5–6), 364–374. <https://doi.org/10.1016/j.cosust.2010.10.009>
- Lawson, E. T., Alare, R. S., Salifu, A. R. Z., & Thompson-Hall, M. (2019). Dealing with climate change in semi-arid Ghana: Understanding intersectional perceptions and adaptation strategies of women farmers. *GeoJournal*, 4, 1–14. <https://doi.org/10.1007/s10708-019-09974-4>
- Lawson, E. T., Alare, R. S., Salifu, A. R. Z., & Thompson-Hall, M. (2020). Dealing with climate change in semi-arid Ghana: Understanding intersectional perceptions and adaptation strategies of women farmers. *GeoJournal*, 85(2). <https://doi.org/10.1007/s10708-019-09974-4>
- McNaught, R., Warrick, O., & Cooper, A. (2014). Communicating climate change for adaptation in rural communities: A Pacific study. *Regional Environmental Change*, 14(4), 1491–1503. <https://doi.org/10.1007/s10113-014-0592-1>
- MoFA. (2015). *Agriculture in Ghana: Facts and figures.* Ghana: Accra.
- Mohammed, S., Egyir, I., & Amegashie, D. (2013). Social capital and access to credit by farmer based organizations in the Karaga District of Northern Ghana. *Journal of Economics and Sustainable Development*, 4(16), 146–156.
- Mudege, N. N., Mdege, N., Abidin, P. E., & Bhatasara, S. (2017). The role of gender norms in access to agricultural training in Chikwawa and Phalombe, Malawi. *Gender, Place and Culture*, 24(12), 1689–1710. <https://doi.org/10.1080/0966369X.2017.1383363>
- Newman, L., & Dale, A. (2007). Homophily and agency: Creating effective sustainable development networks. *Environment, Development and Sustainability*, 9(1), 79–90. <https://doi.org/10.1007/s10668-005-9004-5>
- Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. In C. B. F. Barros, V.R., B. G. D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, & and L. L. W. E. S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.* (Contributi). <https://doi.org/10.1017/CBO9781107415386.002>
- Nightingale, A. J., Eriksen, S., Taylor, M., Forsyth, T., Pelling, M., Newsham, A., ... Whitfield, S. (2020). Beyond technical fixes: Climate solutions and the great derangement. *Climate and Development*, 12(4), 343–352. <https://doi.org/10.1080/17565529.2019.1624495>
- Nyantakyi-Frimpong, H., & Bezner-Kerr, R. (2015). The relative importance of climate change in the context of multiple stressors in semi-arid Ghana. *Global Environmental Change*, 32, 40–56. <https://doi.org/10.1016/j.gloenvcha.2015.03.003>
- Okali, C., & Naess, L. O. (2013). Making sense of gender, climate change and agriculture in sub-Saharan Africa: Creating gender- responsive climate adaptation policy. *Future Agricultures Working Paper (No. 057).* <https://doi.org/10.1039/c3dt52905c>
- Onta, N., & Resurreccion, B. P. (2011). The role of gender and caste in climate adaptation strategies in Nepal. *Mountain Research and Development*, 31(4), 351–356. <https://doi.org/10.1659/MRD-JOURNAL-D-10-00085.1>
- Paavola, J. (2008). Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Environmental Science and Policy*, 11(7), 642–654. <https://doi.org/10.1016/j.envsci.2008.06.002>
- Partey, S. T., Dakorah, A. D., Zougmore, R. B., Ouédraogo, M., Nyasimi, M., Nikoi, G. K., & Huyer, S. (2020). Gender and climate risk management: Evidence of climate information use in Ghana. *Climatic Change*, 158(1), 61–75. <https://doi.org/10.1007/s10584-018-2239-6>
- Paul, C. J., Weinthal, E. S., Bellemare, M. F., & Jeuland, M. A. (2016). Social capital, trust, and adaptation to climate change: Evidence from rural Ethiopia. *Global Environmental Change*, 36, 124–138. <https://doi.org/10.1016/j.gloenvcha.2015.12.003>
- Pearse, R. (2017). Gender and climate change. *WIREs Climate Change*, 1–16. <https://doi.org/10.1002/wcc.451>
- Pelling, M. (2011). Adaptation to Climate Change from resilience to transformation. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* <https://doi.org/10.4324/9780203889046>
- Pelling, M., & High, C. (2005). Understanding adaptation: What can social capital offer assessments of adaptive capacity? *Global Environmental Change*, 15(4), 308–319. <https://doi.org/10.1016/j.gloenvcha.2005.02.001>
- Pelling, M., O'Brien, K., & Matyas, D. (2015). Adaptation and transformation. *Climatic Change*, 133(1), 113–127. <https://doi.org/10.1007/s10584-014-1303-0>
- Putnam, J. (1993). *Making Democracy Work: Civic Traditions in Modern Italy.* Princeton, NJ: Princeton University Press.
- Rademacher-Schultz, C., Schraven, B., & Mahama, E. S. (2014). Time matters: Shifting seasonal migration in Northern Ghana in response to rainfall variability and food insecurity. *Climate and Development*, 6(1), 46–52. <https://doi.org/10.1080/17565529.2013.830955>
- Rao, N., Lawson, E. T., Raditloang, W. N., Solomon, D., Angula, M. N., Rao, N., ... Solomon, D. (2017). Gendered vulnerabilities to climate change: Insights from the semi-arid regions of Africa and Asia. *Climate and Development*, 1–13. <https://doi.org/10.1080/17565529.2017.1372266>
- Ravera, F., Martin-Lopez, B., Pascual, U., & Drucker, A. (2016). The diversity of gendered adaptation strategies to climate change of Indian farmers : A feminist intersectional approach. *Ambio*, 45. <https://doi.org/10.1007/s13280-016-0833-2>
- Riede, J. O., Posada, R., Fink, A. H., & Kaspar, F. (2016). *Adaptation to Climate Change and Variability in Rural West Africa.* 7–24. <https://doi.org/10.1007/978-3-319-31499-0>
- Rivers III, L., Sanga, U., Sidibe, A., Wood, A., Paudel, R., Marquart-pyatt, S. T., ... Liverpool-tasie, S. (2017). Mental models of food security in rural Mali Mental models of food security in rural Mali. *Environment Systems and Decisions*, (December). <https://doi.org/10.1007/s10669-017-9669-y>
- Robert, D. L. (2016). World Christianity as a women's movement. *International Bulletin of Missionary Research*, 30(4), 180–188. <https://doi.org/10.1177/239693930603000403>
- Rotberg, F. J. Y. (2013). Social networks, brokers and climate change adaptation: A Bangladeshi case. *Journal of International Development*, 25, 599–608. <https://doi.org/10.1002/jid>
- Scheffran, J., Marmer, E., & Sow, P. (2012). Migration as a contribution to resilience and innovation in climate adaptation: Social networks and co-development in Northwest Africa. *Applied Geography*, 33(1), 119–127. <https://doi.org/10.1016/j.apgeog.2011.10.002>
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>
- Smith, J. A., McPherson, M., & Smith-Lovin, L. (2014). Social distance in the United States: Sex, race, religion, age, and education homophily among confidants, 1985 to 2004. *American Sociological Review*, 79(3), 432–456. <https://doi.org/10.1177/0003122414531776>
- Smith, S. S., & Kulynych, J. (2002). It may be social, but why is it capital? The social construction of social capital and the politics of language. *Politics and Society*, 30(1), 149–186. <https://doi.org/10.1177/0032329202030001006>
- Stanturf, A. J., Warren, L. M., Charnley, S., Polasky, C., Goodrick, S. L., Armah, F., & Nyako, A. Y. (2011). Ghana climate change vulnerability and adaptation assessment. *This report was produced for review by the United States Agency for International Development (USAID). It was prepared by the USDA Forest Service, International Programs.* Washington DC.
- Thompson, J. A. (2016). Intersectionality and water: How social relations intersect with ecological difference. *Gender, Place & Culture*, 23(9), 1286–1301. <https://doi.org/10.1080/0966369X.2016.1160038>
- Yaméogo, T., Fonta, W., & Wüschler, T. (2018). Can social capital influence smallholder farmers' climate-change adaptation decisions? Evidence from three semi-arid communities in Burkina Faso, West Africa. *Social Sciences*, 7(3), 33. <https://doi.org/10.3390/socsci7030033>
- Yiran, G. A. B. (2016). Mapping social capital for adaptation to climatic variability in a savannah ecosystem Of Ghana. In J. Yaro, & J. Hesselberg (Eds.), *Adaptation to climate change and variability in rural west Africa* (pp. 215–237). <https://doi.org/10.1007/978-3-319-31499-0>